Sub. No. 70

greenstar
setting the standard

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Mr Brian Meaney,
Inspector,
Office of Climate, Licensing and Resource Use,
Environmental Protection Agency
PO Box 3000
Johnstown Castle Estate
Co. Wexford.

16th July 2012

Re: W0129-03; Application by MEHL for a waste licence relating to a facility at Hollywood Great, Nags Head, The Naul, Co. Dublin.

Dear Mr Meaney,

I refer to Greenstar's submission dated 12th December 2011. In light of the points made therein we welcome the Agency's decision to seek further information from the applicant as outlined in part 5 of your letter to MEHL of 11th July 2012.

The Waste Management Act clearly obliges the Agency to adequately assess the areas of financial provision and future gate fees *in advance* of granting a waste licence. Furthermore, as Article 22(e) of the Waste Management (Licensing) Regulations 2004 obliges the Agency to issue any unchallenged Proposed Determination (PD) as 'the final waste licence' without any changes, there is clearly no room in the legislation for deferring these matters until after the issue of a PD.

However we must advise that the outcome of an independent study recently commissioned by Greenstar concludes that a considerable body of information relevant to the preparation of an *Environmental Liabilities Risk Assessment* and a *Closure, Restoration and Aftercare Plan* for this proposed development is missing from the Environmental Impact Statement and licence application documentation. Until this information is provided by the applicant, the request for an accurately costed ELRA and CRAMP is, unfortunately, premature.

Greenstar has demonstrated a particular interest in ensuring the nationwide compliance with Section 53A of the Waste Management Act and has been campaigning in this regard for the past three years. Unless new licence applicants are obliged to comply with the requirements of the existing legislation, the problem of below cost selling will increase as will the risk to the State of being left with the long term restoration burden for abandoned landfills.

To assist the Agency in this regard, Greenstar commissioned consultant G F Parker & Associates Ltd (GFPA) to prepare an assessment of the likely costs of the necessary

financial provision for this hazardous waste landfill licence application. Their report is enclosed.

Whilst the GFPA report makes a 'best' estimate of the financial obligations of the applicant into the aftercare phase of this landfill, the consultants also identify significant omissions in the applicant's EIS which may affect the outcome of such a calculation. This means that the sums estimated by GFPA (€140.4m cash provision + €100m insurance bond) may in fact be underestimated.

Groundwater protection is a critical issue for this landfill proposal which is to be situated in an area of intensive commercial horticulture. The risk of damage to groundwater is a significant aspect of any ELRA. However, from a preliminary review of the application documents GFPA notes a paucity of boreholes and water level data available in the eastern and south eastern part of the site and that the groundwater levels in monitoring wells installed in relation to the Fingal County Council application for the Nevitt landfill do not appear to have been considered in the interpretation of groundwater flow direction. Seasonal variations of groundwater flow also appear not to have not been presented or considered in the interpretation of groundwater flow direction.

Groundwater levels and flow direction within the upper poor aquifer or the overlying overburden were not assessed by the applicant's consultants. No monitoring installations were constructed to determine the water table/phreatic surface beneath the proposed landfill base and outside the foot print of the landfill. A thorough interpretation of ground water movement between hydrostratigraphic units has not been provided.

In an attempt to resolve some of these (and other) issues the Agency wrote to the applicant on 23rd March 2012 requesting detailed further information specific to groundwater protection. The applicant replied on 8th June 2012 but omitted from the response much of the requested information which still remains outstanding in the process.

The GFPA report identifies a tributary of the Ballough Stream[1] flowing along the northern boundary of the site. The elevated location of rock in the bed of this stream and its connection to the groundwater aquifer is also significant to the risk profile of the site and warrants further investigation.

GFPA note that the estimated quantity of leachate from each of the three landfill areas and water balance for the site during operations and in the post closure period are not provided in the EIS or the application documentation. This information is essential to allow a comprehensive assessment of the potential impacts, risks and costs associated with this facility in the short to very long terms. Similar points are made in relation to the absence of a proper quantification of landfill gas from the development.

[1] The Ballough Stream is a salmonid river of county significance, flows into the Ballyboghill Stream and forms the part of the upper sections of the most northern sub-catchment of the Ballyboghill Stream Catchment. The Ballyboghill Stream is the principal freshwater river system that flows into Rogerstown Estuary. The Estuary is a protected ecological site designated as a candidate Special Area of conservation (cSAC) and a special Protection Area (SPA) due to its status as a feeding ground for coastal bird populations.

Given the allegations in some submissions about pyrite-bearing materials in the quarry and the risk implication for the integrity of the landfill construction should this be the case, GFPA points out that a full materials balance needs to be provided documenting quantities of materials required for all aspects of the development and the source of these materials. Unusually, this material balance is not part of the current EIS. Provision of such a material balance will inform the Agency as to whether there is risk of materials containing pyrite being used and adversely affecting the lining systems.

The risk profile is also affected by the unconventional lining system which has been proposed for the hazardous waste cells. The applicant's consultant has suggested that the proposed lining system for the hazardous waste cells is equivalent/ superior to the lining systems prescribed by the EPA and the Landfill Directive. However it is noted by GFPA that this assertion not been supported by any quantitative data for the proposed liner in regard to such matters as leakage rates, attenuation capacity etc. in the application documents

GFPA also states that the rate of filling of the proposed landfill is unclear from the submitted documentation. This in turn leads to uncertainty in the revenue, potential gate fees and rate of accumulation of aftercare provision. Furthermore the timing of the capping of cells is critical to the applicant's proposals to contain emissions between separate cells. GFPA notes that there is an inherent risk in this design that should filling not happen in the manner timetabled by the applicant, and capping commence on time, leachate and gas may flow freely between inert, non-hazardous and hazardous cells.

GFPA could find no information or environmental assessment in the application documents in relation to the excavation and re-disposal of over 500,000 m^3 of contaminated soils at the site. This is a significant quantity of material and according to GFPA the potential environmental liabilities associated with this operation should be addressed. Furthermore, GFPA points to the existence of a substantial 'hole' within the land proposed to be developed. This is a deep excavation below the water table in the aquifer. The EIS has not addressed the significant exercise of filling of this hole, the materials to be used, associated traffic impacts if imported, the pumping of the water therein or the outlet for the pumped water which, if to be consistent with other EPA licences, may have to be considered leachate.

Unless these EIS omissions are addressed, not only is it impossible to complete a fully costed ELRA and CRAMP and other cost estimates to demonstrate compliance with S53a of the Waste Management Act, the entire integrity of the EIA is suspect. Other third party contributors to this process have pointed out the significant alteration in EIS baseline conditions for traffic/roads and groundwater arising from the termination of the proposed nearby Nevitt landfill development, a change in circumstance that occurred after An Bord Pleanala (ABP) completed its contribution to the EIA and prior to the Agency concluding its assessment (in this regard the applicant has very helpfully submitted to the Agency for its consideration a full copy of the planning permission and Inspector's report from the ABP file). The widening gap between the environmental impacts assessed by ABP and the information which must now be assessed by the Agency (including construction related impacts) must be considered

in the context of the implications for this licence application of the March 2011 European Court of Justice ruling in Case C50-09.

Notwithstanding the significant and material omissions in the EIA and licence application documentation, GFPA has applied the Agency's own Environmental Liabilities Risk Assessment guidance and provides best estimates for three distinct cost areas which, under Section 53a of the Waste Management Act (as amended), will have to be provided for in some manner within the gate fees for this facility.

- 'Unknown liabilities' up to €100m of which an estimated €65m will require an insurance bond into the aftercare period; plus
- Closure/ restoration costs of €5.4m; plus
- Aftercare Fund of potentially €135m in the year 2038.

An insurance bond to cover an estimated €65m worth of so called 'unknown liabilities', into an aftercare period of perpetuity (in line with recently published Agency BAT for hazardous waste landfills), may take some time to confirm with brokers. In order to prevent further delay to the process it is therefore desirable that the Agency seek the necessary outstanding information from the applicant as soon as possible to enable the commencement of the process of preparing an ELRA and CRAMP.

In addition to confirming evidence of a bond (€100m during operation falling to €65m into perpetuity), the Agency, in its consideration of *'fit and proper person'* criteria under Article 40 (7) of the original 1996 Waste Management Act, is obliged to seek evidence that the applicant for this waste licence is likely to be in a position to meet the financial commitments of restoration (estimated here at €5.4m) plus aftercare costs (estimated here at €135m in year 25 of operation).

If you require any clarifications or further information in relation to the content of this letter or the enclosed report please do not hesitate to contact the undersigned.

