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9 SOILS AND GEOLOGY

9.1 INTRODUCTION

The geology and soils at the proposed facility are described below. The information regarding the existing environment is based on investigations completed at the site in 2000 and 2001, a desk study and the Geological Survey of Ireland database.

The initial investigations were conducted to establish baseline conditions of soil beneath the site.

9.2 EXISTING GEOLOGY AND SOILS

The existing geology and soils is described under the two distinct units of solid bedrock geology and unconsolidated overburden deposits. The units are discussed below on both a regional and local basis.

9.2.1 Regional Geology

The site is located in a relatively narrow expanse of Carboniferous limestones that outcrops between the Lower Palaeozoic sandstones and shales of the Longford Down Massif to the north and the block of similarly aged meta-sedimentary rocks that extend between Julianstown and Balbriggan to the south (Figure 9.1). The Platin limestones extend westwards to connect with the Carboniferous rocks that underlie much of Meath. To the east and beyond Drogheda, this narrow band of limestones extends as far as the Irish Sea between the Boyne and Nanny estuaries.

9.2.2 Local Geology

The Platin outlier is fault bounded and the limestones at the nearby quarry have a general East North East strike with a shallow (10-20 degree) dip to the northwest. The deposit limestone consists of at least 300 metres deep of grainstones. The types of grainstones that have been recorded at Platin include crinoidal pepper-type, intra-clastic and skeletal. In general, the limestones are massive with few bedding structures clearly developed. The Platin limestones display karst features in and around the nearby Platin quarry.

The geological structure of the proposed site has been determined from boreholes and trial pits undertaken during the May and December 2000 and July 2001 investigations, the location of which are shown on Figure 9.2. Detailed borehole and trial pit logs are presented in Appendix 9.1 and 9.2 respectively. A complete geotechnical report completed by Alpha Engineering Services in March 2000 is presented in Appendix 9.3.

Two cross sections across the site (namely A – A' and B – B') are shown in Figure 9.3.

9.2.3 Soils

The Carranstown site is underlain by soils from the Dunboyne-Ashbourne soil complex. The parent material of the soil is drift deposits intermixed with local limestone and shale. This type of soil is generally poorly drained.

9.2.4 Overburden Geology

The overburden geology consists predominantly of brown silty clays generically known as boulder clays. These consist of medium dense brown silty clays with pebbles, cobbles and occasional boulders. The boulder clay varies in thickness across the site, ranging from 5.0 metres towards the west of the site, to greater than 20 metres towards the centre. Sand and gravel lenses are found throughout the boulder clays.

A total of seven trial pits (TP-1 to TP-7) were excavated across the site during the May 2000 investigation (see Figure 9.2 for locations). These excavations were undertaken to allow representative soil sample collection. Based on visual observations made on site, one composite soil sample was collected from each trial pit location. Samples were sealed in a laboratory-supplied sample container and maintained at a temperature of $<4^{\circ}\text{C}$ in a mobile field laboratory.

Seven soil samples (TP-1 to TP-7) were submitted to Geochem Group Laboratories Ltd. and analysed for the following parameters:

- Metals and Total Phenols
- Volatile Organic Compounds (VOCs)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Polychlorinated Biphenyls (PCBs)
- Pesticides (OPPs, OCPs, ONPs)

Trial pit sampling logs are included in Appendix 9.2.

9.2.5 Analytical Results

The analytical results presented in Tables 9.1 to 9.5. Where relevant, the soil analytical results are discussed below with reference to the Dutch MAC (Maximum Admissible Concentration) thresholds, as standards for soil are not available in Ireland at present.

Under the Dutch criteria for soil, the degree of contamination is assessed using the following guidelines:

S-Value	Reference for normal uncontaminated soil
I-Value	Threshold for intervention

Heavy Metals

The analytical results for heavy metals are presented in Table 9.1. Detected concentrations for Cadmium, Copper, Mercury and Nickel slightly exceeded their respective Dutch S-Values for normal uncontaminated soil at a number of trial pit locations. In particular, the Copper and Nickel results exceeded the S-Values at a number of the soil sampling locations.

Results for Total Phenols did not exceed the laboratory detection limits of 0.01 mg/kg, indicating the absence of Phenols in the soil environment.

Volatile Organic Compounds (VOCs)

The VOC analytical results for soils are presented in Table 9.2. ALcontrol Laboratories (formerly Geochem Group Laboratories Ltd.) analysed for 40 individual VOCs, in accordance with the US EPA Method 624 list

None of the samples analysed exceeded either the laboratory detection limit of 1 µg/kg or the relevant Dutch S- value.

Polynuclear Aromatic Hydrocarbons (PAHs)

The analytical results for the PAHs are presented in Table 9.3 and consist of the 16 Priority PAHs (EPA List). The sum of the PAHs analysed for did not exceed the Dutch S-value for Total PAHs of 1 mg/kg for normal background soil concentrations.

Polychlorinated Biphenyls (PCBs)

The analytical results for PCBs are presented in Table 9.4. No PCBs were detected in any soil sample above the laboratory detection limit of 1 µg/kg (laboratory detection limit).

Pesticides

The analytical results for Pesticides are presented in Table 9.5 of this report. The Geochem suite consists of three separate types of pesticides including Organochloride, Organonitrate and Organophosphate Pesticides, covering a wide range of these parameters. No pesticides were detected in any soil sample above the laboratory detection limit of 1 µg/kg (laboratory detection limit).

9.2.5.1 Summary of Findings

Soil samples taken during the trial pit investigation indicated concentrations above the Dutch S-Value for some of the heavy metals, including the following:

Parameter	Trial Pit
Cadmium	TP-1
Copper	TP-1, TP-2 and TP-7
Mercury	TP-1 and TP-6
Nickel	TP-2, TP-3, TP-4, TP-5, TP-6 and TP-7

All other soil samples taken across the site reflected normal background conditions for the different indicator parameters including the Volatile Organics, PAHs, PCBs and Pesticides.

9.2.5.2 Conclusions

The results of the soil sampling suggest that there is no significant soil contamination at the Carranstown greenfield site in Duleek. However some traces of heavy metals were identified in the soil across the site. It should be noted that the levels of contamination are slight. These trace levels would commonly reflect agricultural activity within the area.

9.3 PERCOLATION TESTING

A test was conducted in December 2000 to assess the suitability of the site for the installation of a Puraflo™ system (see Appendix 9.4 for full report). The test results indicated that a suitable percolation area could be constructed to comply with national guidelines.

On-site investigations were carried out as follows:

- Two trial pits (Test Trial pits 1 and 2) were dug at the site of the proposed percolation area (Figure 9.2). The trial pits were excavated to a depth of 2.8 m and 3 m respectively. Both encountered similar overburden deposits-1.2-1.8m of boulder clay and then a clayey gravel which became more gravelly with depth. No seepages were encountered during the digging and after 48 hours, no water had entered the holes.
- Four percolation pits (PP 1-4) were dug at the site of the proposed percolation area (Figure 9.2). The site failed the percolation test as the T value obtained was greater than 50 (EPA Wastewater Manual). This is due to the presence of clays immediately beneath the site which had become highly saturated during bad weather.
- However, and in accordance with EPA Guidelines, the site can be engineered to meet the required specifications for percolation areas. This will involve the removal of the existing overburden material over an area of 300 m² and the importing of material with a suitable T value-preferably a

fine sand or clayey sand with a T value of between 5 and 15. A reserve percolation area should also be constructed in the event of the main area malfunctioning.

- Alternatively, a sand filter could be constructed with an associated polishing filter. The advantage of this type of sand filter is that it takes up considerably less area than the trenched percolation area. The disadvantages are that a polishing filter is necessary and pumping of wastewater might be required to transfer effluent from the sand filter to the polishing filter.

9.4 POTENTIAL IMPACTS

The following details the potential impacts on soils and geology for both the construction and operational phases of the project.

9.4.1 Construction Phase

Excavation works below the existing ground level will be required during the construction of the facility. All excavated material will be reused onsite.

Potential impacts during the construction phase would be associated with accidental spillage of potentially polluting substances including oils, paints and liquid wastes and any additional substances associated with the construction activities.

The development site is underlain by karst limestone which by its nature can pose difficulties for building foundations due to the unpredictable occurrence, extent and depth of underground cavities. The facility is located in a wide expanse of limestone strata. The development of this facility will not materially impact on the available reserves of limestone in the east Meath area.

9.4.2 Operational Phase

The potential impacts during the operation phase would be limited to accidental spillage of potentially polluting substances including oils, paints, liquid wastes, or raw materials such as lime, caustic soda or ammonia/urea. However it should be noted that with good management practices in place it is expected that the development will not cause any impact on the soils and geology of the site.

The location of the proposed facility in close proximity to the Irish Cement quarry may give rise to concerns relating to impacts from vibration.

9.5 MITIGATION MEASURES

9.5.1 Construction Phase

All oils, chemicals, paints, fuels or other potentially polluting substances used during construction will be stored in designated storage areas which will be bunded to a volume of 110% capacity of the largest tank/container within the bunded area(s).

Filling and draw-off points will be fully located within the bunded area(s).

Drainage for the bunded area(s) will be diverted for collection and safe disposal.

All domestic effluent generated on site will be discharged to temporary sewage containment facilities prior to transport and treatment off site.

A detailed site investigation programme will be carried out in advance of the building works. The planned site investigation programme will define the geo-technical conditions on the development site. The construction of the facility will incorporate the findings of the geo-technical study to ensure that the plant is built to the highest structural standards. The construction and operation of the nearby cement works confirms that it is possible to construct major plants safely in this geological environment.

The founding of the structure on different bearing strata (due to different foundation levels) will be accommodated by the inclusion in the substructure and superstructure of structural joints. These joints will allow sections of the building to act independently of each other with respect to settlements etc.

The implementation of good construction management practices will minimise the risk of pollution to geology and soils.

9.5.2 Operational Phase

All substances that would have the potential to cause a negative impact on the soils and geology will be stored in appropriate containers and/or placed within bunded areas. Raw materials for the process will be stored in containers/silos within the process building. Residues will be stored in a bunker and silos within the process building.

All waste entering the facility will be stored in fully contained structures therefore there will be no potential for leakage to soils. All waste storage facilities will be rendered impervious to the materials stored therein. All concrete underground storage structures whether for waste or liquid (as there is a possibility that firewater run-off may enter any of the tanks) will be constructed as watertight structures in accordance with the requirements of relevant Codes of practice such as BS 8007 British Standard for design and Construction of Aqueous Liquid Retaining Structures. Typically these structures will be

reinforced concrete with minimum wall and base thicknesses of 250 mm or greater depending on the structural requirements. Details for the construction of these tanks will follow good building practice, the guidelines in the Code of Practice and details used successfully in other similar structures. The structures will be integrity tested in accordance with the guidelines given in the Code of Practice for leakage to confirm that they are watertight. This will be demonstrated to the satisfaction of the local authority following installation and prior to use for storage. Similarly in the instance of the storm water attenuation tank (which can also contain fire-water run-off) it is proposed that this will be constructed from a sealed Hydrocell type storage unit. The sealing membrane will be welded HDPE membrane which is commonly used for forming secondary containment liners in effluent tanks. The attenuation tank will be tested and demonstrated to be watertight to the satisfaction of the local Authority.

All underground piping will be maintained and regularly inspected for integrity.

All domestic effluent will be treated by an appropriate system prior to discharge to the percolation area. All chemicals or other potentially polluting substances will be stored within the main process building and will be provided with adequate containment.

A petrol interceptor will be placed on the surface water drainage outfall line from hardstanding areas to contain any leakages from vehicles on site. Full details of the proposed on site drainage network are presented in Section 11.

The Irish Cement quarry is operated under an Integrated Pollution Control (IPC) Licence issued by the EPA. The licence specifies limits on noise, vibration and overpressure resulting from explosive activity in the quarry. The limit of vibration i.e. 12mm/sec is sufficiently low to prevent interference with monitoring equipment and items of plant associated with the proposed facility.

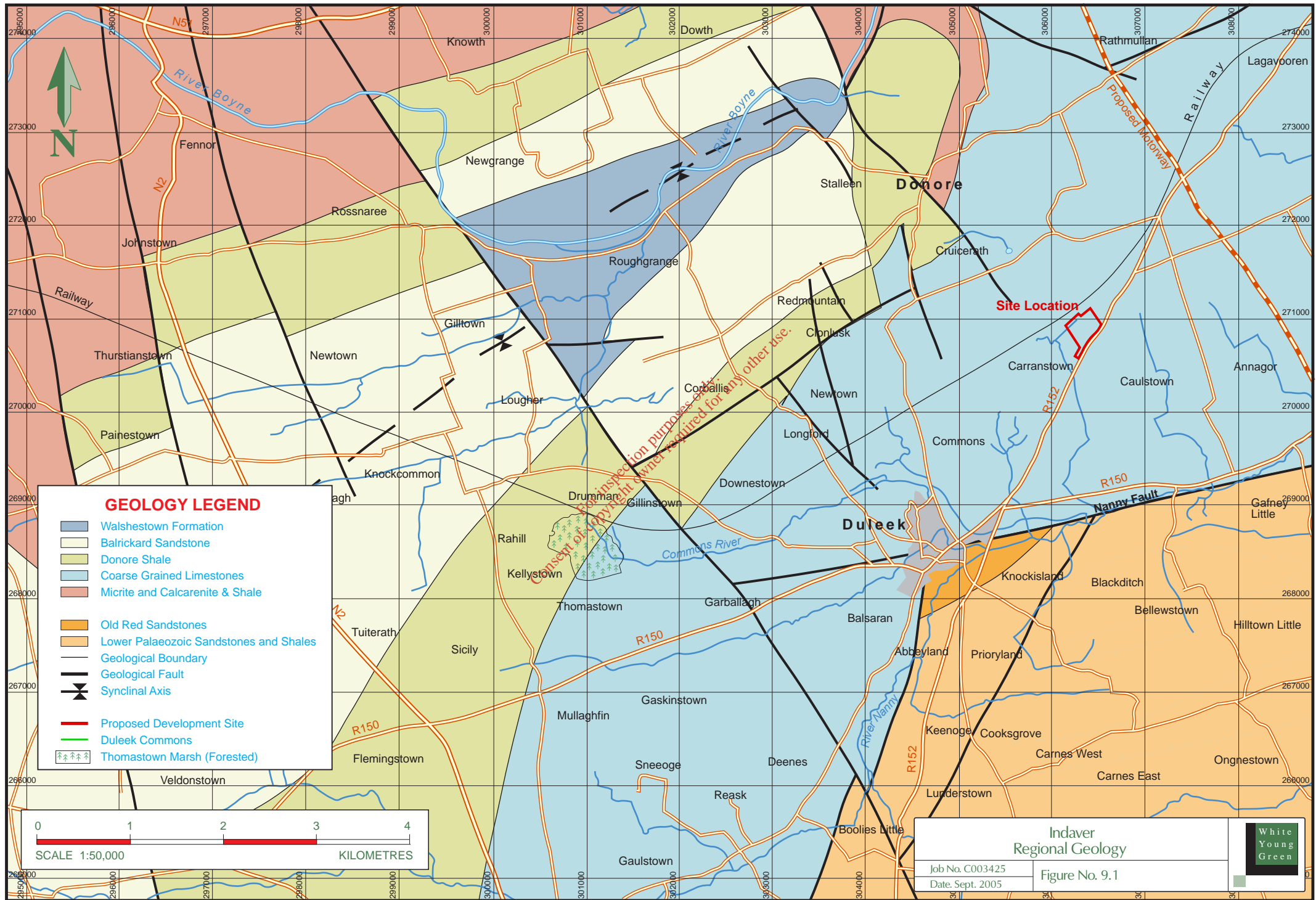
9.6 RESIDUAL IMPACTS

There are no sites of geological interest within the proposed development property. The impact to the soils and geology of the site will be limited to the excavation works. The excavations will vary in depth across the development site with the greatest level of impact being within waste bunker and ash bunker areas where the overburden will be excavated to a level of 24.0 mOD. At the location of the waste bunker the rock level is approximately 15m OD which is well below the construction level. However there may be local outcrops which protrude in to the construction area. Elsewhere the overburden will be excavated to shallow depths along the site roads and other infrastructure. As part of the detailed design a second stage site investigation will be carried out in order to map in greater detail the soils characteristics of the site and to minimise their potential impacts on the construction. These additional investigation works will include additional boreholes, trial pits, geophysics, rock proving (to confirm if any cavities exist) etc.

The bedrock is karst limestone which can pose difficulties for building foundations however, as is demonstrated by the nearby cement works, the ground conditions here can accommodate the type and scale of industrial building proposed for this development. Should cavities exist the effects of these will be considered in the detailed design of the facility. Typically swallow holes or cavities can be dealt with by bridging over the area or by grouting if appropriate.

The proposed facility will not have a significant impact on the soils and geology of the site or the surrounding lands.

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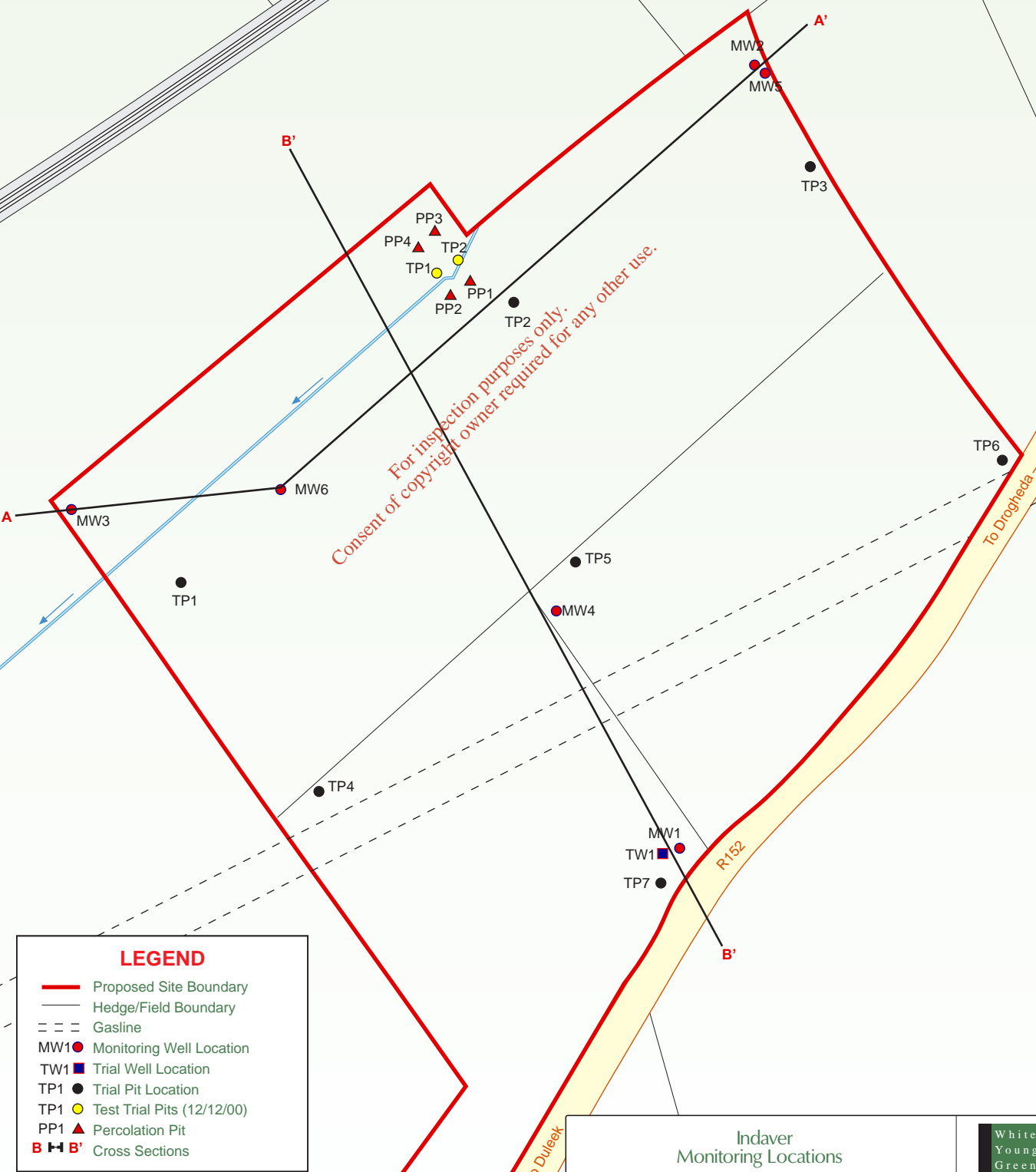


