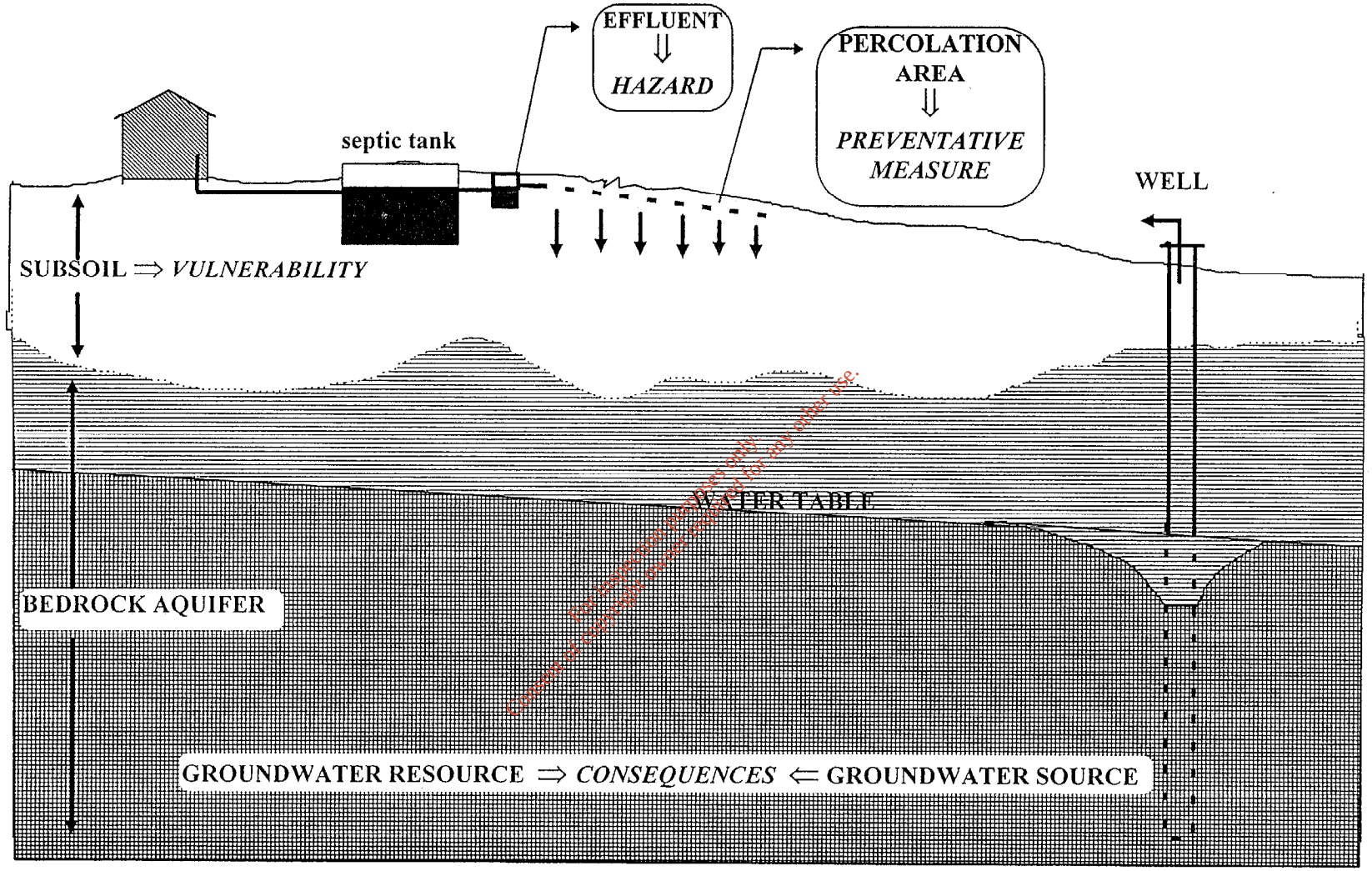


Figure 2.1 A Conceptual Model of the Elements of Risk and Risk Management

Same as P8 10 of S.I. Report

Land surface zoning provides the general framework for a groundwater protection scheme. The outcome is a map, which divides any chosen area into a number of groundwater protection zones according to the degree of protection required. The quality and level of sophistication of the land surface zoning map usually depends on the data and resources (time, money and staff) available, and on the degree of hydrogeological analysis used. Delineation of protection zones based on adequate hydrogeological information and analysis is recommended as a defensible basis for planning decisions.

There are three main hydrogeological elements to land surface zoning:

- Division of the entire land surface according to the **vulnerability** of the underlying groundwater to contamination. This requires production of a vulnerability map showing four vulnerability categories.
- Delineation of **areas surrounding** individual **groundwater sources** (usually public supply sources); these are termed source protection areas.
- Delineation of areas according to the value of the groundwater resources or **aquifer category**; these are termed resource protection areas.

These three elements are integrated together to give maps showing **groundwater protection zones**.

The location and management of potentially polluting activities in each groundwater protection zone is by means of a **code of practice** for each activity or group of activities, which describes (i) the degree of acceptability of each activity, (ii) the conditions to be applied and, in some instances, (iii) the investigations that may be necessary prior to decision-making.

While the two components – maps showing the zones and the control measures – are different, they are incorporated together and closely interlinked in the scheme.

2.3 Land Surface Zoning for Groundwater Protection

2.3.1 Groundwater Vulnerability Categories

Vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities.

The vulnerability of groundwater depends on the time of travel of infiltrating water (and contaminants), on the relative quantity of contaminants that can reach the groundwater and on the contaminant attenuation capacity of the geological materials through which the water and contaminants infiltrate. As all groundwater is hydrologically connected to the land surface, it is the effectiveness of this connection that determines the relative vulnerability to contamination. Groundwater that readily and quickly receives water (and contaminants) from the land surface is considered to be more vulnerable than groundwater that receives water (and contaminants) more slowly and in lower quantities. The travel time, attenuation capacity and quantity of contaminants are a function of the following natural geological and hydrogeological attributes of any area:

(i) the subsoils that overlie the groundwater;
(ii) the recharge type - whether point or diffuse; and
(iii) the thickness of the unsaturated zone through which the contaminant moves.

In general, little attenuation of contaminants occurs in the bedrock in Ireland because flow is almost wholly via fissures. Consequently, the subsoils - sands, gravels, glacial tills (or boulder clays), peat, lake and alluvial silts and clays, - are the single most important natural feature in influencing groundwater vulnerability and groundwater contamination prevention. Groundwater is most at risk

where the subsoils are absent or thin and, in areas of karstic limestone, where surface streams sink underground at swallow holes.

The geological and hydrogeological characteristics can be examined and mapped, thereby providing a groundwater vulnerability assessment for any area or site. Four groundwater vulnerability categories are used by the GSI - **extreme**, **high**, **moderate** and **low**. The hydrogeological basis for these categories is summarised in Table 2.1 and further details can be obtained from the GSI. The ratings are not scientifically precise; they are based on pragmatic judgements, experience and limited technical and scientific information. However, provided the limitations are appreciated, vulnerability assessments are an essential element when considering the location of potentially polluting activities. As groundwater is considered to be present everywhere in Ireland, the vulnerability concept is applied to the entire land surface. The ranking of vulnerability does not take into consideration the biologically-active soil zone, as contaminants from point sources are usually applied below this zone, often at depths of at least 1m.

Table 2.1. Vulnerability Mapping Guidelines

Vulnerability Rating	Hydrogeological Requirements				
	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 only)	
Extreme	0 - 3.0 m	0 - 3.0 m	0 - 3.0 m	0 - 3.0 m	point (<30 m radius)
High	>3.0 m	3.0 - 10.0 m	3.0 - 5.0 m	>3.0 m	diffuse
Moderate	N/A	>10.0 m	5.0 - 10.0	N/A	diffuse
Low	N/A	N/A	>10.0 m	N/A	diffuse

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 and Warren, 1997)

Vulnerability maps are an important part of groundwater protection schemes and are an essential element in decision-making on the location of potentially polluting activities. Firstly, the vulnerability rating for any area indicates, and is a measure of, the likelihood of contamination. Secondly, the vulnerability map assists in ensuring that the groundwater protection scheme is not unnecessarily restrictive on human economic activity. Thirdly, the vulnerability map helps in the choice of preventative engineering measures and enables major developments, which have a significant potential to contaminate, to be located in areas of relatively low vulnerability and therefore of relatively low risk, from a groundwater point of view.

In summary, the entire land surface is divided into four vulnerability categories - extreme (**E**), high (**H**), moderate (**M**) and low (**L**) - based on the geological and hydrogeological factors described above and this subdivision is shown on a groundwater vulnerability map. The map shows the vulnerability of the first groundwater encountered (in either sand/gravel aquifers or in bedrock) to contaminants released at depths of 1-2 m below the ground surface. Where contaminants are released at significantly different depths, there will be a need to determine groundwater vulnerability using site-specific data. The characteristics of individual contaminants have not been taken into account.

2.3.2 Groundwater Source Protection Zones

Groundwater sources, particularly public, group scheme and industrial supplies, are of critical importance in any region. Consequently, the objective of source protection zones is to provide an additional element of protection, by placing tighter controls on activities within all or part of the zone of contribution (ZOC) of the source.

There are two main elements to source protection land surface zoning:

- Areas surrounding individual groundwater sources; these are termed source protection areas (SPAs)
- Division of the SPAs on the basis of the vulnerability of the underlying groundwater to contamination.

These elements are integrated to give the source protection zones.

2.3.2.1 Delineation of Source Protection Areas

Three source protection areas are recommended for delineation:

- Source Site (SS)
- Inner Protection Area (SI)
- Outer Protection Area (SO), encompassing the source catchment area or zone of contribution.

The orientation, shape and size of the Source Site is based on practical non-technical considerations.

In delineating the Inner and Outer Protection areas, there are two broad approaches: first, using arbitrary fixed radii, which do not incorporate hydrogeological considerations; and secondly, a scientific approach using hydrogeological information and analysis, in particular the hydrogeological characteristics of the aquifer, the direction of groundwater flow, the pumping rate and the recharge.

Where the hydrogeological information is poor and/or where time and resources are limited, the simple zonation approach using the arbitrary fixed radius method is a good first step that requires little technical expertise. However, it can both over- and under-protect. It usually over-protects on the downgradient side of the source and may under-protect on the upgradient side, particularly in karst areas. It is particularly inappropriate in the case of springs where there is no part of the downgradient side in the zone of contribution. Also, the lack of a scientific basis reduces its defensibility as a method.

There are several hydrogeological methods for delineating SPAs. They vary in complexity, cost and the level of data and hydrogeological analysis required. Four methods, in order of increasing technical sophistication, are used by the GSI:

(i) calculated fixed radius
(ii) analytical methods
(iii) hydrogeological mapping
(iv) numerical modelling, using FLOWPATH.

Each method has limitations. Even with relatively good hydrogeological data, the heterogeneity of Irish aquifers will generally prevent the delineation of definitive SPA boundaries. Consequently, the boundaries must be seen as a guide for decision-making, which can be reappraised in the light of new knowledge or changed circumstances.

2.3.2.2 Source Site (SS)

This is the innermost protection area, which includes the source and usually the operational activities associated with water supply. It should be under the ownership and control of the local authority. The area should be fenced off and the boundaries should be at least 10m from the source. All potentially polluting activities not directly related to the production of drinking water should be prohibited and

care should be taken that the operational activities do not cause contamination (e.g. runoff from paved areas, storage of fuel and chemicals).

2.3.2.3 Inner Protection Area (SI)

This zone is designed to protect against the effects of human activities that might have an immediate effect on the source and, in particular, against microbial pollution. The area is defined by a 100-day time of travel (TOT) from any point below the water table to the source. (The TOT varies significantly between regulatory agencies in different countries. The 100-day limit is chosen for Ireland as a relatively conservative limit to allow for the heterogeneous nature of Irish aquifers and to reduce the risk of pollution from bacteria and viruses, which in some circumstances can live longer than 50 days in groundwater.) In karst areas where conduit flow is dominant, the TOT approach is not applicable, as there are large variations in permeability, high flow velocities and a low level of predictability.

If it is necessary to use the arbitrary fixed radius method, a distance of 300m is chosen. A semi-circular area is used for springs. The distance may be increased for sources in karst (cavernous) aquifers and reduced in granular aquifers and around low yielding sources.

2.3.2.4 Outer Protection Area (SO)

This zone covers the zone of contribution (ZOC) (or complete catchment area) of the groundwater source. It is defined as the area needed to support an abstraction from long-term groundwater recharge (the proportion of effective rainfall that infiltrates to the water table). The abstraction rate used in delineating the zone will depend on the views of the source owner. The GSI currently increases the maximum daily abstraction rate by 50% to allow for possible future increases in abstraction and for expansion of the ZOC in dry periods. In order to take account of the heterogeneity of many Irish aquifers and possible errors in estimating the groundwater flow direction, a 20° variation in the flow direction is frequently included as a safety margin in delineating the ZOC. A conceptual model of the ZOC (or outer protection area) and the 100-day TOT boundary (or inner protection area) is given in Figure 2.3.

If the arbitrary fixed radius method is used, a distance of 1000m is chosen with, in some instances, variations in karst aquifers and around springs and low-yielding wells.

