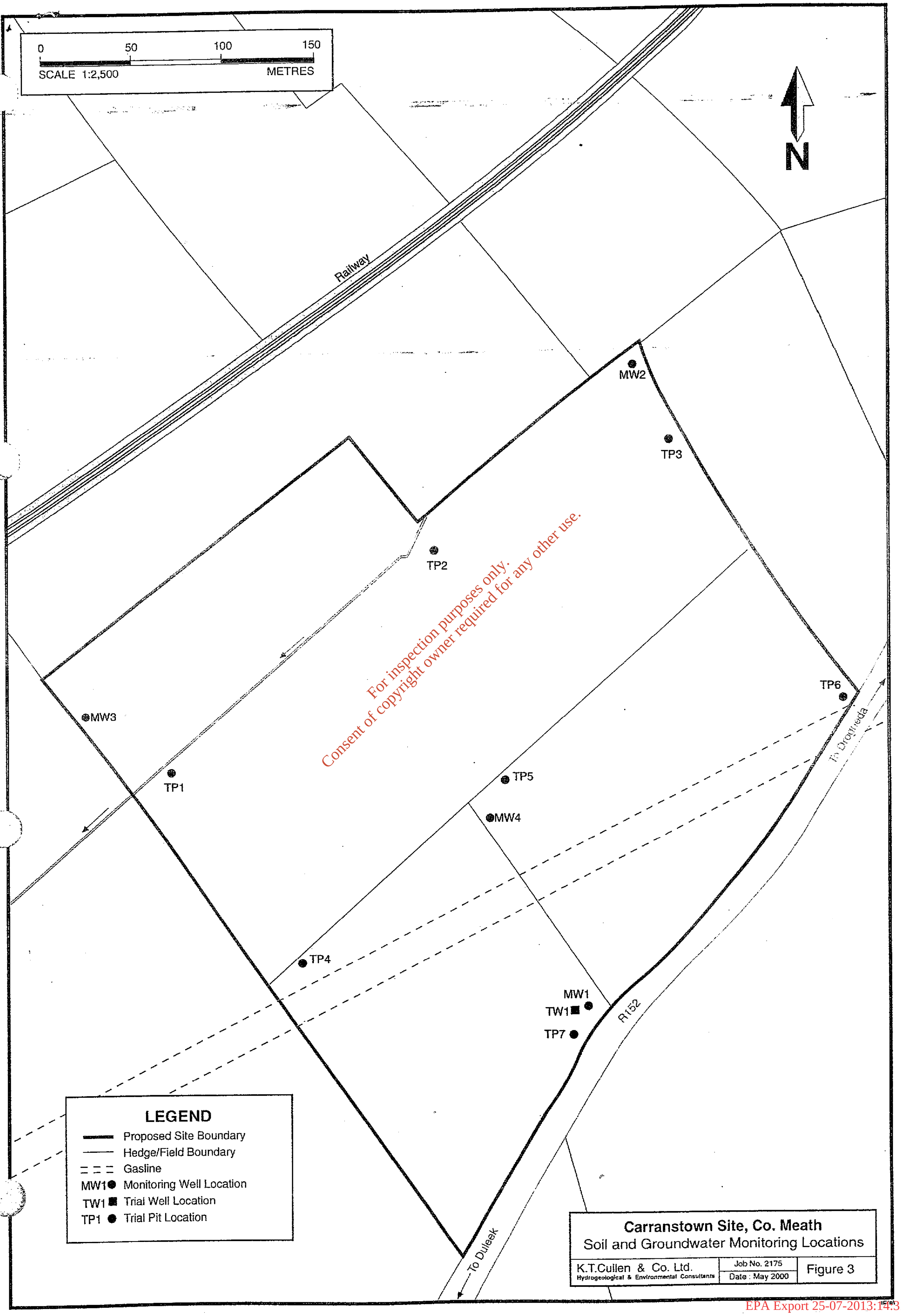

Drogheda
Bellewstown
Julianstown
Duleek
R. Nanny
R. Mosney
BOYNE ESTUARY
Boyne
R. Mattock


0
50
100
150
SCALE 1:2,500
METRES
N
Railway
MW2
TP3
TP2
TP6
MW3
TP1
TP5
MW4
TP4
MW1
TW1
TP7
R152
To Drogheda
To Duleek
LEGEND
Proposed Site Boundary
Hedge/Field Boundary
Gasline
MW1 Monitoring Well Location
TW1 Trial Well Location
TP1 Trial Pit Location
Carranstown Site, Co. Meath
Soil and Groundwater Monitoring Locations
K.T.Cullen & Co. Ltd.
Hydrogeological & Environmental Consultants
Job No. 2175
Date : May 2000
Figure 3

32a

SUBMISSION

On the eight of January, 2001 INDAVER quoted the W.H.O. criteria for site selection :-

STEP 1 of which was ELIMINATE UNSATISFACTORY AREAS. Included in such areas were: Areas with Limestone Deposits; Areas critical for aquifer recharge; and areas of High Well Yield. All three of which apply to the Carranstown Site.

In the same document they admit that the area they have chosen "Constitutes a Regionally Important Aquifer, which displays both Karst and Fracture features". Both of which would rule it OUT on the W.H.O. criteria.

They then go on to state in that document, that "The aquifer vulnerability for this site is considered MODERATE (By them) under the G.S.I. guidelines for aquifer protection, EVEN THOUGH the HYDROGEOLOGICAL MAPS FOR THE AREA IN QUESTION (held in Beggars Bush) show that part of the original site for which Planning Permission was sought is actually rated as EXTREMELY VULNERABLE and the remainder of the site is rated as HIGHLY VULNERABLE (both of which rule the site out on W.H. O. criteria. The maps in question are those drawn up by the Hydrogeological Survey of Ireland and are obtainable from their headquarters in Beggars Bush, Dublin 4.