Railway

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To Drogheda

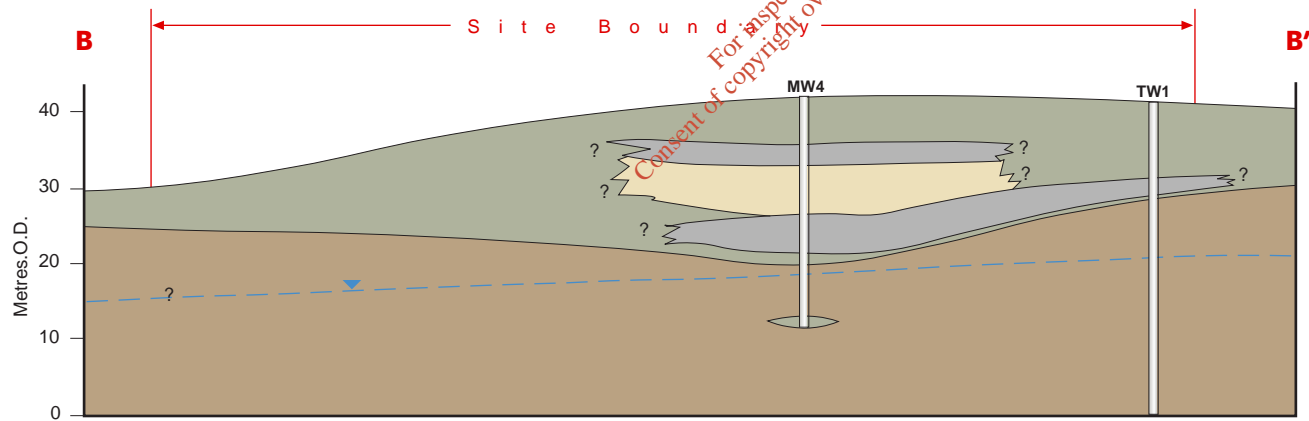
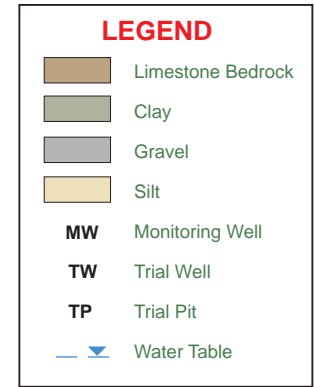
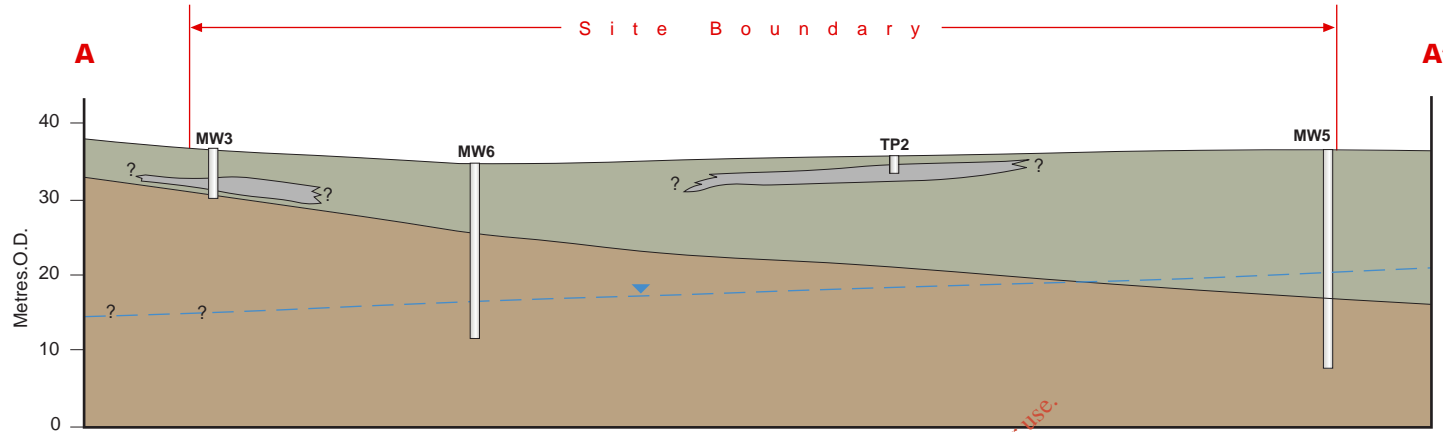
To Duleek



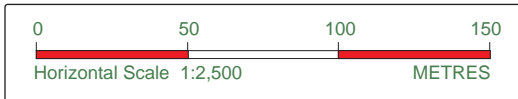
LEGEND	
	Proposed Site Boundary
	Hedge/Field Boundary
	Gasline
	MW1 Monitoring Well Location
	TW1 Trial Well Location
	TP1 Trial Pit Location
	TP1 Test Trial Pits (12/12/00)
	PP1 Percolation Pit
	B-B' Cross Sections

Indaver Monitoring Locations			
Figure No. 9.2	Job No. C003425	Date. Sept. 2005	
Finalised By - CC			

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.



Note: Any Overburden water could reasonably be assumed to be locally perched.



NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

Indaver			
Cross Section A - A' & B - B'			
Figure No. 9.3	Job No. C003425	Date. Sept. 2005	
Finalised By - CC			

Table 9.1: Soil Analytical Results - Metals Phenols (28/4/00)

Sample Identity	Depth (m)	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Copper mg/kg	Mercury mg/kg	Nickel mg/kg	Lead mg/kg	Selenium mg/kg	Zinc mg/kg	Total Phenols mg/kg
TP1	0 - 3.3	<1	2	16	37	2	33	10	<1	54	0.01
TP2	0 - 3.4	1	<1	44	48	<1	58	13	<1	72	<0.01
TP3	0 - 3.4	<1	<1	46	26	1	46	9	<1	54	<0.01
TP4	0 - 3.5	<1	<1	49	30	<1	54	12	<1	66	<0.01
TP5	0 - 3.4	19	<1	43	25	<1	43	11	<1	51	<0.01
TP6	0 - 3.1	<1	<1	36	29	3	47	11	<1	59	<0.01
TP7	0 - 3.3	23	<1	39	27	<1	55	13	<1	60	<0.01
TP-7 Duplicate	0 - 3.3	3	<1	42	38	<1	39	9	<1	46	n.a.

Dutch MAC S Values	29	0.8	100	36	0.3	85	35	140	-	-
Dutch MAC I Values	55	12	380	190	10	530	210	720	-	-

Legend

mg/kg: milligrams per kilogram

MAC: Dutch Standard Maximum Admissible Concentration

S Value: Dutch Guideline for normal uncontaminated soil

I Value: Dutch Guideline for Intervention

"-": MAC Guideline not available

n.a. = not analysed

"<" = below detection limit

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Table 9.2: Soil Analytical Results - VOCs (28/4/00)

Trace Organics (VOCs)		TP1	TP2	TP3	TP4	TP5	TP6	TP7	Dutch MACs	
									S-Value	I-Value
Dichlorofluoromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Vinylchloride	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	100
Bromomethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Trichlorofluoromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
trans-1,2-Dichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dichloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	20,000
1,1 Dichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,1 Dichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
cis-1,2-Dichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Bromochloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chloroform	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
2,2-Dichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	4,000
1,1,1-Trichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,1-Dichloropropene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Benzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	1,000
Carbontetrachloride	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dibromomethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Bromodichloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Trichloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	1	60,000
cis-1,3-Dichloropropene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
trans-1,3-Dichloropropene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,1,2-Trichloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Toluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	130,000
1,3-Dichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dibromochloromethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dibromoethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Tetrachloroethene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	4,000
1,1,1,2-Tetrachloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Chlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Ethylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	50,000
p/m Xylenes	µg/kg	<1	<1	<1	<1	<1	<1	<1	50	25,000
Bromoform	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Styrene	µg/kg	<1	<1	<1	<1	<1	<1	<1	100	100,000
1,1,2,2-Tetrachloroethane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
o - Xylene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,3-Trichloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Isopropylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Bromobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
2-Chlorotoluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Propylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
4-Chlorotoluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,4-Trimethylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
4-Isopropyltoluene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,3,5-Trimethylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
1,4-Dichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
sec-Butylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
tert-Butylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,3-Dichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
n-Butylbenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2-Dibromo-3-Chloropropane	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,4-Trichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	10	-
Naphthalene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
1,2,3-trichlorobenzene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Hexachlorbutadiene	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-

LEGEND

µg/kg: micrograms per kilogram
MAC: Maximum Admissible Concentration
Dutch S-Value: Target Value
Dutch I-Value: Intervention Value
-: MAC Guideline Not Available
<: Below current laboratory detection limit

Table 9.3: Soil Analytical Results - Polynuclear Aromatic Hydrocarbons (28/4/00)

Parameters	Depth (m)	Units	TP1	TP2	TP3	TP4	TP5	TP6	TP7	Dutch MAC Values	
										S-Value	I-Value
Acenaphthene	<1	µg/kg		12	<1	<1	<1	<1			-
Acenaphthylene	<1	µg/kg		<1	<1	<1	<1	<1			-
Benzo(B)fluoranthene	38	µg/kg		25	5	9	5	11	9		-
Dibenz(AH)anthracene	<1	µg/kg		<1	<1	<1	<1	<1	<1		-
Fluorene	5	µg/kg		25	3	12	4	3	3		-
Pyrene	12	µg/kg		25	6	7	9	16	4		-
PAHs included in 'PAH (Sum of 10)' Dutch S and I MAC values for PAHs in soil											
Anthracene		µg/kg	28	13	9	7	4	9	5		-
Benzo(a)anthracene		µg/kg	65	18	5	<1	6	4	10		-
Benzo(a)pyrene		µg/kg	21	21	<1	<1	<1	<1	<1		-
Benzo(ghi)perylene		µg/kg	<1	<1	<1	<1	<1	<1	<1		-
Benzo(k)fluoranthene		µg/kg	22	15	4	4	2	6	4		-
Chrysene		µg/kg	51	28	7	11	2	10	7		-
Fluoranthene		µg/kg	17	28	8	9	12	14	5		-
Indeno(123-cd)pyrene		µg/kg	4	10	<1	<1	<1	<1	3		-
Naphthalene		µg/kg	67	148	59	94	40	54	34		-
Phenanthrene		µg/kg	120	63	13	21	16	18	12		-
PAH (Sum of 10)		µg/kg	395	344	105	135	82	115	80		-
PAH (Total)		µg/kg	449	432	118	162	100	148	100		-

Legend

µg/kg: micrograms per kilogram

MAC: Maximum admissible concentration

S-level: Dutch guideline for normal uncontaminated soil

I-Level: Dutch guideline for Intervention

Results awaiting confirmation

"-": MAC not available

< = below laboratory detection limit

Table 9.4: Soil Analytical Results - Polychlorinated Biphenyls (28/4/00)

Parameters	Depth	Units	TP1	TP2	TP3	TP4	TP5	TP6	TP7	Dutch MAC Values	
											S
PCB Aroclor 1016		µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1221		µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1232		µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1242		µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1248		µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1254		µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB Aroclor 1260		µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
PCB total		µg/kg	<1	<1	<1	<1	<1	<1	<1	20	1000

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Legend

µg/kg: micrograms per kilogram

MAC: Maximum admissible concentration

S-level: Dutch guideline for normal uncontaminated soil

I-Level: Dutch guideline for Intervention

-: MAC not available

< = below laboratory detection limit

Table 9.5: Soil Analytical Results - Pesticide Analysis (28/4/00)

Pesticide	Units	TP 1	TP 2	TP 3	TP 4	TP 5	TP 6	TP 7	Dutch Values	
									S-Value	I Value
Dichlorvos	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Mevinphos	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Phorate	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Alpha-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1	2.5	-
Beta-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1	1	-
Gamma-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1	0.05	-
Diazinon	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Disulfoton	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Delta-BHC	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Methyl Parathion	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Heptachlor	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Fenitrothion	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Aldrin	µg/kg	<1	<1	<1	<1	<1	<1	<1	2.5	-
Malathion	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Parathion	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Heptachlor Epoxide	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Endosulfan I	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Dieldrin	µg/kg	<1	<1	<1	<1	<1	<1	<1	0.5	-
4,4-DDE	µg/kg	<1	<1	<1	<1	<1	<1	<1	2.5	4000
Endrin Ketone	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Endosulfan II	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
4,4-DDD	µg/kg	<1	<1	<1	<1	<1	<1	<1	2.5	4000
Ethion	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Endrin	µg/kg	<1	<1	<1	<1	<1	<1	<1	1	-
Endosulfan Sulphate	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
4,4-DDT	µg/kg	<1	<1	<1	<1	<1	<1	<1	2.5	4000
Methoxychlor	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Azinphos Methyl	µg/kg	<1	<1	<1	<1	<1	<1	<1	-	-

Legend

µg/kg: micrograms per kilogram

MAC: Maximum Admissible Concentration

S-Level: Dutch guideline for normal uncontaminated soil

I-Level: Dutch guideline for Intervention

-: MAC not available

< = below laboratory detection limit

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Appendix 9.1
Borehole Logs

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WELL LOG

Well No. TW1	Description Trial Well	Client Project Management
	Location Carranstown, Duleek	Driller Tom Briody & Son

Date Drilled
26/4/00

Scale

Water Level (mbtoc)

*All diameters in mm
All depths in metres*

Vertical 375.0	Horizontal 250.0
-------------------	---------------------

Depth [m]	Hole	Annulus	Casing	Screen	Lithology	Elev. [m]
5	200	150mm Steel Casing			5.5	-5
					6.7	-6.7
10					9.7	-9.7
					10.9	-10.9
15	14.63		14.8		13.4	-13.4
					14.3	-14.3
20						-20
25						-25
30						-30
35						-35
40						-40
45	150					-45
50						-50
55						-55
60						-60
65						-65
70					67.1	-67.1
						-70
75	75					75

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WELL LOG

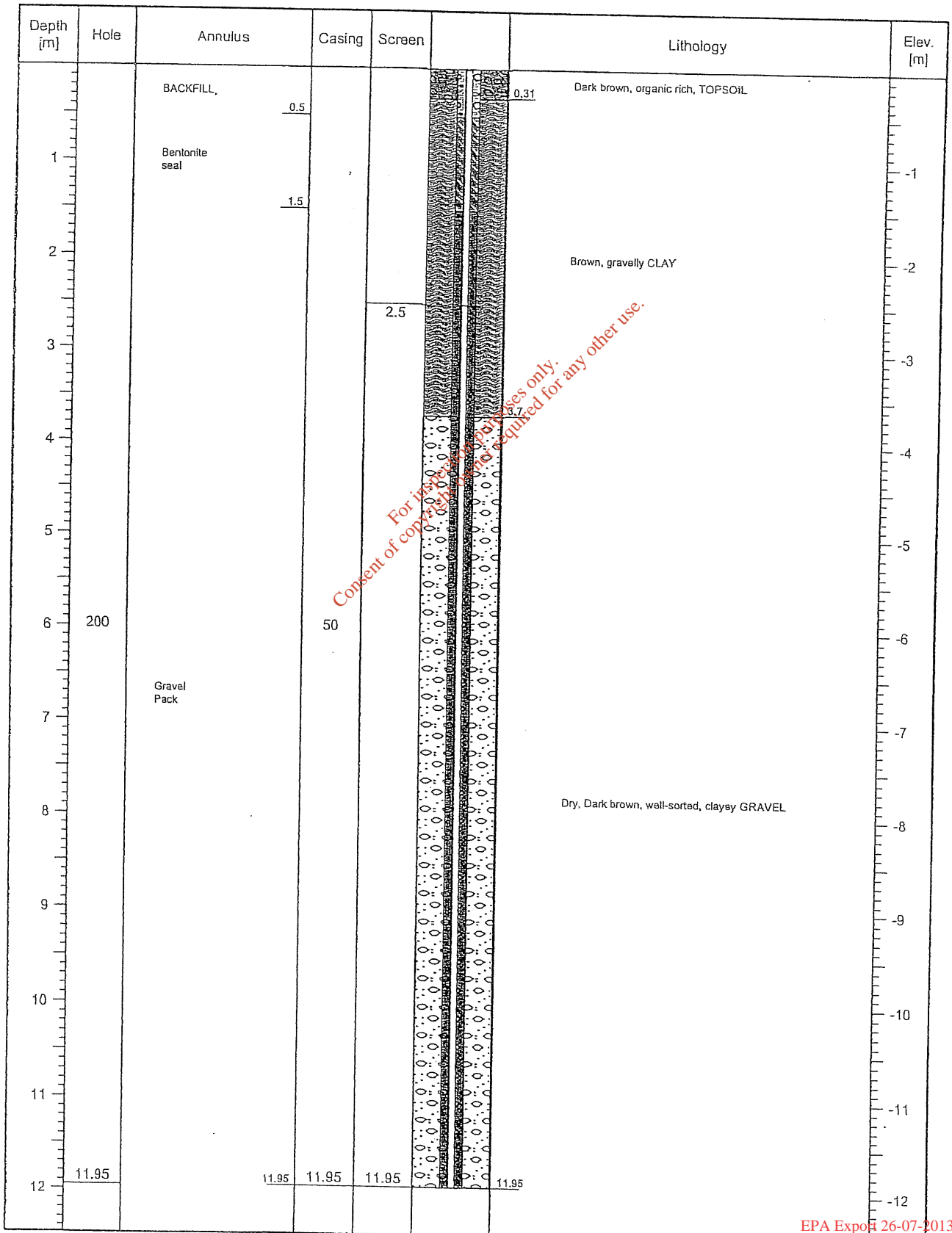
Well No. MW1	Description Overburden well	Client Project Management
Location Carranstown, Duleek		Driller Tom Briody & Son

Date Drilled
2/5/00

Water Level (mbtoc)

All diameters in mm
All depths in metres

<i>Scale</i>	
Vertical 60.0	Horizontal 50.0



WELL LOG

Well No.
MW2

Description
Overburden well

Client
Project Management

Location
Carranstown, Duleek

Driller
Tom Briody & Son

Date Drilled
3/5/00

Scale

Water Level (mbtoc)

All diameters in mm
All depths in metres

Vertical	Horizontal
60.0	50.0

Depth [m]	Hole	Annulus	Casing	Screen	Lithology	Elev. [m]
		BACKFILL, 0.4			Brown organic-rich TOPSOIL	
1		Bentonite seal 1.4				-1
2				2.4	Moist, brown, sticky CLAY with occasional pebbles	-2
3						-3
4						-4
5					4.9 Wet, brown, loose gravelly CLAY	-5
6	150		50		5.5 Wet, grey, gravelly CLAY	-6
7		Gravel Pack			6.7 Brownier CLAY with INFLOW at 7.3m	-7
8					7.3	-8
9						-9
10					Wet, brown, sticky CLAY with pebbles	-10
11						-11
12	12.4	12.4	12.4	12.4		-12

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WELL LOG

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

Date Drilled
3/5/00

Scale

Water Level (mbtoc)

*All diameters in mm
All depths in metres*

Vertical 50.0	Horizontal 40.0
-------------------------	---------------------------

Depth [m]	Hole	Annulus	Casing	Screen	Lithology	Elev [m]
0.5		Bentonite seal			Dark brown organic rich TOPSOIL	-0.5
1			1.1			-1
1.5				1.45		-1.5
2					Medium brown gravelly CLAY ; subangular pebbles	-2
2.5	150		50			-2.5
3		Gravel Pack				-3
3.5						-3.5
4						-4
4.5					Medium well sorted, silty sandy GRAVEL (up to 3cm)	-4.5
5						-5
5.5	5.45		5.45	5.45		-5.5
6						-6
6.5						-6.5
7						-7
7.5						-7.5
8						-8
8.5						-8.5
9						-9
9.5						-9.5
10						-10

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WELL LOG

Well No. MW4	Description Bedrock monitoring Well	Client Project Management
Location Carranstown, Duleek		Driller Tom Briody & Son

Date Drilled
5/4/00

Scale

Water Level (mbtoc)

*All diameters in mm
All depths in metres*

Vertical 150.0	Horizontal 100.0
--------------------------	----------------------------

Depth [m]	Hole	Annulus	Casing	Screen	Lithology	Elev. [m]
		Bentonite seal <u>1</u>				
2					Loose, light to medium brown CLAY; some pebbles	-2
4						-4
6						-6
8					Fine, dark brown clayey GRAVEL	-8
10	200					-10
12		BACKFILL			Loose, dark brown, sandy SILT with pebbles	-12
14						-14
16			50		Well-sorted, subangular GRAVEL	-16
18						-18
20					Sticky, medium brown CLAY	-20
22		Bentonite seal <u>22</u>				-22
24						-24
26	150				Dry, soft brown weathered LIMESTONE	-26
28		Gravel Pack				-28
30	30.1		30.1	30.1	Wet, sticky brown CLAY (Possible fracture infilling)	-30

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Appendix 9.2
Trial Pit Logs

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Trial Pit Records

Project No. : 2175

Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.1

Geology :

- 0 - 0.25 Dark brown organic-rich TOPSOIL
- 0.25 - 0.9 Medium brown silty CLAY with occasional subrounded pebbles.
- 0.9 - 3.0 Fine grained, homogeneous, brown SAND.
- 3.0 - 3.2 Brown BOULDER CLAY with occasional large limestone boulders
- 3.2 - 3.3 Stiff, black BOULDER CLAY

Depth to Rock : >3.3m

Rock Type :

Water Entry : None

Static Water :

Total Depth : 3.3m

Comments : Composite soil samples taken; Dry deposits. No unusual colours or odours noted.

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Trial Pit Records

Project No. : 2175 Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.2

Geology :

- 0 - 0.2 Brown organic-rich TOPSOIL
- 0.2 - 1.1 Medium brown silty CLAY with occasional subangular pebbles.
- 1.1 - 1.6 Medium brown, silty BOULDER CLAY with large limestone boulders
- 1.6 - 3.4 Extremely coarse, clayey GRAVEL deposits (boulders up to 40 - 45cm), with water.

Depth to Rock : >3.4m

Rock Type :

Water Entry : 3.2m

Static Water : 3.2

Total Depth : 3.4m

Comments : Water seen to be flowing in through the gravels. Composite soil sample taken. No unusual colours or odours noted.

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Trial Pit Records

Project No. : 2175 Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.3

Geology :

- 0 - 0.15 Dark brown organic-rich TOPSOIL
- 0.15 - 1.9 Dark brown, moderately well-sorted , dry, clayey, sandy GRAVEL.
- 1.9 - 3.4 Lighter brown, clayey SAND with occasional pebbles up to 3-4cm in size.

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Depth to Rock : >3.4m

Rock Type :

Water Entry : Seepage into the excavation from approx. 1.9m

Static Water :

Total Depth : 3.4m

Comments : Water was seen to be seeping in through the clayey SAND layer.
Composite soil sample was taken. No unusual colours or odours.

