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This Report has been cleared for submission to the Director by Programme Manager Frank Clinton.

Signed *Joe Reilly* Date *1/6/11*

**LICENSING & RESOURCE USE**

**INSPECTOR'S REPORT ON A LICENCE APPLICATION**

TO:	DIRECTORS	
FROM:	Brian Meaney	- Environmental Licensing Programme
DATE:	31 May 2011	
RE:	Application for a waste licence review from <b>Wicklow County Council</b> in relation to <b>Ballymurtagh Landfill</b> , Ballygahan Upper, Ballygahan Lower, Tinnahinch, Co. Wicklow Licence Register <b>W0011-02</b>	

Type of facility:	Closed landfill. Civic amenity site.
Classes of Activity <sup>1</sup> : (P = principal activity)	3 <sup>rd</sup> Schedule: D1[P] 4 <sup>th</sup> Schedule: R3, R4, R5
Category of Activity under IPPC Directive (2008/1/EC):	5.4 Landfills receiving more than 10 tonnes per day or with a total capacity exceeding 25,000 tonnes, excluding landfills of inert waste
Quantity of waste managed per annum:	600 tonnes at civic amenity site – up to 10,000 tonnes may be accepted per existing licence
Classes of Waste:	Deposited in landfill: Non-hazardous municipal solid waste, sewage and industrial sludge. Civic amenity site: Dry recyclable non-hazardous and hazardous household waste.

<sup>1</sup> Waste Management Acts, 1996 to 2011 – the Third and Fourth Schedules as amended by the European Communities (Waste Directive) Regulations 2011

Location of facility:	Ballygahan Upper, Ballygahan Lower and Tinnahinch, Co. Wicklow
Licence application received:	27/11/2009
Third Party submissions:	None
Article 14 Notices sent:	30/7/2010 3/3/2011
Article 14 compliance date:	9/5/2011
Site visit:	28/6/2010

## 1. FACILITY

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The Ballymurtagh landfill is an existing development authorised as a landfill and civic amenity site under licence register number W0011-01 held by Wicklow County Council. The landfill closed in 2002. A civic amenity site is operated at the facility and regulated by the existing waste licence. Approximately 600 tonnes per annum of household recyclable waste is accepted at the civic amenity site. Three people are currently employed at the facility.

Wicklow County Council operated a landfill at this location between 1989 and 2002. The site is 1.5km north of Avoca on the Avoca-Rathdrum Road (R752) in the Avoca River valley. Around the landfill and the general area of the Avoca mines, the land is characterised by forestry and pasture, farms and several groups of houses, as well as areas of mine spoil. Ballymurtagh landfill is located above the Avoca River, some 1.5km downstream of the Meeting of the Waters where the Avonmore and Avonbeg rivers join to form the Avoca River. It is 5km upstream of Woodenbridge where the Aughtim River joins the Avoca River. The river discharges into the Irish Sea at Arklow some 7km further downstream. The location of the landfill relative to the Avoca River is illustrated in Figure 1.

The original licence application was made in September 1997 and a licence granted in April 2001 following consideration of first party objections. It was understood at the time of licensing that the landfill would close at the end of 2001 with up to six months additional operation to bring in soils for restoration. It was recognised by the Agency at the time that the facility was being operated on a dilute and disperse basis. The conditions in the licence were considered adequate to allow for authorisation of the landfill in compliance with Directive 80/68/EC on groundwater.

On 31 December 2002 the landfill closed. Restoration commenced in 2004, capping was carried out in 2005 and landscape works were completed in 2006. The civic amenity site opened in February 2003. Under the existing licence, the closed landfill is subject to ongoing monitoring. Figure 2 illustrates the layout of the facility as it exists today.

It is estimated that 480,000 tonnes of non-hazardous waste were deposited in the landfill between 1989 and 2002. The waste mostly came from the domestic sector although sludge was also deposited.

The Recommended Decision (RD) that accompanies this report is a new document reflecting current styles and conditions in licences (as opposed to an amended version of the existing 10-year old licence).



**Figure 1 Location of Ballymurtagh Landfill, the Avoca River and surroundings**

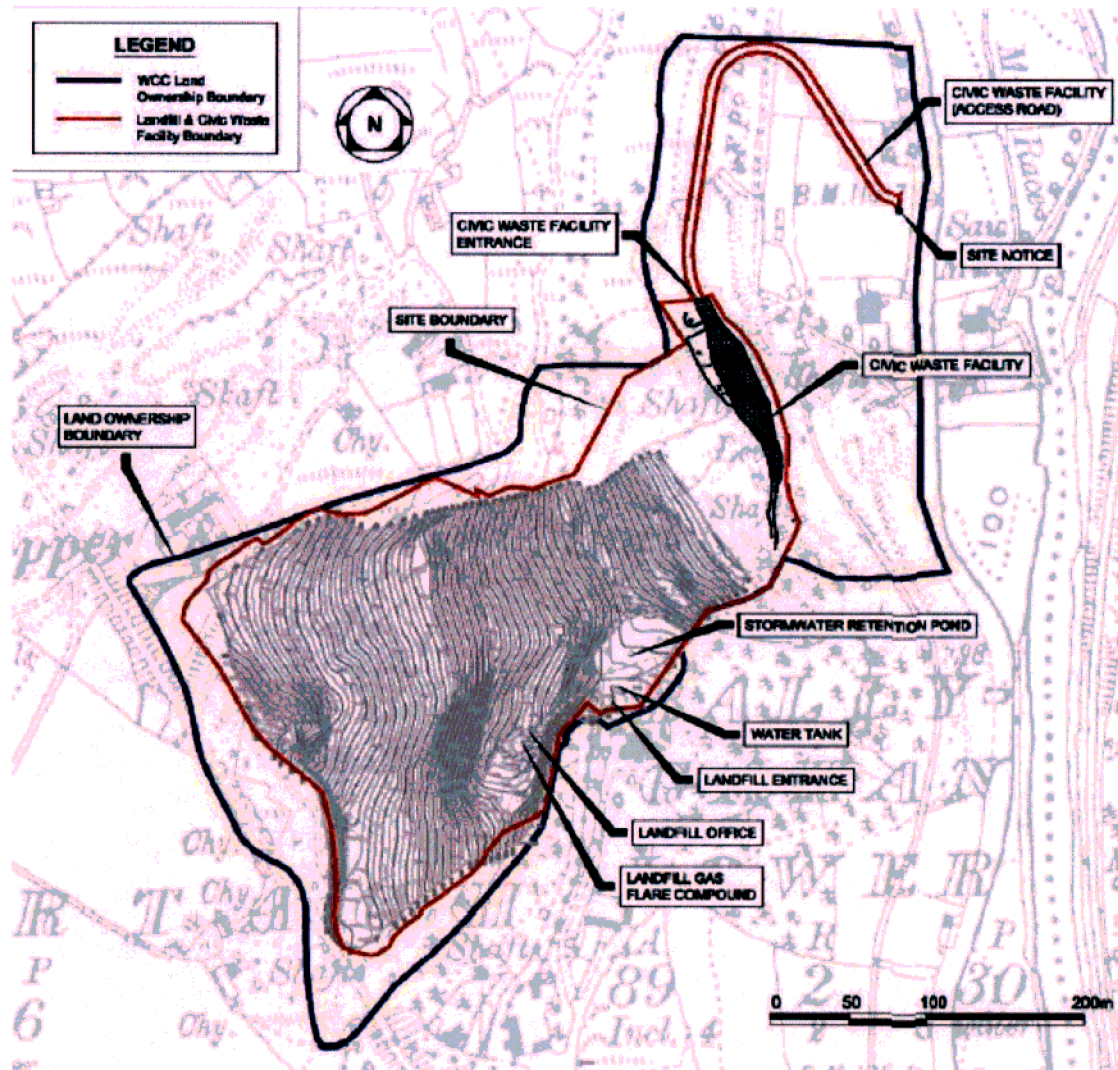


Figure 2 Site ownership and licence boundary and other points of interest

## 2. REASON FOR LICENCE APPLICATION

On 25 October 2007 the European Court of Justice (case C-248/05) found against Ireland in a case that related partly to a complaint concerning the Ballymurtagh landfill. The Court in particular found Ireland failed to comply with articles 4, 5, 7 and 10 of Council Directive of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances (80/68/EC) in the design, constructing and authorisation of the landfill.

At a meeting with the European Commission on 12 December 2007 it was decided that the waste licence for the landfill should be reviewed. The purpose of the licence review is to address the deficiencies in the earlier authorisation process identified by the Court.

### 3. HISTORY OF THE SITE

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#### 3.1 Mining and the legacy of the Avoca mines

Copper mining began in Avoca around 1720 and continued episodically for the next 260 years until 1982 when the mine went into receivership. In modern times, the mine has comprised two distinct areas, East Avoca and West Avoca. West Avoca is characterised by two adjacent mines – Ballymurtagh and Ballygahan. The Ballymurtagh landfill is located in an open pit that was part of the Ballygahan mine. The adjacent Ballymurtagh mine is now an almost fully backfilled (with tailings) open cast mine. See Figure 1 for illustration.

The area was mined for pyrite and copper and the open excavation that is now the Ballymurtagh landfill was part of the exploited vein. Avoca Mines Ltd commenced mining in West Avoca in 1969 (it had been inactive since 1962) and produced almost 8,900,000 tonnes of copper ore (0.73% Cu) in the period to 1982. Most ore was extracted underground but the open Ballygahan pit was excavated during this period.

The EPA/GSI 2009<sup>2</sup> study concludes as follows in relation to the mine area as a whole: A large volume of acid mine drainage drains from underground mine workings in East and West Avoca, causing extensive ongoing pollution of the Avoca River. Groundwater in the immediate vicinity of the mine is also contaminated as a consequence of interaction with solid mine waste. Large volumes of this waste remain on the site and the waste has high concentrations of lead, arsenic, copper and zinc, among other metals. Stream sediments downstream of the site have high concentrations of copper, lead and zinc and contamination is apparent up to 10km from the site.