The boundaries of the SPAs are based on the horizontal flow of water to the source and, in the case particularly of the Inner Protection area (SI), on the time of travel in the aquifer. Consequently, the vertical movement of a water particle or contaminant from the land surface to the water table is not taken into account. This vertical movement is a critical factor in contaminant attenuation, contaminant flow velocities and in dictating the likelihood of contamination. It can be taken into account by mapping the groundwater vulnerability to contamination.

2.3.2.5 Delineation of Source Protection Zones

The matrix in Table 2.2 below gives the result of integrating the two elements of land surface zoning (source protection areas and vulnerability categories) – a possible total of 12 source protection zones. In practice, the source protection zones are obtained by superimposing the vulnerability map on the source protection area map. Each zone is represented by a code e.g. **SO/H**, which represents an Outer Source Protection area where the groundwater is highly vulnerable to contamination. All of the hydrogeological settings represented by the zones may not be present around each local authority source.

8 mentioned on pg 13 of G.W.P.S.

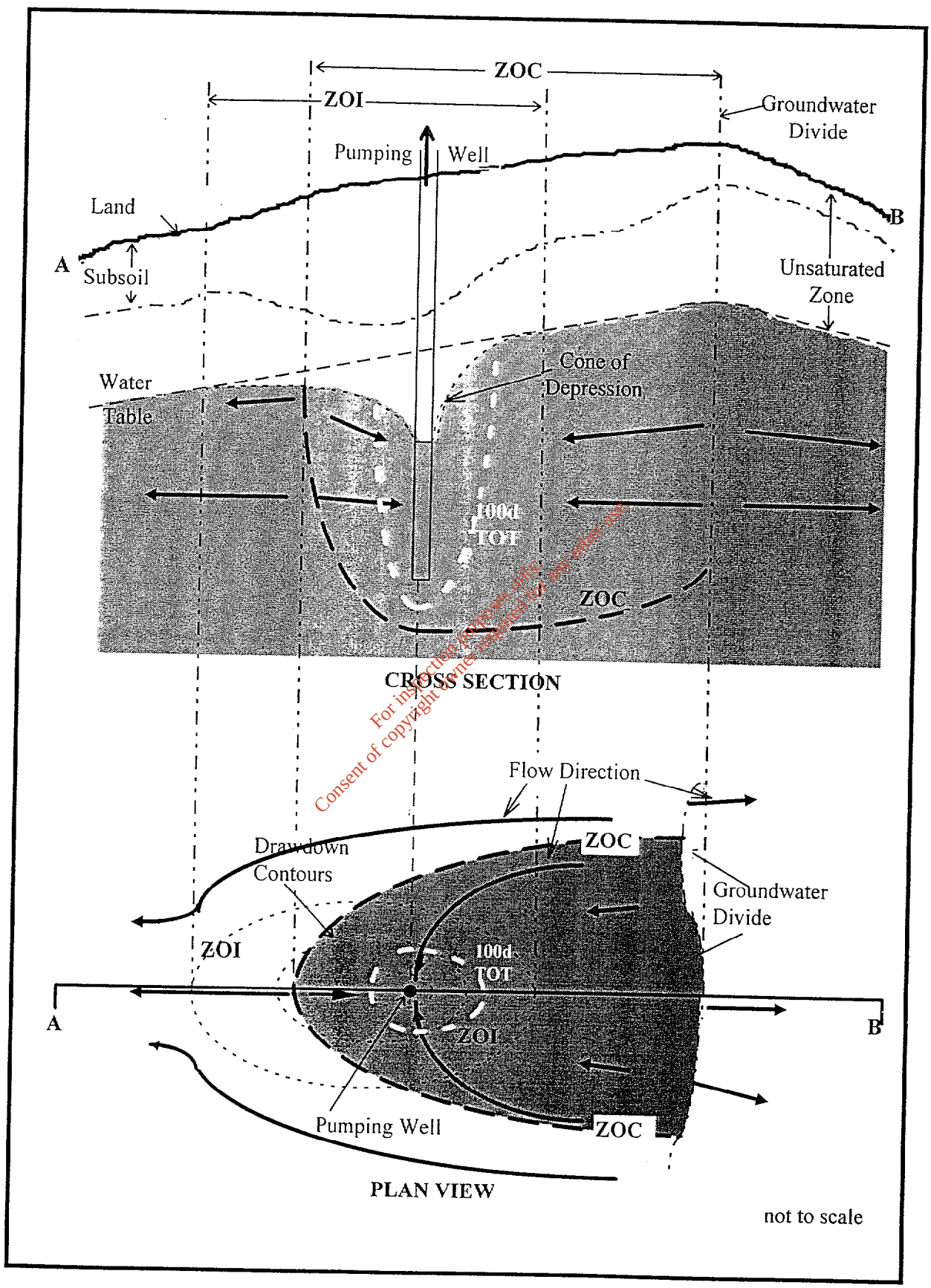


Figure 2.3 **Conceptual Model of the Zone of Contribution (ZOC) and the Zone of Influence (ZOI) at a Pumping Well (adapted from U.S. EPA, 1987)**

5. Hydrogeology & Aquifer Classification

5.1 Introduction

Groundwater is a very important resource and provides about 20% of the public water supply in County Meath. 28% is taken from major rivers and 17% from lakes. The remaining 35% is obtained from other local Authorities: Drogheda Corporation (which extracts from the River Boyne to supply east Meath), Dublin County Council (extracts from the River Liffey at Lexlip), Westmeath County Council and Cavan County Council.

Meath County Council operates 14 major groundwater supplies and 51 minor groundwater supplies, some of which supply only a few houses each. Groundwater from all the major supplies and 17 minor supplies (Table 5.1) were sampled for chemical and bacteriological analyses. The following minor supplies were not sampled due to their very small demand:

Table 5.1 Minor County Council Supplies

Minor County Council boreholes (*A)		Minor County Council Supplies (*B)	
Anneville	Donore	Ballinabrackey	Moylough
Balfeaghan	Julianstown	Baltrasna	Mullaghroy
Ballymacad	Knockmark	Baxter	Mullaghteelin
Bective	Leggagh	Belper	Rathkeenan
Carnaross	Moat	Collestown	Ross Road
Castlepole	Oakley Park	Crowpark	Ross
Clonlyon	Ross	Croboy	Toberultan
Cookstown		Danestown	
Crossdrum		Dean Hill	
Cross Guns		Mitchelstown	

**The locations of the minor sources listed (A) in the above table, have been verified and these wells are still in operation. The sources listed in (B) have not been verified.*

There are also many private abstractions of groundwater for industrial, domestic and farming purposes. Well data have been compiled from a variety of sources including GSI surveys, water well drillers, consultants' reports and the Council. The data are unevenly dispersed throughout the county and vary in quality from very poor to good.

Many wells have not been adequately tested to obtain reliable information on the specific aquifer characteristics. The well records are incomplete, and many private wells are not recorded. Some of the data are out of date, especially where boreholes have now replaced old shallow dug wells.

5.2 Aquifer Classification

The rocks in Co. Meath have been classified into three main bedrock aquifer categories, with each category being sub-divided into two or three sub-classes.

1. **Regionally Important Aquifers**
   (i) Groundwater flow mainly in Karst conduits (enlarged by solution) (**Rk**)
   (i) Groundwater flow mainly in fissures/fractures in the rock (**Rf**)
2. **Locally Important Aquifers**
   (i) Generally moderately productive (**Lm**)
   (i) Moderately productive only in local zones (**Ll**)
3. **Poor Aquifers**
   (i) Generally unproductive except for local zones (**Pl**)
   (i) Generally unproductive (**Pu**)

The Quaternary deposits of sands and gravels are classified as aquifers where they are sufficiently extensive (greater than 1km^2) and have a saturated thickness of at least 5m. Sand and gravel aquifers are classified into Regionally or Locally important:

1. **Regionally Important Aquifers:** Greater than 10km^2 in extent (**Rg**)
2. **Locally Important Aquifers:** Less than 10km^2 in extent (**Lg**)

5.3 Regionally Important Aquifers

The Shallow Water Limestones are the only rocks in Co. Meath which fall into the regionally important category and are classified as having both karst flow dominant (Rk on the map) and fissure flow dominant (Rf on the map) in different areas. These rocks are found in the east just south of Drogheda, in the north from around Ardagh to Nobber, and in the west around Lough Sheelin.

These limestones are pale grey, thickly bedded, fine to coarse grained limestones with abundant fragments of crinoids and coral fossils. The lower part of the rock succession is often dolomitised and karstified, which can be seen where drift cover is absent. These limestones have a moderate to good secondary permeability and the development of joints and fissures by solutional processes and the dolomitisation and decalcification have increased the available storage of the limestones. The greater the degree of solution within the limestones, the greater the likelihood of karstic features and thus karstic groundwater flow patterns. The permeability of the resulting solution features may have been reduced by later (Quaternary) infilling with sands, silts and clays.

5.3.1 Regionally Important Aquifers - karst flow dominant (Rk)

The shallow water limestones in the Kingscourt Outlier around Ardagh to Nobber are classified as having karst flow dominant (Rk on the map). This classification is based on evidence from County Monaghan, where there is extensive karstification of this limestone unit; swallow holes, caves, collapse features and springs have been observed (Personal Communication, M. Burke). These limestones in County Meath have been extensively covered by Quaternary subsoils and karst features have not been located except for two swallow holes which were noted by John Jackson (1955) just south of Barley Hill House, Ardagh, where dark grey micaceous shales overlie dolomitised clean limestones. Evidence for some palaeokarstic features are also reported at Bridge Farm quarry, Nobber and Barley Hill quarry, Ardagh.

The well records show two locations with "excellent" well yields in excess of 1000m^3/d (at Meath Hill and Rolagh). The Meath Hill well was artesian with an overflow rate of 600m^3/d, and the specific capacity was 550m^3/d/m. A third "good" well was located north of Nobber (270m^3/d) and the specific capacity was 38m^3/d/m, while the apparent transmissivity was 50-60 m^2/d.

Based on the geology, evidence for karstication and the occurrence of high yielding wells, these shallow water limestones are classified as a Regionally Important Aquifer - karst flow dominant (Rk on the map).

* The Site at Carranstown for the proposed incinerator has karst features. See Platin Quarry Ext. 5.1.5

5.3.2 Regionally Important Aquifers - fissure flow dominant (Rf)

The remainder of the shallow water limestones which are found in east Meath, just south of Drogheda, and in the west around Lough Sheelin, are classified as having fissure flow dominant (Rf on the map), as the evidence available at present does not indicate extensive development of karst.

The presence of fissuring within these limestones at Drogheda is shown in boreholes at Drybridge, Co. Louth, (drilled as part of the investigation by the North East Regional Development Organisation (NERDO) in 1981), where 8m out of the 16m of borehole which was calliper logged had a diameter greater than the drill bit size. Trial wells at Mell, County Louth also showed cavities up to 10% of the total rock penetrated. The porosity is estimated at 5% at Mell Quarries and 10% at Platin Quarry (NERDO 1981).

Recent borehole records from the site investigation for the Northern Motorway in these limestones have recorded cavities/fissures with a vertical depth up to 3m (BMA 1995). Evidence from the Platin Quarries in Co. Meath also suggests karstic solution of fissures has developed within this limestone.

The GSI manuscript maps record karstic features at Ross Quarry, near Lough Sheelin, Co. Meath. George Du Noyer illustrates deep hollows and trenches in the surface of the limestone at Ross Quarry, which were later infilled with stiff brown clay and overlain by a gravelly limestone till. This illustration (on the cover of this report) may represent a buried or infilled karst system, which is no longer in operation.

From the well records six locations indicate well yields in excess of 100m^3/d. The highest yield was at Platin Quarry, with a present pumping rate of 3,600m^3/d. A sand filled fissure was encountered in Production Well No.2 between -17m O.D, and -19m O.D. The specific capacity at the end of the pumping test was 230m^3/d/m, while the transmissivity ranged from 80-150 m^2/d.

Based on the geology, evidence for fissure flow and the presence of 'good' wells, these shallow water limestones are classified as a Regionally Important Aquifer - fissure flow dominant (Rf on the map).

5.4 Locally Important Aquifers

Locally important aquifers cover approximately half of Meath and are mainly located in the south.

5.4.1 Locally Important Aquifers - generally moderately productive (Lm)

5.4.1.1 Permian & Triassic

These rocks outcrop within the Kingscourt Outlier in the north of Co. Meath. The Permian and Triassic are a very significant aquifer in Northern Ireland due to the high yields. As a result of their small areal extent (<25Km^2) in the Republic they are classified as only "Locally important and generally moderately productive" (Lm on the map).

They generally consist of red shales, siltstones and sandstones. There is little hydrogeological information available for these rocks in Co. Meath. An investigation at Knocknacran Mine, Co. Monaghan by Geoffrey Walton (1982) indicated transmissivities in the range of 20-200m^2/d.

The North East Regional Development Organisation (NERDO) drilled at Mullantra, Kingscourt in 1981 to investigate the potential of the Triassic sandstone. The sandstone was very friable and liable to collapse. The well yielded 915m^3/d with a specific capacity of 23-33m^3/d/m. Transmissivity was calculated at 48m^2/d. The aquifer is locally confined by 48 metres of till at this location. Recent drilling (1994-1996) east of Kingscourt in Countries Cavan, (Corgarry) Monaghan (Descart) and Meath for the Kingscourt water supply, indicated estimated yields between <10 to >1000m^3/d. The high yielding wells which were tested indicated specific capacities of 110m^3/d/m. One of the wells encountered a grey to white rock unit which may be gypsum (calcium sulphate). The Triassic

sandstones also contain very muddy and silty units which can give very poor yielding supplies. During the pumping tests, steady state conditions were not obtained (Personal Communication, K. O'Dwyer, K.T. Cullen & Co.).

