Appendix I1: Results of 2001 – 2002 Studies on HF, PM_{10} and Dioxin levels

tms environment ltd

Confidential Report

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1.0 Scope

This report presents the results of a survey of ambient air quality at the site of a proposed industrial development at Carranstown, Co Meath. The scope of the survey included 24-hour average measurements of smoke, sulphur dioxide, nitrogen oxides, hydrogen fluoride, hydrogen chloride and heavy metals over a period of 28-days between 12th June and 13th July 2000. A suite of nineteen metals was included in the analysis (job reference 2510). A further study of 1-hour average nitrogen oxide measurements was completed over a period of 28 days during the period 4th September to 7th October 2000 (job reference 2671). This report is a composite report on the measurement results from both surveys.

2.0 Site location and description

The location of the proposed development is identified in Figure 1 attached as Appendix I to this report.

The site is in a rural location, situated 6 km to the south west of Drogheda and 2 km north east of Duleek. The site is adjacent to the Navan-to-Drogheda railway line on one side and a regional road, the R152, to the other side.

The existing site and surrounds are predominantly rural with a cluster of rural residences approximately 200 m north east of the monitoring location. A cement factory owned by Irish Cement Limited is located approximately 1 km to the north east of the site.

3.0 Survey methodology

3.1 Sampling protocol

Two surveys were conducted by TMS Environment Ltd personnel. Samples for the range of contaminants in the survey were collected within the site of the proposed development area for a total of twenty-eight 24-hour periods over the period 12th June to 13th July 2000. One-hour average nitrogen oxide levels were monitored for 28 days over the period 4th September to 7th October.

An automated 8-day sampler was employed for sample collection for the 24-hour samples. The 1-hour average nitrogen oxide samples were collected in a series of 3 automated 8-day samplers, programmed to collect samples at one-hour intervals.

Measurements were taken at the monitoring location identified in Appendix I, Figure 1. The monitoring site was located in accordance with the relevant standards and was approximately 100 m distant from the regional road and 200 m distant from the nearest rural residences.

Concentrations were expressed at the standard air temperature of 20 °C to allow comparison with the relevant ambient air standards and in particular those of the European Union.

All the sampling and analytical methodologies employed conformed with the relevant Standard Methods.

3.2 Smoke, sulphur dioxide and nitrogen oxides

Samples were collected over 24-hour and1-hour sampling periods conforming to the relevant standard methods. Sulphur dioxide was collected by absorption in hydrogen peroxide and nitrogen oxides were collected in Griess-Saltzmann reagent (for nitric oxide and nitrogen dioxide) and the results expressed as nitrogen dioxide.

Sulphur dioxide analysis was performed according to BS1747: Part 7: 1983 Barium-Thorin spectrophotometric method, and nitrogen oxides were determined according to ASTM D1607: 1976 and the Griess-Saltzmann method.

Particulate matter was collected by filtration and smoke was measured using a Reflectometer.

3.3 Hydrogen fluoride and hydrogen chloride

Hydrogen fluoride, and hydrogen chloride measurements were performed according to US EPA Method 26.

Samples were collected over 24-hour sampling periods by absorption in a solution of sulphuric acid and analysis for the halide ions using the ion selective electrodes method.

3.4 Metals

Metal sampling was performed using a filtration technique according to the US Intersociety Committee Methods of Air sampling and analysis. Samples were collected onto MCE filters over 24-hour sampling periods.

The samples were returned to the laboratory for digestion and ICP analysis according to the relevant Standard Methods. Samples were analysed for nineteen metals.

4.0 Measurement results

Full result tables for sulphur dioxide, nitrogen oxides, metals, smoke, HF and HCl are presented in Appendicies II and III. Table 1 provides a summary of the results for smoke, sulphur dioxide, nitrogen oxides, HF and HCl. Table 2 provides a summary of the results for metals.

Table 1 Summary of ambient air quality monitoring results for smoke and inorganic substances at Carranstown

Pollutant Concentration µg/m³, 24-hour averages, June and July 2000			
	Minimum	**Average**	**Maximum**
Smoke	0.5	4.3	11
Sulphur Dioxide	< 1	1	7
Nitrogen Oxides, as NO_2	0.3	1.3	2.6
Hydrogen Flouride, as HF	< 0.0001	< 0.0001	< 0.0001
Hydrogen Chloride, as HCl	< 0.0001	0.0002	0.0018
Pollutant Concentration µg/m³, 1-hour average, September to October 2000			
	Minimum	**Average**	**Maximum**
Nitrogen Oxides, as NO_2	< 2.1	8.1	36.4

Note 1. The < values are less than the limit of detection.
Note 2. The average values were calculated by including values at the limit of detection where appropriate.

Table 2 Summary of 24-hour average ambient air quality monitoring results for metals at Carranstown June and July 2000

Metal	Minimum measured concentration µg/m³	Maximum measured concentration µg/m³
Zinc	< 0.005	0.08
Copper	< 0.003	0.03
Nickel	< 0.003	0.069
Chromium	< 0.003	0.12
Lead	< 0.003	0.13
Selenium	< 0.005	0.38
Arsenic	< 0.02	< 0.02
Antimony	< 0.0003	0.012
Molybdenum	< 0.001	0.007
Titanium	< 0.002	0.01
Tin	< 0.011	4.7
Barium	< 0.0002	< 0.0002
Boron	< 0.004	0.22
Cobalt	< 0.001	< 0.001
Thallium	< 0.021	< 0.021
Silver	< 0.01	< 0.01
Mercury	< 0.005	< 0.005
Cadmium	< 0.002	< 0.002
Vanadium	< 0.001	< 0.001

Note 1. A mean concentration has not been calculated for metals because many of the results were below the limit of detection of the method of analysis.

Note 2. The < values are less than the limit of detection.

5.0 Evaluation of results

5.1 Air Quality Standards

Air quality standards and guidelines are available from a number of sources. The guidelines and standards referenced in this report include those from the European Union, Ireland, WHO and Germany (TA Luft).

Where ambient air quality criteria do not exist, as is the case for some of the metals surveyed, it is usual to use $^1/_{40}{}^{th}$ of the occupational exposure limit (OEL) for an eight-hour reference period[1]. Occupational exposure limits are published in Ireland by the National Authority for Occupational Safety and Health and worldwide by other occupational safety agencies[2].

Air quality standards are developed at different levels for different purposes. European legislation on air quality has been framed in terms of two categories, limit values and guide values. Limit values are concentrations that cannot be exceeded and are based on WHO guidelines for the protection of human health. Guide values are set as a long-term precautionary measure for the protection of human health and the environment.

In this report these guidelines provide the context for categorising air quality measured at the development site as good (well below guidelines levels), poor (approaching guideline levels) or unacceptable (exceeding guideline levels).

Ambient air quality guidelines and standards relevant to the pollutants measured in this survey are summarised in Tables 3, 4, 5,7 and 8 below. It should be noted that Table 6 presents the EC Daughter Directive Limit Values for PM_{10}, which are included for completeness only. No PM_{10} monitoring was undertaken in this survey and no specific conclusions can be drawn in regard to ambient concentrations of PM_{10}. The relevant OELs and the values for $^1/_{40}{}^{th}$ of the OEL are presented in Table 10.

A discussion of the results in relation to the guidelines and standards and expected typical concentrations for similar environments is presented for all pollutants surveyed.

[1] Her Majesty's Inspectorate of Pollution, Environmental Protection Act 1990,Technical Guidance Note (Dispersion), D1, Guidelines on discharge stack heights for polluting emissions, June 1993.
[2] Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations, 1994.

Table 3 Current air quality standards and guidelines for sulphur dioxide, smoke and nitrogen oxides

Air Quality Standard		Parameter and averaging period
Source	**µg/m³**	
		NO_2
EU Directive Limit value	200	98th -percentile of hourly means
Guide Value	135 50	98th-perentile of hourly means 50th-percentile of hourly means
WHO Guideline	40 – 50 200	Annual mean Maximum of one-hour means
		SO_2
EU Directive Limit value	350 if smoke = or < 150 250 if smoke > 150	98th-percentile of daily means; no more than three consecutive days
	180 if smoke = or < 60 130 if smoke > 60	Winter median of daily mean values
Guide Value	120 if smoke = or < 40 80 if smoke > 40	Annual median of daily mean values
WHO Guideline	40 – 60	Annual mean
	50 350 500	Annual mean Maximum one-hour mean Maximum 10-minute mean
		Smoke
EU Directive Limit value	80	Annual median of daily mean values
	130	Winter median of daily mean values
	250	98th-perentile of daily means
	250	No more than three consecutive days

Table 4 EC Daughter Directive Limit Values for nitrogen dioxide and nitric oxide, (EC/99/30)

Purpose	Averaging period	Limit value	Date by which limit value is to be met
Protection of human health	1 hour	200 μgm^{-3} NO_2 not to be exceeded more than 18 times per calendar year	1 January 2010
Protection of human health	Calendar year	40 μgm^{-3} NO_2	1 January 2010
Protection of vegetation	Calendar year	30 μgm^{-3} $NO + NO_2$	-

Table 5 EC Daughter Directive Limit Values for sulphur dioxide, (EC/99/30)

Purpose	Averaging period	Limit value	Date by which limit value is to be met
Protection of human health	1 hour	350 μgm^{-3} not to be exceeded more than 24 times per calendar year[(1)]	1 January 2005
Protection of human health	24 hours	125 μgm^{-3} not to be exceeded more than 3 times per calendar year	1 January 2005
Protection of ecosystems	Calendar year (1 October to 31 March)	20 μgm^{-3}	Two years from entry into force of the Directive

(1) Designed to protect against exceedances of the WHO 1996 10-minute guideline to protect health

Table 6 EC Daughter Directive Limit Values for PM_{10}, (EC/99/30)

Purpose	Averaging period	Limit value	Date by which limit value is to be met
Protection of human health	24- hour	50 μgm^{-3} not to be exceeded more than 35 times per calendar year	1 January 2005
Protection of human health	Calendar year (1 October to 31 March)	40 μgm^{-3}	1 January 2005
Protection of human health	24- hour	50 μgm^{-3} not to be exceeded more than 7 times per calendar year	1 January 2010
Protection of human health	Calendar year (1 October to 31 March)	20 μgm^{-3}	1 January 2010

Table 7 Air quality standards and guidelines for hydrogen chloride and hydrogen fluoride

Air Quality Standard		Parameter and averaging period
Source	**µg/m³**	
TA Luft, 1986	100	**HCl** Arithmetic mean (2)
	200	95th -percentile
	300 (1)	95th -percentile
TA Luft, 1986	1.0	**HF** Arithmetic mean (2)
	3.0	95th -percentile

(1) As long as HCl cannot be clearly separated from Chlorides the 95th -percentile shall be 300 µg/m³.

(2) Interpreted as an hourly average.

Table 8 Ambient air quality standards and guidelines for metals

Air Quality Standard		Parameter and averaging period
Source	**µg/m³**	
EU Daughter Directive (EC/99/30)		**Lead**
Limit value 1999	0.5	Annual average
WHO 1999	0.5	Annual average
WHO 1999	0.005	**Cadmium** Annual average
WHO 1999	1	**Mercury** Annual average
WHO 1987	1	**Vanadium** 24 hour average

Note: WHO Guidelines quoted are as published in "Guidelines for Air Quality," WHO, Geneva, 2000.

5.2 Nitrogen oxides

The measurement results for nitrogen oxides as a 24-hour average are presented in Table A1 of Appendix II. The daily mean concentration was 1.3 $\mu g/m^3$ as a 24-hour average. A survey of nitrogen oxides was previously conducted by TMS Environment Ltd in the vicinity of this site, which gave a daily mean concentration of 4.5 $\mu g/m^3$ as a 24-hour average. The results of this survey are similar to those obtained during a previous survey conducted by TMS Environment Ltd at Platin.

Hourly-average measurements were completed at Carranstown for NO_2 for 28 - days during September and October 2000. The average hourly concentration over this period was 8.1 $\mu g/m^3$ and the range of results was < 2.1 to 36 $\mu g/m^3$. The variation that occurred during the month is likely to have been due to variations in wind direction and strength relative to sources of NO_2 and variations in temperature.

Nitrogen oxide monitoring in Ireland is relatively limited. The only full time measurement sites are in Dublin. Some monitoring near point sources has been done in non-urban areas. No data relevant to the Carranstown site is available. Annual mean concentrations of nitrogen oxides in rural atmospheres are however, expected to be in the range 0 - 30 $\mu g/m^3$, and 20 - 90 $\mu g/m^3$ in urban locations. Winter averages are generally higher than summer averages (World Health Organisation: Guidelines for Air Quality May 2000.)

The results of this survey are within the expected concentration range for a rural environment. The air quality with respect to nitrogen oxide concentrations is described as very good and the results are consistent with expectations for this type of environment.

Limit and Guide values have been set by the European Community. The EU Limit Value as referenced in Table 3 is 200 $\mu g/m^3$ for NO_2, expressed as the 98th percentile of hourly averages over a period of one year. The associated EU Guide Value is 135 $\mu g/m^3$. The EU Limit and Guide Values are not even approached in the area where the survey was completed.

The EU Daughter directive as referenced in Table 4 has specified a new Limit Value of 200 $\mu g/m^3$ for the 1-hour average concentration of NO_2, not to be exceeded more than 18 times in a calendar year (99.8th percentile). This is to be met before January 2010. The results of the one-hour average monitoring conducted in September and October 2000, presented in Tables A9 – A24 of Appendix III. The results demonstrate that the existing ambient air quality also meets the requirements of the proposed new EU legislation.

5.3 Sulphur dioxide

The measurement results for sulphur dioxide are presented in Table A2 of Appendix II. The daily mean concentration was 1 $\mu g/m^3$ as a 24-hour average.

There are 20 networks that monitor sulphur dioxide in Ireland. One station monitoring SO_2 is located in Drogheda. The annual median concentration for

1998[3] was 13 µg/m^3 and the 98th percentile was 26 µg/m^3. Annual mean concentrations of sulphur dioxide in rural areas are expected to be in the range 3 - 6 µg/m^3 and 25 – 100 µg/m^3 in urban locations (World Health Organisation: Guidelines for Air Quality May 2000).

The values recorded in this survey are consistent with expectations as the site is located in a predominantly rural area.

Limit and Guide values have been set by the European Community. The EU Limit Value for SO_2 as referenced in Table 3 is 80 µg/m^3 where smoke is greater than 40 µg/m^3. This is expressed as the annual average of daily mean concentrations over a period of one year. The associated Guide Value is 40 µg/m^3. The existing ambient air quality at the site meets the regulatory requirements.

The EU Daughter directive as referenced in Table 5 has specified a new Limit Value of 125 µg/m^3 for the 24-hour average concentration of SO_2, not to be exceeded more than 3 times in a calendar year. This is to be met before January 2010. A Limit Value of 20 µg/m^3 as an annual average is also being introduced for the protection of ecosystems. The existing ambient air quality also meets the requirements of the proposed new legislation, although it is noted that no comparison is possible with the EU Daughter Directive 1 hour limit value because no 1 hour data was collected for SO_2 and the 24-hour results are not directly comparable.

5.4 Hydrogen fluoride and hydrogen chloride

The measurement results for hydrogen fluoride and hydrogen chloride are presented in Table A3 and A4 of Appendix II. Results for hydrogen fluoride and hydrogen chloride were very low. Most results for HCl were below the limit of detection of the method and all the results for HF were below the limit of detection. All of the results were many orders of magnitude lower than the respective TA Luft guideline values.

No background data for HF and HCl was available from other studies.

5.5 Smoke

The measurement results for smoke are presented in Table A5 of Appendix II. The daily mean concentration was 4.3 µg/m^3 as a 24-hour average. A previous two week survey of smoke was conducted by TMS Environment Ltd at Platin, report reference 1811 Rev. 3.0. The study gave a daily mean concentration of 8 µg/m^3 as a 24-hour average for smoke, similar to the results from this study.

There are 20 networks that monitor smoke in Ireland. Data relevant to the Carranstown site is available for Drogheda. The winter average concentrations of smoke (24-hour averaging period) for Drogheda are reported in the EPA State of the Environment in Ireland Report, dated 1996 and the Air Quality Monitoring Report for 1998, which were reviewed for the purposes of this study.

For the period 1984 to 1994, the winter mean smoke concentration recorded at

[3] Environmental Protection Agency, Air Quality Monitoring Annual Report, 1998.

Drogheda was in the range 29 - 69 $\mu g/m^3$ and the corresponding 98th percentile range was 118 - 163 $\mu g/m^3$. The annual median concentration for 1998 was 10 $\mu g/m^3$ and the 98th percentile was 34 $\mu g/m^3$.

The monitoring results obtained during this study are much lower that that recorded at Drogheda and can be said to be representative of a rural background site.

The Air Quality Standards for smoke specify that the annual median of daily mean values should not exceed 80 $\mu g/m^3$. It is clear from the data presented in Table A5 that the levels recorded during the four weeks over which the monitoring was carried out were very substantially lower than the Limit Value. The Standards further specify that a limit of 250 $\mu g/m^3$ should not be exceeded for more than 3 consecutive days, and again this Limit Value is not approached or exceeded during the period for which monitoring data is available.

5.6 Metals

The measurement results for metals are presented in Tables A6 to A8 of Appendix II. The maximum measured concentrations for the metals included in the survey are summarised in Tables 9 and 10 below. Where there are no ambient air quality guidelines for the concentration of metals in air, $^1/_{40}{}^{th}$ of the occupational exposure limit (OEL) for an eight-hour reference period has been used for comparison with measured concentrations.

Table 9 Maximum 24 - hour metal concentration measured compared with air quality guidelines

Air Quality Guidelines WHO $\mu g/m^3$		**Maximum measured 24 – hour concentration $\mu g/m^3$**	**Annual average concentration range $\mu g/m^3$**
Lead Annual mean of daily values	0.5	0.13	0.01 – 2
Cadmium Annual average	0.005	< 0.002	0.0001 – 0.02
Mercury Annual average	1	< 0.005	0.002 – 0.01
Vanadium 24 hour average	1	< 0.001	0.05 – 0.2

Note 1. WHO Guidelines quoted are as published in "Guidelines for Air Quality," WHO, Geneva, 2000.

Note 2. The < values are less than the limit of detection.

Table 10 Maximum 24-hour metal concentration measured compared with OEL guidelines

Metal	OEL mg/m^3	OEL 1/40th $\mu g/m^3$	Maximum measured 24 - hour concentration $\mu g/m^3$
Zinc – total inhalable dust	10	250	0.08
Copper – dusts and mists	1	25	0.03
Nickel	0.1	2.5	0.069
Chromium	0.5	12.5	0.12
Lead	0.15	3.75	0.13
Selenium	0.1	2.5	0.38
Arsenic	0.1	2.5	< 0.02
Antimony	0.5	12.5	0.012
Molybdenum (soluble compounds)	5	125	0.007
Titanium (dioxide) total inhalable dust	10	250	0.01
Tin – inorganic	2	50	4.7
Barium	0.5	12.5	< 0.0002
Boron (oxide)	10	250	0.22
Cobalt	0.1	2.5	< 0.001
Thallium	0.1	2.5	<0.021
Silver	0.1	2.5	<0.01
Mercury (Inorganic)	0.025	0.625	< 0.005
Cadmium	0.025	0.625	< 0.002

Note 1. The < values are less than the limit of detection.

Lead monitoring is undertaken in Dublin at 8 locations. Monitoring as reported in the the EPA State of the Environment in Ireland Report, dated 1996 has shown that major reductions in lead emissions have occurred since the mid-1980s with the reduction in the lead content of petrol. The maximum annual mean concentration of airborne lead at eight sites in Dublin over 1988 to 1993 was approximately 1.75 $\mu g/m^3$. The annual mean concentration for most sites was less than 0.5 $\mu g/m^3$.

Data relevant for rural locations was not available for Lead. Concentrations in rural areas are expected to be much lower and will be substantially less than relevant guideline levels as demonstrated by this study.

Data from the World Health Organisation: Guidelines for Air Quality May 2000 for annual average concentrations of metals in ambient air where available are provided in Table 9. No background data for other metals was available.

All of the maximum measured 24-hour values for the metals measured are within the limit of $^1/_{40}{}^{th}$ of the occupational exposure limit (OEL) and comply with the available air quality standards.

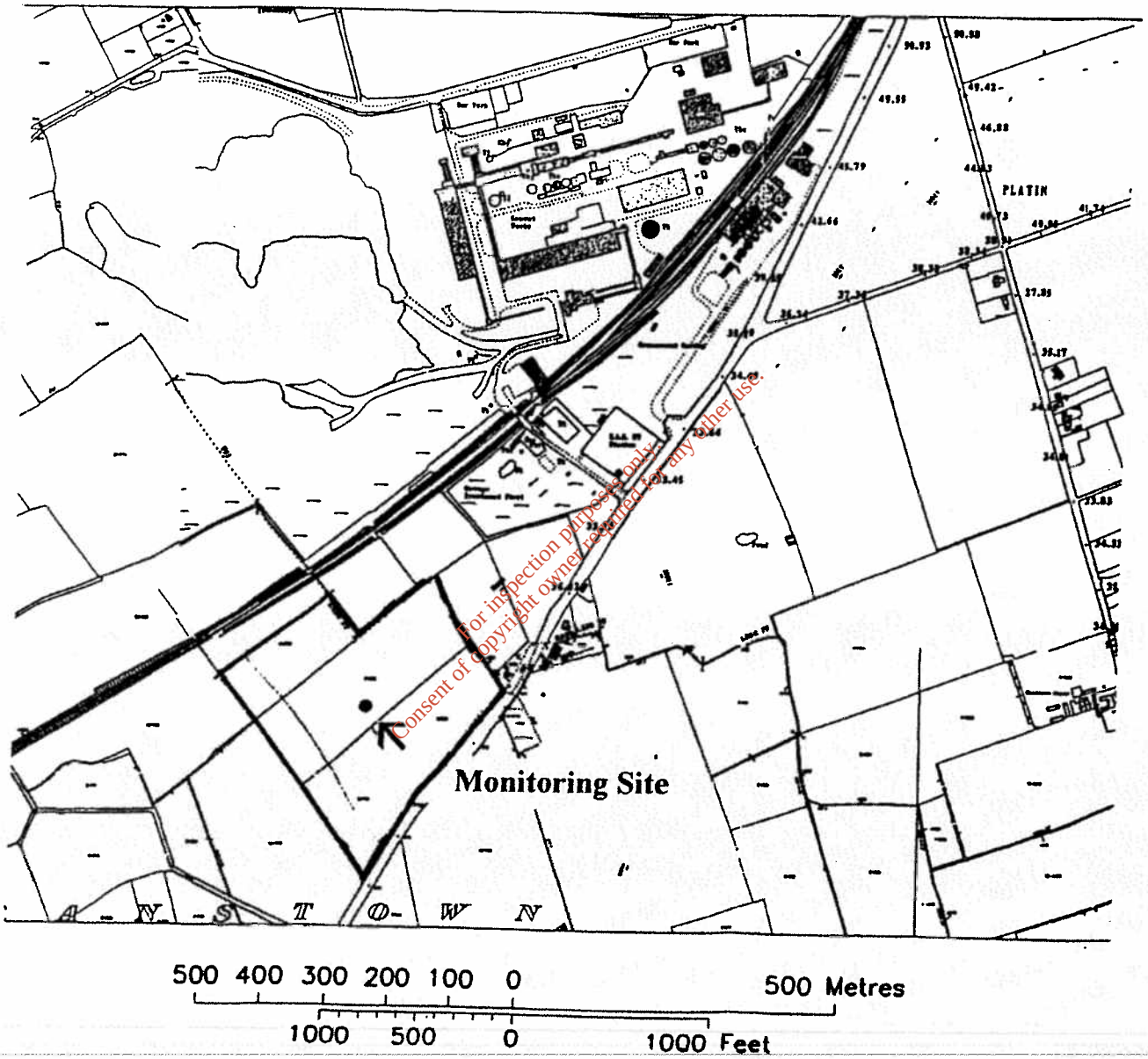
6.0 Conclusion

Ambient air quality at Carranstown has been monitored over a period of 28 days for 24-hour averages of sulphur dioxide, smoke, nitrogen oxides, metals, hydrogen fluoride and hydrogen chloride and 1-hour averages of nitrogen oxides. Air quality with respect to ambient concentrations of pollutants surveyed is extremely good. The air quality complies with all relevant guidelines and is characteristic of an unpolluted rural location.

APPENDIX I

MONITORING LOCATION FOR CARRANSTOWN AMBIENT AIR QUALITY SURVEY

Figure 1 Monitoring Site Location for Ambient Air Survey at Carranstown



APPENDIX II

RESULT TABLES FOR SULPHUR DIOXIDE, NITROGEN OXIDES, METALS, HF, HCl AND SMOKE

Table A1 Ambient 24 - hour NO_X as NO_2 at Carranstown, 15 June to 13 July 2000

Date	Start day	Finish day	Sample ID	NO_2 $\mu g/m^3$
15/06/00	Thu	Fri	2510-22	1.9
16/06/00	Fri	Sat	2510-23	1.7
17/06/00	Sat	Sun	2510-24	1.6
18/06/00	Sun	Mon	2510-25	1.6
19/06/00	Mon	Tue	2510-51	1.4
20/06/00	Tue	Wed	2510-52	1.2
21/06/00	Wed	Thu	2510-53	0.9
22/06/00	Thu	Fri	2510-54	0.8
23/06/00	Fri	Sat	2510-55	0.8
24/06/00	Sat	Sun	2510-56	0.7
25/06/00	Sun	Mon	2510-57	0.8
26/06/00	Mon	Tue	2510-86	1.9
27/06/00	Tue	Wed	2510-87	1.9
28/06/00	Wed	Thu	2510-88	1.9
29/06/00	Thu	Fri	2510-89	1.8
30/06/00	Fri	Sat	2510-90	1.6
01/07/00	Sat	Sun	2510-91	1.3
02/07/00	Sun	Mon	2510-92	1.2
03/07/00	Mon	Tue	2510-100	2.4
04/07/00	Tue	Wed	2510-101	2.6
05/07/00	Wed	Thu	2510-102	1.4
06/07/00	Thu	Fri	2510-103	1.3
07/07/00	Fri	Sat	2510-104	0.6
08/07/00	Sat	Sun	2510-105	0.5
09/07/00	Sun	Mon	2510-106	0.5
10/07/00	Mon	Tue	2510-135	0.7
11/07/00	Tue	Wed	2510-136	0.7
12/07/00	Wed	Thu	2510-137	0.6
13/07/00	Thu	Fri	2510-138	0.3

Table A2 Ambient 24 - hour SO_2 at Carranstown, 12 June to 9 July 2000

Date	Start day	Finish day	Sample ID	SO_2 $\mu g/m^3$
12/06/00	Mon	Tue	2510-8	< 1
13/06/00	Tue	Wed	2510-9	7
14/06/00	Wed	Thu	2510-10	< 1
15/06/00	Thu	Fri	2510-11	1
16/06/00	Fri	Sat	2510-12	< 1
17/06/00	Sat	Sun	2510-13	< 1
18/06/00	Sun	Mon	2510-14	< 1
19/06/00	Mon	Tue	2510-37	< 1
20/06/00	Tue	Wed	2510-38	< 1
21/06/00	Wed	Thu	2510-39	< 1
22/06/00	Thu	Fri	2510-40	< 1
23/06/00	Fri	Sat	2510-41	< 1
24/06/00	Sat	Sun	2510-42	< 1
25/06/00	Sun	Mon	2510-43	< 1
26/06/00	Mon	Tue	2510-72	< 1
27/06/00	Tue	Wed	2510-73	< 1
28/06/00	Wed	Thu	2510-74	< 1
29/06/00	Thu	Fri	2510-75	< 1
30/06/00	Fri	Sat	2510-76	< 1
01/07/00	Sat	Sun	2510-77	< 1
02/07/00	Sun	Mon	2510-78	< 1
03/07/00	Mon	Tue	2510-121	< 1
04/07/00	Tue	Wed	2510-122	< 1
05/07/00	Wed	Thu	2510-123	< 1
06/07/00	Thu	Fri	2510-124	< 1
07/07/00	Fri	Sat	2510-125	< 1
08/07/00	Sat	Sun	2510-126	< 1
09/07/00	Sun	Mon	2510-127	< 1

Table A3 Ambient 24 - hour HCl at Carranstown, 12 June to 9 July 2000

Date	Start day	Finish day	Sample ID	HCl $\mu g/m^3$
12/06/00	Mon	Tue	2510-1	0.0005
13/06/00	Tue	Wed	2510-2	0.0003
14/06/00	Wed	Thu	2510-3	0.0018
15/06/00	Thu	Fri	2510-4	0.0010
16/06/00	Fri	Sat	2510-5	0.0003
17/06/00	Sat	Sun	2510-6	0.0002
18/06/00	Sun	Mon	2510-7	< 0.0001
19/06/00	Mon	Tue	2510-30	< 0.0001
20/06/00	Tue	Wed	2510-31	< 0.0001
21/06/00	Wed	Thu	2510-32	< 0.0001
22/06/00	Thu	Fri	2510-33	< 0.0001
23/06/00	Fri	Sat	2510-34	< 0.0001
24/06/00	Sat	Sun	2510-35	< 0.0001
25/06/00	Sun	Mon	2510-36	< 0.0001
26/06/00	Mon	Tue	2510-65	< 0.0001
27/06/00	Tue	Wed	2510-66	< 0.0001
28/06/00	Wed	Thu	2510-67	< 0.0001
29/06/00	Thu	Fri	2510-68	< 0.0001
30/06/00	Fri	Sat	2510-69	< 0.0001
01/07/00	Sat	Sun	2510-70	< 0.0001
02/07/00	Sun	Mon	2510-71	< 0.0001
03/07/00	Mon	Tue	2510-114	< 0.0001
04/07/00	Tue	Wed	2510-115	< 0.0001
05/07/00	Wed	Thu	2510-116	< 0.0001
06/07/00	Thu	Fri	2510-117	< 0.0001
07/07/00	Fri	Sat	2510-118	< 0.0001
08/07/00	Sat	Sun	2510-119	< 0.0001
09/07/00	Sun	Mon	2510-120	< 0.0001

Table A4 Ambient 24 - hour HF at Carranstown, 12 June to 9 July 2000

Date	Start day	Finish day	Sample ID	HF $\mu g/m^3$
12/06/00	Mon	Tue	2510-1	< 0.0001
13/06/00	Tue	Wed	2510-2	< 0.0001
14/06/00	Wed	Thu	2510-3	< 0.0001
15/06/00	Thu	Fri	2510-4	< 0.0001
16/06/00	Fri	Sat	2510-5	< 0.0001
17/06/00	Sat	Sun	2510-6	< 0.0001
18/06/00	Sun	Mon	2510-7	< 0.0001
19/06/00	Mon	Tue	2510-30	< 0.0001
20/06/00	Tue	Wed	2510-31	< 0.0001
21/06/00	Wed	Thu	2510-32	< 0.0001
22/06/00	Thu	Fri	2510-33	< 0.0001
23/06/00	Fri	Sat	2510-34	< 0.0001
24/06/00	Sat	Sun	2510-35	< 0.0001
25/06/00	Sun	Mon	2510-36	< 0.0001
26/06/00	Mon	Tue	2510-65	< 0.0001
27/06/00	Tue	Wed	2510-66	< 0.0001
28/06/00	Wed	Thu	2510-67	< 0.0001
29/06/00	Thu	Fri	2510-68	< 0.0001
30/06/00	Fri	Sat	2510-69	< 0.0001
01/07/00	Sat	Sun	2510-70	< 0.0001
02/07/00	Sun	Mon	2510-71	< 0.0001
03/07/00	Mon	Tue	2510-114	< 0.0001
04/07/00	Tue	Wed	2510-115	< 0.0001
05/07/00	Wed	Thu	2510-116	< 0.0001
06/07/00	Thu	Fri	2510-117	< 0.0001
07/07/00	Fri	Sat	2510-118	< 0.0001
08/07/00	Sat	Sun	2510-119	< 0.0001
09/07/00	Sun	Mon	2510-120	< 0.0001

