Groundwater Protection Responses to the Landspreading of Organic Wastes

Background

Groundwater in Ireland is protected under European Community and national legislation. Local authorities and the Environmental Protection Agency (EPA) have responsibility for enforcing this legislation. The Geological Survey of Ireland (GSI) in conjunction with the Department of Environment and Local Government (DoELG) and the EPA have developed a methodology for the preparation of groundwater protection schemes to assist the statutory authorities and others to meet their responsibility to protect groundwater (DoELG/EPA/GSI, 1999). This methodology incorporates land surface zoning and groundwater protection responses.

These groundwater protection responses are concerned with the landspreading of organic fertilisers and wastes such as animal slurries from intensive farming enterprises, sewage sludges, poultry litter and industrial waste water treatment plant sludges. Most of these wastes are potentially beneficial to crops. However, they are also potentially polluting and if not correctly managed can present a risk to groundwater quality.

For all other farm activities generating slurries, landspreading should be carried out in accordance with the following guidance: (a) Control of Farm Pollution (DAFF, 1992); and (b) Code of Good Agricultural Practice to Protect Waters from Pollution by Nitrates (DoE and DAFF, 1996), incorporating current Teagasc crop fertility recommendations and production techniques.

The risk to groundwater from landspreading activities is mainly influenced by:

- the chemical and microbiological content of the waste;
- the loading rate, method and timing of application;
- the groundwater vulnerability;
- the proximity of a groundwater source;
- the groundwater resource;
- the type and state of vegetation;
- and the weather.

The topsoil and subsoil, depending on their type, permeability and thickness, play a critical role in preventing groundwater contamination and mitigating the impact of many potential pollutants. They act as a protecting filtering layer over groundwater. The vulnerability of the groundwater is the most important factor in deciding on the control measures for any area. It should be noted however, that in areas classed as 'Low Vulnerability' (thick deposits of low permeability subsoils) there may be an increased risk to surface waters due to run-off, which should be addressed in the landspreading programme.

In general the pollution risk is greater near groundwater abstraction sources, in particular within the Inner Source Protection Zone.

Guidance presented in this document is based on the precautionary principle. This guidance should be used to assist in selection and management of landspreading areas. Each landspreading programme will be unique and should take local factors into account in applying the responses.

These groundwater protection responses should be read in conjunction with *Groundwater Protection Schemes* (DoELG/EPA/GSI, 1999).

Landspreading of Organic Wastes: a Hazard for Groundwater

Organic wastes, by their nature contain high concentrations of the nutrients nitrogen (N), phosphorus (P) and potassium (K). Wastes such as manures and slurries from piggeries are likely to contain faecal bacteria, viruses, protozoa (e.g. Cryptospiridium) and helminthic parasites. Some wastes may also contain metals such as copper which must be considered in developing nutrient management plans.

NITRATE

Nitrate is one of the common contaminants identified in groundwater world-wide. It is highly mobile and easily leached from the rooting zone. Nitrates in groundwater have posed less problems to date in Ireland than in most other countries with intensive agriculture. However, draft EPA reports on nitrate (1997) have shown that a significant number of public supply sources in eastern, south-eastern and southern counties have mean nitrate levels greater than 25 mg/l. Agricultural activities, whether from yard or field losses, are a significant source of nitrate in these areas.

PHOSPHORUS

Phosphorus poses less of a threat to groundwater than nitrate because it is relatively immobile in topsoil and subsoil. However, in areas with thin topsoils and subsoils, application of organic wastes could potentially result in the contamination of groundwater as a result of rapid flow through preferential flowpaths (macropores). More importantly, groundwater may act as a pathway for phosphorus movement to lakes, streams and wetlands.

MICROBIAL POLLUTANTS

The greatest threat posed to groundwater and human health by landspreading is from faecal bacteria, viruses and protozoa. There may be a tendency to under-estimate the impact of these in Ireland. The number of annual waterborne illnesses in the US is estimated as between 1 and 15 million cases. While a direct comparison between Ireland and the US may not be possible, in Ireland as elsewhere waterborne illnesses are an issue of concern.

The presence of *E. coli* in water is taken as an indicator of the possible presence of pathogenic microbes, which have a greater potential for health impacts than *E. coli.* The drinking water regulation require zero *E. coli* per 100 ml in a water supply (after treatment).

More than 100 types of viral pathogens have been identified in groundwater. The most common impact of ingestion is likely to be gastro-enteritis, which can result in diarrhoea. Certain types of viruses can live for up to 170 days in groundwater. As they are smaller than bacteria and can survive for longer, they may pose a greater threat to groundwater than bacteria. Unfortunately, they are difficult to detect in water and the absence of faecal indicator bacteria from water samples does not guarantee the absence of viruses.

Cryptosporidium has emerged as a common cause of gastro-enteritis in recent years. Cryptosporidium oocysts are hardy and can persist for longer than *E. coli*; they cause infection at low levels (probably <10 viable oocysts); they are present in farm animals; they are resistant to disinfectants such as chlorine; and consequently they pose a threat to groundwater and human health.

IRON AND MANGANESE

High iron and manganese concentrations in groundwater can be due to natural conditions. However, effluent from wastes can cause deoxygenation in the ground which results in dissolution of iron and manganese from soil, subsoil and bedrock. This can occur from the spreading of excessive quantities of slurries and from high BOD effluents such as dairy wastes and blood.

Groundwater Protection Response Matrix for Landspreading

The reader is referred to *Groundwater Protection Schemes* (DoELG/EPA/GSI, 1999) for an explanation of the role of groundwater protection responses in a groundwater protection scheme.

