



## *WFD Pressures and Impacts Assessment Methodology*

# **POINT SOURCE PRESSURE RISK ASSESSMENT FOR GROUNDWATERS**

## *Paper for the Working Group on Groundwater*

**Guidance document no. GW7**

This is a guidance paper on the application of a **Point Source Pressure Risk Assessment Methodology**. It documents the principles to be adopted by River Basin Districts and authorities responsible for implementing the Water Framework Directive in Ireland.

### **REVISION CONTROL TABLE**

<b>Status</b>	<b>Approved by National Technical Co-ordination Group</b>	<b>WFD Requirement</b>	<b>Relevant EU Reporting Sheets</b>	<b>Date</b>
Final	March 2005	Pressures and Impacts	GWPI4	10 November 2004

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# ***WFD Pressures and Impacts Assessment Methodology***

## **Guidance on Point Source Pressure Risk Assessment for Groundwaters**

### **1. Introduction**

#### **1.1 Background**

As part of the characterisation of groundwater bodies (GWBs) under Article 5 of the Directive, Member States must:

- (a) identify the pressures to which groundwater bodies, or groups of such bodies are subject, and;
- (b) carry out an assessment of the risk of failing to meet the Directive's environmental objectives.

For those bodies identified as being at risk on the basis of the initial characterisation, and for any bodies that cross the boundary between Member states, specific information on pressures must be collected and maintained.

#### **1.2 Aim of this paper**

This paper presents guidance for the assessment of point source pressures on bodies of groundwater for initial characterisation. This paper sets out the data requirements and criteria for deciding whether a groundwater body is at risk of failing to achieve environmental objectives due to point source pressures.

In compiling this paper, account has been taken of:

- The information requirements specified in Annex II of the Directive;
- The ability to collect information and compile National datasets on pressures that can be equally applied by all RBD projects within the deadlines to complete the Article 5 analysis;
- The requirement to assess groundwater pollution related risks to dependent terrestrial ecosystems and surface water bodies;
- Information, where available, on approaches being taken by other Member States (IMPRESS guidance, UK-TAG guidance);
- Information contained in the EU Commission reporting sheet (GWPI 3) on Groundwater Point Source Pollution.

The methodology developed is in line with the UKTAG guidance document '*7(i) Pollution Pressures on Groundwater*' in that the risk assessment methodology "*...is likely to be based on expert opinion taking into account available information. This is likely to screen out those point sources which are not significant*". General guidance on the risk assessment methodology is given in Guidance Document GW4 (GW WG, 2004).

#### **1.3 Groundwater Point Pressures**

To undertake the groundwater point pressure Risk Assessment, datasets and information relevant to the pressures are described in the following table (Table 1):

**Table 1: Pressure Type and Information requirement for Point Source Pressures**

<b>Point Source</b>	<b>Pressure</b>	<b>Data used</b>
<i>Mine Sites</i>	Former Mine Sites; Active Mine Sites	EPA/GSI register of former and current mine sites*; EPA IPPC register of active sites.
<i>Quarry Sites</i>	Accidental Spillages in Active Mine Sites	GSI register of Active Mine Sites
<i>Contaminated Sites</i>	Sites with contaminated land associated with such activities as: energy production; metal works and refinery; chemical manufacturing; pharmaceuticals; dairy production; paper pulp manufacturing; wood treatment; organic solvent coating; electroplating etc.	Licensed activity sites (LA or EPA) that are/may be/or had contaminated land issues.
<i>Landfills</i>	Waste license landfill sites and old landfills/dumps.	List of Current Local Authority landfills and EPA list of old dumps
<i>Oil Industry Infrastructure</i>	Large Storage Facilities or import facilities.	List of EPA licensed VOC site;
<i>Licence wastewater discharges to groundwater</i>	Wastewater effluents.	List of LA Section 4 and EPA licensed sites with wastewater discharges to the ground or to groundwater. List of Local Authority Urban Wastewater Discharges to the ground or to groundwater
<i>Licensed Trade Effluent discharges to groundwater</i>	Industrial effluents.	List of LA Section 4 and EPA licensed sites with discharges to the ground or to groundwater.

\*EPA register of former mine sites compiled by Sligo IT and reported to EPA as a small scale study by E. Grennan, 1996.

The individual risk assessment (RA) sheets outline the process undertaken to categorise GWBs into risk categories according to pressure magnitudes, pathway vulnerability or expert judgement using as much as possible information and datasets available at a National level. Risk Assessment sheets are given in GW8 (GW WG, 2004).

## **2. Data Requirements**

The data requirements varied depending on the particular pressure, and on the amount of information available. The extent of information that could be obtained for the assessment is currently determined by the existing databases at National level, but in the future there is the potential for additional data to be collated as part of further characterisation.