Table A5 Ambient 24 - hour Smoke at Carranstown, 12 June to 9 July 2000

Date	Start day	Finish day	Sample ID	Black Smoke $\mu g/m^3$
12/06/00	Mon	Tue	2510-15	2
13/06/00	Tue	Wed	2510-16	3
14/06/00	Wed	Thu	2510-17	6
15/06/00	Thu	Fri	2510-18	4
16/06/00	Fri	Sat	2510-19	5
17/06/00	Sat	Sun	2510-20	5
18/06/00	Sun	Mon	2510-21	6
19/06/00	Mon	Tue	2510-44	4
20/06/00	Tue	Wed	2510-45	3
21/06/00	Wed	Thu	2510-46	2
22/06/00	Thu	Fri	2510-47	2
23/06/00	Fri	Sat	2510-48	4
24/06/00	Sat	Sun	2510-49	3
25/06/00	Sun	Mon	2510-50	3.5
26/06/00	Mon	Tue	2510-79	7
27/06/00	Tue	Wed	2510-80	4
28/06/00	Wed	Thu	2510-81	1
29/06/00	Thu	Fri	2510-82	11
30/06/00	Fri	Sat	2510-83	9
01/07/00	Sat	Sun	2510-84	5
02/07/00	Sun	Mon	2510-85	6
03/07/00	Mon	Tue	2510-128	4
04/07/00	Tue	Wed	2510-129	9
05/07/00	Wed	Thu	2510-130	6
06/07/00	Thu	Fri	2510-131	2
07/07/00	Fri	Sat	2510-132	2.5
08/07/00	Sat	Sun	2510-133	0.5
09/07/00	Sun	Mon	2510-134	1

Table A6 Ambient 24 - hour Metals at Carranstown, 15 June to 13 July 2000

Sample number	Sample Date	Sample Concentration $\mu g/m^3$					
		Ag	As	B	Ba	Cd	Co
2510-26	15/06/00	< 0.010	< 0.021	0.082	< 0.0002	< 0.002	< 0.001
2510-27	16/06/00	< 0.010	< 0.021	< 0.004	< 0.0002	< 0.002	< 0.001
2510-28	17/06/00	< 0.010	< 0.021	0.100	< 0.0002	< 0.002	< 0.001
2510-29	18/06/00	< 0.010	< 0.021	< 0.004	< 0.0002	< 0.002	< 0.001
2510-58	19/06/00	< 0.010	< 0.021	0.098	< 0.0002	< 0.002	< 0.001
2510-59	20/06/00	< 0.010	< 0.021	0.082	< 0.0002	< 0.002	< 0.001
2510-60	21/06/00	< 0.010	< 0.021	0.035	< 0.0002	< 0.002	< 0.001
2510-61	22/06/00	< 0.010	< 0.021	< 0.004	< 0.0002	< 0.002	< 0.001
2510-62	23/06/00	< 0.010	< 0.021	0.056	< 0.0002	< 0.002	< 0.001
2510-63	24/06/00	< 0.010	< 0.021	0.115	< 0.0002	< 0.002	< 0.001
2510-64	25/06/00	< 0.010	< 0.021	0.011	< 0.0002	< 0.002	< 0.001
2510-93	26/06/00	< 0.010	< 0.021	< 0.004	< 0.0002	< 0.002	< 0.001
2510-94	27/06/00	< 0.010	< 0.021	< 0.004	< 0.0002	< 0.002	< 0.001
2510-95	28/06/00	< 0.010	< 0.021	< 0.004	< 0.0002	< 0.002	< 0.001
2510-96	29/06/00	< 0.010	< 0.021	< 0.004	< 0.0002	< 0.002	< 0.001
2510-97	30/06/00	< 0.010	< 0.021	< 0.004	< 0.0002	< 0.002	< 0.001
2510-98	01/07/00	< 0.010	< 0.021	< 0.004	< 0.0002	< 0.002	< 0.001
2510-99	02/07/00	< 0.010	< 0.021	< 0.004	< 0.0002	< 0.002	< 0.001
2510-107	03/07/00	< 0.010	< 0.021	0.051	< 0.0002	< 0.002	< 0.001
2510-108	04/07/00	< 0.010	< 0.021	0.051	< 0.0002	< 0.002	< 0.001
2510-109	05/07/00	< 0.010	< 0.021	0.216	< 0.0002	< 0.002	< 0.001
2510-110	06/07/00	< 0.010	< 0.021	0.152	< 0.0002	< 0.002	< 0.001
2510-111	07/07/00	< 0.010	< 0.021	0.154	< 0.0002	< 0.002	< 0.001
2510-112	08/07/00	< 0.010	< 0.021	0.031	< 0.0002	< 0.002	< 0.001
2510-113	09/07/00	< 0.010	< 0.021	0.069	< 0.0002	< 0.002	< 0.001
2510-139	10/07/00	< 0.010	< 0.021	0.056	< 0.0002	< 0.002	< 0.001
2510-140	11/07/00	< 0.010	< 0.021	0.037	< 0.0002	< 0.002	< 0.001
2510-141	12/07/00	< 0.010	< 0.021	0.130	< 0.0002	< 0.002	< 0.001
2510-142	13/07/00	0.010	< 0.021	0.024	< 0.0002	< 0.002	< 0.001

Table A7 Ambient 24 - hour Metals at Carranstown, 15 June to 13 July 2000

Sample number	Sample Date	Sample Concentration $\mu g/m^3$					
		Cr	Cu	Hg	Mo	Ni	Pb
2510-26	15/06/00	0.079	< 0.003	< 0.005	< 0.001	0.009	0.006
2510-27	16/06/00	0.015	< 0.003	< 0.005	< 0.001	0.006	0.007
2510-28	17/06/00	0.063	< 0.003	< 0.005	< 0.001	< 0.003	< 0.003
2510-29	18/06/00	0.012	< 0.003	< 0.005	< 0.001	< 0.003	< 0.003
2510-58	19/06/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	0.008
2510-59	20/06/00	0.034	< 0.003	< 0.005	< 0.001	< 0.003	< 0.003
2510-60	21/06/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	< 0.003
2510-61	22/06/00	0.044	< 0.003	< 0.005	< 0.001	< 0.003	< 0.003
2510-62	23/06/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	< 0.003
2510-63	24/06/00	0.077	< 0.003	< 0.005	< 0.001	< 0.003	0.025
2510-64	25/06/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	< 0.003
2510-93	26/06/00	0.124	< 0.003	< 0.005	< 0.001	0.020	0.010
2510-94	27/06/00	< 0.003	0.004	< 0.005	< 0.001	< 0.003	0.017
2510-95	28/06/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	0.008
2510-96	29/06/00	< 0.003	0.014	< 0.005	< 0.001	< 0.003	< 0.003
2510-97	30/06/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	0.019
2510-98	01/07/00	0.019	0.005	< 0.005	< 0.001	0.009	0.004
2510-99	02/07/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	0.036
2510-107	03/07/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	0.002
2510-108	04/07/00	< 0.003	< 0.003	< 0.005	0.001	< 0.003	0.034
2510-109	05/07/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	0.024
2510-110	06/07/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	0.130
2510-111	07/07/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	0.045
2510-112	08/07/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	0.032
2510-113	09/07/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	< 0.003
2510-139	10/07/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	< 0.003
2510-140	11/07/00	< 0.003	< 0.003	< 0.005	< 0.001	< 0.003	< 0.003
2510-141	12/07/00	< 0.003	< 0.003	< 0.005	0.007	< 0.003	0.068
2510-142	13/07/00	< 0.003	0.029	< 0.005	< 0.001	0.069	0.075

Table A8 Ambient 24 - hour Metal at Carranstown, 15 June to 13 July 2000

Sample number	Sample Date	Sample Concentration $\mu g/m^3$						
		Sb	Se	Sn	Ti	Tl	V	Zn
2510-26	15/06/00	< 0.0003	< 0.005	0.297	< 0.002	< 0.021	< 0.001	< 0.005
2510-27	16/06/00	< 0.0003	< 0.005	4.664	< 0.002	< 0.021	< 0.001	< 0.005
2510-28	17/06/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-29	18/06/00	< 0.0003	< 0.005	0.038	< 0.002	< 0.021	< 0.001	< 0.005
2510-58	19/06/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-59	20/06/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-60	21/06/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-61	22/06/00	< 0.0003	< 0.005	3.638	< 0.002	< 0.021	< 0.001	< 0.005
2510-62	23/06/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-63	24/06/00	0.0115	< 0.005	< 0.011	0.014	< 0.021	< 0.001	< 0.005
2510-64	25/06/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-93	26/06/00	< 0.0003	0.260	< 0.011	< 0.002	< 0.021	< 0.001	0.027
2510-94	27/06/00	< 0.0003	0.364	< 0.011	< 0.002	< 0.021	< 0.001	0.077
2510-95	28/06/00	< 0.0003	0.166	0.050	< 0.003	< 0.021	< 0.001	0.012
2510-96	29/06/00	< 0.0003	0.376	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-97	30/06/00	< 0.0003	0.296	0.245	0.005	< 0.021	< 0.001	< 0.005
2510-98	01/07/00	< 0.0003	0.366	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-99	02/07/00	< 0.0003	0.122	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-107	03/07/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-108	04/07/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-109	05/07/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-110	06/07/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-111	07/07/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-112	08/07/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-113	09/07/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-139	10/07/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-140	11/07/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-141	12/07/00	< 0.0003	< 0.005	< 0.011	< 0.002	< 0.021	< 0.001	< 0.005
2510-142	13/07/00	< 0.0003	< 0.005	1.896	< 0.002	< 0.021	< 0.001	< 0.005

TECHNICAL REPORT

BASELINE PM_{10} MONITORING AT CARRANSTOWN, CO. MEATH

FOR

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Report prepared by: **Dr. Eoin Collins**, PhD AMRSC
Our reference: EC/02/1398AR03

EXECUTIVE SUMMARY

AWN Consulting has carried out a detailed baseline assessment of PM_{10} levels over a three-month period at a roadside location in Carranstown, Co. Meath. Ambient PM_{10} concentrations were measured for three months (December 2001 – March 2002) over successive 24-hour periods using a sequential air sampler. This report details the results obtained and compares them with the relevant EU Limit Values.

The 24-hour PM_{10} concentrations measured over the three-month period are generally significantly below the 24-hour EU limit value of 50μg/m^3 which is applicable in 2005. Three exceedances of the 24-hour limit value were recorded over the three months of this monitoring campaign. However, the 24-hour limit value is expressed as a 90.1th%ile, which means the 36th highest value measured over a full year is compared to the limit value. Since only three exceedances were recorded over the 84 days of this monitoring survey (equivalent to the 96.4th%ile), it is unlikely that 35 exceedances would occur over 365 days at the current location.

The average PM_{10} concentration measured over the three month period is 18 μg/m^3 which is only 45% of the EU annual limit value of 40 μg/m^3. The PM_{10} levels measured at Carranstown are similar to those measured by Dublin City Council at the Phoenix Park in Dublin (an urban background location).

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Senior Environmental Consultant

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Environmental Consultant

CONTENTS

1.0 INTRODUCTION

AWN Consulting was requested by Indaver Ireland to perform a detailed baseline assessment for PM_{10} (particulate matter <10μm) at a roadside location in Carranstown, Co. Meath. Ambient PM_{10} concentrations were measured for three months (December 2001 – March 2002) over successive 24-hour periods using a sequential air sampler. The daily results and the average concentration over the three month monitoring period are compared with the relevant 24-hour and annual limit values set by the European Union. In addition, the daily results are compared with wind speed data from Dublin Airport.

2.0 METHODOLOGY

The PM_{10} monitoring program, using a PM_{10} continuous monitor, focused on assessing 24-hour average concentrations over a three-month at a monitoring station located close to the R152 approximately 3.5 km north-east of Duleek (see Figure 1). PM_{10} sampling was carried out by means of an R&P Partisol®-Plus Sequential Air Sampler (Model 2025). The sampler is a manual air sampling platform which has been designed to meet US EPA Reference Designation (RFPS-1298-127). Approximately 24 m^3 of air was sampled daily through a size selective inlet, which removed particles with a diameter >10 μg. The remaining particles were collected on pre-weighed 47mm diameter filters. The Partisol® sampler was programmed to automatically replace each sampled filter by a new pre-weighed filter at midnight. This ensured that each filter represented a sampling period of exactly 24 hours. Gravimetric determination was carried out pre- and post-sampling at a NAMAS accredited laboratory. The gravimetric results allowed a calculation of the average PM_{10} concentration over each 24-hour period. The results, which are shown in Table 2, can be directly compared with the 24-hour limit value (which is set as a 90.1th%ile), and the three-month average can be indicatively compared with the annual limit value.

3.0 AMBIENT AIR QUALITY COMPLIANCE CRITERIA

EU Directive 1999/30/EC has set 24-hour and annual limit values for PM_{10} (see Table 1). A 24-hour limit of 50 μg/m^3 is set as a 90.1th%ile, which means it must not be exceeded more than 35 times per year. A margin of tolerance of 30% currently applies for this limit value, and this will reduce linearly to 0% by 2005. Thus the current 24-hour limit value is 65 μg/m^3. EU Directive 1999/30/EC has also set an annual limit value of 40 μg/m^3. However, a margin of tolerance of 12% currently applies, and this will also reduce linearly to 0% by 2005. In addition, an indicative limit value of 20 μg/m^3 may be applicable in 2010. However, this is to be reviewed in the light of further information on health and environmental effects, technical

feasibility and experience in the application of the current limit values in the EU Member States (see Table 1).

4.0 RESULTS AND DISCUSSION

Daily concentrations of PM_{10} measured using the sequential PM_{10} sampler are shown in Figure 2 and Table 2. The 24-hour PM_{10} concentrations measured over the three-month period are generally significantly below the 24-hour EU limit value of 50 $\mu g/m^3$ which is applicable in 2005.

Three exceedances of the 24-hour limit value were recorded over the three months of this monitoring campaign. However, the 24-hour limit value is expressed as a 90.1th%ile, which means the 36th highest value measured over a full year is compared to the limit value. Since only three exceedances were recorded over the 84 days of this monitoring survey, it is unlikely that 35 exceedances would occur over 365 days at the current location.

Average wind speed data measured by Met Eireann at Dublin Airport, which would be representative of conditions at Carranstown, are listed in Table 3 and are compared to the PM_{10} monitoring results in Figures 3 and 4. The data in Figures 3 and 4 indicate that the highest levels of PM_{10} measured at Carranstown generally correspond to days with calm winds. However, this relationship is not linear, since smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds, while fugitive emissions of coarse particles ($PM_{2.5}$ - PM_{10}) will actually increase at higher wind speeds. In addition, wind direction will also have an influence on the on-site PM_{10} concentrations.

The average PM_{10} concentration measured over the three-month period is 18 $\mu g/m^3$ which is only 45% of the EU annual limit value of 40 $\mu g/m^3$, which is applicable in 2005.

Average PM_{10} levels measured at Carranstown can be compared to results of monitoring carried out as part of the UK Air Quality Monitoring Network(1) at Lough Navar Lake, Co. Fermanagh (see Figure 5). The monitoring site at Lough Navar is defined as rural (i.e. distanced from population centres, roads and industrial areas). The annual average PM_{10} concentration recorded in both 2000 and 2001 was 10 $\mu g/m^3$. As expected the levels measured at the Carranstown monitoring station, which is a roadside location and is also in close proximity to an industrial facility, are generally higher than the average levels measured at Lough Navar. The results measured at Carranstown can also be compared to levels measured by Dublin City Council at the Phoenix Park in Dublin(2). The monitoring site at the Phoenix Park is defined as urban background (i.e. an urban location distanced from sources and broadly representative of city-wide background concentrations). Annual average

PM_{10} levels at the Phoenix Park are around 16 $\mu g/m^3$ which are similar to those measured at Carranstown.

REFERENCES

(1) UK Air Quality Monitoring Archive (2001) http://www.aeat.co.uk/netcen/airqual/
(2) Dublin Corporation (2000) Air Monitoring Report 1999

FIGURE 1

Map Detailing Location of PM_{10} Monitoring Station

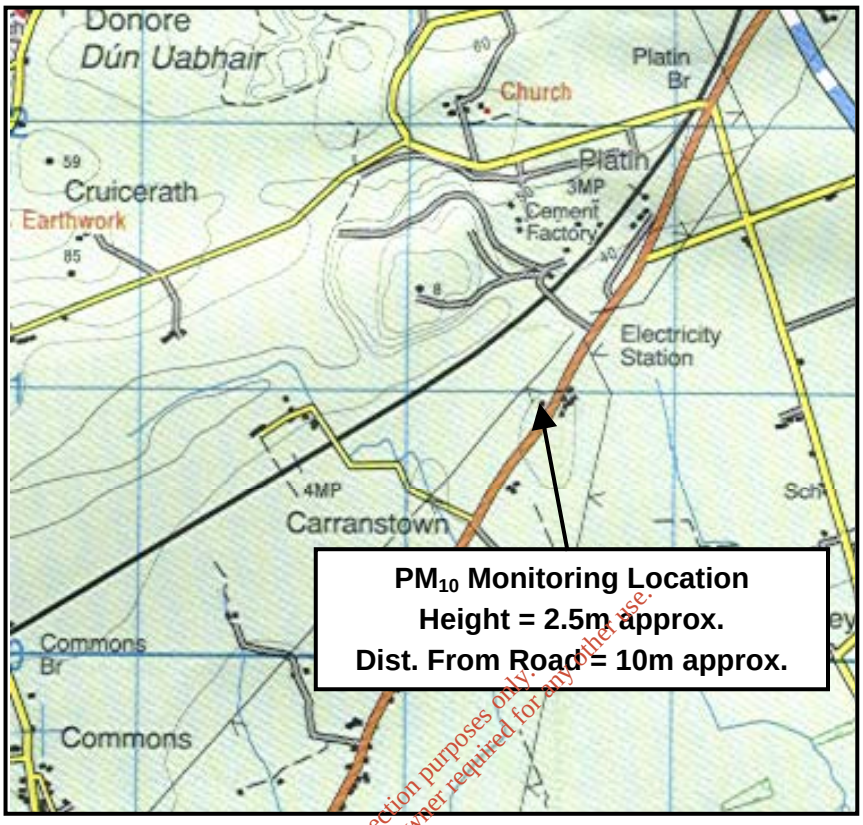


FIGURE 2

PM_{10} Monitoring Results at Carranstown, Co. Meath (December 2001 – March 2002)

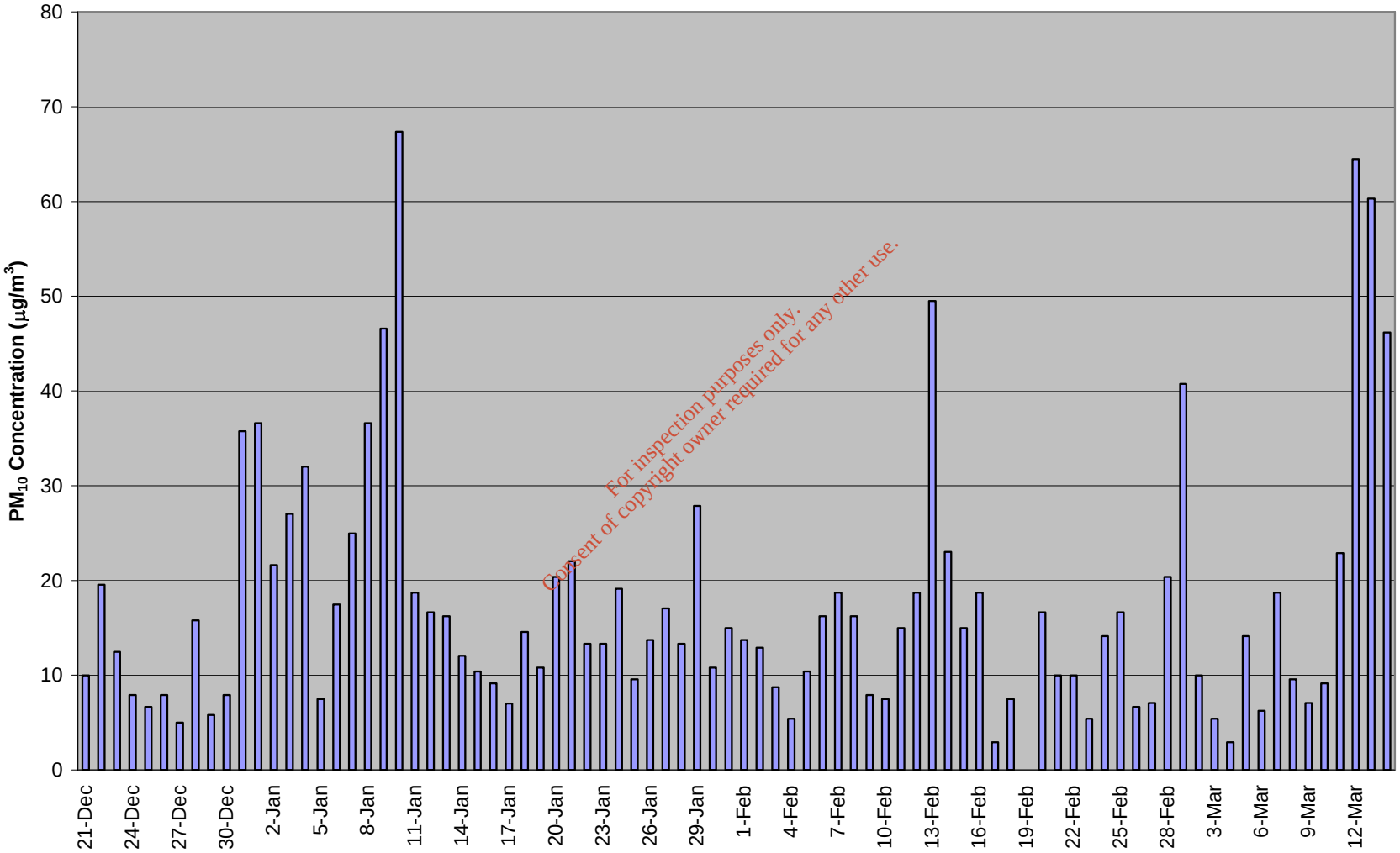


FIGURE 3

Comparison of PM_{10} Monitoring Results With Available Data for Average Daily Wind Speed from Dublin Airport (December 21st 2001 – January 31st 2002)

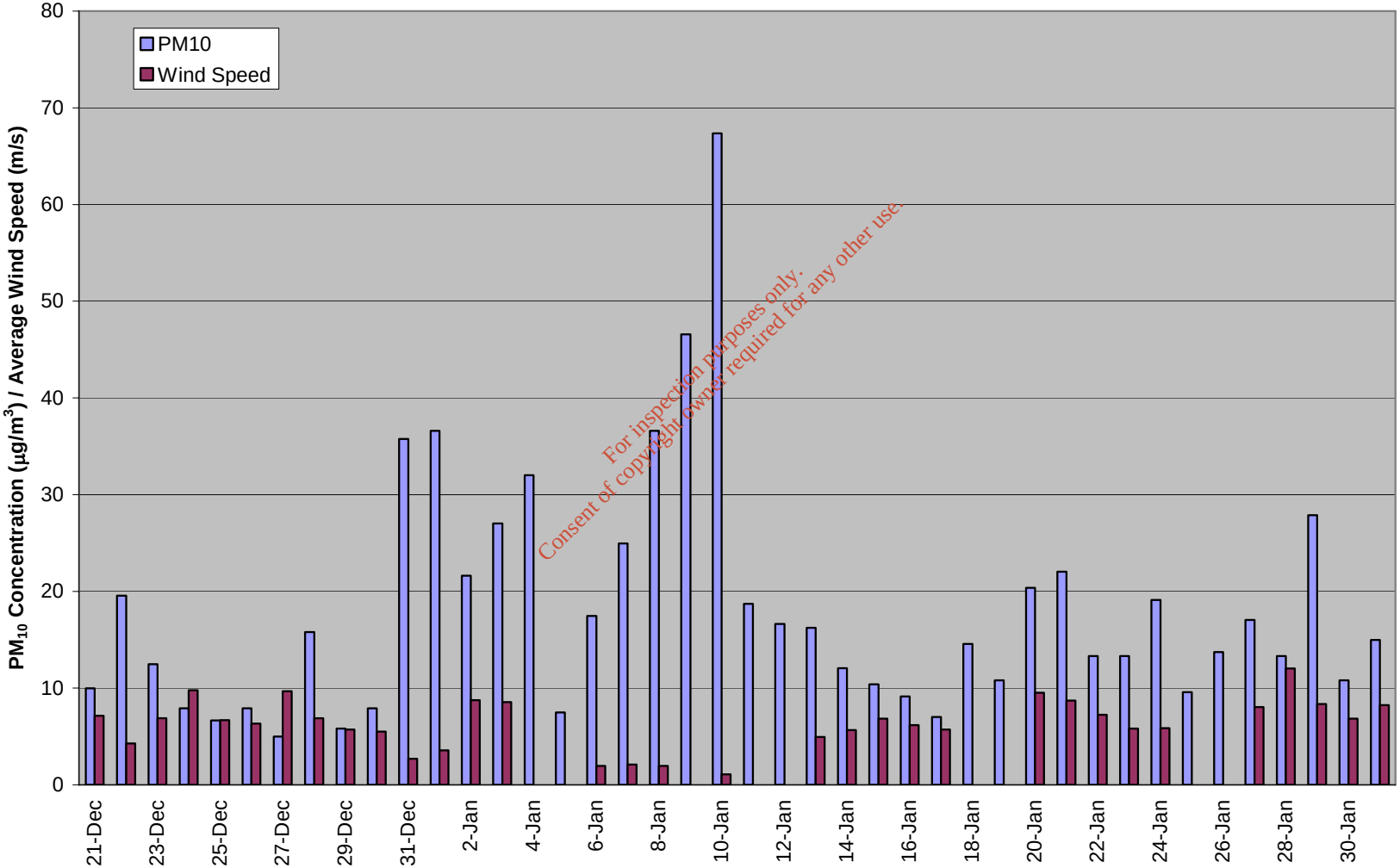


FIGURE 4

Comparison of PM_{10} Monitoring Results With Available Data for Average Daily Wind Speed from Dublin Airport (February 1st 2002 – March 14th 2002)

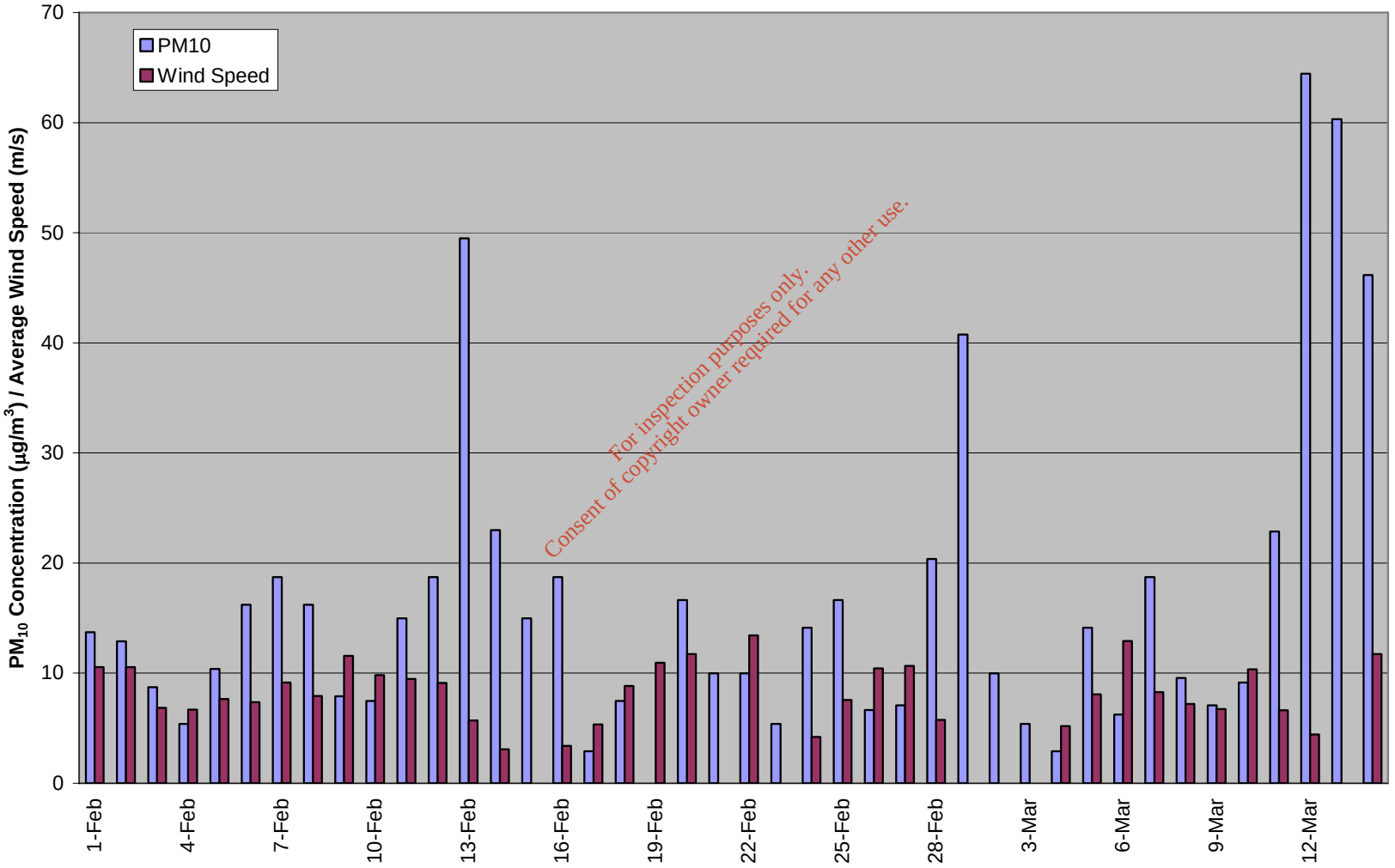
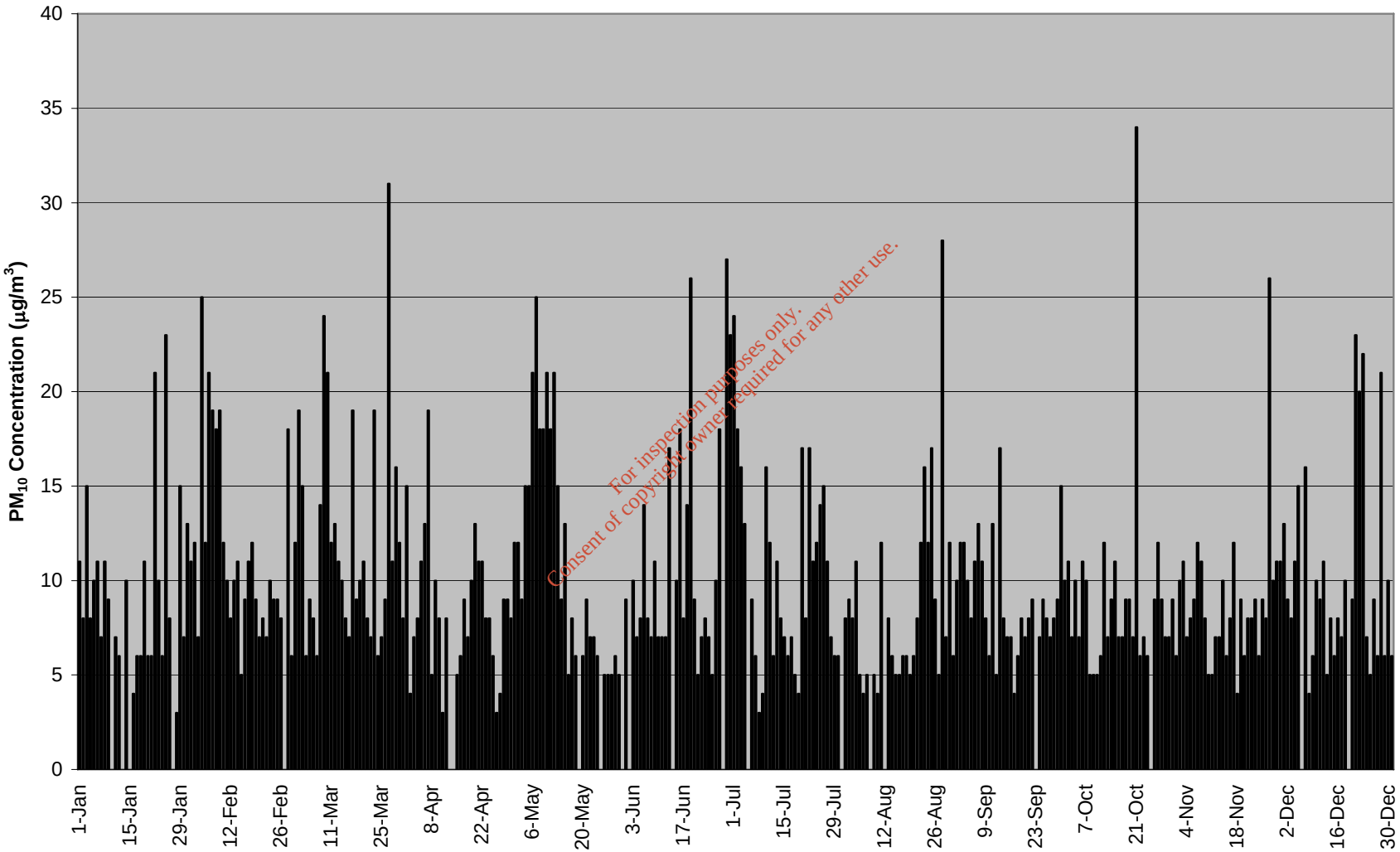


FIGURE 5

PM_{10} Monitoring Results at Lough Navar Forest, Co. Fermanagh in 2000



Pollutant	Regulation	Limit Type	Margin of Tolerance	Value
Particulate Matter Stage 1	1999/30/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50% until 2001 reducing linearly to 0% by 2005	50 $\mu g/m^3$ PM_{10}
		Annual limit for protection of human health	20% until 2001 reducing linearly to 0% by 2005	40 $\mu g/m^3$ PM_{10}
Particulate Matter Stage 2(1)	1999/30/EC	24-hour limit for protection of human health - not to be exceeded more than 7 times/year	To be derived from data and to be equivalent to Stage 1 limit value	50 $\mu g/m^3$ PM_{10}
		Annual limit for protection of human health	50% until 2005 reducing linearly to 0% by 2010	20 $\mu g/m^3$ PM_{10}

(1) Indicative limit values to be reviewed in the light of further information on health and environmental effects, technical feasibility and experience in the application of Stage 1 limit values in the Member States

Table 1 EU Ambient Air Standard - Council Directive 1999/30/EC

Sampling Date	PM_{10} ($\mu g/m^3$)	Sampling Date	PM_{10} ($\mu g/m^3$)	Sampling Date	PM_{10} ($\mu g/m^3$)
21-Dec-01	10	18-Jan-02	15	15-Feb-02	15
22-Dec-01	20	19-Jan-02	11	16-Feb-02	19
23-Dec-01	12	20-Jan-02	20	17-Feb-02	3
24-Dec-01	8	21-Jan-02	22	18-Feb-02	7
25-Dec-01	7	22-Jan-02	13	19-Feb-02	(1)
26-Dec-01	8	23-Jan-02	13	20-Feb-02	17
27-Dec-01	5	24-Jan-02	19	21-Feb-02	10
28-Dec-01	16	25-Jan-02	10	22-Feb-02	10
29-Dec-01	6	26-Jan-02	14	23-Feb-02	5
30-Dec-01	8	27-Jan-02	17	24-Feb-02	14
31-Dec-01	36	28-Jan-02	13	25-Feb-02	17
01-Jan-02	37	29-Jan-02	28	26-Feb-02	7
02-Jan-02	22	30-Jan-02	11	27-Feb-02	7
03-Jan-02	27	31-Jan-02	15	28-Feb-02	20
04-Jan-02	32	01-Feb-02	14	01-Mar-02	41
05-Jan-02	7	02-Feb-02	13	02-Mar-02	10
06-Jan-02	17	03-Feb-02	9	03-Mar-02	5
07-Jan-02	25	04-Feb-02	5	04-Mar-02	3
08-Jan-02	37	05-Feb-02	10	05-Mar-02	14
09-Jan-02	47	06-Feb-02	16	06-Mar-02	6
10-Jan-02	67	07-Feb-02	19	07-Mar-02	19
11-Jan-02	19	08-Feb-02	16	08-Mar-02	10
12-Jan-02	17	09-Feb-02	8	09-Mar-02	7
13-Jan-02	16	10-Feb-02	7	10-Mar-02	9
14-Jan-02	12	11-Feb-02	15	11-Mar-02	23
15-Jan-02	10	12-Feb-02	19	12-Mar-02	64
16-Jan-02	9	13-Feb-02	49	13-Mar-02	60
17-Jan-02	7	14-Feb-02	23	14-Mar-02	46
Average			18		
No. Exceedances of 24-hour Limit Value			3		
Limit Values			$40^{(2)}$, $50^{(3)}$		

(1) Filter damaged post sampling.
(2) EU Council Directive 1999/30/EC - Limit value to be enforced in 2005 (as an annual average).
(3) EU Council Directive 1999/30/EC - Limit value to be enforced in 2005 (as a 90.1th percentile of 24 hour averages).