Yours sincerely

Margaret Heavey
for Greenstar

Encl report '*AN INDICATIVE ENVIRONMENTAL LIABILITY RISK ASSESSMENT FOR A PROPOSED INTEGRATED WASTE MANAGEMENT FACILITY AT HOLLYWOOD, CO. DUBLIN'*.

AN INDICATIVE ENVIRONMENTAL LIABILITY RISK ASSESSMENT

For a

Proposed Integrated Waste Management Facility

Hollywood, Co. Dublin

Waste Licence Reference W0129-03

Prepared for Greenstar Holdings Limited

Sandyford Dublin 18

June 2012

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EXECUTIVE SUMMARY

ES1. Objective of this Report

Greenstar Recycling Holdings Ltd. (Greenstar) has retained G. F. Parker & Associates Limited (GFPA) to provide advisory consulting services in relation to an application for a waste licence made by Murphy Environmental Hollywood Limited (MEHL) in December 2010.

The site in question currently operates as an inert waste landfill and is located at Hollywood Hill in North County Dublin approximately 9 kilometres north of Dublin City Centre within an important fruit and vegetable growing area. The proposed MEHL integrated waste management facility will comprise specially engineered landfill cells for inert, non-hazardous and hazardous solid waste.
Prior to the making of a decision by the Agency in relation to the current application, national legislation requires that the specifics of the financial provisions and the planned disposal charges should be provided by the applicant, together with firm evidence that the applicant is likely to be in a position to meet any financial commitments or liabilities that the Agency reasonably considers will be entered into or incurred by him or her in carrying on the activity.

In the absence of such information within the application documentation, and to assist the process, Greenstar has instructed GFPA to prepare an indicative estimate of the likely order of magnitude of financial provisions required for unknown liabilities during the operating phase and the unknown and known liabilities in the closure and aftercare phases of this development going into the future.

The Agency's 'Guidance on Environmental Liability Risk Assessment and Residuals Management Plans and Financial Provision (2006)' was followed throughout this process. The guidance outlines the definition of environmental liabilities and presents a step wise approach to providing Closure Restoration and Aftercare Plans (CRAMP), Environmental Liabilities Risk Assessments (ELRA) and Financial Provisions (FP).

The advisory services provided by GFPA included:

- preparation of an indicative ELRA for the proposed development based on a review of the waste licence application documents; and

- documentation of the known (anticipated) CRAMP costs and unknown costs to cater for unexpected events that, based on the risk assessment, may give rise to environmental liabilities.

This report is not for the purpose of satisfying the statutory requirements of the applicant. In fact the process has highlighted a lack of sufficient information within the application documentation to meet this purpose. The applicant remains obliged to provide detailed information to the process in this regard.

ES2. Legal Context

Directive 1999/31/EC of 26 April 1999 on the landfill of waste requires an application for a landfill permit to contain certain minimum particulars, including *"the proposed plan for the closure and after-care procedures"* (i.e., Closure Restoration Aftercare and Management Plan CRAMP) and the *"financial security by the applicant or any other equivalent provision, as required under Article 8(a)(iv) of this Directive."*

To comply with national legislation the assessment and quantification of environmental risks as a precursor to determining financial provision and its impact on gate fees is necessary to satisfy the Agency pursuant to Sections 40(4), 40(7), 53 and 53A the Waste Management Act (WMA) as amended and to satisfy statutory requirements specified in SI No. 395 of 2004.

At the time of writing, such information, as it applies to the proposed development has not yet been provided by the applicant to the licensing process or sought by the Agency.

ES3. Factors affecting environmental liabilities and financial provisions

Duration of Aftercare

The Final Draft BAT for Waste Sector: Landfill Activities, published by the EPA in December 2011, notes the following: *"in the case of hazardous waste landfill facilities there is no end date for financial liabilities and aftercare. Hazardous waste usually does not degrade or diminish in risk and so the aftercare requirements should be in perpetuity."* Based on this it seems that the Agency will require evidence that the applicant can finance and manage the aftercare of this facility into perpetuity.

Rate of Acceptance of Waste

The applicant will need to explain how it is proposed to translate the long term obligation to care for the site into a *gate fee* in compliance with section 53A of the WMA. To do this adequately, more evidence is needed in relation to the rate of intake of different waste types and the likely sources of such waste streams.

The development proposes to accept a 'maximum' of 500,000 tonnes per annum however the supporting documentation does not provide evidence to justify an intake of this magnitude and describes a peak intake of 285,300 tonnes for the years 7 to 23 of the 25 year operation. In comparison, the total intake for 2011 was just 27,378 tonnes.

The rates at which the three wastes types arrive at the site will very much affect the filling and restoration plans proposed by MEHL. Based on current and projected trends in the generation of incinerator ash and contaminated soils in the country there is a risk that the projected waste intakes, and the filling and restoration plan are optimistic, i.e. the quantity of wastes will be less and the void capacity for hazardous and non hazardous waste is oversized for the proposed 25 year life.

Should a lower than anticipated annual tonnage rate arise, the operational duration will lengthen and the costs of operation and aftercare will increase. Variations to the predicted intake of inert, non-hazardous and hazardous waste will also affect the leachate water-balance particularly given the vague to non-existent nature of the applicant's estimates of leachate generation and management proposals which are strongly dependant on the phasing and rate of filling. Landfill gas generation will also be affected by the nature of the wastes. For these reasons it is essential that an adequate justification of the projected waste intake and a water balance for the site are provided within the applicant's ELRA.

Quantity and Nature of Wastes

The nature of the wastes to be accepted is provided in terms of EWC codes in Attachment H, Appendix H1.1 of the application documentation. However, there is no estimate provided of the expected *quantity* of these wastes.

The exact mix of wastes in each of the three landfills is not known. Therefore, how the wastes will react when in contact with each other and the nature of the leachate or gas that may form is also an unknown.

Geology

The geology of the site comprises various lithologies, the oldest being the Lucan, Naul and Loughshinny formations which are prevalent in the southern portion of the site where much of the quarrying has taken place. This limestone in the southern portion of the site has been excavated to the greatest depth - 50 to 60 metres below ground level (bgl). It appears that excavation may have taken place below the water table in this area of the site. The depth of this excavation and the depth of water both represent operational and health and safety risks as well as risks to the stability of the liner. The logistics of filling this hole have not been adequately considered.

Hydrogeology/Groundwater

The Bog of the Ring collection of groundwater wells to the north and north-east of the site is an important water supply to a significant population of North County Dublin. The MEHL site lies approximately 1 km outside the Source Protection Area for the Bog of the Ring and approximately 3 km from the well locations. The applicant has not clearly proven that there is no hydrogeological continuity between the site and the Bog of the Ring collection of wells.

There are other important water supply wells for agri-sector activities to the south, south east and east of the site. North County Dublin and its environs have developed a reputation for producing high quality fruit and vegetables. This local agri-industry is of vital importance to not only the local economy, but to the national economy as well. Large suppliers of fresh vegetables such as Keoghs Potatoes and Potato crisps, Moores prepared vegetables and Country Crest potatoes and precooked vegetables rely on a continuous supply of fresh, un-contaminated water in order to wash and prepare their produce. These suppliers require upwards of one million litres per day for their activities and this water is tested on a weekly basis by customers such as Tesco, the Regional Health Authorities and through the Bord Bia Quality Assurance Scheme.

Groundwater contamination in this region could potentially damage the reputation and lead to the closure of up to 100 businesses, putting at risk a business sector believed to be worth €60m in 2006. The replacement of this water supply to the agri-industry, upwards of 10 million litres per day, would cost approximately €5m over 12 months to provide at current commercial water rates.

The applicant's consultants have inferred that groundwater flow in the lower aquifer is generally in a south easterly direction from the site. However, from a preliminary review of the application documents there is a paucity of boreholes and water level data available in the eastern and south eastern part of the site and the groundwater levels in monitoring wells installed in relation to the Fingal County Council application for the Nevitt landfill do not appear to have been considered in the interpretation of groundwater flow direction. Seasonal variations of groundwater flow also appear not to have not been presented or considered in the interpretation of groundwater flow direction.

Groundwater levels and flow direction within the upper poor aquifer or the overlying overburden were not assessed by the applicant's consultants. No monitoring installations were constructed to determine the water table/phreatic surface beneath the proposed landfill base and outside the foot print of the landfill.

A thorough interpretation of ground water movement between hydrostratigraphic units has not been provided.

Surface Water

A stream flows along the northern boundary of the site. This stream is a tributary of the Ballough Stream. The Ballough Stream is a salmonid river of county significance and flows into the Ballyboghill Stream and forms the part of the upper sections of the most northern sub-catchment of the Ballyboghill Stream Catchment. The Ballyboghill Stream is the principal freshwater river system that flows into Rogerstown Estuary. The Estuary is a protected ecological site designated as a candidate Special Area of conservation (cSAC) and a Special Protection Area (SPA) due to its status as a feeding ground for coastal bird populations.