Trial Pit Records

Project No. : 2175

Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.4

Geology :

- 0 - 0.15 Brown organic-rich TOPSOIL
- 0.15 - 0.4 Medium brown subsoil.
- 0.4 - 1.25 Loose, light brown, silty, sandy, CLAY with occasional rounded pebbles.
- 1.25 - 3.45 Poorly sorted, subrounded, brown, clayey, sandy, GRAVEL with some black colouration due to presence of shaley fragments.

Depth to Rock : >3.45m

Rock Type :

Water Entry : Gravels moist- Very small amount of seepage.

Static Water :

Total Depth : 3.45m

Comments : Gravel layer collapsing into the hole. No unusual colours or odours noted. Composite soil samples taken.

Trial Pit Records

Project No. : 2175

Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.5

Geology :

- 0 - 0.12 Medium brown organic-rich TOPSOIL
- 0.12 - 1.3 Loose, light brown, sandy CLAY.
- 1.3 - 2.7 Loose, fine grained, homogeneous brown SAND.
- 2.7 - 3.4 Quite stiff, light brown BOULDER CLAY

Depth to Rock : >3.4m

Rock Type :

Water Entry : Water seeping into the hole at approx 2.7m through the bottom of the sands.

Static Water : Not available. Hole filled up with sand.

Total Depth : 3.4m

Comments : Walls of the excavation very unstable and sand collapsing into the hole. No unusual colours or odours noted. Composite soil samples taken.

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Trial Pit Records

Project No. : 2175 Location : Duleek, Co. Meath

Date : 28/4/00

Drilling Method : JCB

Supervisor : Amy Brennan

TRIAL PIT NO.6

Geology :

- 0 - 0.15 Dark brown organic-rich TOPSOIL
- 0.15 - 0.6 Medium brown silty CLAY with only occasional subrounded pebbles.
- 0.6 - 1.85 Grey brown, loose, silty CLAY with boulders up to 25cm in size.
- 1.85 - 3.15 Moderately well sorted, clayey GRAVEL, with occasional large boulders (up to 30cm).

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Depth to Rock : >3.15m

Rock Type :

Water Entry : Spring seen to be flowing into the excavation at approx 1.85m

Static Water : 3.0m and rising

Total Depth : 3.15m

Comments : Spring flowing in from the northern side of the excavation, quite quickly. No unusual colours or odours. Composite soil sample taken.

Trial Pit Records

Project No.: 2175

Location: Duleek, Co. Meath

Date: 28/4/00

Drilling Method: JCB

Supervisor: Amy Brennan

TRIAL PIT NO.7

Geology:

- 0 - 0.3 Dark brown organic-rich TOPSOIL & subsoil
- 0.3 - 0.95 Dark brown, clayey, sandy, SILT with occasional pebbles
- 0.95 - 3.1 Moderately well-sorted, dark brown, sandy, clayey, GRAVEL
- 3.1 - 3.3 Tight, dark brown BOULDER CLAY.

Depth to Rock: >3.3m

Rock Type:

Water Entry: None

Static Water:

Total Depth: 3.3m

Comments: Composite soil samples taken; Dry deposits. No unusual colours or odours noted.

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Appendix 9.3
Geotechnical Report

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**GEOTECHNICAL
REPORT**

FOR

GREEN FIELD SITE

AT

PLATIN, Co. MEATH

FOR

PROJECT MANAGEMENT LTD.

Alpha Engineering Services
Consulting Engineers, Land Surveyors
March 2000
A228

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REPORT ISSUE

Report Title: Draft Geotechnical Report For Green Field Site at Platin, Co. Meath for Project Management.

Issue No.	Date	Checked	Passed
1 (Draft)	February 2000	MAL	
2	March 2000	MAL	

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Alpha Engineering Services
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Tel 01 4563362, Fax 01 4563372, e-mail: alphaeng@iol.ie

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- 1.0 INTRODUCTION
- 2.0 SITE INVESTIGATION
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 - 2.2 Stratigraphy
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 - 3.1 Foundations
 - 3.2 Slabs
 - 3.3 Groundwater
- 4.0 FURTHER SITE INVESTIGATION

Drawing A228 - 02 – Site Investigation Locations

Appendix A – Trial Pit Logs

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1.0 INTRODUCTION

Alpha Engineering Services (AES) have been requested by Project Management Ltd. to carry out a site investigation at a green field site in Platin, Co. Meath. The total area investigated is approximately 45 acres, which is subdivided into 6 fields.

The site investigation was carried out on the 22nd January 2000 and consisted of excavating fifteen trial pits. This report details the findings of the site investigation along with making a number of geotechnical recommendations.

The trial pits were excavated on the 24th January 2000 using a 13 tonne excavator and were logged by a geotechnical engineer from Alpha Engineering Services.

2.0 SITE INVESTIGATION

2.1 Introduction

15 No. trial pits were excavated on the site at the locations indicated on Drawing No. A228-02. All ground stratas revealed in the trial pits were classified in accordance with BS 5930 "British Standard Code of Practice for Site Investigation". The trial pit logs are represented in Appendix A.

The site is bounded to the north by a railway embankment, to the west by a small side road and the south by the R152 road.

A gas pipe is located through the centre of the site. In order to avoid the pipe, trial pits were not excavated within 25m of the pipeline.

Topographical levels on the site were noted to vary from approximately 34 mOD in the north west corner of the site to 43 mOD in the south east corner of the site. Topographical low points of 32 mOD were noted in the centre and the south east corner of the site.

2.2 Site Stratigraphy

The trial pits were examined by a Geotechnical Engineer from AES. The stratigraphy varied across the site but generally consisted of topsoil overlaying brown boulder clay on a clayey gravel layer which was in turn underlain by a black boulder clay. Bedrock was noted to be carboniferous limestone. In both the gravel and clay layers large boulders up to 600mm in diameter were noted. A summary of the stratigraphy is presented in Table 1 below.

STRATUM	Depth (m bgl)
TOPSOIL	0 – 0.4
Soft to firm brown silty CLAY with cobbles.	0.4 – 1.0
Firm to hard brown silty CLAY with cobbles and large boulders (Brown boulder clay).	0.4 – 4.0
Medium dense to dense sandy GRAVEL approximately 1m in depth with local sand lenses	0.4 – 5.0
Hard black silty CLAY cobbles and large boulders (Black boulder clay)	2.5 – 4.0

Table1 – Summary of Ground Stratigraphy Revealed by the Site Investigation

2.3 Brown Boulder Clay

In TP No.'s 1, 2, 5, 6, 7, 8, 9 & 12 a soft to firm brown silty clay was noted to a maximum depth of 0.9 m bgl, directly under the topsoil.

The brown boulder clays which underlay the upper soft to firm layer were noted as being firm to stiff silty gravelly low plasticity clays, with a high cobble and boulder content. The undrained shear strength of the clay was estimated to be in the order of 50kPa to 100kPa.

In TP 8 a soft clay layer was noted between 1.5mbgl and 2.6mbgl. The material was of low strength while significant side collapsing of the sides of

the pit and ground water seepage were noted. In TP 14 adjacent to TP 8 a similar soft sandy clay was noted to extend from 2.4 to 4.4 mbgl however collapsing was not as significant and ground water ingress was not noted.

In TP 11 a soft clay with large boulder clay was noted to extend from 2.0 to 2.7 mbgl.

2.4 Gravel

Gravel layers were noted to underlay the brown boulder clay layer in all trial pits excluding TP No.'s 1, 2, 4, 10 & 11.

The gravels were generally noted as a competent medium dense to dense sandy clayey gravels with large boulders. Intermittent localised sand lenses typically in the order of 100 – 200mm were also noted. In TP 15 2m of loose sand was noted from 1.5m bgl.

The gravels were generally noted to be dry and stable with only moderate localised seepage occurring in some trial pits (TP 16). However, it is noted that trial pits were generally were not left over for a significant length of time, typically in the order of 15 – 25 minutes.

TP 13 was left open for five hours and significant ground water seepage was noted, localised failure of side slopes had occurred.

2.5 Black Boulder Clay

The black boulder clay stratum was noted in trial pits No.'s 1, 2, 5, 6, 8 & 15.

The black clay layer was noted to be a hard silty gravelly clay with cobbles and large boulders.

As with the brown clay it was described as a low plasticity clay while the undrained strength is estimated to be in the order of 75kPa to 150kPa.

2.6 Bedrock

Refusal was noted at shallow depth in trial pit No. 4 and No. 10 at 2.6 and 2.2m bgl respectively. From a visual inspection the refusal was attributed to the presence of limestone bedrock (rather than large boulders).

3.0 RECOMMENDATIONS

3.1 Excavation

Excavations of subsoils, to the depth investigated by the trial pits, will not require any extraordinary means. Use of conventional excavation plant will be sufficient. However, the presence of large boulders (diameter greater than 0.5m) could make excavation more difficult and slower than would be normally expected in such materials. Also, the preparation of formations may prove more difficult because of the presence of the boulders.

The trial pits were generally noted to be stable. However, when TP 5 was left open for five hours localised collapsing was noted. In TP No.'s 8 and 14 immediate collapsing was noted during excavation. It should be assumed, therefore, that excavations will require temporary support or the side slopes to be graded at a safe angle. Typical side slopes in the clayey subsoils encountered during the excavation would be 1.0 vertical to 1.5 horizontal for temporary slopes and 1.0 vertical to 2.0 horizontal for permanent slopes. Any gravel encountered should be graded at 1.0 vertical to 2.0 horizontal in the temporary and permanent condition.

It is noted that the depth to bedrock is suspected to be shallow in a number of places across the site (TP 4 and TP 10). Therefore if deep excavations are required (for drainage pipes or localised lift pits etc.) it is recommended that the depth and integrity of the rock is proven by rotary coring.

3.2 Foundations

Given the variation in the upper layers of the brown clays noted in Section 2 the preferable foundation option is pad foundations bearing 1.5 onto the brown boulder clay stratum. It is noted that in some trial pits (TP 9 and TP 15), given the shallow depths of the gravel stratum, foundations will be required to be founded on the same. The gravels typically are dense enough to provide adequate bearing capacity for shallow foundations. However, if the

site layout means that building will be founded on both strata (gravels and clays), pads should be designed such as to prevent differential settlement occurring.

A net allowable bearing pressure for sizing foundations would be 200kPa based on a steel frame building while for concrete buildings a bearing of 150kPa should be used.

In TP 3 a localised soft spot was noted between 2.0 and 2.7m bgl. It is recommended, therefore, that some contingency is allowed for extending structural pads deeper than such soft spots using leanmix. Foundation formations should be inspected by suitably qualified engineers to detect such layers. It is also recommended that further investigation (Dynamic Loads or similar) are carried out to confirm that such soft spots do not exist in other areas of the site. The probes should also be carried out in the location of Trial Pit 15, to confirm the extent and density of the sand stratum noted, to confirm the above bearing pressure are acceptable in this stratum.

In the area of TP 8 and TP 14 given the presence of low quality clays and sand, a suitable formation level for foundations would be in the order of 4m bgl making pad foundations impracticable. Pile foundations would most likely be the most cost effective and technically suitable solution.

Typically, allowable working of various driven piles are provided below:

<u>Pile size (mm x mm)</u>	<u>Design Load Capacity (kN)</u>
350 sq.	1300
300 sq.	900
250 sq.	600

It is recommended more detail site investigation is carried out in the area to confirm the ground conditions.

The brown and black clay layers would be very susceptible to moisture and will degrade if over exposed to water. Therefore all excavations should be kept as dry as possible and all formations blinded immediately when excavated.

3.3 Slabs

All topsoil and subsoil layers should be removed in the areas of all slabs and carparks.

The upper soft to firm clay layer is most likely not competent enough to support ground bearing slabs and trafficed areas. CBR tests should be carried out to confirm the consistency of these upper clay layers and if a capping layer/geotextile can be employed to avoid removing these layers. A contingency should be allowed for the removal and backfilling of soft spots.

The underlying firm brown boulder clay will be more than competent to support ground bearing slabs and trafficed areas.

It is noted that the upper soft to firm clays would be susceptible to temporary construction traffic and therefore sufficiently deep haul roads should be employed to prevent the permanent formation to be disturbed.

3.4 Groundwater

Groundwater was generally encountered in small quantities. However in TP No. 8 significant seepage was noted. Therefore any excavations in this area will mostly require de-watering methods (pumps etc.) to control groundwater.

3.5 Earthworks

From a visual inspection of the gravels and clays on site, it is estimated that reuse of excavated subsoils as fill under flexibly finished trafficed areas would be acceptable if finished floor/carpark levels result in significant cut and fill volumes.

However given the cost implication of overestimating the strengths of subsoils for reuse, it is recommended that detail classification tests are carried out if this is anticipated.

The upper soft to firm clay would only be suitable for reuse in soft landscape areas.

APPENDIX A – TRIAL PIT LOGS

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Alpha		Alpha Engineering Services Site Investigation Field Report		Job No:	A228			
				Name	DW			
Job Title:		Platin S I Client: P M		Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples				
				Type	Depth	Ref	Ms %	
	Topsoil/Subsoil		0.4					
	Soft Brown CLAY		0.9					
	Firm becoming very stiff brown silty CLAY with cobbles and large boulders		2.8					
	Very stiff to hard black CLAY with cobbles and boulders							
	End of Trail Pit		3.8					
Remarks	Trial Pit Stable, Minor Seepage at			Trial Pit No.		1		
Equipment	1.1m bgl							
Personnel	15 Tonne Excavator							

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Alpha	Alpha Engineering Services Site Investigation Field Report			Job No:	A228			
				Name	DW			
Job Title: Platin S I Client: P M			Date:	24.01.00				
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples				
				Type	Depth	Ref	Ms %	
	Topsoil		0.5					
	Soft Brown CLAY		0.7					
	Firm brown silty CLAY with some cobbles		1.8					
	Stiff brown silty CLAY with some cobbles		2.3					
	Firm to stiff Brown Sandy SILT		4.0					
	Hard black silty CLAY with boulders		4.3					
Remarks	Pit Stable and No Seepage			Trial Pit No.		2		
Equipment								
Personnel								

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Alpha	Alpha Engineering Services Site Investigation Field Report			Job No:	A228			
				Name	DW			
Job Title:			Platin S I	Client:	P M			
				Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples				
				Type	Depth	Ref	Ms %	
	Topsoil		0.3					
	Firm Brown silty CLAY with cobbles		1.0					
	Firm brown silty CLAY with lots of cobbles and boulders		1.6					
	Medium dense clayey GRAVEL with cobbles and boulders.		3.0					
	Medium dense silty Sand		3.1					
	Dense clayey GRAVEL with cobbles and boulders							
	Medium dense brown clayey SAND							
Remarks	Pit Dry and Stable			Trial Pit No. 3				
Equipment	15 Tonne Excavator							
Personnel								

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Alpha		Alpha Engineering Services Site Investigation Field Report			Job No:	A228				
					Name	DW				
Job Title:				Platin S I Client: P M		Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples						
				Type	Depth	Ref	Ms %			
	Topsoil		0.3							
	Firm brown silty CLAY with cobbles and boulders		1.0							
Hard Digging	As above but becoming stiff with depth and size of boulders increasing		2.3							
	REFUSAL: PRESUMED BEDROCK									
Remarks	Pit Dry and Stable				Trial Pit No.					
Equipment					4					
Personnel										

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Alpha		Alpha Engineering Services Site Investigation Field Report			Job No:	A228			
					Name	DW			
Job Title:		Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples					
				Type	Depth	Ref	Ms %		
	Topsoil		0.3						
	Soft to firm brown CLAY		0.7						
	Firm brown CLAY with cobbles and boulders		0.9						
Hard Digging	Dense clayey GRAVEL with cobbles and large boulders		2.1						
	Very dense clayey GRAVEL with cobbles and large boulders		2.7						
	Very dense GRAVEL with cobbles and boulders		4.0						
	Hard Black Silty CLAY with cobbles and boulders		4.5						
Remarks	TP open for 6 hours, Pit dry with			Trial Pit No.					
Equipment	Local Collapsing								
Personnel	15 Tonn Excavator								
				5					

Alpha		Alpha Engineering Services Site Investigation Field Report		Job No:	A228			
				Name	DW			
Job Title:		Platin S I Client: P M		Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples				
				Type	Depth	Ref	Ms %	
	Topsoil		0.3					
	Soft to firm brown CLAY		0.7					
	Firm brown silty CLAY with cobbles and boulders		1.4					
	Medium Dense brown silty SAND		1.8					
	Stiff brown silty CLAY with cobbles and boulders		2.5					
	As above but "Very Stiff"		3.0					
Hard Digging	Hard black silty CLAY with cobbles and boulders		3.8					
Remarks	Trial Pit Stable, No Seepage			Trial Pit No.				
Equipment								
Personnel				6				

Alpha		Alpha Engineering Services Site Investigation Field Report			Job No:	A228			
					Name	DW			
Job Title:		Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples				
					Type	Depth	Ref	Ms %	
	Topsoil			0.4					
	Firm brown CLAY with cobbles			1.3					
	Sandy SILT			1.4					
	Stiff brown CLAY with cobbles and boulders			2.0					
	Clayey Sand Medium Dense			2.4					
Hard Digging	Dense clayey GRAVEL with cobbles and large boulders			3.9					
	Very dense clayey GRAVEL with cobbles and boulders			4.5					
Remarks	Trial Pit Dry and Stable				Trial Pit No.		7		
Equipment									
Personnel									

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Alpha	Alpha Engineering Services Site Investigation Field Report			Job No:	A228			
				Name	DW			
Job Title: Platin S I Client: P M			Date:		24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples				
				Type	Depth	Ref	Ms %	
	Topsoil		0.3					
	Soft to firm brown CLAY		0.7					
Pit Collapsing at this depth. A lot of Seepage	Soft brown silty CLAY with cobbles and boulders		2.6					
Moderate Seepage	Dense brown silty sandy GRAVEL with cobbles and boulders		3.8					
Significant Seepage	Dense brown silty sandy GRAVEL with cobbles and boulders - a lot of seepage		4.3					
	Hard black Silty CLAY							
Remarks	Pit Unstable - Collapsing			Trial Pit No.		8		
Equipment								
Personnel								

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Alpha		Alpha Engineering Services Site Investigation Field Report		Job No:	A228			
				Name	DW			
Job Title:		Platin S I Client: P M		Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples				
				Type	Depth	Ref	Ms %	
	Topsoil		0.3					
	Soft to firm brown CLAY		0.7					
Pit Collapsing at this depth. A lot of Seepage	Soft brown silty CLAY with cobbles and boulders		2.6					
Moderate Seepage	Dense brown silty sandy GRAVEL with cobbles and boulders		3.8					
Significant Seepage	Dense brown silty sandy GRAVEL with cobbles and boulders - a lot of seepage		4.3					
	Hard black Silty CLAY							
Remarks	Pit Unstable - Collapsing			Trial Pit No.				
Equipment								
Personnel								
				8				

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Alpha		Alpha Engineering Services Site Investigation Field Report		Job No:	A228			
				Name	DW			
Job Title:		Platin S I Client: P M		Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples				
				Type	Depth	Ref	Ms %	
	Topsoil		0.3					
	Soft Brown CLAY		0.7					
	Sorf to firm brown CLAY with cobbles and boulders		1.4					
Hard Digging	Dense Slightly clayey GRAVEL with cobbles and boulders		2.8					
Hard Digging	Very dense slightly clayey GRAVEL with cobbles and boulders		3.1					
	Very Dense Clean GRAVEL with cobbles and boulders		3.7					
	END							
Remarks	Trial Pit Stable: Local			Trial Pit No. 9				
Equipment	Collapsing and Dry							
Personnel								

Alpha	Alpha Engineering Services Site Investigation Field Report		Job No:	A288			
			Name	DW			
Job Title:		Platin S I Client: P M		Date:	24.01.00		
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples			
				Type	Depth	Ref	Ms %
	Topsoil		0.3				
	Firm brown CLAY with cobbles		0.8				
Hard Digging	Stiff brown CLAY with lots of boulders and cobbles		2.2				
	REFUSAL: Possibly bedrock						
Remarks	Pit Dry and Stable		Trial Pit No.		10		
Equipment							
Personnel							

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Alpha		Alpha Engineering Services Site Investigation Field Report			Job No:	A288			
					Name	DW			
Job Title:		Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples					
				Type	Depth	Ref	Ms %		
	Topsoil		0.3						
	Firm brown CLAY with cobbles and boulders		1.2						
	Hard brown boulder CLAY with cobbles		1.6						
	Loose to medium dense clayey SAND		2.0						
Pit Collapsing	Soft to firm brown CLAY with cobbles		2.7						
Hard Digging	Hard brown boulder CLAY with cobbles and boulders		3.5						
Remarks	Pit Dry				Trial Pit No.		11		
Equipment									
Personnel									

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Alpha		Alpha Engineering Services Site Investigation Field Report			Job No:	A288			
					Name	DW			
Job Title:		Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples					
				Type	Depth	Ref	Ms %		
	Topsoil		0.4						
	Soft to firm brown CLAY with cobbles		0.8						
	Firm brown sandy CLAY with cobbles and boulders		1.6						
	Firm brown sandy CLAY with cobbles and boulders		2.1						
	Stiff brown silty CLAY with cobbles and boulders		2.7						
Hard Digging	Very dense clayey GRAVEL with cobbles and boulders		4.5						
Remarks	Trial Pit Dry and Stable				Trial Pit No.				
Equipment					12				
Personnel									

Alpha		Alpha Engineering Services Site Investigation Field Report			Job No:	A288			
					Name	DW			
Job Title:		Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples					
				Type	Depth	Ref	Ms %		
	Topsoil		0.4						
	Soft to firm CLAY		0.8						
	Firm brown CLAY with cobbles and boulders		1.8						
	Stiff brown CLAY with cobbles and boulders		2.6						
	Firm brown CLAY with cobbles and boulders		3.4						
	Dense clayey GRAVEL wth cobbles and boulders		4.4						
	Hard brown silty CLAY								
Remarks					Trial Pit No.		13		
Equipment									
Personnel									

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Alpha		Alpha Engineering Services Site Investigation Field Report		Job No:	A288			
				Name:	DW			
Job Title:		Platin S I Client: P M		Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples				
				Type	Depth	Ref	Ms %	
	Topsoil		0.3					
	Soft to firm CLAY		0.7					
	Firm brown CLAY with cobbles and boulders		1.4					
	Stiff brown CLAY with cobbles and boulders		2.4					
Sides Collapsing	Soft sand CLAY with cobbles		4.4					
	Hard black boulder CLAY							
Remarks	Pit Collapsing - Minor Seepage			Trial Pit No.		14		
Equipment								
Personnel								

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Alpha		Alpha Engineering Services Site Investigation Field Report		Job No:	A288			
				Name	DW			
Job Title:		Platin S I Client: P M		Date:	24.01.00			
Remarks	Description Of Strata	Level (mOD)	Depth (m)	Samples				
				Type	Depth	Ref	Ms %	
	Topsoil		0.45					
	Soft brown CLAY		0.70					
Sides Collapsing	Loose to medium dense grey SAND. No clay content		3.0					
	Medium dense GRAVEL with boulders and cobbles		4.0					
Hard Digging	Hard brown silty CLAY							
Remarks				Trial Pit No.				
Equipment								
Personnel				15				

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Alpha		Alpha Engineering Services Site Investigation Field Report			Job No:	A288			
					Name	DW			
Job Title:		Platin S I Client: P M			Date:	24.01.00			
Remarks	Description Of Strata		Level (mOD)	Depth (m)	Samples				
					Type	Depth	Ref	Ms %	
	Topsoil			0.3					
	Soft to firm brown CLAY with cobbles			0.8					
	Firm brown CLAY with cobbles			1.2					
	Stiff brown CLAY with cobbles			1.4					
Hard Digging	Very stiff sandy gravelly CLAY with cobbles and large boulders			2.6					
Hard Digging and Sides Collapsing	Dense clayey GRAVELS with cobbles and boulders			3.5					
Remarks	Sides Collapsing - Minor Seepage				Trial Pit No.		16		
Equipment	at 24m bgl								
Personnel									

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Appendix 9.4
Puratio Report

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	Original to File No: 002666.21.001
Date:	09 JAN 2001
Copy to:	J. Cavanaugh.
Action:	

**Report on the Suitability of a
Site for the Installation
of a Puraflo™ System at
Carranstown, Co Louth.**

December 2000

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Prepared by:

**K.T. Cullen & Co. Ltd.,
Hydrogeological & Environmental Consultants,
Bracken Business Park,
Bracken Road,
Sandyford Industrial Estate,
Dublin 18.**



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2.2	Trial Pits	1
2.3	Percolation Pits	2
3.	Conclusions	3
4.	Recommendations	3

Figures

Figure 1: Site Location

Figure 2: Design of the Percolation Pits as recommended by the EPA Wastewater Treatment Manual.