The following were collated for each significant point source to a groundwater body:

- Pollutants emitted (Nitrate as NO<sub>3</sub>; Ammonium as NH<sub>4</sub>; Priority Substances);
- Other Pollutants e.g. Organic Load (as TOC, BOD, COD);
- Loads of pollutants emitted (annual load);
- A description of the methodology used (see work sheets)

### **2.1 Reporting Requirements**

The following information was provided:

- Geographic information on point location (Easting and Northing);
- Points identified by activity e.g. industrial sector (NACE or other codes);
- Type of Pressure (e.g. discharge/spillage etc of effluent to ground);
- Details of the source (e.g. landfill, old gas works, etc.);
- Description of the discharge (continuous/intermittent, controlled/uncontrolled);
- Volume of discharge and annual load of each pollutant emitted;
- Summary statistics for the RBD by point source type (for 2005);

Summary statistics for each GWB by point source type will be provided for 2008.

### **3. Overall Approach**

The approach taken accounted for the need to rapidly screen large numbers of GWBs, and also the timetable for applying screening methods. The technical application of the risk assessments for the various point source pressure types is outlined in the risk assessment sheets that accompany this document in the Appendix.

#### **3.1 Stage 1 Identification of the main point source types**

The following point source pressures were identified:

- Mine water discharges;
- Quarries;
- Leakages from contaminated sites;
- Leakages from waste disposal sites (landfills);
- Leakages associated with oil industry infrastructure;
- Licensed Wastewater Discharges to groundwater (section 4 or UWW discharges);
- Licensed Trade Effluent Discharges to groundwater

#### **3.2 Stage 2 Identification of Receptors**

Groundwater bodies (also Drinking water protected areas) as identified and delineated by the Geological Survey of Ireland, and the dependent terrestrial ecosystems locations outlined by the National Parks and Wildlife Services, were obtained. The point source locations were then plotted onto the groundwater bodies using GIS.

#### **3.3 Stage 3 Risk Assessment**

The risk assessments were undertaken according to the RA sheets (Appendix) to determine whether the identified pressures are likely to lead to the risk of the GWB, groundwater dependent ecosystem (GWDTE) or drinking water protected area (DWPA) of failing to achieve the environmental objectives.

In line with guidance produced in other Member States (UK-TAG 7(i), 2004), for the initial characterisation the assessments of whether a point source is of sufficient magnitude to cause failure of a groundwater body to achieve its environmental objectives were based on expert opinion taking into account available information. This approach is outlined in the RA sheets for mines, quarries, landfills and contaminated sites. For licensed activities such as the wastewater and trade effluent discharges to groundwater, and oil industry infrastructure (VOC licensed sites), the UKTAG approach was followed whereby controlled and regulated activities (e.g. licensed activities) are assumed to have no impact on the groundwater body, unless there are actual measured impacts on the groundwater. The approach also takes into consideration time lags in the groundwater system, hence the need to include historic sources of pollution (e.g. old contaminated sites).

#### **3.4 Stage 4 Review of monitoring data to validate assessment**

The risk assessment was validated using groundwater quality monitoring data (if available). Available monitoring data was examined to:

- validate and if necessary further develop the pressure and impact assessment and increase the confidence that can be associated with the assessment;
- check whether there is any evidence of other, unexplained impact.;
- assess whether the additional but separate objective relating to significant and sustained trend in groundwater quality can be met.

#### **3.5 Stage 5 Further GRB Delineation and Characterisation**

For a GWB identified to be “at risk” it will be necessary to undertake further characterisation as detailed in Annex II 2.2 of the Directive. At this stage, further sub-division of GWB may be an option if this provides more manageable units in terms of monitoring and implementation of a programme of measures.

In most GWBs, point sources will affect only a small proportion of the GWB. Thus, it was recommended that where a point source(s) is considered to be putting a groundwater body 'at risk' or 'potentially at risk' (categories 1a or 1b) and the impacted area is <50% of the GWB, subdivision should normally be undertaken. The boundaries must be based on the conceptual understanding of the area and on hydrogeological boundaries to flow. For instance, the surface water catchment may be used where it equates closely to the impacted catchment area (providing that groundwater divides coincide with surface water catchments). Alternatively, groundwater flow lines (estimated, in most instances) may be used.

Further characterisation will proceed if appropriate.

### **3.6 Stage 6 Combine the results of the groundwater risk assessment**

The groundwater point source risk assessment was carried out after the Diffuse Source risk assessment was completed. The results of the point source assessment were then fed-into the overall risk assessment for groundwater quality before producing an overall risk that relates to all the environmental objectives for each groundwater body.

## **4. Summary**

Guidance for the assessment of point source pressures on GWBs for initial characterisation has been given, including data requirements and criteria for deciding whether a groundwater body is at risk of failing to achieve environmental objectives due to point source pressures.

Provision is made for sub-division of GWBs if the impacted areas are <50% of the area of the GWB. Further characterisation of GWBs will be undertaken if the results of the Risk Assessment indicate that this is required.

## **5. References**

ARTICLE 5 of *DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 23 OCTOBER 2000 Establishing a Framework for Community Action in the Field of Water Policy*: Characteristics of the river basin district, review of the environmental impact of human activity and economic analysis of water use.

ANNEX II of *DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 23 OCTOBER 2000 Establishing a Framework for Community Action in the Field of Water Policy: Part 2*. Groundwaters: Initial Characterisation; Further Characterisation; Review of Impact of human activity on groundwaters; Review of the impact of changes in groundwater levels and Review of the impact of pollution on groundwater quality.