Table 2 Results of PM_{10} monitoring carried out at a roadside location in Carranstown, Co. Meath.

Sampling Date	Wind Speed (m/s)[1]	Sampling Date	Wind Speed (m/s)[2]	Sampling Date	Wind Speed (m/s)[1]
21-Dec-01	13.9	18-Jan-02	n.a.	15-Feb-02	n.a.
22-Dec-01	8.3	19-Jan-02	n.a.	16-Feb-02	n.a.
23-Dec-01	13.4	20-Jan-02	9.5	17-Feb-02	3.4
24-Dec-01	19.0	21-Jan-02	8.7	18-Feb-02	5.4
25-Dec-01	13.0	22-Jan-02	7.3	19-Feb-02	8.8
26-Dec-01	12.3	23-Jan-02	5.8	20-Feb-02	11.0
27-Dec-01	18.8	24-Jan-02	5.9	21-Feb-02	11.7
28-Dec-01	13.4	25-Jan-02	n.a.	22-Feb-02	n.a.
29-Dec-01	11.1	26-Jan-02	n.a.	23-Feb-02	13.4
30-Dec-01	10.7	27-Jan-02	8.0	24-Feb-02	n.a.
31-Dec-01	5.2	28-Jan-02	12.0	25-Feb-02	4.2
01-Jan-02	6.9	29-Jan-02	8.3	26-Feb-02	7.6
02-Jan-02	17.0	30-Jan-02	6.8	27-Feb-02	10.4
03-Jan-02	16.6	31-Jan-02	8.2	28-Feb-02	10.6
04-Jan-02	n.a.	01-Feb-02	10.5	01-Mar-02	5.8
05-Jan-02	n.a.	02-Feb-02	10.5	02-Mar-02	n.a.
06-Jan-02	3.8	03-Feb-02	6.8	03-Mar-02	n.a.
07-Jan-02	4.1	04-Feb-02	6.7	04-Mar-02	n.a.
08-Jan-02	3.8	05-Feb-02	7.7	05-Mar-02	5.2
09-Jan-02	n.a.	06-Feb-02	7.4	06-Mar-02	8.1
10-Jan-02	2.1	07-Feb-02	9.2	07-Mar-02	12.9
11-Jan-02	n.a.	08-Feb-02	7.9	08-Mar-02	8.3
12-Jan-02	n.a.	09-Feb-02	11.6	09-Mar-02	7.2
13-Jan-02	9.6	10-Feb-02	9.8	10-Mar-02	6.7
14-Jan-02	11.0	11-Feb-02	9.5	11-Mar-02	10.3
15-Jan-02	13.3	12-Feb-02	9.1	12-Mar-02	6.6
16-Jan-02	12.0	13-Feb-02	5.7	13-Mar-02	4.4
17-Jan-02	6.0	14-Feb-02	3.1	14-Mar-02	n.a.

(1) Meteorological data recorded by Met Eireann at Dublin Airport (n.a. signifies data not currently available).

Table 3 Wind speed data recorded as daily averages between January 21st 2001 and March 14th 2002.

ANALYTICAL SERVICES & ENVIRONMENTAL PROJECTS

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DIOXIN LEVELS

in

AIR, SOIL and FOLIAGE

in the vicinity of

A PROPOSED DEVELOPMENT

at

CARRANSTOWN, Co. MEATH

A Report to Project Management
Dublin

September, 2000

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1. Introduction

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), commonly referred to as dioxins and furans or simply as "dioxins" are generated as by-products from various chemical manufacturing processes and from combustion processes where chlorine is present. This group of compounds has a very high toxicity to human health and consequently very low guideline values have been set for human exposure.

2. Toxic Equivalent Value (TEQ)

There are a great many different isomeric chlorinated species covered by the term "dioxins". Of these, the most toxic is the 2,3,7,8 tetrachlorodibenzo-p-dioxin. In relative terms, many other "dioxins" are much less toxic. The accepted convention is to derive a total toxic equivalent value for any sample relative to the 2,3,7,8 TCDD, which is given a TEQ of unity. This is achieved by applying the relevant agreed toxic equivalent factor to the concentration of each dioxin and furan species.

The weighting scheme proposed by NATO/CCMS (North Atlantic Treaty Organisation's Committee on Challenges of Modern Society) is the most widely accepted and is the one used in this exercise. The TEQs are tabulated below.

NATO/CCMS I- Toxic Equivalence Factors

Congener	1-TEF
2378 TCDD	1
12378 PeCDD	0.5
123478HxCDD	0.1
123678HxCDD	0.1
123789HxCDD	0.1
1234678HpCDD	0.01
OCDD	0.001
2378 TCDF	0.1
12378 PeCDF	0.5
123478 HxCDF	0.05
123678 HxCDF	0.1
234678 HxCDF	0.1
123789HxCDF	0.1
1234678 HpCDF	0.01
OCDF	0.001

3. Baseline Study

A development is proposed for a green field site, at Carranstown, Co Meath, to the south west of Drogheda. Project Management has commissioned ASEP to carry out a baseline study of dioxin levels at the site. This has involved collection of samples from ambient air, soil and vegetation from four locations around the site.

This report presents the results of the analysis of those samples.

4 Sampling Protocol

4.1 Air Samples

Sampling was carried out using a procedure based on Method TO 9A, described in the US EPA Compendium for the Determination of Toxic Organic Compounds in Ambient Air. In summary, air was sampled through a quartz fibre/polyurethane foam filter assembly using a metered high volume battery operated pump. Battery operated pumps were necessary because there was no access to mains power and the use of portable generators was discounted because of security considerations. Sampling was carried out over a seventeen-day period in order to collect between 100 and 200m^3 of air. The exposed sampling media were wrapped in aluminium foil and returned to the laboratory for analysis.

4.2 Soil and Vegetation Samples

Sampling was carried out using the UK HMIP protocol. This operates on an approximate one metre square area. Five sub-samples of soil were removed from the points of a "W" shape using a corer. Surface vegetation was collected from each point and from any adjacent hedgerows, trees etc. The corer samples to an approximate depth of 15 cm with an approximate weight of 200g being taken from each point. The two sets of five sub samples were each combined to provide two composite samples, one of soil and one of vegetation which were double wrapped in heavy duty polyethylene bags and returned to the laboratory for analysis.

5 Sampling Programme

The air sampling equipment was set up by ASEP personnel at the four sites tabulated below on 22 August, 2000. Soil and vegetation samples were collected at the same time. The sites were inspected at regular intervals during the air-sampling programme which was terminated on 7 September, 2000. The sites are indicated on the outline maps of the area and photographs, which are appended.

Sampling Site Grid References

Site Reference	Grid Reference
D1	53° 40.494 N, 006° 23.535 W
D2	53° 40.688 N, 006° 23.717 W
D3	53° 40.708 N, 006° 23.420 W
D4	53° 40.672 N, 006° 23.366 W

6 Analysis

Analysis was carried out by ENSR International, a specialist "dioxin" laboratory, based in Manchester. The analytical procedure, which is detailed below, involves a complex extraction, clean-up and concentration programme, followed by multiple ion high resolution gas chromatography - high resolution mass spectrometry, (GC/MS) using procedures based on USEPA methods 8290 and 1613, allied with UK acceptance criteria (Chemosphere, 21, 999 1990). All laboratory work is undertaken under fully documented QA/QC control, providing reproducible and traceable results under the UKAS accreditation scheme.

6.1 Extraction

Each PUF and corresponding filter pair was transferred to a Soxhlet thimble and spiked with a known amount of spike material. The soil and vegetation samples were air dried to constant weight. The soil samples were sieved through a 1mm sieve. The> 1mm fraction was retained and an aliquot of the < 1mm fraction transferred to a Soxhlet thimble. The vegetation samples were finely chopped and an aliquot of the chopped sample transferred to a Soxhlet thimble. The samples were spiked with a known amount of spike material, containing the following ^{13}C isomers (*Cambridge Isotopes Laboratories mixes ED998 and EF999*)

Dioxin	Furan
2,3,7,8 TCDD	2,3,7,8 TCDF
1,2,3,7,8 PeCDD	1,2,3,7,8 PeCDF 2,3,4,7,8 PeCDF
1,2,3,4,7,8 HxCDD 1,2,3,6,7,8 HxCDD 1,2,3,7,8,9 HxCDD	1,2,3,4,7,8 HxCDF 1,2,3,6,7,8 HxCDF 2,3,4,6,7,8 HxCDF
1.2.3.4.6.7.8 HpCDD	1.2.3,4,6,7,8 HpCDF 1,2,3,4,7,8,9 HpCDF
OCDD	OCDF

The added ^{13}C mixes are used as a quantitative standard to compensate for recovery efficiency and as an internal retention time reference in the gas chromatographic analysis.

The air samples were extracted with a hexane/acetone (4:1) mixture for at least 8 hours. The Soxhlet extract was then water washed to remove the acetone and reduced in volume to ~5 ml by freeze drying.

The soil samples were Soxhlet extracted with toluene for at least 16 hours. The toluene extract was then reduced to dryness by freeze-drying and the residue re-dissolved in hexane.

The vegetation samples were extracted with hexane/acetone (4:1). The extracts were water washed to remove the acetone and reduced in volume by freeze-drying.

All the hexane extracts were then subjected to the clean-up procedure described below.

6.2 Clean-up Procedure

The clean-up is based on the method of di Domenico et al (*Anal Chem., 51. 735 1979*) which has proved effective in removing most substances which interfere with the subsequent GC/MS analysis.

The hexane extract is put on to a pre-washed column containing, in order, anhydrous sodium sulphate, 1/2(w/w) concentrated sulphuric acid/50-100 mesh silica gel, 9/1(w/w) anhydrous sodium sulphate/sodium bicarbonate, 50-100 mesh silica gel and finally anhydrous sodium sulphate. The column is eluted with 90ml of hexane to ensure efficient elution of the PCDDs and PCDFs.

The 100ml extract volume obtained is reduced to about 2mls by freeze-drying and then transferred onto a pre-washed basic chromatography grade alumina (Woelm

Super I) column. The column is eluted with about 20mls of hexane containing 2% dichloromethane and the eluate collected.

A subsequent wash, using a 50/50 hexane/dichloromethane mixture (10 mls) is used to elute the PCDDs and PCDFs. The eluate is reduced to <lml under a stream of clean, dry nitrogen.

Dodecane (containing a known concentration of $^{37}Cl_4$ 2,3,7,8-TCDD as an overall recovery standard) is added to the sample to act as a keeper. The solution is then further reduced to the volume of the keeper.

This is then transferred into a micro-vial, which is capped and sent to the MS Laboratory.

6.3 GC/MS Analysis

6.3.1 GC Conditions

Instrument:	HP5890 Series II, split/splitless injector at 280°C operated in splitless mode for 1 mm after injection.
Column:	60 m DB5 capillary column, 0.25 mm ID, 0.25 µm film thickness.
Temperature Programme:	190°C for 2 mins then at 2.5°C /min to 230°C, held for 1 min, then at 2.5°C/min to 250°C, held for 2 mins, then at 4°C/min to 290°C, held for 17 mins (total run time 56 mins)
Transfer line:	280°C.
Helium carrier gas:	at ~1 ml/min (head pressure 29 psi)

6.3.2 MS Conditions

Instrument: VG Autospec

Resolution: > 7500 on PFK

Electron Energy: ~32eV (optimised on m/z 92 of toluene)

Operational Mode: multiple ion detection using the 5 groups tabulated below

Group1:TCDD and TCDF

M/z	Ion	Species
303.9016	M	TCDF
305.8987	M+2	TCDF
315.9419	M	$^{13}C_{12}$TCDF
316.9824	PFK Lock	
317.9389	M+2	$^{13}C_{12}$TCDF
319.8965	M	TCDD
321.8936	M+2	TCDD
327.8847	M	$^{37}Cl_4$TCDD
331.9368	M	$^{13}C_{12}$TCDD
333 9338	M+2	$^{13}C_{12}$TCDD

Group 2: PeCDD and PeCDF

M/z	Ion	Species
337.8627	M	PeCDF
339.8597	M+2	PeCDF
349.9029	M	$^{13}C_{12}$PeCDF
351.9000	M+2	$^{13}C_{12}$PeCDE
353.8576	M	PeCDD
355.8546	M+2	PeCDD
365.8978	M	$^{13}C_{12}$PeCDD
366.9792	PFK Lock	
367.8949	M+2	$^{13}C_{12}$PeCDD

Group 3: HxCDD and HxCDF

M/z	Ion	Species
373.8207	M+2	HxCDF
375.8178	M+4	HxCDF
380.9760	PFK Lock	
385.8610	M+2	$^{13}C_{12}$HxCDF
387.8580	M+4	$^{13}C_{12}$HxCDF
389.8156	M+2	HxCDD
391.8127	M+4	HxCDD
401.8559	M+2	$^{13}C_{12}$HxCDD
403.8530	M+4	$^{13}C_{12}$HxCDD

Group 4: HpCDD & HpCDF

M/z	Ion	Species
407.7818	M+2	HpCDF
409.7788	M+4	HpCDF
419.8220	M+2	$^{13}C_{12}$HpCDF
421.8191	M+4	$^{13}C_{12}$HpCDF
423.7767	M+2	HpCDD
425.7737	M+4	HpCDD
435.8169	M+2	$^{13}C_{12}$HpCDD
437.8140	M+4	$^{13}C_{12}$HpCDD
442.9729	PFK Lock	

Group 5: OCDD & OCDF

M/z	Ion	Species
441.7428	M+2	OCDF
443.7398	M + 4	OCDF
453.7830	M+2	$^{13}C_{12}$OCDF
454.9728	PFK Lock	
455.7801	M+4	$^{13}C_{12}$OCDF
457.7377	M+2	OCDD
459.7348	M+4	OCDD
469.7780	M+2	$^{13}C_{12}$OCDD
471.7750	M+4	$^{13}C_{12}$OCDD

7. Data Handling

Relative response factors (RRF's) for the ^{12}C and ^{13}C congeners are calculated as the ratio of the sum of the areas of the two isotopic ions of the ^{13}C congener to the sum of the corresponding ^{12}C congener, scaled by the relative concentrations of the two species in a standard calibration mix.

The RRF's so obtained are then compared with the running mean values and, provided they do not differ by more than ± 15% the samples are then analysed.

The unknown samples are analysed by extracting the areas and retention times of all the peaks in each mass chromatogram and transferring them to a spread sheet programme. This programme then filters the peaks on the basis of the isotopic ratios, targets the 2,3,7,8-containing congeners from retention time data and, using the RRF's derived from the calibration mix data and the amount of spike mix added, calculates the concentrations of the 2,3,7,8-containing congeners and the totals for each congener group, as well as the data on any peaks rejected on isotopic ratio grounds.

The integrated traces are then inspected to ensure that peaks are not included or rejected on the basis of an incorrect integration baseline.

These values are scaled by the amount of the original sample, when known, to give the concentrations of the various species in the sample. A TEQ is then calculated based on the concentration of the 2,3,7,8-containing congeners multiplied by the appropriate TEFs (in this case the NATO/CCMS I-TEFs) and summed.

All the resulting values are automatically compensated for extraction and clean-up efficiency by being referenced to the added spike mix concentrations. The actual recovery (for 2,3,7,8- TCDD) is obtained by comparing the areas of the ^{13}C TCDD spike and the added $^{37}Cl_4$ TCDD GC standard, scaled for relative amounts, with those obtained from a standard mix of the two compounds.

The use of more than one mass for monitoring each congener group and for monitoring the ^{13}C congeners means that in addition to mass specificity, intensity ratio measurements of the different ions can be made to detect any interference which may have occurred due to the elution of other species at or close to the retention time of the species of interest.

The criterion of similar GC retention time in the sample relative to the calibration standard is also used to aid identification and specificity. It is assumed for the 2,3,7,8-containing congener specific analyses that the sample response at the retention time of the 2,3,7,8- containing ^{13}C standard is due only to the 2,3,7,8- containing congener.

The criteria used are those of the UK Acceptance Criteria Guidelines [*Ambidge et al Chemosphere, 2], 999 (1990)].*

8. Results

Results are tabulated below giving the weights of the various isomers detected in the samples, together with the toxic equivalent value (derived from NATO/CCMS Toxic Equivalent Factors).

Weight of Dioxin/Furan in Ambient Air Samples

ASEP Ref. No.	D1	D2	D3	D4
ENSR Ref. No.	**23245**	**23246**	**23247**	**23248**
2378-TCDD	<0.002	< 0.002	< 0.002	< 0.002
Total TCDD	< 0.02	< 0.02	< 0.02	< 0.02
12378 PeCDD	< 0.002	< 0.002	< 0.002	< 0.002
Total PeCDD	< 0.02	< 0.02	< 0.02	< 0.02
123478-HxCDD	< 0.002	< 0.002	< 0.002	< 0.002
123678-HxCDD	< 0.002	< 0.002	< 0.002	< 0.002
123789-HxCDD	< 0.002	< 0.002	< 0.002	< 0.002
Total HxCDD	< 0.02	< 0.02	< 0.02	< 0.02
1234678-HpCDD	< 0.005	< 0.005	< 0.005	< 0.005
Total HpCDD	< 0.05	< 0.05	< 0.05	< 0.05
OCDD	0.01	0.01	0.02	0.02
2378-TCDF	< 0.002	< 0.002	< 0.002	< 0.002
Total TCDF	< 0.02	< 0.02	< 0.02	< 0.02
23478-PeCDF	< 0.002	< 0.002	< 0.002	< 0.002
12378 PeCDF	< 0.002	< 0.002	< 0.002	< 0.002
Total PeCDF	< 0.02	< 0.02	< 0.02	< 0.02
123478-HxCDF	< 0.002	< 0.002	< 0.002	< 0.002
123678-HxCDF	< 0.002	< 0.002	< 0.002	< 0.002
234678-HxCDF	< 0.002	< 0.002	< 0.002	< 0.002
123789-HxCDF	< 0.002	< 0.002	< 0.002	< 0.002
Total HxCDF	< 0.02	< 0.02	< 0.02	< 0.02
1234678-HpCDF	0.005	0.005	< 0.005	< 0.005
1234789-HpCDF	< 0.005	< 0.005	< 0.005	< 0.005
Total HpCDF	< 0.05	< 0.05	< 0.05	< 0.05
OCDF	< 0.01	< 0.01	< 0.01	< 0.01
I-TEQ	0.006	0.006	0.006	0.006

Note: Total refers to all isomers of the congener group ITEQ (max) calculated with "<"values at their reported limits

Dioxin/Furan Content of Soil Samples (ng/g air dried)

ASEP Ref. No.	D1	D2	D3	D4
ENSR Ref. No.	23107	23108	23109	23110
Weight loss on drying (%)	16	19	22	24
2378-TCDD	0.0002	< 0.0001	< 0.0001	< 0.0001
Total TCDD	0.015	0.002	0.001	0.003
12378 PeCDD	0.0002	0.0003	< 0.0001	< 0.0001
Total PeCDD	0.004	0.005	0.001	0.001
123478-HxCDD	0.0005	0.0004	0.0002	0.0002
123678-HxCDD	0.0002	0.0003	0.0002	0.0002
123789-HxCDD	0.0003	0.0003	0.0002	0.0001
Total HxCDD	0.007	0.006	0.004	0.004
1234678-HpCDD	0.0032	0.0030	0.0024	0.0022
Total HpCDD	0.005	0.006	0.004	0.004
OCDD	0.015	0.025	0.011	0.012
2378-TCDF	0.0003	0.0003	0.0002	0.0002
Total TCDF	0.004	0.002	0.003	0.002
23478-PeCDF	0.0004	0.0004	0.0004	0.0003
12378 PeCDF	0.0006	0.0003	0.0004	0.0004
Total PeCDF	0.005	0.003	0.003	0.003
123478-HxCDF	0.0015	0.0014	0.0005	0.0005
123678-HxCDF	0.0004	0.0003	0.0003	0.0004
234678-HxCDF	0.0003	0.0003	0.0003	0.0003
123789-HxCDF	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Total HxCDF	0.003	0.003	0.003	0.002
1234678-HpCDF	0.0044	0.004	0.0026	0.0049
1234789-HpCDF	0.0003	0.0003	0.0001	< 0.0001
Total HpCDF	0.005	0.006	0.003	0.005
OCDF	0.007	0.008	0.005	0.006
I-TEQ	0.0010	0.0009	0.0006	0.0006

Note: Total refers to all isomers of the congener group ITEQ (max) calculated with "<"values at their reported limits

Dioxin/Furan Content of Vegetation Samples (ng/g air dried)

ASEP Ref. No.	D1 VEG	D2 VEG	D3 VEG	D4 VEG
ENSR Ref. No.	23111	23112	23113	23203
Weight loss on drying (%)	77	70	71	73
2378-TCDD	< 0.0002	< 0.0002	< 0.0005	< 0.0002
Total TCDD	< 0.002	< 0.002	< 0.005	0.003
12378 PeCDD	< 0.0002	< 0.0002	< 0.0005	< 0.0002
Total PeCDD	< 0.002	< 0.002	< 0.005	0.003
123478-HxCDD	< 0.0002	< 0.0002	< 0.0005	< 0.0002
123678-HxCDD	< 0.0002	< 0.0002	< 0.0005	< 0.0002
123789-HxCDD	< 0.0002	< 0.0002	< 0.0005	< 0.0002
Total HxCDD	< 0.002	< 0.002	< 0.005	< 0.002
1234678-HpCDD	0.0007	0.0005	< 0.0005	0.0010
Total HpCDD	< 0.002	< 0.002	< 0.005	0.002
OCDD	0.005	0.004	0.005	0.007
2378-TCDF	0.0002	0.0002	< 0.0002	0.0005
Total TCDF	0.003	0.003	0.002	0.008
23478-PeCDF	0.0002	0.0002	< 0.0002	0.0003
12378 PeCDF	0.0001	< 0.0002	< 0.0002	< 0.0002
Total PeCDF	0.007#	< 0.002	0.002	0.003
123478-HxCDF	0.0006	< 0.0002	< 0.0002	< 0.0002
123678-HxCDF	< 0.0001	< 0.002	< 0.002	< 0.002
234678-HxCDF	< 0.0001	< 0.002	< 0.002	< 0.002
123789-HxCDF	< 0.0001	< 0.002	< 0.002	< 0.002
Total HxCDF	0.004#	< 0.002	< 0.002	< 0.002
1234678-HpCDF	< 0.0005	< 0.0002	< 0.0002	0.0010
1234789-HpCDF	< 0.0005	< 0.0002	< 0.0002	< 0.0002
Total HpCDF	< 0.005	< 0.002	< 0.002	0.001
OCDF	0.003	0.001	0.003	0.004
I-TEQ	0.0006	0.0006	0.0011	0.0007

 # maximum value due to interference
Note: Total refers to all isomers of the congener group ITEQ (max) calculated with "<"values at their reported limits

9. Concentrations in Ambient Air

The volumes of air sampled at the various locations are tabulated below together with the corresponding concentrations of dioxins expressed as I-TEQ(max)/m^3. The volume of air is reported as dry gas at ambient temperature and pressure.

Site Ref	Sample Volume m^3 ATP	Dioxin Concentration I-TEQ (max) pg/m^3
D1	213.668	0.028
D2	130.137	0.046
D3	182.652	0.033
D4	128.518	0.046

10. Confidence Limits

The analytical measurement should have a precision of ±10 % (from measurements of calibration standards and repeat linear injections)

11. Conclusions

Examination of the analytical results from the current study would indicate that the concentrations of the individual dioxin congeners being measured in each of the three sample matrices are at levels that are close to the limits of detection of the analytical system. The practice that has been adopted is to take all the "<" values at their reported limits so as to derive a worst case maximum value.

On this basis, the range in the soil samples is from 0.6 - 1 ng /kg and in the vegetation samples it is from 0.6 - 1.1 ng/ kg of dry sample in each case. The air sample range is from 0.028 to 0.046 pg/m^3.

There are only limited data on background levels in Ireland. An *Eolas*, study looking at 8 rural sites in Co Cork in 1991, showed soil levels in a range of 0.2 to 23.7 ng/kg. A *Forbairt* study was carried out in 1993/94 on behalf of Cork County Council on dioxin levels in soil and milk samples from a number of locations in Cork City and County. The level reported in soil was from 1.5 to 8.6 ng/kg TEQ.

Dioxins were also measured in soil in the Askeaton area in the course of the investigation of animal health problems. "Worst case" levels were reported in the range 1.1 – 2.0 ng/kg.

In a baseline study prior to the installation of a thermal oxidiser at Rathdrum, levels in the range 0.8 to 13.3 ng/kg were reported.

In a 1999 baseline survey for a proposed development at Kilcock in Co Kildare dioxin levels in soil samples were reported in the range 0.6 - 1.2 ng/kg.

By way of an international reference, the German Bund-Lander- Arbeitsgruppe DIOXINE shows a target value of < 5ng/kg for uncontaminated soils. HMIP data from the United Kingdom shows a range for 11 rural and 5 urban sites from 5.2 to 28.4 ng/kg.

In the Kilcock survey, dioxin levels in ambient air were reported in the range 0.003-0.007 pg/m^3. That same report quotes other data from Ireland in the range 0.0002-0.08 pg/m^3

However, these various data should only be compared with caution since the levels quoted are to a very large extent simply a function of the detection limits, which can vary not only between laboratories but also between samples.

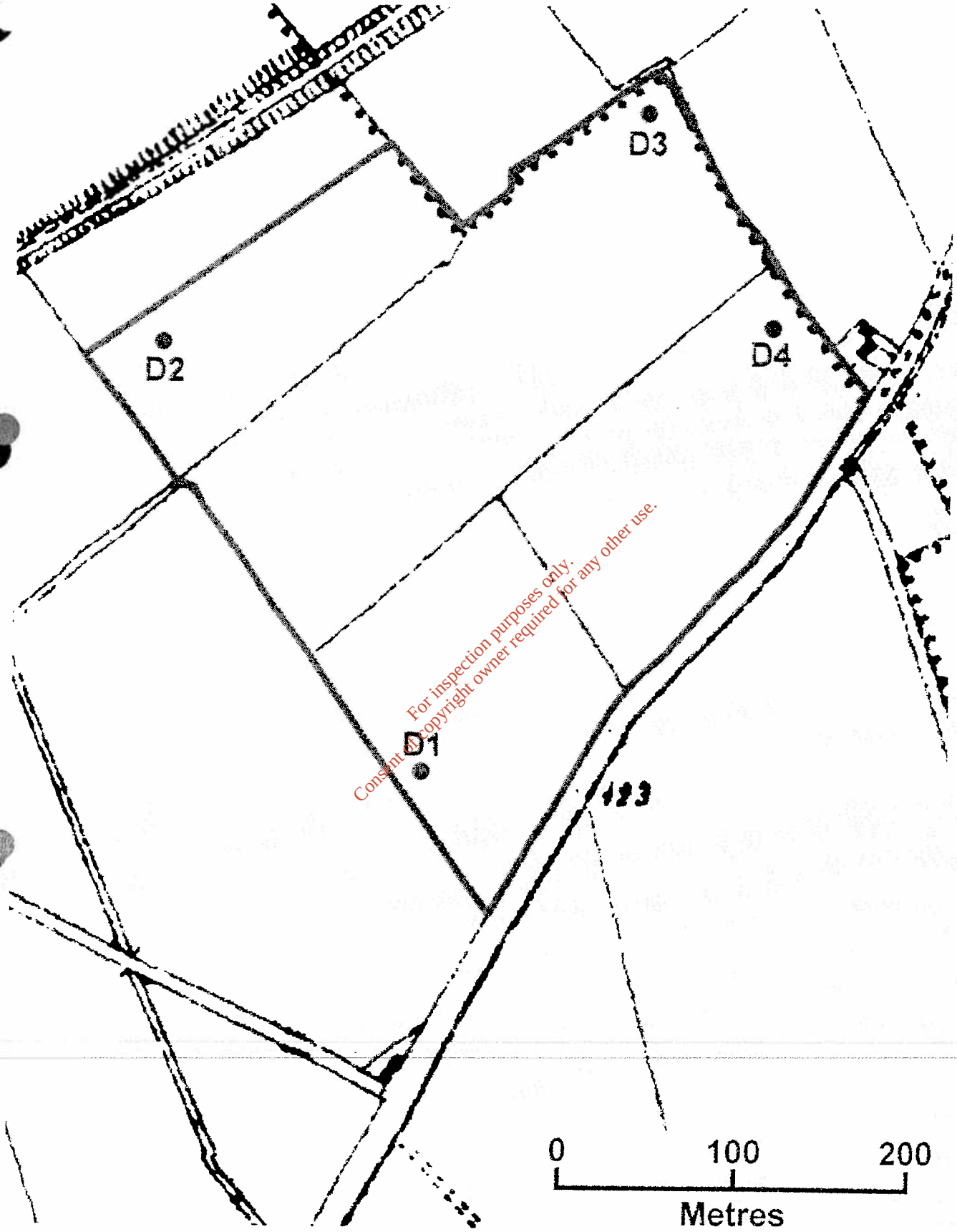
In "*Dioxins in the Irish Environment, An Assessment based on levels in Cow's Milk*" Colman Concannon of the EPA's Regional Inspectorate comments on the caution necessary in making such comparisons. He refers to the uncertainty introduced by the procedure of assigning TEQs for "non-detects", quoting examples where this can produce a range of ± 50% on reported data. He also notes that the problem is further compounded by the very large analytical uncertainties to which absolute concentrations at close to detection limits are normally subject and which are usually difficult to quantify. It is clear, he concludes that it would be unwise to place an overemphasis on comparisons of the individual values for I-TEQs.

