OH(2) Sub No. 4A

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Your ref:

Mr John Shortt
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Co Dublin
Republic of Ireland

19 November 2008

Dear John

Ref.: Proposed Fingal Landfill

Following the reopened An Bord Pleanala Oral Hearing to which I submitted evidence yesterday, and the recent letter from the EPA to Fingal County Council requiring the completing of a quantitative risk assessment, I have prepared this letter summarising what I would expect to see as the normal components of such a risk assessment. The EPA's requirements are stated briefly, and I have set out in more detail what would be expected of such a risk assessment conducted according to normal good practice.

I would be happy for you to forward this letter to An Bord Pleanala and the EPA.

Before addressing the EPA's letter, there are two issues which are not referred to in the EPA letter: the need for a conceptual model, and the inclusion in the risk assessment of the old landfill that is at the site.

Conceptual model

A prerequisite for any risk assessment is the development of a detailed conceptual model which can be agreed by all parties. Such a conceptual model would use the geological and hydrogeological information available from the various investigations and data gathering exercises by all the parties (including the data collected by objectors on private well usage in the area), in order to set out:

- Plans and sections showing the thickness, depth and lateral extent, and the geological and hydrogeological properties of the various strata that have now been identified at the site (including the gravel strata that are recognised as being present at the site), and showing the occurrence and depth to groundwater in the strata.
- Information on the usage of groundwater by private wells in the area for potable and agricultural use.
- Information on how the development of the landfill would proceed, including schedules and plans showing the depth of excavation and residual till thickness beneath the landfill during its lifetime.

This data review and analysis is not a simple undertaking. At the two previous hearings this technical information has been the subject of significant discussion and disagreement between the different parties. I am concerned that unless the review and analysis is carried out in advance and time is allowed to

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identify areas of agreement and disagreement between the parties, and then for the completion of a comprehensive risk assessment, the new hearing will make little further progress.

Former landfill

The EPA letter does not clarify the relationship of the risk assessment to the former landfill known to be on the site. It is understood that a part of the proposed landfill development project includes remediation of the old landfill. The remediation process, which may include capping and/or excavation and redeposition of the old waste, has not been finally determined.

The EU Environmental Assessment Directive (amendment 97/11/EC), however, states that *"The characteristics of projects must be considered having regard, in particular, to.....the cumulation with other projects."* The EU has also published "Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions, 1999" which covers the same issue. It appears from this that the risk assessment (and the EIA) ought to cover the complete project of both old landfill remediation and new landfill development.

EPA letter

The following table lists the EPA requirements and my comments thereon.

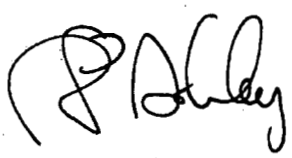
EPA requirements set out in letter to Fingal County Council 17 October 2008	**Comment**
Provide a probabilistic quantitative risk assessment that evaluates the potential for leachate leakage/migration to groundwater below the proposed facility.	The terminology used here and elsewhere in the EPA's letter implies assessment of not just the groundwater in the glacial till immediately below the landfill liner, but also in the exploitable aquifer beneath the site, i.e. the gravel and underlying bedrock. The term probabilistic means that the inputs to the risk assessment will take the form of a probability distribution of the various parameters, such as permeability, contaminant concentrations, hydraulic gradients, source input rates, liner properties etc. A major challenge will be to define and justify realistic probability distributions based on the limited amount of data that is available from the site investigation. It may be necessary to carry out additional investigations where not enough information is available to define the distributions.
This assessment shall, in particular, evaluate the predicted concentrations of List I or II substances (as defined in the EU Groundwater Directive 80/68/EC) likely to be present in any potential leachate leakage.	List I and List II are large, and it is normal to predict the behaviour of a small number of representative substances selected from predicted leachate composition e.g. chloride, ammonia, benzene and a metal. The risk assessment then makes comparisons between these substances and List I and List II substances with similar behaviour in groundwater systems.

EPA requirements set out in letter to Fingal County Council 17 October 2008	**Comment**
Predicted concentrations should be compared to relevant quality standards or background standards, for the relevant receptor, and a conclusion made as to the potential for, and significance of, any impact of the predicted leachate on groundwater chemical status.	There is a difficulty here because of the presence of the old landfill at the site which is understood to be already contaminating local groundwater. It is therefore difficult to determine the true background concentration. Given that the groundwater is otherwise suitable for abstraction for potable and market gardening use, the applicable standards should be drinking water standards.
The assessment used should justify: • *model software……*	A model can be based on a spreadsheet, a standard software package designed for landfill risk assessment (e.g. LANDSIM), or a bespoke groundwater model (e.g. MODFLOW). **Spreadsheets** can in principle be used for simple or complex systems, but essentially the model hast to be written from scratch, which is difficult for all but the simplest cases. **LANDSIM** is purpose designed for landfill risk assessment, but is not usable where the water table is above the base of the landfill, as at Fingal. **MODFLOW** (and associated contaminant transport software such as MT3D or MODPATH) and similar models are highly versatile, but are time consuming to construct and calibrate. The requirement for it to be probabilistic can be satisfied in a spreadsheet by use of an add-in such as AtRisk or Crystal Ball. LANDSIM is designed as a probabilistic model. MODFLOW is not normally probabilistic, but suitable versions are available (e.g. Stochastic MODFLOW).
• *…… and any model inputs such as source term, declining source term, and retardation.*	Source terms (i.e. leachate production rates and seepage rates through the liner) are readily included in all models. Retardation, which is the consequence of physical processes such as diffusion, dispersion and sorption, is readily modelled, but requires real-world data on the sorptive characteristics of the aquifer. I am not aware of any such data from the proposed landfill site, so additional field tests to obtain these data will have to be carried out. A major difficulty arises from selection of values for the permeability of the glacial till beneath the site, because there was a wide range of permeabilities measured during the site investigation. However, as a probabilistic approach is required, the permeability probability distribution can be based on the fullest range of permeabilities measured. Such permeabilities selected should take account of the shallow weathered/oxidised zone (where permeabilities are likely to be higher). As additional site investigations are likely to be needed (see above) they could include additional permeability tests in these strata.

EPA requirements set out in letter to Fingal County Council 17 October 2008	**Comment**
• *predicted leakage losses and attenuations factors (e.g. dilution, dispersion, diffusion, sorption).*	The attenuation factors referred to here are discussed above. Obtaining these data will, as noted above, require additional field tests.
• *receptors selected for assessment (such as aquifers, abstraction wells).*	The risk assessment is specified by the EPA as referring to "groundwater below the proposed facility". The reference to receptors "such as …. abstraction wells" implies that the risk assessment is not to consider only the groundwater immediately below the landfill liner, or even the groundwater in the aquifer beneath the glacial till, but also nearby wells, such as Kerrigan's well. Obligations under EU legislation probably require groundwater in the gravel and bedrock immediately beneath the landfill to be the main receptor to be considered.

I trust that these comments are clear to you. Please do not hesitate to contact me if you require clarification.

Yours sincerely



Dr Paul Ashley