Potential surface water contamination during the operation or aftercare of the landfill not only is a risk to the surface water systems and associated habitats, but is also an added risk to groundwater protection, given the location of rock in this stream bed.

Leachate

The estimated quantity of leachate from each of the three landfill areas and water balance for the site during operations and in the post closure period are not provided in the EIS or the WLA. This information is essential to allow a comprehensive assessment of the potential impacts, risks and costs associated with this facility in the short to very long terms.

Furthermore, sufficient information was not found in the EIS and/or WLA documents in relation to emissions to satisfy the requirements of Article 12 (1)

(k) of the Waste Management (Licensing) Regulations 2004 - SI. No. 395 of 2004, in relation to leachate emissions.

Landfill Gas

The SKM-Enviros July 2010 report to the EPA, entitled *Technical and Economic Aspects of Developing a National Difficult Waste Facility (NaDWaF)* recommends:

"*The potential risk of gas production in an engineered* (hazardous) *waste landfill facility should be assessed by the landfill operator when the types of waste that will be deposited are determined.*"

The EIS and WLA documents do not contain a gas risk assessment for the mix of hazardous or non hazardous wastes or any proposed control measures for landfill gas that will potentially be generated and emitted.

Furthermore, sufficient information was not found in the EIS and/or WLA documents in relation to emissions to satisfy the requirements of Article 12 (1) (k) of the Waste Management (Licensing) Regulations 2004 - SI. No. 395 of 2004.

Liner

Three liner types are proposed, a different one for each type of waste/landfill cell: inert, non hazardous and hazardous. The application documents do not provide any information on the sources and quantities of the filling materials to raise levels to formation levels and the lining and leachate collection layers.

It is understood that pyrite bearing materials have been found in the quarry at the site. A materials balance needs to be provided documenting quantities of materials required for all aspects of the development and the source of these materials. Provision of such a material balance will inform the Agency as to whether there is risk of materials containing pyrite being used and adversely affecting the lining systems.

An unconventional lining system has been proposed for the hazardous waste cells. The applicant's consultant has suggested equivalency/superiority of the proposed lining system for the hazardous waste cells as compared to the lining systems prescribed by the EPA and the Landfill Directive. However it is noted that this assertion not been supported by any quantitative data, for the proposed liner in regard to such matters as leakage rates, attenuation capacity etc. in the application documents

Cell Construction Methodology

Fingal County Council, in its submission to this process, expressed concern about the design of the cells and the ability of the operator to keep separate the emissions from inert, non-hazardous and hazardous wastes. The timing of the capping of cells is critical to the applicant's proposals to contain emissions between separate cells. However this timing will be affected by the waste intake rate and sources of waste, which is not clear from the documentation. There is an inherent risk in this design that should filling not conclude as timetabled by the applicant, and capping commence, leachate and gas may flow freely

between inert, non-hazardous and hazardous cells. In any event capping of the cells may not take place in the theoretical manner that the applicant has suggested in the application documents. Furthermore no information or environmental assessment could be found in the application documents in relation to excavation and re-disposal of over 500,000 m3 of lightly contaminated soils at the site. This is a significant quantity of material and the potential environmental liabilities associated with this operation should be addressed to allow an assessment of the potential environmental liabilities.

ES4. Risk Assessment

To characterise and assess the risks identified, (see Table A1 of this report), the risk assessment model set out in the EPA's Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision (2006) has been employed. The results of the risk assessment are outlined in Table A1, Appendix A.

ES5. Potential Likely Costs

Based on the exercise carried out as part of the assessment presented herein the expenditures relating to unknown liabilities if they all arose could range up to circa **€102 million** (in terms of 2012 euros). Some of these unknown liabilities will not exist upon closure. However, some will continue and the cost of remediation measures will increase over time in line with annual inflation rates between now and when the costs arise.

In terms of 2012 euros, the unknown liabilities in the aftercare period may exceed circa **€69 million**, if they all arose. Some of these liabilities may be less or more severe and the potential costs may be lower or higher depending on the further information that the Agency should seek and the applicant should provide, in relation to a number of matters, as highlighted above and, as discussed in more detail in the main body of this report. A bond or indemnity insurance or a combination of these two financial instruments will be needed and paid for in perpetuity.

These sums are very large and it may not be possible to obtain cover for such liabilities. It is incumbent on the applicant to assess and substantiate the likely potential costs of the unknown liabilities and provide an appropriate and acceptable instrument to the Agency to cover these potential costs.

An indicative closure/restoration cost in year 2038 in terms of 2038 euros assuming an inflation rate of 2% per annum from 2012 to 2038 is **€5.4 million**.

The cost of aftercare requirements in perpetuity depends on inflation and interest rates. The size of the aftercare fund to be available in 2038, the assumed year aftercare commences, could be in the order of **€70 million and €135 million** based on a present value computations assuming the net real discount rate is between 1 and 2 percent. A financial instrument such as cash, a trust fund or an escrow account will need to be provided to cater for the aftercare expenditures.

1.0 INTRODUCTION

1.1 Background

Greenstar Recycling Holdings Ltd. (Greenstar) has retained G. F. Parker & Associates Limited (GFPA) to:

- review the waste licence application documents submitted by Murphy Environmental Hollywood Limited (MEHL) between December 2010 and February 2012;
- review the Closure, Restoration and Aftercare Plan (CRAMP), Environmental Liabilities Risk Assessments (ELRA) and Financial Provision (FP) Report previously submitted in May 2010 for the inert landfill facility;
- prepare an indicative Environmental Liabilities Risk Assessment (ELRA) for the proposed integrated waste management facility at Hollywood Co. Dublin and;
- estimate the known (anticipated) CRAMP costs and unknown costs to cater for unexpected events that, based on the risk assessment, may give rise to environmental liabilities.

MEHL currently operates an inert landfill at Hollywood, County Dublin under Waste Licence Reg. No.W0129-02. In December 2010 MEHL made concurrent applications to An Bord Pleanala (ABP) and the Environmental Protection Agency (EPA) to develop an integrated landfill facility accepting inert, non hazardous and hazardous wastes. An Environmental Impact Statement (EIS) was prepared and submitted to ABP and the EPA. Waste Licence application documents, as required by the EPA, were also submitted to the EPA (Ref W0129-03.). ABP held an oral inquiry in relation to the application in March 2011 and granted planning permission for the facility in June 2011. The EPA requested further information in August 2011 pursuant to Article 14 of the Waste Licensing Regulations (the Regulations). MEHL responded to this request by submitting further information in August 2011.

On 23 March 2012, the Agency made a further request for information under Article 14 (to fulfil the requirements of Article 12 of the Licensing Regulations) and a request for information under Article 16 of the Regulations. As of 12 June 2012, MEHL has made four submissions, dated 19 April, 1 May 2012, 28 May and 7 June 2012 to these requests. This latest further information submitted by MEHL has not been reviewed or taken into consideration by GFPA in the preparation of the report that follows. In addition there have been approximately 70 submissions by third parties in relation to this application

1.2 Methodology

The Agency's *'Guidance Documents and Assessment Tools on Environmental Liabilities Risk Assessments and Residual Management Plans incorporating Financial Provision Assessment' (2006)* outlines the definition of environmental

liabilities and presents a step wise approach to providing Closure Restoration and Aftercare Plans (CRAMP), Environmental Liabilities Risk Assessments (ELRA) and Financial Provisions (FP).

Table 1.2.1: Outline of Environmental Liability Assessment

Liability Type	Definition	Quantification Method	Financial Instrument
Known liability	Planned/anticipated liabilities associated with facility closure, restoration and aftercare management	CRAMP	Cash based (Cash, Trust Fund, Escrow)
Unknown liability	The risk of environmental liabilities occurring due to unexpected events (e.g. leaking chemical storage tank resulting in groundwater contamination)	ELRA	Risk transfer instruments (insurance, bonds etc.) or combination of these instruments

The Agency's recommended step wise approach is as follows:

Table 1.2.2: Approach to Assessment and Management of Environmental Liabilities

Step	Description
1	Initial Screening and Operational Risk Assessment
2	Preparation of a CRAMP for known liabilities
3	ELRA for unknown liabilities
4	Identification of Financial Provision Instruments

The scope of the work carried out by GFPA included:

- Completion of Step 1;
- Completion of Step 2 in so far as cost estimate was prepared for the closure, restoration, and aftercare management of the proposed facility that was based on the existing CRAMP for the facility (May 2010) and revised CRAMP details outlined in the 2010 EIS/WLA documents; and
- Completion of Step 3 including an estimate of the potential most likely costs to remedy/address the unknown liabilities if they were to arise.

