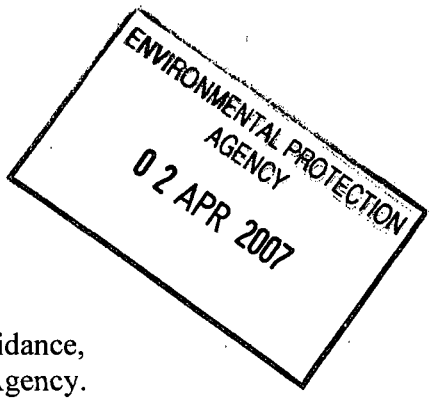
Sub. 86



Dr. Ian Marnane,
Licensing Unit,
Office of Licensing and Guidance,
Environmental Protection Agency.
Johnstown Castle Estate,
County Wexford.

Sliding Rock,
Blackglen Road,
Sandyford,
Dublin 18.

30-3-07

Re: Waste Licence Application W 0231-01 Fingal Landfill

Dear Dr. Marnane,

I refer to your Notice to the Applicant in accordance with Article 14(2)(ii) of the Waste Management (licensing) Regulations dated March 23rd, 2007.

In particular I refer to your Point III :- *Based on investigations carried out to date please indicate the potential range of sustainable yields, compared to the existing abstraction rates from the Bog of the Ring system, that may be attainable from the area to the South of Decoy Bridge. For the maximum of this range provide a plot of the area of likely zone of influence.*

I assume that the 'investigations to date' in your request would naturally include the results of the;

- groundwater investigations completed at the Bog of the Ring in the 1980's & 1990's,
- GSI 1: 100,000 Sheet 13, Geology of Meath, 1999
- work of the GSI in delineating the Groundwater Source Protection Zones (2005)
- TES Final Hydrogeological Assessment Report (2007)
- Hydrogeological studies carried out by the Applicant described in the EIS

A quantitative picture can only be provided through a modeling exercise that would allow for an examination of the interactions between aquifer transmissivity, aquifer storage, recharge to the aquifer, boundary conditions, discharges to surface water and existing groundwater abstractions.

The above immense volume of work however, can be readily used to provide the Agency with a qualitative picture. The following groundwater analysis indicates the likely quantum of the groundwater resource that lies in the limestone aquifer to the south of Decoy Bridge.

1. Prospects For High Yielding Wells South of Decoy Bridge

The potential groundwater productivity of the lands to the south of Decoy Bridge is already evidenced by the;

- tested yield from Trial Well No.9 completed in 1993 (Table 5, GSI March 2005)
- tested yields from the pumping wells completed by the Applicant
- reported high yields from private wells drilled in The Five Roads area

The above factors, when taken together with the geological conditions found here and which are identical to those at the Bog of the Ring. These favourable conditions are;

- Loughshinney Formation
- Faulting
- Extensive gravel deposits

The occurrence of these conditions would lead to a conclusion that a successful well field could be developed at Nevitt-Tooman.

However, the relatively poor yield reported from Trial 6 (Figure A.1 GSI, 2005) completed in 1993 highlights the difficulties of developing groundwater resources in facture controlled aquifers.

2. Possible Production Well Locations

1. Groundwater Development in Fracture Controlled Aquifers

In is important to use all the available geological, geophysical and hydrogeological information in locating groundwater trial and/or production wells in fracture controlled aquifers to ensure that the abstraction points are located within the areas of potentially the highest transmissivity.

Information from a variety of sources should be brought together to provide to update the existing (in this case the 1:100,000 Geology of Meath, Sheet 13, of 1999) geological model so that drilling sites are targeted at those areas likely to provide the highest yields within the search area.

For example, the trial wells associated with the Bog of the Ring development the trial wells were located in 1983 on the basis of published GSI map of that time. These wells tested the likelihood that the major east west fault at the Bog of the Ring would be associated with fracturing of the surrounding limestones.

The present GSI map, published in 1999, indicates that a major north south fault continues southwards from the Bog of the Ring in the direction of the Five Roads

junction. This fault line was positioned without the benefit of any outcrop or drill hole information.

The work completed in relation to the Nevitt-Tooman landfill has greatly added to the geological picture to the south of Decoy Bridge and in particular in the area to the west of the Five Roads junction. This work has clearly demonstrated that the GSI fault lies further to the west and is represented not by a single, narrow fault zone but rather by a wide major graben like feature in the bedrock surface.

This major depression in the bedrock surface is confirmed by both the geophysics and drilling programmes completed at the Nevitt-Tooman development site. The anticipated increased transmissivity in the underlying limestones associated with the faulting is confirmed by the groundwater flow pattern and the changes in the groundwater gradient at the margins of and within the fault zone.

The location of possible production wells to the south of Decoy Bridge would therefore naturally be based on the most recent and accurate geological picture rather than the earlier and less accurate GSI regional map.