EU Commission (2003) Reporting Sheet GWPI 3: *Point Source Pollution*. Pierre Hecq/ Joachim D'Eugenio/Philippe Quevauviller. 3 June 2004.

Grennan, E. (1996) *Small Scale Study of former Mine Sites in Ireland*. Compiled by Sligo Institute of Technology and presented to the EPA.

IMPRESS (2002) Document 5.3 *Guidance for the analysis of Pressures and Impacts In accordance with the Water Framework Directive*. 04 December 2002.

UK-TAG (UK Technical Advisory Group) (2004) *Guidance on Pollution Pressures on Groundwater*. Working Paper Version (v8)TAG7i, 13/01/04.

Working Group on Groundwater (2004) Guidance Document GW4: *Guidance on Pressures and Impacts Methodology*, 40 pp.

Working Group on Groundwater (2004) Guidance Document GW8: *Methodology for Risk Characterisation of Ireland's Groundwater*, 69 pp.

## **6. Appendix – Point Source Pressure Risk Assessment Sheets**

## 6.1 Groundwater Risk Assessment GWRA6

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWRA6</b>
Receptor type	Groundwater body
Pressure type	Mining – mobile inorganics
WFD objective	Chemical status
Assessment area	Surface extent of the groundwater body

#### A. Pathway susceptibility

As mines are generally deep, this is not a factor in the RA process. The value of the groundwater resource is taken into account in considering the potential impacts.

#### B. Impact potential

		Impact Potential
Pressure magnitude*	High (based largely on expert judgement)	High
	Low (based largely on expert judgement)	Low

\*expert judgement provided by GSI, Grennan (1996), RPS-KMM and EPA.

#### C. Risk category based on predictive risk assessment

RISK CATEGORY		Impact potential (from Table B)	
		<i>High</i>	<i>Low</i>
Receptor Sensitivity	High sensitivity*	n/a	n/a
	Moderate	1b	2a

\*not applicable – see RA sheet GWDTERA4.

#### D. Risk category of groundwater body adjusted using available impact data

Predictive risk category (from Table C)	Adjustments made using available impact data	
	<i>Data criteria</i>	<i>Adjusted risk category</i>
1b	Where significant impacts are known to occur by GSI, EMD, EPA, RBD consultants or local authorities	1a
2a	Where impacts are known to occur by GSI, EMD, EPA, RBD consultants or local authorities	1b or 1a, depending on confidence in data and/or degree of impact.



## **E. Delineating Groundwater Bodies ‘At Risk’ from Point Sources**

In most GWBs, point sources will affect only a small proportion of the GWB. In order to focus monitoring and further characterisation on relevant areas, it is recommended that where a point source(s) is considered to be putting a groundwater body ‘at risk’ (categories 1a or 1b) and the impacted area is <50% of the GWB, subdivision should normally be undertaken. The boundaries must be based on the conceptual understanding of the area and on hydrogeological boundaries to flow. For instance, the surface water catchment may be used where it corresponds closely to the impacted catchment area. Alternatively, groundwater flow lines (estimated, in most instances) may be used.

## 6.2 Groundwater Risk Assessment GWRA7

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWRA7</b>
Receptor type	Groundwater body
Pressure type	Quarries – mainly mobile organics
WFD objective	Chemical status
Assessment area	Surface extent of the groundwater body

#### A. Pathway susceptibility

This RA is based on expert judgement and impact data; consequently, pathway susceptibility is not included in the process.

#### B. Impact potential

		Impact Potential
Pressure magnitude*	High (based largely on expert judgement)	High
	Low (based largely on expert judgement)	Low

\*expert judgement provided by GSI, RPS-KMM and EPA.

#### C. Risk category based on predictive risk assessment

RISK CATEGORY		Impact potential (from Table B)	
		<i>High</i>	<i>Low</i>
Receptor Sensitivity	High sensitivity*	n/a	n/a
	Moderate	1b	2a

\*not applicable – see RA sheet GWDTERA5.

#### D. Risk category of groundwater body adjusted using available impact data

Predictive risk category (from Table C)	Adjustments made using available impact data	
	<i>Data criteria</i>	<i>Adjusted risk category</i>
1b	Where significant impacts are known to occur by GSI, EMD, EPA, RBD consultants or local authorities	1a
2a	Where impacts are known to occur by GSI, EMD, EPA, RBD consultants or local authorities	1b or 1a, depending on confidence in data and/or degree of impact.

#### E. Delineating Groundwater Bodies ‘At Risk’ from Point Sources

In most GWBs, point sources will affect only a small proportion of the GWB. In order to focus monitoring and further characterisation on relevant areas, it is recommended that where a point source(s) is considered to be putting a groundwater body ‘at risk’ (categories 1a or 1b) and the

impacted area is <50% of the GWB, subdivision should normally be undertaken. The boundaries must be based on the conceptual understanding of the area and on hydrogeological boundaries to flow. For instance, the surface water catchment may be used where it corresponds closely to the impacted catchment area. Alternatively, groundwater flow lines (estimated, in most instances) may be used.