The E.P.A. Inspector's report states that the Vulnerability of the site in question is HIGH, (not Moderate as stated by INDAVER).

The area of the site which was retrenched by Indaver "Illegally?" from the original site for which Planning Application had been made, is actually "EXTREMELY VULNERABLE" and when I asked Mr. John Aherne why they had retrenched that area from their original planning application , his explanation was that the "Family" wanted to retain that portion of the site. In view of the isolation of this part of their lands from the remainder of their property this sounded incredible to me, "Would it be possible therefore to obtain affidavits from the family that this was in fact the reason for the retrenchment, and not the fact that the area in question was discovered by Indaver to have been "extremely vulnerable""

As you can appreciate Inspector, if the latter were to be the case, that would be a very serious situation, where a firm would have submitted a knowingly faulty E.I.S. in order to obtain planning permission. So in the interests of allowing Indaver the opportunity to clear their name of such behaviour , can we get agents of the High Court to call to the family and obtain such affidavits?

Or perhaps Indaver would prefer to withdraw their application completely?

Similar inaccuracies occur in their treatment of "Land surface zoning for groundwater protection" where "Inter alia" they state in section 3.3.1 DELINEATION OF SOURCE PROTECTION AREAS that there areTWO areas recommended for delineation whereas in fact there are THREE.

They appear to have INADVERTANTLY left out the most important one . "In error perhaps?"

The first area for delineation is the SOURCE SITE (SS) The County Meath Groundwater Protection Scheme is at pains to point out that the SOURCE SITE is the most vulnerable and stresses that the simple approach of using arbitrary fixed radius method , "May UNDERPROTECT on the upgradient side" which is all the more important here at Carranstown where the natural flow in the aquifer is Eastward towards the sea.

Further the 100 day time of travel (TOT) is of little relevance here where we are dealing with an Incinerator, as we will not just be dealing with Bacteriological or Viral contaminants (whose life in the aquifer may usually be less than 100 days). Rather are we dealing with Dioxins whose half-life is measured in decades, and with Heavy Metals which will also be long term contaminants of the aquifer.

As this aquifer is now being used as a major source of drinking water for the people of East Meath, and South Louth (There is no regionally important aquifer in the whole of County Louth!) it is essential that NO RISK OF CONTAMINATION be allowed, as it would affect somewhere in the region of 100,000 people in the very near future.

One accident in an INCINERATOR in this site would ruin the drinking water for 100,000 people for several generations to come!

This type of RISK is unacceptable! An Incinerator such as this should not be built on a Regionally Important Aquifer. To do so risks the lives and the health of approx. 100,000 people, by virtue of the damage that one single accident could cause to the aquifer.

Indaver E.I.S.

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. Sandy subsoil)	Low permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30 m radius)
Extreme (E)	0 - 3.0m	0 - 3.0m	0 - 3.0m	0 - 3.0m	-
High (H)	>3.0m	3.0 - 10.0m	3.0 - 5.0m	>3.0m	N/A
Moderate (M)	N/A	> 10.0m	5.0 - 10.0m	N/A	N/A
Low (L)	N/A	N/A	> 10.0m	N/A	N/A

Notes: (1) N/A = not applicable.
(2) Precise permeability values cannot be given at present.
(3) Release point of contaminants is assumed to be 1-2 m below ground surface.

Table 1. Vulnerability Mapping Guidelines

3.3 Source Protection Zones

Groundwater sources, particularly public, group scheme and industrial supplies, are of critical importance in many regions. Consequently, the objective of source protection zones is to provide 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.

3.3.1 Delineation of Source Protection Areas

Two source protection areas are recommended for delineation: Source site omitted

- Inner Protection Area (**SI**);
- Outer Protection Area (**SO**), encompassing the remainder of the source catchment area or ZOC.

In delineating the inner (SI) and outer (SO) 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 ZOC. Also, the lack of a scientific basis reduces its defensibility as a method.