For example, it should be noted that the approach adopted in the Kilcock report was to take "<" values at half the reported limit value for the purposes of TEQ determination.

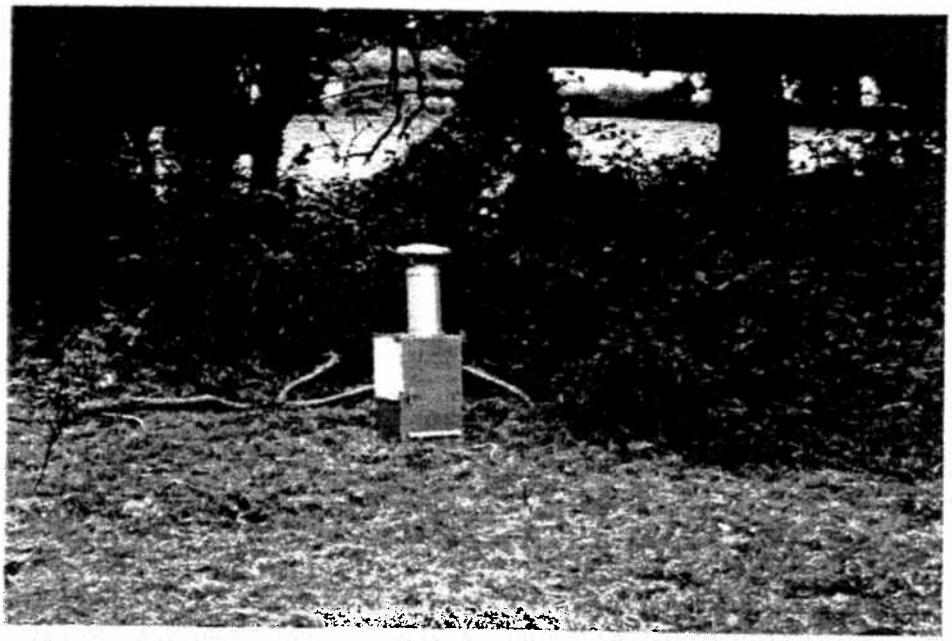
It is reasonable to conclude that the Drogheda data are within the range of background levels of dioxins in air and soils previously reported in Ireland and the vegetation data show no evidence of any accumulation from the soil.

The data from the Drogheda study provide a baseline against which to monitor the impact of the proposed development.

R.A. Patrick BSc, PhD, CChem, FICI, FRSC **29 September, 2000**
Assistant Director



Appendix: Sampling Sites



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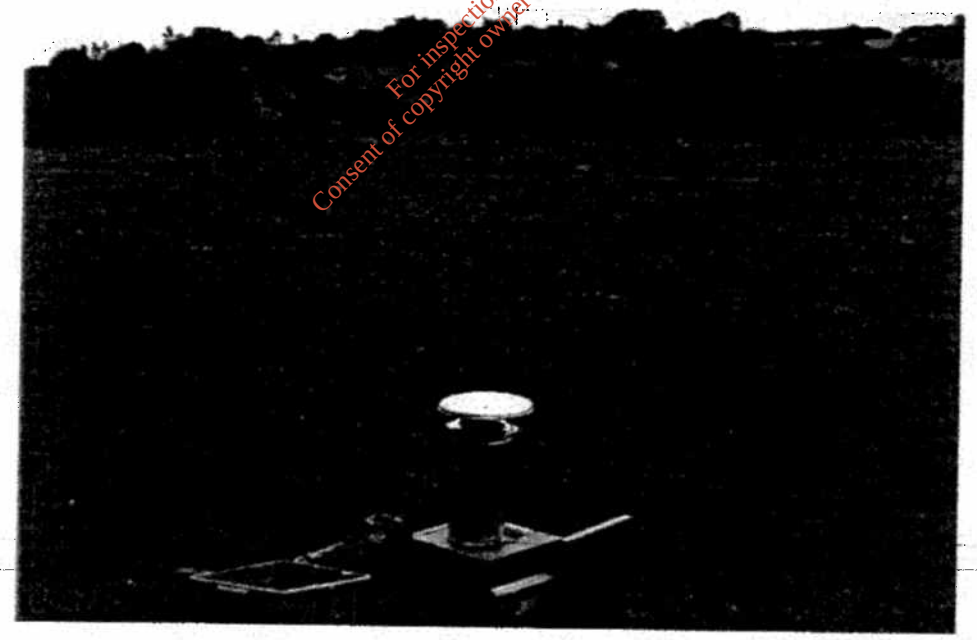
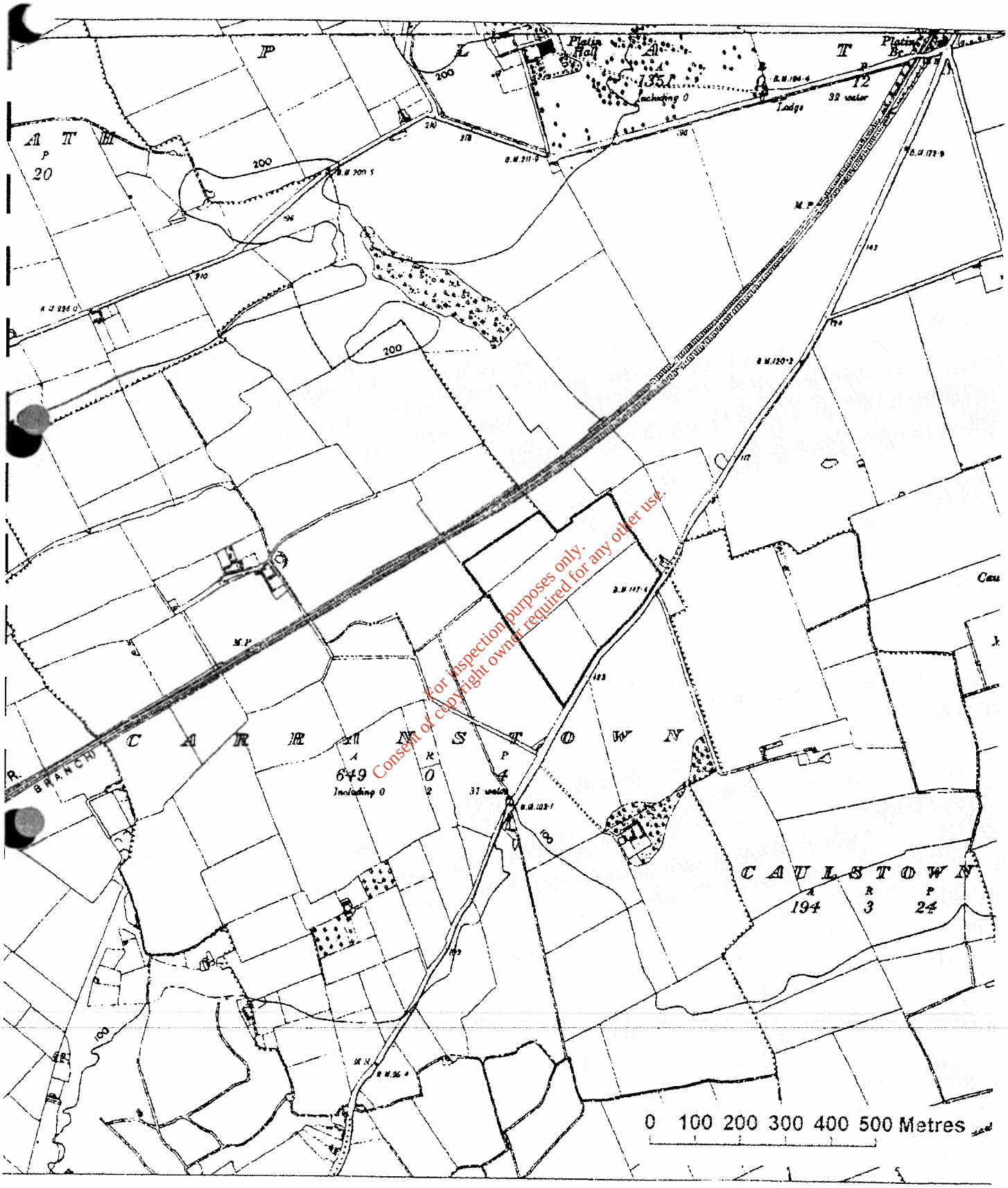


Sampling Site D2

Sampling Site D3

Sampling Site D4



Appendix: Site Location Map

Appendix I2: Results of 2005 Soil Study

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TECHNICAL REPORT

Sampling and Analysis of Soil for PCDD/F, Dioxin-Like PCBs and Heavy Metals at Carranstown, Duleek, Co. Meath and the surrounding area

FOR

White Young Green,
Apex Business Centre,
Blackthorn Road,
Sandyford,
Dublin 18

Report prepared by:
Dr Fergal Callaghan AMIChemE & **Brian Tiernan** MSc
Our reference: BT/05/2903SR01
Date: 23 January 2006

EXECUTIVE SUMMARY

Soil sampling was conducted at 6 locations at and around Carranstown, Co. Meath, with the aim of determining baseline PCDD/F, dioxin-like PCBs and Heavy Metals in the soil. Soil samples were analysed for PCDD/F and the results compared with current Irish data and data from other countries. The samples were also analysed for dioxin-like PCBs and Heavy Metals. The conclusions of the sampling and analysis programme were as follows:

- Background soil PCDD/F concentrations for the sites sampled in the Duleek area were typical of a mixed urban/rural area.

- The results were similar to those found by AWN Consulting Ltd. during surveys carried out in June and December 2001 at mixed urban/rural sites in Co. Dublin and Co. Cork, and the rural samples taken were similar to results obtained at a rural site in Co. Meath which was sampled in April 2002.

- Background soil dioxin-like PCBs were undetectable for all sites sampled in the area.

- Heavy Metals were within the typical range of trace elements in Non-Polluted Agricultural Soils in Ireland and were below any relevant contamination threshold indicators.

Definitions:

PCDD: Polychlorinated dibenzo-*p*-dioxins
PCDF: Polychlorinated dibenxo-*p*-furans
PCB: Polychlorinated Biphenols

DR FERGAL CALLAGHAN
Senior Environmental Consultant

BRIAN TIERNAN
Environmental Consultant

TABLE OF CONTENTS

1.0 INTRODUCTION

AWN Consulting Ltd was instructed by White Young Green to undertake the following scope of work in the Duleek area:

- Selection of sampling sites,
- Surface soil sampling,
- Analyses for PCDD/F, Dioxin-like PCBs and Heavy Metals
- Reporting including an interpretation and significance assessment,

The work was undertaken to provide a baseline assessment of the surrounding area as a part of a planning application for a proposed Waste to Energy Plant (WTE) at Carranstown, Co. Meath.

2.0 LOCATION OF SAMPLING SITES AND RATIONALE FOR CHOOSING INDIVIDUAL LOCATIONS

The sampling programme carried out by AWN Consulting Ltd. was designed to achieve the following goals:

- Establish a background concentration for an on-site location and locations identified offsite.

- Establish a background concentration at the nearest centre of population to the site.

Soil sampling was carried out by AWN Consulting Ltd. at the locations described in Table 2.1. The rationale for choosing these sampling locations is outlined in Table 2.2. All six soil sampling locations are shown in Figure 1.1. The sampling programme was conducted during the month of November, 2005 by Dr. Fergal Callaghan and Brian Tiernan of AWN Consulting Ltd.

Table 2.1 – Soil Sampling Locations

Location No.	*Sampling Point Location*	*Position (Grid Ref.)*	*Sample Date*
A	**Duleek Village** Green area at edge of the village	05273 68830	15th Nov. '05
B	**The Commons, North of Duleek** Open area next to residential estate	04679 69275	17th Nov. '05
C	**Donore Village** Open area next to residential estate	04516 72249	16th Nov. '05
D	**On a public road near entrance to Cement Plant** Grass verge along road	06969 72061	16th Nov. '05
E	**At proposed site location** On the agricultural land	06349 70729	15th Nov. '05
F	**Gafney, on road leading southbound** Grass verge along road	07696 70236	16th Nov. '05

Table 2.2 – Rationale for Choosing Sampling Locations

Location No.	*Rationale for Sample Location*
A	Closest residential community to the site
B	West of site
C	Closest residential community to the north
D	East of the site
E	Proposed site location
F	South of the site

Notes:

It was noted from an inspection of the wind rose data from Dublin Airport, for the period 1999 – 2002, that the predominant wind direction is south-westerly (Appendix 1).

3.0 SAMPLING METHODOLOGY

The aim of the sampling programme at each site was to establish baseline topsoil PCDD/F, dioxin-like PCB and Heavy Metal concentrations for each particular sampling location.

US EPA guidance, as presented in the US EPA EISOPQAM, was followed in the selection and design of the sampling methodology [1]. The EISOPQAM Areal Composite Methodology was selected as the method most applicable for determining background soil concentrations for an area [2]. This method ensures the sample collected is representative of an area. Briefly, the methodology consists of taking a number of samples in an identical manner and of an identical size and then combining these samples to form a composite sample, which is then thoroughly mixed. A sample of this composite material is then sent for analysis.

3.1 Sampling Depth

The investigation was designed to measure background contaminant concentrations in surface soils, which has been defined by EISOPQAM as soils between the ground surface and up to 6 - 12 inches (15 – 30 cm) below the ground surface [3]. Other authors, such as Hendriks *et al* [4] have taken samples of cores, which are 0 – 5 cm thick, whereas the team that has been working for many years on assessing the impact of the Seveso accident near Milan, Italy, has used samples of 7 cm thickness[5].

As the aim of this study was to assess the impact of surface deposition of contaminants, it was felt that the depth used by the Seveso study team (who were studying airborne deposition and were among the first teams to actively study the impact of dioxin deposition on soil concentrations) was the most appropriate. Therefore, soil samples of 7 cm thickness (from the surface to 7 cm below the surface) were taken.

3.2 Sampling Pattern

The sampling on each site was carried out in a “W” Pattern or a series of “W” patterns (where the site area was confined). Following the EPA EISOPQAM sampling methodology, samples were taken at 1 m centres due to constraints of space on the different locations.

The field records for each sampling site can be seen in Appendix 3. The layout of the sampling grid at each sampling location can be seen from the plates in Appendix 4.

3.3 Sample acquisition and Handling

The field records note that between 100 - 150 soil samples were taken at 1 m intervals, using a 2 cm diameter corer extended to a depth of 7 cm, at the sampling sites, with the sample number and sampling interval being determined by the area available for sampling.

Each composite soil sample weighed between 5 and 6 kg. Samples were thoroughly mixed in a clean plastic basin and then a 1 kg aliquot extracted from the mixed sample. The 1 kg sample was placed in an amber glass jar (supplied by Scientific Analysis Laboratories Ltd. in the U.K. an analytical laboratory used by AWN Consulting Ltd.). All soil samples were labelled samples A-F, and the analysis required for each sample was listed on a Sampling and Chain of Custody Record.

The samples were collected in one batch by First Direct Couriers, on 21st November 2005, and couriered overnight to Scientific Analysis Laboratories Ltd. in the U.K., for analysis.

3.4 Analysis suite

Scientific Analysis Laboratories Ltd. (SAL) are a UKAS 1549 Group accredited laboratory and were instructed to undertake the following analysis by AWN Consulting Ltd.

I. PCDD/F (NATO/CCMS I-TEQ)
   For all soil samples.

II. Dioxin-like PCBs (WHO 12)
   For all soil samples.

III. Heavy Metal Suite (as per Directive 2000/76/EC on the Incineration of Waste)

SAL holds UKAS accreditation for these tests.

4.0 RESULTS OF LABORATORY ANALYSES

The analysis results for PCDD/F have been summarised in Table 4.1 with more detailed results provided in Tables 5.1 and 5.2. the analysis results for Dioxin-like PCBs and Heavy Metals are shown in Tables 4.2 and 4.3.

Table 4.1 PCDD/F Analysis results

Sample ID	*Amount ng/kg I-TEQ*[1]
A	0.7
B	1.2
C	1.4
D	3.5
E	1.5
F	<0.5

1. NATO/CCMS I TEQ
2. Limit of (accurate) Detection of PCDD/F analysis suite is 0.5 ng/kg

Table 4.2 Dioxin-like PCBs

Determinand / *Ortho PCB's* [1]	*Method*	*Units*	*A*	*B*	*C*	*D*	*E*	*F*
Pentachloro, BZ#105	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01
Pentachloro, BZ#114	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01
Pentachloro, BZ#118	GC/MS	µg/kg	<0.05[2]	<0.05[2]	<0.05[2]	<0.05[2]	<0.05[2]	<0.05[2]
Pentachloro, BZ#123	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01
Hexachloro, BZ#156	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01
Hexachloro, BZ#157	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01
Hexachloro, BZ#167	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01
Hepachloro, BZ#189	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01
Non-Ortho PCB's								
Tetrachloro, BZ#81	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01
Tetrachloro, BZ#77	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01
Pentachloro, BZ#126	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01
Hexachloro, BZ#169	GC/MS	µg/kg	<0.01	<0.10[2]	<0.01	<0.10[2]	<0.01	<0.01

1. Limit of Detection is 0.01 µg/kg unless otherwise stated
2. Limit of Detection raised due to dilution of sample

Table 4.3 Heavy Metals

Determinand	*Method*	*Units*	*A*	*B*	*C*	*D*	*E*	*F*
Antimony (Sb)	ICP/OES	mg/kg	<1	<1	<1	<1	<1	<1
Arsenic (As)	ICP/OES	mg/kg	12	11	17	9	10	10
Cadmium (Cd)	ICP/OES	mg/kg	1	1	2	<1	<1	1
Chromium (Cr)	ICP/OES	mg/kg	15	14	17	13	17	18
Cobalt (Co)	ICP/OES	mg/kg	12	9	15	8	11	10
Copper (Cu)	ICP/OES	mg/kg	36	31	40	21	24	29
Lead (Pb)	ICP/OES	mg/kg	28	32	34	38	29	55
Manganese (Mn)	ICP/OES	mg/kg	1000	940	1100	850	930	1200
Mercury (Hg)	ICP/OES	mg/kg	<1	<1	<1	<1	<1	<1
Nickel (Ni)	ICP/OES	mg/kg	35	29	34	21	22	27
Thallium (Tl)	ICP/OES	mg/kg	<1	<1	2	<1	<1	2
Vanadium (V)	ICP/OES	mg/kg	23	17	27	21	25	25

1. Limit of Detection is 1.0 mg/kg

5.0 DISCUSSION OF RESULTS

The format for this Chapter of the report is as follows:

5.1 Issues associated with historical comparison of PCDD/F values.
5.2 Analysis of measured PCDD/F values.
5.3 Comparison of measured PCDD/F values with data for locations around Ireland.
5.4 Comparison of measured PCDD/F values with published data for other countries.
5.5 Analysis of measured dioxin-like PCBs.
5.6 Analysis of Heavy Metals

5.1 Issues associated with historical comparison of PCDD/F values

Polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzo-p-furans (PCDF) are a group of tricyclic aromatic compounds, with similar chemical and physical properties and are ubiquitous in the modern environment [6]. Mixtures of the two groups are normally referred to as PCDD/F.

The ability of chlorine atoms to substitute at various positions on the benzene ring structures of these compounds allows numerous positional isomers to be formed. In total, there are 210 positional isomers of both groups, 75 for PCDD and 135 for PCDF. The majority of these compounds are of no concern with respect to ecological and human toxicity, with the exception of 17 (7 PCDD and 10 PCDF) which have chlorine substitution in the 2,3,7,8 positions [7].

2,3,7,8 TCDD is the most studied dioxin and is considered to be the most toxic by far of the 17 congeners. As evidence began to accumulate in the 1970's and early 1980's of the toxic effects of 2,3,7,8 TCDD, a number of systems for assessing the toxicity of other PCDD/F were developed, all using the concept of Toxic Equivalence (TEQ) [7]. This concept assesses the toxicity of other PCDD/F congeners and assigns a weighting compared to the known toxicity of 2,3,7,8 TCDD.

Examples of the systems which have been developed include the Swiss (published in 1982), German (published in 1985), Danish (published in 1984) and Canadian (published in 1983) systems [8,9,10,11].

These systems applied slightly different weighting factors for calculating TEQ expressed as units of 2,3,7,8 TCDD. For instance, 1,2,3,4,6,7,8 HeptaCDD (non 2,3,7,8) was assigned a Toxic Equivalency Factor (TEF) of 0.1 by the Swiss system, but was given a TEF of 0.001 by the German system, a one hundred fold difference.

Similar differences in weightings were noted for a number of the other congeners. These differences meant that it was not possible in many instances to compare TEQ data from different countries. The NATO/CCMS system began to be more widely used through the early 1990's and the WHO also introduced a similar system with variations in a number of TEFs [12,13].

The US EPA, NATO/CCMS and the EC systems now use the same TEF Factors and the World Health Organisation has also adopted a similar system but not identical, allowing direct comparability of TEQ values with some conversion still required [14].

The NATO/CCMS TEFs (giving a result which is defined as I-TEQ), which correspond exactly with the EC and US EPA TEFs, have been used to calculate TEQs for the PCDD/Fs measured during this study.

It is also important to examine, when comparing PCDD/F measurements acquired by different laboratories, the approach taken when adding the Toxic Equivalents. It is current best practice by UKAS laboratories to exclude values which are below the limit of detection from the calculation of toxic equivalents, however, other laboratories have previously assumed that any value recorded as being below the limit of detection should be assigned a value for the relevant congener of 50% of the limit of detection. This can lead to slight discrepancies between laboratories.

Discrepancies can also arise when comparing soil samples taken with a hand corer or similar instrument, as the greater the depth of the core, the greater the potential for dilution of the sample by "cleaner soil". As dioxin concentrations in soil are influenced by airborne deposition rates, a concentration gradient will exist in the soil, with the greatest concentrations in the upper layer and decreasing concentrations being measured as depth increases and the influence of surface deposition decreases.

5.2 Analysis of measured PCDD/F values

The full laboratory analysis results are shown in Appendix 6. For comparative purposes, the absolute amounts of each of the 17 PCDD/F congeners and the tetra through to hepta homologues measured for soil are presented in Table 5.1 (in ng/kg). The I-TEQ values for the congeners are presented in Table 5.2. All concentrations are expressed in ng/kg air-dried soil, unless otherwise stated.

All the sample sites showed PCDD/F concentrations of equal to or less than 1.5 ng/kg I-TEQ, with the exception of the sample site D. Sample site D is located at the public road near the entrance to the Platin Cement Plant and showed concentrations of 3.5 ng/kg I-TEQ.

In general, sample sites A, B, C and E were very similar in their I-TEQ congener profiles. All of these sites showed traces of the dioxins 1,2,3,4,6,7,8 HpCDD and OCDD. The furans present were 2,3,7,8 TCDF, 1,2,3,7,8 PeCDF, 2,3,4,7,8 PeCDF, 1,2,3,4,7,8 HxCDF, 1,2,3,6,7,8 HxCDF, 2,3,4,6,7,8 HxCDF (absent in Location B) and 1,2,3,4,6,7,8 HpCDF. 1,2,3,4,7,8-HxCDF was the most predominant dioxin/furan for all of these sites.

Sample site D showed a greater number of dioxins and furans than the other sites. The site showed traces of dioxins 1,2,3,6,7,8 HxCDD, 1,2,3,4,6,7,8 HpCDD and OCDD. The furans present were 2,3,7,8-TCDF, 1,2,3,7,8-PeCDF, 2,3,4,7,8-PeCDF, 1,2,3,4,7,8-HxCDF, 1,2,3,6,7,8-HxCDF, 2,3,4,6,7,8-HxCDF, 1,2,3,4,6,7,8-HpCDF and OCDF.

Sample site F showed no measure of furans and a small number of dioxins. The dioxins present were 2,3,4,7,8-PeCDF, 1,2,3,6,7,8-HxCDF, 2,3,4,6,7,8-HxCDF and1,2,3,4,6,7,8-HpCDF.

Table 5.1 Mass of PCDD/F congeners measured in each Soil sample (ng/kg)

Congener	Sample Sites					
	A	B	C	D	E	F
	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg	ng/kg
2,3,7,8-TCDD	ND	ND	ND	ND	ND	ND
1,2,3,7,8-PeCDD	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-HxCDD	0.39	0.78	0.69	1.5	ND	ND
1,2,3,4,7,8-HxCDD	ND	ND	0.5	ND	ND	ND
1,2,3,7,8,9-HxCDD	ND	ND	0.38	ND	ND	ND
1,2,3,4,6,7,8-HpCDD	4.7	10	3.8	23	7.9	ND
OCDD	27	71	19	61	24	ND
TCDD	38	3.0	ND	45	2.4	ND
PeCDD	ND	ND	2.4	1.9	2.8	ND
HxCDD	1.2	3.0	ND	17	4.3	ND
HpCDD	5.5	16	ND	18	6.5	ND
2,3,7,8-TCDF	0.36	0.61	0.78	4.4	0.96	ND
1,2,3,7,8-PeCDF	0.43	0.6	0.8	3.1	1.2	ND
2,3,4,7,8-PeCDF	0.70	1.2	1.2	2.8	1.4	0.34
1,2,3,4,7,8-HxCDF	0.65	1.3	1.1	3.6	2.1	ND
1,2,3,6,7,8-HxCDF	0.53	0.81	1.3	2.3	1.1	0.2
2,3,4,6,7,8-HxCDF	0.63	ND	1.9	3.4	1.7	0.37
1,2,3,7,8,9-HxCDF	ND	ND	ND	ND	ND	ND
1,2,3,4,6,7,8-HpCDF	2.3	9.3	3.2	10	5.3	0.27
1,2,3,4,7,8,9-HpCDF	0.19	ND	ND	ND	ND	ND
OCDF	2.8	12	3.1	7.9	6.6	ND
TCDF	4.2	22	21	ND	4.2	3.8
PeCDF	3.5	3.0	8.4	12	10	0.4
HxCDF	2.8	6.4	ND	15	0.62	0.85
HpCDF	1.1	5.2	ND	ND	1.3	ND
Total	***96.98***	***166.2***	***69.55***	**231.9**	**84.38**	**6.23**

Table 5.2 Mass of PCDD/F congeners measured (converted to toxic equivalents) in each Soil sample and I-TEQ values

Sample Sites						
Toxic Equivalents	**A**	**B**	**C**	**D**	**E**	**F**
Congener	**ng/kg**	**ng/kg**	**ng/kg**	**ng/kg**	**ng/kg**	**ng/kg**
2,3,7,8-TCDD	ND	ND	ND	ND	ND	ND
1,2,3,7,8-PeCDD	ND	ND	ND	ND	ND	ND
1,2,3,6,7,8-HxCDD	0.039	0.078	0.069	0.15	ND	ND
1,2,3,4,7,8-HxCDD	ND	ND	0.05	ND	ND	ND
1,2,3,7,8,9-HxCDD	ND	ND	0.038	ND	ND	ND
1,2,3,4,6,7,8-HpCDD	0.047	0.1	0.038	0.23	0.079	ND
OCDD	0.027	0.071	0.019	0.061	0.024	ND
TCDD	0	0	ND	0	0	ND
PeCDD	ND	ND	0	0	0	ND
HxCDD	0	0	ND	0	0	ND
HpCDD	0	0	ND	0	0	ND
2,3,7,8-TCDF	0.036	0.061	0.078	0.44	0.096	ND
1,2,3,7,8-PeCDF	0.021	0.03	0.04	0.16	0.06	ND
2,3,4,7,8-PeCDF	0.35	0.58	0.62	1.4	0.7	0.17
1,2,3,4,7,8-HxCDF	0.065	0.13	0.11	0.36	0.21	ND
1,2,3,6,7,8-HxCDF	0.053	0.081	0.13	0.23	0.11	0.02
2,3,4,6,7,8-HxCDF	0.063	ND	0.19	0.34	0.17	0.037
1,2,3,7,8,9-HxCDF	ND	ND	ND	ND	ND	ND
1,2,3,4,6,7,8-HpCDF	0.023	0.093	0.032	0.1	0.053	0.0027
1,2,3,4,7,8,9-HpCDF	0.0019	ND	ND	ND	ND	ND
OCDF	0.0028	0.012	0.031	0.0079	0.0066	ND
TCDF	0	0	0	ND	0	0
PeCDF	0	0	0	0	0	0
HxCDF	0	0	ND	0	0	0
HpCDF	0	0	ND	ND	0	0
Total I-TEQ	**0.7287**	**1.236**	**1.445**	**3.4789**	**1.5086**	**0.2297**

5.3 Comparison with other soil testing programmes in Ireland

A number of surveys have been carried out for rural, mixed urban/rural and industrial sites in Ireland over the past number of years. Two soil dioxin surveys have been carried out in the Ringaskiddy area in Cork - one by the EPA and a second by AWN Consulting Ltd. Three additional studies were undertaken in rural Co. Meath, mixed urban/rural Co. Dublin and urban Co. Dublin and in 2001 and 2003, respectively.

Table 5.3 I-TEQ values of soil samples taken from differ rent locations (Urban, Mixed Urban/Rural and Rural)

Sample Site	Duleek Village	Nobber	Clontarf	Cobh	Balbriggan
Location Type	Mixed Urban/Rural	Rural	Urban	Mixed Urban/Rural	Mixed Urban/Rural
Units	ng/kg I-TEQ	ng/kg I-TEQ	ng/kg I-TEQ	ng/kg I-TEQ	ng/kg I-TEQ
Total I-TEQ	0.7	<0.5	4.0	1.0	1.2

Table 5.3 shows a comparison of results between the different sampling locations in areas around Ireland. All sampling was carried out by AWN Consulting in recent years and used the same methodology.

The results show that Duleek had a slightly lower concentration than those measured at Cobh and Balbriggan but a higher concentration than the site outside Nobber which is located in a rural environment. Duleek village (location A in this report) shows a similar congener profile to Nobber, and Cobh, see Figure 5.1. The urban sampling location (Clontarf) shows an elevated total I-TEQ and congener profile, due to the various combustion sources present at a reasonably high density in an urban area such as Clontarf including domestic fires, traffic and industrial combustion activities.