Acid mine drainage is generated by the oxidation of sulphide minerals in the presence of air and water; the reaction being catalysed by sulphur-producing bacteria. The most important mineral in this respect is pyrite (iron sulphide) which is abundant in the mineralized rocks of Avoca. Acid mine drainage can arise from groundwater passing through the rocks or abandoned underground workings and rain water passing vertically through the mine or spoil heaps. The GSI 1997 report concludes that virtually all the acid mine drainage generated in Avoca, whether by leaching of bedrock sulphides or spoil heap sulphides, is eventually discharged from the mine workings into the Avoca River. Calculations of available sulphur in bedrock reserves at Avoca compared to sulphur in spoil heaps show that underground sourcing of acid mine drainage greatly exceeds that arising from spoil heaps.

Within the overall Avoca mine site, the Ballygahan site (including the Ballymurtagh landfill) encloses 22 hectares of which the landfill comprises 6.5ha. The Ballymurtagh landfill is directly above an extensive network of underground mines that are drained mainly by the 19<sup>th</sup> century “Road Adit”, also called the “Ballymurtagh Road Adit” - shown on Figure 3. This adit<sup>3</sup> emerges beside the Rathdrum-Avoca road at the foot of the river valley below the landfill. A flume is used to monitor water levels. The discharge flows through a channel parallel to the road for a short distance (blue line

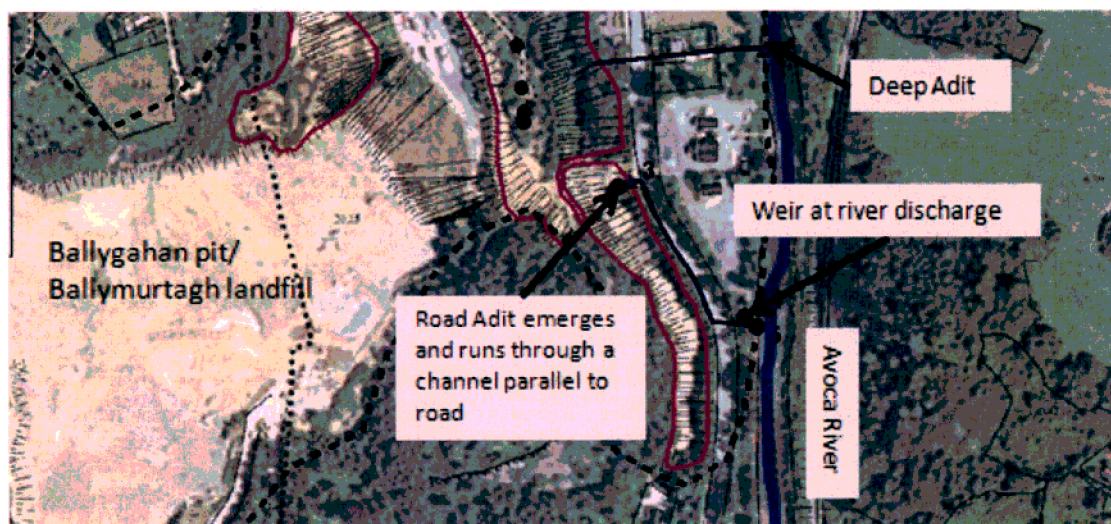
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<sup>2</sup> *Historic Mine Sites Inventory and Risk Classification*, Vol. 1, EPA/GSI 2009.

<sup>3</sup> An adit is an entrance to an underground mine. In Avoca, adits are now the principal sources of drainage from the mine and they control the water level within the mines.

on Figure 3) before passing under the road and discharging into the Avoca River. In West Avoca most of the acid mine drainage discharges through the Road Adit. The smaller Ballygahan Deep Adit discharges from West Avoca through a narrow pipe at the Avoca River. In the 2006/7 sampling campaign referred to in the next paragraph, the pipe was not accessible during winter and had stopped flowing in summer.

Analysis carried out for the EPA/GSI 2009 report (winter 2006/7 and summer 2007) showed that the Road Adit discharge had a low pH with elevated copper, lead, zinc, nickel and cadmium. In general, there is little seasonal variation in the Road Adit discharge. Samples taken several metres downstream of the Road Adit discharge show high concentrations – particularly in winter – of acidity, lead, zinc, copper, nickel and chromium (total).



**Figure 3 Location of Road Adit and Deep Adit and discharge of mine drainage to Avoca River (Source: adapted from EPA/GSI 2009)**

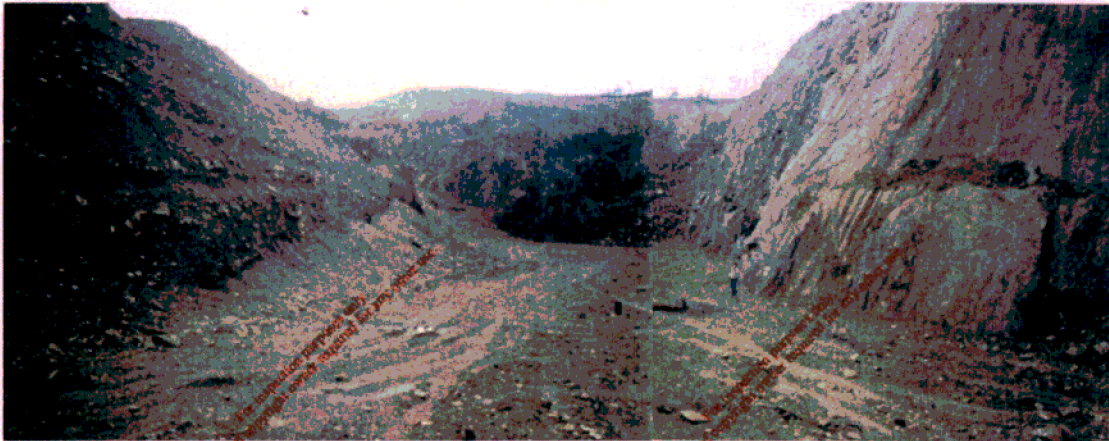
### 3.2 Pre-landfill and site investigations

The Ballymurtagh landfill was constructed in an open, disused mining excavation void. Subsurface workings beneath the void extend down to 330 metres below sea level. Since cessation of mining, the underground workings were left to flood. Groundwater rose to present levels and these levels are maintained by adits that drain to the Avoca River.

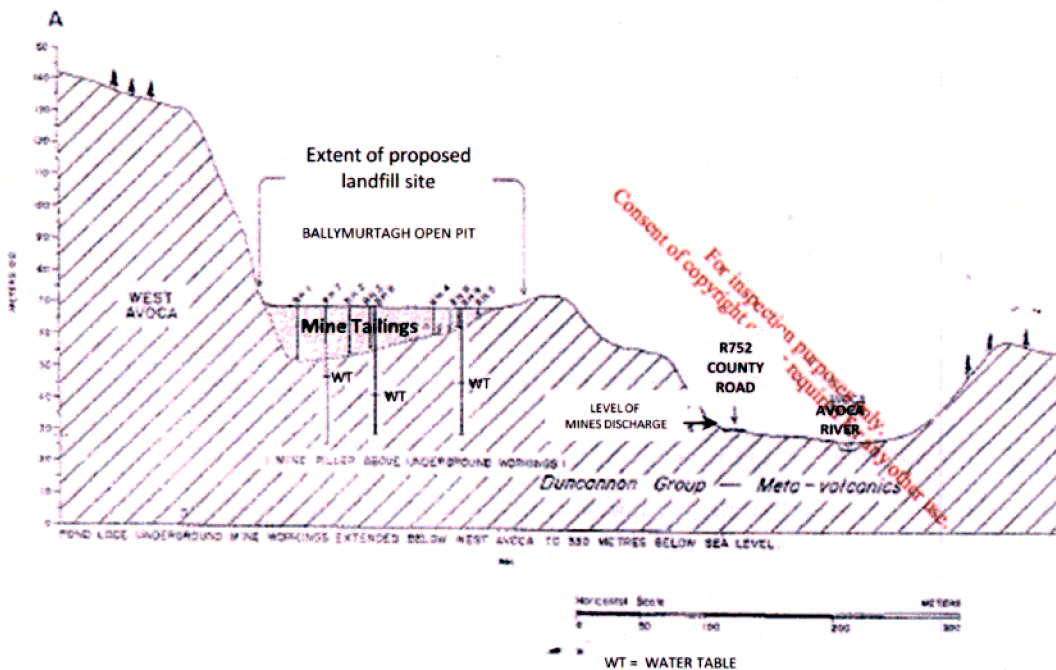
The open pit that is now the landfill covered an area of approximately one hectare and was an excavation of some 180m by 55m enclosed almost fully by high walls of rock and mine waste. The photographs in Figure 4 illustrate the size of the pit pre-landfilling. The floor of the pit is flat as a result of its use as a settlement pond for mine waste tailings (sludge) pumped from the nearby ore mill. The tailings are waste products from the primary and secondary crushing of the ore after the base metals have been abstracted. They are mainly in the silt range (0.002-0.06mm) and drainage through the base of the open pit allowed the tailings to dry out and consolidate. Drilling operations carried out by KT Cullen in 1986 indicated that the tailings were at that time “in a medium dense condition and only show signs of softening in the

deeper levels below 6m.” Cullen states that “this process of consolidation will continue as further drainage takes place.”

Cullen’s site investigations in 1986 consisted of six boreholes sunk to the base of the mine tailings and three boreholes into the bedrock beneath the tailings, as shown in the cross-section in Figure 5. The boreholes show tailings of 16.5 metres thickness at the western end of the open pit and less than 2 metres at the entrance of the excavation. The lack of water in these six boreholes indicated that drainage of the tailings was complete. The three deeper boreholes indicated a water table in the bedrock below the base of the open pit.



**Figure 4 Photomontage looking west from the entrance into Ballymurtagh pit showing side walls and back of pit.** For scale note the person standing towards the right of the pit. (Source: from two photos provided in KT Cullen report, 1986)



**Figure 5 Cross section through West Avoca and the Avoca River, showing 1986 boreholes and proposed landfill site** (Source: KT Cullen report, 1986)

A single set of water samples taken by KT Cullen in winter 1986 shows a rapid deterioration in river water quality in the Avoca River as it flows first past the East Avoca mining area and then the West Avoca mining area. At the latter point (compared to upstream of the mine area) its measured pH had gone from 6.3 to 4.5, sulphate concentrations from 13mg/l to 32mg/l, iron from 0.2mg/l to 2mg/l, magnesium from 1mg/l to 6.3mg/l and conductivity from 56µs/cm to 100µs/cm. Reference in the Cullen report to earlier IIRS sampling campaigns in 1980 show pH as low as 2.7 and copper, zinc and magnesium concentrations of 46mg/l, 90mg/l and 118mg/l respectively at a sampling location *between* the discharges from the East Avoca (upstream) and West Avoca (downstream) mining areas. The Avoca River was at that location and time said to be particularly toxic to fish life. Analysis of the discharge from the West Avoca mining area showed a significant contribution of metal and organic load to the river. Analysis of groundwater samples from beneath the Ballymurtagh pit showed similar chemistry to both the West and East Avoca mine discharges.