In regard to the ELRA, GFPA's approach included:

- Identification and assessment of existing and potential risks of environmental pollution that could impact on surface water, groundwater, soils, sub-soils, and air;
- Examination of the 2010 EIS and WLA documents to establish the current environmental status of the site;
- Identification of any particular sensitive receptors that could be impacted in the short, medium and long term by licensed activities; and
- Preparation of potential most likely costs and maximum likely costs to remedy potential impacts of the hazards identified through the ELRA in accordance with the EPA's Guidance document.

2.0 LEGAL FRAMEWORK FOR AN ELRA

2.1 EU Legislation

ELRAs and Financial Provisions are required of operators of all licensed facilities in Ireland. This requirement arises from the following EU legislation.

Landfill Directive

Directive 1999/31/EC of 26 April 1999 on the landfill of waste makes direct reference, in particular, to Residual Management Plan and Financial Provision under Article 7.

The application for a landfill permit must contain certain minimum particulars, including *"the proposed plan for the closure and after-care procedures"* (i.e., Closure Restoration Aftercare and Management Plan CRAMP) and the *"financial security by the applicant or any other equivalent provision, as required under Article 8(a)(iv) of this Directive".*

Furthermore Article 8 (a) (iv) stipulates that the competent authority (the EPA) must not issue a landfill permit/licence unless it is satisfied that:

"adequate provisions, by way of financial security or any other equivalent, on the basis of modalities to be decided by Member States, has been or will be made by the applicant prior to commencement of disposal operations to ensure that the obligations (including after-care provisions) arising under the permit issued under the provisions of this Directive are discharged and that closures procedures required by Article 13 are followed. The security or its equivalent shall be kept as long as required by maintenance and after-care operation of the site in accordance with the Article 13(d)…"

Environmental Liability Directive

The Directive 2004/35/EC of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage provides a framework of environmental liability based on the "polluter pays" principle. This was transposed into Irish law through S.I. No. 547 of 2008 - The European Communities (Environmental Liability) Regulations. This regulation came into force on 1 April 2009. The Directive applies to certain occupational activities, including the operation of installations under the IPPC Directive, the Waste Framework Directive, the Landfill Directive and the Waste Incineration Directive. The Directive will also apply to activities under the proposed Extractive Industry Waste Directive.

It imposes strict liability on those who cause environmental damage (that is, damage to biodiversity and water resources and land contamination that causes

significant risk of harm to human health). It requires such persons to take preventative measure to avoid damage occurring, remedy damage that occurs and bear the remediation costs of damage that is remedied by the competent authority. Liability is principally to the competent authority and the Directive does not provide for compensation to third parties who suffer damage.

2.2 Irish Waste Legislation

Section 40(4) and Section 53 and 53A of the WMA as amended require that before a license is granted by the Agency that certain information be provided by the licensee in relation to financial provisions and to satisfy the Agency that disposal charges will be imposed that will provide sufficient funds to cover not only the costs of setting up and operation of the facility but also the estimated costs during the aftercare period for the facility which will be no less than 30 years.

WMA as amended Section 40(7)(c) indicates a person shall be regarded as a fit and proper person if (among other things):

"In the opinion of the Agency, that person is likely to be in a position to meet any financial commitments or liabilities that the Agency reasonably considers will be entered into or incurred by him or her in carrying on the activity to which the waste licence will relate in accordance with the terms thereof or in consequence of ceasing to carry on that activity."

In addition to the foregoing, SI No. 395 of 2004 – Waste Management (Licensing) Regulations 2004 Article 12 deals with the contents of an application for a waste licence or the review of a waste licence. Article 12 (r) states:

(r) *In the case of an application in respect of the landfilling of waste, give particulars of –*

(i) such financial provision as is proposed to be made by the applicant, having regard to the provisions of Articles(7)(i) and (8)(a)(iv) of the Landfill Directive and section 53(1) of the Act and

(ii) such charges as are proposed or made, having regard to the requirements of section 53A of the Act,

2.3 Licence Conditions

In regard to waste licences in Ireland which are required under the Waste Management Act, 1996, as amended and the Waste Management (Licensing) Regulations 2004, it is standard to have conditions attached that are as per the existing licence for the MEHL facility reference W0129-02 dated 21 May 2008.

Condition 12 of Waste Licence W0129-02 is entitled **Financial Charges and Provisions.**

Condition 12.2 deals with Environmental Liabilities as follows:

Condition 12.2.1 The licensee shall as part of the AER provide an annual statement as to the measures taken or adopted at the site in relation to the prevention of environmental damage, and the financial provisions in place in relation to the underwriting costs for the remedial actions following anticipated events (including closure) or accidents/incidents, as may be associated with the carrying on of the activity.

Condition 12.2.2 The licensee shall arrange for the completion, by an independent and appropriately qualified consultant, of a comprehensive and fully costed Environmental Liabilities Risk Assessment (ELRA), which addresses the liabilities and costs identified in Condition 10 for execution of the CRAMP. A report on this assessment shall be submitted to the Agency for agreement within twelve months of date of grant of this licence. The ELRA shall be reviewed as necessary to reflect any significant change on site, and in any case every three years following initial agreement: review results are to be notified as part of the AER.

Condition 12.2.3 As part of the measures identified in condition 12.2.1, the licensee shall, to the satisfaction of the Agency, make financial provision to cover any liabilities identified in condition 12.2.2. The amount of indemnity held been reviewed and revised as necessary, but at least annually. Proof of the renewal or revision of such financial indemnity shall be included in the annual 'statement of measures' report identified in condition 12.2.1.

Condition 12.2.4 Unless otherwise agreed, any revision to that part of the indemnity dealing with restoration and after-care liabilities (refer Condition 10.8.1) shall be computed using the following formula:

Cost=(ECOST x WPI) + Ci CC

Where:

Cost = revised restoration and aftercare cost.

ECOST= Existing restoration and aftercare cost.

WPI = Appropriate Wholesale Price Index [Capital Goods, Building and Construction (i.e. Materials and Wages) Index], as published by the Central Statistics Office, for the years since last closure calculation/revision.

CiCC = Change in compliance costs as a result of change in site conditions, changes in law, regulations, regulatory authority charges, or other significant changes.

Condition 12.3 deals with Cost of Landfill of Waste as follows:

Condition 12.3 Cost of landfill of waste

In accordance with the provisions of Section 53A of the Waste Management Acts 1996 to 2007, the licensee shall ensure that costs in the setting up, operation of, provisions of financial security enclosure and after-care for a period of at least 30 years shall be covered by the price to be charged for the disposal of waste at the facility. The statement required under section 53A(5) of said Acts is to be included as part of the AER.

Reason: to provide for adequate financing for monitoring and financial provisions for measures to protect the environment.

It is highly likely that similar conditions will be attached to the new Waste Licence W0129-03 if it is granted. However, as discussed in sections 2.2 and 2.3 above, the legal obligation to provide this information begins during the licence application stage, prior to the making of any decision. These requirements arise from the Landfill Directive 1999/31/EC and Irish legislation as discussed above.

Section 40(4) of the WMA, 1996 as amended states that the Agency shall not grant a waste licence unless it is satisfied in relation to certain matters including that:

- The activity concerned will not cause environmental pollution;
- For landfills, the activity will comply with the Landfill Directive;
- The applicant is a fit and proper person to hold a waste licence;and
- The applicant has complied with the requirements of provision of financial security under section 53;

2.4 Aftercare Period –Final Draft BAT Guidance Note Waste Sector: Landfill Activities

The Final Draft BAT for Waste Sector: Landfill Activities, that was recently published by the EPA (December 2011) includes the following text (see section *4.2.4.1 Closure and Aftercare* of the Final Draft BAT)in relation to the appropriate aftercare period to be considered in relation to financial provisions.

The Landfill Directive (Article 10) requires that there is sufficient financial provision to cover the cost of closure and aftercare for a period of at least 30 years. For facilities that are to accept only inert, pre-treated or monolithic type wastes with minimal landfill gas and leachate forming potential, a site-specific assessment will be required to determine the most appropriate aftercare period (for financial provision purposes). In the Irish context, adequate financial provision is required for at least 30 years and possibly for 50 years and longer in the case of facilities accepting (or which have accepted) appreciable quantities of leachate and gas forming wastes. The requirement of financial provision for a specified period does not free a licensee of responsibility for excess environmental cost that may arise during this period or indeed thereafter. It should also be noted that, in the case of hazardous waste landfill facilities there is no end date for financial liabilities and aftercare. ***Hazardous waste usually does not degrade or diminish in risk and so the aftercare requirements should be in perpetuity. (Note – our emphasis added)***

2.5 Final Comments

Before the Agency makes a decision in relation to the current application, W0129-03, legislation demands that an ELRA should be prepared and submitted; proof of fit and proper person is furnished; and the specifics of the financial provisions and the disposal charges should be provided by the Applicant to satisfy the Agency pursuant to Sections 40(4), 40(7), 53 and 53A of the Waste Management Act as amended and to satisfy statutory requirements specified in SI No. 395 of 2004.