### 6.3 Groundwater Risk Assessment GWRA8

#### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWRA8</b>
Receptor type	Groundwater body
Pressure type	Landfill Sites
WFD objective	Chemical status
Assessment area	Surface extent of the groundwater body

#### A. Pathway susceptibility

This RA is based on expert judgement and impact data; consequently, a pathway susceptibility matrix is not included in the process.

#### B. Impact potential

		<b>Impact Potential*</b>
Pressure magnitude**	High (based largely on expert judgement)	High
	Low (based largely on expert judgement)	Low

\* expert judgement provided by EPA and RPS-KMM.

\*\* Modern engineered landfills with fully lined cells are considered to exert a low pressure magnitude on groundwater, whereas, older un-lined cells in landfills and older closed landfills are assumed to exert a high pressure magnitude on the groundwater.

#### C. Risk category based on predictive risk assessment

<b>RISK CATEGORY</b>		<b>Impact potential (from Table B)</b>	
		<i>High</i>	<i>Moderate/Low</i>
Receptor Sensitivity	High sensitivity*	n/a	n/a
	Moderate	1b	2a

\*not applicable – see RA sheet GWDTERA6.

#### D. Risk category of groundwater body adjusted using available impact data

<b>Predictive risk category (from Table C)</b>	<b>Adjustments made using available impact data</b>	
	<i>Data criteria</i>	<i>Adjusted risk category</i>
1b	Where significant impacts are known to occur by EPA, RBD consultants or local authorities	1a
2a	Where impacts are known to occur by EPA, RBD consultants or local authorities	1b or 1a, depending on confidence in data and/or degree of impact.

#### E. Delineating Groundwater Bodies ‘At Risk’ from Point Sources

In most GWBs, point sources will affect only a small proportion of the GWB. In order to focus monitoring and further characterisation on relevant areas, it is recommended that where a point

source(s) is considered to be putting a groundwater body 'at risk' (categories 1a or 1b) and the impacted area is <50% of the GWB, subdivision should normally be undertaken. The boundaries must be based on the conceptual understanding of the area and on hydrogeological boundaries to flow. For instance, the surface water catchment may be used where it corresponds closely to the impacted catchment area. Alternatively, groundwater flow lines (estimated, in most instances) may be used.

## 6.4 Groundwater Risk Assessment GWRA9

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWRA9</b>
Receptor type	Groundwater body
Pressure type	Oil Industry Infrastructure
WFD objective	Chemical status
Assessment area	Surface extent of the groundwater body

#### A. Pathway susceptibility

This RA is based on expert judgement and impact data; consequently, a pathway susceptibility matrix is not included in the process.

#### B. Impact potential

		<b>Impact Potential*</b>
Pressure magnitude**	High (based largely on expert judgement)	High
	Low (based largely on expert judgement)	Low

\* expert judgement provided by EPA and RPS-KMM.

\*\* The EPA list of VOC licensed activities where there is large-scale storage of petroleum products is used as the national available dataset.

#### C. Risk category based on predictive risk assessment

<b>RISK CATEGORY</b>		<b>Impact potential (from Table B)</b>	
		<i>High</i>	<i>Moderate/Low</i>
Receptor Sensitivity	High sensitivity*	n/a	n/a
	Moderate	1b**	2a**

\*not applicable – see RA sheet GWDTERA7.

\*\*based on expert judgement of EPA staff

#### D. Risk category of groundwater body adjusted using available impact data

<b>Predictive risk category (from Table C)</b>	<b>Adjustments made using available impact data</b>	
	<i>Data criteria</i>	<i>Adjusted risk category</i>
1b	Where significant impacts are known to occur by EPA, RBD consultants or local authorities	1a
2a	Where significant impacts are known to occur by EPA, RBD consultants or local authorities	1b or 1a, depending on confidence in data and/or degree of impact.

#### E. Delineating Groundwater Bodies ‘At Risk’ from Point Sources

In most GWBs, point sources will affect only a small proportion of the GWB. In order to focus monitoring and further characterisation on relevant areas, it is recommended that where a point

source(s) is considered to be putting a groundwater body 'at risk' (categories 1a or 1b) and the impacted area is <50% of the GWB, subdivision should normally be undertaken. The boundaries must be based on the conceptual understanding of the area and on hydrogeological boundaries to flow. For instance, the surface water catchment may be used where it corresponds closely to the impacted catchment area. Alternatively, groundwater flow lines (estimated, in most instances) may be used.

## 6.5 Groundwater Risk Assessment GWRA10

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWRA10</b>
Receptor type	Groundwater body
Pressure type	Contaminated Land
WFD objective	Chemical status
Assessment area	Surface extent of the groundwater body

#### A. Pathway susceptibility

This RA is based on expert judgement and impact data; consequently, a pathway susceptibility matrix is not included in the process.

#### B. Impact potential

		<b>Impact Potential*</b>
Pressure magnitude*	High (based largely on expert judgement)	High
	Low (based largely on expert judgement)	Low

\* expert judgement provided by EPA and RPS-KMM.