### 3.3 Landfill design

The KT Cullen 1986 report presents broad recommendations to Wicklow County Council concerning the design and method of operation for the proposed Ballymurtagh landfill. It is useful to present verbatim KT Cullen's conclusions with regard to the conditions prevailing at the Ballymurtagh pit and the outline of options for its use as a landfill:

The principal physical and hydrogeological conditions at the Ballymurtagh open pit can be summarised as follows:

- (i) The excavation is a long, narrow deep feature surrounded by high walls of rock and overburden.
- (ii) The base of the open pit is underlain by between 6 m and 16 m of settled and partly consolidated mine tailings overlying competent bedrock.
- (iii) The base of the open pit is dry and free draining with the permanent water table located at the rock head.
- (iv) The position of the water table is controlled by an overflow pipe which discharges groundwater in the mine workings beneath the site to the nearby Avoca River.
- (v) The Avoca River below the Meeting of the Waters is severely contaminated by mine discharges from East and West Avoca and the present conditions within the river below this point are toxic to fish life.



- (vi) The groundwater beneath the open pit is highly mineralised with elevated levels of copper, iron, manganese and sulphate. This mineralisation is due to leaching of the sulphide ores by naturally occurring bacteria.

The various physical features of the open pit together with its central and concealed position make it a suitable site for development as a modern landfill. However, the unique hydrochemical status of the local groundwater and the Avoca River allows two different site designs to be proposed which differ only in the manner in which the leachate generated within the refuse is controlled. One design would allow the open-pit to be left in its present state and infilled with refuse with the resulting leachate allowed to drain through the unsaturated tailings and pass into the water table below the base of the open excavation. The second proposal would involve sealing the base of the open pit with an impermeable liner, collecting the leachate and following treatment discharging it to the Avoca River by way of the mine over-flow pipe. The first proposal can be considered as a "dilute and disperse" option with the leachate undergoing attenuation during its passage through the unsaturated tailings, being diluted firstly by the groundwater passing through the dis-used underground workings and then secondly by the flow within the Avoca River. The highly contaminated nature of both the groundwater beneath the mine and of the Avoca River allows this option to be worthy of serious consideration as the principal effect on the quality of either the mine overflow or the Avoca River would be a discoloration dependant on the nature and composition of the leachate. The second option can be described as a "contaminated site" with all leachate generated within the refuse being collected, treated and eventually

discharged to the Avoca River. Such a site would not add to the pollution levels already affecting the Avoca River and would therefore not effect any plans to rehabilitate this major river in the years to come. However, the costs of developing and operating a fully contained landfill site are significantly higher than those associated with a dilute and disperse site. These additional costs at Avoca must be considered in terms of the unique hydrochemical quality of the groundwater in West Avoca, the prospects of ever rehabilitating the Avoca River and the Council's policy on effluent discharges into the Avoca River between Arklow and the mining area.

A landfill with void space of 200,000m<sup>3</sup> was envisaged with waste deposited in a single cell to a depth of 20m and a lifespan of some 25 years at a fill rate of 8,000 tonnes per annum. Using the dilute-and-disperse principle, it was estimated that the groundwater beneath the site would dilute the leachate 45 times before discharge to the Avoca River. It was then estimated that the combined leachate/groundwater would be diluted a further 54 times at low flow in the Avoca River (1981, 1.27m<sup>3</sup>/s) – an overall dilution rate for leachate of over 2,400. Were an unlined landfill to be developed, KT Cullen recommended the acceptance of domestic refuse only.

A later report<sup>4</sup> on the design of the landfill proposes a number of land drains be installed in the tailings. It also proposes the installation of a 500mm sub-base drainage layer with stone graded to 12-100mm. A "Terram 1000" membrane is proposed to go beneath the drainage layer. To quote the report: "This sub-base will then provide a base on which the generated leachate can be dispersed laterally into the drains and tailings. ...The purpose of this layer is two fold, one to provide a working base to carry the imposed truck loading and two, to provide lateral dispersal of generated leachate." The report goes on to confirm the status of the landfill as a "dilute and disperse site, i.e. its leachate to filter through the mine tailings, in the base into its mine working shafts and there diluted by the mine waters." [sic]

To contain the leachate, the design calls for a bund at the eastern (entrance) end of the pit. The bund, which is shown as "embankment" on Figure 6, was to be raised to a level of 5 metres over the base of the pit and lined on the pit side using a butyl rubber lining – the lining to be 2 metres below the existing floor of the pit. To further quote the report: "On top of the impermeable lining, a free draining layer of stones shall be placed to ensure that any liquid reaching the face of the bund is drained off into the drains running back into the pit."

There is no evidence provided one way or another that the landfill was constructed as designed or as discussed in the report. There is a bund or embankment at the toe of the landfill, and there is a photograph showing what might be a liner extending part of the way up the base of the pit (but not buried). There is no photographic or documentary evidence of a 500mm drainage layer or "Terram 1000" having been installed.

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<sup>4</sup> The report is unattributed and undated but contains drawings dated April 1988 prepared by Malachi Cullen Assoc., Consulting Engineers, Athlone.

### 3.4 Feasibility Study for Management and Remediation of the Avoca Mining Site

In December 2008, CDM (Camp Dresser and McKee Inc.) published a report commissioned by the Department of Communications, Energy and Natural Resources entitled *Feasibility Study for Management and Remediation of the Avoca Mining Site*. The work was directed by the Geological Survey of Ireland. Its overall objective was to prepare a management plan for the site to address human and ecological concerns, safety and physical hazards, heritage, future uses and long-term site management. The environmental issues identified at the site are as follows:

- acid mine drainage;
- contaminated river sediments;
- contaminated river water;
- impacted aquatic life;
- contaminated alluvial groundwater; and
- acid generating potential within the spoil piles.

Two alternative plans were put forward in the feasibility study.

Plan 1 is the more expensive and extensive option and would involve moving, regrading and stabilising spoil heaps in the mine areas, treating them with lime and covering them with HDPE (in some places), soil and vegetation. The purpose is to remove the physical hazards presented by tailings and reduce rainwater infiltration into the spoil. Contaminated sediments would be removed from the Avoca River, deposited in an on-site repository and stabilised. (The available documentation is silent on the method of stabilisation). The purpose is to reduce the continued release of metals into the river and improve habitat and water quality. Finally, a water treatment-lime stabilisation plant would be constructed to treat all acid mine water discharges (to be captured at adits) and extracted groundwater. The treatment plant is envisaged as providing the most important improvement to river water quality. Measures to influence mine and groundwater flow to the river are also proposed – including plugging shafts, controlling flows and installation of bentonite walls and groundwater extraction wells. It is also proposed to install an experimental, pilot scale, passive water treatment system, probably comprising reed beds.

Plan 2 generally presents less effective but less costly combinations of remedial technologies and process options for each site location. Lime and HDPE would be used less in spoil heap remediation and the experimental pilot scale water treatment plant is excluded.

The available documentation for the feasibility study makes no reference to actions regarding the Ballymurtagh landfill. No opinion is offered in the documentation on the contribution of the landfill to groundwater and river contamination. It can be inferred however that the interception and treatment of groundwater emerging from the Ballymurtagh Road Adit will also capture discharges from the landfill.

In November 2010, €3 million were committed by the Department of Communications, Energy and Natural Resources to the preliminary phase of these works. The first phase of works will address public safety in the Avoca mines area and facilitate the preparatory stages of groundwater diversion and treatment infrastructure as recommended in the Feasibility Study. In West Avoca, this will

ultimately include diversion and treatment of water from the Road Adit which drains the underground mines that underlie the landfill site.

#### **4. EMISSIONS FROM THE LANDFILL TO THE WATER ENVIRONMENT**

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##### **4.1 Groundwater context and quality**

The GSI has characterised the rocks in the West Avoca area as being of type “Pu”, meaning “poor aquifer, generally unproductive”. Rocks of this type are generally characterised as poorly productive aquifers in that they tend to transmit limited quantities of water and are not generally suitable for water production beyond supply for private homes. As a result of limited capacity, poorly productive aquifers will “reject” recharge water and this can result in increased surface run-off or shallow groundwater flow in the bedrock transition zone.

Under normal conditions, groundwater would be expected to flow from the elevated areas to the Avoca river valley. However the underground mine workings beneath the landfill have significantly altered the hydrogeological conditions in the mining area and act as preferential conduits for captured groundwater – that subsequently emerges at the adits in the river valley. The ‘Ballymurtagh Road Adit’ (or ‘Road Adit’) discharges groundwater at an elevation of +31mOD. By comparison, the base of the landfill is at approximately +70mOD. This is illustrated conceptually in Figure 6.

Groundwater that escapes the mine workings will discharge diffusively to the deep alluvial deposits along the Avoca River valley. This flux has been estimated at 1 to 3 litres per second, compared to the mean annual flow at the Road Adit of 17.7 L/s.

There are no water supply wells downgradient of the landfill and there are no projected future developments of groundwater in the West Avoca mining area.

Wicklow County Council propose three basic groundwater receptors associated with leachate emanating from the Ballymurtagh landfill:

1. Groundwater in bedrock directly beneath the landfill which is captured by the underground mine workings and discharges via the Road Adit:

Leachate will vertically migrate through the base of the landfill into the groundwater in the underlying bedrock and mine workings. Data from 1986 shows that List II substances (including ammonium and copper, as well as a BOD of 23mg/l) were elevated in the Road Adit groundwater pre-landfilling. Ammonia (5-8mg/l, but demonstrably decreasing over time) associated with landfill leachate is now present at greater concentrations in the Road Adit discharge.