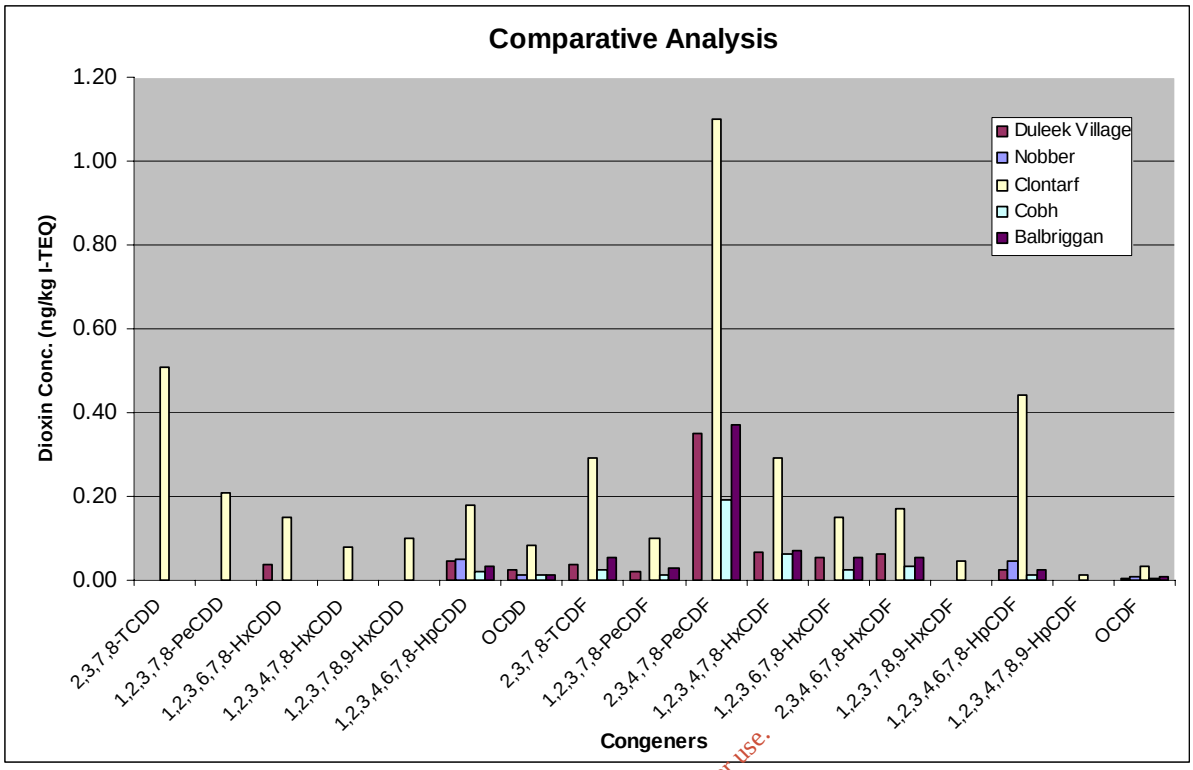

Figure 5.1 Congener profile for each sampling location used in Comparative Analysis

For comparison purposes, the EPA data for the Cork Harbour area, which was collected during soil testing carried out in December 2000 is presented in Table 5.3. The AWN Consulting Ltd. data from the same area which was obtained in 2001 is also presented.

Table 5.4 EPA and AWN (2001) Analysis Data and Sampling Locations

EPA (Dec. 2000)			AWN (Jul. 2001)		
EPA Sampling Location	***EPA Sample***	***I-TEQ (ng/kg)***	***I-TEQ (ng/kg)***	***AWN Sample***	***AWN Sampling Location***
Church Area	1	28	N/A	N/A	Not applicable
Main Square	2	7.1	N/A	N/A	Not applicable
Area beside foot.field	3	11.8	N/A	N/A	Not applicable
Cdr. Daly Area	4	3.1	N/A	N/A	Not applicable
Foot. Pitch (dockyard)	5	1.6	N/A	N/A	Not applicable
W. of Martello Tower	6	0.8	3.4	A	At base of Mart. Tower
Pfizer/ADM (to s. of site)	7	0.7	0.55	B	IDA land south of Pfizer
Ballymore (SW face field)	8	1	1.8	C	Cushkinny Nature Res.
Carrignafoy GAA Ground	9	1	1	D	Cobh Water Tower
Iniscarra WTW	10	0.6	<0.5	H	EPA Inishcarra

Sources of PCDD/F in the environment are generally anthropogenic in nature, with PCDD/F being products of activities such as domestic fires, accidental house fires, back yard burning, bin fires, traffic and industrial point sources.

The study of a mixed urban/rural area at Balbriggan in Dublin, which was carried out in December 2001, showed dioxin levels in the soil to range between <0.5 and 1.2 I-TEQ ng/kg. The <0.5 ng/kg value was recorded at a location 2km form Balbriggan, the 1.2 ng/kg value was recorded for a farmland site on the edge of Balbriggan. The rural study carried out in Co. Meath found the results from all 8 sample locations to range between <1.0 and 1.5 I-TEQ ng/kg. Taking this into account it can be seen from the above data that the rural areas with little immediate human activity generally have low PCDD/F concentrations, typically in the range of <0.5-0.7 ng/kg.

Mixed rural/urban areas, small towns or villages surrounded by agricultural land do contain sources of PCDD/F emissions from the domestic and commercial sources referred to above (towns such as Balbriggan and Cobh) and hence have slightly higher soil PCDD/F concentrations typically in the range of 0.7-1.5ng/kg.

The measured values for built up urban areas, such as Clontarf, Irishtown and Ringsend in Dublin (3.9, 5.7 and 3.2 ng/kg respectively) are significantly higher than those measured in rural/urban areas due to the higher density of population and hence the higher density of combustion sources.

In summary, the measured concentrations in Duleek and the surrounding area are low and are typical of urban/rural areas where a number of anthropogenic sources of PCDD/F are present.

5.4 Comparison with PCDD/F data for other countries

There have been numerous studies of PCDD/F soil concentrations undertaken by many countries over the last 25 years. Comparing different studies can sometimes be difficult, especially as many studies have given total PCDD/F values rather than expressing results as I-TEQ values. Nevertheless, there is sufficient data available for comparisons to be made.

A comprehensive US study, published in 1986, found 2,3,7,8 TCDD (*note* not 2,3,7,8 TCDD I-TEQ) concentrations in urban soils to range from 1 – 10 ng/kg [18]. The values measured by this survey (which includes the other 16 congeners) found 2,3,7,8 TCDD I-TEQ values to be at the lower end of this range and the survey suggests that 2,3,7,8 TCDD concentrations in the Duleek area are below the limit of detection of the analysis techniques.

A comprehensive German soil survey by Knoth et al.[30] reported the following TEQ values: Forests 5.4-112 (mean 34.6) ng/kg I-TEQ, grasslands 0.4-4.8 (mean 1.9) ng/kg I-TEQ, plowlands 0.3-3.7 (mean 1.6) ng/kg I-TEQ. In Spain Eljarrat et al. [31] found TEQ levels in rural soils of 0.3-3.1 ng/kg I-TEQ.

A study of archived rural soil samples from British agricultural research was carried out by Wood et al. [32]. In soil from the years 1856, 1881, 1904, 1913 concentrations of 0.79, 0.73, 0.94 and 1.4 ng/kg TEQ, respectively, were measured, demonstrating a rise in TEQ-level over time and a significant concentration of PCDD/F in soil influence by a society that was largely rural in nature.

A study of 19 urban locations in England and Wales found soil 2,3,7,8 TCDD concentrations ranging from <0.5 ng/kg to 11 ng/kg [19]. Again, results were not expressed as 2,3,7,8 TCDD I-TEQ values, but a comparison between this data and

the data obtained during the AWN Consulting Ltd. survey work shows that the background soil PCDD/F concentrations for sites sampled in the Duleek area are at the lower end of this scale.

Dioxin levels in soil were also measured in another survey carried out in the UK [20]. The median background level was found to be 6.3 ng/kg I-TEQ. The two regions measured for dioxin levels in soil, Pontyfelin House and the Panteg Region, showed dioxin levels to be 112 and 19 ng/kg I-TEQ respectively. The soil dioxin levels found in the Duleek area are extremely low in comparison to these UK levels, as the maximum level found in the Duleek area was 3.5 ng/kg I-TEQ.

An investigation of the floodplain soils in the Rhine Delta (Tienhoven, Lexmond and Hagestein) in the Netherlands found soil PCDD/F concentrations, expressed as 2,3,7,8 TCDD I-TEQ values, ranging from 23 – 93 ng/kg [4].

Measured values in the Duleek area are again well below these values.

Dioxin levels for two regions in Spain (Tarragona and Montcada) found dioxin levels to range between 0.3 and 44.26 ng/kg [21]. The rural background level ranged from 0.08 to 8.4 ng/kg.

Decreasing trends in environmental PCDD/F concentrations have been noted in many developed countries throughout the 1980's and 1990's. It has been proposed that this is due to a combination of the phasing out of leaded petrol, reduction in emissions from manufacturing industries and the introduction of emission controls on incinerator emissions [22].

Some countries have set limits for maximum soil concentrations of PCDD/Fs. The German limit values are defined in Table 5.5.

Table 5.5 Recommendation values and action levels for PCDD/PCDF in soil (Concentrations in ng I TEQ/kg d.m)

ng I TEQ	
<5	Target concentration
5-40	Control of products if dioxin transfer
>40	Restriction to crops with minimum dioxin transfer
>100	Soil exchange on children playgrounds
>1000	Soil exchange in residential areas
>10000	Soil exchange independent of the location

The PCDD/F values measured in the AWN Consulting Ltd. survey are well below any of the recorded levels or limits defined in the above literature.

5.5 Analysis of Dioxin-like PCBs

Dioxin-like PCBs were not detected at any of the sample sites. The levels were below the limits of detection of 0.01 µg/kg and 0.05 µg/kg, (used by SAL, the accredited laboratory that undertook the analysis.

5.6 Analysis of Heavy Metals

The suite of heavy metals sampled were chosen from the Directive 2000/76/EC on the Incineration of Waste. The suite covers the relevant heavy metal emissions from a typical waste to energy facility.

There are no threshold limits for heavy metals in the soil in relation to emissions form waste to energy facilities. The significance of measured levels must therefore be assessed by comparison with published standards for heavy metal concentrations in soil (the Dutch Guidelines – which are described below) and a comparison with other data for background soil metals concentrations in Ireland.

The Dutch Guidelines (Intervention values and target values – soil quality standards, published by The Ministry of Housing, Spatial Planning and Environment, The Hague, the Netherlands) are used to assess the significance of contamination in soil and groundwater. However, caution should be used when applying the Dutch Values, as the values are not “site end-use specific”. There are two values for each contaminant, an intervention value and a target value. The target value is the value one would expect in un-contaminated soil (from say an agricultural environment). The intervention value is set on the basis of a toxicological assessment of the impact of the contaminant on the health of human receptors and assumes that the human receptor is exposed to the contaminant through ingestion of soil and water, dermal contact with soil and water, eating vegetables grown on soil and inhalation of soil dust and vapour. According to the publication accompanying the Dutch Values, any value above the intervention value is regarded as indicating contamination, which may require further investigation and possible remediation.

The Dutch Values provide an over estimate of significance of contamination, as they are not site end use specific and therefore assume that a site will be used for the worst possible scenario, which includes vegetable growing, provision of drinking

water and washing and showering in water form the site. Nevertheless, they are a useful screening tool for determining the significance of site contamination, if a site is found to be uncontaminated with respect to the Dutch Standards, further screening is not considered necessary. If site contamination is found above Dutch Intervention Values, it would be necessary to further assess the site, using a risk assessment model such as the Dutch RISC HUMAN package, to determine the risk posed by the contamination to potential residents/occupants of the proposed development.

An EPA study highlighted the typical range of trace elements in non-polluted agricultural Irish soils (Table 5.6). All heavy metals measured in the Duleek and surrounding area, with the exception of Thallium, had levels within the range measured by the EPA, at the different sample sites. It can be seen that the slightly elevated thallium concentrations noted were well below the intervention limit set by the Dutch Standards and are therefore of no significance.

Table 5.6 Typical range of trace elements in Non-Polluted Agricultural Soils [26] and Dutch Intervention Values[27]

Element	Range (mg/kg) (Total content)	Dutch Intervention value (mg/kg)
Antimony (Sb)	0.2-3.0	15
Arsenic (As)	1.0-50	55
Cadmium (Cd)	0.1-1.0	12
Chromium (Cr)	5-250	380
Cobalt (Co)	1-25	240
Copper (Cu)	2-100	190
Lead (Pb)	2-80	530
Manganese (Mn)	20-3000	-
Mercury (Hg)	0.03-0.8	10
Nickel (Ni)	0.5-100	210
Thallium (Tl)	0.1-0.5	15
Vanadium (V)	20-250	250

Studies undertaken by Teagasc in 1999 and 2000 showed heavy metal levels in their study area to be consistent with the levels in the Duleek study area. See Table 5.7.

Table 5.7 Results from Teagasc study into soil and herbage heavy metal/ trace element variability and relationships at farm and regional Level[28]

Metal	mg/kg
Cadmium	0.51
Chromium	50.7
Copper	19.2
Mercury	0.1
Lead	29
Arsenic	14.4
Vanadium	58.8
Manganese	560

It can therefore be concluded that measured heavy metal concentrations were within the expected range and were well below any significance criteria.

6.0 CONCLUSIONS

- A comparison with data from other rural and mixed urban/rural sites around Ireland indicates that measured concentrations at Duleek and the surrounding area were similar to the values measured elsewhere.
- Measured concentrations for the Duleek and surrounding area were found to be low in comparison with other countries
- There were no dioxin-like PCBs detected at any of the sample sites.
- Heavy metal concentrations were similar to those measured at other sites in Ireland and did not exceed the threshold limits.

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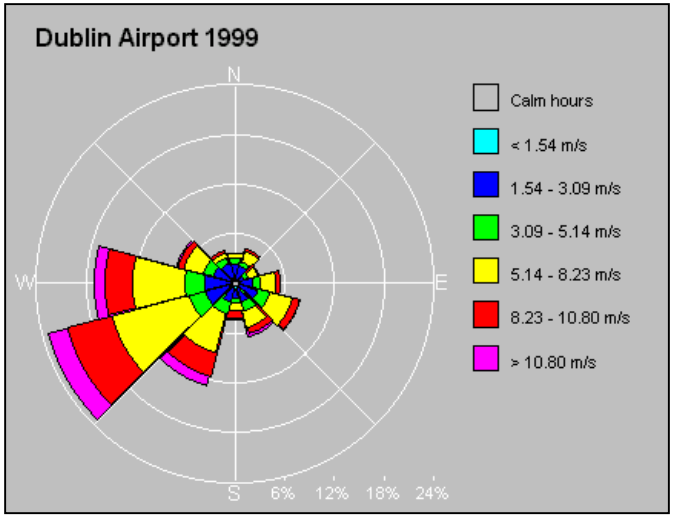
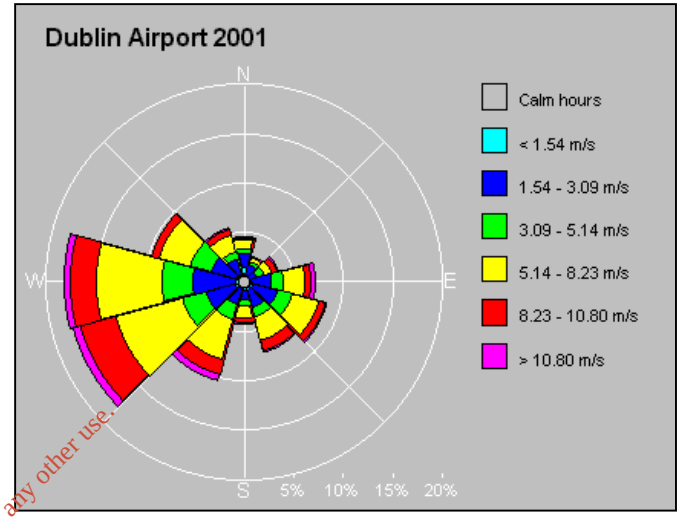
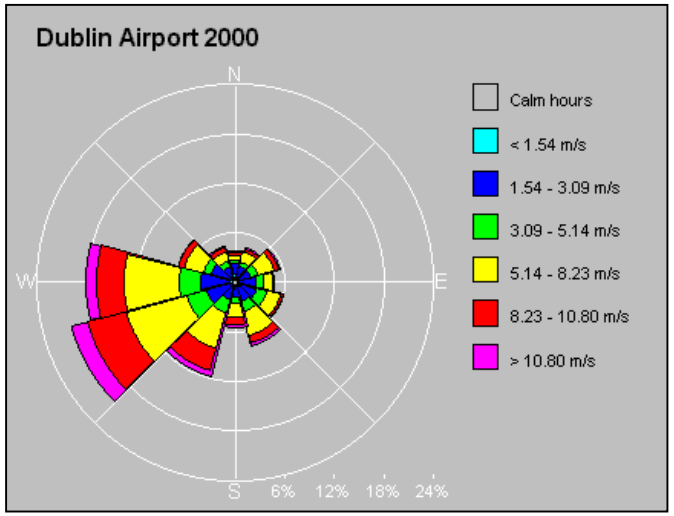
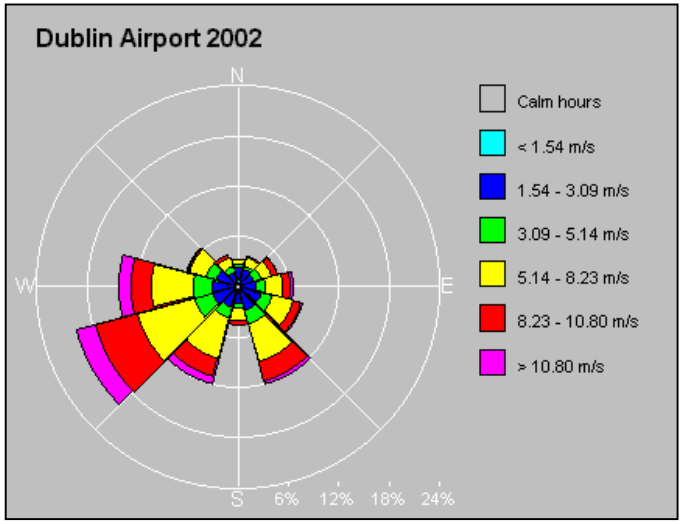
APPENDIX 1

Wind Rose Data for Dublin Airport (1999 – 2002)



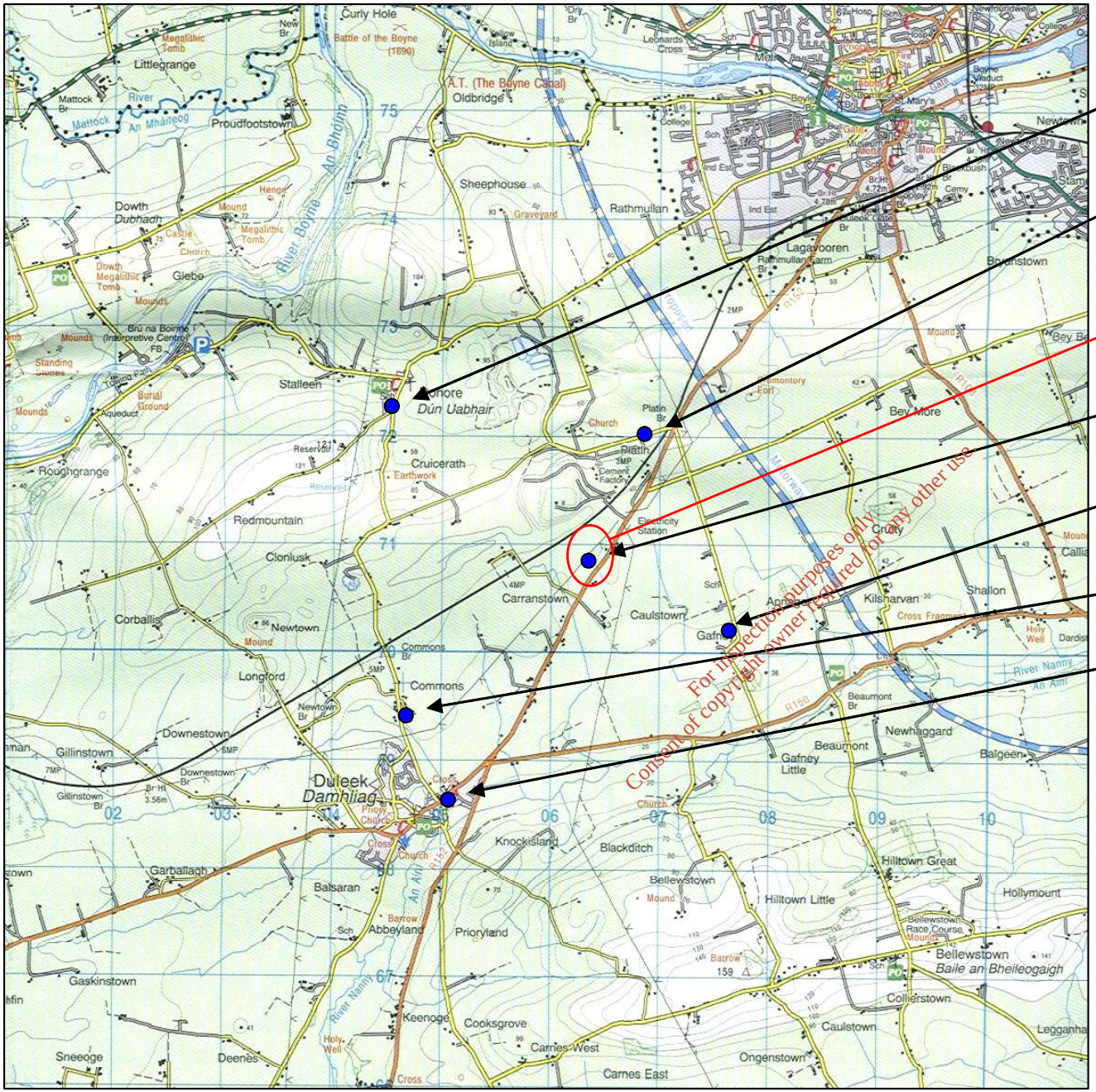






Appendix 2

Sampling Locations



Ordnance Survey Licence No. EN 00075 05

Project

Proposed WTE Facility, Carranstown

Reference

05_2905

Figure 1.1

Sampling Locations

awn consulting

The Tecpro Building, Clonshaugh Industrial Estate, Dublin 17. Tel: +353 (0)1 847 4220 Fax: +353 (0)1 847 4257

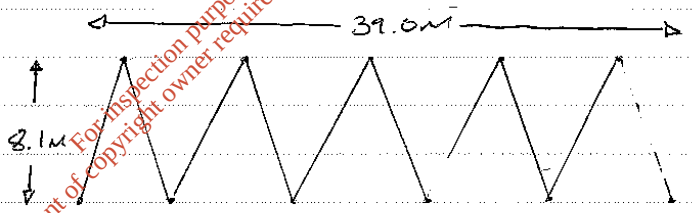
Appendix 3

Field Notes

Sample Site A : Dulcek village in Town Park area
Grid ref : O 305273 268830 (GPS)
Sampling conducted by : Brian Tiernan, AWN

12 samples were taken at 1m. intervals. The site is located in a large green area in the village. A flat surface is located close to the road and it slopes off southwards to residences.
Dimensions : 39.0m (lenght) x 8.1m (width)
area = 315.9 m^2

Samples taken from the transect which used the zig zag pattern sampling methodology.

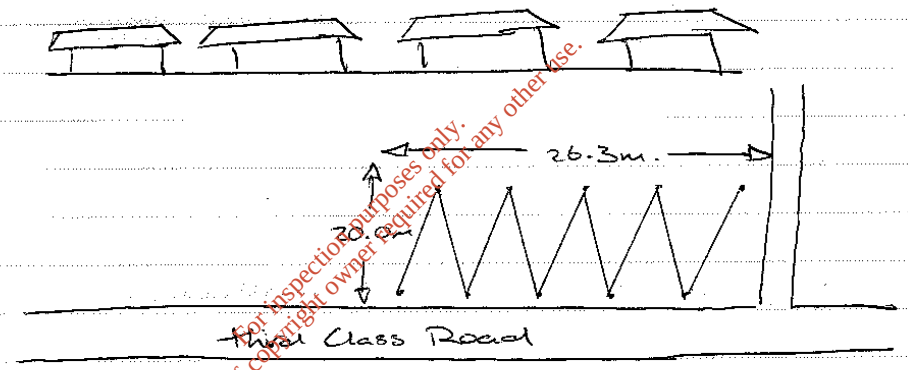


notes : soil was dark brown in colour, slight clayey texture, no pebbles or stones present

Date : 15/11/05

location B: Commons, residential area, N of Duleek village.
Grid Ref: O 304679 269275

147 samples were taken at 1m. intervals at the location. The site is located on a green area situated in between a row of houses and a third class road that runs from Duleek to Donore. The area is flat. The sampling area dimensions are 20.0m (width) x 26.3m. (lenght). Area = 526.0m².

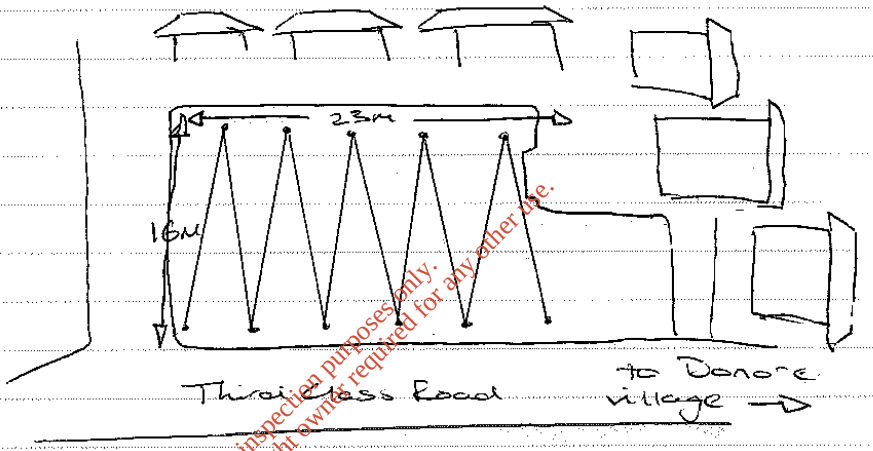


Notes: soil is dark brown in colour, clayey and sandy texture. The auger could not reach the 70-80mm at some intervals due to the hard ground.

Date: 17/11/05

Location C. Residential Area, Donore Village.
Grid Ref: C 304516 272249 (GPS)

112 samples were taken at 1m intervals at the location. The site is located in the landscape area of a residential development in Donore village. The site slopes slightly towards the road.



The dimensions of the sampling area was 16.0m (Width) & 23.0m (Length). Area = 368m²

Notes: soil was light brown to brown in colour, clayey texture and sand particles present.

Date 16/11/05

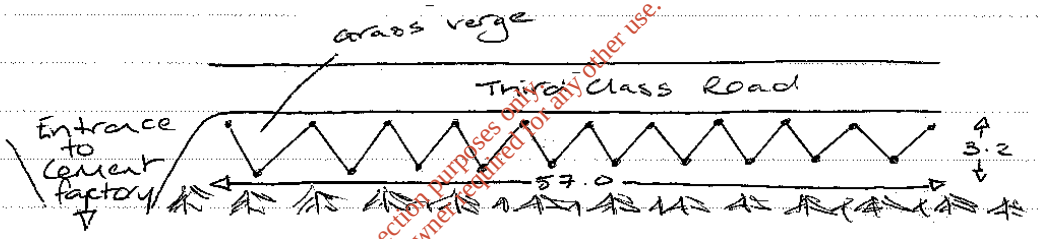
Location 2 : Outside Irish Cement Works, Platin.

Grid Ref : C 306969 272061 (GPS)

10 samples were take at 1m intervals at th location. The site is located along the grass verge running along the road next to the entrance to the Irish Cement factory.

Dimensions of the area : 3.2 (width) x 57.0 (lenght)

Area : 182.4 m^2



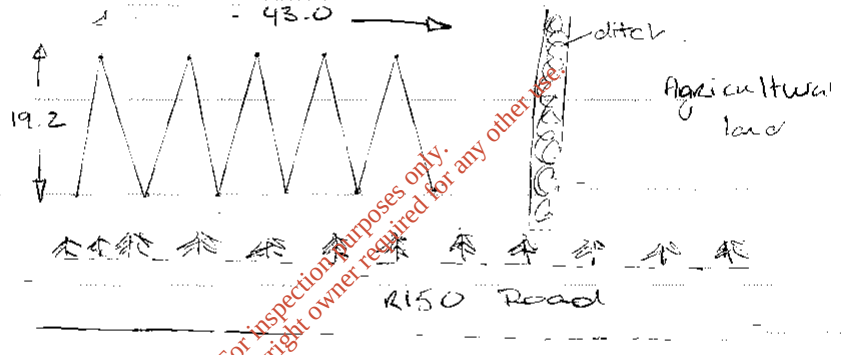
notes : Grass growing along the verge very thick, soil dark brown in colour, clayey in texture, some pebbles present. The auger could not reach the 70-80mm. at some intervals due to the hard ground.

Date : 16/11/05

Sample Site 1. At Proposed development location
Grid ref.: C 306345 270729 (GPS)
Sampling conducted by. Brian Tiernan (AWN)

136 samples were taken at 1m. intervals The site is located on agricultural land. The area was filled in the last few years soil on site not very compact.

Dimensions of sample area: 19.2 (width) x 43.0 (length).
area = 825.6 m²



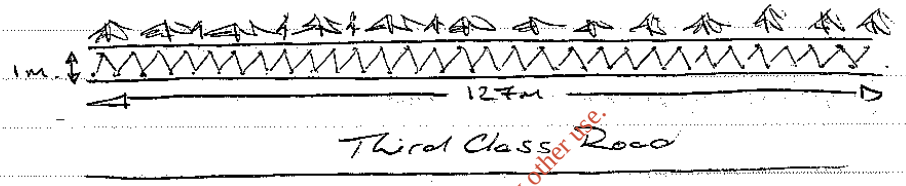
Notes soil is dark brown iron moisture content due to previous agricultural practices sandy texture and clay in parts

Date: 15/11/05

Location F. Gabrey, SE of proposed facility location.

Grid ref. C 307696 270236 (OSI)

123 samples taken at 1m. intervals at the location. The site is located on a grass verge running along a third class road in the townland of Gabrey. The dimensions of the sampling area was 1m. x 127m.