The highly weathered Permian and Triassic sandstones are capable of transmitting large volumes of groundwater, although the interbedded mudstones can act as barriers to groundwater movement. Karstic features have been developed in the gypsum units (revealed by mining) and can transmit groundwater. The quality of water from the gypsum units could be unacceptable for drinking as a result of the very high sulphate concentrations that would be expected.

Based upon the lithologies and hydrogeological data available the Permian and Triassic rocks have been classified as "Locally important aquifers - generally moderately productive" (Lm on the Map).

5.4.1.2 Namurian Sandstone

The Namurian succession found in the Kingscourt Outlier is younger than the successions found elsewhere in Meath and is composed of thick alternating sequences of sandstones with shales. These sandstones are poorly cemented and often very weathered which increases their permeabilities.

Recent drilling (1994-1996) in the Namurian east of Kingscourt in County Meath, for the Kingscourt water supply, encountered yields estimated between 200 to 800m^3/d from four trial wells. These high yielding wells indicate the potential of these sandstones for groundwater development. The pumping tests which were conducted on these trial wells provided specific capacities from 40 - 85m^3/d/m. During the pumping tests, steady state conditions were not obtained (Personal Communication, K. O'Dwyer, K.T. Cullen & Co.).

The Council well at Kilmainham provided a discharge of 240m^3/d with a transmissivity in the order of 15-30m^2/d and a specific capacity of 6m^3/d/m.

The results of the drilling have established the potential of these rocks as an aquifer and on this basis the Namurian rocks of the Kingscourt Outlier have been classified as "Locally important aquifers - generally moderately productive" (Lm on the Map).

5.4.1.3 Calp Limestone

The Calp limestone occur over much of the county, particularly in the south. They are composed of dark grey to black, fine grained, well bedded limestones and shales.

The base of the Calp succession consists of coarse grained, cleaner limestones with occasional thin shale bands and often sandstone units are present. Where these variations are encountered especially where secondary permeability is well developed due to the faulting of the rocks, well yields are often much higher than would be expected for the Calp limestones. The lower Calp limestone may also be dolomitised in certain areas.

The base of the Calp limestone succession is more productive than the top but not enough geological information is available to divide the Calp limestone. Basal Calp limestone is found for example at Curragha, and at Kilmoon where the underlying Lower Palaeozoic rocks were encountered.

The upper Calp limestone are deeper basinal limestones and are dominantly fine grained black shales with limestones. The higher shale content ensures a much lower permeability and results in a lower yield. The cleaner limestone units are also found closer to the basin margins where they have slumped into the deeper water sediments.

In Co. Dublin, the proposed Powerstown Landfill site (County Fingal), located on Calp limestone was classified as "Locally important aquifer, moderately productive only in local zones" (Ll) by the consultant to An Bord Pleanala. The site investigations undertaken are site specific and cannot be applied to the entire Calp limestones of Counties Dublin and Meath. This classification of the Calp (Ll) concurs with the GSI's views for the Calp limestones in County Dublin.

5.4.2.2 Waulsortian Limestone

The Waulsortian bank or reef limestones are comprised of almost unbedded pale grey, very fine grained limestones which formed as massive mounds of lime mud. These limestones originally had very open structures with a large cavity volume. These cavities may or may not have been later infilled with calcite. Clean limestones such as the Waulsortian are highly susceptible to dissolution and karstification which involves the enlargement of the primary openings.

The Waulsortian can also be extensively dolomitised which is often joint or fault controlled. Dolomitisation increases the porosity of limestones by up to 15%. Dolomitisation and karstification are usually local and unpredictable, which gives the limestones a greater potential to provide high yielding wells, but frequently gives very low yields (<20m^3/d).

There is very limited evidence of dolomitisation and karstification within the Waulsortian of Co. Meath, other than the warm springs. Two warm springs in particular are located in the south near Longwood: St Gorman's Spring and Ardanew Spring.

The Geothermal Project undertaken by Minerex Ltd. in 1983 found that Waulsortian reef limestones tended to have groundwater circulation, whether it was cold or warm water. As part of the Geothermal Project two boreholes were drilled adjacent to St Gorman's Spring to a depth of 13m. The first borehole, 2m from the spring encountered very broken Waulsortian limestone and a cavity which was connected to the spring. The second borehole, 12m from the spring also encountered fractured limestone. Both boreholes responded rapidly to the abstraction of water from the spring and to fluctuation in the pumping rate (1300-1800m^3/d). The temperature ranged from 20.9-21.3°C and the conductivity from 570-585µS/cm.

The well records indicate seven "good" wells (100-400m^3/d) which are all located around the Longwood and Summerhill areas. Specific capacities range from 5-140m^3/d/m and transmissivities from 30 to 40 m^2/d.

The Waulsortian has the potential of being highly dolomitised and karstified, but with the lack of good evidence it is classified as a "locally important aquifer - moderately productive only in local zones" (Ll on the map).

5.5 Poor Aquifers

These aquifers are characterised by very low permeabilities and transmissivities and are therefore generally very low yielding. Consequently groundwater movement is relatively slow and is often restricted to shallow flow paths near the surface, along fracture zones or through slightly more permeable units. The water table is usually close to ground level and closely mirrors the topography. Well yields are often very low (<40m^3/d), though sufficient for domestic usage, and occasional high yields may be encountered.

5.5.1 Poor Aquifers - generally unproductive except for local zones (Pl)

5.5.1.1 Namurian Shale

The Namurian rocks in north Meath have been classified as locally important aquifers (section 4.3.1.2), while the remainder of the Namurian successions in the south are classified as poor aquifers. These rocks are predominantly composed of siltstones, mudstones and shales with only occasional sandstones. The sandstones possess slightly higher permeabilities and yields, owing to their greater ability to fracture than the shaly units.

Wells are in generally very low yielding, although higher yields have been recorded from Warrenstown and Summerhill with 545m^3/d and 110m^3/d respectively.

North Eastern Health Board
Bord Sláinte an Oir Thuaiscirt

COMMUNITY CARE SERVICES,
Co. Clinic,
Navan, Co. Meath.

Tel: (046) 21595, Fax (046) 22818

Mr. M. Donnelly,
Principal Environmental Health Officer,
County Clinic,
Navan,
Co. Meath.

22nd February 2001

Planning Reference :- 00/4014
Applicant :- Indaver Ireland
Re:- Application for planning permission by Indaver Ireland for Main Process Building; Waste Reception Hall; Waste Sorting Plant; Bunker; Operations/Turbine Building, Boiler, Grate Furnace, Ash Bunker, Demineralisation Unit, Boiler Feed Pumps, Flue Gas Treatment Building, Solidification Unit, AC Unit, Turbine Cooler & 40m high Stack & Ancillary structures, at Carranstown, Duleek, Co. Meath.

In order to properly assess this application request applicant to submit the following further information :-

1. The applicant shall restructure the proposal taking into account European and National Integrated Waste Management Policy i.e. Waste Management – Changing Our Ways, Department of the Environment and Local Government, 1998 and the European Directive on Incineration (2000/76/EC). The developer proposes to use the sorting bay only when a delivery of dry recyclable waste is received while unsorted waste shall be disposed of in the incineration process. This is contrary to the basic principles of the waste management hierarchy of prevention, minimisation, reuse and recycling. *

N.B. *

2. The Environmental Impact Statement does not provide a breakdown of source and quantity of municipal, industrial and commercial waste. The applicant shall list explicitly the category and quantity of waste as required by the European Directive on Incineration (2000/76/EC).

3. Alternative sites for this development shall be fully assessed and examined in accordance with EIS requirements.

This was not properly done

4. The Environmental Impact Statement referred to the World Health Organisation's criteria for Site Selection for New Hazardous Waste Management Facilities (1993). These criteria are not confined to landfill activities as stated in the applicant's submission and specifically exclude areas with limestone deposits. The applicant shall clarify this issue.

5. The limestone bedrock constitutes a regionally important aquifer which is karst and fractured and is therefore susceptible to ground water pollution. This aquifer is the sole source of water for numerous houses in the vicinity. The impacts of this aquifer underneath the site shall be fully assessed and discussed.

6. The effects of the removal of overburden during preparation of the site were not discussed, nor were the impacts addressed in relation to the aquifer.

7. The impacts of the development on the gas line running directly underneath the site were ignored i.e. potential for gas leaks, fire, explosion. These impacts shall be fully addressed.

8. The applicant shall carry out a feasibility study on the sourcing of waste which would ensure the viability, sustainability and continued efficient operation of the incineration plant.

9. The applicant proposes to collect recyclable waste on the site. Applicant shall submit details as to how or where this waste shall be recycled.

10. The amount of green waste which will be accepted on site must be quantified. Storage facilities and method of composting shall also be included.

11. Details on the stockpiling of waste – capacity and length of time waste will be stored on site – for both waste bunker and community recycling park.

12. The applicant failed to submit sufficient details of the processes involved in this development as follows :-

    -Site layout was not adequately detailed.

    -Processing areas and systems were not fully indicated and described. These areas shall be clarified on plan.

13. The Environmental Impact Statement states that boiler ash shall be sent to landfill whilst flue gas cleaning residues shall be removed to a hazardous waste landfill. Boiler ash is classed as a hazardous waste under the EC Council Directive on Hazardous Waste 91/689/EEC. However the company is not treating it as such. The applicant shall provide for the segregation of flue gas cleaning residues and boiler ash.

14. Provision shall be made for the visual inspection, weighing of each load, a storage tank inspection area for waste and quarantine area for waste which cannot be dealt with by the plant i.e. hazardous or clinical waste.

15. Details regarding the storage and treatment of overburden shall also be submitted.

16. The effect of the development on the drawdown of local wells shall be addressed.

17. The applicant failed to give sufficient detail with regard to volume of surface and rain water, site drainage layout, run off and run off controls. The direction and relative magnitude of flow of surface water movement shall be quantified.

18. Provision shall be made for the retention of firewater on site to avoid the potential threat of ground water pollution.

19. Details of the location of the puraflo waste water treatment system and percolation area shall be submitted. In addition, request applicant to submit details of water table and soil percolation tests.

was this done?

20. The management policy and procedures of the plant shall be described i.e. operational and quality control procedures.

21. Back- up or failsafe procedures which would effectively mitigate very severe impacts in the event of failure of the proposed measures shall be submitted.

22. A detailed description of the manner in which waste will be transported from the site i.e. enclosed waste containers or fully enclosed collection vehicles for the transport of waste to and from the site shall be submitted.

23. Detail proposed method and location of wheel washing facilities.

24. Measures taken to limit movement of heavy goods vehicles on and off site during unsociable hours shall be considered.

25. A detailed decommissioning proposal shall be submitted.

26. A public complaints procedure shall be addressed.

27. The applicant shall submit a detailed rodent control programme for the site.

28. Details of method of ventilation of the administration building, sanitary accommodation, offices and canteen shall be detailed on plan.

29. Submit proposals for the control and monitoring of dust and noise during the construction phase of the development.

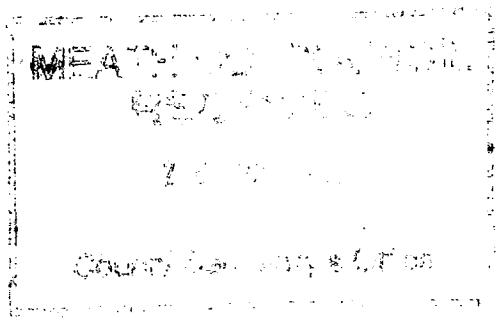
North Eastern Health Board
Bord Sláinte an Oir Thuaiscirt

COMMUNITY CARE SERVICES,
Co. Clinic,
Navan, Co. Meath.

Tel: (046) 21595, Fax (046) 22818

M Donnelly,
Principal Environmental Health Officer,
County Clinic,
Navan,
Co. Meath.

23rd July 2001



Planning Application Ref No. 01/4014
Applicant: Indaver Ireland
Proposal: Application for planning permission for a main process building: Waste Reception Hall, Waste sorting Plant, Bunker, Operations/Turbine Building, Boiler, Grate Furnace, Ash Bunker, Demineralisation Unit, Boiler Feed Pumps, Flu Gas Treatment Building, Solidification Unit, AC Unit, Turbine Cooler and 40m High Stack & Ancillary Structures, at Carrantown, Duleek, Co. Meath.

There are no objections to proposed development subject to the following conditions:

1. The planning authority shall satisfy itself that the proposed development is viable and sustainable to ensure the continued safe and efficient operation of the incinerator.

2. A segregation unit shall be provided at the entrance to the site to receive all waste. It shall include a bunded visual inspection area and a separate quarantine area.

3. Boiler ash is classed as hazardous waste under the EC Council Directive on Hazardous Waste 91/686/EEC. It shall be treated as such. Boiler Ash shall be removed from the site and disposed of at an approved hazardous waste facility. Every precaution shall be taken to ensure that there is no dust blow from this waste.