Appendix

Appendix A: Trial Pit Logs





K.T.Cullen & Co. Ltd.

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EMAIL: INFO@KTCULLEN.IE



Report on the Suitability of a Site for the Installation of a Puraflo™ System at Carranstown, Co. Louth.

1. Introduction

K.T Cullen & Co. were requested by Project Management to carry out trial pitting and percolation tests at a site in Carranstown Co. Louth. The purpose of the work was to assess the suitability of the site for the installation of a Puraflo™ system with associated septic tank and percolation area. The system was designed to cater for a maximum of 100 people.

2. Field Work

2.1 On Site Assessment

The site is underlain by limestone bedrock. No outcrops, springs or karst features were seen at the site. Monitoring wells and trial wells drilled at the site in May 2000 indicate relatively deep overburden deposits varying from approximately 5 metres to 21 metres of clays and gravels. The water table in one of these boreholes (MW1) was measured as being approximately 10.5 metres below the ground level at the time of trial pitting (12/12/00).

The field in which the work was carried out has a shallow ditch to the south-east which had water in it at the time of trial pitting. Prior to fieldwork, the weather in general had been extremely wet and parts of the field near the ditch were experiencing ponding of surface water.

The site is presently under grass and apart from the localised ponding appears to be well-drained. The brown/red colour of the subsoil would also indicate a well-drained site.

2.2 Trial Pits

Two trial pits were dug at the site of the proposed percolation area. The trial pit logs are shown in Appendix A and their location is shown in Figure 1. The trial pits were excavated to a depth of 2.8 m and 3 m respectively. Both encountered similar overburden deposits-1.2-1.8 m of boulder clay and then

a clayey gravel which became more gravelly with depth. No seepages were encountered during the digging and after 48 hours, no water had entered the hole.

2.3 Percolation Pits

Four percolation pits were dug at the site of the proposed percolation area. The top 0.30 metres of soil was removed at the location of each of the four pits by the JCB. 0.30 metres was chosen as this is the depth at which effluent will be introduced to the soil according to Puraflo™ Agrément Certificate 97/00060. The pits were then dug in these depressions with in accordance to dimensions specified in the EPA's Wastewater Treatment Manuals. The percolation pits measured 0.3 m by 0.3 m and were completed at a depth of 0.4 m-approximately 0.7 m below the ground surface.

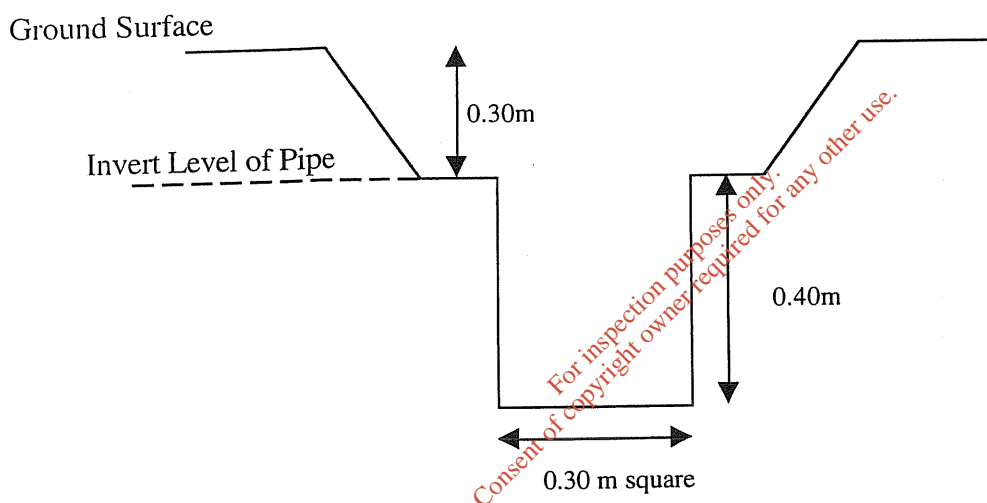


Figure 2: Design of the Percolation Pits as recommended by EPA Wastewater Treatment Manual.

The sides of the percolation pits were scored with a trowel and filled with water to simulate fully saturated soil conditions. The pits were then left overnight to soak.

On the following day the water had still not drained completely out of the holes even though it had dropped in each of them. The holes were refilled to a depth of 0.30 m with water, in order to assess the time taken for the water level to drop 0.1 m (100 mm). After 4 hours the water level had dropped 0.04 m in Percolation Pits 1 and 4, 0.01 m in Percolation Pit 2 and 0 m in Percolation Pit 3. This would give a minimum T value of 150.



3. Conclusions

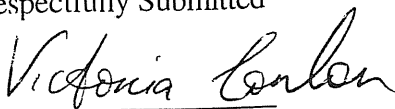
The site has failed the percolation test as the T value obtained was greater than 50 (EPA Wastewater Manual). This is due to the presence of clays beneath the site which had become highly saturated during the recent bad weather.

The water table at the site is not high and no seepages were seen in the trial pits.

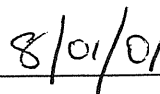
4. Recommendations

- We would recommend, in accordance with EPA Guidelines, that the site be engineered to meet the required specifications. This will involve the removal of the existing overburden material over an area of 300 m² and the importing of material with a suitable T value-preferably a fine sand or clayey sand with a T value of between 5 and 15. The imported soil can be placed in layers 0.3 m thick and each layer should be compacted lightly prior to the adding of the next layer. Percolation tests should be carried out on every 0.3 m thick layer. The depth of the fill should be approximately 2 metres to allow at least 1 m between the lowest level of a percolation trench (0.7 m below ground level) and the original soil level. This is a total volume of material of 600 m³. Once the overburden material is in place a full percolation test should be carried out. A reserve percolation area should also be constructed in the event of the main area malfunctioning.
- Alternatively, a sand filter could be constructed with associated polishing filter. The loading rate on this constructed filter is recommended to be 50 l/m²/day. The advantage of this type of sand filter is that it takes up considerably less area than the trenched percolation area. The disadvantages are that a polishing filter is necessary and pumping of wastewater might be needed to transfer effluent from the sand filter to the polishing filter. Sand filters are used in conjunction with septic tanks in soil which is unsuitable for conventional percolation areas. The filter system consists of 600-900 mm of graded sand underlain by 200 mm of gravel. The filter system is overlain by the natural topsoil but is separated from it by a geotextile membrane. The wastewater is treated by moving through the sand filter and can then be directed under gravity or pumping to a final polishing filter. (EPA Wastewater Treatment Manual).

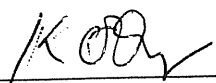
Respectfully Submitted



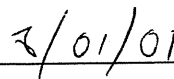
Victoria Conlon B.Sc.M.Sc.



Date



Kieran O Dwyer BE MIEI

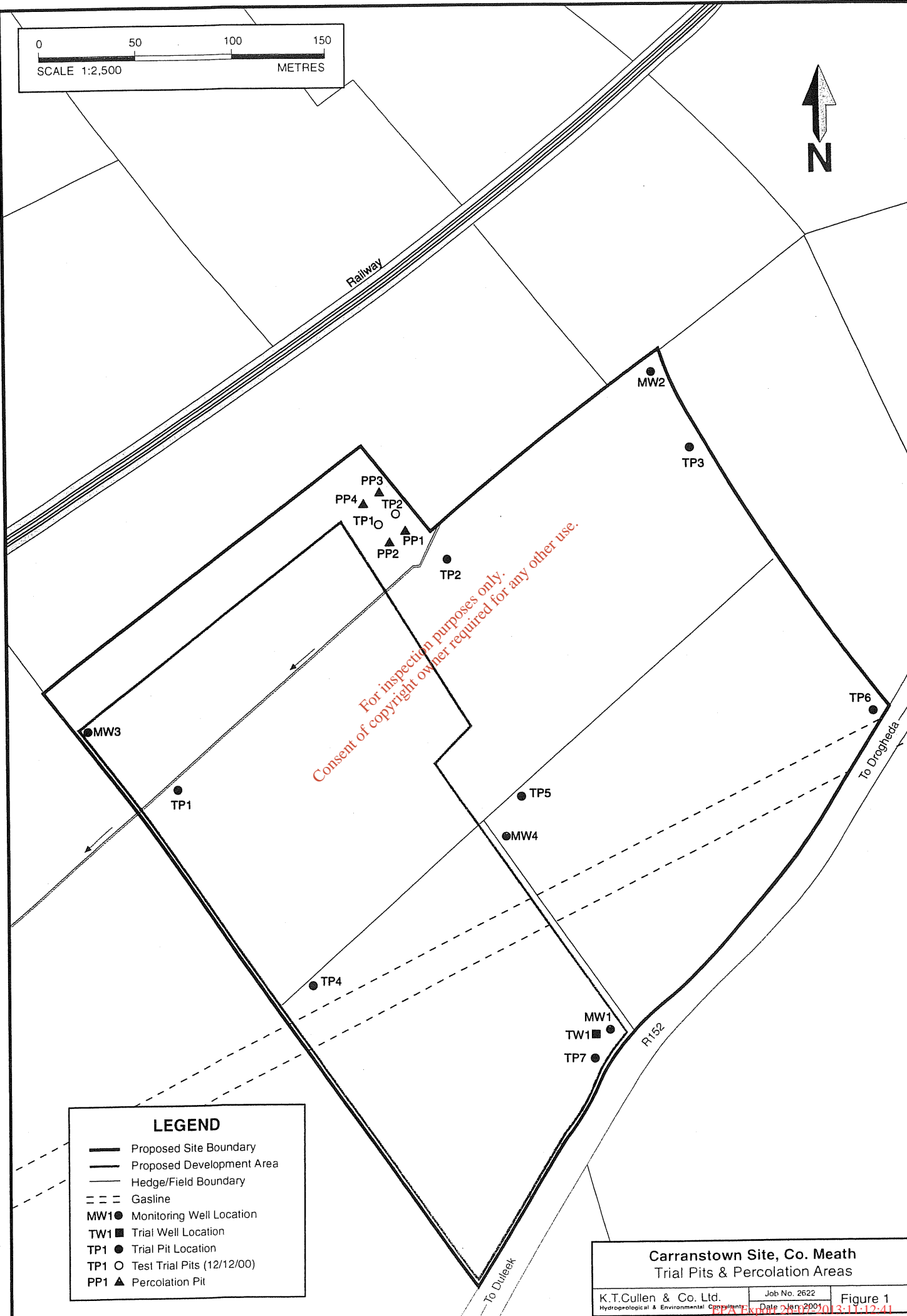
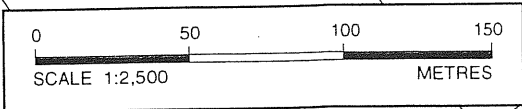


Date



FIGURE

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LEGEND	
	Proposed Site Boundary
	Proposed Development Area
	Hedge/Field Boundary
	Gasline
MW1 ●	Monitoring Well Location
TW1 ■	Trial Well Location
TP1 ●	Trial Pit Location
TP1 ○	Test Trial Pits (12/12/00)
PP1 ▲	Percolation Pit

Carranstown Site, Co. Meath Trial Pits & Percolation Areas		
K.T.Cullen & Co. Ltd. Hydrogeological & Environmental Consultants	Job No. 2622 Date: Jan 2001	Figure 1 EPA Expt 2577-2013-11-12-41

APPENDIX A

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Trial Pit Records

Project No. : 2622

Location : Carranstown Duleek

Date : 12/12/00

Drilling Method : JCB

Supervisor : VC

TRIAL PIT NO. 1

Geology :

0 - 0.1 Grass and Topsoil

0.1 - 1.8 Light Brown Silty BOULDER CLAY with pebbles and cobbles

1.8-2.8 Light Grey Clayey Sandy GRAVEL with well rounded boulders, becoming more gravelly with depth.

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Depth to Rock : >2.8

Rock Type : None Encountered

Water Entry : None Encountered

Static Water : None after 48 hours

Total Depth : 2.8 metres

Elevation

Comments : N/A

K.T.Cullen & Co. Ltd.

Hydrogeological & Environmental Consultants

Trial Pit Records

Project No. : 2622

Location : Carranstown Duleek

Date : 12/12/00

Drilling Method : JCB

Supervisor : VC

TRIAL PIT NO. 2

Geology :

- 0 - 0.1 Grass and Topsoil
- 0.1 - 1.2 Light Brown Silty BOULDER CLAY with pebbles and cobbles
- 1.2 - 3.0 Light Grey Clayey, Sandy GRAVEL with well rounded boulders, becoming more gravelly with depth. Mostly limestone boulders

Depth to Rock : >3 metres

Rock Type : None Encountered

Water Entry : None Encountered

Static Water : None after 48 hours

Total Depth : 3 metres

Elevation

Comments :

10 GROUNDWATER / HYDROGEOLOGY

10.1 INTRODUCTION

The information regarding the existing hydrogeological environment is based on investigations completed at the site in 2000 and 2001, a desk study and the Geological Survey of Ireland database.

10.2 OVERBURDEN HYDROGEOLOGY

The development site is underlain by a thick deposit of low permeability brown silty clays.

The vulnerability of the entire proposed site has been classified by the Geological Survey of Ireland (GSI) as Moderate (Figure 10.1).

The boulder clay varies in thickness across the site, ranging from 5.0 metres towards the west of the site, to greater than 20 metres towards the centre.

10.3 BEDROCK AQUIFER

As detailed in Section 9, the limestones found beneath the development site are part of the Platin Formation. The grey limestone which was weathered at the surface was proven by borehole drilling at the site. The limestone is typical of the Lower Carboniferous shallow water limestones. These are typically pale thick-bedded with minor shales, possible dolomitised, with palaeokarstic features (GSI Sheet 16 and Meath Groundwater Protection Scheme). The Platin Formation has been classified by the GSI as; *regionally important, diffuse karst aquifer, good development potential (Rkd)* (Figure 10.2). This classification was determined by the GSI in 2004. This regionally important aquifer displays both karst and fracture flow features.

The karstic nature and productivity of the Platin Formation are demonstrated at the nearby Platin Quarry where a significant dewatering operation is required to maintain dry working conditions at the quarry floor.

The development site is located within the local groundwater regime which is now largely determined by the Platin Quarry dewatering programme.

10.4 Aquifer Vulnerability and Resource Protection

The GSI/EPA/DoEHLG Groundwater Protection Scheme Classification (see table below) ranks the site as having a moderate (M) vulnerability due to the thickness and type of overburden cover present at the site.

Table 10.1 GSI Vulnerability Mapping Guidelines.

Vulnerability Rating	Hydrogeological Requirements (below the point of release of contaminants)				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Recharge Type
	high permeability (sand/gravel)	moderate permeability (sandy till)	low permeability (clayey till, clay, peat)	(sand & gravel aquifers <u>only</u>)	
Extreme	0-3.0m	0-3.0 m	0-3.0m	0-3.0m	point (<30 m radius)
High	>3.0	3.0-10.0m	3.0-5.0m	>3.0m	N/A
Moderate	N/A	>10m	5.0-10.0m	N/A	N/A
Low	N/A	N/A	>10.0m	N/A	N/A

Notes: i) N/A =not applicable

ii) Precise permeability values cannot be given at present

iii) Release point of contaminants is assumed to be 1-2 m below ground surface

(from Daly & Warren 1997)

Figures 9.2 and 9.3 present the location of the soil borings and trial pits across the site together with lines of cross section. The lines of cross section are presented on Figure 10.3 and show schematically that the shallow geology across the site comprises boulder clays for the most part with some discontinuous lenses of silts and gravels. In addition, percolation testing was undertaken at the site which measured extremely low percolation rates due to the presence of these clays.

10.4.1 Assessment of Resource Protection Zonation

As the bedrock is considered Regionally important, and the soil cover varies from 5 metres in thickness to at least 20 metres in thickness, the site is assigned a rating of Regionally important-moderate (Rk/M) under the GSI classification system for designating resource protection zones.

Response levels have been developed for three polluting activities (septic tanks, landspreading and landfills) using this matrix of resource protection zones. Based on the risk involved in each of these potentially polluting activities, they are either acceptable, acceptable subject to conditions, not acceptable with some exemptions or not acceptable. There is no response level developed for waste-to-energy facilities.

10.5 GROUNDWATER FLOW

Groundwater flow beneath the development site is now determined by cone of depression centred on the Platin excavation (see Figures 10.3 and 10.4). Prior to the quarry development, the groundwater flow beneath the development site would have been towards the River Nanny and in a general south easterly direction.

Today, the groundwater flow beneath the development site has been reversed and is now northwards towards the nearby Platin quarry due to the lowering of the water table within the excavation.

The groundwater abstracted from the excavation is piped directly to the River Nanny and so there is no loss of groundwater to this river. In fact there is a small increase due to the Platin excavation drawing some groundwater from the Boyne River catchment.

Details of the wells completed on the development site and the results of a pump test are provided in Appendix 9.1 and 10.1 respectively.

10.6 GROUNDWATER ABSTRACTIONS

Groundwater is extensively used by the local community as a source of water supply. A GSI well search revealed 22 recorded wells within 3km of the proposed site (see Table 10.1 for well data).

10.6.1 On Site Groundwater Abstraction

Following the installation of trial wells at the site, it is intended to install a production well from which the water requirements of the site will be supplied.

Trial wells have been drilled on the site and one of the trial wells, TW1, was tested to assess the available sustainable yield. The pumping test indicated that a yield in the order of 300m³/d could be sustainably abstracted from a well at the site.

The production well will be drilled adjacent to TW1. The well will be drilled using an air-rotary rig and will take 3-4 days to complete. The target depth of the well is 75m. The well will be initially opened at 200mm (8") and steel casing will be grouted several metres into bedrock. The grout cement will take 24 – 48 hours to set. Bedrock was encountered at 14.3m bGL in TW1. Once in bedrock the well will be drilled on at 150mm (6"). PVC well screen will be installed adjacent to any water bearing zones to facilitate the ingress of water and PVC well casing will be installed elsewhere in the well. The PVC casing/screen will have a closed bottom and will be placed centrally in the hole.

It will be necessary to develop the well with compressed air for a period of at least 3 hours once the drilling is completed.

10.7 SITE SELECTION

The proposed facility is for the treatment of non hazardous waste however it should be noted that the WHO publication *Site Selection for New Hazardous Waste Management Facilities* have been incorporated as one aspect of the site selection process for the proposed facility thus adopting a conservative approach in the overall assessment.

The screening criteria in the guidelines are to:

assist in judging the overall suitability of a location, but are not necessarily decisive in the choice of location

For example, in the case of landfill sites, the production of leachate and its potential to pollute groundwater would limit/prevent the siting of such facilities on limestone deposits Whereas a waste-to –energy facility, as that proposed, handles all waste within a contained building and water tight bunker thus preventing the generation of leachate would not require the same criteria to be applied.