The appropriate response to the risk of groundwater contamination is given by the assigned response category (**R**) appropriate to each protection zone (Table 1).

R1 Acceptable, subject to normal good practice.

R2[1] Acceptable subject to a maximum organic nitrogen load (including that deposited by grazing animals) not exceeding 170 kg/hectare/yr.

R3[1] Not generally acceptable, unless a consistent minimum thickness of 1 m of soil and subsoil can be demonstrated.

R3[2] Not generally acceptable, unless a consistent minimum thickness of 2 m of soil and subsoil can be demonstrated.

R3[3] Not generally acceptable, unless it is shown that there are no alternative areas available and detailed evidence is provided to show that contamination will not take place. (No spreading will be allowed within a 50 m radius of a groundwater source.)

R4 Not acceptable.

These responses assume that there is no significant groundwater contamination problem in the landspreading area. Should contamination by nitrate (or other contaminants) be a problem in any particular area, then more restrictive responses may be necessary. Monitoring carried out as part of any Local Authority or Agency authorisation will assist in determining whether or not a variation in any of these responses is required.

Response Matrix for Landspreading

VULNERABILITY RATING	SOURCE PROTECTION AREA		RESOURCE PROTECTION Aquifer Category					
			Regionally Important (R)		Locally Important (L)		Poor Aquifers (P)	
	Inner	Outer	Rk	Rf/Rg	Lm/Lg	Ll	Pl	Pu
Extreme (E)	R4	R4	R3[2]	R3[2]	R3[1]	R3[1]	R3[1]	R3[1]
High (H)	R4	R2[1]	R1	R1	R1	R1	R1	R1
Moderate (M)	R3[3]	R2[1]	R1	R1	R1	R1	R1	R1
Low (L)	R3[3]	R2[1]	R1	R1	R1	R1	R1	R1

Site Investigation

An investigation of soil and subsoil properties and thickness should be completed to assist in the development of the landspreading programme. Such investigations (e.g. trial pits, auger holes, boreholes) should reach sufficient depths to show that the minimum required subsoil thickness is present. The required density of sampling points depends on the risk of contamination of the groundwater. In cases of extreme vulnerability areas or within source protection zones there should be at least one investigation point per hectare. In all other cases the sampling points should be at a minimum frequency of one per 5 hectares. Data obtained should be logged, and the depth to water inflow, if any, recorded.

General Guidelines for Landspreading

For new landspreading proposals the applicant is encouraged to use lands away from source protection areas, extremely vulnerable areas, regionally important aquifers and karst aquifers. This can be considered a best practice principle. For existing operations it is accepted that the landbank in use may not reflect this objective. In such cases the relevant authority (either LA or EPA) may require the operator to identify and bring into use more suitable lands over an agreed time-scale.

It is important that the approach to landspreading of organic wastes is practical, economic and environmentally sustainable. All landspreading should be carried out under a comprehensive landspreading programme incorporating a Nutrient Management Plan for the lands in question. This programme should take account of:

- the nutrient requirements of the crop and stage of growth;
- the nutrient status of the soil;
- the contribution of mineral fertilisers;
- the nutrient content of the organic material to be applied;
- local authority bye-laws;
- the groundwater vulnerability assessment;
- the requirements of the DAFF and Teagasc guidance on landspreading (nitrate risk areas, hydraulic loads, buffer zones, etc.); and
- BATNEEC for the activity.

The Nutrient Management Plan should be developed and submitted for approval to the appropriate authority with the relevant applications (e.g. for Planning Permission, an Integrated Pollution Control Licence, a Waste Licence or in response to a Notice issued under Section 21A of the Local Government (Water Pollution) (Amendment) Act (1990)).

All spreading should be carried out in accordance with normal good practice as outlined in the Code of Good Agricultural Practice to Protect Waters from Pollution by Nitrates (DoE and DAFF, 1996).

The total nitrogen (organic and inorganic) load applied should not exceed Teagasc's nutrient recommendations for growing crops.

Special attention should be given to private water supplies. No spreading should be allowed within 50 m of groundwater sources.

In karst areas, features such as swallow holes, caves, streams connected to karst systems, must be taken into account. Karst features can occur in any limestone rock type irrespective of aquifer category. Landspreading should not occur within 30 m of karst features.

It is difficult to define calendar dates governing the landspreading of organic wastes. Landspreading should coincide with the periods of plant growth so that the nutrients applied will be utilised by the growing crop. Landspreading should be avoided when soil conditions prevent infiltration or when heavy rain is forecast within 48 hours. It is generally unacceptable to carry out landspreading during the period November to February inclusive. Operators who are considering landspreading during this period should consult the relevant authority.

Further guidance may be obtained from:

DAFF, 1992. The Control of Farm Pollution. Department of Agriculture, Food and Forestry guidance document.

DAFF, 1996. Rural Environment Protection Scheme (REPS) – Agri-Environmental Specifications.

DoE and DAFF, 1996. Code of Good Agricultural Practice to Protect Waters from Pollution by Nitrates. 57 pp.

DoELG/EPA/GSI, 1999. Groundwater Protection Schemes. Department of the Environment and Local Government, Environment Protection Agency and Geological Survey of Ireland.

DoELG, 1998. Waste Management (Use of Sewage Sludge in Agriculture) Regulations, SI 148 of 1998.

EPA BATNEEC Guidance Notes.

EPA, 1997. Nitrates in Groundwater (County Reports) (Draft).

EU Nitrates Directive 91/676/EEC, 12 December, 1991.

Teagasc, 1994. Soil Analysis and Fertiliser, Lime, Animal Manure and Trace Element Recommendations (amended).

Teagasc, 1997. Phosphorus fertiliser recommendations: Silage, Grazing.