Notes: Soil was dark brown in colour, clayey in texture and also stone particles present

Date: 16/../05

Appendix 4

Plates

Plate 1 Location A

Plate 2 Location B

Plate 3 Location C

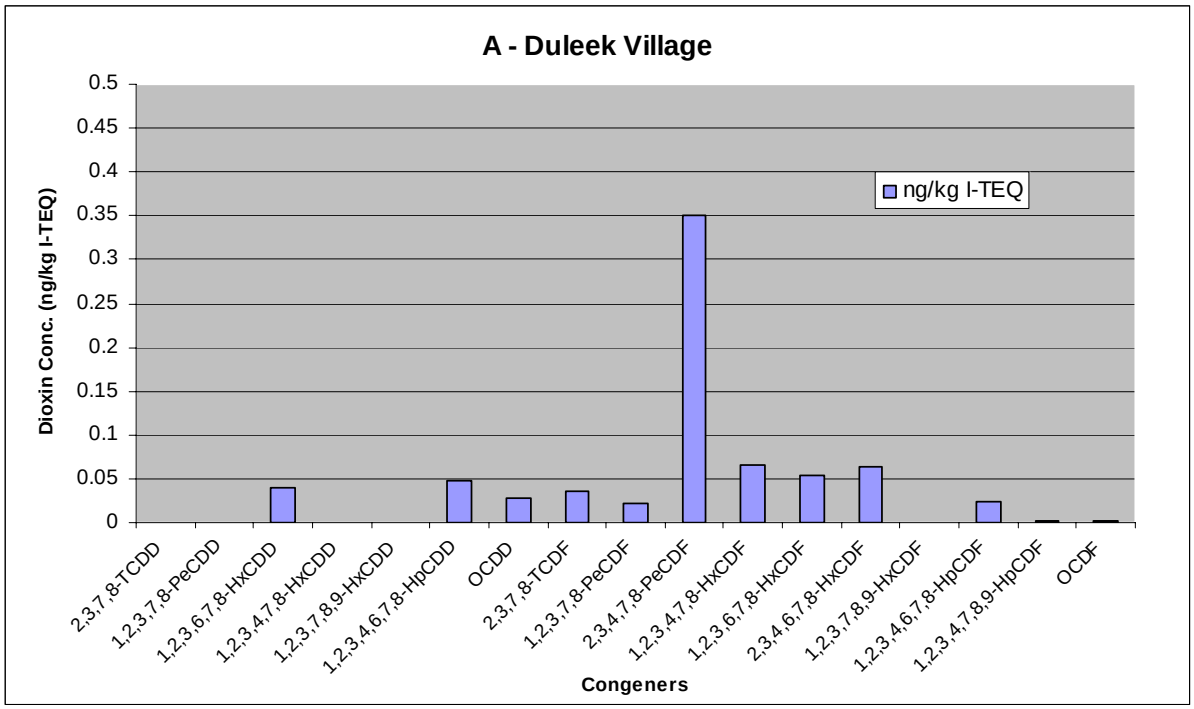
Plate 4 Location D

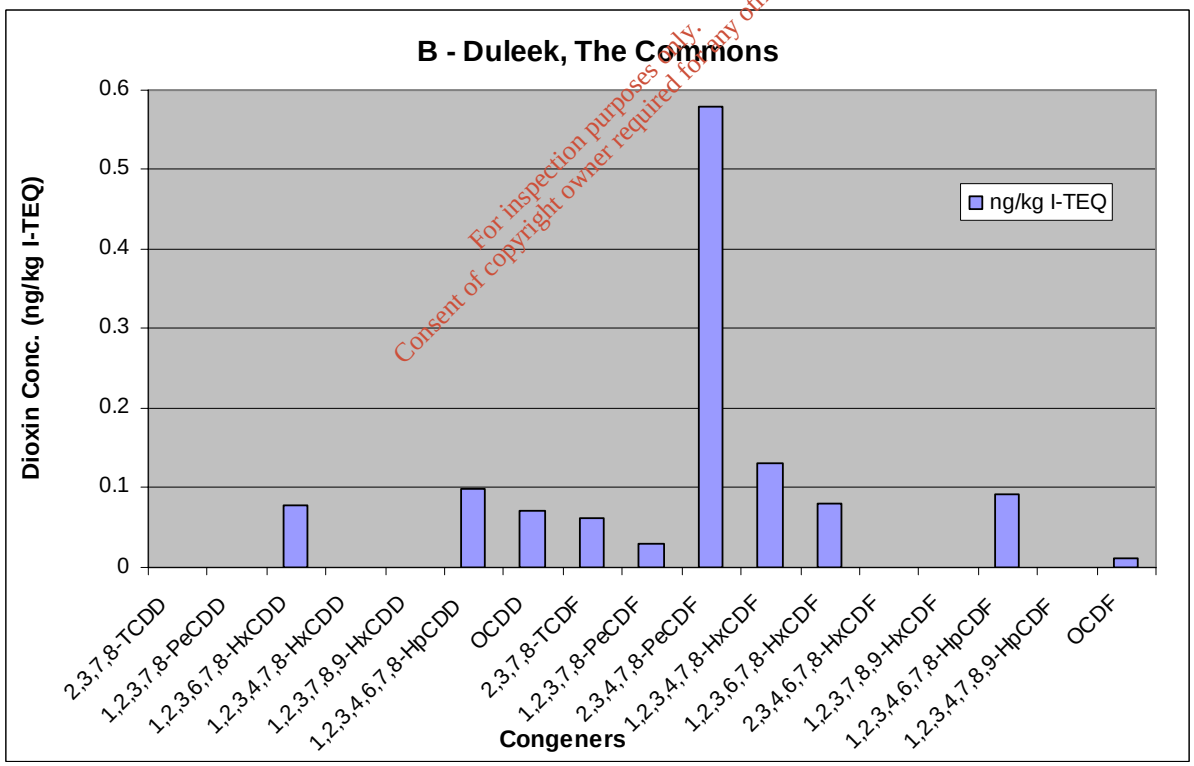
Plate 5 Location E

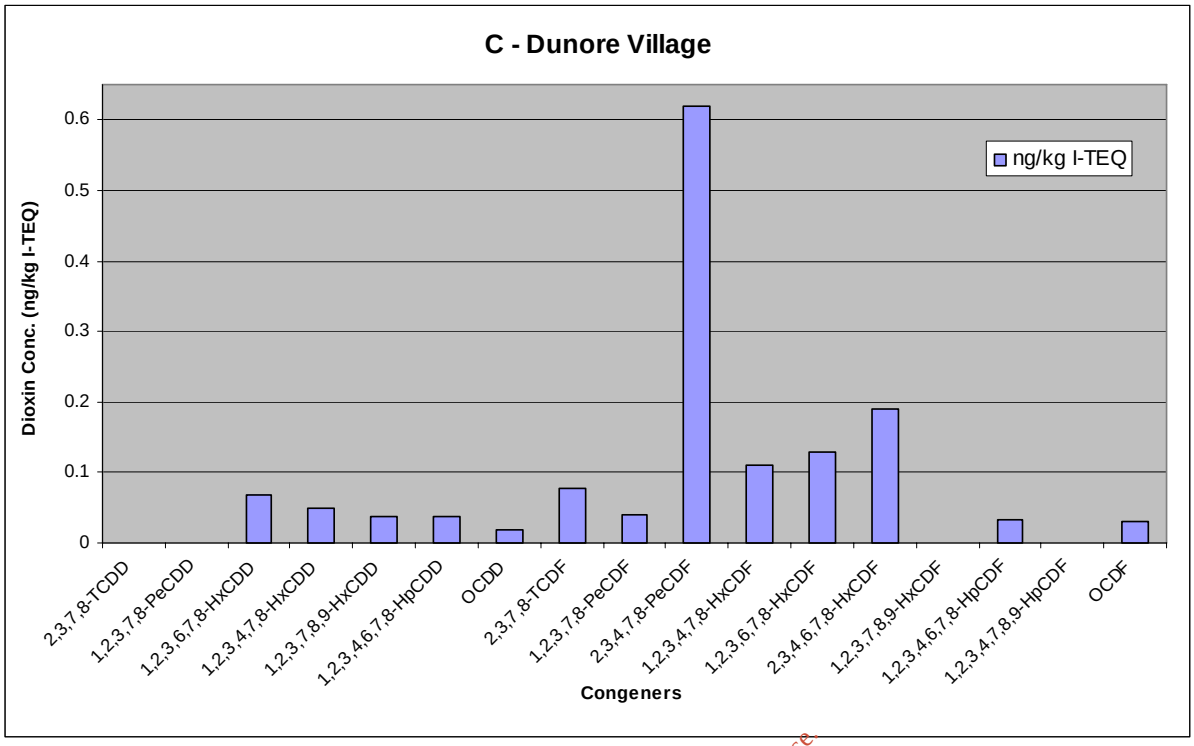
Plate 6 Location F

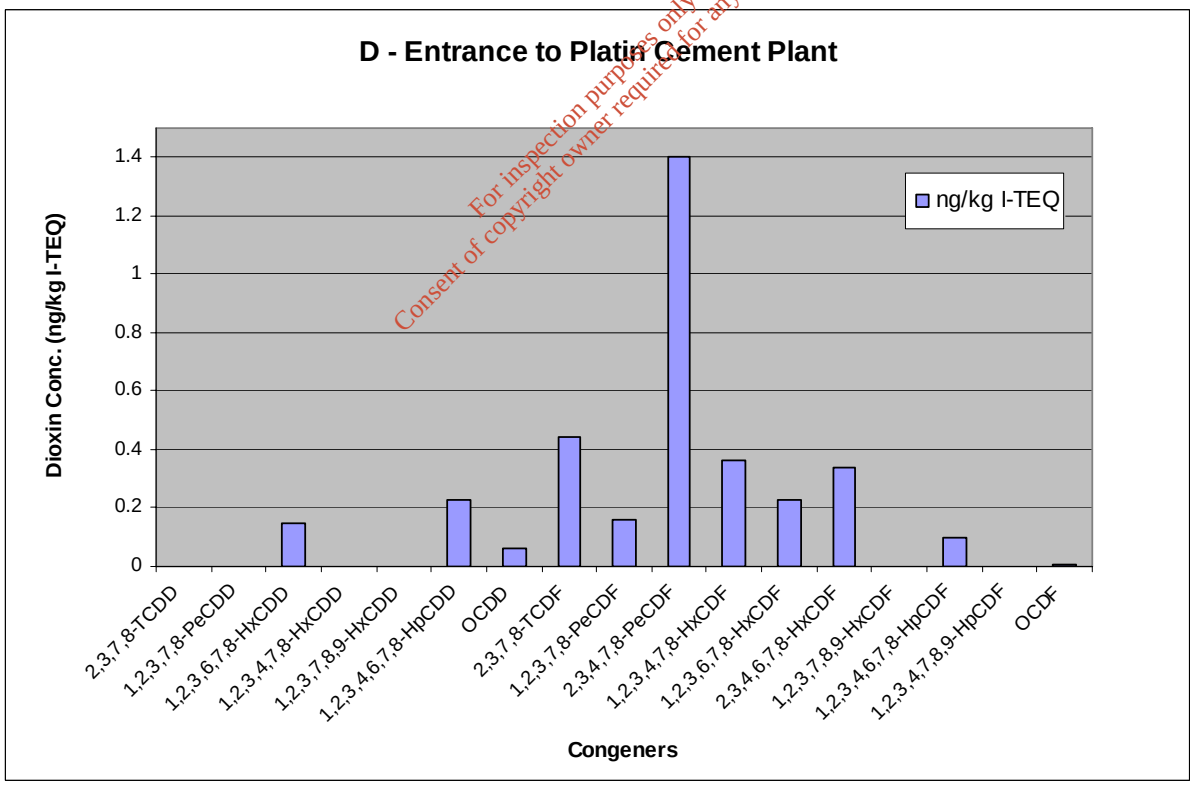
Appendix 5

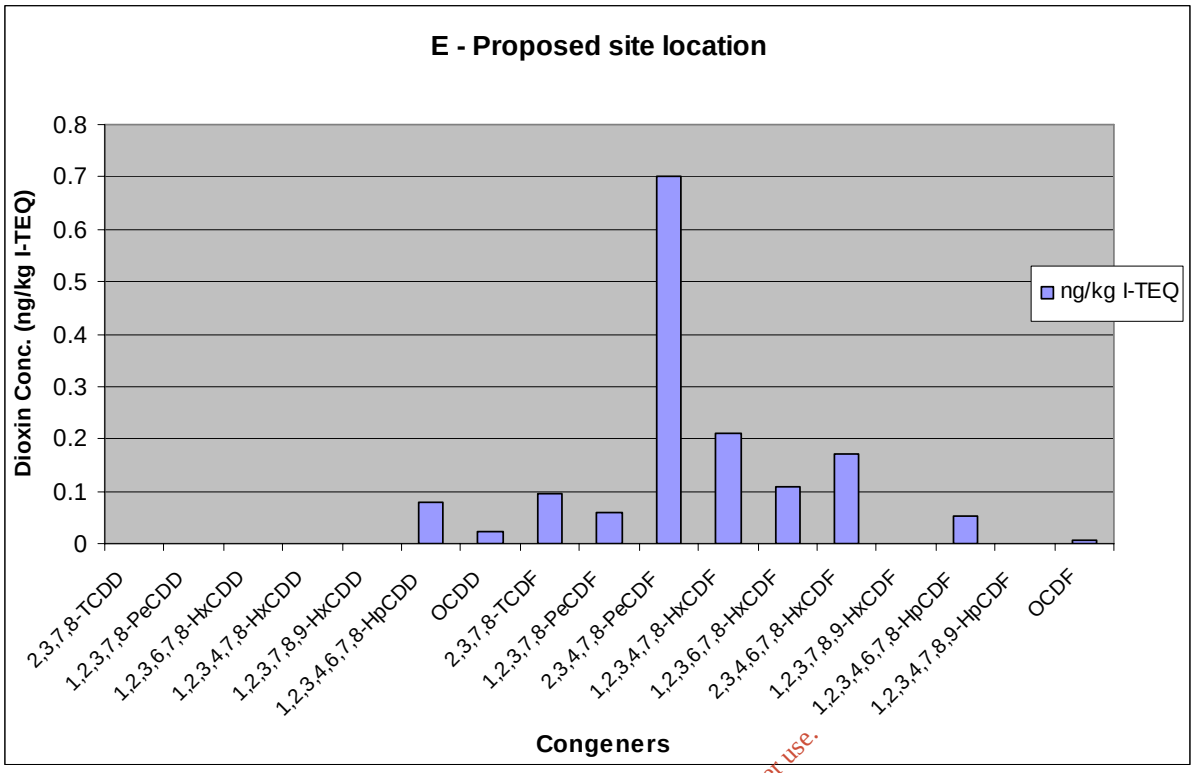
Congener Profiles

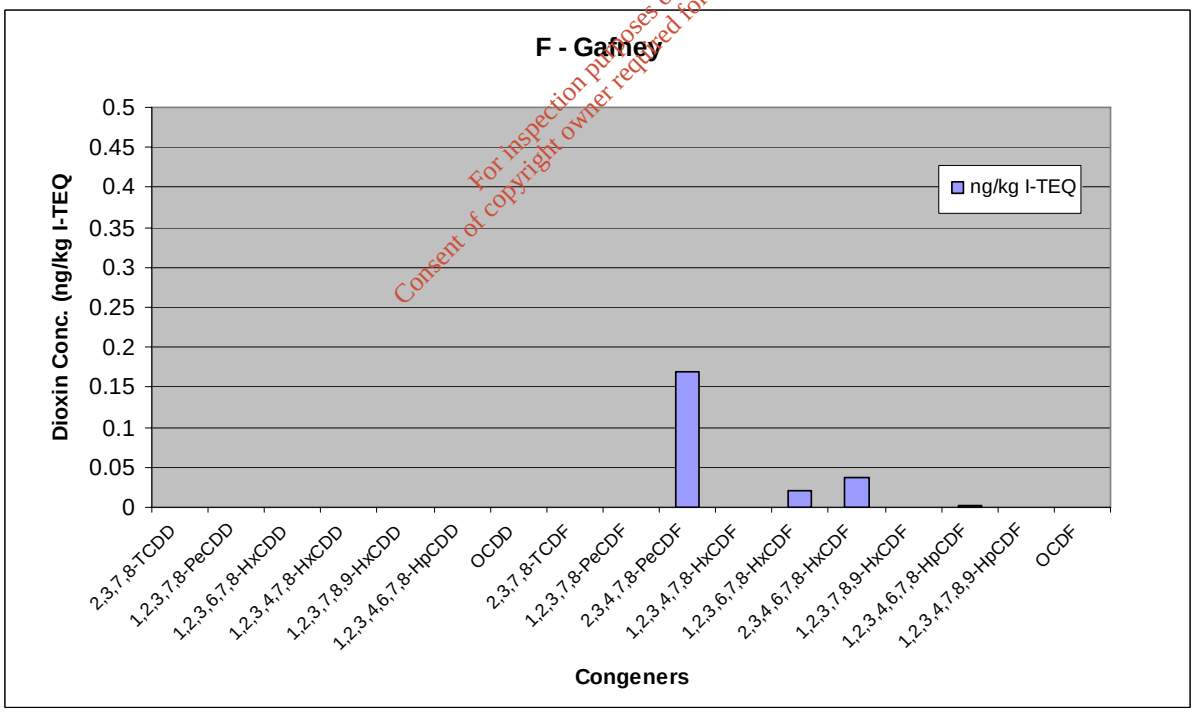












Appendix 6

Laboratory Analysis Results

Appendix I3: Groundwater Quality

Table I.4(i): GROUNDWATER QUALITY (Sheet 1 of 2)
Monitoring Point/ Grid Reference: MW-2, MW-4, TW-1

Parameter	Results (mg/l) All samples taken on 16/05/2000			Sampling method (composite etc.)	Normal Analytical Range	Analysis method / technique
	MW-2	MW-4	TW-1			
pH	7.5	7.2	7.7	Standard methods	Standard range	Standard methods
Temperature	-	-	-	-	-	-
Electrical conductivity EC	537 µS/cm	617 µS/cm	552 µS/cm	As above	As above	As above
Ammoniacal nitrogen NH_4-N	0.4	<0.01	<0.05	As above	As above	As above
Dissolved oxygen DO	-	-	-		-	-
Residue on evaporation (180°C)	-	-	-		-	-
Calcium Ca	110	150	130	As above	As above	As above
Cadmium Cd	<0.005	<0.005	-	As above	As above	As above
Chromium Cr	0.02	<0.01		As above	As above	As above
Chloride Cl	18	29	30	As above	As above	As above
Copper Cu	0.03	0.02	<0.01	As above	As above	As above
Cyanide Cn, total	-	-	-	-	-	-
Iron Fe	18	9.3	<0.01	As above	As above	As above
Lead Pb	<0.05	0.05	-	As above	As above	As above
Magnesium Mg	18	14	10	As above	As above	As above
Manganese Mn	0.39	0.72	<0.01	As above	As above	As above
Mercury Hg	<0.5	<0.5	-	As above	As above	As above
Nickel Ni	0.04	0.02	-	As above	As above	As above
Potassium K	<0.05	<0.05	1.3	As above	As above	As above
Sodium Na	8.6	16	13	As above	As above	As above

GROUNDWATER QUALITY (SHEET 2 OF 2)

Parameter	Results (mg/l)			Sampling method (composite etc.)	Normal Analytical Range	Analysis method / technique
	MW-2	MW-4	TW-1			
Phosphate PO_4	-	-	-	-	-	-
Sulphate SO_4	25	31	40	As above	As above	As above
Zinc Zn	0.21	0.18	-	As above	As above	As above
Total alkalinity (as $CaCO_3$)	271	322	239	As above	As above	As above
Total oxidised nitrogen TON	-	-	-	-	-	-
Arsenic As	<0.05	<0.05	-	As above	As above	As above
Barium Ba	0.69	0.7	-	As above	As above	As above
Boron B	0.66	0.48	-	As above	As above	As above
Fluoride F	-	-	-	-	-	-
Phenol	-	-	-	-	-	-
Phosphorus P	0.25	0.2	-	As above	As above	As above
Selenium Se	-	-	-	-	-	-
Silver Ag	-	-	-	-	-	-
Nitrite NO_2	0.12	<0.01	<0.01	As above	As above	As above
Nitrate NO_3	43	6.6	62	As above	As above	As above
Plate Count (22°C) (Total coliform count / ml)	-	-	42	As above	As above	As above
Plate Count (37°C) (Total coliform count / ml)	-	-	0	As above	As above	As above
Coliforms (/ 100mls)	-	-	Nil	-	-	-
E. coli (/ 100mls)	-	-	Nil	-	-	-
Water level (m OD)	-1.87	-21.69	-20.73	-	-	-
Colour (Hazen units)	<5	<5	<5	As above	As above	As above
Turbidity	18	40	<0.1	As above	As above	As above
Total Hardness (as $CaCO_3$)	349	617	366	As above	As above	As above

Appendix I4: Report on Attempted Sampling of Monitoring Wells

Environmental Monitoring Report

Carranstown, Duleek, Co Meath

for

Indaver Ireland Ltd

July 2008

Reference: CE06752 – Carranstown –Environmental report July 2008				
Issue		Prepared by	Checked by	Verified by
V1	-DMCD			
V2	-			
V3	-			
V4	-	David McDermott		Donal Marron
V5	-	Principal Scientist		Regional Director
File Ref: CE06752/P-05 Project Development/Reports				

WYG Apex Business Centre, Blackthorn Road, Sandyford Dublin 18
Telephone: +353 (0) 1293 1200 Facsimile: +353 (0) 1293 1250 E-Mail: dublin@wyg.com

INDAVER IRELAND

CARRANSTOWN, DULEEK, CO MEATH

ENVIRONMENTAL MONITORING REPORT

JULY 2008

CONTENTS

1 INTRODUCTION

White Young Green Environmental (Ireland) Ltd (WYG) were commissioned by Indaver Ireland Ltd (INI) to conduct groundwater monitoring at Carranstown, Duleek, Co. Meath in June 2008. Construction on a proposed materials recovery facility (MRF) and incineration plant to burn non hazardous waste and recover energy in the form of steam and electricity for export to the National Grid is due to commence in August 2008.

Groundwater monitoring was undertaken on 26th June 2008 as required under Waste Licence W0167-01. Schedule C.6.1 of Waste Licence W0167-01 requires that ambient groundwater monitoring be undertaken at two locations downgradient and one location upgradient of the proposed facility. The network of groundwater monitoring locations at the site was evaluated by WYG on 26th of June 2008. Three monitoring wells MW1-MW3 were identified and found to be intact. MW4 was also located but found to be damaged beyond use. Well logs for these monitoring boreholes are attached in Appendix 1.

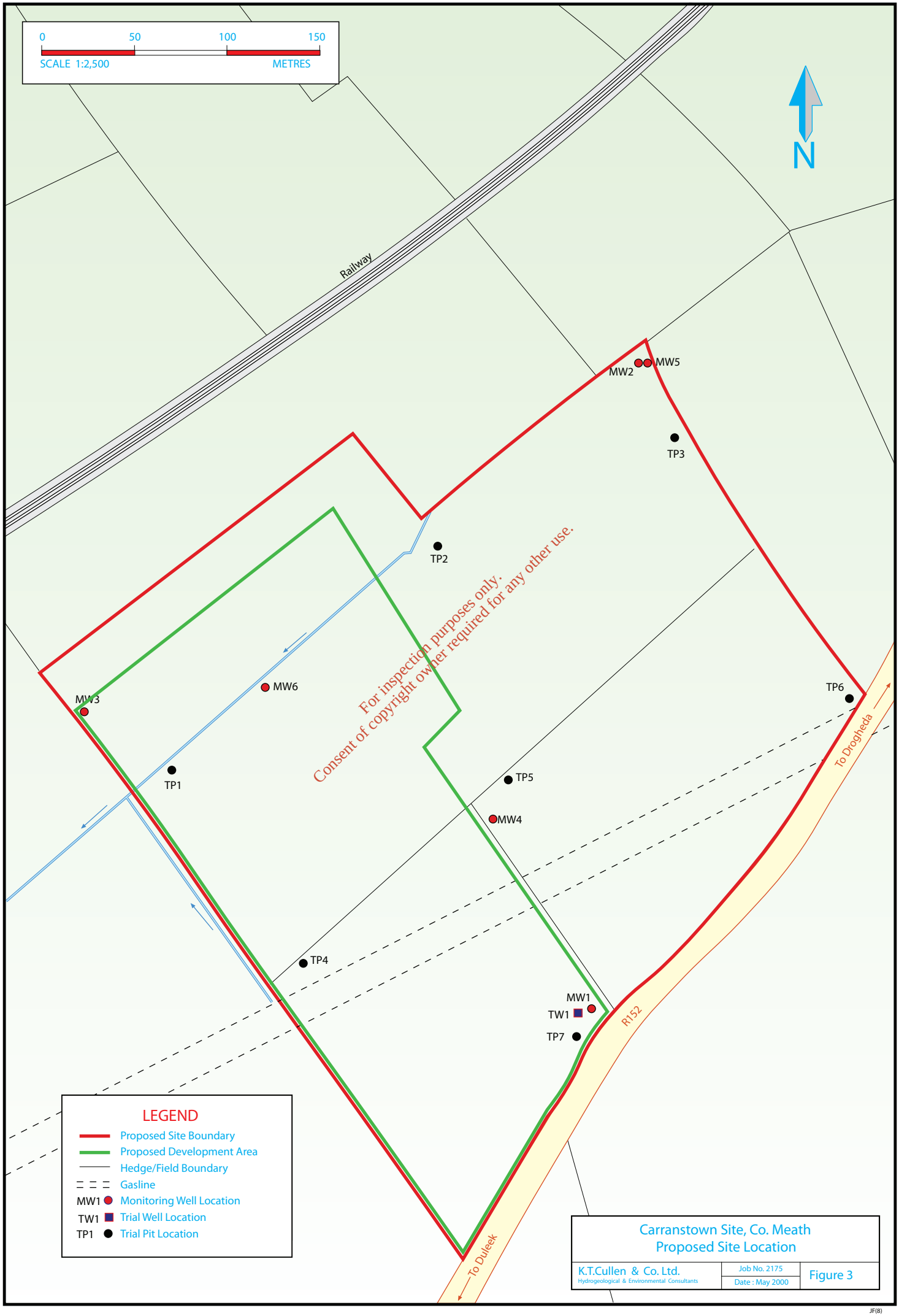
2 SAMPLING OF GROUNDWATER

2.1 Groundwater sampling

On 26th June 2008, WYG visited the monitoring locations as outlined above. All monitoring locations were found to be dry and no samples could be retrieved. A copy of the sampling logs are attached in Appendix 2.

3 CONCLUSIONS AND RECOMMENDATIONS

All monitoring locations were found to be dry and no samples could therefore be retrieved. Following a review of previous monitoring data available to WYG, it was found that monitoring wells MW1 and MW3 were dry in July 2001. In order to undertake effective ambient monitoring of groundwater quality at the facility in accordance with the licence, additional groundwater monitoring boreholes may be required. The locations of any additional groundwater monitoring boreholes should be agreed with the Agency.



JF(8)

WELL LOG

Well No.	Description	Client
MW1	Overburden well	Project Management
	Location: Carranstown, Duleek	Driller: Tom Briody & Son

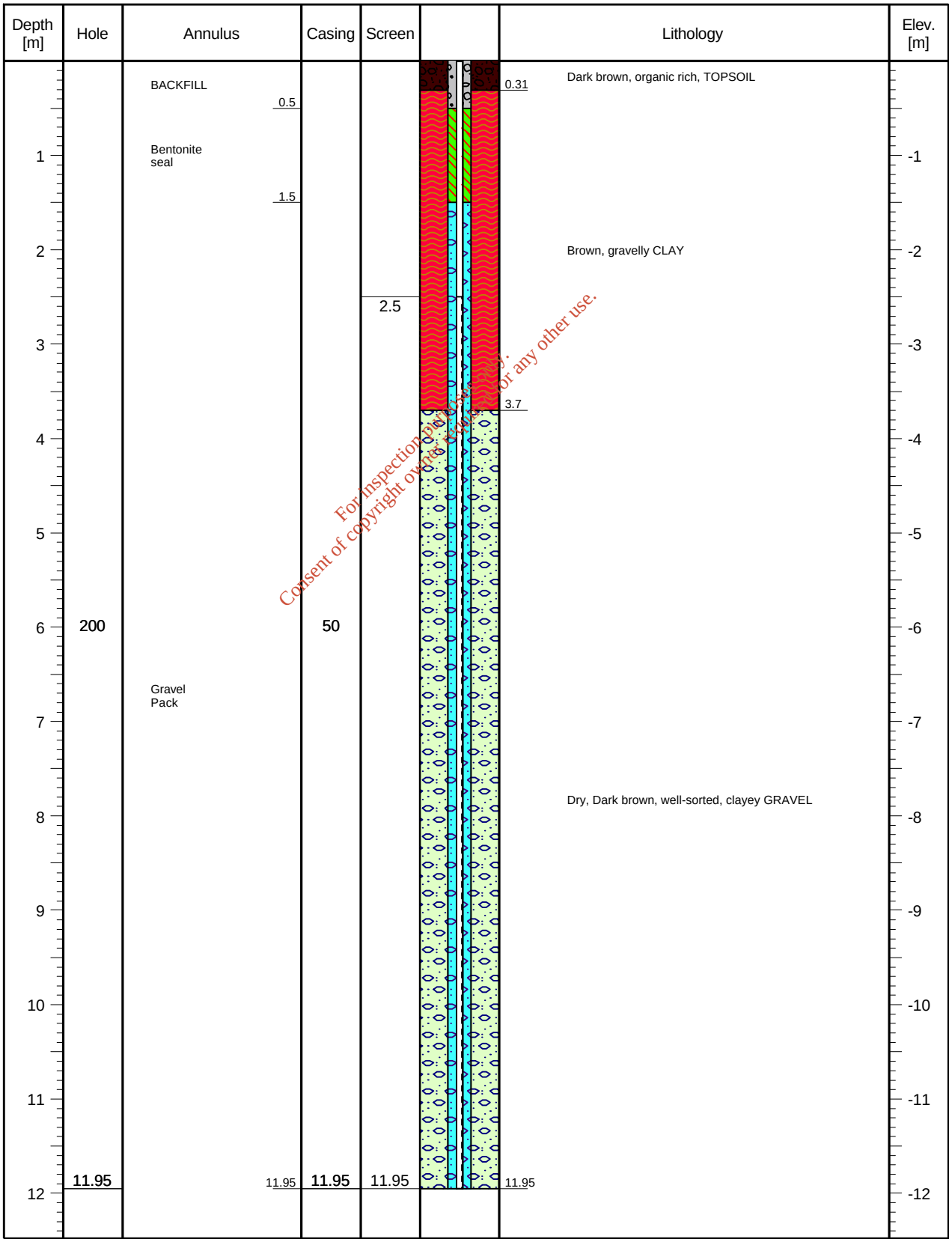
Date Drilled: 2/5/00

Water Level (mbtoc):

All diameters in mm
All depths in metres

Scale

Vertical	Horizontal
60.0	50.0



WELL LOG

Well No.	Description	Client
MW2	Overburden well	Project Management
	Location: Carranstown, Duleek	Driller: Tom Briody & Son

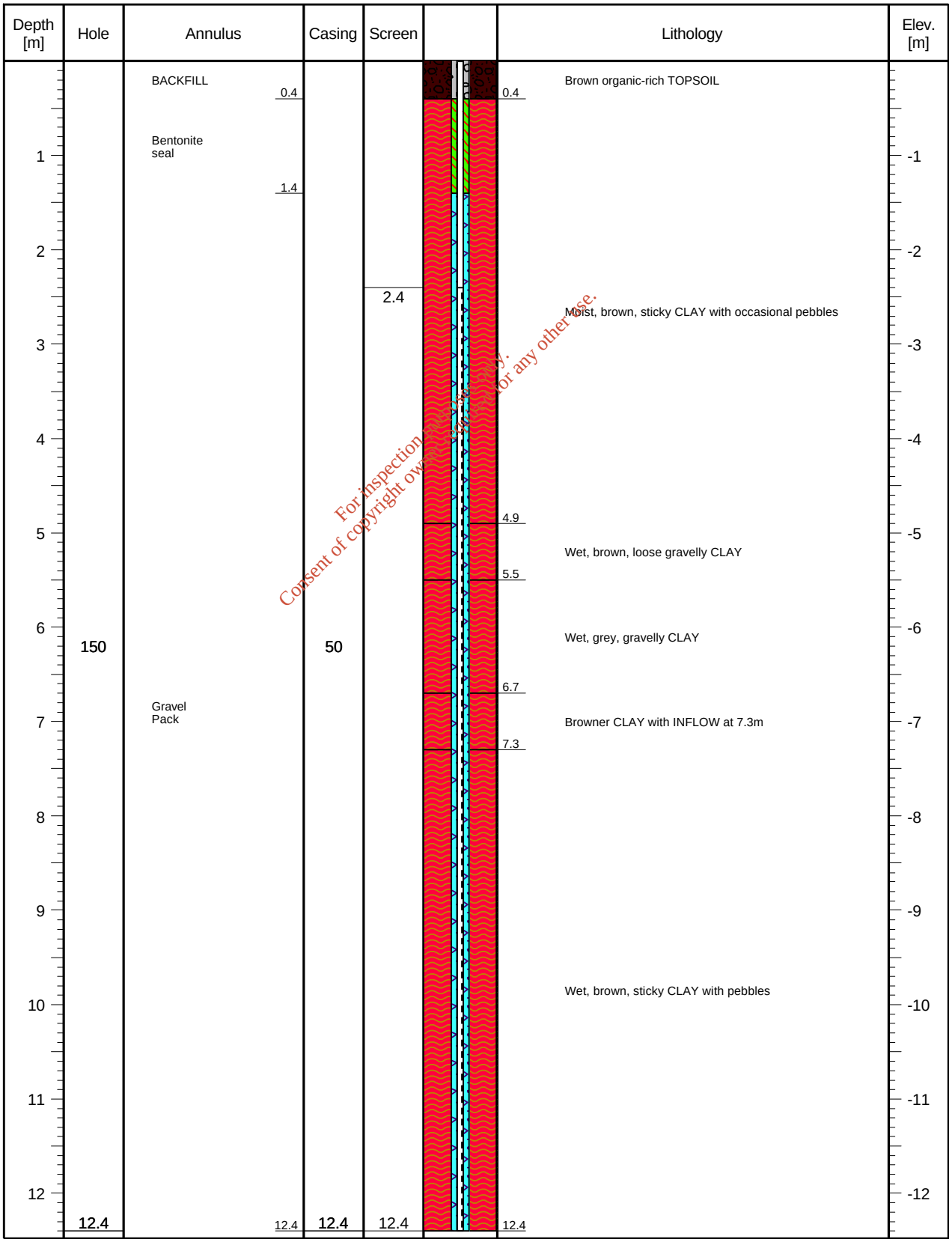
Date Drilled: 3/5/00

Water Level (mbtoc)

All diameters in mm
All depths in metres

Scale

Vertical	Horizontal
60.0	50.0



WELL LOG

Well No.	Description	Client
MW3	Overburden well	Project Management
	Location: Carranstown, Duleek.	Driller: Tom Briody & Son