The report that follows has been prepared for the purpose of highlighting information not provided in the application documents, which would be required to prepare a fully costed ELRA and to satisfy Section 53A of the WMA as amended. This report has also been prepared to outline the potential environmental liabilities and the order of magnitude of the potential financial provisions in regard to the CRAMP and the unknown liabilities identified through the ELRA methodology recommended by the EPA. This report is not for the purpose of satisfying the statutory requirements of the Applicant, MEHL, for the proposed integrated waste management facility.

3.0 SITE DESCRIPTION

3.1 Site Location

The site which currently operates as an inert waste landfill is located at Hollywood Hill in North County Dublin approximately 9 kilometres north of Dublin City Centre. The site is approximately 4 kilometres from the small village of Naul and 12 kilometres west of Skerries Town. The small village of Garristown is located approximately 9 kilometres to the west of the site and the village of Ballyboghill is located approximately 4 kilometres to the south of the site.

The M1 motorway is located approximately 3.5 kilometres to the east of the site. The nearest junction onto/off the motorway is located at Junction 5 (Walshestown Junction or Rowans Little Junction) which is c.4 kilometres to the north-east of the site. The R108 (Dublin - Naul Regional Route) is c.1 kilometre to the west of the site. Two local roads bound the southern and western boundary of the site, the LPO1080 and the LP01090 respectively. The former road which runs along the southern boundary of the site is generally the better of the two roads in terms of surface and width alignment. The LP01080 is between 5 and 6 metres in width.

The existing entrance to the site is located on the LP01090 along the western boundary of the site approximately 300 metres north of the junction with the LP01080. The road rises from south to north along the western boundary of the site. The 80kph speed limit applies to the wider area in which the site is located.

3.2 Settlement near the Site

In terms of settlement, the area surrounding the landfill can generally be described as rural and agricultural with dispersed dwellings in the vicinity of the site. The predominant land use in the wider area is agricultural. There are a few dwellings within the immediate vicinity of the site. These dwellings are mainly adjoining the LP01080 and include two dwellings along the southern boundary of the site facing southwards onto the public road. The dwelling adjacent to the south-eastern boundary of the site is owned by the applicant and is currently vacant. There are no dwellings along the local road along the western boundary of the site. The nearest dwelling house located on this road is approximately 250 metres from the north-western boundary of the site. Three telecommunication masts and the Fingal County Council covered water reservoir is located to the immediate south of the existing entrance to the site.

3.3 Site Description

The site itself has a stated area of 39.8 hectares. The overall landholding is stated as 54.4 hectares. The entrance to the site is provided off the LP01090

along the western boundary of the site. The main buildings are located on a concrete apron adjacent to the entrance. These include a portal cabin, which accommodates the site office, and a larger maintenance shed. A shed containing bunded diesel tanks is located at the lower level to the immediate north of the main buildings on site. Walled bays which provide a quarantine area for inert waste are located adjacent to the shed which houses the bunded diesel tank.

The main haul road traverses the site in an east-west direction to the immediate north of the main surface water bodies within the site (the excavated quarry areas to the south). The area to the north of the haulage road accommodates lined cells for the acceptance of inert materials. The cells on the western portion of the site are being actively filled at present and rise to a height of between 4 and 10 metres above the surrounding ground levels. Part of the central area to the north of the haulage road is being lined at present. This area has been excavated to a depth of between 10 and 20 metres below the surrounding area.

Two small settlement ponds are located centrally within the site adjacent to the northern boundary. Lands to the east of the site (located within the site boundary and within the EPA licence W0129-02) comprise a 200-250 metre buffer zone. This area is under grass. A further 250 metre wide strip is located to the east. This land is within the ownership of the applicants but is located outside the confines of the site.

3.4 Geology

The geology of the site comprises various lithologies, the oldest being the Lucan, Naul and Loughshinny formations which are prevalent in the southern portion of the site where much of the quarrying has taken place. This limestone in the southern portion of the site has been excavated to the greatest depth - 50 to 60 metres below ground level (bgl). It appears that excavation may have taken place below the water table in this area of the site. This carboniferous limestone is folded in a gentle syncline beneath newer rocks of Namurian age described in the EIS as the Walshestown and Balrickard formation. These rocks were laid down in deeper waters and in general are less permeable than the older carboniferous limestone. These newer formations dominate the eastern and northern portion of the site. The rocks in this area have been excavated to a lesser extent. The Namurian shale in the northern portion of the site is overlain with the clay based soils and sub-soils.

3.5 Hydrogeology

The aquifer units are classified by the GSI as Locally Important (Lm) and Poor (Pl).

The majority of the site is underlain by a poor aquifer. The locally important aquifer outcrops in the southern part of the MEHL site and then dips to the north, where it is covered by at least 60m of the poor aquifer in the northern parts of the site.

It has been reported that the permeability of the locally important aquifer unit is higher than that of the poor aquifer.

According to the applicants' consultants there are at least two faults in the central part of the site, a north-south aligned fault which appears to restrict groundwater movement and an east-west aligned fault which does not.

The applicant's consultants have inferred that groundwater flow in the lower aquifer is generally in a south easterly direction from the site. However, from a preliminary review of the application documents there is a paucity of boreholes and water level data available in the eastern and south eastern part of the site and the groundwater levels in monitoring wells installed in relation to the Fingal County Council application for the Nevitt landfill do not appear to have been considered in the interpretation of groundwater flow direction. Seasonal variations of groundwater flow also appear not to have not been presented or considered in the interpretation of groundwater flow direction.

Groundwater levels and flow direction within the upper poor aquifer or the overlying overburden were not assessed by the Applicant's consultants. No monitoring installations were constructed to determine the water table/phreatic surface beneath the proposed landfill base and outside the foot print of the landfill. A review of the groundwater level data provided in Figure 14.13 of the EIS suggests groundwater flow in the upper poor aquifer (the Namurian shales etc.) unit is in an easterly and possibly north-easterly direction following the falls in the land and the direction of flow in the stream that flows from west to east along the northern edge of the site.

A thorough interpretation of ground water movement between hydrostratigraphic units has not been provided, however, it appears from the data presented on Figure 14.13 of the EIS that there are downward groundwater gradients between the upper shale and the lower limestone units. It is also clear that there are upward gradients from the Namurian formations through the clay overburden adjacent to the stream that borders the north side of the site.

The Bog of the Ring collection of groundwater wells to the north-east of the site is an important water supply. The MEHL site lies approximately 1 km outside the Source Protection Area for the Bog of the Ring and approximately 3 km from the well locations. There are other important water supply wells for agri-sector activities to the south east of the site. North County Dublin and its environs have developed a reputation for producing high quality fruit and vegetables. This

local agri-industry is of vital importance to not only the local economy, but to the national economy as well. Large suppliers of fresh vegetables such as Keoghs Potatoes, Moores prepared vegetables, and Country Crest potatoes and precooked vegetables rely on a continuous supply of fresh, un-contaminated water in order to wash and prepare their produce. These suppliers require upwards of one million litres per day for their activities and this water is tested on a weekly basis by customers such as Tesco, the Regional Health Authorities and through the Bord Bia Quality Assurance Scheme. Groundwater contamination in this region could potentially damage the reputation and lead to the closure of up to 100 businesses, putting at risk a business sector believed to be worth €60m in 2006. The replacement of this water supply to the agri-industry, upwards of 10 million litres per day, would cost approximately €5m over 12 months to provide at current commercial water rates.

3.6 Surface Water

A stream flows along the northern boundary of the site. This stream is a tributary of the Ballough Stream. The Ballough Stream is a salomonid river of county significance and flows into the Ballyboghill Stream and forms the part of the upper sections of the most northern sub-catchment of the Ballyboghill Stream Catchment. The Ballyboghill Stream is the principal freshwater river system that flows into Rogerstown Estuary. The Estuary is a protected ecological site designated as a candidate Special Area of conservation (cSAC) and a Special Protection Area (SPA) due to its status as a feeding ground for coastal bird populations.

Run off from the site will be either contained as leachate in the landfill areas or will be contained in the quarry excavation from which it will be directed to surface silt settlement pond and wetlands (one to the north and one near the proposed site entrance); or flows randomly overland towards surface water drainage features to the north, east and south. Potential surface water contamination during the operation or aftercare of the landfill not only is a risk to the surface water systems and associated habitats, but is also an added risk to groundwater protection, given the location of rock vis a vis stream bed.