2. Groundwater in bedrock beneath the landfill that may escape capture by the underground mine workings and which subsequently flows and discharges into the river valley:

The thick alluvial deposits in the river valley are highly permeable and groundwater flux is high and responsive to levels in the river. There is little or no evidence of landfill-associated parameters in groundwater samples taken in this zone, despite their presence at the foot of and immediately down-gradient of the landfill.

3. Groundwater in fill and boulder clay at the downgradient edge of the landfill, near the present recycling facility:

There is no evidence of leachate leaking through the embankment at the foot of the landfill, although the possibility is not at all discounted. Four groundwater wells in this area show contamination by leachate – G1/04, G2/04, RC6 and ‘monitoring well’ (for location, see Figure 7). These wells are located immediately adjacent (to the east) of the civic amenity site boundary and downhill from the landfill embankment.

Wicklow County Council sought through a statistical analysis known as Principal Component Analysis (PCA) to demonstrate that leachate, through its transmission via groundwater, is not having an impact on the Avoca River. Principal Component Analysis is a means by which a statistical ‘fingerprint’ can be attributed to a set of data. The PCA sought to assign a ‘fingerprint’ to the mixture of contaminants that can comprise acid mine drainage and leachate. The PCA in this case found that ammonium, potassium, chloride and sodium could be statistically indicative of leachate and the following parameters predominantly of acid mine drainage: zinc, copper, manganese, sulphate, magnesium, iron and cadmium. This is not to say that the two sources, acid mine drainage and leachate, will not both contribute to concentrations of these substances in mixtures of groundwater or river water. It is simply to say that these substances are predominantly associated with one or other of the two sources.

The PCA found that it was possible to separate out three distinct and unique groups of samples – those associated with the background environment (e.g. upstream groundwater and river water), leachate (e.g. leachate wells, leachate contamination in downgradient wells close to the landfill) and acid mine drainage (e.g. East Avoca samples, river water etc.). The chemical signature of leachate is very different to the chemical signature of acid mine drainage. When water samples from the Avoca River at and downstream of the mines area were assessed using PCA, it was concluded that “no stream [surface water] samples show dominant concentration by landfill leachate.” The possibility of landfill leachate reaching the Avoca River is discussed further in section 4.5 below.

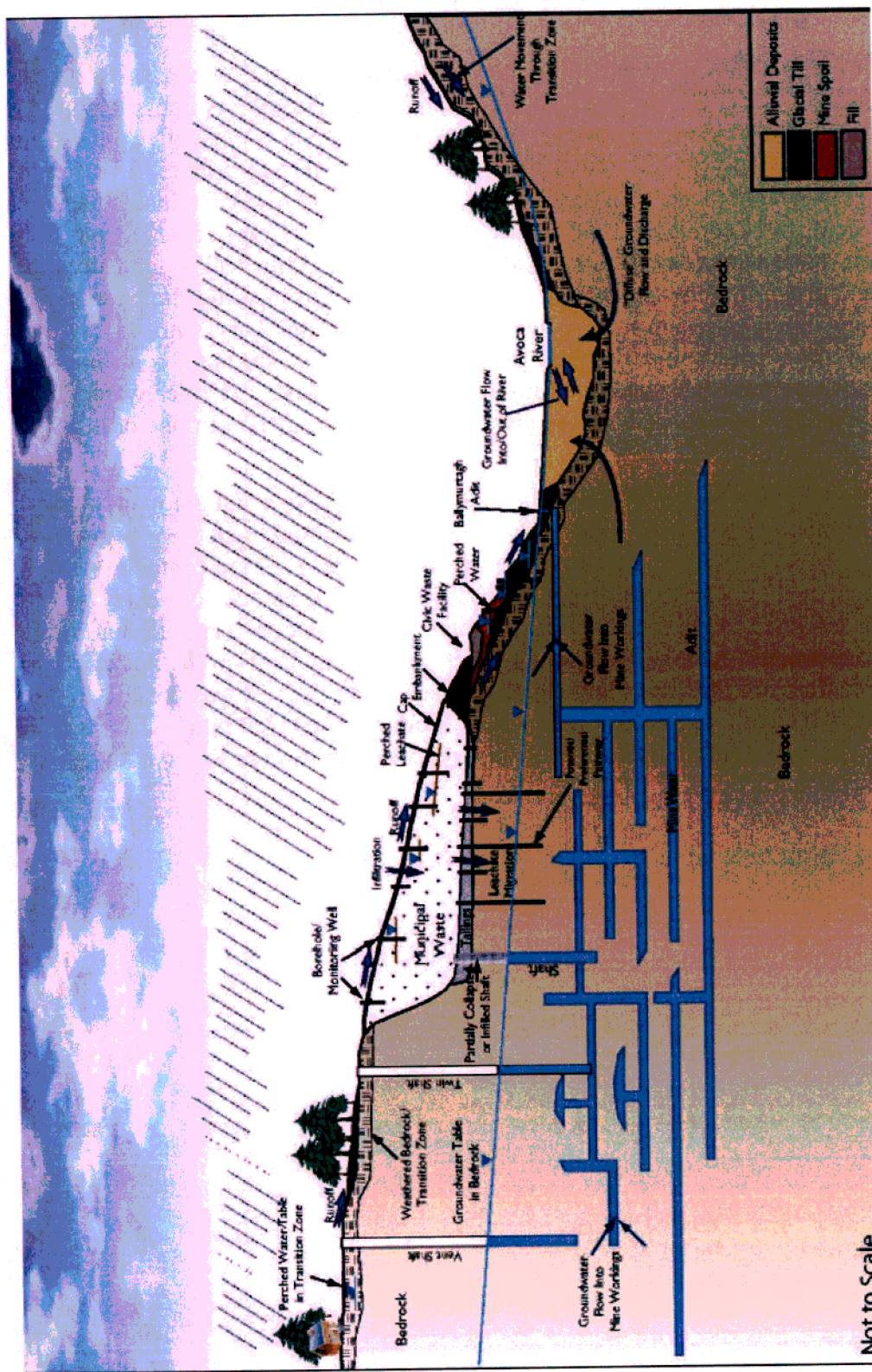
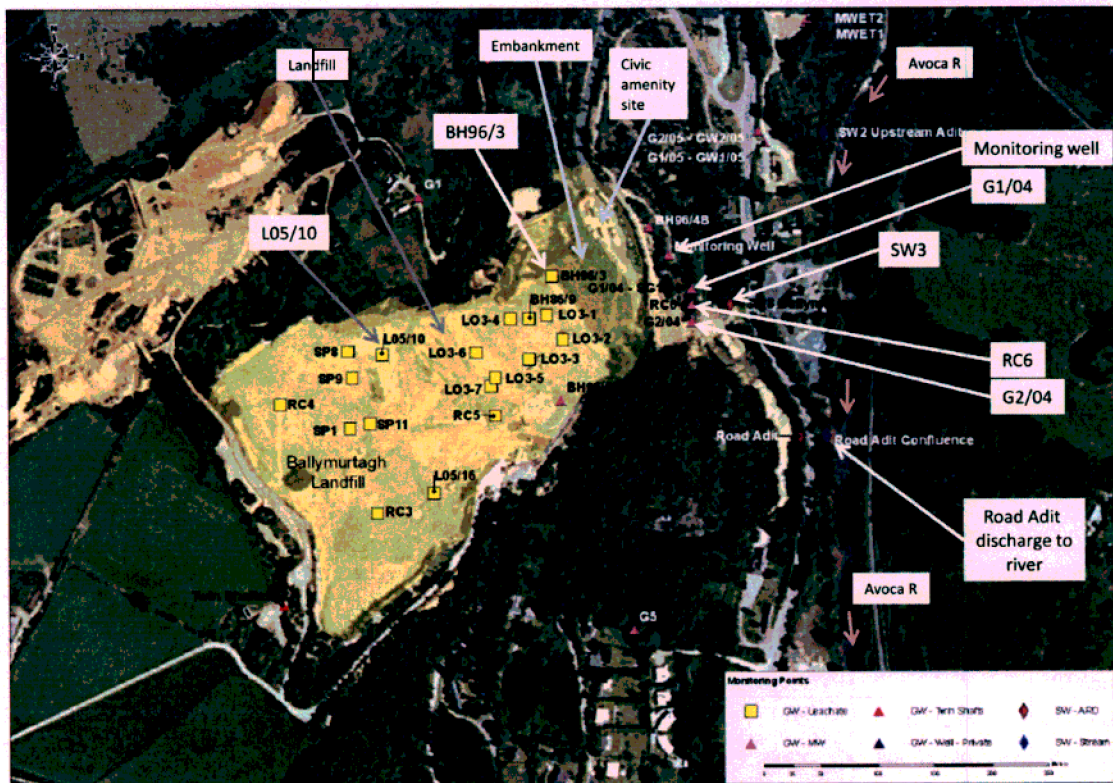


Figure 6 Schematic cross section of West Avoca including the conceptual hydrogeology of Ballymurtagh landfill



**Figure 7 Monitoring points in the vicinity of the landfill – highlighting certain leachate and groundwater points**

#### 4.2 River water quality

The ECJ judgement against Ireland found that the Avoca River was part of a separate aquatic system to the groundwater beneath the landfill. In a submission to Wicklow County Council on the environmental impact statement, the Eastern Regional Fisheries Board noted that the Avoca system is an important salmonid water with excellent populations of salmon, sea trout and brown trout.

Table 1 shows that ammonia (as a potential indicator of leachate contamination) was not detected to any great extent at a sampling point less than 2km downstream of the Ballymurtagh Road Adit discharge to the Avoca River. Data from 2007/8 show that ammonia is indeed present in the Road Adit discharge (to the river) at levels of approximately 7mg/l. This can be contrasted with discharges from other areas of the mine where there is no landfill influence on water quality - discharges from adits in these areas show ammonia concentrations of <0.3mg/l. Wicklow County Council have presented evidence of a gradual reduction in ammonia concentrations in the Road Adit discharge from beneath the landfill, from up to 30mg/l before the landfill was capped, to current levels in the range 5-10mg/l. This is shown in the graph for “SW3” in Figure 8. Localised sampling (since 2006) in the Avoca River/Road Adit mixing zone shows that ammonia in this area stabilised at a level of 0.08mg/l to 0.15mg/l – shown in the graph for “SW4” in Figure 8. Further downstream (graph “SW5”), with two exceptional readings in recent years, there is no more evidence of excess ammonia in the river than upstream - shown in graphs “SW1” and “SW2” in Figure 8.