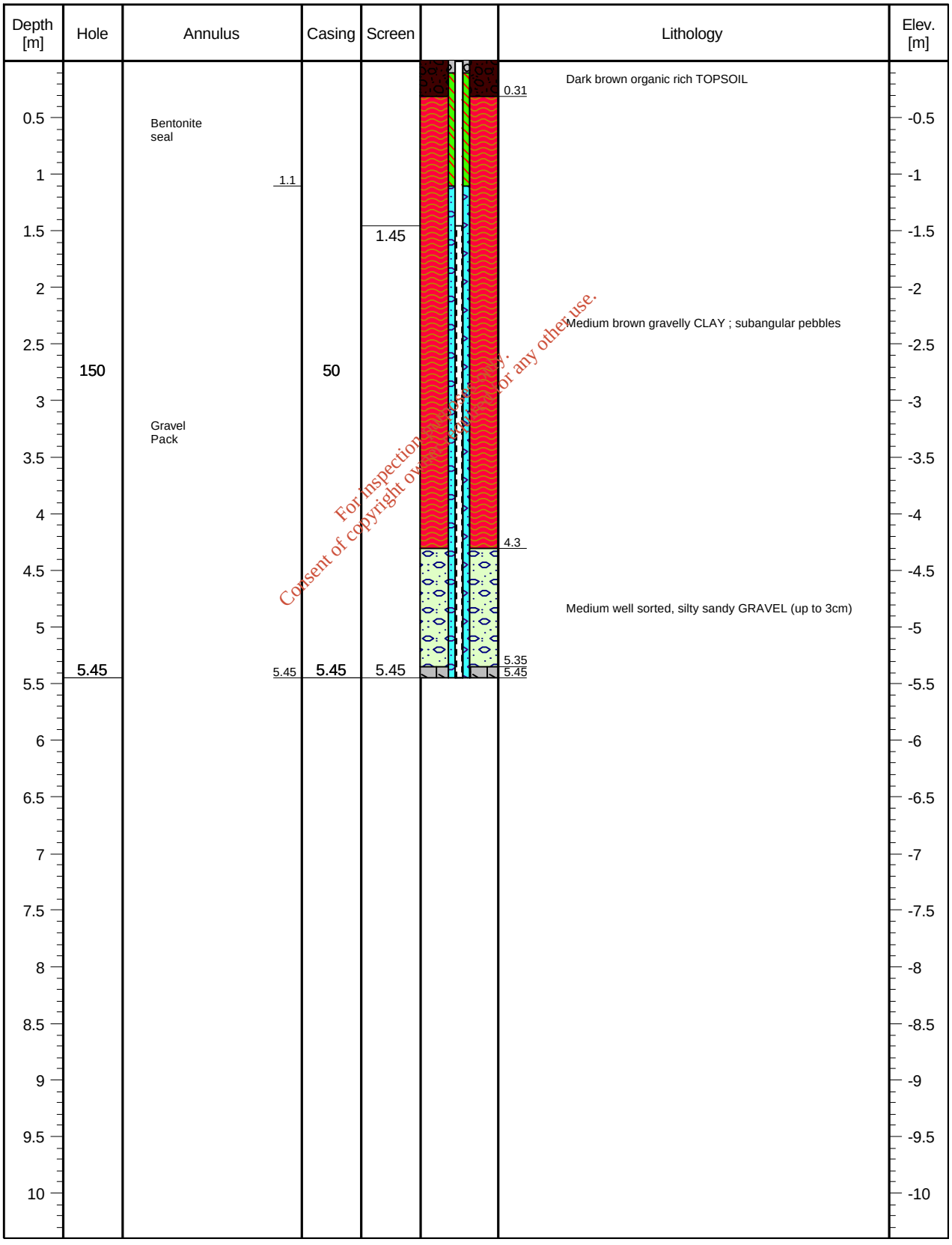
Date Drilled: 3/5/00

Water Level (mbtoc):

All diameters in mm
All depths in metres

Scale

Vertical	Horizontal
50.0	40.0



Monitoring Well Sampling Log

Well No.:MW1

Project Details

Project No.:	CE06752	***Location:***	Carranstown
Date:	26/06/2008	***Sampler:***	MK

Well Details

Well No.:	MW1	***Measurement Point:***	TOC
Stick up:	0.68	***TOC Elevation:***	41.1
Water Level:	DRY	***Well Depth:***	11.95
Head:	N/A	***Well Diameter:***	50mm
Volume in Well (L):	N/A	***Volume Purged (L):***	N/A
Decon. Procedure:	As per WYG protocol	***Bailer Type:***	N/A
Containers Used:	N/A		

Field Parameters

Observed Colour:	N/A	***Odour:***	N/A
Temperature (^{o}C):	N/A	***Conductivity (µS):***	N/A
pH:	N/A		

Analysis Required

Comments

White Young Green

Monitoring Well Sampling Log

Well No.:MW2

Project Details

Project No.:	CE06752	***Location:***	Carranstown
Date:	26/06/2008	***Sampler:***	MK

Well Details

Well No.:	MW2	***Measurement Point:***	TOC
Stick up:	0.45	***TOC Elevation:***	36.4
Water Level:	DRY	***Well Depth:***	12.4
Head:	N/A	***Well Diameter:***	50mm
Volume in Well (L):	N/A	***Volume Purged (L):***	N/A
Decon. Procedure:	As per WYG protocol	***Bailer Type:***	N/A
Containers Used:	N/A		

Field Parameters

Observed Colour:	N/A	***Odour:***	N/A
Temperature (^{o}C):	N/A	***Conductivity (µS):***	N/A
pH:	N/A		

Analysis Required

Comments

White Young Green

Monitoring Well Sampling Log

Well No.:MW3

Project Details

Project No.:	CE06752	***Location:***	Carranstown
Date:	26/06/2008	***Sampler:***	MK

Well Details

Well No.:	MW3	***Measurement Point:***	TOC
Stick up:	0.35	***TOC Elevation:***	35.86
Water Level:	DRY	***Well Depth:***	5.45
Head:	N/A	***Well Diameter:***	50mm
Volume in Well (L):	N/A	***Volume Purged (L):***	N/A
Decon. Procedure:	As per WYG protocol	***Bailer Type:***	N/A
Containers Used:	N/A		

Field Parameters

Observed Colour:	N/A	***Odour:***	N/A
Temperature (^{o}C):	N/A	***Conductivity (µS):***	N/A
pH:	N/A		

Analysis Required

Comments

White Young Green

Appendix I5: Ambient Noise Assessment

Background noise levels experienced at four locations on and near to the site are recorded in Tables 8.1, 8.2, 8.3 and Appendix 8.1 of the EIS. Figure 8.1 of the EIS shows the position of these monitoring points and of the sensitive receptors.

Predicted sound pressure levels experienced at locations on the site boundary and at noise sensitive locations outside the boundary are given in Table I.6(i) below. Please note that while locations R2, R3 and R4 are outside the boundary of the operation they are located close to it hence their inclusion in the site boundary section of the table.

Table I.6(i): Ambient Noise Assessment

	National Grid Reference	Sound Pressure Levels		
	(5N, 5E)	$L(A)_{eq}$	$L(A)_{10}$	$L(A)_{90}$
1. SITE BOUNDARY				
Location R2[1]:	27095N, 30651E	37	N/A	N/A
Location R3[2]:	27065N, 30639E	34	N/A	N/A
Location R4[3]:	27049N, 30622E	33	N/A	N/A
2. NOISE SENSITIVE LOCATIONS[4]				
Location R1:	27087N, 30548E	33	N/A	N/A
Location R5:	27032N, 30643E	30	N/A	N/A

[1] Sensitive receptor R2 is located close to the north-eastern border of the site
[2] Sensitive receptor R3 is located close to the eastern border of the site
[3] Sensitive receptor R4 is located close to the southernmost point of the site
[4] Please refer to Table 8.12 of the EIS and following explanation for cumulative impacts

Appendix I6: Revised Ecology Study

12 ECOLOGY

12.1 CONSULTATION

The Heritage Division, Dept. of Environment Heritage and Local Government, was consulted with respect to the proposed development (May, 2005). The area comprises largely of intensive agricultural land use and no ecological issues were raised with regard to the proposed development (Local Conservation Ranger (Dr. Maurice Eakin), pers. comm. and written communication, See Appendix 12.1).

The Eastern Regional Fisheries Board (ERFB) was consulted with respect to the Local Area Plan implementation (May, 2005). The River Nanny supports populations of brown trout. Any contamination of watercourses which feed into this area would have a negative impact on water quality and fish populations in this river (Environmental Officer (Mr. Noel McGlone), pers. comm.). It is therefore necessary that preventative measures are taken to ensure that there is no negative impact on the watercourses.

At the time of writing this report, written correspondence had not been received from the ERFB. The relevant individual was consulted by telephone and their comments were included. Letters of consultation will be offered as an addendum when written correspondence is received.

12.2 NATURE CONSERVATION DESIGNATIONS

A review of the Heritage Divisions datasets (www.heritagedata.ie) indicates that there are no parts of the site or the immediate surroundings covered by a scientific or conservation designation or proposed designation as recognized by the National Parks and Wildlife Service (NPWS). Four designated sites occur within approximately 5km of the site and are detailed below (see Figure 12.1). A Site Synopsis of each habitat is given in Appendix 12.2.

Table.12.1. Designated sites within approximately 5 km of the study area.

Site	Designation	Site Code	Description	Approx. distance to study area
01578	Duleek Commons	pNHA	Calcareous marsh and fen system	2 km
01593	Thomastown Bog	pNHA	Raised bog surrounded by wet woodland and wet grassland	5 km
01862	Boyne River Islands	cSAC	Alluvial wet woodland	5 km
01861	Dowth Wetland	pNHA	floodplain marsh with an associated area of deciduous woodland	4 km

12.3 FLORA

12.3.1 Desk Study and Field Survey Methodology

The desk study comprised the following elements:

- A review of the National Parks and Wildlife Service database of existing and proposed designated sites,
- A review of relevant Ordnance Survey maps,
- A review of relevant literature and reports,
- Consultation with National Parks and Wildlife Service
- Consultation with Eastern Regional Fisheries Board

Habitats were mapped and described according to *A Guide to Habitats in Ireland* (Fossitt, 2000) and in general accordance with *Draft Habitat Survey Guidelines: A Standard Methodology for Habitat Survey and Mapping in Ireland* (Heritage Council, 2002). Habitats were mapped with Target Notes used to describe features of interest. The conservation value of habitats is described in terms of international, national, regional and local importance as appropriate. An assessment of the potential impacts of the proposed development on the existing flora is made. Mitigation measures and recommendations are made in relation to ecologically important areas and features.

Botanical nomenclature followed Webb *et al.* (1996) for vascular plants excluding grasses and Hubbard (1984) for grasses.

The field survey was carried out on July 26th under good weather conditions. The survey was therefore carried out during the growing season and the optimal period for habitat surveys, which is generally regarded as being from April to September inclusive (JNCC, 2003).

12.3.2 Receiving Environment

12.3.2.1 Survey Results

An assessment of the habitats on the site was conducted. Six main habitats were identified within the site boundary. The location and approximate extent of the habitats are indicated on Figure 12.2. The dominant habitat was arable crops. The habitats recorded on the site are:

i. Arable crops BC1
ii. Improved agricultural grassland GA1
iii. Hedgerows WL1
iv. Drainage ditches FW4
v. Treelines WL2
vi. Spoil and bare ground ED2

i. Arable Crops BC1

The dominant habitat on site is arable corps, which occurs in all the fields except one (Figure 12.2; Appendix 12.3, Plate 1). This habitat as classified by Fossitt (2000) includes agricultural land used for the production of potatoes. The land was fallow at the time of visit but had been last sown with potatoes and several potato plants were growing in the fields. The vegetative cover was patchy and covered approximately 20% of the field area. The vegetative cover mostly comprised of potatoes. Other plant species recorded included ruderal species such as nettle (*Urtica dioica*), creeping thistle (*Cirsium arvense*), greater plantain (*Plantago major*), redshank (*Polygonum persicaria*), chickweed (*Stellaria media*) and meadow buttercup (*Ranunculus repens*). The arable crop area is of low ecological value.

ii. Improved Agricultural Grassland GA1

The improved agricultural grassland found on site was grazed by cattle at the time of the field survey and the sward height was c. 10 cm (Appendix 12.3, Plates 2). The species composition is dominated by typical agricultural grassland species including meadow fox-tail (*Alopecurus pratensis*), Yorkshire fog (*Holcus lanatus*), perennial ryegrass (*Lolium perenne*), cock's-foot (*Dactylis glomerata*), creeping bent (*Agrostis stolonifera*) and meadow-grasses (*Poa* spp.), which occur frequently. Broadleaved herbs include creeping buttercups (*Ranunculus repens*), meadow buttercup (*Ranunculus acris*), dandelion (*Taraxacum* spp.), white clover *(Trifolium* repens), cuckoo-flower (*Cardamine pratensis*) and thistles (*Cirsium* spp.), which occurred occasionally. The improved agricultural grassland is of low conservation value.

iii. Hedgerows WL1

Individual hedgerows were mapped for the purposes of this study. Hedgerow habitats are widespread within the area and define the boundary of field parcels. The dominant species is hawthorn (*Crataegus monogyna*). Most of the site boundary hedgerows are maintained as dense, stock-proof hedges and some support semi-mature and mature tree standards of ash (*Fraxinus excelsior*) along their length. A number have drainage ditches at their base. The internal hedgerows are poorly maintained and are gappy and overgrown in appearance. The ground flora is generally species-poor and dominated by grasses. A description of the individual hedgerows is given below.

H1: A well maintained hedgerow c.2m high forms the boundary between the site and the R152 road (Appendix 12.3, Plate 3). The hedgerow is dominated by dense hawthorn (*Crataegus monogyna*) and the ground flora is sparse and composed of grasses including bents (*Agrostis* spp.), Yorkshire fog

(*Holcus lanatus*) and forbs including cleavers (*Galium aparine*), germander speedwell (*Veronica chamaedrys*), herb-Robert (*Geranium robertianum*), hogweed (*Heracleum sphondylium*) and bush vetch (*Vicia sepium*), which occur occasionally. This hedgerow has a good structure but limited species-richness and is of low ecological value.

H2: This forms the site boundary to the north (Appendix 12.3, Plate 4) and west of the site. It is c. 2-3 m wide, varies in height between c. 4-5 m and is mostly stock-proof along its length. The dominant species is hawthorn (*Crataegus monogyna*). Bramble (*Rubus fruticosus*), ivy (*Hedera helix*) and rose (*Rosa* spp.) occur frequently. There is one sycamore standard (*Acer pseudoplatanus*) and elder (*Sambucus nigra*), occurs occasionally. A wide ditch is located at the base and hawthorn is planted on both sides. A number of shade tolerant species typical of hedgerows were found growing along the ditch including hart's-tongue fern (*Phyllitis scolopendrium*), dog violet (*Viola riviniana*), herb-Robert (*Geranium robertianum*) and ferns. Lords and ladies (*Arum maculatum*) was also found on a previous survey (Madden, 2000). Other ground flora species included cock's-foot (*Dactylis glomerata*), Yorkshire fog (*Holcus lanatus*), bush vetch (*Vicia sepium*) and ragwort (*Senecio jacobaea*). This hedgerow is of moderate ecological value.

H3: The hedgerow is largely intact, tall c. 5-7 m and stock-proof but becomes gappy towards the west where two ash standards occur (Appendix 12.3, Plate 5). The dominant species is hawthorn (*Crataegus monogyna*) and some old specimens occur here that are heavily clad in ivy (*Hedera helix*). Ground flora consists largely of bramble (*Rubus fruticosus*) and grasses including bents (*Agrostis* spp.), cock's-foot (*Dactylis glomerata*), Yorkshire fog (*Holcus lanatus*) and limited forbs including nettle (*Urtica dioica*), creeping thistle (*Cirsium arvense*) and docks (*Rumex* spp), which occur occasionally. This hedgerow is of low ecological value.

H4: Large gaps occur between the hawthorn (*Crataegus monogyna*) bushes along the length of this hedgerow (Appendix 12.3, Plate 6). The hedgerow is approximately 4-5 m in height and 2-3 m in width. Bramble (*Rubus fruticosus*) occurs abundantly within these gaps and along the ditch that occurs at the base of the hedgerow. Immature ash (*Fraxinus excelsior*), c.10 individuals, occur along the hedgerow. The ground flora is species poor comprising nettle (*Urtica dioica*), creeping thistle (*Cirsium arvense*), spear thistle (*Cirsium vulgare*), cock's foot (*Dactylis glomerata*) and ragwort (*Senecio jacobaea*). This hedgerow is of low ecological value.

H5: The hedgerow is poorly maintained and comprises largely of hawthorn (*Crataegus monogyna*), gorse (*Ulex europaeus*) and bramble (*Rubus fruticosus*). Wire fence runs the length of the hedgerow. The ground flora is species-poor comprising nettle (*Urtica dioica*), creeping thistle (*Cirsium arvense*), spear thistle (*Cirsium vulgare*), cock's foot (*Dactylis glomerata*) and ragwort (*Senecio jacobaea*). This hedgerow is of very low ecological value.

H6: Large gaps occur between the hawthorn (*Crataegus monogyna*) bushes along the length of this hedgerow. One standard of ash (*Fraxinus excelsior*) occurs and a ditch occurs at the base of the

hedgerow (Appendix 12.3, Plate 7). The ground flora comprises cock's foot (*Dactylis glomerata*), perennial rye-grass (*Lolium perenne*), nettle (*Urtica dioica*), creeping thistle (*Cirsium arvense*), spear thistle (*Cirsium vulgare*), sow-thistle (Sonchus asper) and ragwort (*Senecio jacobaea*). This hedgerow is of low ecological value.

H7: The hedgerow is stock-proof and dominated by hawthorn (*Crataegus monogyna*) with two standards of ash (*Fraxinus excelsior*), one of which has supported part of a rookery, indicated by the nests c. 15 and an abundance of bird excrement and feathers below (Appendix 12.3, Plate 8). The ground flora comprises cock's foot (*Dactylis glomerata*), nettle (*Urtica dioica*), creeping thistle (*Cirsium arvense*), spear thistle (*Cirsium vulgare*) and ragwort (*Senecio jacobaea*). This hedgerow is of moderate ecological value.

iv. Drainage Ditches FW4

A number of drainage ditches were noted at the base of the hedgerows and the species composition is described with the appropriate hedgerow. These were dry at the time of visit. The network links up and drains to the west where it eventually enters a tributary of the River Nanny.

v. Treelines WL2

The treeline to the south east of the site that bounds the R152 road (Figure 12.2) is dominated by c. 30 semi-mature and mature ash (*Fraxinus excelsior*) trees of c. 15-20 m in height (Appendix 12.3, Plate 9). Hawthorn (*Crataegus monogyna*) occurs intermittently along its length along with bramble (*Rubus fruticosus*), ivy (*Hedera helix*) and rose (*Rosa* spp.), which occur frequently. The ground flora is typical of the hedgerows on site and includes cleavers (*Galium aparine*), bush vetch (*Vicia sepium*), nettle (*Urtica dioica*), creeping thistle (*Cirsium arvense*), spear thistle (*Cirsium vulgare*), hogweed (*Heracleum sphondylium*) and ragwort (*Senecio jacobaea*).

The treeline to the west of the site (Figure 12.2) is also dominated by c. 10 ash (*Fraxinus excelsior*) trees of c. 15-20 m in height (Appendix 12.3, Plate 10). Hawthorn (*Crataegus monogyna*) occurs sparsely along its length and large gaps occur between the trees. The ground flora is similar in composition to the treeline described above. The treelines are of moderate ecological value.

vi. Spoil and Bare Ground ED2

A spoil and rubble heap was found in the northern corner of the site (Appendix 12.3, Plate 4). This comprised largely of soil and building rubble. The heap had become colonised with plant species common throughout the field.

12.3.2.2 Adjacent Habitats

The surrounding habitats consist largely of improved agricultural grassland bounded by hedgerows of similar composition and structure as those described on site. A tributary of the River Nanny flows to the south east c. 130 m to the east of the site at its nearest point.

The network of drainage ditches on site feeds into the tributary. The River Nanny is not a designated salmonid river but does support a population of brown trout (Fisheries Environmental Officer, pers comm.)

12.3.2.3 Evaluation

No designated habitats of international or national value were recorded on or adjacent to the site. All the habitats recorded on site are widespread within the landscape and of moderate to low species-richness. The dominant habitats on site are arable crops and improved agricultural grassland, which are highly modified habitats. They are of low scientific interest and represent a low contribution to local biodiversity.

The hedgerows on site are of moderate to low conservation value. The hedgerows H3, H4, H5 and H6 are particularly species-poor and support species typical of disturbed habitats. They are structurally poor largely due to lack of maintenance. Hedgerow 2 (H2) and both treelines are of moderate local conservation value. H2 supports some species typical of this habitat. The species-richness of these treelines is slightly greater than in the surrounding hedgerows and some trees, particularly H7, provide habitat for birds.

No rare, threatened or legally protected plant species, as listed in the Irish Red Data Book (Curtis & McGough, 1988), were found throughout the site nor have been known to occur in the general area in the past. The species are widespread within the landscape and are typical of the habitats in which they were found.

12.3.3 Impact Assessment

12.3.3.1 Potential and Predicted Impacts of the Proposal

In general, the impacts of a proposed development can be divided into three categories:

i. **Direct habitat change**: the removal/destruction of habitats or the creation of different habitat types.
ii. **Indirect habitat changes**. This occurs when a habitat not directly affected through development is altered as a consequence of the development through effects such as disturbance, drainage or pollution. The quality or character of a habitat may change as a result of these activities.
iii. **Habitat fragmentation**. This involves the break up of a habitat by a development, resulting in a number of smaller habitat areas. A reduction in the size of a habitat may cause a decline in species numbers where the habitat area becomes too small to support viable populations.

The proposed development is largely located in the western part of the site. It will result in the removal of arable crop land, improved agricultural grassland and a number of hedgerows in this area. The loss of theses habitats is of minimal consequence for the flora in the area as these are common, widespread habitats of moderate to low species diversity.

The hedgerows are the habitat of highest ecological importance on site but they do not represent good examples of hedgerow structure or species-richness. The loss of H2 and either of the treelines would be of moderate significance. These represent the most species-rich habitats on site. However, all species are common within the immediate and wider landscape. The loss of H7 to the west would impact negatively on the rookery located in that area.

Any contamination of the drainage ditches or any run-off from the site into the local drainage ditches has the potential to impact negatively on the River Nanny, to which these drains are connected.

12.3.4 Mitigation

12.3.4.1 Avoidance Remedial and Reductive Measures

Intact hedgerows including H1, H12, H3 and H7) , and treelines **will** be maintained and incorporated into new developments where possible. Regular and appropriate maintenance of the retained hedgerows will help improve the ecological quality to these features. Hedgerows will be trimmed so that they are wider at the base and narrower at the top and established hedges **will** be trimmed every second or third year. Coppicing could also be used as a management practice to increase the light intensity reaching the ground and thereby improve the species-richness of the ground flora. This would be of particular benefit to H2. Cutting of hedgerows and site clearance **will** take place outside the bird-

nesting period which starts on March 1st and ends 31st of August. The use of herbicide will be avoided within 1.5m of hedgerows.

Best practices will be employed, such as the use of bunding, oil and grease interceptors and sediment traps, to prevent contaminated water from the site entering the watercourses in the area.

12.3.4.2 Monitoring

All measures employed to prevent water pollution will be regularly maintained and monitored to ensure that they are working efficiently.

12.3.4.3 Reinstatement

The proposed development provides an opportunity for sensitive landscaping that has the potential to improve the floral diversity of the site. Suggested species for planting are given in Appendix 12.4.

The soil appear to be of good quality and they are likely to support a mixture of native broadleaved trees including ash (*Fraxinus excelsior*), oak (*Quercus robur*) and hazel (Corylus avellana). Other species which could be used in planting schemes for new developments include hawthorn (Crataegus monogyna), blackthorn (Prunus spinosa), rowan (Sorbus aucuparia), birch (Betula spp.), willow (Salix spp.). Tree species planted **will** reflect the local native species composition.

New developments provide an opportunity to establish wildflower areas, which improves the amenity and biodiversity value of the site. Seed stocks will be sourced from locally or regionally grown seed where possible.

12.3.5 Conclusions and Recommendations

There are no habitats on site of high ecological importance that warrant conservation. Hedgerows and treelines will be incorporated where possible and enhanced to improve the biodiversity value of these features. The development provides good potential to increase the biodiversity value of the site if appropriate landscaping is implemented. Best practices methods will ensure that there is no impact on surrounding watercourses and subsequently the River Nanny. By undertaking, these measures it is envisaged that there will be no negative impact on the ecology of the area and there will be a net gain in biodiversity value of the site.

A review of the Heritage Divisions datasets indicates that no part of the site or the immediate surroundings is covered by a scientific or conservation designation or proposed designation as recognized by the National Parks and Wildlife Service (NPWS). Four designated sites occur within the vicinity of the site; the nearest Duleeks Common proposed Natural Heritage Area c. 2km to the south-

west of the proposed development. The surrounding habitats consist largely of arable land and improved agricultural grassland bounded by hedgerows of similar composition and structure as those described on site. In addition, no rare, threatened or legally protected plant species, as listed in the Irish Red Data Book (Curtis & McGough, 1988), were found throughout the site nor have been known to occur in the general area in the past. The species are widespread within the landscape and are typical of the habitats in which they were found.

The air dispersion modeling analysis shows that the nearest conservation designation site is outside the range of air emission plume. The other designated sites; the Boyne River Islands candidate Special Areas of Conservation; Dowth Wetlands proposed Natural Heritage Area and Thomastown Bog are c. 4-5km away from the site and are also outside of the range of the air emission plume.

The studies carried out by AWN showed that the entire maximum predicted ground level concentrations of emissions were forum to be below limits specified in the Council Directive 2000/76/EC air quality standard limits and WHO guideline values. The cumulative emissions form the waste to energy plant and the other developments in the vicinity did not cause the maximum predicted ground level concentrations of emissions to reach air quality standard limit values and guidelines. As the projected emissions will be within European limits, it is considered that there would be no significant impacts by air emissions on the flora and fauna within the surrounding area or on designated sites for conservation in the region.

12.4 TERRESTRIAL FAUNA – MAMMALS, AMPHIBIANS AND REPTILES

12.4.1 Receiving Environment

The study area, c. 25 acres in size, falls within 1 km square O 0670 of the National Grid (Discovery Series Sheet no. 43).

12.4.1.1 Fauna Survey

This report presents the results of a fauna study undertaken on the 28th of June 2005. The fauna occurring on the site are described, and the likely impacts of the proposed development on the fauna discussed, with recommendations for mitigation or remedial measures.

The general format of this report is in accordance with guidelines recommended by the EPA (2002) *Guidelines on the Information to be contained in Environmental Impact Statements*. Recommendations and evaluation techniques utilised are in general accordance with *Guidelines for Baseline Ecological Assessment* (Institute of Environmental Assessment, UK, 1995), *Wildlife Impact: the treatment of nature conservation in environmental assessment* (RSPB, 1995) and *Guidelines for ecological evaluation and impact assessment* (Regini, M. 2000).

12.4.1.2 Survey Methodology

A field survey was conducted by Dr. Chris Smal on the 28th June 2005 in good weather conditions: dry, overcast, warm and breezy.

Survey of fauna was carried out by means of a thorough search within the site. Presence of mammals is indicated principally by their signs, such as dwellings, feeding signs or droppings - though direct observations are also occasionally made.

The nature and type of habitats present are also indicative of the species likely to be present; the habitats were assessed in general accordance with techniques adopted for the Badger & Habitat Survey of Ireland (Smal, 1995); habitats listed by Fossitt (2000) and by Nature Conservancy Council (1990) were referred to. The habitat survey is not intended to serve as a detailed botanical study.

The field survey was supplemented by evaluation of relevant literature and existing information. An earlier impact assessment report (flora and fauna, prepared by Biosphere Environmental Services in June 2000) was reviewed.

12.4.1.3 Survey Constraints

There were seasonal constraints in regard to badger survey due to high vegetational cover within hedgerows, treelines or areas of scrub. At this season, high grass growth limits findings of badger paths, and, also, badger activity is lower at this time than in late winter or autumn.

Both sides of internal boundaries were searched. Only one side of site boundary hedgerows and treelines was searched. It was not considered appropriate to enter adjoining lands. In practice, the nature of findings on site indicated that this constraint did not lead to any significant loss of information.

12.4.1.4 General Description of Area

The site is located in generally flat agricultural landscape between the towns of Drogheda and Duleek. Elevation drops gently from the east to the west, rising again at the extreme west. The elevation of the site is between 30 and 40m asl. The site is within an agricultural area of good soils.

A railway line is present a short distance from the site to the west. The site is immediately adjacent to the R152.

All but one of the several fields on site have been recently ploughed. All were under potatoes in the preceding year. At the west of the site is one field of permanent improved pasture grassland, currently grazed by cattle. The previous survey (Biosphere Environmental Services) noted that all of the fields on site were under pasture or meadow at that time (June 2000).

The principal habitats present in the area are mapped on Figure 12.3, and are approximate. The habitat map (Figure 12.3) serves to provide a framework for assessment of fauna and is not intended to serve as a botanical survey.

The composition of hedgerows and treelines is not diverse. There is some variation in structure and species composition. The habitat map illustrates whether hedgerows and treelines or present at various portions of the site.

In brief overview: all hedgerows and treelines are composed primarily of hawthorn *Crataegus monogyna* and ash *Fraxinus excelsior*, with other species scarce or occasional. The width of boundaries varies from thin (with little ground cover) to relatively wide corridor - perhaps up to c. 4m in width. These wider field boundaries have dense ground cover of low scrub, mainly of bramble *Rubus fruticosus* agg, or have weedy vegetation – mainly of nettle *Urtica dioica* or thistle *Cirsium* sp. Ploughing in arable areas approached very close to hedgerow and treeline boundaries, leaving little cover alongside, but there were occasional grassy areas. These also included a limited number common vetch *Vicia sativa*, and a restricted range of other flora. Other species frequent throughout include dog rose Rosa canina, ivy *Hedera helix* , and hogweed *Heraclium sphondylium*.
Uncommon, but present, are blackthorn *Prunus nigra* (at the eastern boundary), gorse *Ulex europaeus* (at a central field boundary) and elder *Sambucus nigra*. One central boundary, with double hedgerow and ditch between, has a somewhat more diverse flora, with ferns present in the shady areas.

Most of the boundaries on site are dominated by hawthorn. At the north-east, the entire boundary is of low-cut hawthorn, but most boundaries are of semi-mature or mature hawthorn, with occasional tall ash. Some of these boundaries are incomplete (but fenced) with scrubby gaps present. There are tall ash-dominated treelines along the R152 and at the extreme west of the site. The most westerly boundary of the site (towards the railway line) was observed to be the widest and is, again, composed of hawthorn and ash. It has a dense scrub cover at ground layer, and copious ivy cover also.

At the extreme north corner of the site is located a small area used for dumping of farming wastes, including soil, rubble, rocks, tyres, plastics and machinery parts. Much of this area is bare, but is being colonised by weedy ephemeral species.

Near this dumping area is located the only pool found on site: a very small pool (c. 1.5 m across) next to the eastern boundary ditch.

There are no structures on site. A small disused dwelling at the extreme south is off-site. The building has a slated roof, from which several slates are missing. The building offers potential for bat roosts.

The field boundaries include ditches, all of which were dry at time of survey. There are no streams or rivers present. The site is within the watershed of the River Nanny, a small tributary of which is present c. 100m to the south of the site. The River Nanny flows into the Irish Sea at Laytown.

12.4.1.5 Designated Conservation Areas in the Vicinity

There are no designated conservation areas in the immediate locality. Duleek Commons (pNHA no. 01578) is situated c. 2km to the south-west. Thomastown Bog (pNHA no. 01593) is situated c. 5 km to the south-west also. The Boyne River Islands cSAC is situated c. 5km to the north-west. The River Nanny reaches the Irish Sea at Laytown, where the estuary is a pNHA and an pSAC (site code: 000554, Laytown Dunes/Nanny Estuary).

12.4.1.6 Fauna

12.4.1.6.1 Mammals

A list of mammalian species observed on site or likely to occur in the locality is included in the Appendices (11.4 – 11.6).

The site has a very low representation of Irish fauna, due to the intensive agricultural practice (most of the site is composed of arable land) and limited range of habitats on site. The vegetated boundaries are of low species diversity and poor structure. There is an almost total lack of ponds, and there are no rivers or streams. There are very limited areas of scrub or other habitat types.