4. There shall be no open stock piling of waste under any circumstances in order to prevent the creation of nuisances.

5. A suitable rodent control programme shall be devised and implemented for the site.

6. (a) The composting of green waste shall take place on a hardstanding area. All leachate shall be collected and disposed of at an approved waste facility in order to prevent the contamination of ground and surface water.

   (b) Control measures shall be implemented in order to prevent the escape of offensive odours from the composting area.

7. (a) The puraflo unit shall be installed by qualified personnel of Bord Na Mona.

   (b) A maintenance plan for the unit shall be devised and implemented.

   (c) The filter media shall be replaced as necessary and disposed of to an approved waste facility.
   (d) All connections must be carried out so as not to give rise to a public health nuisance.

8. Adequate ventilation shall be provided in the administration block:
   (a) In the case of natural ventilation openings directly to the external air equivalent to a minimum of 5% of individual floor areas must be provided in each office and w.c.
   (b) In the case of mechanical ventilation, it shall be capable of achieving the following:

Toilets:	6 – 8 air changes per hour
Lobbies/Corridors:	4 – 6 air changes per hour
Offices:	4 – 6 air changes per hour
Canteen:	8 – 12 air changes per hour
Kitchen:	15 air changes per hour

   W.c's shall not open directly into any work or food preparation areas and instead shall be served by a suitable ventilated intervening lobby.

This office is precluded from commenting on air, noise and odour control at this time, as it will be dealt with by the Environmental Protection Agency at the IPCL application stage.

Elizabeth Byrne,
Senior Environmental Health Officer.

Carmel Lynch,
Environmental Health Officer.

Note: The Environmental impact statement claimed that the applicant consulted with the North Eastern Health Board during the pre-application process however no such consultation took place.

This office is precluded from commenting on air, noise and odour control at this time as it will be dealt with by the Environmental Protection Agency at the IPCL application stage.

Elizabeth Byrne
Senior Environmental Health Officer

Carmel Lynch
Environmental Health Officer

Principal EHO

22/2/07

Extract from Index 8.1.3.

4.2.2 Possible damage to hedgerows by construction works

During the construction phase, there is a possibility that damage could be caused to some of the hedgerows outside the main development area by construction traffic, machinery, storage of bulk materials etc. Any damage to the hedgerow (H2) along the townland boundary would be of some local significance as this is one of the better formed hedgerows in the area and is considered as of some ecological value. Damage to this hedgerow can be avoided with proper care (see recommendations section).

N.B.

4.2.3 Potential for water pollution

As already noted, the possibility exists for contaminated water to enter the drainage ditch immediately west of the site and which leads to a tributary of the River Nanny. Potentially polluting substances could include suspended solids, wash down cement products, fuels, lubricants etc. If such substances were to enter the watercourses in significant amounts they could cause serious damage to the aquatic flora and fauna

4.2.4 Impacts on rookery

The rookery which exists in the ash tree in hedgerow no. 8 may be directly affected if this tree is removed. The significance of this could only be considered as low as the rook is a very common bird species. Nevertheless, efforts should be made to retain this tree.

5. Mitigation measures and recommendations

The following measures relate to retention and protection of the hedgerows and to the possibility of enhancing those which will remain in situ. Also, there is an opportunity for the planting of new hedgerows. Suitable landscaping proposals for the development site could enhance the area for wildlife. Recommendations are also made relating to prevention of possible water pollution and to retention of the rookery.

5.1 Retention, protection and enhancement of hedgerows

Efforts should be taken to reduce the loss of hedgerows to a minimum. In particular the sections of hedgerow containing tall ash trees (H9) should be retained as far as is possible, along with the two single ash trees in hedgerow no. 8.

As discussed above, the loss of the hedgerow (H6) will be of minor significance in a local context. This will be mitigated by the extensive landscaping proposals, involving the planting of native species of trees along the boundary and on site.

During the construction phase, measures should be taken to avoid damage to the hedgerows elsewhere on site and especially that along the townland boundary (H2). Care should be taken while machinery is operating in the area, and building materials should not be stored within about 10 m of the hedgerows. Accidental damage which might be caused to the hedgerows should be repaired using the same tree and shrub species as already present (i.e. ash, hawthorn).

Note that an opportunity exists to lay a new hedgerow along the north-west boundary of the site (parallel to the railway line) and possibly along the eastern boundary of the development area. This would partly compensate for the loss of hedgerows elsewhere on site. Appropriate species would be ash and hawthorn. Also, if some of the hedgerows along the western boundary are to be retained, these could be improved by replanting the various gaps.

5.2 Prevention of water pollution

Appropriate engineering practices will be required to prevent water polluting substances from entering the drain leading to the tributary stream of the River Nanny.

5.3 Retention of rookery

If possible, the ash tree in hedgerow no. 8 which contains rook's nests should be retained. If this has to be removed, the tree should be felled during the period when the birds are not nesting (i.e. from late July to early March).

5.4 Landscaping

An opportunity exists to enhance the wildlife value of the site by planting species which are useful to wildlife as part of the landscaping proposals. Preference should be given to the planting of native tree and shrub species (see list below), most of which would already be established in the general vicinity. If space is available, it is more useful to plant trees in small groups or copses rather than as scattered individuals.

Recommended species to plant include low to medium sized trees such as hawthorn (*Crataegus monogyna*), blackthorn (*Prunus spinosa*), alder (*Alnus glutinosa*), willow (*Salix* spp.), birch (*Betula* spp.), holly (*Ilex aquifolium)* and rowan (*Sorbus aucuparia*). Native oak (*Quercus petraea* or *Q. robur*) would also be a useful addition and would blend in well with the surrounding landscape. Useful shrubs include guelder rose (*Viburnum opulus*), wild current (*Ribes rubrum*), dogwood (*Cornus sanguinea*) and roses which produce hips (*e.g.* dog rose *Rosa canina*). The various cultivated species of cotoneasters and pyracanthas are all useful for providing berries for birds. Cultivated varieties of crab apple, such as yellow hornet, are both attractive and useful for wildlife.

K.T.Cullen & Co. Ltd.

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1 INTRODUCTION

At the request of Project Management Ltd., K.T. Cullen & Co. Ltd were requested to undertake a full baseline hydrogeological investigation of a greenfield site at Carranstown, Duleek, Co. Meath.

This hydrogeological investigation involved the excavation of trial pits, the installation of a trial water well and monitoring wells, and sampling/analyses of both soil and groundwater.

The investigation was carried out to establish baseline conditions of soil and groundwater beneath the site, and to determine the potential for groundwater development at the site. Field data was also collected on the hydrogeological conditions encountered on site.

2 SITE DESCRIPTION

2.1 Physical Features

The site is a greenfield site situated approximately 2.7 km north-east of Duleek, Co. Meath, in the townland of Carranstown. The proposed site area is about 10 hectares in size (c. 25 acres), and the location of the site is outlined in Figure 1 of this report.

The property lies in an area of gently undulating farmland in the River Boyne Catchment at between 25 metres and 35 metres above sea level.

2.2 Land Use

The site and surrounding land is predominantly agricultural and is mostly used for grazing. Existing developments include a cement factory located to the north of the property. A number of water reservoirs are located in the vicinity of the Carranstown site, as indicated in the proposed Development Plan for Co. Meath. These reservoirs are aboveground contained water-storage tanks, and will not be affected by any proposed developments in the site outlined in Figure 1.

2.3 Hydrology

2.3.1 Regional Drainage

The proposed area for development lies close to the Nanny catchment. The Nanny rises in the south-west of Co. Meath and flows through Duleek towards Laytown where it discharges to the sea. The Nanny drains a catchment of 250 km².

2.3.2 Local Drainage

Surface water in the vicinity of the site appears to drain naturally through land drains along the field boundaries, following the natural topography of the landscape towards the River Nanny. A walk-over survey of the site indicated the absence of any naturally occurring streams, and all drainage channels appeared to be mostly dry due to the summer conditions.

2.3.3 Meterological Data

A meterological station is located at Duleek village, which is located approximately 2 kms south-west of the proposed site. The average rainfall at this station is 802 mm per annum, as measured in the period 1951 – 1980. The monthly averages vary from a low of 57 mm in April to a high of 87 mm in December.

The average monthly rainfall is lower than the average evapotranspiration during the months April to August. In the remaining 6 months, the rainfall exceeds evapotranspiration with the greatest rainfall surpluses being recorded in the months November, December and January.

2.4 General Geology and Hydrogeology

In considering the impact of the proposed development on the geology and groundwater quality, K.T. Cullen & Co. Ltd. have examined the following factors:

- Rock type and permeability
- Overburden type, thickness and, permeability
- Depth to water table
- Importance of groundwater as a resource
- Groundwater vulnerability

Data has been collated from investigations undertaken by this office and from the GSI database for Meath County.

2.4.1 Bedrock 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 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.

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 consists of at least 300metres deep of grainstones, which can be subdivided into some 18 units depending on their composition, grainsize, chert content and colour. 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.

2.4.2 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, and allow some water movement through the otherwise low permeability clay material.

2.4.3 *Hydrogeology*

The regional limestone bedrock constitutes a regionally important aquifer which displays both karst and fracture flow features. Groundwater within the limestone aquifer flows eastwards and either discharges directly into the Irish Sea or into the Boyne and Nanny River systems as base flow. Based on the groundwater flow direction for the proposed site, the groundwater discharges into the River Nanny by means of local tributaries of the Nanny.

Currently the limestone aquifer in the vicinity of the site is used by a large number of groundwater abstractors. Figure 2 shows the location of these abstraction points. This information was obtained from the Environmental Impact Statement entitled "Proposal for the Development of Limestone Quarry" dated 1997 and produced by Brady Shipman Martin.

Irish Cement Ltd., located to the north west of the development site, is currently de-watering the groundwater for their quarrying activities. It is estimated that the groundwater level in the limestone aquifer has been lowered by 5.0 to 9.0 metres below its normal level in the vicinity of this site, and will remain lowered until the extraction of rock discontinues. This dewatering has altered the natural groundwater flow within the bedrock aquifer, which currently flows towards the Platin abstraction zone.

The till overburden on site contains groundwater, however this has moderate to low permeability thus holding little or no potential for groundwater development. The overburden water does represent a pathway for potential localised contaminant migration.

3 FIELD ACTIVITIES

Field activities for the purpose of this hydrogeological investigation were undertaken in May 2000 and consisted of the following stages:

- Soil Sampling
- Monitoring Well Installation

- Trial Well Installation
- Groundwater Sampling
- Elevation Survey

3.1 Soil Sampling

A total of seven trial pits (TP-1 to TP-7) were excavated across the site, the sampling locations are shown on Figure 3 of this report. 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 °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 C.

3.2 Monitoring Well Installation

Four permanent monitoring boreholes locations (MW-1, MW-2, MW-3 & MW-4) were drilled by Tom Briody & Sons Ltd. under the continuous supervision of a K.T. Cullen & Co. Ltd. (KTC) Geologist. The well locations are shown on Figure 3 of this report. These locations were selected during the preliminary site inspection based on anticipated groundwater flow directions.

Monitoring Wells MW-1, MW-2 and MW-3 were installed in the overburden to monitor groundwater quality and movement in the shallow water table. MW-4 was installed into the bedrock, and was used as an observation well for the trial well (TW-1) pumptest.

Drilling and well construction logs are included in Appendix A of this report. A continuous examination of the drill cuttings from each well boring provided information on the sediments and water table depths beneath the site.

The depths and screened intervals of the wells were chosen based on the geology encountered during drilling. Well borings were drilled to depths depending on their location on the site and the geology which was encountered.

Narrow slotted screen was installed at all well borings locations, with an internal diameter of 0.05 metres. All screens were connected to the surface by PVC risers. A fine gravel pack was installed around each screen in order to filter water entering the well. Each pack was sealed above by a bentonite seal in order to prevent the vertical migration of fluids through the well annulus.

3.3 Trial Well Installation

TW 1 was drilled to a depth of 75 metres by Tom Briody & Sons Ltd. under the continuous supervision of a K.T. Cullen & Co. Ltd. (KTC) Geologist. The well location is shown on Figure 3 of this report. The well log is included in Appendix A. The overburden consisted of gravelly clay to 9.7 metres with a sand layer from 5.5 to 6.7 metres. This was underlain by sandy gravel to 13.4 metres. There was little water in the overburden. The limestone was weathered and broken from where it was encountered at 13.4 to 14.3 metres. This was underlain by solid grey limestone to 67.1 metres. The limestone was fractured and weathered at this depth and infilled with gravelly clay to the end of the borehole, at 75 metres below ground level.

The groundwater yield from the well during drilling indicated that a pumping test should be carried out to estimate the potential yield and quality. An average yield of 470m3/day was pumped for the 72 hour pumptest with a resultant drawdown of 2.99 m (i.e. a water level of 23.72 metres below ground level). TW 1 recovered to 0.32 metres of the static water level within one hour of the pump being turned off.

Water levels in three monitoring wells MW 2, MW 4 and a private monitoring well located c. 20 metres from TW-1 outside the site boundary, were recorded during the pumptest. Water level data for MW 2 shows a drawdown of 0.48 metres at the end of the pumptest. MW 4 was at static water level having been drawdown by 0.06 metres. The drawdown in the private monitoring

The soil analytical results are presented in Tables 1 – 5.

4.1.1 *Heavy Metals*

The analytical results for heavy metals are presented in Table 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.