**Table 1 Water chemistry in Avoca River***(Water Quality in Ireland 2007-2009, EPA 2010)*

Determinand	No. Samples	1km downstream of Avonbeg River confluence (upstream of mine area)			Avoca Bridge (downstream of mine area)			EQS <sup>5</sup>
		Min	Mean	Max	Min	Mean	Max	
Alkalinity-total (mg/l CaCO <sub>3</sub> )	23	6.0	15.9	25.0	9.0	15.3	50.0	-
Chloride (mg/l Cl)	11	6.9	9.4	11.0	6.7	9.4	11.2	-
Conductivity @20°C (µS/cm)	23	53.0	69.5	119.0	54.4	79.6	114.0	-
pH	23	5.5	6.4	7.9	5.4	6.2	7.4	4.5-9.0
Temperature °C	23	2.6	9.8	14.7	2.6	9.9	14.8	-
Total Hardness (mg/l CaCO <sub>3</sub> )	23	13.0	22.7	37.0	17.0	27.0	40.0	-
True Colour (Hazen)	23	2.5	51.0	110.0	2.5	43.6	110.0	-
Nitrite (mg/l N)	22	0.002	0.003	0.007	0.002	0.003	0.006	-
Ortho-phosphate (mg/l P)	23	0.000	0.007	0.015	0.000	0.006	0.014	0.075 (as MRP)
Total oxidised nitrogen (mg/l N)	23	0.610	1.000	1.480	0.640	1.062	1.630	-
Ammonia-total (mg/l N)	22	0.000	0.008	0.021	0.000	0.031	0.061	0.14
BOD - 5 days (Total) (mg/l O <sub>2</sub> )	23	0.5	1.2	1.9	0.5	1.0	1.6	2.6
Dissolved Oxygen (mg/l)	23	10.09	11.39	13.48	10.20	11.33	13.40	-
Dissolved Oxygen (% saturation)	23	97.0	100.3	104.8	97.3	100.0	104.0	80-120

It is interesting to note that elevated ammonium (1mg/l) and BOD (23mg/l) were detected in a one-off sample in the Road Adit discharge in the 1980s before the landfill was constructed. Groundwater from beneath the site of the proposed landfill at the same time showed ammonium concentrations of >1mg/l. Wicklow County Council assumes these contaminants to be associated with agricultural activities in the upland areas to the west of the landfill.

General chemical monitoring in the river, published in *Water Quality in Ireland 2007-2009*, EPA 2010, shows no major influence of non-metallic elements of river quality between upstream monitoring points and downstream (Avoca Bridge) monitoring – see Table 1. There is an increase in ammonia concentration between the two monitoring points. However the concentration of ammonia at the downstream location remains within the environmental quality standard for good status waters.

*Water Quality in Ireland 2007-2009* reports exceedences (Table 2) of environmental quality standards in the 2007-2009 surveillance programme in the Avoca River for three metals.

<sup>5</sup> European Communities Environmental Objectives (Surface Waters) Regulations, S.I. No. 272 of 2009 (95<sup>th</sup>ile, good status).



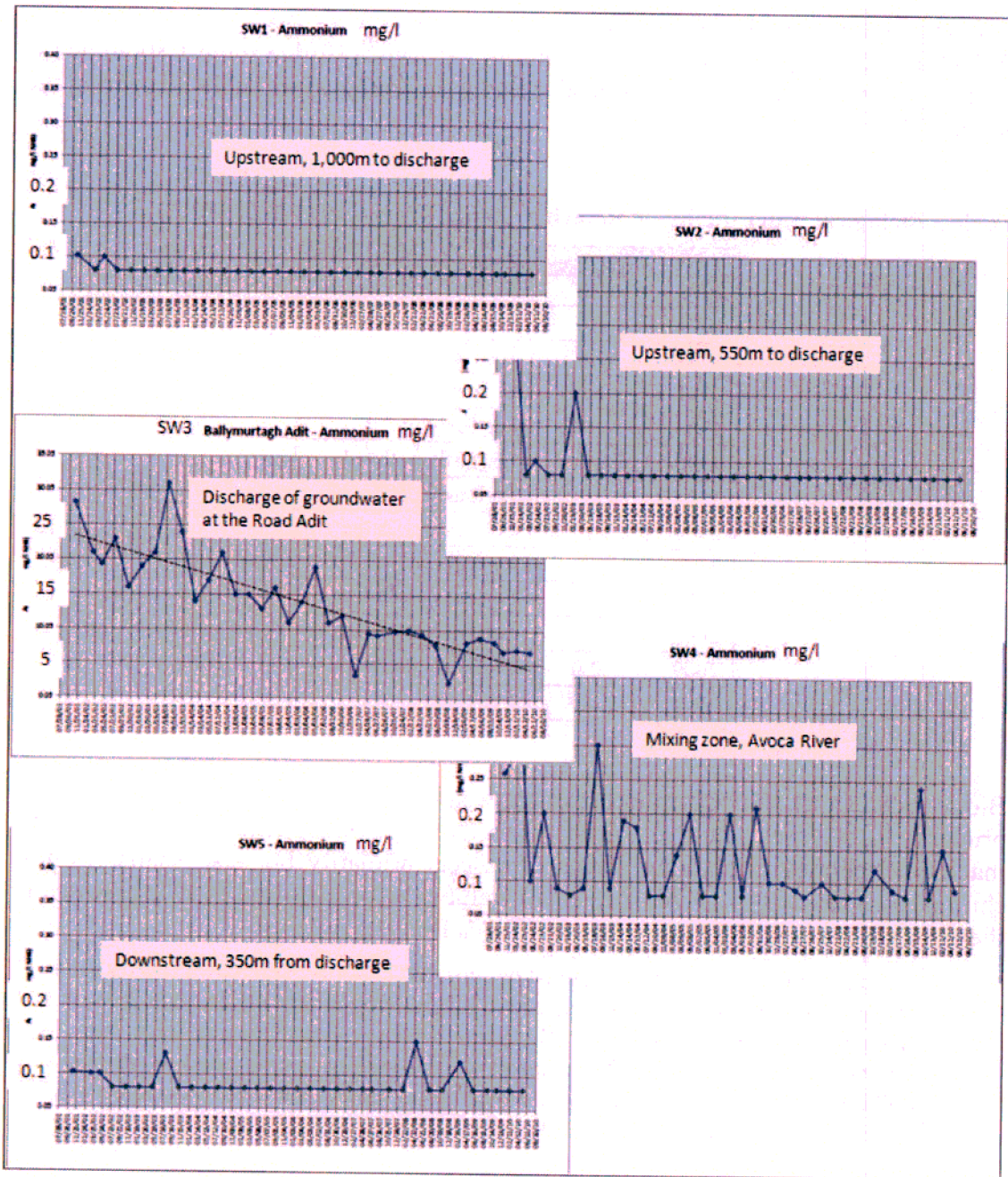


Figure 8 Ammonia concentrations in Avoca River and mine water discharge, 2001 to 2010 (Source: Wicklow County Council)

Table 2 Exceedences of environmental quality standards in Avoca River, 2007-2009 (EPA)

Metal	AA-EQS* (µg/l)	No. of samples	No of samples detected	Mean (µg/l)	Median (µg/l)
Zinc	50	12	12	112	102
Copper	5	12	12	7	-
Cadmium	0.08	30	28	0.32	-

\* Annual average - environmental quality standard

Biological monitoring has shown water quality in the Avoca River to be in the range Q4/3-4 upstream of the Ballymurtagh Landfill. At Avoca Bridge some 1,800m below the Ballymurtagh Road Adit, biological status is as presented in Table 3 covering the period 1971 to 2010.

**Table 3 Biological water quality monitoring, Avoca Bridge, 1971-2010 (EPA)**

Year	Q-value	Pollution status
1971	1/0	Seriously polluted
1974	1/0	Seriously polluted
1977	1/0	Seriously polluted
1981	1/0	Seriously polluted
1986	1/0	Seriously polluted
1990	1/0	Seriously polluted
1994	1/0	Seriously polluted
2000	1/0	Seriously polluted
2006	4	Unpolluted
2007	1/0	Seriously polluted
2008	2/0	Seriously polluted
2009	2/0	Seriously polluted
2010	4	Unpolluted

Biotic indices ("Q-values") reflect average water quality at a location and are based primarily on the relative proportions of pollution-sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site. The Q-value of 4 for 2006 and 2010 is assessed in the EPA's latest biological report for the Avoca River as follows:

A marked improvement in biological quality (to Q4, Good Status) was indicated by the numbers and diversity of sensitive macroinvertebrates observed at Avoca Bridge in late September 2010. Similar temporary improvements have been observed in recent surveys however ecological quality has returned to serious pollution due to acid mine drainage effluent upon return surveys. It is expected that this improvement will again only be temporary.

#### 4.3 Surface water run-off

Surface water, as overland flow, drains via diversion drains around the perimeter of much of the landfill and surface and sub-surface drains on the landfill cap to a stormwater retention pond. These were constructed in order to prevent surface run-off onto the landfill and minimise water infiltration into the landfill. **Condition 3.19.5** of the RD proposes an assessment of this infrastructure in the event of it becoming necessary to generally assess water management at the landfill from the point of view of preventing its ingress to the landfill. Measuring run-off flowrates from the stormwater retention pond is also proposed (**Schedule C.2.2**). Captured surface water run-off is piped directly to the Avoca River and is not a source of pollution in the river.

#### 4.4 Water ingress to the landfill

Upon restoration of the landfill, a low permeability cap was installed on the landfill. The cap was installed in places against a sheer rock face. The risk of water ingress from this rock face was addressed by the design of the cap but it is not possible to prove the efficacy of these design measures. It is a proposed objective of the RD that ingress of water into the landfill should be minimised. To this end, **condition 6.21** of the RD proposes that a study be undertaken to establish, 6 years on from capping, that the cap is operating as designed.

Groundwater can in all likelihood enter the waste mass by infiltration through the pit side-walls. The scale of this infiltration mechanism is unknown and in any event would appear to be uncontrollable short of major engineering works at the landfill.