4.0 THE PROPOSED FACILITY

4.1 Overview of the Proposed Development

The proposed MEHL integrated waste management facility will comprise specially engineered landfill cells for inert, non-hazardous and hazardous solid, non-biodegradable solid waste.

This facility will also consist of:

- New site entrance and access road at the southern boundary
- New administration building and site management infrastructure
- Solidification plant with associated storage tanks and silos
- A storage building for curing solidified fly ash
- Surface water and foul water management systems
- Leachate management system

The quantity of waste accepted at the facility will not exceed the existing planning and waste licence limit of 500,000 tonnes per annum (which none the less is significantly higher than the current baseline waste intake). The quantities of waste accepted have been declining sharply over time as a consequence of the economic downturn in Ireland. The quantities of inert waste accepted between 2003 (a part year) and 2011 were as follows:

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Tonnes	20,750	173,037	330,973	339,753	433,602	225,996	42,206	30,626	27,378

Waste acceptance at the facility will be between the hours of 8:00 am and 6:00 pm, Monday to Friday inclusive and 7:00 am to 4:00 pm on Saturdays.

The facility will operate between the hours of 7:00 am and 7:00 pm Monday to Friday and 7 to 5 on Saturdays. The early start and later finishing will allow for preparation, cleaning, etc. of the facility. The site will not operate on Sundays or Bank Holidays.

The main features of the facility are described further below.

4.2 Landfill Cells for Hazardous, Non Hazardous and Inert Waste

4.2.1 Landfill Cells and Phases

Four phases of construction, filling and restoration of the landfill cells will occur over the 25 year operational life of the proposed MEHL facility, with construction

originally scheduled to commence in 2011 and landfilling of wastes in lined cells starting in 2012 and continuing until an estimated 2036.

Three cells for landfilling hazardous waste will be developed and restored over three phases, two cells for the landfilling of non hazardous waste will be developed and restored over two phases and three cells for inert waste will be developed and restored over three phases.

4.2.2 Lining Systems

It is proposed to use Dense Asphaltic Concrete (DAC) to line the base and sidewalls of the cells for landfilling hazardous waste. The applicant's Drawing PP_WLA_22_02 depicts the proposed lining system.

A composite clay and geo-membrane liner will be installed on the base and side walls of the proposed cells for landfilling of non-hazardous waste. The applicant's Drawing PP_WLA_23_02 . depicts the proposed lining system.

A clay liner will be installed on the base and sidewalls of the proposed cells for landfilling of inert waste, in compliance with the current licence requirements.

4.3 New site entrance and access road at southern boundary

A new site entrance will be constructed from the LP01080 public road at the southern boundary to the MEHL site. The new entrance will cater for all construction and operation related traffic. Once the new facility entrance is operational, the existing entrance from the road to the west of the site will be used only as emergency entrance and exit. The existing haul road through the central portion of the MEHL site will be developed to provide access to the landfill cells. Secondary haul roads with access control will be constructed to ramp down into each of the cells.

4.4 New Administration Building and Site Management Infrastructure

A new administration building with access control, twin weighbridges and car parking will be located on the eastern side of the proposed MEHL facility, approximately 200m from the southern site boundary. The administration building will comprise a reception area, two offices, one meeting room, a canteen, a file store and shower and toilet facilities. The building will be a single storey building with a flat roof. Ten car parking spaces will be provided adjacent to the administration building.

Wheel washing facilities will be provided on the exit from the landfill facility. The wash water will be recycled and residual water will be disposed to the leachate holding tanks.

4.5 Solidification Plant

The solidification plant will be used to receive and treat flue gas treatment residues from energy from waste facilities prior to their deposition in the hazardous landfill cells.

Flue gas treatment residues typically contain a mixture of fine ash, residues from reactions that take place during cleaning like salts and carbon containing heavy metals and dioxins as well as un-reacted residues such as lime. They also contain heavy metals released during combustion. The residues are generally pale grey to white in colour, often containing small black particles of activated carbon. They are fine-grained, free-flowing, granular and mostly dry (0.2% moisture).

Due to the high lime content, these flue gas treatment residues are classified as hazardous as an irritant to skin and the respiratory system. The elevated total lead concentration can also exceed the threshold resulting in an eco-toxic hazardous classification.

The solidification plant will have a capacity of approximately 50,000 tonnes per annum and will consist of the following:

- An enclosed process building with process area, storeroom, process control room and welfare facilities (showers, canteen, toilets, etc.).
- Process area housing a mixing unit and weighing scales.
- 4 x storage silos to store flue gas treatment residues awaiting solidification.
- 1 x cement silo.
- 2 x 30m^3 bunded acid tanks.
- Storage building for curing solidified ash.

The solidification plant will be located on the eastern side of the non hazardous waste cell and will be screened by constructing the plant at a lower level than the administration building.

4.6 Leachate Management

Leachate is generated by the percolation of rainfall through the waste. The leachate would be expected to contain soluble and suspended material picked up from the waste deposited. No quantitative details on leachate generation rates or a site water balance are available.

Leachate produced in the hazardous waste cells will be collected above the liner in pipes running through a drainage layer. The liner will slope downwards towards a sump at the cell perimeter where the leachate will be pumped into sealed pipes which will connect to a concrete leachate holding tank. An

unspecified volume of the collected leachate will be used in the solidification process as described earlier.

It is intended to minimise leachate generation by using rainfall deflectors on the landfill cell sidewalls. These deflectors will attempt to collect surface water from the sidewall and divert it away from the waste to an inactive cell or temporary sump. The clean surface water will then be discharged through the wetlands to the stream along the northern boundary of the site.

The management of leachate from the non hazardous waste cells will be the same as for the management of leachate from the hazardous waste cells as described above. During periods of intense rainfall, it is likely the leachate collected from the non hazardous waste cells will not be required for the solidification process and will be disposed off site to an EPA licensed waste water treatment plant.

Leachate generated by the inert waste is not currently collected or treated. At present it is recirculated to keep levels of leachate within the cells to a minimum. There is no proposal to undertake collection and treatment of leachate from inert waste cells other than for recirculation.

5.0 FURTHER ENGINEERING DETAILS

5.1 Waste Types and Volumes

The current waste licence authorises the acceptance of 500,000 tonnes of inert waste annually for disposal and/or recovery. However this tonnage has never been accepted and in fact the quantities of waste have been decreasing steeply as a result of the economic downturn in the Irish economy as indicated in Section 4.1.

In the future there will be a mix of inert, non hazardous and hazardous wastes disposed at the facility. Based on the volume estimates of the three demarcated landfill areas which are provided in the EIS and WLA it is inferred that the approximate following tonnages will be added over a 25 year operating life to the site which already contains circa 1.6 million tonnes of inert waste and lightly contaminated soils.

Table 5.1.1: Landfill Void Capacity

Landfill Type	Volume (m^3)	Waste Density (t/m^3)	Tonnes
In-situ inert	Not available	2.00	1,596,853
Excavated in-situ[1]	-534,500	2.00	-1,069,000
Inert	1,290,000	2.00	2,580,000
Total Inert at end of life			**3,107,853**
Non Hazardous	1,324,000	1.75	**2,317,000**
Hazardous	1,735,500	1.75	**3,037,125**

[1]Note 534,500$m^3$of in-situ inert waste will be excavate and re-disposed on the site in the proposed inert cell IN1 that comprises the deep rock quarry formed in the limestone strata in the south central part of the site. The void created by excavation of in-situ inert waste will be re- filled with inert and hazardous wastes.

5.2 Waste Intake and Landfilling Rates

The rate of intake of the various waste types at the gate will be controlled by market driven forces. The landfilling rate will be controlled by the rate of receipt of waste.

MEHL has proposed that intake rate and duration of the intake of the three waste types will vary. According to the WLA inert wastes will be received and landfilled over 25 years. Whereas non hazardous and hazardous wastes will be received and landfilled over 19 and 23 years, respectively.

The proposed waste intakes are as follows:

Table 5.2.1: Proposed Waste Intake (tonnes per annum)

Waste	Year 1 to 6	Year 7 to 23	Year24 to 25	Total (tonnes)
Inert	60,400	60,400	60,400	1,510,000
Non Hazardous	0	102,300	206,400	2,151,900
Hazardous	122,600	122,600	0	2,819,800
Total	183,000 tpa	285,300 tpa	266,800 tpa	6,481,700

The rates at which the three wastes types arrive at the site will very much affect the filling and restoration plans proposed by MEHL. Based on current and projected trends in the generation of incinerator ash both Incinerator Fly Ash (IFA) and Incinerator Bottom Ash (IBA) and contaminated soils in the country there is a risk that the projected waste intakes, and the filling and restoration plan are optimistic i.e. the quantity of wastes will be less and the void capacity for hazardous and non hazardous wastes (in particular IFA and IBA) is oversized for the proposed 25 year life.