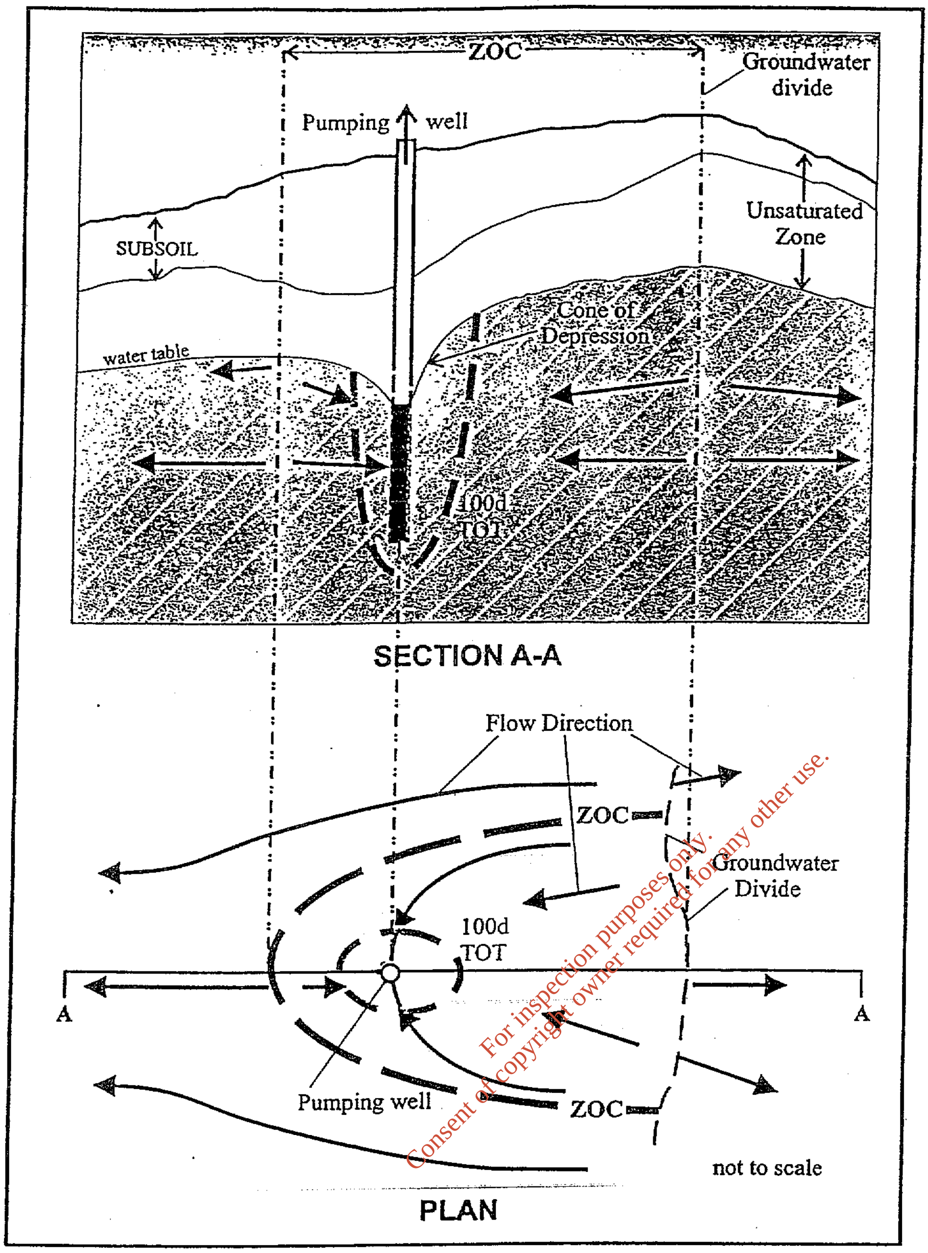


Figure 5. Conceptual Model of the Zone of Contribution (ZOC) at a Pumping Well (adapted from US EPA, 1987)

3.3.2 Delineation of Source Protection Zones

The matrix in Table 2 below gives the result of integrating the two elements of land surface zoning (SPAs and vulnerability categories) – a possible total of eight 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. The recommended map scale is 1:10,560 (or 1:10,000 if available), though a smaller scale may be appropriate for large springs.

VULNERABILITY RATING	SOURCE PROTECTION ZONE	
	Inner (SI)	Outer (SO)
Extreme (E)	SI/E	SO/E
High (H)	SI/H	SO/H
Moderate (M)	SI/M	SO/M
Low (L)	SI/L	SO/L

Table 2. Matrix of Source Protection Zones

Site omitted in Indaver document

Table 2.2. Matrix of Source Protection Zones

VULNERABILITY RATING	SOURCE PROTECTION		
	Site	*Inner*	*Outer*
Extreme (E)	SS/E	SI/E	SO/E
High (H)	SS/H	SI/H	SO/H
Moderate (M)	SS/M	SI/M	SO/M
Low (L)	SS/L	SI/L	SO/L

2.3.3 Groundwater Resource Protection Zones

For any region, the area outside the source protection areas can be subdivided, based on the value of the resource and the hydrogeological characteristics, into eight resource protection areas. *

Regionally Important (R) Aquifers

(i) Karstified aquifers (where conduit flow is dominant) (**Rc**)
(ii) Fissured bedrock aquifers (**Rf**)
(iii) Extensive sand/gravel (**Rg**)

Locally Important (L) Aquifers

(i) Sand/gravel (**Lg**)
(ii) Bedrock which is Generally Moderately Productive (**Lm**)
(iii) Bedrock which is Moderately Productive only in Local Zones (**Ll**)

Poor (P) Aquifers

(i) Bedrock which is Generally Unproductive except for Local Zones (**Pl**)
(ii) Bedrock which is Generally Unproductive (**Pu**)

These aquifer categories are shown on an aquifer map, which can be used not only as an element of the groundwater protection scheme but also for groundwater development purposes.

The matrix in Table 2.3 below gives the result of integrating the two regional elements of land surface zoning (vulnerability categories and resource protection areas) – a possible total of 24 resource protection zones. In practice this is achieved by superimposing the vulnerability map on the aquifer map. Each zone is represented by a code e.g. **Rf/M**, which represents areas of regionally important fissured aquifers where the groundwater is moderately vulnerable to contamination. In land surface zoning for groundwater protection purposes, regionally important sand/gravel (**Rg**) and fissured aquifers (**Rf**) are zoned together. as are locally important sand/gravel (**Lg**) and bedrock which is moderately productive (**Lm**). All of the hydrogeological settings represented by the zones may not be present in each local authority area.