#### 4.5 Leachate in the landfill and emissions

In recent years until 2010, no leachate well was providing credible readings on leachate levels in the landfill. Older wells are said to have collapsed, moved, or otherwise no longer reach the base of the landfill. High level readings for leachate are attributed to perched leachate in the waste mass. One new borehole was drilled in 2010 to the landfill base. Attempts were made to drill two others, but failed to penetrate through the waste. The single usable monitoring borehole, L10/01, showed consistent readings over 2 months in 2010 of 1.5-2m leachate at the base of the landfill. Borehole L10/01 was drilled to a depth of 15 metres and ended in mine waste – presumed to be the tailings at the base of the landfill. The borehole is located near the embankment at the foot of the landfill.

Better knowledge of or information on leachate depth and generation in the landfill would not and cannot influence the manner in which the landfill can be authorised. Short of actively extracting leachate from the landfill (discussed below), leachate, whatever its volume, will continue to discharge as designed through the base of the landfill and into the groundwater beneath. It is however imperative that information on leachate level and character in the landfill is better utilised as a management tool at the landfill. In the event of a contaminative incident at the Avoca River for example, knowledge of leachate head and character will be important in attributing the source of contamination to the landfill, or eliminating it as a source.

In addition to the new borehole L10/01, more boreholes would appear to be appropriate in order to monitor the depth and character of leachate across the landfill. The base of the landfill would appear to be flat, or almost flat, being composed as it is of dewatered tailings. Photographs from the period suggest a flat base. Therefore it is to be assumed that leachate will not necessarily pool or fall to any one particular point in the base of the landfill. **Conditions 6.16.1** and **6.16.2** propose a network of new leachate monitoring wells, at least four in addition to L10/01, to be installed in the landfill in an appropriate pattern and in a manner that will allow for the profile of leachate depth in the landfill as a whole to be monitored and if necessary controlled.

Should it prove necessary as a strategy of last resort, **Condition 6.16.6** of the RD proposes a requirement to extract leachate from the landfill should it be demonstrated beyond reasonable doubt that leachate is the source of serious new contamination in the Avoca River and extraction of leachate from the landfill will reduce contamination in the river. The extraction of leachate, while unlikely to address specific point

sources of contaminants, would reduce the driving head of leachate above the mine tailings at the base of the landfill, thus reducing the volume of leachate passing into the contaminated groundwater beneath the landfill and attenuating contaminative fluxes.

#### *Can leachate reach the Avoca River?*

List I and II substances are present in leachate that was sampled from two boreholes (L05/10 and BH96/3) at concentrations that exceed the limit of detection. A simple linear analysis of available dilutions in the groundwater and Avoca River was carried out, taking a conservative view of the leachate data<sup>6</sup>. Calculating available dilutions, the following substances have the potential, at low rates of dilution (low groundwater flow and maximum predicted leachate flow), to be present in the groundwater at concentrations that would, were the groundwater to be surface water and not otherwise contaminated with acid mine drainage, exceed the environmental quality standard for surface water:

- cadmium (list I),
- ammonium (list II),
- chromium (list II), and
- lead (list II).

It is thus theoretically possible that these substances can leave the landfill and reach the Avoca River at concentrations that would, if there were no diluting flow in the Avoca River, cause the environmental quality standards to be exceeded in the river. The flow in the Avoca River is in actual fact *at least* three orders of magnitude greater than groundwater discharges. Thus the leachate-based contaminants in the groundwater are immediately and massively diluted by the Avoca River to an extent that, with one exception, they cannot exceed the environmental quality standards for surface water:

- In the period 2003 to 2010, a maximum concentration of 1,309mg/l of ammonium in leachate was recorded. There are several other readings up to this level from the same borehole. However the borehole represents a perched leachate and might not represent the leachate that actually passes from the base of the landfill. (The single deeper boreholes L10/01 installed in 2010 has to date yielded a single reading of 460mg/l ammonium). That said, at *maximum* predicted outflows of leachate, *low* groundwater flow and *low* (dry weather) river flow (i.e. least possible dilution), it is predicted that ammonium in the Avoca River could be 0.25mg/l. This prediction is supported by data for monitoring point SW4 (350m downstream of the groundwater discharge, see Figure 8) that shows periodic if infrequent readings of in or around 0.2mg/l.<sup>7</sup> The EQS for waters of good status is 0.14mg/l as 95%ile. As noted above in the Eastern River Basin Management Plan, the objective of achieving good status in the Avoca River is deferred beyond 2015. Wicklow County Council have demonstrated that the concentration of ammonia appearing in the

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<sup>6</sup> Typically taking the maximum recorded concentration of these substances recorded in Ballymurtagh landfill's leachate, and at that, at levels that might be classified as unusual or outliers by comparison to other readings for these substances in the same sampling location on different dates.

<sup>7</sup> Data from EDEN and the EPA monitoring programme, which doesn't include this monitoring point, shows no exceedence of the 0.14mg/l EQS at Avoca Bridge some 1,500m further downstream.

groundwater discharge is decreasing with time, as would be expected from a capped landfill.

(In the period 2003 to 2010, one exceptional reading of 41mg/l for chromium in leachate was recorded. No other reading for chromium in leachate in the period exceeded 2mg/l and even this is greater than the more usual 0.005mg/l or lower readings. At this concentration in leachate, it is possible for chromium to be present in the Avoca River at double the EQS of 0.0034mg/l. Given that there is no analytical evidence of chromium in the Road Adit discharge or the river in almost ten years of monitoring, this exceptional leachate reading was discarded in predicting potential contamination of the river.)

## 5. LANDFILL GAS

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Landfill gas is generated at the Ballymurtagh landfill. In 2001, it was determined that it was not feasible to utilise landfill gas for energy recovery. Landfill gas is flared and subject to emission limit values in the existing licence. New emission limit values are proposed in **schedule B.1** of the RD following the current general requirements for flare monitoring at landfills. In this regard, only NO<sub>x</sub> remains to be controlled by emission limit value. The limit value for NO<sub>x</sub> in the existing licence is 500mg/m<sup>3</sup>. The more usual limit value for NO<sub>x</sub> for enclosed flares is 150mg/m<sup>3</sup>. The latter emission limit value is proposed in **schedule B.1**.

Limit values for CO, particulates, TA Luft organics, HCl and HF are recommended for deletion, again following current styles.

Proposed monitoring frequencies are as per the existing licence with the exception of the introduction in **schedule C.1.2** of a requirement to continuously monitor combustion temperature and quarterly measure residence time.

It is proposed in **condition 6.17.8** of the RD that biannual surface emissions monitoring be carried out to ensure the integrity of the landfill cap with regard to containment of landfill gas. Exceedence of trigger levels set in the condition is to be regarded as an incident with corrective action taken.

## 6. CIVIC AMENITY SITE

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There are no new controls proposed in the RD for the existing civic amenity site. The new **condition 8.4(c)** of the RD will allow Wicklow County Council to develop the civic amenity site in accordance with the recommendations of the National Hazardous Waste Management Plan. The limit on waste acceptance of 10,000 tonnes per annum in the existing licence seems unnecessarily high. Approximately 600 tonnes per annum is currently accepted. The RD proposes an annual limit of 1,000 tonnes per annum.

## 7. CULTURAL HERITAGE, HABITATS & PROTECTED SPECIES

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The Avoca River Valley NHA is located approximately 2km downstream of the Ballymurtagh Landfill. The Vale of Clara (Rathdrum Wood) SAC is located

approximately 7.7km to the north and upstream of the landfill on the Avonmore River. The Wicklow County Development Plan lists several protected structures, structures on the national inventory of architectural heritage and visible industrial archaeology artefacts in the vicinity of the landfill.

## **8. WASTE MANAGEMENT PLANS**

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### Wicklow Waste Management Plan

Reference is made in the Plan to the civic amenity site at Ballymurtagh. There are no references of note in relation to the landfill – other than to observe that it is closed.

### National Hazardous Waste Management Plan

To assist in achieving the objectives of the National Hazardous Waste Management Plan 2008-2012, it is proposed that the civic amenity site be operated in a manner that allows for the maximum breadth reasonably possible of household hazardous waste acceptance. The objective is to provide the local authority the opportunity to establish an essential public service. In accordance with the Plan, civic amenity sites are also to be encouraged to provide for the acceptance of commercial and agricultural hazardous wastes in relatively small quantities where they are of a similar nature to household hazardous wastes and can be managed properly within the operational, health and safety and staff training boundaries of the site. **Condition 8.4(c)** of the RD is proposed to these ends.

Wicklow County Council did not request this amendment to the existing licence.

## **9. COMPLIANCE WITH DIRECTIVES/REGULATIONS**

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### Landfill Directive [1999/31/EC]

Landfills that were open on 16/07/01 but closed by 16/07/09 are not subject to the requirements of the entire Directive. The RD provides for closure and aftercare of the landfill in accordance with relevant requirements.

### IPPC Directive [2008/1/EC]

As an IPPC facility the proposals would be considered BAT and compliant with the requirements of the Directive.

### Water Framework Directive [2000/60/EC] and Groundwater Directives [80/68/EC and 2006/118/EC]

The judgement made by the European Court of Justice concerned poor implementation of Directive 80/68/EC on groundwater in the planning, operation and subsequent licensing of the Ballymurtagh landfill. The judgement and Directive 80/68/EC are addressed in detail in other sections of this report.

Directive 2006/118/EC on the protection of groundwater against pollution and deterioration is also relevant in that article 7 of this Directive requires that any new authorisation procedure pursuant to articles 4 and 5 of Directive 80/68/EC shall, until 22 December 2013, take into account the requirements of articles 3, 4 and 5 of Directive 2006/118/EC. The new Directive is already in force and has close linkages to the Water Framework Directive. The new Directive sets criteria for setting Water Framework Directive status objectives for groundwater both in terms of quality and quantity. Article 6 of Directive 2006/118/EC specifically addresses measures to prevent or limit the input of pollutants to groundwater. For the Avoca area, relevant measures have been presented in the Eastern River Basin Management Plan (2009).

The European Communities Environmental Objectives (Ground Water) Regulations, 2010, give effect to the measures needed to achieve the environmental objectives established for groundwater by the Water Framework Directive and the new Groundwater Directive (2006/118/EC).