2. *Geology*

On the basis of the investigations to date it will be necessary to locate potential production water wells south of Decoy Bridge on, and in order of priority;

- geological structural grounds i.e. proximity to known and postulated faults
- gravel thicknesses
- lithological considerations.

The structural considerations derive from the fault bounded trough like featured revealed by the Applicant's depth to bedrock contours. The potential for increased transmissivity conditions would be greater in such areas of obvious structural disruption.

The planned production wells should also take advantage of the areas of deep gravel deposits highlighted by the Applicants contours of gravel thickness.

The coincidence of the southward flow of groundwater at the Applicant site with the fault bounded bedrock trough would suggest that the more permeable Loughshinney Formation lies directly beneath the landfill.

This hypothesis remains to be confirmed by biostratigraphic studies. As the Loughshinny Formation is very similar lithologically to the older Lucan and Naul Formations it will necessary to carry out biostratigraphic studies to establish the presence and exact distribution of each of these components of the Dinantian biozone.

It is very unfortunate that the Applicant did not take the opportunity, following the Agency's earlier request, to revise the bedrock geology of the Nevitt – Tooman area as published by the GSI in 1999.

The cores recovered (and presumably still available for examination) from 13 of the drill holes completed by the Applicant would have provided the fossil bearing material to allow for the necessary biostratigraphic studies. This work would allow for the formation boundaries to be drawn more accurately.

The Agency could of course still request the Applicant to submit these cores for examination and so add to a better understanding of the bedrock geology in this area and it particular to the distribution of the productive Loughshinney Formation.

3. Groundwater Flow Pattern

The Applicant's groundwater flow contours indicate that the area immediately to the south east of the landfill represents an area of preferential groundwater flow. Groundwater flow lines are seen converging into this area indicating an area of increased transmissivity.

Production wells located in this region would benefit from the already strong groundwater throughput indicated by the converging flow lines.

4. Chosen Production Well Locations.

The accompanying map Figure 1 shows the position of 4 No. possible production water wells. These wells (subsequent to trial well drilling) would be drilled to at least 90m, possibly to 120m if required, and with the expectation that each well would be capable of a sustainable yield in the order of 1,000 m^3/day or greater.

The Nevitt –Tooman well field would therefore have a projected sustainable yield of c.4,000m^3/day, which is similar to the proven capacity of the Bog of the Ring scheme.

In the event that the average production well yield falls below1,000 m^3/day then additional abstraction wells would be required. Where the transmissivity is say on average only 50% of the transmissivity determined by the GSI at the Bog of the Ring then some 8 wells might be required to provide the required well field output. Figure 2 shows a possible 8 No. production well network.

The pumped groundwater could be collected by a ring or collector main and pumped via a single main to the nearby Jordanstown Reservoir as indicated in Figures 1 & 2.

Note: The number of abstraction points will be a function of the transmissivity of the bedrock and the hydraulic efficiency of the wells. This situation is often compared to drawing water from a beaker with a single straw, where many less efficient straws would be required to achieve the same result in the same time. However, the number of straws

(or wells) required does not diminish the value of the resource but only the cost of the achieving the abstraction.

The need for a high number of wells in low transmissive aquifers often renders such proposals too costly to bring into production. And so a cost – benefit analysis is required before exploring in low transmissive aquifers.

The final location of the production wells in the Nevitt-Tooman area would naturally follow on from the results of the trial wells and of course be positioned as not to interfere with housing, the M1, roads, gas main etc. The proximity to the existing Jordanstown Resevoir being an important consideration.

5. Zone of Influence and Groundwater Catchment Boundary

The TES Report of January 2007 (page 88) on the Bog of the Ring scheme concluded that the recharge to the limestone aquifer varied from 57mm to 322mm/year. The low recharge values reflecting areas of thick clay overburden with the higher recharge occurring where the overburden is more permeable and the bedrock closer to the surface. TES concluded that 25% of the catchment was recharged at the higher rate while the lower recharge rate applied to the remainder.

It follows that the average recharge over the Bog of the Ring catchment is c.120mm/year allowing for the extent of the sustainable groundwater catchment area defined in the TES Report (page 90).

As the overburden and bedrock conditions are broadly similar at Nevitt-Tooman to those described by both TES and the GSI at the Bog of the Ring it is reasonable to apply the average recharge conditions at the Bog of the Bog to a possible groundwater abstraction at Nevitt-Tooman. This would suggest that a groundwater catchment of some 12km^2 in area and with an average annual recharge of 120mm would sustain a well field abstraction of 4,000 m^3/day .

A higher average recharge would naturally lead to a more restricted groundwater catchment.

The likely extent of the groundwater catchment boundary associated with the abstraction of 4,000m^3/day from a well field at Nevitt-Tooman is shown on Figure 3.