4.1.2 *Volatile Organic Compounds (VOCs)*

The VOC analytical results for soils are presented in Table 2. 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.

4.1.3 *Polynuclear Aromatic Hydrocarbons (PAHs)*

The analytical results for the PAHs are presented in Table 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.

4.1.4 *Polychlorinated Biphenyls (PCBs)*

The analytical results for PCBs are presented in Table 4. No PCBs were detected in any soil sample above the laboratory detection limit of 1 µg/kg (laboratory detection limit).

4.1.5 *Pesticides*

The analytical results for Pesticides are presented in Table 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).

4.2 Groundwater Analytical Results

The water analytical results are presented in Tables 6 - 10.

4.2.1 Inorganics & Heavy Metals

The analytical results for Inorganics and Metals for MW-2 and MW-4 are presented in Table 6(a) of this report.

A number of inorganic parameters were slightly elevated at both monitoring well locations, including Iron and Manganese. The indicator parameters for agricultural contamination were also slightly elevated in the shallow well location MW-2 and included Nitrate, Nitrite and Total Ammonia.

Where Potable Water MAC values are available, the heavy metal concentrations were below their respective threshold values.

Analytical results for TW 1 are presented in Table 6(b). The raw water meets the MACs for Potable Water SI No. 81 of 1988 for all parameters except Nitrate. There were no Coliforms, E. Coli. or Faecal Streptococci present in the raw water sample. This single result indicates that the groundwater is bacteriologically suitable as a potable supply.

4.2.2 Volatile Organic Compounds

The VOC analytical results for the monitoring wells MW-2 and MW-4 are presented in Table 7. The Geochem Group Laboratories analysed for 40 individual VOCs, in accordance with the US EPA Method 624 list.

All samples analysed for were below the laboratory detection limit of 1 μg/l.

4.2.3 Polynuclear Aromatic Hydrocarbons (PAHs)

The 16 priority PAH pollutants, for groundwater are presented in Table 8. A number of PAHs were slightly above the laboratory detection limit of 0.01 μg/l, however these PAHs can be found naturally at such low concentrations. Detected concentrations for all other PAHs were below the laboratory detection limit of 0.01 μg/l.

4.2.4 *Polychlorinated Biphenyls*

The analytical results for PCBs are presented in Table 9. PCBs were not detected in any samples above the laboratory detection limit of 0.1 μg/l.

4.2.5 *Pesticides*

The analytical results for Pesticides are presented in Table 10 of this report. Pesticide compounds were not detected in any samples above the laboratory detection limit of 1 μg/l.

5 SUMMARY OF FINDINGS

5.1 *Initial Observations*

The initial visual walk-over survey showed no physical evidence of contamination across the c. 25 acre site.

The physical examination of the soil and groundwater samples carried out at the Greenfield Site, Duleek, Co. Meath revealed no physical evidence of contamination, such as chemical odours, iridescence, or other signs of contamination in any of the samples.

5.2 *Soil Quality Investigation*

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

Cadmium	TP-1 only
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.

5.3 *Groundwater Quality Investigation*

Groundwater results also indicated above background concentrations for some of the inorganic and metal parameters, including the following:

Iron	MW-2 and MW-4
Manganese	MW-2 and MW-4
Nitrate	MW-2 only
Nitrite	MW-2 only
Ammonia	MW-2 only

All other groundwater results reflected normal background conditions for this type of environmental setting. Concentrations for all parameters were below the Potable Drinking Water MAC Guidelines.

Due to the nature of the bedrock, groundwater results from TW 1 indicated a naturally elevated concentration for calcium, which is typical of this type of geological setting. Concentrations for all parameters except Nitrate were below the Potable Drinking Water MAC Guidelines.

5.4 Evaluation of Groundwater Potential

The average yield of 470m3/day was pumped for the 72 hr. pumptest with a resultant drawdown of 2.99 m (i.e. a water level of 23.72 metres below ground level). TW 1 recovered to 0.32 metres of the static water level within one hour of the pump being turned off. The minimal effect on the water levels in the monitoring wells indicate that the water supply for the proposed development can be meet from groundwater.

6 CONCLUSIONS

6.1 Soil and Groundwater Quality

The results of the soil and groundwater sampling suggest that there is no significant soil or groundwater contamination at the Carranstown greenfield site in Duleek. However some traces of heavy metals were identified in the soil across the site, and inorganic contaminants including Nitrate, Nitrite and Ammonia were observed in the shallow water table in MW-2 and Nitrate in TW 1. Heavy metals, Nitrates and Ammonia in soils and groundwater can be associated with previous landspreading activities, in particular the spreading of wastes from the piggery industry.

High inorganics in the shallow groundwater, as observed in MW-2 can include landspreading

activites, slurry pits or septic tanks. Contamination of this nature is typically associated with some form of agricultural activity.

It should be noted that the levels of contamination are slight, and commonly reflect agricultural works carried out in the vicinity of this site.

6.2 *Site Vulnerability*

Based on visual observations made on site during drilling and soil sampling, the overburden consists of boulder clay and gravels with occasional sand and gravel lenses throughout. Where clay is present, it should act as protection to the underlying bedrock aquifer from surface contaminants.

Based on the thickness and type of overburden cover, the aquifer vulnerability for this site is considered moderate (GSI Guidelines for aquifer protection). According to the GSI, the bedrock aquifer is classified as regionally important, aquifer, Rf. As the Vulnerability Rating of the overburden is considered moderate, the site is considered to have a Resource Protection Zone Classification of Rf/M (see Appendix E).

6.3 *Groundwater Abstraction*

Drilling results and a pumptest indicated a high potential for groundwater development at the site (c. 20m³/hour) from a single borehole. It is reasonable to assume this yield could be increased using a well field approach. The raw water sampled from the trial well TW 1 met the Potable Drinking Water MAC Guidelines, with the exception of Nitrate. It should be noted that the Nitrate concentration at MW-4 bedrock monitoring well was below the Potable Water MAC, and Nitrate levels in the general vicinity of this site are generally below the Water MAC.

Due to the indication of minor contamination from agricultural activities in the shallow aquifer, adequate measures should be incorporated in the design of the production well to ensure against the vertical migration of contaminants through the borehole annulus.

6.4 *Future Monitoring*

Additional sampling of the trial well TW-1 should be undertaken in the near future to determine the variation in the concentration of Nitrates in the bedrock aquifer.

To assess any variations in groundwater during the development of the Carranstown Greenfield Site, bi-annual monitoring of certain indicator parameters at all sampling locations is recommended. This analysis should include any parameters, which were observed to exceed the MAC Values discussed previously.

Respectively submitted,

K. T. Cullen & Co. Ltd.

CONOR WALL M.Sc., Dip. EIA Man. — DATE 11th July 2000

TERI HAYES M.Sc., PGeo — DATE 11/7/2000

5. Hydrogeology & Aquifer Classification

5.1 Introduction

Groundwater is a very important resource and provides about 20% of the public water supply in County Meath. 28% is taken from major rivers and 17% from lakes. The remaining 35% is obtained from other local Authorities: Drogheda Corporation (which extracts from the River Boyne to supply east Meath), Dublin County Council (extracts from the River Liffey at Lexlip), Westmeath County Council and Cavan County Council.

Meath County Council operates 14 major groundwater supplies and 51 minor groundwater supplies, some of which supply only a few houses each. Groundwater from all the major supplies and 17 minor supplies (Table 5.1) were sampled for chemical and bacteriological analyses. The following minor supplies were not sampled due to their very small demand:

Table 5.1 Minor County Council Supplies

Minor County Council boreholes (*A)		Minor County Council Supplies (*B)	
Anneville	Donore	Ballinabrackey	Moylough
Balfeaghan	Julianstown	Baltrasna	Mullaghroy
Ballymacad	Knockmark	Baxter	Mullaghteelin
Bective	Leggagh	Belper	Rathkeenan
Carnaross	Moat	Collestown	Ross Road
Castlepole	Oakley Park	Crowpark	Ross
Clonlyon	Ross	Croboy	Toberultan
Cookstown		Danestown	
Crossdrum		Dean Hill	
Cross Guns		Mitchelstown	

**The locations of the minor sources listed (A) in the above table, have been verified and these wells are still in operation. The sources listed in (B) have not been verified.*

There are also many private abstractions of groundwater for industrial, domestic and farming purposes. Well data have been compiled from a variety of sources including GSI surveys, water well drillers, consultants' reports and the Council. The data are unevenly dispersed throughout the county and vary in quality from very poor to good.

Many wells have not been adequately tested to obtain reliable information on the specific aquifer characteristics. The well records are incomplete, and many private wells are not recorded. Some of the data are out of date, especially where boreholes have now replaced old shallow dug wells.

5.2 Aquifer Classification

The rocks in Co. Meath have been classified into three main bedrock aquifer categories, with each category being sub-divided into two or three sub-classes.

1. **Regionally Important Aquifers**
   (i) Groundwater flow mainly in Karst conduits (enlarged by solution) (**Rk**)
   (i) Groundwater flow mainly in fissures/fractures in the rock (**Rf**)
2. **Locally Important Aquifers**
   (i) Generally moderately productive (**Lm**)
   (i) Moderately productive only in local zones (**Ll**)
3. **Poor Aquifers**
   (i) Generally unproductive except for local zones (**Pl**)
   (i) Generally unproductive (**Pu**)

The Quaternary deposits of sands and gravels are classified as aquifers where they are sufficiently extensive (greater than 1km^2) and have a saturated thickness of at least 5m. Sand and gravel aquifers are classified into Regionally or Locally important:

1. **Regionally Important Aquifers:** Greater than 10km^2 in extent (**Rg**)
2. **Locally Important Aquifers:** Less than 10km^2 in extent (**Lg**)

5.3 Regionally Important Aquifers

The Shallow Water Limestones are the only rocks in Co. Meath which fall into the regionally important category and are classified as having both karst flow dominant (Rk on the map) and fissure flow dominant (Rf on the map) in different areas. These rocks are found in the east just south of Drogheda, in the north from around Ardagh to Nobber, and in the west around Lough Sheelin.

These limestones are pale grey, thickly bedded, fine to coarse grained limestones with abundant fragments of crinoids and coral fossils. The lower part of the rock succession is often dolomitised and karstified, which can be seen where drift cover is absent. These limestones have a moderate to good secondary permeability and the development of joints and fissures by solutional processes and the dolomitisation and decalcification have increased the available storage of the limestones. The greater the degree of solution within the limestones, the greater the likelihood of karstic features and thus karstic groundwater flow patterns. The permeability of the resulting solution features may have been reduced by later (Quaternary) infilling with sands, silts and clays.

5.3.1 Regionally Important Aquifers - karst flow dominant (Rk)

The shallow water limestones in the Kingscourt Outlier around Ardagh to Nobber are classified as having karst flow dominant (Rk on the map). This classification is based on evidence from County Monaghan, where there is extensive karstification of this limestone unit; swallow holes, caves, collapse features and springs have been observed (Personal Communication, M. Burke). These limestones in County Meath have been extensively covered by Quaternary subsoils and karst features have not been located except for two swallow holes which were noted by John Jackson (1955) just south of Barley Hill House, Ardagh, where dark grey micaceous shales overlie dolomitised clean limestones. Evidence for some palaeokarstic features are also reported at Bridge Farm quarry, Nobber and Barley Hill quarry, Ardagh.

The well records show two locations with "excellent" well yields in excess of 1000m^3/d (at Meath Hill and Rolagh). The Meath Hill well was artesian with an overflow rate of 600m^3/d, and the specific capacity was 550m^3/d/m. A third "good" well was located north of Nobber (270m^3/d) and the specific capacity was 38m^3/d/m, while the apparent transmissivity was 50-60 m^2/d.

Based on the geology, evidence for karstication and the occurrence of high yielding wells, these shallow water limestones are classified as a Regionally Important Aquifer - karst flow dominant (Rk on the map).

* The Site at Carrans Cross for the proposed Incinerator has karst features. See Platin Quarry Ext. G.I.S.

5.3.2 Regionally Important Aquifers - fissure flow dominant (Rf)

The remainder of the shallow water limestones which are found in east Meath, just south of Drogheda, and in the west around Lough Sheelin, are classified as having fissure flow dominant (Rf on the map), as the evidence available at present does not indicate extensive development of karst.

The presence of fissuring within these limestones at Drogheda is shown in boreholes at Drybridge, Co. Louth, (drilled as part of the investigation by the North East Regional Development Organisation (NERDO) in 1981), where 8m out of the 16m of borehole which was calliper logged had a diameter greater than the drill bit size. Trial wells at Mell, County Louth also showed cavities up to 10% of the total rock penetrated. The porosity is estimated at 5% at Mell Quarries and 10% at Platin Quarry (NERDO 1981).

Recent borehole records from the site investigation for the Northern Motorway in these limestones have recorded cavities/fissures with a vertical depth up to 3m (BMA 1995). Evidence from the Platin Quarries in Co. Meath also suggests karstic solution of fissures has developed within this limestone.

N.B.

The GSI manuscript maps record karstic features at Ross Quarry, near Lough Sheelin, Co. Meath. George Du Noyer illustrates deep hollows and trenches in the surface of the limestone at Ross Quarry, which were later infilled with stiff brown clay and overlain by a gravelly limestone till. This illustration (on the cover of this report) may represent a buried or infilled karst system, which is no longer in operation.