10.8 POTENTIAL IMPACTS

The main potential impacts relate to the abstraction of groundwater from the proposed supply well to be located on the development site and for groundwater contamination relating to the storage of chemicals on the site and the percolation of treated waste water.

10.8.1 Construction Phase

Potential impacts during the construction phase would be associated with accidental spillage of potentially polluting substances including oils, paints and liquid wastes and any additional substances associated with the construction activities.

All potentially polluting chemicals will be securely stored during the construction phase and refuelling of earth moving machinery will be carried out according to an appropriate Method Statement. Waste water generated during the construction phase will be removed from the development site for disposal in an approved waste water treatment plant. Meath County Council has confirmed its agreement to accept domestic effluent generated during construction of the facility for treatment in an appropriate wastewater treatment plant (see Appendix 10.2).

Table 10.2 GSI Well search (3km radius around 306300, 270900)

DTB	DEPTH	GSI HOLENAME	TYPE	EASTING	NORTHING	TOWNLAND	USAGE	YIELD	YIELD CLASS	AVE DAILY ABSTRACT	WATER STRIKE	MAIN AQUIFER	ABSTR-ACTION
8.2	22.9	2925NWW070	Bored Well	30460	26835	DULEEK		109	Good			Limestone	
7.6	48.2	2925NWW071	Bored Well	30460	26830	DULEEK	Agri/ domestic use	101	Good			Limestone & Drift	
31.5	63.1	2925NWW072	Unknown well	30460	26825	DULEEK		12.5	Poor			Boulder Clay, Sand & Gravel, Limestone	
	18.9	2925NEW070	Bored Well	30855	26940	BEAUMONT		49	Moderate				
0	61	2927SEW047	Bored Well	30605	27150	PLATIN	Industrial	3600	Excellent	3600	41	Limestone with fissures.	137.5
	30	2927SEW048	Bored Well	30590	27135	PLATIN	Industrial	3600	Excellent	3600		Limestone	
	24.4	2925NWW060	Bored Well	30359	26852	DOWNESTOWN	Public supply		Poor	10			
	4.6	2925NEW058	Dug Well	30551	26899	BELLEWSTOWN	Public supply	3.3	Poor				
9.1	42.7	2927SEW036	Bored Well	30665	27210	PLATIN	Public supply	54.5	Moderate				
0	61	2927SEW037	Bored Well	30600	27150	PLATIN, DULEEK	Industrial		Unknown		2.5		
15.2	47.2	2927SEW038	Bored Well	30665	27190	PLATIN	Industrial	872.7	Excellent		28.9		51.12
11.3	34.1	2927SEW039	Bored Well	30665	27185	PLATIN	Industrial	164	Good		14.6		
	21.9	2927SEW041	Bored Well	30630	27335	DROGHEDA		28	Poor				
		2927SEW035	Bored Well	30665	27205	PLATIN			Unknown				
	6.7	2927SEW001	Dug Well	30745	27211	BEYMORE			Unknown				
		2927SEW003	Dug Well	30500	27200	DONORE			Unknown				
	6.1	2927SEW106	Dug Well	30387	27362	OLDBRIDGE			Unknown				
9.8	10.3	2927SEW107	Dug Well	30380	27363	OLDBRIDGE							

Table 10.2 GSI Well search (3km radius around 306300, 270900) Contd.

DTB	DEPTH	GSI HOLENAME	TYPE	EASTING	NORTHING	TOWNLAND	USAGE	YIELD	YIELD CLASS	AVE DAILY ABSTRACT	WATER STRIKE	MAIN AQUIFER	ABSTR-ACTION
5.1	5.1	2927SEW108	Dug Well	30372	27364	DOWTH							
1.8	1.8	2927SEW109	Dug Well	30367	27365	DOWTH							
0	76.2	2927SEW110	Bored Well	30601	27258	DONORE	Agri/ domestic use	21.8	Poor				
0	42.7	2827SEW111	Bored Well	30602	27251	DONORE	Agri/ domestic use	1091	Excellent		36.5		

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10.8.2 Operational Phase

The potential impacts during the operation phase would include;

- Impact on groundwater levels and quality in private wells
- Impact on regional groundwater quality

The development site lies within the groundwater regime now established by the Platin dewatering programme. The quarry abstracts sufficient groundwater to maintain the water table just below the working quarry floor. This operation has resulted in a cone of depression in the water table that is centred on the deep excavation.

The proposed groundwater abstraction at the development site will be located within the Platin cone of depression. The proposed abstraction will not alter the extent of the Platin cone of depression as the planned abstraction is relatively small in comparison to the Platin extraction.

Also, as the amount Platin abstracts is varied to maintain the water table level at or just below the quarry floor the proposed abstraction will not materially add to the total amount of groundwater abstracted from the aquifer. Rather the planned abstraction at the development site will probably result in a small net reduction in the amount of groundwater abstracted from beneath the nearby quarry excavation with the total being abstracted from the aquifer remaining largely unchanged.

However, if the planned abstraction on the development site were to impact on the groundwater levels in nearby private wells, the Company would remedy the situation by deepening the impacted well(s).

The planned disposal of treated waste water to the ground has the potential to impact on groundwater quality immediately below the percolation area.

This discharge of treated effluent would normally have the potential to impact on private wells located downgradient of the percolation area. However, as the development site is located beside the Platin excavation and within its cone of depression any plume of contaminated groundwater generated below the percolation area will now move towards the Platin excavation and eventually form part of the quarry's piped discharge to the River Nanny. As the percolated water will be treated and then passed through different filtering layers before mixing with the local groundwater it will not result in significant contamination of the groundwater beneath the site or that being pumped from the Platin excavation.

The same situation applies to the potential for contamination of the groundwater beneath the development site through accidental spillage of potentially polluting substances including oils, paints and liquid wastes. In such circumstances, any resulting plume would move in the direction of the Platin excavation and potentially result in the deterioration of the groundwater being pumped from the quarry.

10.9 MITIGATION MEASURES

10.9.1 Construction Phase

All oils, chemicals, paints or other potentially polluting substances used during construction will be stored in designated storage areas which will be bunded to a volume of 110% capacity of the largest tank/container within the bunded area(s).

Filling and draw-off points will be fully located within the bunded area(s).

Drainage for the bunded area(s) will be diverted for collection and safe disposal.

All domestic effluent generated on site will be discharged to temporary sewage containment facilities prior to transport and treatment off site.

10.9.2 Operational Phase

Monitoring wells will be located around the perimeter of the facility. These will be sampled in advance of the facility becoming occupied and then sampled frequently to ensure continuation of the base line conditions. Where there is deterioration in groundwater beneath the development site the cause of the contamination will be identified and removed. The company will consult with Irish Cement to ensure that the quality of the groundwater being pumped to the River Nanny is not compromised as a result of any discharge or leakage from the development site.

All substances that would have the potential to cause a negative impact on groundwater will be stored in appropriate containers and/or placed within bunded areas. Raw materials for the process will be stored in containers/silos within the process building. Residues will be stored in a bunker and silos within the process building.

All waste entering the facility will be stored in fully contained structures therefore there will be no potential for leakage to soils. All waste storage facilities will be rendered impervious to the materials stored therein. All concrete underground storage structures whether for waste or liquid (as there is a possibility that firewater run-off may enter any of the tanks) will be constructed as watertight structures in accordance with the requirements of relevant Codes of practice such as BS 8007 British Standard for design and Construction of Aqueous Liquid Retaining Structures. Typically these structures will be reinforced concrete with minimum wall and base thicknesses of 250 mm or greater depending on the structural requirements. Details for the construction of these tanks will follow good building practice, the guidelines in the Code of Practice and details used successfully in other similar structures. The structures will be integrity tested in accordance with the guidelines given in the Code of Practice for leakage to confirm that they are watertight. This will be demonstrated to the satisfaction of the Local Authority following installation and prior to use for storage.

Similarly in the instance of the storm water attenuation tank (which can also contain fire-water run-off) it is proposed that this will be constructed from a sealed Hydrocell type storage unit. The sealing membrane will be welded HDPE membrane which is commonly used for forming secondary containment liners in effluent tanks. The attenuation tank will be tested and demonstrated to be watertight to the satisfaction of the local Authority.

All underground piping will be maintained and regularly inspected for integrity.

All domestic effluent will be treated by an appropriate system prior to its discharge to the percolation area.

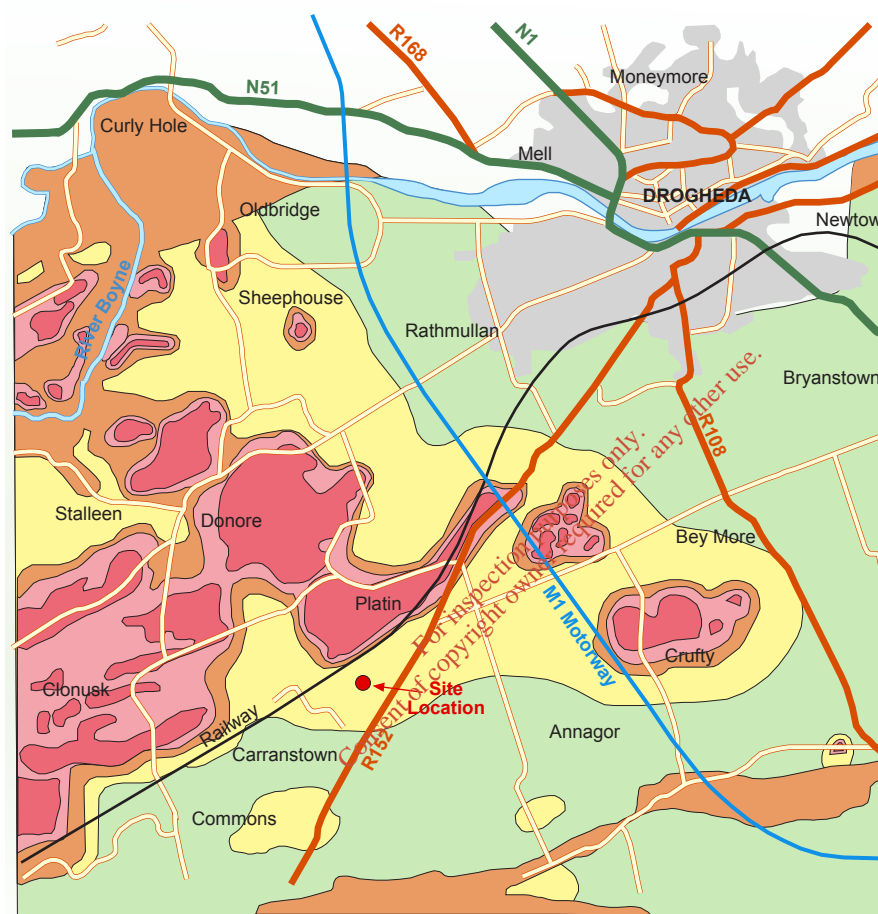
All underground piping will be maintained and regularly inspected for integrity.

A petrol interceptor will be placed on the surface water drainage outfall line from hardstanding areas to contain any leakages from vehicles on site. Full details of the proposed on site drainage network are presented in Section 11.

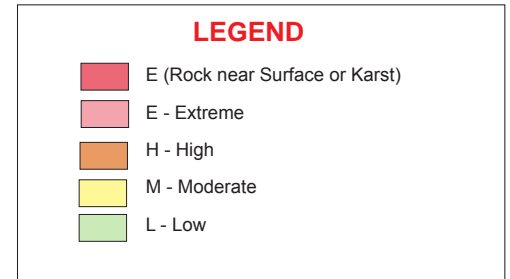
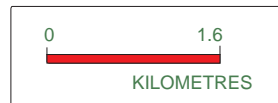
10.10 RESIDUAL IMPACTS

The proposed facility will not have a significant impact on the hydrogeology of the development site or beneath the surrounding lands.

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Source: www.gsi.ie

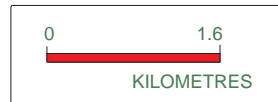


NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

Indaver Regional Vulnerability			
Figure No. 10.1	Job No. C003425	Date. Nov.2005	
	Finalised By -		



Source: www.gsi.ie

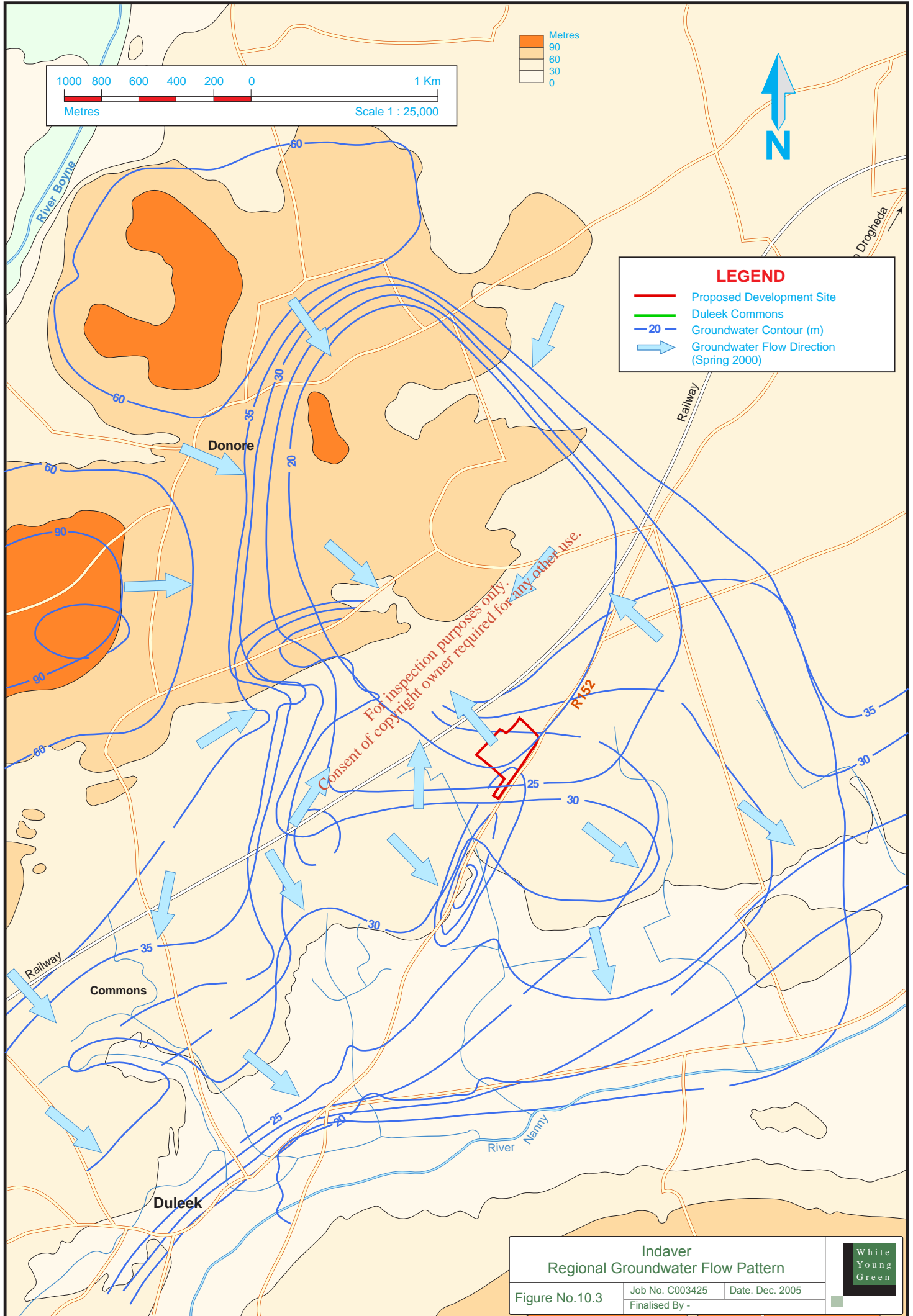


LEGEND

- Rkd - Regionally important, diffuse karst aquifer, good development potential
- Lm - Locally important, generally moderately productive
- Ll - Locally important, generally moderate productive in local zones
- Lg - Locally important, sand/gravel aquifers
- Pl - Poor aquifer, generally unproductive except in local zones
- Pu - Poor aquifer, bedrock which is generally unproductive

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

Indaver		
Regional Aquifers		
Figure No. 10.2	Job No. C003425	Date. Nov.2005
Finalised By -		



Indaver Regional Groundwater Flow Pattern			
Figure No.10.3	Job No. C003425	Date. Dec. 2005	
Finalised By -			



Railway

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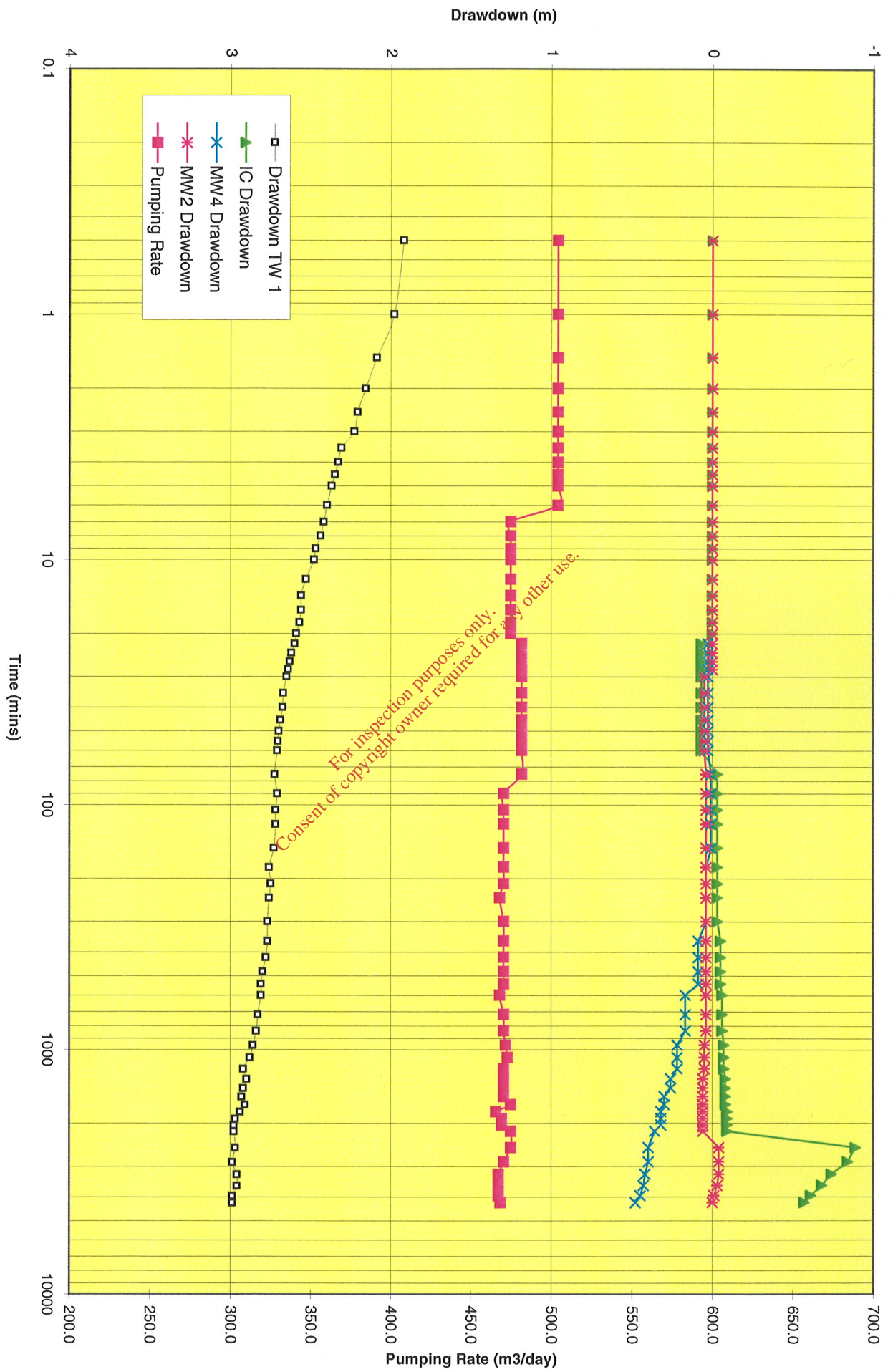
- LEGEND**
- Proposed Site Boundary
 - Proposed Development Area
 - Hedge/Field Boundary
 - - - Gasline
 - MW1 ● Monitoring Well Location
 - TW1 ■ Trial Well Location
 - TP1 ● Trial Pit Location
 - TP1 ● Test Trial Pits (12/12/00)
 - PP1 ▲ Percolation Pit
 - 17— Inferred Groundwater Contour (July 2001)
 - Groundwater Flow Direction

Indaver			
Bedrock Groundwater Contours (mOD)			
Figure No. 10.4	Job No. C003425	Date. Sept. 2005	
Finalised By - CC			

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

Appendix 10.1
Pump Test

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Pumping Rate and Drawdown versus Time for TW 1 and Monitoring Wells 70hr Pumping Test, at Carranstown, Co. Meath, May 2000

Elapsed Time (MINS)	WATER LEVEL	DRAWDOWN	YIELD
	BELOW G.L. (m.)	(METRES)	(M3/DAY)
	TW 1		
0	20.73	0.00	0.0
0.5	22.65	1.92	504.0
1	22.71	1.98	504.0
1.5	22.82	2.09	504.0
2	22.89	2.16	504.0
2.5	22.94	2.21	504.0
3	22.96	2.23	504.0
3.5	23.04	2.31	504.0
4	23.06	2.33	504.0
4.5	23.08	2.35	504.0
5	23.10	2.37	504.0
6	23.13	2.40	504.0
7	23.15	2.42	474.8
8	23.17	2.44	474.8
9	23.20	2.47	474.8
10	23.21	2.48	474.8
12	23.26	2.53	474.8
14	23.29	2.56	474.8
16	23.29	2.56	474.8
18	23.30	2.57	474.8
20	23.32	2.59	474.8
22	23.33	2.60	481.7
24	23.35	2.62	481.7
26	23.36	2.63	481.7
28	23.37	2.64	481.7
30	23.38	2.65	481.7
35	23.40	2.67	481.7
40	23.41	2.68	481.7
45	23.42	2.69	481.7
50	23.43	2.70	481.7
55	23.44	2.71	481.7
60	23.44	2.71	481.7
75	23.46	2.73	481.7
90	23.44	2.71	470.4
105	23.45	2.72	470.4
120	23.45	2.72	470.4
150	23.46	2.73	470.4
180	23.49	2.76	470.4
210	23.48	2.75	470.4
240	23.49	2.76	468.0
300	23.50	2.77	470.4
360	23.50	2.77	470.4
420	23.51	2.78	470.4
480	23.53	2.80	470.4
540	23.54	2.81	470.4
600	23.54	2.81	468.0
720	23.56	2.83	470.4
840	23.57	2.84	470.4
960	23.59	2.86	471.6
1080	23.61	2.88	472.8
1200	23.65	2.92	470.4
1320	23.63	2.90	470.4
1440	23.65	2.92	470.4
1560	23.66	2.93	470.4
1680	23.64	2.91	474.8
1800	23.67	2.94	465.6
1920	23.70	2.97	469.2
2040	23.71	2.98	469.2
2160	23.71	2.98	474.8
2520	23.70	2.97	474.8
2880	23.72	2.99	470.4
3240	23.69	2.96	467.2
3600	23.69	2.96	467.2
3960	23.72	2.99	467.2
4230	23.72	2.99	468.3

**Time Drawdown Data from 70.5 hour Pumping Test on TW 1
at Carranstown, Co. Meath, May 2000**

Appendix 10.2
Meath County Council Correspondence

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10th July, 2003

Ms L. Burke,
Indaver Ireland,
Kilakee House,
Tallaght,
Dublin 24

**Re: Disposal of Domestic type effluent for construction stage of thermal
treatment plant at Carranstown Duleek**

Dear Ms Burke,

I refer to your query on the above matter.