#### C. Risk category based on predictive risk assessment

<b>RISK CATEGORY</b>		<b>Impact potential (from Table B)</b>	
		<i>High</i>	<i>Moderate/Low</i>
Receptor Sensitivity	High sensitivity*	n/a	n/a
	Moderate	1b	2a

\* not applicable – see RA sheet GWDTERA8.

#### D. Risk category of groundwater body adjusted using available impact data

<b>Predictive risk category (from Table C)</b>	<b>Adjustments made using available impact data</b>	
	<i>Data criteria</i>	<i>Adjusted risk category</i>
1b	Where significant impacts are known to occur by EPA, RBD consultants or local authorities	1a
2a	Where impacts are known to occur by EPA, RBD consultants or local authorities	1b or 1a, depending on confidence in data and/or degree of impact.

#### E. Delineating Groundwater Bodies ‘At Risk’ from Point Sources

In most GWBs, point sources will affect only a small proportion of the GWB. In order to focus monitoring and further characterisation on relevant areas, it is recommended that where a point source(s) is considered to be putting a groundwater body ‘at risk’ (categories 1a or 1b) and the



impacted area is <50% of the GWB, subdivision should normally be undertaken. The boundaries must be based on the conceptual understanding of the area and on hydrogeological boundaries to flow. For instance, the surface water catchment may be used where it corresponds closely to the impacted catchment area. Alternatively, groundwater flow lines (estimated, in most instances) may be used.

## 6.6 Groundwater Risk Assessment GWRA11

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWRA11</b>
Receptor type	Groundwater body
Pressure type	Trade Effluent Discharges
WFD objective	Chemical status
Assessment area	Surface extent of the groundwater body

#### A. Pressure Magnitude

Licensed discharges to groundwater, by virtue of their regulation either by a local authority or by the EPA (Section 4 licences and IPPC licences respectively) are assumed to exert a low pressure magnitude on the groundwater.

#### B. Pathway susceptibility

As most discharges to groundwater are directly into the ground, the soil layer is by-passed and hence groundwater vulnerability may be more appropriate than pathway susceptibility to represent the influence of the pathway. This assumption was made on the basis of expert opinion of the GSI, EPA and RPS-KMM.

#### C. Impact potential

With the assumption that licensed discharges to groundwater do not constitute a high pressure magnitude, an impact potential matrix is not required as the impact potential will be low in all cases. Therefore, the predicted risk category will always be 2a.

#### D. Risk category of groundwater body adjusted using available impact data

Predictive risk category	Adjustments made using available impact data	
	<i>Data criteria</i>	<i>Adjusted risk category</i>
2a	Where significant impacts are known to occur by EPA, local authorities or RBD consultants	1b or 1a, depending on confidence in data and/or degree of impact.

## 6.7 Groundwater Risk Assessment GWRA12

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWRA12</b>
Receptor type	Groundwater body
Pressure type	Wastewater Licensed Discharges to Groundwater – inorganics (N&P)
WFD objective	Chemical status
Assessment area	Surface extent of the groundwater body

#### A. Pressure Magnitude

Local Authority wastewater discharges to groundwater that have discharge consents from the EPA and Local Authority Section 4 licenses are assumed to exert a low pressure on the groundwater as opposed to non-consented discharges that are assumed to exert a high pressure on the groundwater. EPA expert judgement is also used to determine other instances of high pressure magnitude discharges.

#### B. Pathway susceptibility

As some of the urban waste-water discharges to groundwater are direct and others are indirect via percolation areas etc. it is not possible to factor in one single pathway into the risk assessment. For this risk assessment, EPA expert knowledge was used to assign a risk rating on a case-by-case basis.

#### C. Impact potential

		Impact Potential
Pressure magnitude	High (based largely on expert judgement)*	High
	Low (based largely on expert judgement)	Low

\*expert judgement provided by EPA and RPS-KMM.

#### D. Risk category based on predictive risk assessment

RISK CATEGORY		Impact potential	
		<i>High</i>	<i>Low</i>
Receptor Sensitivity	High sensitivity*	n/a	n/a
	Moderate	1b	2a

\*not applicable – see RA sheet GWDTERA9.

#### E. Risk category of groundwater body adjusted using available impact data

Predictive risk category	Adjustments made using available impact data	
	<i>Data criteria</i>	<i>Adjusted risk category</i>
1b	Where significant impacts are known to occur by EPA, RBD consultants or local authorities	1a
2a	Where impacts are known to occur by EPA, RBD consultants or local authorities	1b or 1a, depending on confidence in data and/or degree of impact.

## 6.8 Groundwater Risk Assessment SWRA2

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>SWRA2</b>
Receptor type	Groundwater dependent ecosystems in rivers, lakes and estuaries
Pressure type	Diffuse – mobile inorganics (NO <sub>3</sub> )
WFD objective	Chemical status
Assessment area	Surface extent of the groundwater body

#### A. Pathway susceptibility

PATHWAY SUSCEPTIBILITY			Flow Regime (Horizontal pathway)			
			<i>Karst aquifers</i>	<i>Fissured aquifers</i>	<i>Intergranular aquifers</i>	<i>Poorly productive aquifers*</i>
Vertical pathway***	Soil & subsoil	'Wet' soil	L	L	L	L
		Low permeability subsoil	L	L	L	L
	Vulnerability	Extreme	E	E	H	L
		High	H	H	H	L
		Moderate	M	M	M	L
		Low	L	L	L	L
		High to Low**	H	H	H	M

\* These aquifers are not considered to be contributing a significant proportion of water to rivers and lakes and therefore are not included in pathway susceptibility.