From the well records six locations indicate well yields in excess of 100m^3/d. The highest yield was at Platin Quarry, with a present pumping rate of 3,600m^3/d. A sand filled fissure was encountered in Production Well No.2 between -17m O.D, and -19m O.D. The specific capacity at the end of the pumping test was 230m^3/d/m, while the transmissivity ranged from 80-150 m^2/d.

Based on the geology, evidence for fissure flow and the presence of 'good' wells, these shallow water limestones are classified as a Regionally Important Aquifer - fissure flow dominant (Rf on the map).

5.4 Locally Important Aquifers

Locally important aquifers cover approximately half of Meath and are mainly located in the south.

5.4.1 Locally Important Aquifers - generally moderately productive (Lm)

5.4.1.1 Permian & Triassic

These rocks outcrop within the Kingscourt Outlier in the north of Co. Meath. The Permian and Triassic are a very significant aquifer in Northern Ireland due to the high yields. As a result of their small areal extent (<25Km^2) in the Republic they are classified as only "Locally important and generally moderately productive" (Lm on the map).

They generally consist of red shales, siltstones and sandstones. There is little hydrogeological information available for these rocks in Co. Meath. An investigation at Knocknacran Mine, Co. Monaghan by Geoffrey Walton (1982) indicated transmissivities in the range of 20-200m^2/d.

The North East Regional Development Organisation (NERDO) drilled at Mullantra, Kingscourt in 1981 to investigate the potential of the Triassic sandstone. The sandstone was very friable and liable to collapse. The well yielded 915m^3/d with a specific capacity of 23-33m^3/d/m. Transmissivity was calculated at 48m^2/d. The aquifer is locally confined by 48 metres of till at this location. Recent drilling (1994-1996) east of Kingscourt in Countries Cavan, (Corgarry) Monaghan (Descart) and Meath for the Kingscourt water supply, indicated estimated yields between <10 to >1000m^3/d. The high yielding wells which were tested indicated specific capacities of 110m^3/d/m. One of the wells encountered a grey to white rock unit which may be gypsum (calcium sulphate). The Triassic

sandstones also contain very muddy and silty units which can give very poor yielding supplies. During the pumping tests, steady state conditions were not obtained (Personal Communication, K. O'Dwyer, K.T. Cullen & Co.).

The highly weathered Permian and Triassic sandstones are capable of transmitting large volumes of groundwater, although the interbedded mudstones can act as barriers to groundwater movement. Karstic features have been developed in the gypsum units (revealed by mining) and can transmit groundwater. The quality of water from the gypsum units could be unacceptable for drinking as a result of the very high sulphate concentrations that would be expected.

Based upon the lithologies and hydrogeological data available the Permian and Triassic rocks have been classified as "Locally important aquifers - generally moderately productive" (Lm on the Map).

5.4.1.2 Namurian Sandstone

The Namurian succession found in the Kingscourt Outlier is younger than the successions found elsewhere in Meath and is composed of thick alternating sequences of sandstones with shales. These sandstones are poorly cemented and often very weathered which increases their permeabilities.

Recent drilling (1994-1996) in the Namurian east of Kingscourt in County Meath, for the Kingscourt water supply, encountered yields estimated between 200 to 800m^3/d from four trial wells. These high yielding wells indicate the potential of these sandstones for groundwater development. The pumping tests which were conducted on these trial wells provided specific capacities from 40 - 85m^3/d/m. During the pumping tests, steady state conditions were not obtained (Personal Communication, K. O'Dwyer, K.T. Cullen & Co.).

The Council well at Kilmainham provided a discharge of 240m^3/d with a transmissivity in the order of 15-30m^2/d and a specific capacity of 6m^3/d/m.

The results of the drilling have established the potential of these rocks as an aquifer and on this basis the Namurian rocks of the Kingscourt Outlier have been classified as "Locally important aquifers - generally moderately productive" (Lm on the Map).

5.4.1.3 Calp Limestone

The Calp limestone occur over much of the county, particularly in the south. They are composed of dark grey to black, fine grained, well bedded limestones and shales.

The base of the Calp succession consists of coarse grained, cleaner limestones with occasional thin shale bands and often sandstone units are present. Where these variations are encountered especially where secondary permeability is well developed due to the faulting of the rocks, well yields are often much higher than would be expected for the Calp limestones. The lower Calp limestone may also be dolomitised in certain areas.

The base of the Calp limestone succession is more productive than the top but not enough geological information is available to divide the Calp limestone. Basal Calp limestone is found for example at Curragha, and at Kilmoon where the underlying Lower Palaeozoic rocks were encountered.

The upper Calp limestone are deeper basinal limestones and are dominantly fine grained black shales with limestones. The higher shale content ensures a much lower permeability and results in a lower yield. The cleaner limestone units are also found closer to the basin margins where they have slumped into the deeper water sediments.

In Co. Dublin, the proposed Powerstown Landfill site (County Fingal), located on Calp limestone was classified as "Locally important aquifer, moderately productive only in local zones" (Ll) by the consultant to An Bord Pleanala. The site investigations undertaken are site specific and cannot be applied to the entire Calp limestones of Counties Dublin and Meath. This classification of the Calp (Ll) concurs with the GSI's views for the Calp limestones in County Dublin.

5.4.2.2 Waulsortian Limestone

The Waulsortian bank or reef limestones are comprised of almost unbedded pale grey, very fine grained limestones which formed as massive mounds of lime mud. These limestones originally had very open structures with a large cavity volume. These cavities may or may not have been later infilled with calcite. Clean limestones such as the Waulsortian are highly susceptible to dissolution and karstification which involves the enlargement of the primary openings.

The Waulsortian can also be extensively dolomitised which is often joint or fault controlled. Dolomitisation increases the porosity of limestones by up to 15%. Dolomitisation and karstification are usually local and unpredictable, which gives the limestones a greater potential to provide high yielding wells, but frequently gives very low yields (<20m^3/d).

There is very limited evidence of dolomitisation and karstification within the Waulsortian of Co. Meath, other than the warm springs. Two warm springs in particular are located in the south near Longwood: St Gorman's Spring and Ardanew Spring.

The Geothermal Project undertaken by Minerex Ltd. in 1983 found that Waulsortian reef limestones tended to have groundwater circulation, whether it was cold or warm water. As part of the Geothermal Project two boreholes were drilled adjacent to St Gorman's Spring to a depth of 13m. The first borehole, 2m from the spring encountered very broken Waulsortian limestone and a cavity which was connected to the spring. The second borehole, 12m from the spring also encountered fractured limestone. Both boreholes responded rapidly to the abstraction of water from the spring and to fluctuation in the pumping rate (1300-1800m^3/d). The temperature ranged from 20.9-21.3°C and the conductivity from 570-585µS/cm.

The well records indicate seven "good" wells (100-400m^3/d) which are all located around the Longwood and Summerhill areas. Specific capacities range from 5-140m^3/d/m and transmissivities from 30 to 40 m^2/d.

The Waulsortian has the potential of being highly dolomitised and karstified, but with the lack of good evidence it is classified as a "Locally important aquifer - moderately productive only in local zones" (Ll on the map).

5.5 Poor Aquifers

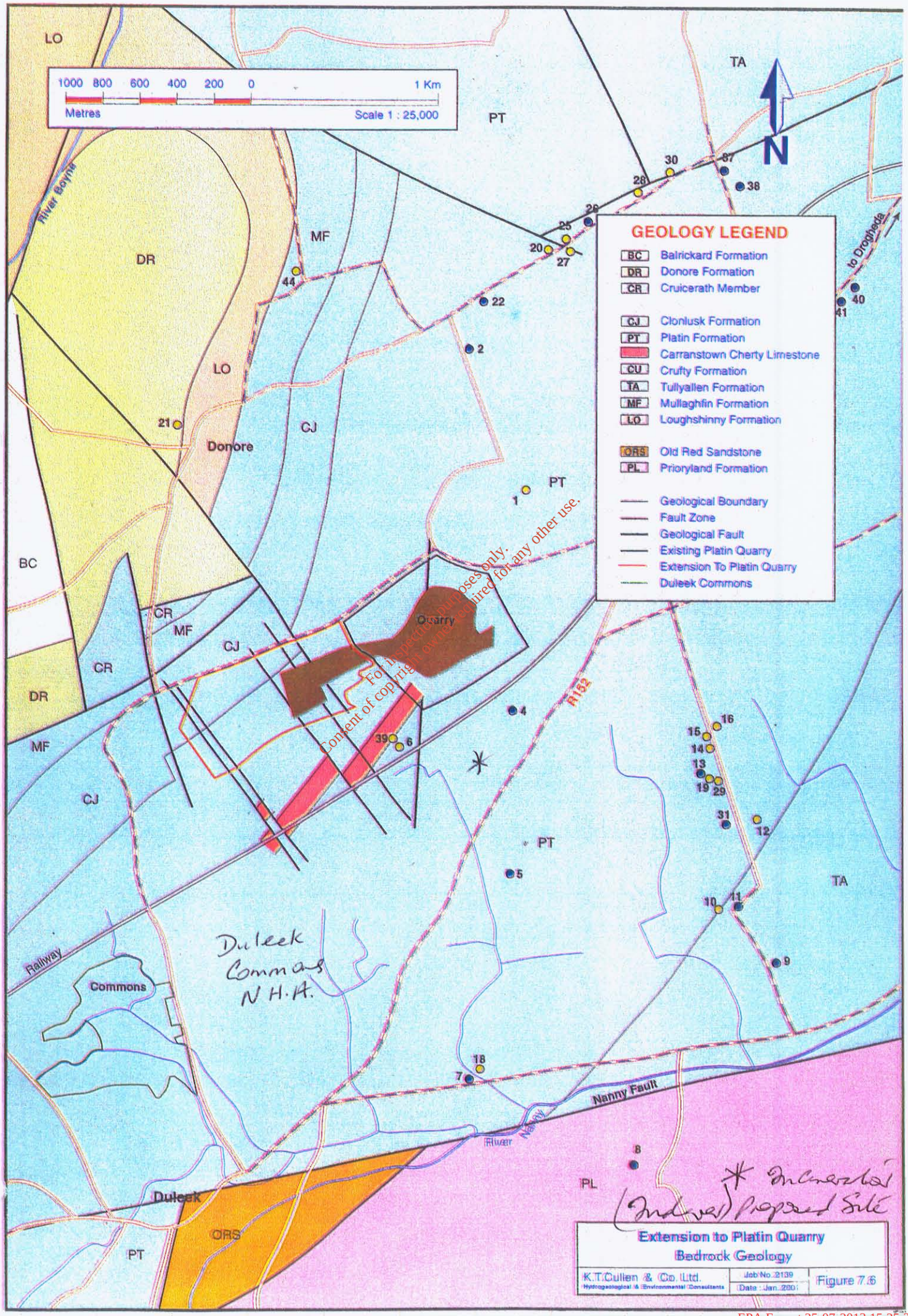
These aquifers are characterised by very low permeabilities and transmissivities and are therefore generally very low yielding. Consequently groundwater movement is relatively slow and is often restricted to shallow flow paths near the surface, along fracture zones or through slightly more permeable units. The water table is usually close to ground level and closely mirrors the topography. Well yields are often very low (<40m^3/d), though sufficient for domestic usage, and occasional high yields may be encountered.

5.5.1 Poor Aquifers - generally unproductive except for local zones (Pl)

5.5.1.1 Namurian Shale

The Namurian rocks in north Meath have been classified as locally important aquifers (section 4.3.1.2), while the remainder of the Namurian successions in the south are classified as poor aquifers. These rocks are predominantly composed of siltstones, mudstones and shales with only occasional sandstones. The sandstones possess slightly higher permeabilities and yields, owing to their greater ability to fracture than the shaly units.

Wells are in generally very low yielding, although higher yields have been recorded from Warrenstown and Summerhill with 545m^3/d and 110m^3/d respectively.



While these criteria relate to hazardous waste facilities, and many of the criteria are more applicable for a landfill site than a waste to energy plant, their application potential sites provided a useful objective assessment of the site's suitability.

(b) Feasibility Study for North East Region

The Feasibility Study on Thermal Treatment Options for the North East Region adopts a two stage site selection process of short listing and assessment, using the following criteria:

Short listing:

- Proximity to Origin of Waste
- Transport links with surrounding region
- Proximity to Potential Energy Users

Assessment:

- Cross border possibilities
- Site availability
- Transfer stations
- General considerations

These criteria are specifically designed for evaluating sites for thermal treatment plants in the North East Region and were therefore applied to the site selection exercise.

2.10.2 Alternative Locations Considered

An overall screening exercise was carried out with a view to finding suitable locations within the north east region. This preliminary screening involved the application of the above criteria, namely:

- Indaver's technical selection criteria.
- Steps 1&2 of the WHO selection procedure (where the criteria are applicable to non hazardous waste to energy facilities)
- Shortlisting criteria from the Feasibility Study for the North East

The most important criteria for selection of the general area in which to locate a Waste Management Facility are

a. the Centre of Gravity of waste production, that is to select the area where the haul distance to bring waste to the facility is minimised.

b. Existing industrial character and suitability for industrial development

c. Availability of Sites

(a) Centre of Gravity

In order to calculate the centre of gravity of waste production it was assumed that waste arisings in a town is approximately proportional to the population of that town. The total haul distance at any location is then estimated by:

- Multiplying the population of any given town by the distance of the town from the location (kilometers) for each town to give estimated tonne kilometer haul distance.
- Adding the estimated tonne kilometers haul distance calculated for each town to give the estimated total tonne kilometer haul distance.