3. Need For Computer Modeling

The picture presented in Figure 3 is derived from a qualitative examination of the groundwater flow conditions and in particular of the 'investigations to date'. The required quantitative picture can only be provided by the modeling exercise previously requested of the Applicant by the Agency.

For example, the picture presented in Figure 3 is representative of a steady state situation and takes no account of variations between the summer and winter conditions as shown in the Applicant's hydrographs. Such transient conditions and the possible interaction (if any) between the Bog of the Ring abstraction and a possible abstraction at Nevitt-Tooman would be best examined with the modeling exercise requested earlier by the Agency.

The impact of induced recharge to the aquifer by the lowering of the water table within the Nevitt-Tooman catchment zone could also be examined. This would likely increase the average recharge rate and lead to a reduction in the extent of the groundwater catchment supplying the pumping wells. This option is not possible at the Bog of the Ring where it is necessary to maintain water levels in the associated wetland.

A modeling exercise would provide a much better definition of the catchment boundary taking into account of the;

- groundwater flow pattern presented by the Applicant
- distribution of gravels
- distribution of fault lines
- the relative transmissivity of the bedrock formations
- distribution of recharge rates.

That the GSI was able to undertake a modeling exercise to establish source protection zones at the Bog of the Ring so too is it possible to undertake a similar modeling exercise to examine the potential for a similar abstraction at Nevitt-Tooman.

4. Fault Beneath Footprint

On a less serious note, the Agency can rest assured that the postulated fault beneath the proposed landfill is extremely unlikely to ever be reactivated and so the Agency should have no worries in this regard.

The issue with the fault lies not with any threat to the structural foundation of the landfill but rather the value of the associated deformation of the limestone bedrock. The increased transmissivity associated with the fault is clearly demonstrated by the rapid reduction in the groundwater gradient in this area.

5. Conclusions

The investigations to date clearly indicate that a significant groundwater resource can be developed to the south of Decoy Bridge and particularly at Nevitt-Tooman.

This qualitative analysis indicates that the groundwater resource located to the south of Decoy Bridge can be developed without interference with the existing Bog of the Ring scheme.

The groundwater catchment boundary associated with the development of this resource to the south of Decoy Bridge would include the planned landfill site at Nevitt.

The development of the landfill at this location would compromise the future exploitation of this natural renewable groundwater resource by either the Local Authority or the neighbouring landowners.

In would be considered inappropriate to locate the planned landfill within the catchment of the Bog of the Ring scheme.

It is equally unsustainable to locate the landfill within the catchment of a possible similar scheme at Nevitt-Tooman simply because the production wells have yet to be drilled and commissioned.

This position is already dealt with in the GSI's / DOELG's / EPA's Groundwater Protection Scheme manual where it is 'Unacceptable' to develop a landfill within the Inner Source Protection Area of a production well. Such a protection must surely also be available to as yet undeveloped but proven groundwater resource.

The EIS did not identify either the existence or scale of the groundwater resource that potentially could be developed to the south of Decoy Bridge nor did the EIS identify the 'likely significant impact' of the landfill on this resource.

Hopefully the above qualitative resource analysis will have gone some small way to rebalance the situation and to inform the Agency of the hydrogeological conditions to the south of Decoy Bridge and especially at Nevitt-Tooman.

The previously requested revised geological map and in particular the computer modeling are required to provide a ***quantitative*** basis for discounting the overall conclusions of the above ***qualitative*** resource analysis.

Yours Sincerely,

EurGeol Kevin T. Cullen PGeo

nmatic purposes only.
be taken from the drawing.

ction Well Sites

Legend

- : Outline of Study Area B
- : Landfill Footprint
- : Line of GSI Fault
- : Possible Extent of Fault Zone

Site: Nevitt Landfill & Bog of the Ring Well Field

Title: **Possible 4. No Well Abstraction Scheme**

Drawn: --

Scale: Not to Scale

Job. No: --

mmatic purposes only.
be taken from the drawing.

ction Well Sites

Legend

: Outline of Study Area B
: Landfill Footprint
: Line of GSI Fault
: Possible Extent of Fault Zone

Site: Nevitt Landfill & Bog of the Ring Well Field

Title: **Possible 8. No Well Abstraction Scheme**

Drawn: --

Scale: Not to Scale

Job. No: --

Fingal County Council

Project

Fingal Landfill

Title

Proposed Nevitt - Tooman Well Field

APPENDIX A 5.8

RPS Consulting Engineers

RPS Consulting Engineers
West Pier Business Campus,
Dun Laoghaire,
Co Dublin

Ph: 01-2804499
Fax: 01-2835675
E: ireland@rpsgroup.com
W: www.rpsgroup.com/ireland

Issue Details