\*\* For areas where complete vulnerability map is not available from GSI.

\*\*\* The 'wet' soil and low permeability subsoil layers take precedence over the vulnerability layers.

#### B. Impact potential

IMPACT POTENTIAL*		Pathway Susceptibility (from Table A)			
		<i>Extreme</i>	<i>High</i>	<i>Moderate</i>	<i>Low</i>
Pressure magnitude	>2.0 LU ha <sup>-1</sup> or >33% tillage	High	High	Moderate	Low
	1.5-2.0 LU ha <sup>-1</sup> or 18-33% tillage	Moderate	Moderate	Low	Low
	1.0-1.5 LU ha <sup>-1</sup> or 3-18% tillage	Low	Low	Low	Low
	<1.0 LU ha <sup>-1</sup> or <3% tillage	Negligible	Negligible	Negligible	Negligible

\*Deriving Impact Potential

Individual Impact Potential maps are derived for the three types of pressures: cattle/sheep, pigs/poultry and tillage i.e. each grid cell within the maps will have three Impact Potential categories.

The **highest** Impact Potential category is taken for each cell, regardless of the type of pressure.

Within each GWB, the total area of '**H**' plus '**M**' Impact Potential is used to determine whether the GWB is 'at risk' (see C below).

**C. Risk category based on predictive risk assessment**

RISK CATEGORY		Proportion of assessment area with high and moderate impact potential					
		>50%	25-50%*	15-25%	10-15%	5-10%	<5%
Receptor Sensitivity	High sensitivity (nitrate-limited ecosystems)	1b	1b	1b	2a	2a	2b
	Moderate (Rivers)	1b	1b	2a	2a	2b	2b

\*The basis for this threshold is given in Guidance Document no. GW10 (GW WG, 2004).

**D. Risk category of groundwater body adjusted using available impact data**

Predictive risk category	Adjustments made using available groundwater impact data	
	<i>Data criteria</i>	<i>Adjusted risk category</i>
1b	Weighted mean NO <sub>3</sub> -N >11.3 mg l <sup>-1</sup>	1a or 1b, depending on level of confidence in the monitoring data
2a	Weighted mean NO <sub>3</sub> -N 5.65-11.3 mg l <sup>-1</sup>	1b or 2a, depending on level of confidence in the monitoring data
2b		
2b	Weighted mean NO <sub>3</sub> -N 2.0-5.65 mg l <sup>-1</sup>	2a
	Weighted mean NO <sub>3</sub> -N <2.0 mg l <sup>-1</sup>	2b

## 6.9 Ground Water Risk Assessment GWDTERA4

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWDTERA4</b>
Receptor type	Groundwater Dependent Terrestrial Ecosystems
Pressure type	Mining
WFD objective	Chemical status
Assessment area	Catchment area of GWDTE

This risk assessment process is based largely on expert judgement. The matrices below are intended to assist the process; however, expert judgement and, where available, impact data can override the conclusions in the matrices.

#### A. Pathway susceptibility

The pathway susceptibility is assumed to depend on:

- Groundwater flow regime, as indicated by aquifer type.
- Length of pathway or distance from boundary of GWDTE. A maximum distance of 3km is likely to be sufficient for this risk assessment process.

**Table A**

PATHWAY SUSCEPTIBILITY		Flow Regime			
		<i>Karst aquifers</i>	<i>Fissured aquifers</i>	<i>Intergranular aquifers</i>	<i>Poorly productive aquifers</i>
Distance from GWDTE boundary	<100 m	E	E	H	H
	100-1000 m	H	H	M	M
	1000-3000 m	M	M	M	L
	>3000 m	L	L	L	L

#### B. Impact potential

IMPACT POTENTIAL		Pathway Susceptibility (from Table A)			
		<i>Extreme</i>	<i>High</i>	<i>Moderate</i>	<i>Low</i>
Pressure magnitude*	Present within 3000 m	High	High	High	Low
	Absent	None	None	None	None

\* Based on expert judgement of NPWS, GSI, EPA and RBD consultants.

**C. Risk category based on predictive and impact risk assessments**

<b>Assessments made on the basis of predictions from pressure-susceptibility analysis</b>		<b>Adjustments to risk assessment category based on available impact data</b>	
<i>Impact potential (from Table B)</i>	<i>Risk category for whole groundwater body</i>	<i>Data type</i>	<i>Adjusted risk assessment category</i>
High	1b	NPWS or RBD consultants identify known impact with a high level of certainty	1a
Low	2a	NPWS or RBD consultants identify impact with a low level of certainty	1b
None	2b		

## 6.10 Ground Water Risk Assessment GWDTERA5

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWDTERA5</b>
Receptor type	Groundwater Dependent Terrestrial Ecosystems
Pressure type	Quarries
WFD objective	Chemical status
Assessment area	Catchment area of GWDTE

This risk assessment process is based largely on expert judgement. The matrices below are intended to assist the process; however, expert judgement and, where available, impact data can override the conclusions in the matrices.