Table 2.3. Matrix of Groundwater Resource Protection Zones

VULNERABILITY RATING	RESOURCE PROTECTION ZONES					
	Regionally Important Aquifers (R)		Locally Important Aquifers (L)		Poor Aquifers (P)	
	Rc	Rf/Rg	Lm/Lg	Ll	Pl	Pu
Extreme (E)	Rc/E	Rf/E	Lm/E	Ll/E	Pl/E	Pu/E
High (H)	Rc/H	Rf/H	Lm/H	Ll/H	Pl/H	Pu/H
Moderate (M)	Rc/M	Rf/M	Lm/M	Ll/M	Pl/M	Pu/M
Low (L)	Rc/L	Rf/L	Lm/L	Ll/L	Pl/L	Pu/L

2.4 Codes of Practice

The Codes of Practice contain a series of **Response Matrices**, each setting out the recommended response to a certain type of development. The level of response depends on the different elements of risk - the vulnerability, the value of the groundwater (with sources being more valuable then resources and regionally important aquifers more valuable than locally important and so on) and the contaminant loading. By consulting a Response Matrix in a Code of Practice, it can be seen (a) whether such a development is likely to be acceptable on that site, (b) what kind of further investigations may be necessary to reach a final decision, and (c) what planning or licensing conditions may be necessary for that development. The codes of practice are not necessarily a restriction on development, but are a means of ensuring that good environmental practices are followed.

Four levels of response (**R**) to the risk of a potentially polluting activity are recommended for the Irish situation:

R1 Acceptable subject to normal good practice.

R2[a,b,c,...] Acceptable in principle, subject to conditions in note a,b,c, etc. (The number and content of the notes may vary depending on the zone and the activity).

R3[m,n,o,...] Not acceptable in principle; some exceptions may be allowed subject to the conditions in note m,n,o, etc.

R4 * Not acceptable

2.5 Integration of Groundwater Protection Zones and Codes of Practice

The integration of the groundwater protection zones and the code of practice is the final stage in the production of the groundwater protection scheme. The approach is illustrated for a hypothetical potentially polluting activity in the matrix in Table 2.4 below:

Table 2.4. Groundwater Protection Scheme Matrix for Activity X

VULNERABILITY RATING	SOURCE PROTECTION			RESOURCE PROTECTION						
				Regionally Imp.		Locally Imp.		Poor Aquifers		
	Site	*Inner*	*Outer*	*Rk*	*Rf/Rg*	*Lm/Lg*	*Ll*	*Pl*	*Pu*	
Extreme (E)	R4	R4	R4	R4	R4	R3[m]	R2[d]	R2[c]	R2[b]	↓
High (H)	R4	R4	R4	R4	R3[m]	R3[n]	R2[c]	R2[b]	R2[a]	↓
Moderate (M)	R4	R4	R3[m]	R3[m]	R2[d]	R2[c]	R2[b]	R2[a]	R1	↓
Low (L)	R4	R3[m]	R3[o]	R2[d]	R2[c]	R2[b]	R2[a]	R1	R1	↓
	→	→	→	→	→	→	→	→	→	

(Arrows (→ ↓) indicate directions of decreasing risk)

The matrix encompasses both the geological/hydrogeological and the contaminant loading aspects of risk assessment. In general, the arrows (→ ↓) indicate directions of decreasing risk, with the ↓ arrow showing the decreasing **likelihood of contamination** and the → arrow showing the direction of **decreasing consequence**. The **contaminant loading** aspect of risk is indicated by the activity type in the table title.

The **response** to the risk of groundwater contamination is given by the response category allocated to each zone and by the site investigations and/or controls and/or protective measures described in notes a,b,c,d,m n and o.

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 <u>guide</u> 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.

Location	Pumping Rate m^3/d	Specific Capacity $m^3/d/m$	Transmissivity m^2/d	Specific Yield
Slane	PWNo.1=780 PWNo.2=1640	60 - 65 130 - 135	70 - 130 150 - 200	0.002
Curragha	PWNo.2=1320	130	60 - 130	0.002
Athboy	1080	800 - 980	100 - 1000	0.075
Dunshaughlin	810	40 - 47	100 - 300	0.0004
Dunboyne	PWNo.1=115 PWNo.2=175 PWNo.3=335 PWNo.4=535	10 - 15 5 - 10 80 30 - 35	10 - 50 10 - 50 60 - 150 30 - 100	0.001-0.04
Ballivor	PWNo.2=265	8 - 15	10 - 200	0.01-0.02
Nobber	175	20 - 30	20 - 40	0.002

Table 7. Pumping test results in Co. Meath

lithologies and hydrogeological data available the Permian and Triassic rocks have been classified as Locally Important Aquifers.

The Namurian succession in the Kingscourt Outlier comprises thick alternating sequences of sandstones with shales. The sandstones are poorly cemented and often very weathered which increases their permeabilities. Recent drilling (1994–1996) in the Namurian, east of Kingscourt, found yields between 2.3 and 9.3 litres/second (200–800m^3/d) in four trial wells, indicating their potential. A public supply well at Kilmainham provided a discharge of 2.8 litres/second (240m^3/d) with a transmissivity of 15–30m^2/d. These Namurian rocks are also tentatively classified as Locally Important Aquifers.

THE BALBRIGGAN AREA

West of Balbriggan, the mixed Carboniferous limestone and clastic succession to the south of the Lower Palaeozoic rocks includes some moderately good (Locally Important) aquifers, as revealed in trial drilling programmes in the 1980s and early 1990s. The Ordovician volcanics have also provided useful well yields.

THE CARBONIFEROUS LIMESTONE LOWLANDS

The principal aquifers are:

- "Calp" limestones across large parts of Counties Dublin, Meath and Westmeath.
- Dinantian limestones in the lower Boyne valley near Drogheda.