The total estimated haul distance was calculated for each of the major towns in the north east. The estimated haul distance (to transport all waste from each of the other towns) for the towns is shown in Table 2.5 below and a detailed calculation is contained in Appendix B.

Table 2.5 Estimated haul distance to major towns in the north east region

Location	Population	% of Total Waste	Estimated Total Tonne Kilometres
Drogheda	25,282	20.81	**4,074,374**
Dundalk	30,195	24.85	4,496,021
Navan	12,810	10.54	4,669,212
Cavan	5,623	4.63	9,053,356
Monaghan	5,842	4.81	8,023,972
Duleek	1,731	1.42	**4,343,593**
Bailieborough	1,529	1.26	5,672,020
Kingscourt	1,190	0.98	4,719,136
Coothill	1,822	1.5	7,163,060
Belturbet	1,248	1.03	9,991,317
Ardee	3,791	3.12	**3,975,693**
Ashbourne	4,999	4.11	5,946,420
Laytown	3,678	3.03	5,254,130
Kells	3,542	2.92	4,997,747
Dunboyne	3,080	2.53	6,942,144
Dunshaughlin	2,139	1.76	6,082,512
Trim	4,405	3.63	6,154,026
Carrickmacross	3,617	2.98	4,770,540
Castleblaney	2,808	2.31	5,886,574
Clones	2,170	1.79	9,473,218

As can be seen from Table 2.5 above, the areas around which the haul distance is minimised are Ardee, Drogheda and Duleek.

In calculating the above tonne miles, the type of roads (motorway, primary routes, secondary roads etc) was not considered. This does not adequately weigh the selection process in favour of sites close to major transport routes (motorways and primary roads), and will tend to underestimate the suitability of sites located close to such roads.

The proximity of the M1 (Drogheda bypass) to the Drogheda and Duleek areas would allow access via motorway to Dundalk which is the largest population centre in the north east region. The Drogheda area also has the second largest population in the north east.

Ardee is also well positioned to provide motorway links to both Dundalk and Drogheda.

(b) Industrial Character

A major consideration in selecting the most appropriate location was to select an area with an existing industrial character. As no large scale industry is located in Ardee, it was not further considered.

So more of the same type of pollution (or worse) should be inflicted on the pop. of the area

The Platin Cement Factory is located some 5 km south of Drogheda and 2 km north of Duleek, and the existing character of the landscape is industrial in character.

The suitability of the Platin area for industrial development was confirmed by the decision of Meath County Council (which was subsequently upheld by an Bord Pleanala) to grant planning permission for the development of a power plant in the area. See Bord Pleanala Inspectors Report

Meath Co. Co Planners & An Bord Pleanala were forbidden in law to consider Env. normalise effects of these developments

(c) Availability of Sites

On the basis of the above criteria it was concluded that the Platin area was ideally suited for the development of a waste management Facility. A number of particular sites were chosen for detailed investigation and the land owners were approached. The Campbell family were refused permission for a houses times by Meath Co Co.

A site in Carranstown was found to be suitable based on the following, as well as satisfying the above selection criteria:

- Lack of designation as a National Heritage Area or a Special Area of Conservation. Untrue. It is contiguous w/ the Duleek Commons N.H.A
- Topography of site, to allow the large building structures to be built on lower ground, thus reducing the visual impact. It would still be seen from Bru na Boinne
- Low population density and distance to large residential development. Untrue, Drogheda is in the path of the prevailing S.W Wind
- Access to the R152 and sufficient road frontage to allow a suitable junction to be built.
- Proximity to electrical distribution system.

2.10.3 Detailed Assessment of the Carranstown Site

The Carranstown site is evaluated with respect to the selection criteria in the following sections. Section (a) relates the suitability of the site to the WHO Guideline Criteria while Section (b) evaluates the site according to the criteria used in the Waste Management Plan for the North East.

(a) WHO Criteria

The following Table (2.6) ranks the proposed site according to the criteria specified by the WHO guidelines. Many of the criteria specified in the guidelines are obviously designed for landfill sites and the applicability of the criterion to the proposed facility is therefore indicated.

As can be seen the site meets the criteria specified by the WHO, where applicable. Where the site does not rank highly with respect to any criterion, the Section where potential impacts are addressed is referenced.

Table 2.6 – Proposed Site Ranked According to WHO Selection Criteria

Step 1 – Eliminate Unsatisfactory Areas	Applicability of Criteria	Sensitivity of Site	Step 2 – Highlight Promising Areas	Applicability of Criteria	Ranking of Site
Coastal Areas Subject to Floods	Low[1]	Low	Industrial areas	High	High[4]
Coastal wetlands	Low[1]	Low	Sites of existing Waste Management Facilities	High	Low
Areas with limestone deposits	Low[3]	High	Compatible public lands	Low	Low
Areas with subsurface mining	Low[1]	Low	Abandoned properties	Low	Low
Areas critical for Aquifer recharge	Low[1] VERY HIGH	Low VERY HIGH	Lands with major highway access	High	High[5]
Lands designated for preservation	High	Low	Lands near waste generators	High	High[6]
Areas of high well yield	~~Low[1]~~ Very high	~~Medium[2]~~ Very high			
Areas of reservoir watersheds	~~Low[1]~~ Very high	~~Medium[2]~~ Very high			

Dublin ??

Notes:

1) These Criteria are mainly applicable to landfill sites
2) The aquifer is considered Locally Important – see Section 9 for assessment of impacts (Rubbish)
3) This criterion is mainly applicable to landfill sites. The potential impact of the plant on limestone reserves is addressed in Section 9.
4) Due to proximity to Platin Cement and the proposed power station
5) The R152 is a National Road with the capacity to accommodate traffic generated and the site is located 2km south of the planned M1 interchange – see Section 7 for assessment of impacts
6) The site is centrally located with respect to centres of waste production No ??!?

It is on the edge of the N E Region

Regionally Important ??!
Aquifer classified with some Karst * R/fH (according to Platin quarry ext. 6.1.5) (swallow holes mentioned)

Step 3 – Assess Promising Areas in Detail (environmental and human impacts)	Applicability of Criteria	Sensitivity of Site	Step 4 – Evaluate and Rank Sites	Applicability of Criteria	Ranking of Site
Riverine areas subject to floods	Low	Low	Population Density	High	High
Freshwater wetlands ; Dulek Commons (contiguous with)	~~Low~~ High N.H.A	~~Low~~ High	Response time of emergency services	Low[4]	Medium
Areas with flood hazards relating to a dam	Low	Low	Critical habitats or potential mineral developments	High	High
Coastal areas for shellfish and fishing	Low	Low	Groundwater and soil characteristics	~~Medium~~ VERY HIGH	Medium VERY HIGH
Areas upstream of water supply intakes	Low	Low	Slope	High	High
Areas of special significance	High	~~Low~~ High	Access to sewers	~~Low~~ none	~~Low~~
Visual corridors of scenic rivers	High	~~Low~~[1] High	Transport restrictions	High	High
Existing developed areas Schools and houses	High	Medium[2] High	Structures along transport corridors	High	Medium
Areas for which non industrial development is planned	High	Medium	Whether the area contains historic sites	High	High
Agricultural districts	High	High[3]	Visual impact	High	High
			Feasibility of acquisition	High	High

Regional Important Aquifer

Area of High Arch. Importance adjacent to Boyne Valley Bru na Boinn

Notes:

1) The potential visual impact on the Boyne Valley is addressed in Section 6
2) The proximity to Platin Cement and the proposed power station is a positive factor in this respect
3) The impact on land use in the area is addressed in Section 3
4) The plant will have its own fire fighting team and will be independent of external emergency services

(b) Feasibility Study for North East Region

The proposed site is evaluated according to the selection criteria as follows. In order to compare the assessment to that carried out in the feasibility study the proposed site is ranked according to the same methodology.

Proximity to Origin of Waste

The centre of gravity of waste production in the north east is very close to the proposed site.

Transport links with surrounding region

The proposed site is adjacent to, and has significant road frontage onto, the R152 regional road. This road is in a good condition, has a large capacity for traffic and connects into the existing N1 and N2 national primary routes. Furthermore, it is a short distance from the proposed new M1 motorway which is due to be finished by the time the facility would be commissioned. The site therefore has excellent transport links with the north east area.

Proximity to Potential Energy Users

The site is in close proximity to 110 kV power lines and to 38 kV power lines. It is also adjacent to Platin Cement – proximity to cement plants is specifically mentioned in the feasibility study. It is therefore relatively simple to export the electricity generated and it may be possible to identify a heat demand in the future.

Cross border possibilities

Indaver Ireland do not anticipate that the proposed facility would accept waste generated in Northern Ireland.

Site availability

As the Meath County Development Plan allows for industrial development on 'white land', there is a good deal of land available for development.

Transfer stations

As for proximity to waste, the proposed site is located centrally with respect to the major towns in the north east.

General considerations

The site, while located close to some residential dwellings is not located 'very close to any major residential areas'. While the site is not specifically zoned for industrial use, the proximity to the Platin Cement factory gives the area an industrial character, as was acknowledged by Meath County Council in the planning report of the proposed power station nearby.

As described above the site is on the R152 and has good transport links via the N1, N2 and planned new motorway.

(a) WHO Criteria

The WHO suggest a four step site selection procedure which is summarised in Table 2.4.

Table 2.4 – WHO Site Selection Criteria

Step 1 – Eliminate unsatisfactory Areas	Step 2 – Highlight Promising Areas
Coastal Areas Subject to Floods	Industrial areas
Coastal wetlands	Sites of existing Waste Management Facilities
Areas with limestone deposits	Compatible public lands
Areas with subsurface mining	Abandoned properties
Areas critical for Aquifer recharge	Lands with major highway access
Lands designated for preservation	Lands near waste generators
Areas of high well yield	
Areas of reservoir watersheds	
Step 3 – Assess Promising Areas in Detail (environmental and human impacts)	**Step 4 – Evaluate and Rank Sites**
Riverine areas subject to floods	Population Density
Freshwater wetlands	Response time of rescue squads and emergency services
Areas with flood hazards relating to a dam	Whether the site includes critical habitats or areas of potential mineral developments
Coastal areas for shellfish and fishing	Groundwater and soil characteristics
Areas upstream of water supply intakes	Slope
Areas of special significance	Access to sewers
Visual corridors of scenic rivers	Transport restrictions
Existing developed areas	Structures along transport corridors
Areas for which non industrial development is planned	Whether the area contains historic sites
Agricultural districts	Visual impact
	Feasibility of acquisition

Table 2.1 Summary of Impacts and Mitigation Measures

	Receiving Environment	Nature and Scale of Impact	Assessment of Impact	Mitigation Measures
Human Beings	The site is surrounded by agricultural land, some houses are situated along the local roads close to the existing quarry. The existing quarry and cement works employs 238 people directly and generates significant additional employment in various service and supply industries.	The development will help maintain the current level of employment in the cement works and quarry. The nature and scale of the impacts on Human Beings are dealt with in the relevant sections of this table.	Positive. See below	Not applicable See below
7Flora & Fauna	The site consists of 3 habitat types, arable crops, hedgerow and drainage ditch. These habitats are of little value. Fauna species are typical of the respective habitat types and are common throughout the county generally. Neither the flora nor fauna on site is of significant ecological interest. The site is not within any habitat designation (e.g. NHA, SPA). Adjacent habitats include tillage/pasture land, the river Nanny and Duleek Commons. The latter two are of some importance. Duleek Commons NHA	The proposed development will gradually remove the existing habitats on site. Recent studies have shown that the River Nanny and Duleek Commons will not be adversely affected by the proposal.	The impact will be minor as the site is of little ecological interest. None	Reinstatement of the site with scrub and woodland will create new habitats. None required.
Soil	The soils in the study area comprise a thick cover of glacial till.	The development of the quarry will result in the removal of soil from the majority of the site. This soil will either be used in the cement manufacturing process or for mounding on-site.	Significant (in that soil will be removed to allow rock to be excavated)	Soil removal is an inevitable step. The removed soil will either be used to provide landscape screening for the development, or be used as a raw material in the cement manufacturing process thus reducing the amount of silica bearing rock required in the process.

Table 2.1 Summary of Impacts and Mitigation Measures (continued)

	Receiving Environment	Nature and Scale of Impact	Assessment of Impact	Mitigation Measures
Water	The proposed development is located in the River Nanny catchment (draining 250km^2) close to the watershed with the River Boyne (draining 2,300km^2). Currently water is pumped from the quarry workings to the River Nanny. Water quality from this pumping is considered to be of potable quality.	The dewatering of the quarry extension will impact on local drainage patterns. A small reduction (0.5%) in the base flow of the river Boyne is expected. The extension of the quarry westwards has the potential to impact on Duleek Commons. Private wells may be adversely affected but is dependent on their proximity to the proposed development and their depth.	See below. Minor. Minor. Minor to significant.	The dewatering process will make additional supplies of water available to the River Nanny, which would be beneficial during periods of low flow. Restricting the quarry extension depth and range will ensure that Duleek Common is protected. Private wells shall be monitored and should impacts occur, measures such as deepening wells, drilling new wells or the provision of piped water supplies will be undertaken.
Air Quality & Dust	As part of an Integrated Pollution Control License monitoring of air emissions is currently required. Sources of air pollution and dust generation within the area arise from houses, road traffic, construction and agricultural activities, the cement works and the quarry. Dust deposition rates to date are well within given guidelines.	The proposed development is unlikely to generate additional impacts on the environment but instead relocate existing impacts. This impact will be principally on lands owned by Irish Cement Ltd.	Minor	A water bowser will be used to keep the quarry floor and haul roads wet. The regular servicing of vehicles which operate on the site is envisaged as well as minimising engine idling to reduce levels of combustion gases.