#### A. Pathway susceptibility

The pathway susceptibility is assumed to depend on:

- Groundwater flow regime, as indicated by aquifer type.
- Length of pathway or distance from boundary of GWDTE. A maximum distance of 3km is likely to be sufficient for this risk assessment process.

**Table A**

<b>PATHWAY SUSCEPTIBILITY</b>		<b>Flow Regime</b>			
		<i>Karst aquifers</i>	<i>Fissured aquifers</i>	<i>Intergranular aquifers</i>	<i>Poorly productive aquifers</i>
Distance from GWDTE boundary	<100 m	E	E	H	H
	100-1000 m	H	H	M	M
	1000-3000 m	M	M	M	L
	>3000 m	L	L	L	L

#### B. Impact potential

<b>IMPACT POTENTIAL</b>		<b>Pathway Susceptibility (from Table A)</b>			
		<i>Extreme</i>	<i>High</i>	<i>Moderate</i>	<i>Low</i>
Pressure magnitude*	Present within 3000 m	High	High	High	Low
	Absent	None	None	None	None

\* Based on expert judgement of NPWS, GSI, EPA and RBD consultants.



**C. Risk category based on predictive and impact risk assessments**

<b>Assessments made on the basis of predictions from pressure-susceptibility analysis</b>		<b>Adjustments to risk assessment category based on available impact data</b>	
<i>Impact potential (from Table B)</i>	<i>Risk category for whole groundwater body</i>	<i>Data type</i>	<i>Adjusted risk assessment category</i>
High	1b	NPWS or RBD consultants identify known impact with a high level of certainty	1a
Low	2a	NPWS or RBD consultants identify impact with a low level of certainty	1b
None	2b		

## 6.11 Ground Water Risk Assessment GWDTERA6

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWDTERA6</b>
Receptor type	Groundwater Dependent Terrestrial Ecosystems
Pressure type	Landfills
WFD objective	Chemical status
Assessment area	Catchment area of GWDTE

This risk assessment process is based largely on expert judgement. The matrices below are intended to assist the process; however, expert judgement and, where available, impact data can override the conclusions in the matrices.

#### A. Pathway susceptibility

The pathway susceptibility is assumed to depend on:

- Groundwater flow regime, as indicated by aquifer type.
- Length of pathway or distance from boundary of GWDTE. A maximum distance of 3km is likely to be sufficient for this risk assessment process.

**Table A**

<b>PATHWAY SUSCEPTIBILITY</b>		<b>Flow Regime</b>			
		<i>Karst aquifers</i>	<i>Fissured aquifers</i>	<i>Intergranular aquifers</i>	<i>Poorly productive aquifers</i>
Distance from GWDTE boundary	<100 m	E	E	H	H
	100-1000 m	H	H	M	M
	1000-3000 m	M	M	M	L
	>3000 m	L	L	L	L

#### B. Impact potential

<b>IMPACT POTENTIAL</b>		<b>Pathway Susceptibility (from Table A)</b>			
		<i>Extreme</i>	<i>High</i>	<i>Moderate</i>	<i>Low</i>
Pressure magnitude*	Present within 3000 m	High	High	High	Low
	Absent	None	None	None	None

\* Based on expert judgement of NPWS, EPA and RBD consultants.

**C. Risk category based on predictive and impact risk assessments**

<b>Assessments made on the basis of predictions from pressure-susceptibility analysis</b>		<b>Adjustments to risk assessment category based on available impact data</b>	
<i>Impact potential (from Table B)</i>	<i>Risk category for whole groundwater body</i>	<i>Data type</i>	<i>Adjusted risk assessment category</i>
High	1b	NPWS or RBD consultants identify known impact with a high level of certainty	1a
Low	2a	NPWS or RBD consultants identify impact with a low level of certainty	1b
None	2b		

## 6.12 Ground Water Risk Assessment GWDTERA7

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWDTERA7</b>
Receptor type	Groundwater Dependent Terrestrial Ecosystems
Pressure type	Oil industry infrastructure
WFD objective	Chemical status
Assessment area	Catchment area of GWDTE

This risk assessment process is based largely on expert judgement. The matrices below are intended to assist the process; however, expert judgement and, where available, impact data can override the conclusions in the matrices.

#### A. Pathway susceptibility

The pathway susceptibility is assumed to depend on:

- Groundwater flow regime, as indicated by aquifer type.
- Length of pathway or distance from boundary of GWDTE. A maximum distance of 3km is likely to be sufficient for this risk assessment process.

**Table A**

<b>PATHWAY SUSCEPTIBILITY</b>		<b>Flow Regime</b>			
		<i>Karst aquifers</i>	<i>Fissured aquifers</i>	<i>Intergranular aquifers</i>	<i>Poorly productive aquifers</i>
Distance from GWDTE boundary	<100 m	E	E	H	H
	100-1000 m	H	H	M	M
	1000-3000 m	M	M	M	L
	>3000 m	L	L	L	L

#### B. Impact potential

<b>IMPACT POTENTIAL</b>		<b>Pathway Susceptibility (from Table A)</b>			
		<i>Extreme</i>	<i>High</i>	<i>Moderate</i>	<i>Low</i>
Pressure magnitude*	Present within 3000 m	High	High	High	Low
	Absent	None	None	None	None

\* Based on expert judgement of NPWS, EPA and RBD consultants.