*Sub-article 4(a)* of the Regulations places a general duty on public authorities to prevent or limit, as appropriate, the input of pollutants into groundwater and prevent the deterioration of the status of all bodies of groundwater. This report demonstrates that, whilst it is not possible to prevent the input of pollutants into the groundwater, the input of pollutants (leachate) into groundwater is limited to the maximum extent possible by technical precautions adopted at the landfill.

*Sub-articles 4(b), (c) and (d)* discuss public authorities' obligations regarding the protection, enhancement and restoration of groundwater bodies, the achievement of good quantitative status and good chemical status by December 2015, the reversal of significant and sustained upward trends in pollutant concentrations and the achievement of groundwater standards and objectives by December 2015. The *Programme of Measures* document for the *Eastern River Basin District Management Plan* finds the Wicklow Central (Avoca Mine) groundwater body to be of poor status with a *Less Stringent Objective* regarding the achievement of good status.

The Agency is obliged under *article 5* to ensure, through its licensing function, that the quantitative and chemical status of the groundwater is not allowed to deteriorate. I am satisfied that the contribution of landfill leachate to groundwater pollution at the Avoca mine is less significant than that from acid mine drainage in the area. I am also satisfied that the pollutant flux from landfill leachate will decrease over time as the waste degrades and leachable substances are depleted.

*Article 7* of the Regulations states that "point source discharges and diffuse sources liable to cause groundwater pollution shall be controlled so as to prevent or limit the input of pollutants into groundwater." As a point source discharge liable to cause groundwater pollution, leachate from the Ballymurtagh landfill can only be controlled so as to limit, not prevent, the input of pollutants into groundwater. Such controls include the technical requirements and monitoring discussed in this report.

*Article 9* of the Regulations states that in order to achieve the objective of preventing and limiting inputs of pollutants into groundwater the following shall apply: (a) the input of hazardous substances into groundwater is prohibited and (b) the input of non-hazardous substances is limited so as to ensure that such inputs do not cause deterioration in groundwater status or upward trends in pollutant concentrations. It is clear that hazardous substances (as defined in *Classification of Hazardous and Non-Hazardous Substances in Groundwater*, EPA 2010) are present in leachate that passes

through the base of the landfill into the groundwater beneath. This fact would appear to preclude the Agency from authorising the landfill under sub-article 9(a) that prohibits any input of hazardous substances. However, by way of exemption, *article 14* of the Regulations provides a mechanism for the establishment of detailed technical rules under which certain categories of pollutant inputs can be exempted from the article 9 prohibitions, including inputs considered incapable, for technical reasons, of being prevented or limited without using (i) measures that would increase risks to human health or to the quality of the environment as a whole, or (ii) disproportionately costly measures to remove quantities of pollutants from or otherwise control their percolation in, contaminated ground or subsoil.

The Agency has not yet established detailed technical rules under article 14. Despite the absence of detailed technical rules, the discharge of leachate from the Ballymurtagh landfill meets the generality of the exemption provided for in article 14(e) of the Regulations and that the exemption in this case should apply.

Overall, the information presented in the application and this report demonstrate that the *de minimus* provisions of the groundwater directives are achieved, i.e. that discharges of hazardous substances and non-hazardous substances and substances in List I and II are likely to be in a quantity and concentration so small as to not represent any present or future danger of deterioration in the quality of the receiving groundwater or indeed of the Avoca River itself.

#### **European Communities Environmental Objectives (Surface Water) Regulations, 2009**

Reference has been made in this report to the quantified environmental quality standards for surface waters expressed in the Regulations.

#### **Environmental Liabilities Directive (2004/35/EC)**

As an IPPC facility, Ballymurtagh landfill is within scope of the Environmental Liability Directive. The RD requires the preparation of an environmental liabilities risk assessment and making of financial provision against potential environmental liabilities. The licence imposes a preventive approach to environmental protection and requires that any environmental incidents (as defined in the licence) are reported to the Agency.

### **10. CROSS OFFICE LIAISON**

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In preparing this report and the Recommended Decision I have consulted with Agency technical and sectoral advisors Dr Catherine Bradley and Dr Donal Daly of the Office of Environmental Assessment. Mr Jason Larkin of OEA provided river water monitoring data.

I was assisted in the assessment of groundwater aspects of the application by Dr Marcus Ford of Ford Consulting Group.



## 11. BEST AVAILABLE TECHNIQUES (BAT)

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I have examined and assessed the application documentation and I am satisfied that the site, technologies and techniques specified in the application and as confirmed, modified or specified in the attached Recommended Decision comply with the requirements and principles of BAT. I consider the technologies and techniques as described in the application, in this report, and in the RD, to be the most effective in achieving a high general level of protection of the environment having regard - as may be relevant - to the way the facility is located, designed, built, managed, maintained and operated.

## 12. COMPLIANCE RECORD

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There are no major issues arising on foot of OEE enforcement of the existing licence. Frequent reports are received of exceedences in CO<sub>2</sub> trigger levels in off-site gas monitoring wells and locations.

## 13. FIT & PROPER PERSON ASSESSMENT

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The legal and technical and financial standing of the applicant qualifies them to be considered fit and proper persons.

## 14. COMPLAINTS

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The Agency has received no complaints since 2003. The last complaint recorded by Wicklow County Council with regard to an emission from the landfill was in August 2005 (according to Agency records).

## 15. CLASSES OF ACTIVITY

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Wicklow County Council applied for the following classes of activity in the revised licence: D1, R2, R3, R4.

To comply with the revised waste activity listings in the new Third and Fourth Schedules to the Waste Management Acts 1996 to 2011 (amended by the European Communities (Waste Directive) Regulations, 2011), these codes transpose as follows:

Old code	Old description (WMA 1996 to 2010)	New code	New description (WMA 1996 to 2011)
D1	Deposit on, in or under land (including landfill)	D1	Deposit into or on to land (e.g. landfill, etc.)
R2	Recycling or reclamation of organic substances which are not used as solvents (including composting and other biological	R3	Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological

	processes)		transformation processes), which includes gasification and pyrolysis using the components as chemicals
R3	Recycling or reclamation of metals and metal compounds	R4	Recycling/reclamation of metals and metal compounds
R4	Recycling or reclamation of other inorganic materials	R5	Recycling/reclamation of other inorganic materials, which includes soil cleaning resulting in recovery of the soil and recycling of inorganic construction materials

The RD is updated accordingly with the new text and references for classes of activity.

The existing licence provides for the following activities at the facility:

D1, D2, D6, D7, D13

R2, R3, R4, R9, R11, R13

Reference to redundant activities is not carried into the RD.

## 16. PROPOSED DECISION

As a somewhat unique landfill facility – constructed unlined in an abandoned open cast mine, coupled with the presence of pre-existing contamination of groundwater and surface water in the area – I am satisfied that the ability of the landfill to add to localised contamination has been characterised and quantified to the extent reasonably possible. I am satisfied that the deficiencies identified by the European Court of Justice (case C-248/05) have been addressed in the licence review application and this report. The application and this report have identified that whilst it is not possible to prevent the leakage of leachate from the landfill into the underlying groundwater, the impact of heavily diluted leachate on the river is not measureable. Surface water monitoring at a point 350m downstream of the discharge shows no evidence of parameters that are attributable to leachate at concentrations exceeding environmental quality standards.

It is an important element of article 4(2) of the Groundwater Directive (80/68/EC) that authorisation can only be granted if all technical precautions have been taken to ensure that list I substances cannot reach other aquatic systems. Given the Court's finding that the Avoca River and the groundwater underlying the landfill are separate aquatic systems, the obligation now rests with the State to ensure that list I substances do not reach the Avoca River. On the latter, analysis of available dilutions shows that any list I contaminants that are potentially attributable to leachate are so diluted by groundwater and river water flow as to be significantly below comparable environmental quality standards for surface waters.

I am satisfied that all technical precautions have been taken to prevent pollution of the Avoca River. I am also satisfied, in accordance with article 5(1) of the Directive that all technical precautions have been taken to prevent groundwater pollution by list II substances. These technical precautions include the following:

- installation of the landfill cap;
- **condition 6.21** of the RD requiring assessment of the landfill cap;
- management of overland flow and **condition 3.17** of the RD;
- **condition 6.16.1** of the RD requiring the installation of four new leachate monitoring boreholes, drilled to the base of the waste body in the landfill;
- **schedule C.4** requiring annual analysis and screening of the leachate for list I and II substances.

Article 7 of the Directive states what is to be included in a prior investigation for a landfill. Paragraph 53 of the judgement states by way of reference to case C-360/87 (*Commission v Italy* 1991) that “article 7...makes the grant of authorisation subject to precise and detailed conditions which must be regarded as mandatory in order to achieve the aim of the Directive.”

Article 7 of the Directive states:

“The prior investigations referred to in Articles 4 and 5 shall include examination of the hydrogeological conditions of the area concerned, the possible purifying powers of the soil and subsoil and the risk of pollution and alteration of the quality of the groundwater from the discharge and shall establish whether the discharge of substances into groundwater is a satisfactory solution from the point of view of the environment.”

To parse the contents of this article of the Directive:

*Examination of the hydrogeological conditions of the area concerned*

The hydrogeological conditions of the area beneath and around the Ballymurtagh landfill are well understood.

*The possible purifying powers of the soil and subsoil*

Other than the presence of mine tailings at the base of the landfill, there are no further possible purifying powers of soil and subsoil to be considered. The tailings beneath the landfill sit on bedrock beneath and within which groundwater flows. The permeability (and potential for attenuation of flow) of the tailings is not known although they are known to be of silt grade, suggesting a permeability of the order of  $1 \times 10^{-8}$  m/s. No leachate purifying powers are to be attributed to the mine tailings.

The nature of chemical reaction between the leachate and mine tailings is unknown. The presence of mine tailings has been presumed by Wicklow County Council to be a positive factor in attenuating leachate flows. However it may be that the presence of the leachate chemically mobilises heavy metals and metalloids in the mine tailings. Knowledge of such chemistry could lead to an understanding of an additional load being exerted on the contaminated groundwater beneath the landfill. However, available water balances show that the likely environmental impact, if any, of small fluxes of leachate/tailings-derived heavy metals is minimal given the pre-existing volume and concentration of acid mine drainage in the groundwater. Acquisition of this knowledge cannot inform any material decisions to be taken regarding authorisation of the landfill. There is nothing that can be done regarding the

chemical interaction between leachate and mine tailings short of extracting leachate from the landfill on an ongoing basis. This latter option is not recommended and is discussed further in the paragraph below.