Comparing the figures in Tables 5.1.1 and 5.2.1 reveals a discrepancy in the mass of waste to be disposed in the non hazardous and hazardous landfill cells. The additional quantity of inert waste to be deposited on the site over the 25 years based on the void capacity and waste intake estimates is approximately 1.51 million tonnes.

Should a lower than anticipated annual tonnage rate arise, the operational duration will lengthen and the costs of operation and aftercare will increase. Variations to the predicted intake of inert, non-hazardous and hazardous waste, projected in the EIS, will also affect the leachate water-balance, which was not presented in the EIS or the WLA documents which are strongly dependant on the phasing and rate of filling. Landfill gas generation will also be affected. For these reasons it is essential that an adequate justification of the projected waste intake and a water balance for the site are provided to carry out an ELRA.

5.3 Waste Composition

The nature of the wastes to be accepted is provided in terms of EWC codes in Attachment H, Appendix H1.1. However, there is no estimate provided of the expected quantity of these wastes.

The EWC and appropriate paper tool and/or computer tools, should be used to classify the wastes. By definition in the EWC some of the wastes will be classified as hazardous. This includes fly ash and may include the bottom ash. Other wastes will be classified as inert, again in accordance with the definition of inert waste provided in European and Irish legislation. Other wastes will be considered non-hazardous and non inert but not hazardous. The exact mix of wastes in each of the three landfills is not known. Therefore, how the wastes

will react when in contact with each other and the nature of the leachate or gas that may form is also an unknown and is not readily predicted in this unique landfill facility.

5.4 Development and Restoration Phasing

The proposed facility will be developed and restored in phases as described in Attachment D.2 of the WLA and Sections 4.13 and 5.2 of the EIS. Four phases of development are planned and there will be three distinct landfill areas for inert, non hazardous and hazardous wastes. Phasing of the development of landfill cells is highly dependent on the rate of waste intake

Table 5.4.1: Development and Restoration Phasing

No.	Activity (See Table D.2.2 in WLA Attachment D.2)	Cell	Year from start of filling
1	**Phase 1**	**2011 -2016**	**-1 to 5**
	Construction	H1, IN1	
	Import and fill inert	C5	
	Excavate in situ inert and fill	IN1	
	Import and fill non hazardous	None	
	Import and fill hazardous	H1	
	capping and closure	C1 and C2	
2	**Phase 2**	**2014-2024**	**3 to 13**
	Construction	IN2, IN3	
	Construction	H2	
	Construction	NH1	
	Import and fill inert	IN2	
	Import and fill inert	IN3	
	Import and fill non hazardous	NH1	
	Import and fill hazardous	H2	
	Capping and Closure	C5	
	Capping and Closure	H1	
	Capping and Closure	IN3	
3	**Phase 3**	**2022-2034**	**11 to 23**
	Construction	H3	
	Import and fill inert	IN1	
	Import and fill inert	IN2	
	Import and fill non hazardous	NH1	
	Import and fill hazardous	H3	
	Capping Closure	H2	
	Capping and closure	IN2	
4	**Phase 4**	**2034-2036**	**23 to 25**
	Construction	NH2	
	Import and fill inert	IN1	
	Import and fill non hazardous	NH2	
	Import and fill hazardous	None	
	Capping and Closure	NH1	
	Capping and closure	H3	
5	**Phase 5**	**2036**	**25**
	Capping and closure	NH2, IN1	

6.0 INITIAL SCREENING /RISK ASSESSMENT

6.1 Risk Categorisation

The risk category for the Hollywood facility can be determined by the Facility Manager at the site using standard Office of Environmental Enforcement (EPA) *Methodology for Determining Enforcement Category of Licences* excel spread sheet. As the integrated facility is still proposed, this assessment was carried out by a suitably experienced staff member of Greenstar. Using this methodology it has been determined that MEHL's proposed integrated waste management facility would be classed as A1.

6.2 Initial Screening and Operational Risk Assessment

Based on guidance for initial screening and operational risk assessment outlined in the EPA 2006 guidance document, a landfill taking hazardous waste would be classified as Risk Category 3. Using the proposed system in the guidance document the Hollywood site can be assessed as follows:

Table 6.2.1 Hollywood Integrated Waste Management Facility – Operational Risk Assessment

Complexity		**Score**
Class D5: Waste Disposal Activity: inert, non hazardous and hazardous landfill Class D9: Physico-chemical treatment – solidification of hazardous ashes,	G5	**5**
Environmental Sensitivity	**Sub-matrix Score**	
Human occupation: 50-250m of landfill footprint	3	
Groundwater protection locally important aquifer	1	
Groundwater vulnerability moderate	1	
Sensitivity of receiving waters: Class C	1	
Air quality and topography:	1	
Protected species within the site	2	
Sensitive Agricultural Receptors 50-100m	0	
Total Environmental Sensitivity	**9**	**2**
Compliance Record		
Minor non compliant		**3**
OVERALL RISK SCORE	5 X 2 X 3	**30**
RISK CATEGORY		**3**

7.0 ENVIRONMENTAL RISK IDENTIFICATION

7.1 Review of Potential Processes that may give rise to Environmental Hazards & Risks

The following processes and activities have been and will be undertaken at the facility:

i. Excavation and re-disposal of some 534,500 m^3 of in-situ inert waste

ii. Removing surface water and backfilling the flooded part of rock quarry (now called Inert cell IN1) with native or imported materials.

iii. The disposal of inert waste, primarily lightly contaminated soil and stone.

iv. The disposal of non hazardous, non biodegradable waste including bottom ash from MSW incinerators.

v. Solidification of fly ash and similar ash wastes.

vi. The disposal of hazardous waste, primarily contaminated soil and solidified fly ash from MSW incinerator.

vii. Leachate collection for recirculation (leachate from inert only), re-use and disposal.

viii. A minor amount of recovery of Non Hazardous and Inert Waste.

ix. Discharge of runoff from the quarry and from capped landfill areas into the stream on the northern border of the site.

x. Discharge of runoff from the new paved areas via silt traps and oil separators into a small ditch on the southern side of the side.

xi. Discharge of treated waste water from the canteen and toilets into the ground via a percolation area.

7.2 Methodology

The methodology used for the risk identification component of the ELRA was as follows;

1. Identification of possible hazards on site,
2. Identification of potential hazard pathways (On site, beneath the site and off site), and,
3. Identification and assessment of environmental receptors (on site and off site) for those identified hazards and pathways.

The aims of the process were to provide an analysis of the environmental conditions at the landfill facility and to provide a baseline from which environmental liabilities may be established and assessed.

Identification of the environmental pathways and receptors has been undertaken with reference to the 2010 Environmental Impact Statement (EIS), which accompanied the December 2010 Planning Application to ABP, and Waste Licence Application W0129-03.

7.3 On Site Hazards

Hazards to the environment and humans that exist or will exist at the facility are as follows:

1. The wastes - *Whilst in transport on site, in processing areas, in storage areas and during tipping within engineered cells. An accidental spill may occur during any of these handling activities.*

2. Leachate from the landfilled wastes – *This will be contained within the landfill cells but leakage through the base liners is possible at rates not specified in the EIS or the WLA documents. Break out from the sides of the landfill body or over the top of the side slope lining systems is possible during operation or post closure depending on the duration of pumping of the leachate collection system and the nature of the wastes. Leachate will be pumped and conveyed in buried or above ground pipelines, it will be stored in (above ground) concrete tanks and it will be transferred into tankers and hauled to WWTPs.*

3. Gas from landfilled wastes – *It is proposed that biodegradable waste will not be accepted but it is possible that non methane volatile and semi volatile organic compound gases may be present in the hazardous waste and possibly the non hazardous waste landfill cells.*

4. Stored hydrocarbon fuels and chemicals - *These are mainly liquids in tanks situated within bunded areas.*

5. Gas and odours from fuel and chemical storage areas – *Volatile and semi violate organic compound gases may be present in the local atmosphere within the landfill itself and near existing fuel storage areas and proposed fuel and chemical storage areas.*

6. Stored surface water in the retention /settling ponds - *High levels of suspended solids, due to erosion and/or inadequate restoration work or other chemicals(hydrocarbons) due to incidental or accidental major spills may exist.;*

7. Treated waste water effluent discharged to ground/groundwater -*This will be an issue if the treatment plant malfunctions.*

8. Contaminated soils in the existing or future fuel or chemical storage areas – *These may exist due to accidental spills or failure of containment measures.*

9. Dust emissions from the landfilled curing bottom ash and the non hazardous and hazardous soils and stone - This dust may contain heavy metals and may occur during dry weather conditions.