The widespread "Calp" Limestone (Boyne Formation, Lucan Formation, Loughshinny Formation, Walshestown Formation) is a much better aquifer in Co. Meath than elsewhere in Ireland. The Calp is the main aquifer used for public supply in Co. Meath, and is tapped for important public supply sources at Athboy, Ballivor, Curragha, Dunboyne, Dunshaughlin, Nobber and Slane. Some pumping test results are summarised in Table 7.

Well records for Co. Meath show over 30 wells in the Calp yielding over 100m^3/d, including 11 yielding over 400m^3/d. However, many wells have lesser yields, often as low as 10m^3/d. These wells are often domestic supplies and occasionally Council supplies, but generally have not been tested to establish their potential output. Typical specific capacities range from 5–150$m^3/d/m$ and transmissivities from 20–1000m^2/d. The Calp in Meath has been classified as a Locally Important Aquifer. It is generally less productive in County Dublin.

The Dinantian limestones in the lower Boyne valley near Drogheda are similar to those around the Kingscourt Outlier and are classified as a Regionally Important Aquifer, but to date they are less extensively exploited and tested than the Calp. The NE(RDO) report (1981) describes a borehole drilled in this succession at Drybridge, which yielded almost 20 litres/second (1676 m^3/d) for a drawdown of 27.5 m, and the aquifer transmissivity was estimated at 160 m^2/d.

Water in the limestone aquifers is always hard (usually over 250 mg/l, often over 300 mg/l). Otherwise the quality is good except where locally contaminated.

OTHER LOCALLY IMPORTANT BEDROCK AQUIFERS

Many of the Lower Carboniferous clastic rocks (sandstones, siltstones, mudstones) are fractured enough to have developed some permeability, but not enough to be regarded as regionally important aquifers. In general, they yield 0.5 to 3 litres per second, and well specific capacities are generally around 5 to 20 m³/day/m.

The argillaceous limestones (e.g. Ballysteen Formation), the Silurian and Devonian slates and mudstones, and the Namurian shales, although fractured, generally have a low permeability. They often yield enough water to a well for a house or small farm (0.2–0.5 litres/second), and occasionally, in major fracture zones, may yield much more. However, the yield often depends on the permeability in the uppermost few metres of broken and weathered rock, and may decrease in dry spells as the water table falls.

QUATERNARY AQUIFERS

Locally Important Quaternary sand/gravel aquifers are limited in extent, but can sometimes supply high yields to boreholes; they have been successfully exploited for irrigation of market gardens near Rush, in north Co. Dublin. Similarly productive gravel aquifers may exist elsewhere but have not been identified. Generally, the Quaternary aquifers are exploited by many small wells and springs, and also provide additional storage for underlying bedrock aquifers.

Water chemistry in the Quaternary aquifers is very variable, depending on the nature of the gravel. Where limestone material is dominant, the waters tend to be hard (over 200 mg/l).

WARM SPRINGS

The southern part of Sheet 13 includes part of the Leinster Geothermal Province, in which a number of springs yield slightly warm water, at temperatures of 13° to 25°C, compared with the normal groundwater temperature of about 10°C. (The remainder of the geothermal province lies within Sheet 16, to the south.) The most notable sites are Kilbrook Spring, Co. Kildare, which reaches a temperature of up to 25°C, St. Gorman's Well, beside Hotwell House, near Enfield, Co. Meath, with a maximum temperature of over 22°C., and St. Margaret's Spring, Co. Dublin, which reaches 19°C. Most of the others are quite tepid, reaching only 14–15°C. Table 8 summarises the data for the springs on Sheet 13.

St. Gorman's Well has been known for centuries, and its discharge ranges from zero in dry periods up to 14 litres per second in winter. Kilbrook Spring resulted from excavations in an esker for ballast for the construction of the nearby railway line in the 19th Century. Its natural discharge varies from zero in dry periods up to 12 litres per second in winter. Detailed recording of the outflow of both springs shows the influence of earth tides (twice-daily changes in gravity, caused by the gravitational pull of the Moon and Sun), and of barometric pressure changes.

The exact source of the warm waters and the details of their flow regime remain unclear, but the pathways allowing these deep warm groundwaters to emerge are presumed to be associated with major fault zones.

Spring Name	Grid Reference	Temperature range, °C
Bride's Well	28923 24268	13-14
Kemmin's Mill Well	28994 24328	13-15
Kilbrook Spring	28146 24220	19-25
St. Gorman's Well	27401 24412	17-23
Ardanew Spring	27346 24887	12-14
St. Margaret's Well #1	31279 24377	15-19
Macetown Spring	30517 24183	15-16
Clonee Spring	30290 24163	13-15
St. Margaret's Spring #2	31286 24396	8-16
Kemmin's Mill Spring	28988 24334	14-15

Table 8. Warm springs on Sheet 13

(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

7 WATER

Receiving Environment

Geology

7.1 The regional bedrock geology for the Platin area is taken from the geology of Meath map as published by the Geological Survey of Ireland (GSI) and dated 1999 (Figures 7.3 and 7.6). The Carranstown Cherty Limestone (Figure 7.6) is not recognised as a Formation or Member within the Platin Formation by the GSI publication but does represent an important local horizon within the context of the Platin Quarry extension.

Bedrock

7.2 Platin Quarry is excavated into the limestone bedrock belonging to the Platin Formation (Figure 7.6). These limestones are part of the Carboniferous succession which here occupies a synclinal structure (Figure 7.3) located between the sandstone cored Lower Palaeozoic Massifs found to the north and south of the Rivers Boyne and Nanny, respectively. Namurian aged sandstones and shales of the Walshestown, Balrickard and Donore Formations occupy the axis of the syncline. The limbs of the east-west trending syncline consist of Dinantian age limestones of the Platin, Clonlusk and Mullaghfin Formations. The Slane (just off Figure 7.3 to the north) and Nanny Faults bound the northern and southern edges of the graben like structure, respectively.