**C. Risk category based on predictive and impact risk assessments**

<b>Assessments made on the basis of predictions from pressure-susceptibility analysis</b>		<b>Adjustments to risk assessment category based on available impact data</b>	
<i>Impact potential (from Table B)</i>	<i>Risk category for whole groundwater body</i>	<i>Data type</i>	<i>Adjusted risk assessment category</i>
High	1b	NPWS or RBD consultants identify known impact with a high level of certainty	1a
Low	2a	NPWS or RBD consultants identify impact with a low level of certainty	1b
None	2b		

### 6.13 Ground Water Risk Assessment GWDTERA8

#### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWDTERA8</b>
Receptor type	Groundwater Dependent Terrestrial Ecosystems
Pressure type	Contaminated land
WFD objective	Chemical status
Assessment area	Catchment area of GWDTE

This risk assessment process is based largely on expert judgement. The matrices below are intended to assist the process; however, expert judgement and, where available, impact data can override the conclusions in the matrices.

#### A. Pathway susceptibility

The pathway susceptibility is assumed to depend on:

- Groundwater flow regime, as indicated by aquifer type.
- Length of pathway or distance from boundary of GWDTE. A maximum distance of 3km is likely to be sufficient for this risk assessment process.

**Table A**

<b>PATHWAY SUSCEPTIBILITY</b>		<b>Flow Regime</b>			
		<i>Karst aquifers</i>	<i>Fissured aquifers</i>	<i>Intergranular aquifers</i>	<i>Poorly productive aquifers</i>
Distance from GWDTE boundary	<100 m	E	E	H	H
	100-1000 m	H	H	M	M
	1000-3000 m	M	M	M	L
	>3000 m	L	L	L	L

#### B. Impact potential

<b>IMPACT POTENTIAL</b>		<b>Pathway Susceptibility (from Table A)</b>			
		<i>Extreme</i>	<i>High</i>	<i>Moderate</i>	<i>Low</i>
Pressure magnitude*	Present within 3000 m	High	High	High	Low
	Absent	None	None	None	None

\* Based on expert judgement of NPWS, EPA and RBD consultants.

**C. Risk category based on predictive and impact risk assessments**

<b>Assessments made on the basis of predictions from pressure-susceptibility analysis</b>		<b>Adjustments to risk assessment category based on available impact data</b>	
<i>Impact potential (from Table B)</i>	<i>Risk category for whole groundwater body</i>	<i>Data type</i>	<i>Adjusted risk assessment category</i>
High	1b	NPWS or RBD consultants identify known impact with a high level of certainty	1a
Low	2a	NPWS or RBD consultants identify impact with a low level of certainty	1b
None	2b		

## 6.14 Ground Water Risk Assessment GWDTERA9

### Summary details on pressures, receptors and WFD objective

<b>RA Sheet</b>	<b>GWDTERA9</b>
Receptor type	Groundwater Dependent Terrestrial Ecosystems
Pressure type	Urban Wastewater Discharges
WFD objective	Chemical status
Assessment area	Catchment area of GWDTE

This risk assessment process is based largely on expert judgement. The matrices below are intended to assist the process; however, expert judgement and, where available, impact data can override the conclusions in the matrices.

#### A. Pathway susceptibility

The pathway susceptibility is assumed to depend on:

- Groundwater flow regime, as indicated by aquifer type.
- Length of pathway or distance from boundary of GWDTE. A maximum distance of 3km is likely to be sufficient for this risk assessment process.

**Table A**

PATHWAY SUSCEPTIBILITY		Flow Regime			
		<i>Karst aquifers</i>	<i>Fissured aquifers</i>	<i>Intergranular aquifers</i>	<i>Poorly productive aquifers</i>
Distance from GWDTE boundary	<100 m	E	E	H	H
	100-1000 m	H	H	M	M
	1000-3000 m	M	M	M	L
	>3000 m	L	L	L	L

#### B. Impact potential

IMPACT POTENTIAL		Pathway Susceptibility (from Table A)			
		<i>Extreme</i>	<i>High</i>	<i>Moderate</i>	<i>Low</i>
Pressure magnitude*	Present within 3000 m	High	High	High	Low
	Absent	None	None	None	None

\* Based on expert judgement of NPWS, EPA and RBD consultants.



**C. Risk category based on predictive and impact risk assessments**

Assessments made on the basis of predictions from pressure-susceptibility analysis		Adjustments to risk assessment category based on available impact data	
<i>Impact potential (from Table B)</i>	<i>Risk category for whole groundwater body</i>	<i>Data type</i>	<i>Adjusted risk assessment category</i>
High	1b	NPWS or RBD consultants identify known impact with a high level of certainty	1a
Low	2a	NPWS or RBD consultants identify impact with a low level of certainty	1b
None	2b		