Please note that domestic effluent may be tankered to Duleek waste water treatment plant or other such plant as may be determined by the Area Engineer from time to time during the construction stage.

Yours sincerely



John Quinlivan
Area Administrator

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11 SURFACE WATER

11.1 DRAINAGE NETWORK

Regional

The proposed development site lies in the River Nanny catchment (Figure 11.1). The River Nanny rises in the south-east of Co. Meath and flows through Duleek towards Laytown, where it discharges to the sea.

A hydrological station located on the River Nanny at Duleek has an estimated dry weather flow of 0.04 m³/s and a 95 percentile flow of 0.25 m³/s.

The River Nanny channel is located approximately 2 km south of the development site. Surface water in the vicinity of the site drains naturally towards the river.

Local

Surface water on and in the vicinity of the site drains through land drains and ditches towards the local streams that flow to the River Nanny. The drainage ditches are mostly dry in the summer months.

11.2 SURFACE WATER QUALITY

As the Nanny River is considered a major tributary of the River Boyne, reference was made to the River Boyne Water Quality Management Plan (1997) and the Three Rivers Project, Water Quality Monitoring and Management (2002).

Chemical and biological data for the River Nanny are available from the EPA. The EPA sampling stations are shown in Figure 1 of Appendix 11.1, and the data is given in Appendix 11.1

11.2.1 River Water Quality

The biological records showed that the water quality has improved in this section of the River Nanny (i.e. Stations 4 and 5 in Figure 1, Appendix 11.1) from an average Q-value rating of 3 in 1988 - 1996 to a Q-rating of 3-4 in 1998 – 2001.

11.3 PROPOSED DRAINAGE NETWORK

11.3.1 Foul Water/Sanitary Management

Construction

During the construction phase, domestic effluent generated on the site will discharge to temporary sewage containment facilities prior to its transport and treatment off site. Meath County Council has confirmed their agreement to accept domestic effluent generated during the construction of the facility for treatment in an appropriate wastewater treatment plant. See Appendix 10.2.

Operation

Domestic sewage from toilets, changing and kitchen areas will discharge via the foul drainage system into an on site effluent treatment system which will then pass through a percolation area to ground. The percolation area will be constructed in accordance with the guidelines in the EPA's Wastewater Treatment Manual. (See Section 9 and Appendix 9.4 for details of assessment of the site for the installation of a Puraflo™ system and associated percolation testing).

11.3.2 Industrial Effluent

Operation

Industrial effluent will be contained within the site and evaporated within the incineration process. There will be no discharge of effluent to the drainage network.

11.3.3 Storm Water Management

Construction

The construction stage will be controlled under an Environmental monitoring process to be agreed with the Local Authority. As noted elsewhere in the EIS this process will monitor such issues as dust generation, noise generation, traffic management and surface water run-off.

Run off during the construction will be directed towards settlement tanks for treatment prior to its discharge to the drainage network. A wheel wash will be installed during construction. The discharge from the wheel wash will be directed to the settlement tanks or will be a self-contained unit.

The settlement tanks will be regularly inspected and subsequently de-silted by the site contractor.

The final discharge from the settlement tanks will pass through an oil interceptor prior to its discharge to the existing drainage ditch network.

Operation

Process Building

All waters produced from wash down etc within the waste processing building will be directed to a spill tank located beneath the floor of the building. The spill tanks will have a capacity of 100m³. Water from this spill tank will be used to supplement process water requirements as detailed in Section 5.2.3.5.1.

Site Drainage

The storm water drainage system will collect rainwater from all roofs, hardstands, roads and grassed areas which fall naturally towards these areas. This area will amount to approximately 6.8Ha. A portion of the site, approximately 3.6Ha will continue to drain naturally to the existing drainage ditches and have not been catered for under the proposed storm water drainage system (all of this area is landscaped).

In order to prevent flooding of the ditches downstream of the facility a discharge rate from the site based on the Dublin City Council Storm Water Management Policy has been incorporated into the drainage design. This discharge rate will be controlled via a hydrobake system. Attenuation for a 1 in 30 year storm will be provided by means of a sealed underground attenuation tank which discharges to the hydrobrake. Attenuation of 1 in 100 year storms will be provided by means of flooding of the kerbed yard and kerbed hardstand areas (see Appendix 11.2 for calculations). The provision of the above system allows the maintenance of the current discharge characteristics to the ditches serving the site ie flows similar to that generated from agricultural land. This will prevent downstream flooding due to "flash flooding" from the site.

The drainage design allows for the monitoring of the storm water discharge at two locations in order to prevent any uncontrolled water discharges from oil leakages, spillages etc entering the watercourses. The parameters required and resultant level limits will be agreed with Meath County Council and the EPA. The first monitoring point will be located prior to the attenuation tank and can divert suspect flows to a watertight storage tank (600m³) located beneath the pump house. This storage tank has been designed to cater for a 1 in 5 year storm event for 15 minutes (502m³) in order to provide adequate capacity should an uncontrolled spillage occur during a rainstorm. The stored suspect water will be re-used in the process where possible while the remainder will be stored within the tank for on site treatment or off site disposal to an authorised facility. Should this storage tank be filled the first monitoring chamber will go into overflow mode and allow water to pass into the attenuation tank (4,100m³) at the outfall of which it will be further sampled by a second monitoring chamber located prior to discharge to the outfall pumps. Should suspect water be detected at this monitoring chamber, the outlet from the attenuation tanks will be shut by an automated valve and the discharge pumps will shut down. In this instance the attenuation tank will be allowed to fill with no discharge.

The outfall from the attenuation tank will be directed to a petrol interceptor. The petrol interceptors will be Class II full retention separator and the separator will be in accordance with European Standard prEN 858 (installations for the separation of light liquids). See Figure 11.2 for a flow diagram of the proposed storm water management system.

11.4 POTENTIAL IMPACTS

Construction Phase

The construction phase will consist, in the main, of the construction of the landscaping bunds, excavation and the construction of the buildings, roads, hardstanding areas, car parks and other ancillary structures.

The main potential impacts arising out of these works will consist of the following:

- Run-off from bare earth surfaces will contain silt and clay particles. Excessive amounts of silt entering the surface water system could clog the stream beds.
- Hydrocarbon contaminated water entering the drainage network has the potential to contaminate the surface water.
- Sewage or canteen effluent entering the surface water system has the potential to contaminate the surface waters.

Operational Phase

The main potential impacts associated with the operational phase will comprise the following:

- Run-off from the site has the potential to impact on surface water quality.
- Fire water run-off generated by a fire occurring in any of the buildings causing uncontrolled flows to the storm water drainage system have the potential to impact on surface water quality.

11.5 MITIGATION MEASURES

Construction Phase

The following mitigation measures will be implemented during the construction phase:

Temporary settlement tanks and interceptors will be constructed as necessary during the early stages of construction mitigating against silt laden run off to the existing drainage network. Prior to commencement of development, written agreement will be sought from the planning authority for details of temporary settlement tanks/silt traps/oil interceptors to control discharges of site surface water run-off during the construction period in advance of the construction of the proposed permanent attenuation tanks. The concentration of suspended solids (SS) of the surface water run-off from the site construction works, for discharge to surface waters, will not exceed 30 mg/litre.

It is proposed to seed and grass the perimeter/screening bunds at the earliest opportunity.

During the construction phase of the development, oil and fuel storage tanks, chemicals and all other materials that pose a risk to waters if spilled, will be stored in designated storage areas, which will be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s). Filling and draw-off points will be located entirely within the bunded area(s). Drainage from the bunded area(s) will be diverted for collection and safe disposal. Bunded pallets will be used for storage of drums.

During the construction phase all domestic effluent generated on site will discharge to temporary sewage containment facilities prior to transport and treatment off site. Meath County Council has confirmed their agreement to accept domestic effluent generated during construction of the facility for treatment in an appropriate wastewater treatment plant.

During the construction stage a temporary wheel wash will be located along the access road to the facility. Site construction roads will be sprayed with water during dry periods to mitigate against the formation of dry dust particles and road sweepers will be operated as required to keep public roads clean.

Operational Phase

There will be no discharge of effluent to the drainage network.

Fuels and oils used on site during the operational phase will be stored in tanks located in concrete containment bunds.

Domestic effluent will be treated by an appropriate system and discharged to the percolation area. Chemicals or other potentially polluting substances will be stored within the main process.

Run-off from clean hard surfaces on site including the roofs of the buildings, site roads, car parks, hardstanding areas and ancillary buildings will be collected into the surface water drainage system as detailed in Section 11.2.2 above.

All drainage arrangements will comply with the requirements of the planning authority for such works and services.

All sludge from the drainage system, bunds, silt traps and oil interceptors will be regularly collected for safe disposal.

An adequate supply of containment booms and/or suitable absorbent material to control, contain and absorb any potential spillages will be maintained at the facility.

Firefighting and Firewater Retention

Fire suppression is provided by an on site water storage tank with a fire fighting volume of 1200m³ which is fed by fire pumps to a fire main and hydrant system throughout both the site and buildings. This will be further augmented by Local Fire Service capabilities. Staff will be trained in Emergency Response techniques in order to deal with emergencies including fire fighting. As part of the detailed design and further to discussions with the local Fire service, an application for a Fire safety Certificate will be made to the Local Fire Service and this application will detail in full all fire fighting capabilities for the Facility.

The greatest potential for fire at the facility arises within the 16,000m³ waste bunker where localised heating can occur due to decomposition of organic material or in the 1,600m³ash bunker from hot ashes.

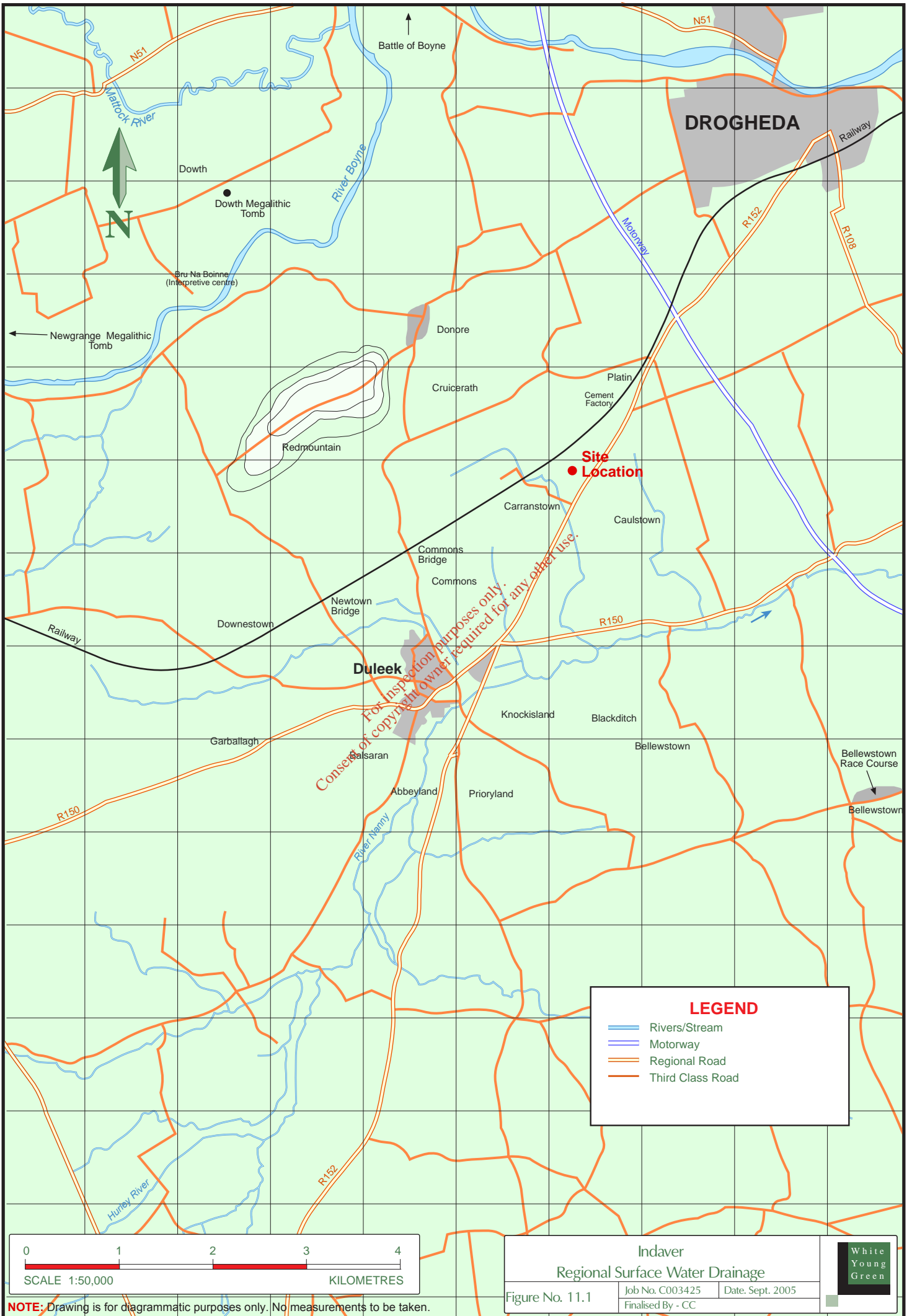
As detailed in Section 5, localised fires within the waste bunker are lifted using the grab crane, into the hoppers which transfer the waste directly to the furnace. Similarly for the Ash Bunker, should a fire occur, water hoses fed from local hydrants/hose reels within the building will be played on the bunker area to suppress the fire. As for the waste bunker, the Ash Bunker will be designed as a water retaining structure and will thus contain any fire water generated within the bunker. The Ash bunker will be integrity tested during construction.

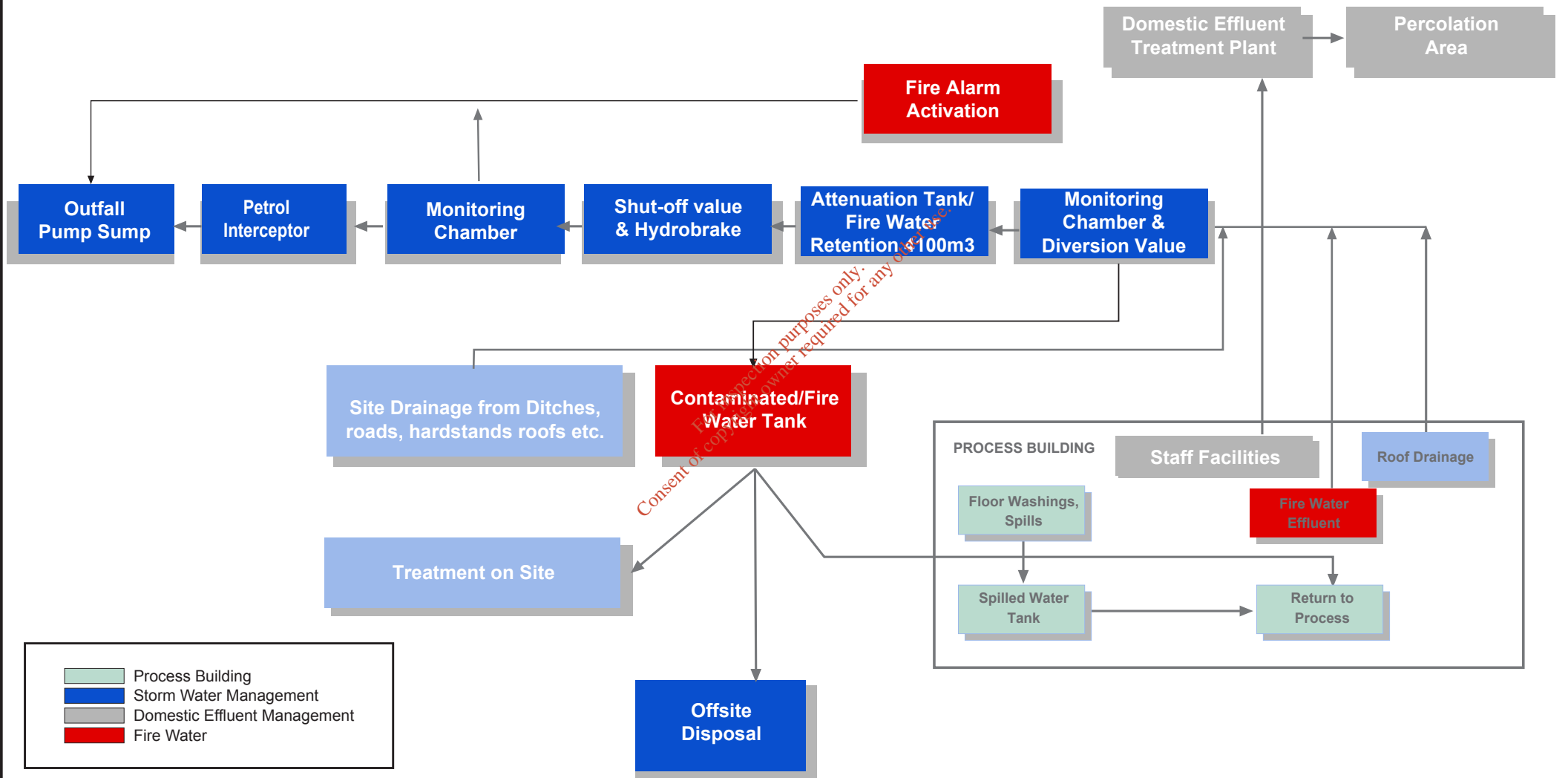
With respect to fire occurring elsewhere in the process building or other buildings on site the run-off will be contained by collection in the surface water drainage system. This in turn will drain to both the diverted water tank located under the pump house and also to the attenuation tank (This will be achieved by the provision of an actuated shut-off valve, controlled by the fire alarm/detection system, at the outfall to the attenuation tank. This water will be stored for on site treatment/reuse or removal from site for disposal. The storage volume has been sized to reflect the guidelines provided in the EPA Guidance note on the Requirements for Fire water Retention Facilities which requires the storage volume to be adequate to contain the total volume of fire water plus the possible rainfall run-off from a 1 in 20 year storm over a 24 hour period which respectively give volumes of 1,200m³ and 3498m³. This will be provided by the diverted water tank 600m³ and the attenuation tank 4,100m³ respectively. As part of the detailed design a full analysis of the Fire water retention requirements will be carried out.

A schematic of the effluent streams and their management is presented in Figure 11.2.

11.5.1 RESIDUAL IMPACTS

The proposed system prevents uncontrolled discharges to the outfall ditch by the provision of two layers of monitoring and a controlled discharge system. As such there will be no significant negative impacts on the existing surface water.