7.3 The Platin Formation consists of crinoidal, peloidal grainstone and packstones. To the east of the existing quarry the Platin Formation contains abundant dolomite and is unsuitable for cement manufacture due to the high magnesium content. Westwards, the presence of the Carranstown Cherty Limestones together with the property boundary and the adjoining public road define the outline of the proposed extension (Figure 7.6). The Carranstown Cherty Limestone is unsuitable for cement manufacture due to the high silica (SiO_2) content and associated high abrasiveness.

7.4 The Carboniferous succession at Platin dips to the northwest towards the synclinal axis and is traversed by faults trending north-northwest by south-southeast. The faulting has no appreciable effect on the limestone chemistry except for local patches of dolomite in the fault zones, but in the quarry area the faulted areas are generally weaker and tend to have abundant solution fissures filled with clay and rubble.

7.5 The limestones at Platin display a range of karst features particularly in the upper bench levels where the solution features are generally filled with clay and rubble. Immediately to the north of the quarry at Cruicerath the local drainage discharges into a swallow hole and emerges in the quarry face south of the intervening public road. *

Overburden

7.6 The rock surface outcrops in the areas shown in Figure 7.7. Elsewhere the bedrock surface is covered by a variable thickness of glacial till. The overburden contours presented in Figure 7.7 indicate a zone of thick till cover passing from Duleek Village and extending into the eastern edge of the proposed extension. In the west of the extension area the glacial till is of the order of 5m thick and this increases eastwards to where the overburden is thickest (over 20m) immediately behind the present quarry face as indicated in the cross sections A-A' and C-C' of Figure 7.4, presented in Figure 7.9.

This additional quarry discharge point is intended as a mitigation measure to minimise any impact of the quarry dewatering on the low flows in the River Nanny immediately downstream of Duleek Village.

Groundwater

7.23 Geologically, Platin Quarry is located in a narrow band of Carboniferous aged limestones that are bounded to the north and south by older Lower Palaeozoic sandstones and shales. The Platin limestones connect westwards with the limestone plains of Meath and extended eastwards to outcrop along the Irish Sea between Termonfeckin in the north and Laytown in the south.

7.24 The Platin limestones constitute a regionally important aquifer while the enclosing Lower Palaeozoic strata have little regional groundwater potential. Groundwater within the limestone aquifer flows towards the east coast and either discharges directly into the Irish Sea or into the River Boyne and River Nanny systems as base flow. The pumping of groundwater from beneath the quarry to maintain dry working conditions has altered the natural groundwater flow regime around the quarry. Some of the groundwater that would previously have discharged into the two rivers as base flow has been intercepted beneath the quarry and this groundwater is now discharged to the River Nanny at the licensed outfall.

7.25 This proposal to extend the quarry as indicated in the plans and cross sections will result in an increased dewatering rate as the final quarry floor area is effectively doubled. The increased abstraction will further alter the natural groundwater flow regime around the quarry with the scheduling of this further reduction in the water table and increased dewatering rate being determined by the quarrying programme over the life of the quarry.

7.26 The available reserves in the extension will be won through a series of benches similar to the practice in the existing quarry with the final floor level of minus 20m below OD being the same over the total excavation. The scheduling of the benching operation in the extension will allow for the economic mixing of overburden stripping and the excavation of the usable limestone reserves. The position of the water table at the completion of the present quarry permission is indicated in Figure 7.9. The extension of the quarry area westwards will entail a further lowering of the water table in this direction as the floor intersects the water table position maintained for the present permission.

7.27 The wetland at Duleek Commons is dependent on the local water table and the inflow from the Commons River. The measured groundwater contours around the margins of the wetland indicate that it receives groundwater from spring risings located within the marshy area. The outflow from Duleek Commons was historically directed to a corn mill to the north east of Duleek village. Today, the outflow is directed through the village and discharges into the River Nanny.

Data Base

7.28 The available groundwater data base includes records from 40 boreholes completed on company property and on adjoining public lands details of which are tabulated in Appendix 2-2 for reference and located on Figure 7.4. In addition, information is available from some 55 private wells (Figure 7.5) located around the quarry of which 20 are reported in use while the remainder are no longer in use. Details of the private wells are given in Appendix 2-2.

7.29 Groundwater level monitoring has been undertaken at Platin since January 1996 and the available data is presented in Appendix 2-2 for both the Company monitoring boreholes and the private well network. The company has an active groundwater

Future Groundwater Flow Pattern at Platin

7.37 The present groundwater flow pattern around the Platin excavation will continue to change as the quarry floor is progressively deepened under the existing permission and subsequently as the floor is extended westwards under the current proposals. The availability of the current and historical groundwater levels from the Platin area provides the necessary data base on which to evaluate the impact of the current dewatering programme on the groundwater flow regime and to predict the likely scenario resulting from the dewatering of the proposed extension. This information has been incorporated into the design of the excavation by limiting the westward extend of the final quarry floor (-20m O.D.) and the –5m O.D. floor level, to minimise the potential impact on Duleek Commons. The longevity of the monitoring record and the availability of monitoring boreholes away from the excavation adds considerable confidence to the analysis of the groundwater flow patterns both presently and into the future. Of equal importance is the extended time frame over which the proposed extension will take place, which will allow for the continued monitoring of the water table and comparison with the predicted scenario.