Common Species

The signs of common species were below expectation on site. For example, no signs of foxes *Vulpes vulpes* were seen, whilst this species is still expected to occur on site on occasion, perhaps more so at the west – in grassland areas. Fox signs had been observed in the 2000 study. Rabbit *Oryctolagus cuniculus* burrows were few on the main part of the site, but were present at the western portion, and several rabbits were observed there. Brown rats *Rattus norvegicus* are frequent in arable areas, and signs were seen of rats feeding on potatoes left from the last harvest.

One Irish hare *Lepus timidus hibernicus* was observed on site, but the habitats on site are not particularly good for this species.

Also noted were signs of long-tailed fieldmouse *Apodemus sylvaticus.* The bank vole *Clethrionomys glareolus* is absent from this part of Ireland. The house mouse *Mus musculus* is almost certainly present as it is present in agricultural areas and in association with residences.

Other species that will be present on occasion on site and in the vicinity include the hedgehog *Erinaceous europaeus* and pygmy shrew *Sorex minutus,* the latter expected to be frequent within hedgerows and at grasslands at the west of the site. No squirrels are expected on site.

The Irish stoat *Mustela erminea hibernica* is also certain to be present on occasion - but densities are expected to be very low. There are no suitable habitats for the pine marten *Martes martes* and this species is considered to be absent from this part of the country. Deer will also be absent in this area.

Other Species of Especial Interest

No signs of badgers *Meles meles* were found on site, whilst there were some seasonal constraints. Badgers tend to be less frequent in arable areas, due to limited suitable foraging habitat. It was considered that there are no badgers on site, whilst they may be expected in the general locality (where there are larger areas of improved pasture). Similarly, no setts or signs of badgers were found in the fauna study conducted in 2000.

There is an absence of watercourses on site, so no otters *Lutra lutra* were present and this species is unlikely ever to occur on site. There were also no significant ponds or pools that might harbour frogs, an important prey species for the otter. Feral American mink *Mustela vison* are not present on site, for similar reasons.

Bats

Opportunities for bat roosts on site and the quality of habitats as foraging areas for bats were assessed during daytime. A small disused dwelling house was indicated as off-site and this structure was, therefore, not checked for bat roosts. No bat detector study was undertaken, as such was not considered necessary given the nature of habitats on site.

The treelines and hedgerows do offer commuting and foraging areas for bats, but with regard to the relatively poor species composition and structure of these linear features, most of the boundaries on site do not provide particularly good foraging habitat.

It may be anticipated that only a few of Ireland's bat species would occur in the study area through the summer months (O'Sullivan, 1994; Richardson, 2000). These will include the common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *Pipistrellus pygmaeus,* and Leisler's bat *Nyctalus leisleri.* Brown long-eared bats *Plecotus auritus* might be present on occasion at the extreme west of the site, where mature treelines offer more foraging habitat than elsewhere on the site. No other bat species are expected to occur on site.

Many of the larger trees on site – of both ash and hawthorn – are ivy-covered and bats may make use of such cover on occasion in summer. Mature ash trees (some of which were substantial in size) may also have crevices, which bats may use as occasional roosts. No significant roosts can be expected on site, but recommendations are included to prevent injury to any bats that might be present in mature trees or ivy-covered trees on site.

The building (off-site) at the extreme south may harbour bat roosts in summer, and there is ready access to the roof-space through gaps left where there are missing slates. There are no structures on site.

12.4.1.6.2 Amphibian and Reptiles

There is only one pool on site and that was not suitable for frogs *Rana temporaria* or newts *Triturus vulgaris.* Pasture grasslands provide forage for frogs and this species may be expected on occasion.

The common lizard *Lacerta vivipara* is a common species and difficult to observe; its presence in the wider countryside is certainly underestimated. There is only limited potential for occurrence of this species on site due to the paucity of good habitats.

12.4.1.7 Overall Assessment of Scientific Interest of Site

The habitats on-site may be considered in terms of extent, diversity, naturalness, rarity, fragility, typicalness, recorded history, position, potential value and intrinsic appeal (Regini, 2000). The potential of these habitats for vertebrate fauna is considered in this framework also.

i the main portion of the site is comprised of arable farmland, with a portion of improved agricultural grassland at the west. These habitats may be considered as of Negligible ecological value.

ii the boundaries on site are of varied but of limited value. They do provide wildlife corridors and foraging areas for common species. Overall, they may be considered as of low ecological value for mammalian species as they are common and ubiquitous habitats in the Irish countryside.

iii the site does provide some potential for bat foraging habitat and occasional small roosts. The habitat quality on site is poor for other protected mammalian, reptilian and amphibian species.

12.4.1.7.1 Species of Conservation Interest

Common Species

Common protected [Wildlife Act (1976) and Wildlife [Amendment] Act (2000)] species observed or expected on site include the Irish hare, pygmy shrew, Irish stoat, and hedgehog. These species are common and generally ubiquitous in Irish agricultural landscapes.

Badger

No signs of current badger activity were found on site.

Legal Status and Conservation Issues - Badgers

A number of mammalian species are protected under the Wildlife Act (1976) and Wildlife [Amendment] Act (2000)[1]. These include the badger (which is also a Red Data Book species). However, the badger is a relatively common species and ubiquitous through much of the Irish countryside (Smal, 1995).

It is standard best practice to make special provisions for badgers affected by development; whilst the species is common in much of the Irish landscape, badgers are notable for their practice of constructing large underground tunnel and chamber systems (setts). Provisions are made for their humane removal or for their conservation on site where feasible or practicable. No active setts were noted on site; the Wildlife [Amendment] Act (2000) protects all setts (as resting places).

Otters

No otter signs were found on site and there is no likelihood that this species ever occurs on site. Otters are protected under the Irish Wildlife Acts and are also listed under Annex II and Annex IV of the EU Habitats Directive.

Bats

The site provides some foraging habitat for bats and three common species are expected to occur on site on occasion. Whilst no definite bat roosts were identified, they might occur within mature or ivy-covered trees on site.

Legal Status and Conservation Issues - Bats

All Irish bat species are protected under the Wildlife Act (1976) and Wildlife Amendment Act (2000). Across Europe, they are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982), which, in relation to bats, exists to conserve all species and their habitats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries. The Irish government has ratified both these conventions. Also, the EC Directive on The Conservation of Natural habitats and of Wild Fauna and Flora (Habitats Directive 1992), seeks to protect rare species, including bats, and their habitats and requires that appropriate monitoring of populations be undertaken.

Birds

This report did not include a bird survey. Mention is made of legal status and conservation issues briefly. The habitats on site do offer refuge and foraging areas for a number of common avian species.

This item is included in relation to season of tree-felling that may affect both bats and birds.

[1] Note that the Wildlife Act (1976) and the Wildlife Amendment Act (2000) allow exemptions for certain types of development [page 32, 2000 Act: "it shall not be an offence for a person - …while constructing a road, or building operation or work of engineering construction, or while constructing or carrying on such other operation or work as may be prescribed, *unintentionally* to kill or injure such an animal or *unintentionally* to destroy or injure the breeding place or resting place of such an animal…"]

Legal Status and Conservation Issues – Birds

Most bird species are protected under the Wildlife Acts (1976, 2000), barring those regarded as pest species, and for those considered as game species (where they may be hunted under conditions). It is an offence to interfere with the breeding place of protected species, though there are certain exemptions for developments such as road construction and building works. For the generally common species, best practice provision is made to limit season of removal of vegetation and nesting habitat. Provisions of section 46 of the Wildlife [Amendment] Act (2000) require that disturbance to vegetation is excluded during the period 1st March to 31st August (with exemptions for certain developments).

12.4.2 Potential Impacts of Proposed Development on Fauna

The proposed scheme involves works and construction of facilities over most of the site, with access to the site from the R152.

There will be almost complete loss of habitats that are currently present on site (except portions at the extreme west). These include arable lands, a portion of improved pasture grassland, and most hedgerows and treelines present.

Principal impacts on mammalian fauna can be summarised as follows:

i loss of some foraging and commuting habitat for bats, and also loss of some boundary hedgerows and treelines that serve as wildlife corridors for common mammalian species. Impacts are considered to be Negligible.

ii loss of some potential bat roosts within trees on site (within the development area), with only common species affected. If safely evacuated from potential roosts prior to development, the bats should find alternative roosting locations in the locality. Impacts are considered as Negligible, if amelioration measures are taken.

iii loss of foraging habitat for species such as Irish hare and pygmy shrew etc. are considered as of Negligible impact.

12.4.2.1 Potential Impacts on Adjoining Areas

There is not expected to be any significant impact on fauna present in adjoining areas arising from this proposal.

Impacts on non-designated areas in the locality are also considered to be Negligible.

12.4.2.2 Impacts on Designated Conservation Areas in the General Vicinity

No designated conservation areas are present in the immediate vicinity of the site. Several are present within c. 6km of the site. Drainage is towards the conservation area of the Nanny Estuary.

No impacts, arising from the proposal, are expected on any of these designated conservation areas.

12.4.3 Mitigation Measures

12.4.3.1 General Fauna

No species of especial ecological importance were observed on site, other than those detailed below.

No special mitigation measures are recommended for common species. General mitigation measures as would apply to any substantial development are recommended below.

12.4.3.2 Badgers

No signs of current active use of the site by badgers were found. Badgers do move and create new setts on occasion.

Measure 1:

If there is any significant period between this study, grant of permission, and initiation of construction works (e.g. 18 months), it is advised that a repeat badger survey be conducted on affected portions of the site only.

Measure 2:

Should any badger setts be found at time of such re-survey, these must be evacuated and destroyed by experts under licence from NPWS. Seasonal constraints will apply.

12.4.3.3 Bats

Bats certainly utilise the area for feeding, and summer (and perhaps winter roosts) may be present in mature trees or within ivy-covered trees on-site.

Measures 1: Felling of Large Trees

A bat expert will survey all trees due for removal prior to construction works commencing. With respect to bats, trees, which are to be removed, will be felled during the spring months of March, April, May or autumn months of September, October or November (felling during the spring or autumn months avoids

the periods when the bats are most active). However cognisance will be taken of the bird nesting season which excludes tree felling during the period March 1st to August 31st.

Any trees showing crevices, hollows etc., will be removed while a bat specialist is present to deal with any bats found. Large mature trees will be felled carefully, essentially by gradual dismantling by tree surgeons, under supervision of a bat specialist.

Care will be taken when removing branches as removal of loads can cause cracks or crevices to close, crushing any animals within. These cracks will be wedged open prior to load removal. The dead branches will be lowered to the ground using ropes to avoid impacts which could injure or kill bats within. Such animals will be retained in a box until dusk and released on-site.

Measure 2: Felling of Ivy-Covered Trees

Any ivy-covered trees (ash and hawthorn) – other than large trees (referred to above) which require felling will be left to lie for 24 hours after cutting to allow any bats beneath the cover to escape.

Measure 3: Landscaping

It would be of benefit to bats if treelines and shrubs of native species were planted on-site, with native species providing more insect life than foreign varieties.

Measure 4: Bat Box Scheme

A bat box scheme will be included in the area to offset the potential loss of roosts due to tree removal. It is recommended that c. 5 bat boxes would suffice; these will be placed upon existing mature tress to be retained at the extreme west of the site.

'Schwegler' woodcrete bat boxes are recommended but other designs are available – timber, concrete and concrete/sawdust). Consult the following publication: *Bat Boxes: A guide to the history, function, construction and use in the conservation of bats by R. E. Stebbings and S. T. Walsh (The Bat Conservation Trust, 1991).* Brown long-eared bats, Leisler's bats, common pipistrelles and soprano pipistrelle bats will frequently use bat boxes both as temporary and maternity roosts. Special hibernation bat boxes are also available. Suppliers of artificial bat roost units:

i) Schwegler Bat Boxes, Jacobi, Jayne & Co: www.jacobijayne.com
ii) Alana Ecology: www.alanaecology.com

12.4.3.4 Retention of Hedgerows, Treelines and Landscaping

Measure 1: Retention of Existing Hedgerows and Treelines

The proposed development will entail loss of many of the internal boundaries on site. Site boundary features - treelines and hedgerows - will be retained where possible to offer continuous corridors for bats and other wildlife. The most valuable treelines are at the west of the site and will not be affected by the proposal.

Measure 2: - Additional Planting of Trees

The proposal involves removal of mature trees. Additional planting is recommended. This will be of native species, such as oak, ash, hawthorn, and other deciduous species, according to local conditions and expert advice.

12.4.3.5 Protection of Birds

There are some treelines and hedgerows to be removed; these provide a feeding and nesting habitat for birds as well as other fauna.

Measure 1: Tree and Scrub Clearance

Clearance of trees, or areas of tall scrub, where required, will take place outside of the bird nesting season, where possible. Clearance between March 1st to August 31st will not take place without prior agreement with the National Parks and Wildlife Service.

12.4.3.6 Works on Site: Construction and Operation Phase

There are no especial constraints on areas suitable for storage, machinery depots, site offices or other uses, but all areas identified as of interest or for protection within the development area will be avoided.

Measure 1: Protection of Trees to be Retained

Where mature trees and treelines are to be retained, these areas will be avoided and fenced off prior to construction traffic entering the site - in order to protect the trees and their root systems.

12.4.3.7 Pollution Hazards: Construction and Operational Phases

Contamination incidents and run-off of sediments into the nearby watercourses could affect the river habitats downstream of the site and affect sensitive species.

Measure 1: Control of Pollutants etc.

Construction works and operation of the plants on site will limit entry of sediments, and avoid entry of pollutants, into the drainage system and natural watercourses in the area.

12.4.3.8 Monitoring

Any wildlife mitigation measures incorporated into the proposed plan will be monitored for effectiveness by means of occasional visits (at appropriate season) during the first two years of operation and additional mitigation measures will be taken as appropriate.

12.4.4 Predicted Impact of the Proposal

The proposed scheme will entail loss of arable lands, improved pasture and boundaries of low ecological interest. Bat foraging and roosting areas may be affected. No significant impacts are expected on other species known or expected on site.

The recommended mitigation measures, if implemented in full, will ensure that impacts on fauna in the locality are Negligible.

12.4.4.1 Worst Case Scenario

The construction and operation of the proposed Incinerator facility and associated works should not lead to exceptional impacts on fauna in a worst case scenario, except by virtue of severe pollution incidents (dissemination of pollutants into the local [and wider] atmosphere and into adjacent watercourses).

Pollution incidents could damage the freshwater ecology of the Nanny River and the river systems downstream. Impacts on invertebrates and vertebrates (fish) could lead to loss of feeding habitat for predators such as otter (Annex II & IV species, EU Habitats Directive). Recovery would be expected, but could be lengthy. The otter is susceptible to organochlorines and heavy metals.

Mitigation measures have been presented for potential impacts to soils, groundwater and surface water (Sections 10-12 respectively). With such mitigation measures in place the proposed development will have no significant impact on such receptors within the surrounding environs.

12.5 TERRESTRIAL FAUNA - BIRDS

12.5.1 Introduction

Biosphere Environmental Services was commissioned by White Young Green Environmental to assess the potential impacts on birds by the proposed Waste Management Facility at Carranstown. A previous survey had been carried out at the site by BES in May 2000.

12.5.2 Sites Designated for Conservation in Area

The nearest site designated for birds is the Boyne Estuary Special Protection Area (code 04080) located approximately 6 km north-east of Carranstown.

The other designated sites in the vicinity, namely Duleek Commons proposed Natural Heritage Area (code 01578) and the Boyne River Islands candidate Special Area of Conservation (code 01861), do not have any particular bird interests.

12.5.3 Methodology

A survey for breeding birds was carried out during the 2005 season. As required for breeding bird surveys, two field surveys of the site were conducted as follows: an early season visit on 18th May and a late-season visit on 29th June. All surveying was between 07.00-10.00 hrs, when birds are most active. Survey was carried out by Dr Brian Madden.

As the objective of the survey was to record all species breeding within the site, the entire site was systematically covered (as opposed to just transects across the site). Birds were recorded by sight (using 8.5 x 42 binoculars) and sound. Birds in the air over the site were also recorded but a judgment was made on whether these were birds associated with the site or merely 'passing over'. A cursory examination was made of adjacent areas from the public road.

During the survey, particular attention was given to the possible presence of bird species that are listed on Annex I of the EU Birds Directive (Council Directive 79/409/EEC) or Birds of Conservation Concern in Ireland (BoCCI) as listed in Newton et al. (1999).

The standard ornithological literature was reviewed, and listings and maps of sites of bird conservation importance in Co. Meath held by Department of the Environment, Heritage & Local Government were accessed. Contact was made with Mr David Norriss of the DoEHLG re. the presence of rare or sensitive breeding birds in the vicinity.

12.5.4 Survey Limitations

The principal survey limitation is that a survey for winter birds at the site was not carried out. However, this is not considered significant as the habitats present (i.e. intensive agriculture) would not be expected to support any species of conservation importance. Further, the literature does not identify any wintering species of note for the area.

12.5.5 Results

12.5.5.1 Overview of Habitats

The site, which comprises three fields and parts of a further two, is entirely used for agriculture which is of an intensive nature. In 2005, the dominant landuse was arable, with potatoes in some fields. The north-western field is used for cattle pasture. Hedgerows form the field boundaries though most of these have not been well maintained and are of only low to moderate quality. The hedgerows are predominantly of hawthorn *Crataegus monogyna,* with ash *Fraxinus excelsior* the principal tall tree species. There are no streams within the site.

The surrounding lands are also farmed intensively, with a mix of arable and grassland. A railway line runs a little north-west of the site and has scrub covered banks. The Platin Cement factory lies a few fields to the north. Associated with the factory is a large quarry.

12.5.5.2 Breeding Birds Within Site

A total of 22 species were recorded during the survey. Of these, 14 species are considered to breed (confirmed or probable) within the site, with a further four possibly breeding. A further 4 species were recorded but are not considered to be breeding within the site. A list of the species recorded is given in Table 12.2. Scientific names of species recorded are given in Table 12.2.

The breeding habitat in this site is provided by the hedgerows. The commonest species recorded were wren, blackbird, chaffinch and blue tit. Other species, such as song thrush, coal tit, dunnock, robin and chiffchaff, had several pairs each. The rook nests were all in ash trees and were distributed as follows: along mid eastern boundary (4 nests), along south-easternmost boundary (7 nests), along north-western boundary (c.20 nests).

12.5.5.3 Breeding Birds Outside Site

A cursory examination of surrounding areas indicated that a similar array of species occur as the habitats are largely similar. Additional species recorded were meadow pipit *Anthus pratensis*, house sparrow *Passer domesticus*, greenfinch *Carduelis chloris* and bullfinch *Pyrrhula pyrrhula.*

A pair of peregrines *Falco peregrinus* is known to breed in a quarry within 1 kilometre of Carranstown (exact site location withheld for confidentiality reasons – D. Norriss NPWS pers. comm.). It is not known if breeding occurred in 2005 though the site has been occupied in most years since the 1990s.

12.5.5.4 Likely birds in Winter

The habitats suggest that most of the species recorded within the site are probably resident and hence would be present in winter. These are likely to be joined by winter species such as redwing *Turdus iliacus* and fieldfare *Turdus pilaris*, as well as larger numbers of crows, finches and woodpigeons. Generally, utilization of the site in winter would depend on the type of agriculture practiced the previous season.

12.5.5.5 Evaluation of Birds at Site

The bird species recorded breeding in the survey area are typical of agricultural habitats in eastern Ireland. The total of 14 (and possibly 18) breeding species is average for the habitats present. In an analysis of the first three years of the Countryside Bird Survey Coombes *et al*. (2002) note that numbers of birds recorded in survey squares ranged from 1 to 48, and when averaged over the three years almost 40% of squares held between 21 and 30 species. All of the species recorded during the present survey are listed by Coombes (op. cit.) as occurring in 30 or more of the CBS survey squares in at least two of the three years from 1998-2000. The diversity of breeding birds at Carranstown reflects the type of habitats present and the small size of the site. No additional species had been recorded within the site during the breeding bird survey in 2002.

None of the species which were recorded within the site, or which are likely to occur in winter, are listed on Annex I of the EU Birds Directive or are 'Red species' (i.e. of high conservation concern) as listed by Newton et al. (1999).

The presence of a nesting pair of peregrines in the locality is of note as this species is listed in Annex I of the EU Birds Directive. However, the peregrine is not a species of high conservation concern in Ireland (see Newton et al. 1999), and a national survey in 2002 indicated a stable population with significant increases in the use of artificial sites, such as quarries and buildings (Madden *et al*. in preparation).

12.5.6 Potential Impacts

12.5.6.1 Characteristics of the Development

The proposed Waste Management Facility will be located in the north-western sector of the site. However, the majority of the site area will be used, with access roads and extensive landscape areas.

The existing perimeter hedgerow boundaries will be left intact, other than at the main site access from the R152. Internal hedgerows will be removed.
The principal impact by this development will be loss and alteration of habitats.

Further impacts which require consideration are possible impacts on birds outside of the site, especially peregrine, and possible impacts on birds in designated sites in the vicinity.

12.5.6.2 Impacts During Construction Phase

12.5.6.2.1 Impacts on Birds by Habitat Loss and Alteration

The main impact by the loss of the internal hedgerow and arable habitats will be the loss of both nesting and feeding habitat for a range of passerine species. However, the habitats that will be lost are frequent in the area and are not of notable quality. Also, the birds which presently use them are all common birds of the countryside. Further, practically all species would be expected to retain a presence on site due to the extensive landscaping programme that will take place. Therefore, the impact by loss of habitats is rated as Negligible and no adverse impacts would be expected on local bird populations. With time, a net positive impact may accrue due to the maturing of the trees and shrubs.

12.5.6.2.2 Potential Impacts on Birds Outside of Site

The proposed development would not be expected to have any impacts on the bird species which inhabit the fields that surround the site. While the construction will involve increased visual and noise activities, this would hardly be expected to have any adverse impacts on any of the countryside bird species as there is already substantial existing disturbance in the area due to road traffic, agricultural activities and industrial activities.

12.5.6.2.3 Potential Impacts on Peregrine

Loss of habitat

The potential loss of 25 acres of agricultural land by this development, which may be of use as hunting habitat to the peregrines that breed in the vicinity, could not be considered as significant as the pair would have a hunting territory in the region of several tens of square kilometres. Peregrines require large territories, with size varying according to the ability of the habitats to support prey. In upland areas of Britain, Ratcliffe (1980) gives an average density in the order of one pair to 325 +/- 50 km^2. Elsewhere in Britain, the smallest quoted territory was 42.3 km^2 for an inland area in north-west England. Further, the site will still support prey items (mainly woodpigeons) for the peregrines and, as peregrines normally take prey in mid air, often at substantial heights, hunting activities could continue at heights well above the complex (as they do over cities and suburban areas).

Disturbance

It is considered that the construction phase would not impact on the peregrines which breed in a local quarry as the birds already contend satisfactorily with a high degree of visual and noise levels associated with routine quarry activities. It is also noted that peregrines have successfully adapted to nesting on buildings in urban areas and on industrial structures such as power stations where there are high degrees of background disturbance. It is concluded that so long as there is no direct interference by construction activities with the nest site, there can be no impact on the nesting peregrines.

12.5.6.3 Impacts During Operation Phase

12.5.6.3.1 Countryside Bird Species

Once constructed, the waste management facility would not be expected to have any adverse impacts on any of the countryside birds which are found in the area.

As already noted, the maturing trees and shrubs within the site will support all of those species which already occur and it is likely that a higher diversity of species will occur than at present due to the diversity of trees and shrubs that will be planted.

12.5.6.3.2 Potential Impacts on Peregrine

Once in operation, the proposed development is likely to have little if any impacts on the peregrines which nest nearby.

As with any industrial complex, vermin will be controlled following professional standards. It is considered that there is little, if any, chance of peregrines picking up a rat after it had ingested poisoned bait as peregrines feed almost exclusively on pigeons (both woodpigeon and feral/racing pigeons).

Consideration also needs to be given to the possibility of collision with tall structures and wires. While the facility will have a tall stack (65 metres), it is considered that there is little or no chance that a peregrine would collide with this as it will be easily visible. As already noted, peregrines cope well in man-made environments where tall structures exist, for instance it is well known that birds have nested successfully in Dublin city and port area. Power lines can cause a problem for peregrines should they be positioned in a regular flight path. In the proposed development, the existing 110kV lines will not be altered and the only new lines from the site are likely to be 38kV lines leading to Rathmullan – as these will be lower than the existing 110kV set up, and probably on timber poles, it is considered that these would not pose any additional risk to the peregrines than which already exists.

12.5.6.3.3 Potential Impacts on Designated Sites

The proposed development could not have any impact on the Boyne Estuary SPA as there are no direct or indirect linkages between the two areas which are separated by a distance of c.6 km. The Boyne Estuary is the only designated bird site in this region.

12.5.7 Mitigation Measures

12.5.7.1 Removal of hedgerows

Section 40 of the Wildlife Act 1976, as amended by Section 46 of the Wildlife (Amendment) Act 2000, restricts the cutting, grubbing, burning or destruction by other means of vegetation growing on uncultivated land or in hedges or ditches during the nesting and breeding season for birds and wildlife, from 1st of March to the 31st of August. Unless otherwise agreed with the National Parks & Wildlife Service, removal of hedgerows and trees will be conducted outside of the restricted period to prevent the destruction of active bird's nests.

12.5.7.2 Landscaping

The extensive landscaping associated with the development will be beneficial for a range of passerine species including most of those species which presently occur within the hedgerows. Whilst birds will readily utilise non-native trees and shrubs (which are often prolific in setting fruit), it would be preferable to include a range of native species that occur in eastern Ireland. Useful native trees and shrubs include oak (*Quercus robur* or *Q. petraea*), hawthorn (*Crataegus monogyna*), blackthorn (*Prunus spinosa*), alder (*Alnus glutinosa*), willow (*Salix* spp.), birch (*Betula pubescens*), mountain ash (*Sorbus aucuparia*), holly (*Ilex aquifolium*), geulder rose (*Virburnum opulus*) and spindle (*Euonymous europaeus).*

Table 12.2. Birds recorded within survey site at Carranstown, Co. Meath, May/June 2005.

An indication of the breeding status is given and, where appropriate, the estimated number of pairs ('several' indicates up to 5 pairs recorded, 'common' more than 5 pairs).

Species	Status
Sparrowhawk *Accipiter nisus*	Not breeding – seen along railway
Pheasant *Phasianus colchicus*	Heard – may breed
Woodpigeon *Columba palumbus*	Breeds – several pairs but 20+ feeding in site
Swallow *Hirundo rustica*	Present feeding over site
Wren *Troglodytes troglodytes*	Breeds – common
Dunnock *Prunella modularis*	Breeds – several pairs
Robin *Erithacus rubecula*	Breeds – several pairs
Blackbird *Turdus merula*	Breeds – several pairs
Song thrush *Turdus philomelos*	Breeds – several pairs
Mistle thrush *Turdus viscivorus*	May breed – 1 pair
Chiffchaff *Phylloscopus collybita*	Breeds – 2 pairs
Goldcrest *Regulus regulus*	May breed
Blue tit *Parus caeruleus*	Breeds – several pairs
Coal tit *Parus ater*	Breeds – several pairs
Great tit *Parus major*	Breeds – 1 pair
Magpie *Pica pica*	Present
Jackdaw *Corvus monedula*	Breeds – several pairs
Rook *Corvus frugilegus*	Breeds – 30+ pairs (3 locations)
Hooded crow *Corvus corone*	Present
Starling *Sturnus vulgaris*	Breeds – several pairs
Chaffinch *Fringilla coelebs*	Breeds – several pairs
Goldfinch *Carduelis carduelis*	Present – could breed

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Appendix I7: Revised Air Dispersion Model Results

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MEMORANDUM

To:	Conor Jones	From:	Edward Porter
Company:	Indaver Ireland	Date:	13/02/09

Subject: Note On Carranstown Stack Base Elevation

Conor,

Please find attached a note on the stack base elevation used for the Carranstown WTE facility assessment in 2005 and subsequently updated in this memo.

Kind regards

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Note On Carranstown Stack Base Elevation

AWN Consulting Ltd undertook the air dispersion modeling of the Carranstown WTE facility for the Waste Licence Application in 2001. For this application, the terrain data was manually input into the air dispersion model due to the unavailability of digital terrain data in the correct format for AERMOD at that time. The base stack elevation used in the model in 2001 was 30.5m O.D which is the correct stack base elevation.

In 2005, the Carranstown WTE facility was re-modelled using the AERMOD air dispersion model as part of a revised EIS and Waste Licence Application. At this stage, digital terrain data from Ordnance Survey Ireland was purchased and input into the model in the form of a DEM (Digital Elevation Model) file. However, in error, the proposed stack base elevation of 30.5m O.D. was overwritten using the digitial terrain data and the prevailing terrain elevation of 33.0m O.D. transposed instead. This error has only recently come to light and thus the AERMOD air dispersion model has been re-run with the correct stack base elevation (30.5m O.D.) to confirm the results of the previous assessment.

The AERMOD air dispersion model is in a continuous state of improvement with model enhancements occurring at least every two years. In 2005, the model algorithm employed had the code name AERMOD 04079. Since then the AERMOD model has been update several times and the current AERMOD code name is AERMOD 07026.

The results of the comparison between the original model run (stack base elevation 33m O.D., AERMOD 04079) and the updated model run (stack base elevation 30.5m O.D., AERMOD 07026) are shown in Table 1 and Figure 1. Results are very similar for all pollutants and averaging periods. Indeed, due to changes to the model algorithm, results using the more recent AERMOD code (AERMOD 07026) with the base elevation of 30.5m O.D. lead to lower ambient ground level concentrations than that reported in the EIS which was based on a stack base elevation of 33m O.D. and using AERMOD 04079. Thus, the original air dispersion modeling assessment is slightly more conservative than the updated modeling results reported here.

Pollutant	**NO_2**		**SO_2**		**PM_{10}**		**$PM_{2.5}$**	**TOC[3]**	**HCl**
Averaging Period	1-hr	Annual	1-hr	24-hr	24-hr	Annual	Annual	Annual	1-hr
Background Concentration	40	20	8	4	20	20	12	0.7	0.01
Process Emissions - AERMOD 04079, Stack Base Elevation 33m	18.9	1.1	7.6	2.0	0.22	0.08	0.08	0.07	0.80
Process Emissions - AERMOD 07026, Stack Base Elevation 30.5m	15.0	1.0	6.0	1.9	0.21	0.07	0.07	0.07	0.79
Process Plus Background - AERMOD 04079, Stack Base Elevation 33m	58.9	21.1	15.6	6.0	20.2	20.1	12.1	0.77	0.81
Process Plus Background - AERMOD 07026, Stack Base Elevation 30.5m	55.0	21.0	14.0	5.9	20.2	20.1	12.1	0.77	0.80
Ambient Air Quality Standard	**200**	**40**	**350**	**125**	**50**	**40**	**25**	**5.0**	**100**

Table 1: Modelling Results Under Maximum Operations (µg/m^3) - AERMOD 04079 (Stack Base Elevation 33.0m) vs AERMOD 07026 (Stack Base Elevation 30.5m).

Pollutant	**HF**		**Dioxins**	**Hg**	**Cd**	**As**	**Ni**
Averaging Period	1-hr	Annual	Annual	Annual	Annual	Annual	Annual
Background Concentration	0.01	0.005	28 - 46 fg/m^3	0.001	0.001	0.001	0.002
Process Emissions - AERMOD 04079, Stack Base Elevation 33m	0.08	0.007	0.8 fg/m^3	0.0004	0.0004	0.0004	0.0004
Process Emissions - AERMOD 07026, Stack Base Elevation 30.5m	0.08	0.007	0.7 fg/m^3	0.0003	0.0003	0.0004	0.0004
Process Plus Background - AERMOD 04079, Stack Base Elevation 33m	0.09	0.012	28.8 - 46.8 fg/m^3	0.0014	0.0014	0.0014	0.0024
Process Plus Background - AERMOD 07026, Stack Base Elevation 30.5m	0.09	0.012	28.7 - 46.7 fg/m^3	0.0013	0.0013	0.0014	0.0024
Ambient Air Quality Standard	**3.0**	**0.30**	**N/A**	**1.0**	**0.005**	**0.006**	**0.020**

Table 1(continued): Modelling Results Under Maximum Operations (µg/m^3) - AERMOD 04079 (Stack Base Elevation 33.0m) vs AERMOD 07026 (Stack Base Elevation 30.5m).