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	Process Building
	Storm Water Management
	Domestic Effluent Management
	Fire Water

Indaver Proposed Drainage		
Figure No. 11.2	Job No. C003425 Date. Dec. 2005	
Finalised By - CC		

Appendix 11.1

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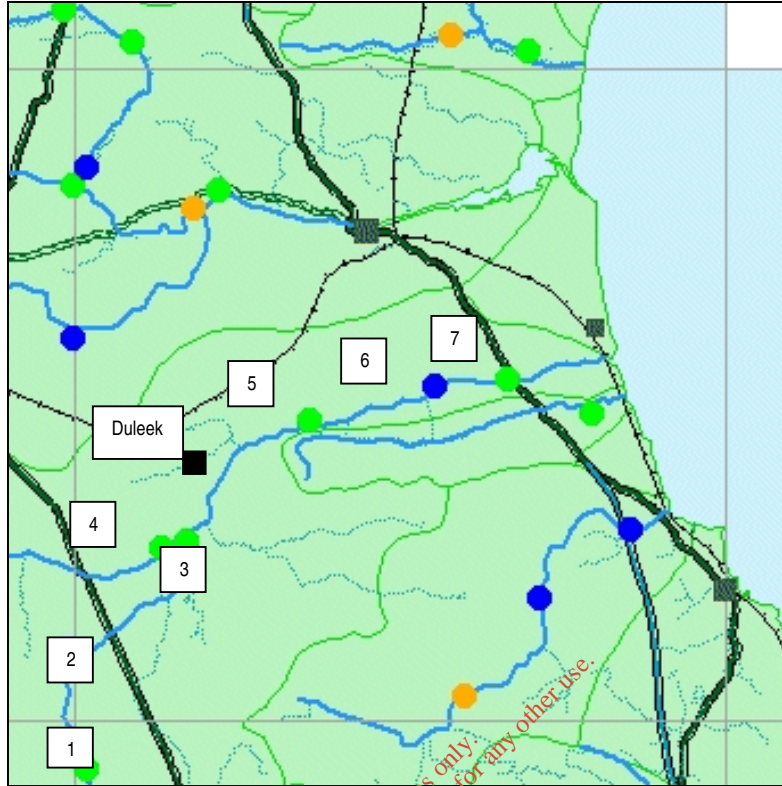


Figure 1. EPA Water Quality Map showing the River Nanny sampling points

EPA data sampling points.

1. Bridge at Painestown
2. Rathfeigh Old Bridge
3. Just upstream River Nanny Confluence
4. **Bridge downstream of Nanny Bridge**
5. **Bridge NE Bellewstown House**
6. Daristown Bridge
7. Bridge at Julianstown

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1 Biological Quality

Current data for biological data show that this section of the river has a Q-value of 3-4, indicating slightly polluted (McGarrigle *et al.*, 2004). The biological records showed that the water quality has improved in this section of the River Nanny from an average Q-value rating of 3 in 1988 - 1996 to a Q-rating of 3-4 in 1998 – 2001.

Comparable biological data are available for the years: 2001, 1998, 1996, 1991 and 1988. A direct comparison between years showed that in 1991 there was an improvement in water quality at the station downstream of Duleek. In other sampling years, there was no change recorded between stations upstream and downstream.

Table 1 Comparable Biological Data (2001, 1998, 1996, 1991 and 1988)

Year	Upstream	Downstream	Change
2001	3-4	3-4	No change
1998	3-4	3-4	No change
1996	3	3	No change
1991	3	3-4	Improvement
1988	3	3	No change

2 Chemical Quality

For the assessment of organic pollution, the more commonly measured parameters include BOC, DO, Phosphates, Oxidised Nitrogen and Ammonia (McGarrigle *et al.*, 2002). The most recent chemical data available for the stations upstream and downstream of Duleek are given in Tables 2 and 3 respectively. There is an increase in median values downstream of Duleek for B.O.D., Ortho-Phosphate and Total Ammonia. Oxidised nitrogen values are higher upstream. D.O values are higher downstream.

EPA guidelines for maximum BOD values are < 3mg/l in unpolluted waters (< 5mg/l Freshwater Fish Regulations and ≤ 4 mg/l Water Quality Guidelines). Maximum values at both stations are in excess of this indicating a high BOD upstream and downstream. DO values in unpolluted waters should be between 80 -120%. Maximum values downstream are slightly in excess of this value. Recommended median values for Ortho-Phosphate are <0.030 mg/l P. Both stations are well in excess of this value. Oxidised Nitrogen and Total Ammonia at both stations are below the recommended maximum of 50mg/l and 0.3 mg/l (Drinking Water Standards).

BOD and Ortho-Phosphate values are higher than recommended values at both stations but there is no clear change in values between these points. This indicates that there is no obvious change in chemical water quality standards between these two stations.

Table 2 Chemical Data Upstream of Duleek (Location 4, Figure 1)

Station No: 0280 Location: Downstream Nanny Bridge Date From: 2001 To: 2005

Parameter	Parameter Units	Minimum	Median	Maximum	No of Samples	Source	Source Type
B.O.D	mg/l O ²		1.17	6.55	12	Meath Co Co	LA
Dissolved Oxygen	% Saturation	84.5		111.1	12	Meath Co Co	LA
Ortho-Phosphate	mg/l P		0.100	0.261	12	Meath Co Co	LA
Oxidised Nitrogen	mg/l N		4.889	5.975	12	Meath Co Co	LA
Total Ammonia	mg/l N		0.042	0.948	12	Meath Co Co	LA

Table 3 Chemical Data Downstream of Duleek (Location 5, Figure 1)

Station No: 0500 Location: Bridge NE Bellewstown House Date From: 2001 To: 2005

Parameter	Parameter Units	Minimum	Median	Maximum	No of Samples	Source	Source Type
B.O.D	mg/l O ²		1.68	5.73	12	Meath Co Co	LA
Dissolved Oxygen	% Saturation	92.2		122.4	12	Meath Co Co	LA
Ortho-Phosphate	mg/l P		0.120	0.235	12	Meath Co Co	LA
Oxidised Nitrogen	mg/l N		4.827	5.819	12	Meath Co Co	LA
Total Ammonia	mg/l N		0.093	0.541	12	Meath Co Co	LA

Appendix 11.2
Calculations

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SITE ATTENUATION

Indaver, Carranstown

Site Area: 67960 m²
 6.796 ha
 0.06796 km²

SAAR = 760 mm
 SOIL Index = 0.3

per Met Eireann fax 03/07/01 letter of 03/07/01
 per Dublin Corp Stormwater Policy Document Jan 1999

Mean Annual Peak Flow (Permissible Outflow Rate)
 QBAR = $0.00108 \times (\text{AREA})^{0.99} \times (\text{SAAR})^{1.17} \times (\text{SOIL})^{2.17}$ m³/s
 (per Dublin Corp Stormwater Policy Document Jan 1999)

QBAR = 0.01698 m³/s
 QBAR = 16.98 l/s

TABLE 1

Attenuation Areas (Developed site):

	Area m ²	Permbly Co-eff	Net non Permeable Area m ²
Roads	24000	1	24000.0
Main Bldg	24960	1.0	24960.0
Grass	19000	0.3	5700.0
TOTAL	67960	-	54,660.0

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TABLE 2: User to input site specific information

Duleek Co.Louth Ave Annual Rain Fall = 760 mm

Maximum Rainfall (mm) over indicated duration, expected in the indicated return period		Return Period (Years)									
Duration		Ave:20&50 Assume 30									
Seconds		0.5	1	2	5	10	20	50	100		
1	min	0.0	0.0	0.0	1.7	2.0	2.4	2.8	3.1	3.5	
2	min	0.0	0.0	0.0	2.9	3.5	4.2	4.8	5.3	6.1	
5	min	0.0	0.0	0.0	5.2	6.3	7.6	8.7	9.7	11.1	
10	min	0.0	0.0	0.0	7.5	9.0	11.0	12.6	14.2	16.4	
15	min	4.5	5.7	6.5	9.2	11.4	14.0	16.2	18.3	21.0	
30	min	6.1	7.3	8.6	12.2	15.1	18.4	21.2	24.0	28.0	
60	min	8.0	10.2	11.3	15.7	19.3	23.0	26.5	30.0	35.0	
2	hours	10.8	13.4	15.0	20.1	24.0	29.0	32.5	36.0	42.0	
4	hours	14.8	18.1	20.0	26.0	31.0	36.0	40.5	45.0	51.0	
6	hours	17.8	21.8	24.0	31.0	37.0	43.0	47.5	52.0	60.0	
12	hours	23.1	28.0	31.0	39.0	46.0	53.0	59.0	65.0	73.0	
24	hours	29.0	34.0	38.0	48.0	56.0	64.0	71.0	78.0	88.0	
48	hours	36.0	43.0	46.0	58.0	68.0	77.0	84.5	92.0	103.0	

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TABLE 3: = Table 2 x 54,660.0 (Net non permeable area m2)

Duration		TOTAL WATER ON SITE (m ³)										
		Return Period (Years)										
Seconds		0.5	1	2	5	10	20	Ave:20&50			100	
								Assume 30	50	100		
1	min	0.0	0.0	0.0	92.9	109.3	131.2	150.3	169.4	191.3		
2	min	0.0	0.0	0.0	158.5	191.3	229.6	259.6	289.7	333.4		
5	min	0.0	0.0	0.0	284.2	344.4	415.4	472.8	530.2	606.7		
10	min	0.0	0.0	0.0	410.0	491.9	601.3	688.7	776.2	896.4		
15	min	246.0	311.6	355.3	502.9	623.1	765.2	882.8	1000.3	1147.9		
30	min	333.4	399.0	470.1	666.9	825.4	1005.7	1158.8	1311.8	1530.5		
60	min	437.3	557.5	617.7	858.2	1054.9	1257.2	1448.5	1639.8	1913.1		
2	hours	590.3	732.4	819.9	1098.7	1311.8	1585.1	1776.5	1967.8	2295.7		
4	hours	809.0	989.3	1093.2	1421.2	1694.5	1967.8	2213.7	2459.7	2787.7		
6	hours	972.9	1191.6	1311.8	1694.5	2022.4	2350.4	2596.4	2842.3	3279.6		
12	hours	1262.6	1530.5	1694.5	2131.7	2514.4	2897.0	3224.9	3552.9	3990.2		
24	hours	1585.1	1858.4	2077.1	2623.7	3061.0	3498.2	3880.9	4263.5	4810.1		
48	hours	1967.8	2350.4	2514.4	3170.3	3716.9	4208.8	4618.8	5028.7	5630.0		

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TABLE 4: = Time (secs) x 0.01698 (QBAR allowable discharge rate in m3/sec)

Duration		ALLOWABLE RUN OFF m ³ OVER GIVEN PERIOD OF TIME									
		Return Period (Years)									
Seconds		0.5	1	2	5	10	20	50	100	Ave:20&50 Assume 30	
1	min	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2	min	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
5	min	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
10	min	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
15	min	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
30	min	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6
60	min	61.1	61.1	61.1	61.1	61.1	61.1	61.1	61.1	61.1	61.1
2	hours	122.3	122.3	122.3	122.3	122.3	122.3	122.3	122.3	122.3	122.3
4	hours	244.5	244.5	244.5	244.5	244.5	244.5	244.5	244.5	244.5	244.5
6	hours	366.8	366.8	366.8	366.8	366.8	366.8	366.8	366.8	366.8	366.8
12	hours	733.5	733.5	733.5	733.5	733.5	733.5	733.5	733.5	733.5	733.5
24	hours	1467.1	1467.1	1467.1	1467.1	1467.1	1467.1	1467.1	1467.1	1467.1	1467.1
48	hours	2934.1	2934.1	2934.1	2934.1	2934.1	2934.1	2934.1	2934.1	2934.1	2934.1

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TABLE 5: = Table 3 - Table 4

Duration		STORAGE REQUIRED m ³										
		Return Period (Years)										
Seconds		0.5	1	2	5	10	20	Ave:20&50		50	100	
								Assume 30				
1	min	0.0	0.0	0.0	91.9	108.3	130.2	149.3	168.4	190.3		
2	min	0.0	0.0	0.0	156.5	189.3	227.5	257.6	287.7	331.4		
5	min	0.0	0.0	0.0	279.1	339.3	410.3	467.7	525.1	601.6		
10	min	0.0	0.0	0.0	399.8	481.8	591.1	678.5	766.0	886.2		
15	min	230.7	296.3	340.0	487.6	607.8	750.0	867.5	985.0	1132.6		
30	min	302.9	368.5	439.5	636.3	794.8	975.2	1128.2	1281.3	1499.9		
60	min	376.2	496.4	556.5	797.0	993.8	1196.1	1387.4	1578.7	1852.0		
2	hours	468.1	610.2	697.6	976.4	1189.6	1462.9	1654.2	1845.5	2173.5		
4	hours	564.5	744.8	848.7	1176.6	1449.9	1723.2	1969.2	2215.2	2543.1		
6	hours	606.2	824.8	945.1	1327.7	1655.7	1983.6	2229.6	2475.6	2912.8		
12	hours	529.1	796.9	960.9	1398.2	1780.8	2163.4	2491.4	2819.4	3256.6		
24	hours	118.1	391.4	610.0	1156.6	1593.9	2031.2	2413.8	2796.4	3343.0		
48	hours	0.0	0.0	236.1	782.7	1274.7	1684.6	2094.6	2695.8			
												3343.0
												2491.4
												MAX STORAGE REQUIRED = (m³)

In order to allow for the volumes generated by Fire Water run-off the attenuation tank is to be greater than the volumes above.

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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 crops, 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.

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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 these 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

Networks of hedgerows especially H2, and treelines should 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 should be trimmed so that they are wider at the base and narrower at the top and established hedges should 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 should take place outside the bird-

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

Best practices should 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 should 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 appears 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 should 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 should 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 should 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 should ensure that there is no impact on surrounding watercourses and subsequently the River Nanny. If these measures are undertaken, it is envisaged that there will be no negative impact on the ecology of the area and there may 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 found to be below limits specified in the Council Directive 2000/76/EC air quality standard limits and WHO guideline values. The cumulative emissions from 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 are 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 *Heracleum 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 *Erinaceus 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 may 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 may 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 may be considered as Negligible.
- ii loss of some potential bat roosts within trees on site (within the development area). Common species will be affected. If safely evacuated from potential roosts prior to development, the bats should find alternative roosting locations in the locality. Impacts may be considered as Negligible, if amelioration measures are taken.
- iii loss of foraging habitat for species such as Irish hare and pygmy shrew etc. may be 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 should survey all trees due for removal prior to construction works commencing. With respect to bats, trees, which are to be removed, should 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 should 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., should be removed while a bat specialist is present to deal with any bats found. Large mature trees should be felled carefully, essentially by gradual dismantling by tree surgeons, under supervision of a bat specialist.

Care should be taken when removing branches as removal of loads may cause cracks or crevices to close, crushing any animals within. These cracks should be wedged open prior to load removal. The dead branches should be lowered to the ground using ropes to avoid impacts which may injure or kill bats within. Such animals should 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 should 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 should 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 should be placed upon existing mature trees 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 - should 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 should 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, should preferably take place outside of the bird nesting season, and should exclude the period March 1st to August 31st.

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 should be avoided.

Measure 1: Protection of Trees to be Retained

Where mature trees and treelines are to be retained, these areas should 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 should 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 should preferably be monitored for effectiveness by means of occasional visits (at appropriate season) during the first two years of operation and additional mitigation measures 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 rooks nest's 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 wood pigeons. 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 km². Elsewhere in Britain, the smallest quoted territory was 42.3 km² 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 should be done 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 (*Viburnum opulus*) and spindle (*Euonymus 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 <i>Accipiter nisus</i>	Not breeding – seen along railway
Pheasant <i>Phasianus colchicus</i>	Heard – may breed
Woodpigeon <i>Columba palumbus</i>	Breeds – several pairs but 20+ feeding in site
Swallow <i>Hirundo rustica</i>	Present feeding over site
Wren <i>Troglodytes troglodytes</i>	Breeds – common
Duncock <i>Prunella modularis</i>	Breeds – several pairs
Robin <i>Erithacus rubecula</i>	Breeds – several pairs
Blackbird <i>Turdus merula</i>	Breeds – several pairs
Song thrush <i>Turdus philomelos</i>	Breeds – several pairs
Mistle thrush <i>Turdus viscivorus</i>	May breed – 1 pair
Chiffchaff <i>Phylloscopus collybita</i>	Breeds – 2 pairs
Goldcrest <i>Regulus regulus</i>	May breed
Blue tit <i>Parus caeruleus</i>	Breeds – several pairs
Coal tit <i>Parus ater</i>	Breeds – several pairs
Great tit <i>Parus major</i>	Breeds – 1 pair
Magpie <i>Pica pica</i>	Present
Jackdaw <i>Corvus monedula</i>	Breeds – several pairs
Rook <i>Corvus frugilegus</i>	Breeds – 30+ pairs (3 locations)
Hooded crow <i>Corvus corone</i>	Present
Starling <i>Sturnus vulgaris</i>	Breeds – several pairs
Chaffinch <i>Fringilla coelebs</i>	Breeds – several pairs
Goldfinch <i>Carduelis carduelis</i>	Present – could breed

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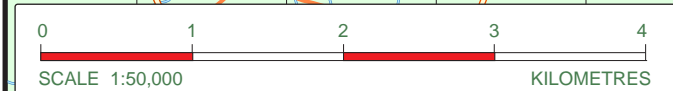
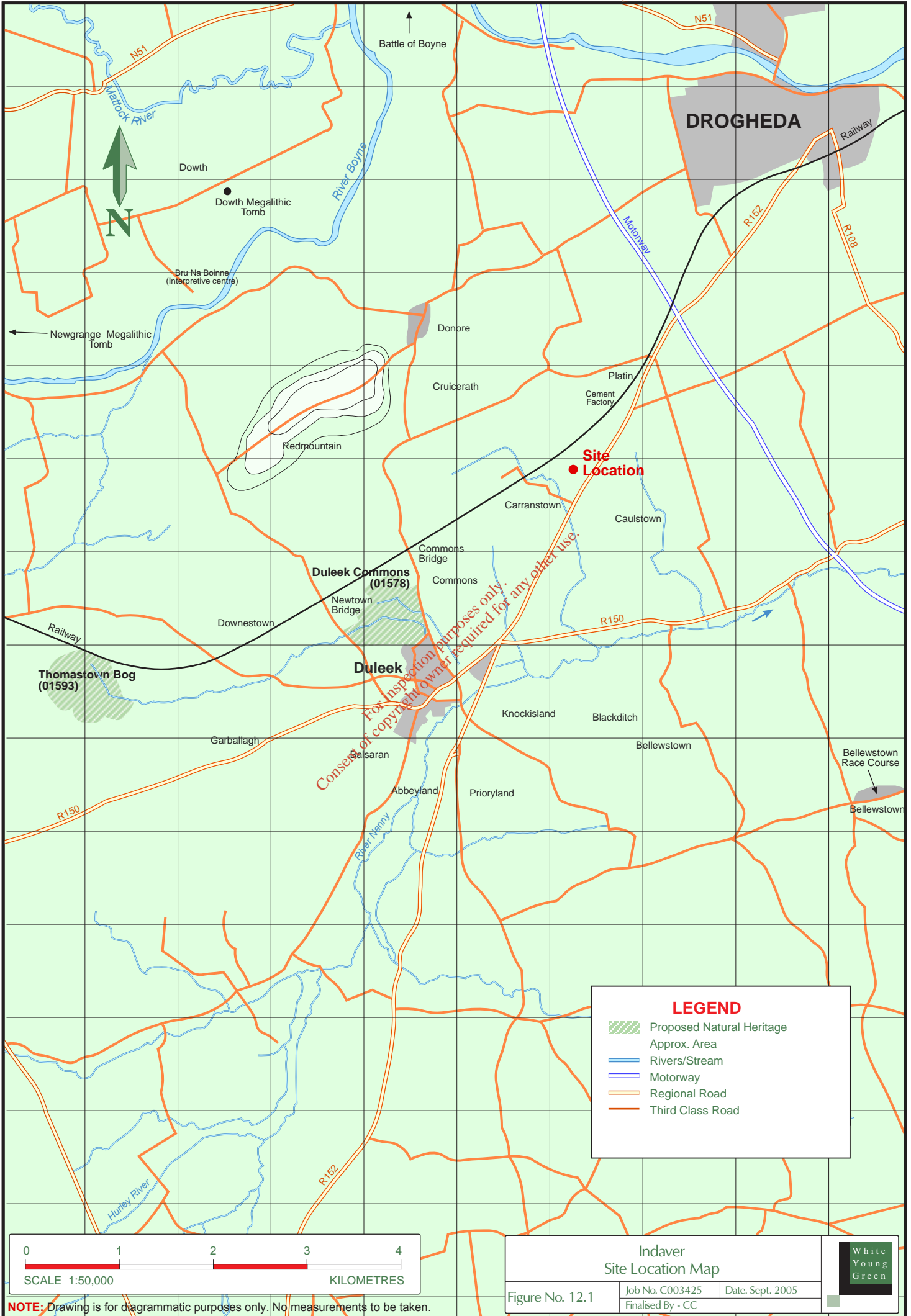
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NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

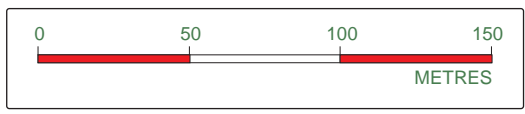
Indaver		
Site Location Map		
Figure No. 12.1	Job No. C003425	Date. Sept. 2005
	Finalised By - CC	





LEGEND

- Site Boundary
- Improved agricultural grassland
- Arable crops
- Spoil & bare ground
- Hedgerow (intact)
- Hedgerow (gappy)
- Treeline
- Drainage ditch

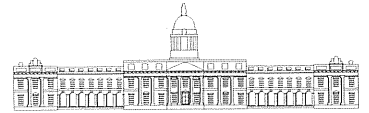


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Indaver Habitat Map			
Figure No. 12.2	Job No. C003425 Finalised By - CB	Date. July 2005	

Appendix 12.1
**Correspondence from the Department of the Environment,
Heritage and Local Government**

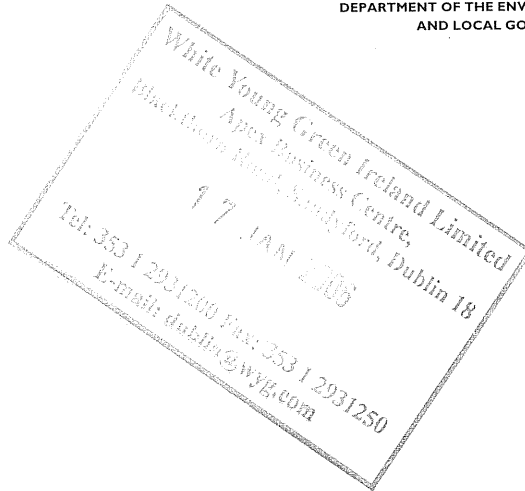
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16 January 2005

Our Ref: G2005/279

Ms. Carmel Brennan,
Ecological Consultant,
White Young Green,
Apex Business Centre,
Blackthorn Road,
Sandyford,
Dublin 18.



