Groundwater Response Matrix for Earth-Lined Slurry/Effluent Stores (ELSs)

An explanation of the role of groundwater protection responses in a groundwater protection scheme is given in *Groundwater Protection Schemes* (DoELG/EPA/GSI, 1999).

The role of the groundwater response matrix is to provide an initial evaluation of the general suitability of a site for an ELS, from a hydrogeological perspective, as part of the desk study. It can also be used to indicate the measures that may be required to meet the required specification.

The geological and hydrogeological data that place a site within a response category is general to an area, and not specific to a site. It is therefore incumbent on the developer to demonstrate that the site conditions of a specific site are determined, before a decision is taken on the suitability or otherwise of a site. Examples of uncertainty on available data can include depth to rock values (and hence vulnerability ratings) and the presence of sand/gravel.

A risk assessment approach is taken in the development of this response matrix. The appropriate response to the risk of groundwater contamination from an ELS in the different hydrogeological settings in Ireland (see Table 1) is given by the assigned response category (**R**) appropriate to each protection zone (see Table 2).

Table 1 Matrix of Groundwater Protection Zones

Vulnerability Rating	Source Protection Area		RESOURCE PROTECTION AREA Aquifer Category							
	Inner (SI)	Outer (SO)	Regionally Important Aquifer			Locally Important Aquifer		Poor Aquifer		
			Rk	Rf	Rg	Lg	Ll/Lm	Pl	Pu	
Extreme	SI/E	SO/E	Rk/E	Rf/E	Rg/E	Lg/E	Ll/E	Pl/E	Pu/E	
High	SI/H	SO/H	Rk/H	Rf/H	Rg/H	Lg/H	Ll/H	Pl/H	Pu/H	↓
Moderate	SI/M	SO/M	Rk/M	Rf/M	Rg/M	Lg/M	Ll/M	Pl/M	Pu/M	
Low	SI/L	SO/L	Rk/L	Rf/L	Rg/L	Lg/L	Ll/L	Pl/L	Pu/L	↓
	→	→	→	→	→	→	→	→		

↓→ directions of decreasing risk to groundwater

Table 2 Response Matrix for ELSs

Vulnerability Rating	Source Protection Area		RESOURCE PROTECTION AREA Aquifer Category						
	Inner (SI)	Outer (SO)	Regionally Important Aquifer			Locally Important Aquifer		Poor Aquifer	
			Rk*	Rf	Rg	Lg	Ll/Lm	Pl	Pu
Extreme	R4	$R3^4$	$R3^3$	$R3^2$	R4	R4	$R3^1$	$R3^1$	$R3^1$
High	$R2^4$	$R2^3$	$R2^2$	$R2^1$	R4	R4	R1	R1	R1
Moderate	$R2^3$	$R2^3$	$R2^2$	R1	R1	R1	R1	R1	R1
Low	$R2^3$	$R2^3$	$R2^2$	R1	R1	R1	R1	R1	R1

*A small proportion of the country (~0.6%) is underlain by locally important karstic aquifers (Lk); in these areas, the groundwater protection responses for the Rk groundwater protection zone shall apply.

R1 Acceptable, subject to normal good practice (i.e. investigation, construction, operation and maintenance in accordance with DAF Minimum Specification S131), as set out in the following requirements:

1. The ELS shall be underlain by at least 1.5 m of cohesive subsoil.
2. An upper portion of the subsoil, which will vary in thickness depending on the level of risk posed by the ELS, shall have a permeability of less than $1x10^{-9}$ m/s. Where this is present in situ, (i.e. the subsoil is classed as CLAY (using BS5930) and has a clay content of >18% (where the particle size distribution is adjusted by excluding materials larger than 20 mm), and is free from preferential flowpaths), the surface of the excavated portion of the tank will require plastering with remoulded subsoil. Where the subsoil is considered to have a permeability of greater than $1x10^{-9}$ m/s, the subsoil must be enhanced by compaction to achieve the required permeability standard.
3. The upper 0.5m shall have a permeability of less than $1x10^{-9}$ m/s.
4. Where the subsoil is sand/gravel in vertical hydraulic continuity with the main water table, an ELS is not acceptable.
5. The ELS shall be at least 60 m away from any well or spring used for potable water.

R2[1] Acceptable, subject to normal good practice, meeting requirements 1, 2, 4 and 5 above, and the following additional requirement:

6. The minimum thickness of subsoil with a permeability of less than $1x10^{-9}$ m/s shall be 1.0 m.

R2[2] Acceptable, subject to normal good practice, meeting requirements 1, 2, 4, 5 and 6 above, and the following additional requirements:

7. The ELS shall be at least 15 m away from karst features that indicate enhanced zones of high bedrock permeability (e.g. swallow holes and dolines (collapse features)).

R2[3] Acceptable, subject to normal good practice, meeting requirements 1, 2, 4, 5, 6 and 7 (in karst areas).

R2[4] Acceptable, subject to normal good practice, meeting requirements 1, 2, 4, 5, 6 and 7 (in karst areas) above, and the following additional requirement:

8. Where microbial pathogens and/or high nitrate concentrations are known to be present in the water supply source, more detailed site investigation and/or restrictive design requirements may be necessary.

R3[1] Not generally acceptable, unless requirements 1, 2, 3, 4 and 5 can be met (see Note 1).

R3[2] Not generally acceptable, unless requirements 1, 2, 4, 5 and 6 can be met (see Note 1).

R3[3] Not generally acceptable, unless requirements 1, 2, 4, 5, 6 and 7 can be met (see Note 1).

R3[4] Not generally acceptable, unless requirements 1, 2, 4, 5, 6 and 7 (in karst areas) can be met (see Note 1).

R4 Not acceptable

Note 1: Achieving the required minimum subsoil thickness beneath the stores (ELSs) is unlikely.