7.38 Lowering the water table to -20m OD at the existing excavation with an abstraction of some 7,000-9,000 m^3/day will have the effect indicated in Figures 7.9 and 7.10 with the cone of depression extending further away from the excavation. The deepened cone will retain the same gradient as presently measured between the quarry margins and the nearby monitoring boreholes. The observed ridge in the water table will remain between the quarry and the River Nanny. This will ensure that there should not be any leakage through the bed of the River Nanny and that the pumped groundwater will continue to provide a positive gain in the base flow in the River Nanny downstream of the quarry discharge. The positive gain will be due to captured groundwater flow from the River Boyne catchment.

7.39 Extending the quarry floor westwards will require a progressive increase in the abstraction rate as each new bench is opened over the lifetime of the reserve. A review of the company's Integrated Pollution Control Licence will be required when the abstraction rate nears the 15,000 m^3/day permissible. At the final quarry floor level of -20m in the proposed extension, an abstraction rate in the range 14,000-18,000 m^3/day will be required. The resulting cone of depression will be elongated along the line of the extension as indicated in Figure 7.9. This will have the effect of moving the capture zone of the Platin excavation westwards towards the Commons River catchment. However, restricting the development of the final quarry floor (-20m O.D.) and the –5m O.D. floor level to not less than 700m and 300m respectively from the western property boundary has the effect of maintaining the wetland catchment.

Groundwater Quality

7.40 The groundwater abstracted from the quarry is partly used in the cement making process while the remainder is pumped directly to the River Nanny. As the dewatering operation is based primarily on deep water wells, the discharge water tends to have a good colour and to be free of suspended solids. These show the pumped water to be a typical limestone groundwater displaying an elevated hardness and a pH of 7.2. The pumped groundwater meets potable standards for the parameters tested and shows no sign of contamination as a result of the quarrying or cement making operations.

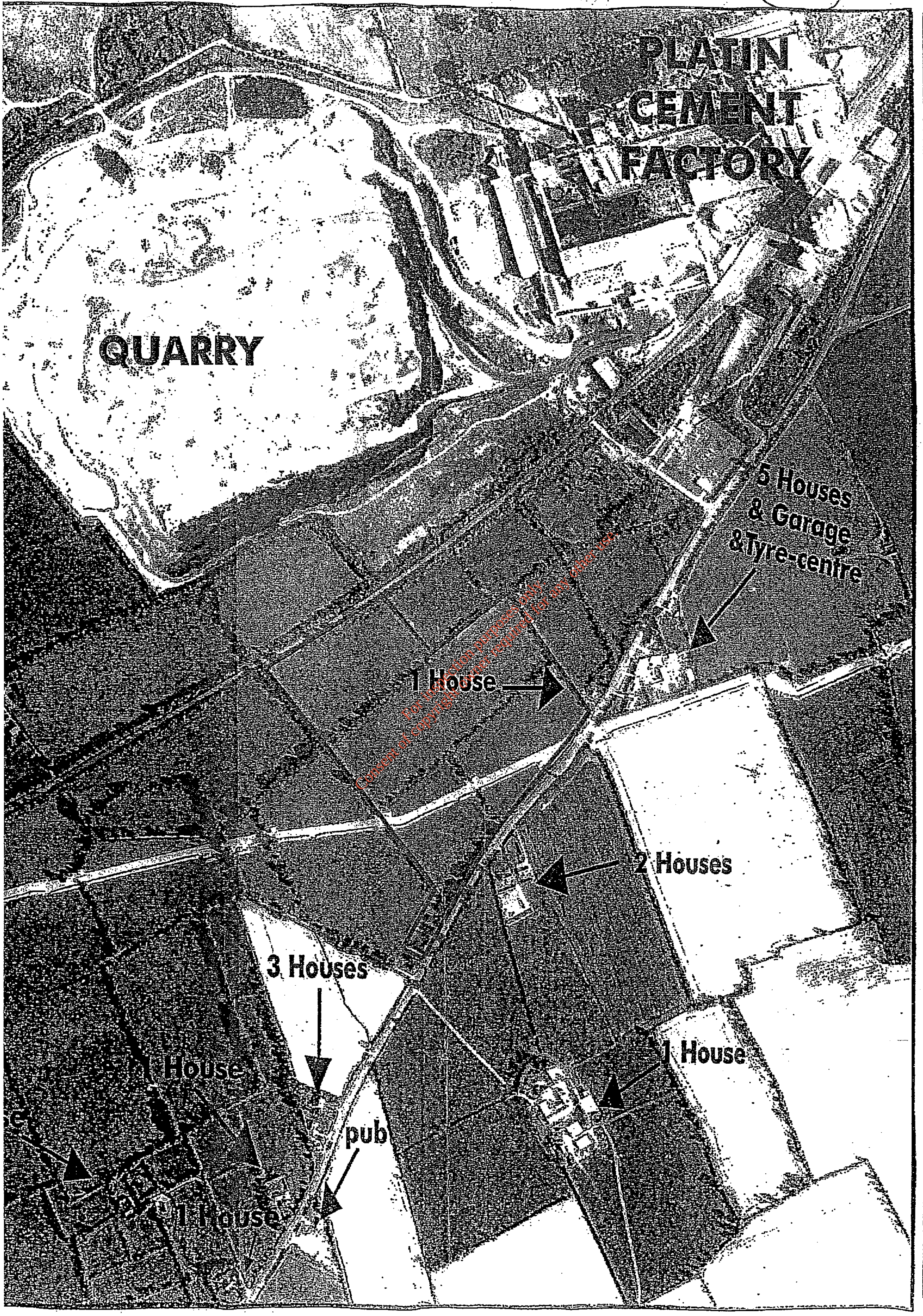
Surface Water Quality

7.41 Chemical analyses of samples taken from the River Nanny in July 1996 at locations immediately above and below the quarry's discharge are given in Appendix 2-2. These indicate that the summer flow in the River Nanny has broadly the same chemical character as the groundwater pumped from the Platin limestones. In this situation, the flow in the River Nanny is dominated by groundwater discharging from

4 March 2005 Submission to the Chairperson of E.P.A.
Oral Hearing Boyne Valley Hotel Drogheda.
Re: Waste Licence for Proposed Incinerator Indaver.