Re: Proposed Waste Management Facility at Carranstown, Co. Meath.

Dear Ms. Brennan,

We refer to your notification in relation to the above-proposed development.

The Department of the Environment, Heritage and Local Government has no requirements from a nature conservation perspective.

Finally, this recommendation is based on the papers submitted to this Department on a pre-planning basis and is made without prejudice to any decision the Minister may take upon sight of a formal planning application or the submission of an Environmental Impact Statement.

Yours sincerely,

Teresa Halloran
Teresa Halloran,
Development Applications Unit.

Tel: +353 1 888 3109

Fax: +353 1 478 0721



APPENDIX 12.2
SITE SYNOPSES

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SITE NAME: DULEEK COMMONS

SITE CODE: 001578

About 1km northwest of Duleek, Duleek Commons Natural Heritage Area (NHA) occupies a level, drained marsh area that was associated with the floodplain of a tributary running from Thomastown Marsh, through the undulating drift landscape to the River Nanny.

The area has suffered a certain amount of drainage activity and is now fairly dry around the periphery, where is found rushy pasture with both Soft and Hard Rush (*Juncus effusus* and *J. inflexus*) grazed by cattle. The centre is somewhat wetter, with wetland herbs such as Water Mint (*Mentha aquatica*), Water Forget-me-not (*Myosotis* sp.) large stands of Yellow Flag (*Iris pseudacorus*), Jointed Rush (*Juncus acutiflorus*) and bulky sedges (*Carex* sp.). The rare spike-rush (*Eleocharis uniglumis*) has been recorded here in one of its very few inland stations. This may be supported here by the high calcium content that is also indicated by the presence of Hard Rush.

Many wetlands in the area have completely disappeared due to drainage. Duleek commons is in relatively good condition, probably due to being in multiple ownerships. Thus this rather degraded wetland is of importance. Further drainage work here would be inappropriate.

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SITE NAME: THOMASTOWN BOG

SITE CODE: 001593

This site is situated 3 km west of Duleek, Co. Meath. The site consists of a raised bog surrounded by wet woodland and wet grassland. The site is in a hollow surrounded by farmland on higher ground and is bordered by an embanked railway track on the northern side. The site is dissected by broad deep drainage channels throughout.

The raised bog was described during an earlier survey as having no bog pools and was considered to be drying out. The species recorded from the bog include Haether (*Calluna vulgaris*), Cross-leaved Heath (*Erica tetralix*), Cranberry (*Vaccinium oxycoccus*), Common Cottongrass (*Eriophorum angustifolium*), Hare's-Tail Cottongrass (*Eriophorum vaginatum*), Purple Moor-grass (*Molinia caerulea*) and Bog Asphodel (*Narthecium ossifragum*).

Wet woodland is the commonest habitat occurring at the site. It is considered to be spontaneous in origin. Large areas of this woodland are flooded during periods of high rainfall as the surrounding farmland drains into this site. The main species are Willow species (*Salix* spp.), Birch (*Betula pubescens*), Pedunculate Oak (*Quercus robur*), and Hawthorn (*Crataegus monogyna*). The south-east section of the woodland has Willow and large Alder (*Alnus glutinosa*) as the dominant tree species. There is some regenerating Wych Elm (*Ulmus glabra*) and a number of large dead Elms were seen.

These wet woodlands have a rich ground flora with Yellow Iris (*Iris pseudacorus*) dominant and associated species include Wild Angelica (*Angelica sylvestris*), Marsh-marigold (*Caltha palustris*), Ragged-robin (*Lychnis flos-cuculi*), Meadowsweet (*Filipendula ulmaria*), Meadow Vetchling (*Lathyrus pratensis*), Marsh Bedstraw (*Galium paluste*), Bog Stitchwort (*Stellaria alsine*) and Marsh Foxtail (*Alopecurus geniculatus*). Also recorded were (Marsh Cinquefoil (*Potentilla palustris*), Cuckooflower (*Cardamine pratensis*) and Lesser Spearwort (*Ranunculus flammula*).

A number of fields containing wet grassland vegetation occur along the southern boundary of the site. These fields contain vegetation dominated by Yellow Iris (*Iris pseudacorus*) with Marsh Speedwell (*Veronica scutellata*), Brooklime (*Veronica beccabunga*), Marsh Ragwort (*Senecio aquaticus*), Meadow Vetchling (*Lathyrus pratensis*), Tufted Forget-me-not (*Myosotis laxa*), Creeping Buttercup (*Ranunculus repens*) and Lesser Spearwort (*Ranunculus flammula*) as associated species.

Other habitats recorded at the site include reedbeds dominated by Common Reed (*Phragmites australis*) on the south-western border of the site, water channels with Yellow Iris and Bur-reed (*Sparganium* spp.) and streams.

Tree-felling has occurred on the eastern border of the site in recent times and there is evidence of an unsuccessful attempt to plant Sitka Spruce. Some areas of the site are grazed by cattle and sheep.

The site is notable for an excellent diversity of habitats and rich flora. The site has remained largely undisturbed due to difficulty of access.

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SITE NAME: BOYNE RIVER ISLANDS

SITE CODE: 001862

The Boyne River Islands are a small chain of three islands situated 2.5 km west of Drogheda. The islands were formed by the build up of alluvial sediment in this part of the river where water movement is sluggish.

All of the islands are covered by dense thickets of wet, Willow (*Salix* spp.) woodland, with the following species occurring: Osier (*S. viminalis*), Crack Willow (*S. fragilis*), White Willow (*S. alba*), Purple Willow (*Salix purpurea*) and Grey Willow (*S. cinerea*). A small area of Alder (*Alnus glutinosa*) woodland is found on soft ground at the edge of the canal in the north-western section of the site. In the past, the islands were used as a source of cane for the construction of coracles and for the basket making industry.

The site includes an area of wet grassland found along the river bank to the north of the islands. This grassland is dominated by Soft Rush (*Juncus effusus*) and Hard Rush (*J. inflexus*), with Creeping Buttercup (*Ranunculus repens*), Red Fescue (*Festuca rubra*), Creeping Bent (*Agrostis stolonifera*) and Marsh Thistle (*Cirsium palustre*) occurring commonly. In places this wet grassland grades into freshwater marsh, which supports a diverse assemblage of sedge (*Carex*) species, including Greater Pond-sedge (*C. riparia*), a locally-occurring species, and Brown Sedge (*C. disticha*). The site also includes areas of reedswamp and part of a canal.

Although the site is small there are few similar examples of this type of alluvial wet woodland remaining in the country. The woodland is notable for its natural, unmodified condition, its diversity of Willow species and in particular for the fact that it conforms well to a type listed, with priority status, on Annex I of the EU Habitats Directive.

SITE NAME: DOWTH WETLAND

SITE CODE: 001861

Dowth wetland is located 4 km east of Slane along the northern bank of the River Boyne. The site is very similar in appearance to Crewbane Marsh (553) which is situated nearby. Both sites consist of an area of floodplain marsh with an associated area of deciduous woodland on steep slopes. The marsh occurs on wet alluvial soils, regularly flooded by the river.

The main area of freshwater marsh is dominated by Canary Reed-Grass (*Phalaris arundinacea*) with Marsh Bedstraw (*Galium palustre*), Reed-Grass (*Glyceria maxima*) and Meadowsweet (*Filipendula ulmaria*). The sedges *Carex disticha* and *Carex elata* are also common here. Fen Bedstraw (*Galium uliginosum*), a scarce species mainly confined to marshy areas in the midlands, is common in this vegetation. Between the marsh and the river there is a narrow strip of bank where dredge material was dumped in the past. This area is now colonised by a dense growth of Nettle (*Urtica dioica*) with some Bittersweet (*Solanum dulcamara*). As one moves further north the marsh grades into tall reedswamp vegetation dominated by Common Reed (*Phragmites australis*).

Above the marsh there is a relatively small area of mixed deciduous woodland on steep slopes. The main canopy species in the woodland are Ash (*Fraxinus excelsior*), Sycamore (*Acer pseudoplatanus*), Hazel (*Corylus avellana*) and Lime (*Tilia cordata*). There is also some Beech (*Fagus sylvatica*), Cherry Laurel (*Prunus laurocerasus*) and Bird Cherry (*Prunus avium*). The woodland floor is quite dry and as a result the ground flora is poor in species. The ferns *Polystichum setiferum* and *Phyllitis scolopendrium* are important components, as are Ivy (*Hedera helix*), Wood Avens (*Geum urbanum*) and Nettle (*Urtica dioica*).

The whole site is not heavily grazed by domestic stock and thus is in very good condition. A small herd of Red Deer graze within the site.

This site is the best remaining example of a floodplain marsh on the River Boyne. Such areas are now very rare, mainly due to agricultural reclamation and drainage schemes along the Boyne in the past.

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Appendix 12.3
Photographs

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Plate 1. Arable crop BC1 is the dominant habitat on site. Potato plants and ruderal species cover approximately 20% of the field area.



Plate 2. Improved agricultural grassland grazed to c. 10 cm.



Plate 3. H1: A well maintained boundary hedgerow dominated by hawthorn (*Crataegus monogyna*).



Plate 4. H2: A section of the boundary hedgerow of varying height and moderate species richness. The adjacent cement factory is in the background and a rubble heap is visible to the left of the picture.



Plate 5. H3: An internal hedgerow of Hawthorn (*Crataegus monogyna*), which becomes increasingly gappy towards the west (left of the picture).



Plate 6. H4: A gappy internal hedgerow dominated by hawthorn (*Crataegus monogyna*) and bramble (*Rubus fruticosus*) with a ditch at the base.



Plate 7. H6: A species-poor and gappy internal hedgerow dominated by hawthorn (*Crataegus monogyna*).



Plate 8. H7: A boundary hedgerow supporting two ash (*Fraxinus excelsior*) trees. The one on the right supported a rookery.



Plate 9. Treeline to the west dominated by ash (*Fraxinus excelsior*). Hawthorn occurs between the trees.



Plate 10. Treeline to the west dominated by ash (*Fraxinus excelsior*). Large gaps occur between the trees and hawthorn is sparse.

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Appendix 12.4
Suggested species for planting

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Tree, Shrub and Climbers Species of Wildlife Value

Natives

<u>Common Name</u>	<u>Latin Name</u>	<u>Comments</u>
Rowan	<i>Sorbus aucuparia</i>	Native, good wildlife value, suitable for artificial environments, streets and public open spaces
Crab apple	<i>Malus sylvestris</i>	Native, good wildlife value,
Silver birch	<i>Betula pendula</i>	Native, suitable for public open spaces, streets and artificial environments
Wild cherry	<i>Prunus avium</i>	Native, suitable for public open spaces, streets and artificial environments
Blackthorn	<i>Prunus spinosa</i>	Native, good wildlife value
Spindle tree	<i>Euonymus europaeus</i>	Native, good for birds
Ash	<i>Fraxinus excelsior</i>	Native, good wildlife value
Oak	<i>Quercus robur</i>	Native, good wildlife value
Aspen	<i>Populus tremula</i>	Native, good wildlife value
Hazel	<i>Corylus avellana</i>	Native, good wildlife value
Strawberry tree	<i>Arbutus unedo</i>	Native, good wildlife value

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Broom	<i>Cytisus scoparius</i>	Native, good for insects
Dog Rose	<i>Rose canina</i>	Native, good wildlife value,
Guelder rose	<i>Viburnum opulus</i>	Native, good wildlife value
Hawthorn	<i>Crataegus monogyna</i>	Native, good wildlife value, suitable for public open spaces, streets and artificial environments
Holly	<i>Ilex aquifolium</i>	Native, good wildlife value, suitable for artificial environments and public open spaces
Honeysuckle	<i>Lonicera periclymenum</i>	Native, good for insects, good clothing plant* in sun or partial shade
Ivy	<i>Hedera helix</i>	Native, good for wildlife, good clothing plant*, suitable for north facing sites in partial or full shade.
<u>Non-natives</u>		
Field maple	<i>Acer campestre</i>	High conservation value, suitable for artificial environments and public open spaces
Sycamore	<i>Acer pseudoplatanus</i>	Good for wildlife, suitable for public open spaces
Butterfly Bush	<i>Buddleja davidii</i>	Good for butterflies, suitable for artificial environments
Cotoneaster	<i>Cotoneaster</i> spp.	Provides berries for birds and small mammals. Shrub and climbing species suitable for public open spaces
Escallonia	<i>Escallonia macrantha</i>	Provides nectar for bees and butterflies. Suitable for gardens and public open spaces
Lavander	<i>Lavandula</i> spp.	Attracts butterflies. Suitable for gardens and public open spaces

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Lilac	<i>Syringa</i> spp.	Good food source for birds, butterflies and bees. Suitable for gardens and public open spaces
Fuchsia	<i>Fuchsia</i> spp.	Good food source for bees. Suitable for gardens and public open spaces
Hebe	<i>Hebe</i> spp.	Good food source for many butterfly species. Suitable for gardens and public open spaces
Firethorn	<i>Pyracantha</i> spp.	Good food source for birds and bees. Suitable for gardens and public open spaces
Viburnum	<i>Viburnum bodnantense</i>	Flower in winter and provide a good food source during this time
Viburnum	<i>Viburnum tinus</i>	Evergreen that flowers through winter and provides a useful nectar source
Japanese quince	<i>Chaenomeles japonica</i>	Good food source for birds
Mahonia	<i>Amelanchier canadensis</i>	Good source of nectar and pollen in early spring
	<i>Mahonia</i> spp	Flower early in the spring and provide a useful source of pollen

**Clothing plant refers to plants which can be successfully grown against a wall or open framework and which is primarily designed to provide a decorative or camouflaging effect*

Suggested native herbaceous species for grassland areas

<u>Common grass species suitable for neutral grassland</u>	<u>Common forb species suitable for neutral grassland</u>	
<i>Festuca rubra</i>	<i>Achellia millifolium</i>	<i>Rumex acetosa</i>
<i>Festuca pratensis</i>	<i>Lucaanthum vulgaris</i>	<i>Centaurea nigra</i>
<i>Agrostis stolonifera</i>	<i>Prunella vulgaris</i>	<i>Lotus corniculatus</i>
<i>Poa annua</i>	<i>Veronica chamaedrys</i>	<i>Cirsium vulgaris</i>
<i>Poa pratensis</i>	<i>Stellaria graminea</i>	
<i>Poa trivialis</i>	<i>Bellis perennis</i>	
<i>Lolium perenne</i>	<i>Cardamine pratensis</i>	
<i>Cynosuros cristatus</i>	<i>Taraxicum officinale</i>	
<i>Arrhenatherum elatius</i>	<i>Ranunculus repens</i>	
<i>Anthoxanthum odoratum</i>	<i>Ranunculus acris</i>	
<i>Holcus lanatus</i>	<i>Lathyrus pratensis</i>	
<i>Phleum pretense</i>	<i>Primula veris</i>	
<i>Alopecurus pratensis</i>	<i>Plantago lanceolata</i>	
	<i>Plantago major</i>	

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Appendix 12.5
List of vertebrates and adjudged status

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Status in study area

Mammals

Insectivora

Hedgehog	<i>Erinaceus europaeus</i>	Certain/occasional
Pygmy Shrew	<i>Sorex minutus</i>	Certain

*Chiroptera*¹

Common Pipistrelle ²	<i>Pipistrellus pipistrellus</i>	Certain ¹
Soprano Pipistrelle ²	<i>Pipistrellus pygmaeus</i>	Likely ¹
Nathusius's Pipistrelle	<i>Pipistrellus nathusii</i>	Absent
Brown Long-eared	<i>Plecotus auritus</i>	Occasional
Leisler's	<i>Nyctalus leisleri</i>	Occasional
Lesser Horseshoe	<i>Rhinolophus hipposideros</i>	Absent
Whiskered	<i>Myotis mystacinus</i>	Absent
Natterer's	<i>Myotis nattereri</i>	Absent
Daubenton's	<i>Myotis daubentonii</i>	Absent
Brandt's ³	<i>Myotis brandtii</i>	Absent

Lagomorpha

Rabbit	<i>Oryctolagus cuniculus</i>	Present
Irish Hare	<i>Lepus timidus hibernicus</i>	Present

Rodentia

Red Squirrel	<i>Sciurus vulgaris</i>	Absent
Grey Squirrel	<i>Sciurus carolinensis</i>	Absent/occasional
Bank Vole	<i>Clethrionomys glareolus</i>	Absent
Wood Mouse/Long-tailed Field Mouse	<i>Apodemus sylvaticus</i>	Present
House Mouse	<i>Mus musculus</i>	Certain
Brown Rat	<i>Rattus norvegicus</i>	Present
Black Rat	<i>Rattus rattus</i>	Absent

¹ Bat distribution records from Ni Lamnha (1979), O'Sullivan (1994), Hayden & Harrington (2000) and also Richardson (2000).

² Two species of Pipistrelle bat are present in Ireland, recent taxonomic revision. The species are identified by the frequency they use for echolocation (45Hz [Common] and 55Hz [Soprano]), and both are common and occur in similar habitats. Roosts occur in buildings and trees.

³ This species is the latest addition to the Irish bat fauna – only discovered in 2003.

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Appendix 12.5 continued: list of Irish mammals, vertebrates and amphibians

		Status in study area
<i>Carnivora</i>		
Fox	<i>Vulpes vulpes</i>	Certain, occasional
Badger	<i>Meles meles</i>	Absent, occasional
Pine Marten	<i>Martes martes</i>	Absent
Irish Stoat	<i>Mustela erminea hibernica</i>	Occasional, infrequent
Otter	<i>Lutra lutra</i>	Absent
American Mink	<i>Mustela vison</i>	Absent
<i>Artiodactyla</i>		
Red Deer	<i>Cervus elaphus</i>	Absent
Sika Deer	<i>Cervus nippon</i>	Absent
Red/Sika Hybrids	<i>Cervus elaphus/nippon</i>	Absent
Fallow Deer	<i>Dama dama</i>	Absent
Feral Goat	<i>Capra</i>	Absent
<i>Amphibians</i>		
Smooth Newt	<i>Triturus vulgaris</i>	Absent
Frog	<i>Rana temporaria</i>	Infrequent
Natterjack Toad	<i>Bufo calamita</i>	Absent
<i>Reptiles</i>		
Common Lizard	<i>Lacerta vivipara</i>	Unlikely

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Appendix 12.6
Description of bat species known or expected on site

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Common pipistrelle Pipistrellus pipistrellus

This species was only recently separated from its sibling, the soprano or brown pipistrelle *Pipistrellus pygmaeus*, which is detailed below (Barratt, E. M., Deauville, R. Burland, T. M., Bruford, M. W., Jones, G., Racey, P. A. & Wayne, R. K., 1997). The common pipistrelle's echolocation calls peak at 45 kHz. The species forages along linear landscape features such as hedgerows and treelines as well as within woodland.

Soprano pipistrelle Pipistrellus pygmaeus

The soprano pipistrelle's echolocation calls peak at 55 kHz, which distinguishes it readily from the common pipistrelle. The pipistrelles are the smallest and most often seen of our bats, flying at head height and taking small prey such as midges and small moths. Summer roost sites are usually in buildings but tree holes and heavy ivy are also used. Roost numbers can exceed 1500 animals in mid-summer.

Both the above species are considered as *Internationally Important*.

Brown long-eared bat Plecotus auritus

This species of bat is a 'gleaner', hunting amongst the foliage of trees and shrubs, and hovering briefly to pick a moth or spider off a leaf, which it then takes to a sheltered perch to consume. They often land on the ground to capture their prey. Using its nose to emit its echolocation, the long-eared bat 'whispers' its calls so that the insects, upon which it preys, cannot hear its approach (and hence, it needs oversize ears to hear the returning echoes). As this is a whispering species, it is extremely difficult to monitor in the field as it is seldom heard on a bat detector. Furthermore, keeping within the foliage, as it does, it is easily overlooked.

The species is considered as *Internationally Important*.

Leisler's bat Nyctalus leisleri

This species is Ireland's largest bat, with a wingspan of up to 320mm; it is also the third most common bat, preferring to roost in buildings, although it is sometimes found in trees and bat boxes. It is the earliest bat to emerge in the evening, flying fast and high with occasional steep dives to ground level, feeding on moths, caddis-flies and beetles. The echolocation calls are sometimes audible to the human ear being around 15kHz at their

lowest. The audible chatter from their roost on hot summer days is sometimes an aid to location. This species is uncommon in Europe and Ireland holds the largest national population.

The species is considered as *Internationally Important*.

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Appendix 12.7
Photographic Record

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Plate 1. Dwelling house just off site at extreme south, and tall treeline next to R152.



Plate 2. Treeline next to Regional Road R152. Note that ploughed area approaches close to the boundary, reducing its quality for wildlife.



Plate 3. Ploughed field and managed hawthorn hedge at north-east of site, next to R152.



Plate 4. View of northern portion of site, with cement factory in background.



Plate 5. Central portion of site; ploughed fields (last crop was potatoes). Hedgerow boundaries are thin and almost entirely of hawthorn.



Plate 6. Mature boundary at extreme west of site. The field is of improved pasture grassland, grazed by cattle.