Table 2.1 Summary of Impacts and Mitigation Measures (continued)

	Receiving Environment	Nature and Scale of Impact	Assessment of Impact	Mitigation Measures
Noise and Vibration	Noise emissions from the quarry and cement works are governed by conditions in the Integrated Pollution Control License No. 268 issued by the Environmental Protection Agency. Blasting has taken place at Platin Quarry over the past thirty years, normally taking place once or twice a week.	The expected exceedances over existing ambient noise levels for both daylight and night-time hours are insignificant. For the working of the second and subsequent benches, the level of acoustic screening will increase and therefore ambient noise levels will decrease. Blasting has the potential to impact on the structure of houses and on human reaction.	Minor. Slight to Low.	Earth berms will be constructed on the north-western boundary of the site to provide acoustic screening. The best professional practice will be adhered to, which is currently used and will continue to be used. Continual monitoring will also be undertaken, as is the current practice.
Landscape	The landscape is predominantly used for agricultural purposes (arable and pasture) with some sporadic housing developments primarily located along the R152 road.	Initially the only visible aspect of the proposed development will be the construction of the berms along the site boundary. In the long term there should be no lasting adverse visual impact on the surrounding roads or properties.	Minor.	Tree planting with deciduous and evergreen trees along the proposed berms will screen the development. Internal hedgerows will only be removed as the quarry face progresses.
Material Assets (Traffic)	The proposed development is located along the R152 between Drogheda and Duleek. Truck movements during 2000 averaged 779 per week.	There will be no increase on the current levels of traffic on public roads due to the proposed development.	None.	None Required.
Cultural Heritage	The region in which the proposed development site is located is of historical and archaeological significance, although the proposed development site is situated on its extremity. Two features of archaeological significance were discovered during field walking. A fulacht fiadh and a hollow were found. Several townland boundaries divide the proposed development site. A small cottage and barn exist on the site and date back to the early part of the 19th century.	The two features of archaeological interest will be removed entirely due to the proposed development. Townland boundaries will inevitably be removed due to the proposed development site. The small cottage and barn will not be removed.	Minor. Minor. Not applicable.	A full archaeological excavation, resulting in the recording of the features will be undertaken. A full archaeological record of the townland boundaries will be made prior to their removal. All excavations and soil removal shall be monitored by a qualified archaeologist.

5 FLORA AND FAUNA

Introduction

5.1 The site proposed for the extension lies to the south-west of the existing quarry and consists of two shallow, linear ridges covered by a heavy glacial till soil. It is all cereal farmland. The fields have been somewhat enlarged since the O.S. map was drawn so not all the hedges are in existence today.

5.2 The area was visited in March 2000 when the flora and vegetation was examined and note taken of the vertebrate fauna. The survey method was a walkover corresponding to a Phase I Habitat Survey (JNCC 1990) but using the results of a recent habitat classification for Ireland (Fossitt, in prep.). The season is adequate to assess habitat quality and flora, though a few species of summer birds will have been missed.

5.3 The surrounding area is generally of similar agricultural land with housing on the roadsides and the town of Duleek to the south-west. There are small copses and ponds in places. A proposed Natural Heritage Area - Duleek Commons occurs 1.4 km from the site and is described below. Since it is a wetland site it was examined in some detail in autumn 1999.

Receiving Environment

Habitats & vegetation

5.4 This area falls from the road in Cruicerath in a south-easterly direction to a broad, flat valley of fields with a stream and line of trees at both edges. The currently used buildings are situated along the northern stream and there are two older groups on the roadside. Otherwise the only features are the hedges which are mostly as indicated on the O.S. map with two exceptions. The three recognisable habitats are arable crops, hedgerow and drainage ditch.

Arable crops

5.5 Autumn-sown cereals are grown in the entire area and the weed control has been such that in March there is almost nothing to be seen other than the wheat itself. At field edges there is sometimes annual meadowgrass *Poa annua*, scutch *Elytrigia repens*, chickweed *Stellaria media*, red deadnettle *Lamium purpureum* or groundsel *Senecio vulgaris* but by and large the crop runs to the edge of the field and the hedge is the next feature. Later in the season there are probably some other species but they are likely to be the ubiquitous 'weeds' of such places - knotgrass *Polygonum aviculare*, charlock *Sinapis arvensis*, field speedwell *Veronica persica* etc.

Hedgerow

5.6 The hedges consist of medium sized bushes of hawthorn *Crataegus monogyna*, blackthorn *Prunus spinosa* or gorse *Ulex europaeus* topped by small trees of ash *Fraxinus excelsior* or planted lines of poplars and beech. The poplars grow along the townland boundary that divides the site in a NE-SW direction together with a few sitka spruce and also on the south-eastern boundary where they are mixed with beech and larch. A short line of beech grows along the Platin road while the gorse forms an

almost pure hedge in the upper field parallel to this road. Bramble *Rubus fruticosus*, roses *Rosa canina*, *Rosa* sp. and privet *Ligustrum vulgare* make up the shrub species with honeysuckle *Lonicera periclymenum* and ivy *Hedera helix*.

5.7 The ground flora is rather uniform in most places with shield fern *Polystichum setiferum* and hartstongue *Phyllitis scolopendrium* in damper sites and elsewhere such species as:

Anthriscus sylvestris	cow parsley
Heracleum sphondylium	hogweed
Primula vulgaris	primrose
Viola riviniana	violet
Veronica chamaedrys	germander speedwell
V.serpyllifolia	thyme-leaved speedwell
Epilobium montanum	willowherb
Urtica dioica	nettle
Galium aparine	goosegrass

5.8 The townland boundary hedge in the western corner contains grey willow Salix cinerea, tutsan *Hypericum androsaemum*, grey sedge Carex divulsa and coltsfoot *Tussilago farfara* while the opposite boundary has wood avens *Geum urbanum* and male fern *Dryopteris affinis*.

Drainage ditches

5.9 The great majority of the hedges grow above and around a drain so that the vegetation of the two habitats are somewhat mixed together. However there are a few open stretches, especially along the two SW-NE valleys where wetland plants grow with minimal shading. Everywhere it is noted that the watertable is at a lower level than would be expected and terrestrial plants are tending to invade formerly more wet sites. At the south-eastern corner there is some wet grassland of creeping bent *Agrostis stolonifera* and scutch *Elytrigia repens* with a small stream running through it. Here sweet grass *Glyceria fluitans*, meadowsweet *Filipendula ulmaria*, great willowherb *Epilobium hirsutum* and wild angelica *Angelica sylvestris* grow and there is a little reed fescue *Festuca arundinacea* upstream. Midway up this valley a dug pool at a field corner contains fool's watercress *Apium nodiflorum* and glaucous sedge *Carex flacca* to this list while higher up a little yellow flag *Iris pseudacorus*, grey willow *Salix cinerea*, bittersweet *Solanum dulcamara* and soft rush *Juncus effusus* reach into this area from flatter ground to the south.

Adjacent habitats

5.10 The area surrounding the site is substantially similar in character with tillage and pasture on the undulating ground. Immediately to the south-east, the farm is in permanent pasture which has been established as such since the 1950's. Characteristic grass and broad-leaved species grow there but the vegetation, though varied, is not especially species-rich. A former marsh area has shrunken to a drinking place in a ditch though there is another larger feature to the south-west which retains marsh communities, if not standing water.

5.11 The Nanny River has a certain amount of botanical interest along its banks though it has been deepened and straightened for drainage purposes. Elsewhere, Duleek Commons is the major habitat of importance.

Fauna

5.12 Arable fields have a distinctive if small vertebrate fauna, containing principally rabbit and brown rat and some fox (in this case associated with a Prunus spinosa thicket in the middle of the north-eastern boundary above the present quarry). Wood mouse and house mouse also probably occur, but the presence of hedgehog is unlikely. A few pygmy shrew may live in the gorse hedge towards the north-western margin. There was no evidence of badger, which would not be expected to be more than an occasional visitor.

5.13 The habitat is not suitable for high numbers of bats but a few (most likely pipistrelle) may feed along the tree lines and roost in the roof spaces of the bungalow and/or older houses.

5.14 The breeding birds include yellowhammer which was present at good density, as well as chaffinch, greenfinch, linnet and goldfinch. These obviously benefit from seeds at harvest time but are unlikely to winter on site because of the autumn sowing. Other species are blackbird, song thrush, dunnock, wren and robin which are associated with the hedges. The tree lines are of some value to woodpigeon, chiffchaff and sparrowhawk - there was a probable nest of the latter species along the south-eastern boundary. The pheasant seems to nest sparingly and there was a single moorhen seen at the south-eastern corner. In summer willow warbler and occasional whitethroat are very likely to occur together with a few pairs of swallows, breeding in the farm buildings. None of these were suitable for a large number of nests.

5.15 Rook, jackdaw and magpie come to feed in the fields regularly but none seem to nest on-site. The peregrine also is likely to feed sporadically there as woodpigeons are an occasional prey item. In winter there would be some wintering thrushes (redwing and fieldfare) as well as snipe though conditions are not suitable for large numbers.

Evaluation

5.16 The area represents typical arable farmland with a characteristically limited flora and fauna brought about by the land use. There are no features of ecological interest and all species seen were common in the county generally.

Designations

5.17 The site is not included in any designated area (proposed Natural Heritage Area, candidate Special Area of Conservation etc) and is most unlikely to be in future. Likewise there are no habitats or species given special protection by the EU Habitats Directive (92/43/EEC) or listed by the Flora Protection Order 1999. The bird species have general protection under the Wildlife Act, except for the pest species (corvids and woodpigeon).

Impacts of Development

5.18 Quarrying will gradually remove the existing habitat and further dry out the ditches and streams. The lack of ecological interest in the site makes this process of no real significance except to the local features concerned.

5.19 The current evidence is that adjacent habitats - the Nanny River and Duleek Commons - will not be affected adversely.

5.20 The eventual restoration of the area around the quarry with scrub and woodland will restore a bird fauna that is at present restricted because of lack of nesting sites. Willow warbler and whitethroat will be favoured but yellowhammer is unlikely to return

as it prefers to nest in the hedges adjacent to cornfields. Despite some reduction this species is not regarded as scarce or endangered.

DULEEK COMMONS

Duleek Commons is contiguous * with the proposed Indaver Incinerator Site at Carnstown

Receiving Environment

5.21 Duleek Commons lies between the town and the Navan-Drogheda railway line and is enclosed by the two roads to Commons and Newtown Bridges respectively. It is a low-lying basin through which two tributaries of the Nanny flow in a series of ponds and ditches. In general the area is wet in winter as water tends to accumulate but there is also an input of spring or seepage water at a higher point on the southern side which forms a fen vegetation.

5.22 The area was examined in some detail because of its sensitivity to possible alterations in the groundwater.

Vegetation

5.23 The northern section is dominated by rushes *Juncus effusus*, *J.inflexus*, yellow flag *Iris pseudacorus* and tufted hairgrass *Deschampsia cespitosa*. Such clumped vegetation is well seen on the aerial photograph (Figure 5.1). Between the clumps are patches of wet grassland where grazing has reduced the height of large herbs like meadowsweet *Filipendula ulmaria* and knapweed *Centaurea nigra* and allowed grasses into the stand. Such areas include smaller species, such as:

Holcus lanatus	Yorkshire fog
Cynosurus cristatus	crested dogstail
Phleum pratense	timothy
Agrostis capillaris	common bent
Lolium perenne	ryegrass
Nardus stricta	mat grass
Trifolium pratense	red clover
Plantago lanceolata	ribwort plantain
Rumex acetosa	sorrel
Ranunculus acris	field buttercup
Senecio aquaticus	marsh ragwort
Leontodon autumnalis	autumn hawkbit
Hypericum tetrapterum	St John's wort

5.24 The surface is generally uneven with the remnants of artificial diggings and former channels adding to the undulating glacial deposits. The clayey nature of this material provides the waterlogging effect.

5.25 Ditches traverse the site and they are often lined with reed grass *Phalaris arundinacea*, sweet grass *Glyceria fluitans* and bur reed *Sparganium erectum* and have water starwort *Callitriche* sp., watercress *Nasturtium officinale*, fool's watercress *Apium nodiflorum* and forget-me-not *Myosotis scorpioides* growing in the water. Muddy places beside them have brooklime *Veronica beccabunga*, bog stitchwort *Stellaria uliginosa*, curled dock *Rumex crispus*, broad-leaved dock *R.obtusifolius* and creeping buttercup *Ranunculus repens*. One of the hedges in the centre has abundant bittersweet *Solanum dulcamara*.

5.26 The south-western corner is the location of fen vegetation produced by groundwater infiltration. There are several discrete springs but the ground also seems to be subjected to a general if slow upwelling. The water is lead generally northwards