*The risk of pollution and alteration of the quality of the groundwater from the discharge*

It is not disputed that the leachate poses a risk of contamination and alteration of the quality of the groundwater. This can be quantified to a certain extent in groundwater outflows at the Ballymurtagh Road Adit (the main adit draining the area beneath the landfill). Some leachate could manifest itself elsewhere (e.g. in the alluvial sediments, in the unsaturated zones beneath the landfill embankment). Sampling of the groundwater issuing from the Road Adit has shown a gradually decreasing concentration of ammonium since the landfill was capped. Current levels are in the range 5-8mg/l. However while it can be said that the leachate will alter the quality of the groundwater, the quality of the groundwater is already and more substantially polluted by acid mine drainage and is unusable in perpetuity. The advice provided to Wicklow County Council in 1986 suggested that the discharge of leachate in this manner into an unpolluted groundwater body would be unacceptable, but its discharge to the already polluted discharge would have no significant additive effect on overall environmental pollution levels. Whilst this is perhaps overly simplistic by today's standards, it is a fact that the groundwater is still more substantially impacted by acid mine drainage (and will be into the foreseeable future) than it is by leachate (a source of contamination that will gradually disappear).

*Establish whether the discharge of substances into groundwater is a satisfactory solution from the point of view of the environment*

It is a fact that there is very little that can be done at this remove in time about the discharge of leachate into the local water environment. It is of course technically feasible to extract the leachate from the landfill and have it treated elsewhere. But this will do no more than move the contaminants from the vicinity of the landfill (and the Avoca River) to another catchment. Many constituents of the leachate will pass through a waste water treatment plant and be discharged to the receiving water or accumulated in the sludge (possibly for subsequent application to agricultural land). It is questionable whether a dilute-and-widely-disperse option is a better environmental solution to the existing dilute-and-locally-disperse circumstance whereby leachate is diluted by 3-6 orders of magnitude and discharged to the Avoca River where it has no measurable impact. Therefore, given the facts and circumstances of the landfill, and the lack of evidence of landfill-sourced pollution within 350m of the groundwater discharge, the current mechanism of allowing leachate to discharge into the local environment is a satisfactory solution from the point of view of the environment.

I am satisfied that the requirements of article 7 for prior investigation have been addressed to the extent reasonably possible for a pre-existing, closed landfill for which all environmental impacts have been quantified.

In paragraph 57 of the judgement it is stated that the licence granted by the Agency does not meet the conditions laid down in article 10 of the Directive. The judgement

does not specify the existing licence's deficiencies in meeting the requirements of article 10, which states:

“When disposal or tipping for the purpose of disposal which might lead to indirect discharge is authorised in accordance with articles 4 or 5, authorisation shall specify in particular:

- the place where such disposal or tipping is done,
- the methods of disposal or tipping used,
- essential precautions, particular attention being paid to the nature and concentration of the substances present in the matter to be tipped or disposed of, the characteristics of the receiving environment and the proximity of water catchment areas, in particular those for drinking, thermal and mineral water,
- the maximum quantity permissible, during one or more specified periods of time, of the matter containing substances in lists I or II and, where possible, of those substances themselves, to be tipped or disposed of and the appropriate requirements as to the concentration of those substances,
- in the cases referred to in article 4(1) and article 5(1) the technical precautions to be implemented to prevent any discharge into groundwater of substances in list I and any pollution of such water by substances in list II,
- if necessary, the measures for monitoring the groundwater, and in particular its quality.”

Most of these provisions are redundant in the context of the closed Ballymurtagh landfill. The only relevant provisions at this stage are the final two: the first on technical precautions (addressed in this report); and the second regarding measures for monitoring groundwater and its quality, to be included as **conditions 6.1 and 6.20** and **schedule C.4** of the RD.

There remain some residual matters to be addressed in the Court's judgement. Taking the matter of the discussions above to a conclusion, the judgement in paragraph 52 finds that “Ireland, in choosing for the Ballymurtagh landfill the method of diluting and dispersing leachate, has failed to take all the technical precautions required...by article 4...and...article 5 [of the Directive]” and in consequence Ireland “could not properly grant authorisation pursuant to those articles, grant of such authorisation being as a matter of fact conditional upon the technical precautions required by those provisions being adopted, which they are not.” It is beyond the scope of this licence review to revisit the decision of an agent of the State – Wicklow County Council – in the 1980s to design and construct a landfill. In authorising the landfill in 2001, the State – the Agency – decided to grant a licence for the landfill in which were addressed the technical precautions considered necessary at the time. Faced with the indisputable fact of the presence of the landfill, the Agency had certain options in making its decision, viz.:

- authorise the landfill and allow continued landfilling in the knowledge of imminent closure of the landfill (anticipated in 2001) – this is what happened (although the landfill didn't close until December 2002);

- authorise the landfill and require immediate cessation of landfilling, the licence to regulate the closure, restoration and aftercare of the landfill – this option was not considered in the inspector’s report at the time; but it is conceivable given the advanced stage of the landfill at the time of licensing that leaving cells partially filled would not have been a favourable option. (The landfill was approximately and at least 80% full at time of authorisation in 2001);
- authorise the landfill and require removal of the deposited waste and restoration of the open cast pit to its previous condition – not a realistic proposition: the excavation and movement of over 400,000 tonnes of waste would have raised insurmountable environmental and health and safety issues, plus massive costs; or
- refuse to authorise the landfill, in which instance operations would have to cease immediately with no oversight of closure, restoration and aftercare – not a desirable outcome.

The original inspector’s report states that the conditions recommended to the Board of the Agency allow Ireland to meet the requirements of the Groundwater Directive. The Agency made the decision to authorise continued landfilling in the knowledge that the landfill would not, if managed in accordance with the conditions in the licence, cause environmental pollution. The Agency also made the decision with the understanding that all available and necessary technical precautions were being taken in authorising the landfill: Including the requirement to cap the landfill – and indeed to cap all completed areas within six months of the date of grant of the licence (condition 4.16) – and examine the feasibility of treating the mine water discharge (and by inference the heavily diluted leachate) as originally proposed by the GSI in 1994 (condition 4.18). On the latter condition in particular, the inspector’s report is clear that this closed out the Agency’s obligations under the Groundwater Directive.

Paragraph 56 of the judgement finds that “the environmental impact of the discharge on groundwater and surface water was not fully understood before [the] licence was granted, in contravention of the requirements laid down by article 7 of the Directive.” This finding is based on a reference to *part* of condition 4.18 of the existing licence: “Within six months of the date of grant of this licence, the licensee shall submit a proposal to the Agency to examine the feasibility of the controlling groundwater discharges and the impact of same on the Avoca” and it is asserted that “articles 4 and 5 of the Directive had been infringed inasmuch as the investigation of the impact of the groundwater and the possible adoption of technical precautions did not precede the granting of authorisation.” Dealing with the latter finding first, this report and Wicklow County Council’s application for a licence review present a comprehensive “investigation of the impact of the groundwater and the possible adoption of technical precautions”, thus preceding any decision to grant a revised authorisation. On the substantive issue of condition 4.18 of the existing licence, that condition in full reads as follows:

Within six months of the date of grant of this licence, the licensee shall submit a proposal to the Agency to examine the feasibility of controlling groundwater discharges and the impact of same on the Avoca river taking account of the GSI Hydrogeological Study, February 1994.

The original inspector's report is clear that this condition is not to infer any lack of understanding of the impact of the landfill on the groundwater and Avoca River. Its intention is to seek to expedite local consideration of recommendations for the treatment of groundwater made by the GSI in 1994. More recently the 2008 Department of Communications, Energy and Natural Resources report (section 3.4 above) recommended the diversion and treatment of groundwater to avoid contamination of the Avoca River. In 2003 Wicklow County Council provided a groundwater modelling report to address the requirements of condition 4.18. In that report, Wicklow County Council sought to obtain a clearer picture of the hydrogeology of the area, distinguish between acid mine drainage and leachate contamination and identify optimal solutions for a remediation system to minimise the impact of the landfill. The model also simulated the effect of capping on groundwater and surface water contaminant concentrations and predicted a reduction in the environmental impact of the landfill. As a landfill-specific action, the report also suggested the modelling of the effects of pumping leachate from the landfill – this was not done. Other potential actions identified are broader in nature and include assessment of acid mine drainage sources and treatment options for contaminated groundwater. More recently and specific to the landfill, the current waste licence review application and this report demonstrates that substances present in landfill leachate have an extremely low probability of reaching the Avoca River at concentrations that will cause environmental quality standards to be exceeded. This being the case it is not appropriate that the operator of the landfill is responsible for the overall control and remediation of groundwater discharges to the Avoca River. Responsibility for broader action in the Avoca mines area rests with DCENR and implementation of its 2008 report (*Feasibility Study for Management and Remediation of the Avoca Mining Site* – section 3.4 above) is to commence. As mentioned above, an initial €3,000,000 has been committed by DCENR to commence works that will ultimately lead to the treatment of acid mine drainage in the area. The scheme will include the capture of groundwater from the Ballymurtagh Road Adit that drains the area beneath the landfill. Thus any additional contamination caused by leachate from the landfill will be captured and passed through the new treatment facility. Condition 4.18 of the existing licence is no longer relevant and I recommend its deletion.

I believe the foregoing discussion and this report as a whole addresses the key points of the Court's judgement.

Overall I am satisfied that, subject to the authorised activities being carried out in compliance with the conditions of the licence, the facility will not cause environmental pollution.

## **17. SUBMISSIONS**

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There were no submissions made in relation to this application.

## **18. CHARGES**

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An annual charge of €16,338 is proposed in the RD, reflecting the existing charge for 2011 at the facility.


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**19. RECOMMENDATION**

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I have considered all the documentation submitted by Wicklow County Council in relation to this application and recommend that the Agency grant a licence subject to the conditions set out in the attached Recommended Decision and for the reasons as drafted.

Signed



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Brian Meaney

**Procedural Note**

In the event that no objections are received to the Proposed Decision on the application, a licence will be granted in accordance with Section 43(1) of the Waste Management Acts 1996-2010.