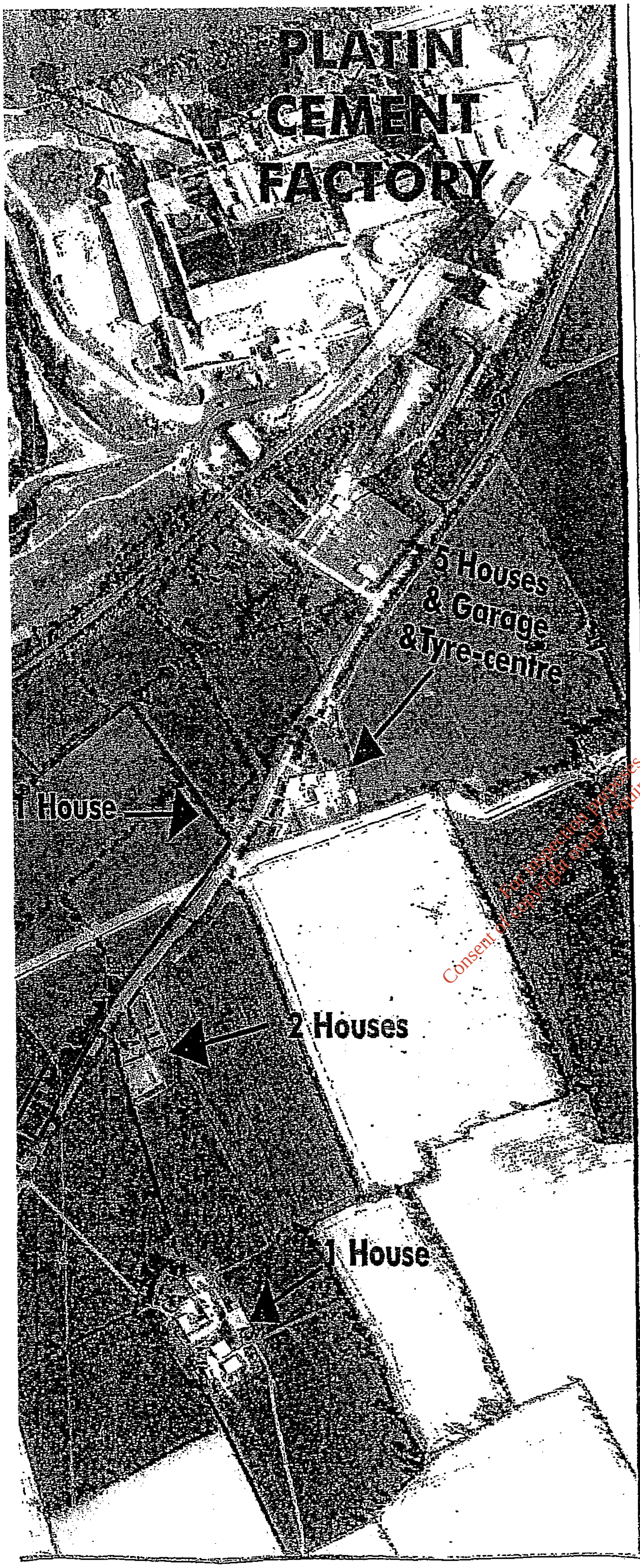
Dear Chairperson,
We wish to appeal to the E.P.A. not to grant a waste licence for a proposed Incinerator, at Carranstown Duleek Co Meath. We are the immediate ~~householders~~, in the area of this proposed Incinerator, namely the Smyth families and Kavanagh families signed below.
The Smyth families have lived there for the last 116 years, and the Kavanagh families for the last 72 years, and the Leonard family is the fourth generation of the Smyth Family. There are so many reasons for objections, but the principal reasons that are causing great concerns are the effects this proposed Incinerator will have on our health. We will not be able to enjoy the countryside as we will be exposed to the highly toxic chemical dioxins, that will contaminate the air we breathe. The increase of heavy goods vehicles, that will bring the rubbish to and from the proposed plant, will cause a continuous flow of traffic past our houses, will make it very difficult to have access in and out of our homes and cause extra danger on an already dangerous busy road. We wont be able to open our windows or doors, in the summer time, because the rubbish in lorries will create a smell and fumes. With the Irish Cement Factory, the Power Plant, and the proposed Incinerator, we will be surrounded by Industrial Plants thereby devalueing our properties, leaving us unable to sell.
This proposed Incinerator will leave us prisoners in our own homes.

Signed: Benny & Claire Kavanagh,
Dan & Tina Kavanagh,
Margaret Smyth
Joe & Nuala Kavanagh
Mary Leonard
Chris Leonard
Marion Leonard
Naomi Leonard
Ciaran Leonard



PLATIN
CEMENT
FACTORY
QUARRY
5 Houses
& Garage
&Tyre-centre
1 House
2 Houses
3 Houses
1 House
1 House
pub
1 House
1 House

(32b)



Indaver Ireland Ltd

Project Management Group

Waste Management Facility, Carranstown

Adjacent Land Uses