7.4 Environmental Hazards

Further discussion on some of these hazards follows.

Wastes

The nature of the wastes is described in Attachment H of the WLA. The total pollutant content of the ash (IFA and IBA) is significant and both wastes exhibit hazardous properties. A spill of these wastes could potentially pollute land and water.

Leachate

Leachate forms when water is in contact with waste. The strength and hazard associated with leachate is dependent on contact time, the nature of waste and numerous other physical parameters. The composition of the leachate will vary as the wastes will vary. All three waste types (inert, non hazardous and hazardous wastes) will generate leachate with varying composition. It is proposed to accept wastes in the hazardous waste cells at 3 times the WAC listed in section 2.3.1 of the Annex to the Council Decision of 19 December 2002 (2003/33/EC) (the WAC decision) for hazardous waste. Similarly, it is proposed to accept wastes into the inert cell at 3 times the inert WAC listed in Annex section 2.1.2.1 of the WAC decision and it is proposed to accept wastes in the non-hazardous waste cells at 3 times the WAC for non hazardous waste accepted in the same cell as stable non reactive hazardous waste Annex, section 2.2.2 of the WAC decision.

The leachate generation rate will vary depending on a number of factors including net rainfall in any given month/ year, the degree of compaction of the wastes and whether wastes are solidified or not. A maximum, of 50,000 tpa of the fly ash waste will be solidified to minimise leaching of the wastes, however, the majority of the hazardous wastes will not be solidified. In fact the arisings of fly ash on the Island are expected to be less than 40,000 tpa until 2018 according to the 2010

SKM-Enviros report entitled *Technical and Economic Aspects of developing a National Difficult Waste Facility (NADWaF)* commissioned by the EPA. Of this, 24,000 tonnes may be attributed to the proposed Poolbeg Incinerator (which is obligated under a planning condition to export its ash) and 40,000 tonnes is from Belfast which may not be allowed to be disposed outside the UK.

Before closure and final capping, the rate of leakage through the lining systems will vary across the site due to varying liner specifications. The rate of leakage through the lining systems will be affected by the hydraulics of the landfill, which is affected inter alia by the head at which the leachate is maintained, by pumping, in the waste body, the permeability of the wastes, the effectiveness of the leachate collection system and pumping regime.

Post closure the leakage rate through the base will be controlled by the nature of the capping systems and their longevity, the longevity of the base lining system, and the level at which leachate is maintained by pumping if indeed pumping is continued indefinitely as may be required for the hazardous waste landfill. No details on leakage through the base of the various cells or the proposed head to be maintained in the landfill base is given over the potential contaminating life of the landfill, which could be in perpetuity in the case of the hazardous waste cells and also possibly the so called non-hazardous cells in which predominantly incinerator bottom ash is disposed.

The Quantified Hydrogeological Risk Assessment (QHRA) (Appendix A14.10 to the EIS) suggested that pumping will be carried out for 35 years after commencement of landfilling at the site (Note – this assumes that there was 10 years of landfilling at the site before landfilling in the hazardous waste cells commenced which was assumed to be in 2012). If this is the case this means that the head in the landfill will rise over time after the pumps are shut off and leachate break out will occur. The QHRA suggests there will be no degradation in the pollutants over millions of years. Thus there appears to be a strong potential for leachate to break out and contaminate shallow groundwater and surface water features. The QHRA suggests that the modelling is conservative in regard to predicting the impact on the aquifer. But the QHRA fails to address potential impacts on groundwater in the upper shale or overburden strata and adjoining surface water features if the pumps are turned off after 35 years.

Leachate from the inert wastes will not be collected but it will be contained in lined areas. Very low permeability clay has been used to line the inert cells and it is expected that this low permeability liner will tend to support a leachate head as opposed to allow leachate to seep away and dilute and disperse in the underlying fractured shale or limestone formations.

The QHRA suggests that leachate (the contaminants in it) will migrate through an unsaturated zone beneath the landfill. However, the hydrogeological site investigation described in the EIS and WLA did not include monitoring installations to provide detailed information on the depth to the water table or phreatic surface and thickness of the unsaturated zone.

Leachate from the other hazardous and non hazardous landfills will be collected. It will be extracted through the use of submersible pumps contained within sumps at the base of the landfill. Once extracted, the leachate will be piped to concrete storage tanks and reused in the solidification process. Leachate that is not reused will be disposed at yet to be identified Wastewater Treatment Plants.

After the landfill is closed, capped and restored, the volume of leachate that is generated and requiring management will diminish initially. However, with time the rate of leachate generation and thus leakage through the base of the landfill will rise if the capping system is not maintained and if the extraction pumps are not operated.

The estimated quantity of leachate from each of the three landfill areas and water balance for the site during operations and in the post closure period are not provided in the EIS or the WLA. This information is essential to allow a comprehensive assessment of the potential impacts , risks and costs associated with this facility in the short to very long terms. Furthermore, sufficient information was not found in the EIS and/or WLA documents in relation to emissions to satisfy the requirements of Article 12 (1) (k) of the Waste Management (Licensing) Regulations 2004 - SI. No. 395 of 2004, in relation to leachate emissions.

Landfill Gas

Where biodegradable material is in a landfill, microbial activity will generate gases. These would be a mixture of flammable, toxic and asphyxiating gases. The quantity of these gases depends on the mass of biodegradable material deposited, the age of the waste and a number of other environmental factors. MEHL do not propose to accept biodegradable wastes hence they say that there is no gas hazard or risks associated with landfill gas.

However, the SKM-Enviros report, dated July 2010, prepared for the EPA and entitled *Technical and Economic Aspect of Developing a National Difficult Waste Facility (NaDWaF)* states the following in relation to landfill gas at hazardous waste landfills(see section 9.2.3 -pp 101 to 104 inclusive):

"Three processes result in the generation of landfill gas – the general bacterial decomposition of biodegradable waste which is the main feature in municipal landfills, volatilisation of chemical substances such as paints or residues in solvent contaminated soils, resulting in the release of NMVOCs (non-methane volatile organic compounds) and chemical reactions that may take place when incompatible waste types in the landfill body come into contact……. Of the above mechanism, waste volatilisation tends to be the most prominent source of landfill gas generation in a hazardous landfill…….

……However, it is more difficult to forecast what type of gases may be generated from the aged or leached material that have become chemically altered within the landfill. These may include nitrogen, oxygen, ammonia, sulphides, hydrogen, carbon monoxide and non methane volatile organic compounds (NMOCS) such as trichloroethylene, benzene and vinyl chloride as well as explosive substances associated with the specific hazardous waste deposited. The precise composition depends on the wastes deposited in the site and trace gases composition in a hazardous landfill may change within a matter of hours even at any singe monitoring borehole. The nature and variability of hazardous wastes makes the prediction of gas generation from a difficult waste facility uncertain."

The SKM-Enviros report goes on to recommend: *"The potential risk of gas production in an engineered waste landfill facility should be assessed by the landfill operator when the types of waste that will be deposited are determined."*

The EIS and WLA documents do not contain a gas risk assessment for the mix of hazardous or non hazardous wastes or any proposed control measures for landfill gas that will potentially be generated and emitted.

Furthermore, sufficient information was not found in the EIS and/or WLA documents in relation to emissions to satisfy the requirements of Article 12 (1) (k) of the Waste Management (Licensing) Regulations 2004 - SI. No. 395 of 2004.

Hydrocarbons/ Chemicals Stored on Site

Hydrocarbons and chemicals are/will be required for the day to day operation of the facility.

The main requirement for hydrocarbon usage on site is derived from the operation of heavy machinery. Liquid hydrocarbon (diesel fuel) is/will be stored in tanks in a bunded area. Refuelling of machinery and site vehicles is/will be undertaken in a bunded area so as to ensure the containment of fuel in the event of a spillage. Operational procedures will be in place to ensure that refuelling occurs in a manner

that minimises the risk of spillage. In the event of a significant liquid hydrocarbon spill either in the bunded area or on the land surface, potentially contaminated material (solids and liquids) will be contained, sampled, tested, removed and then disposed of at a suitably licensed facility.

Oil is required for lubricating plant and equipment on site. There is a maintenance garage located on the west side of the facility which will be retained for most of the life of the landfill. Clean and used oil is/will be stored in drums set in bunded areas, as required under the existing licence and any future licence granted by the Agency. Used oil will be collected by a suitably licensed waste contractor.

Acid will be used in the solidification process. Acid will be stored in tanks placed in reinforced concrete bunds. The maximum quantity of acid to be stored will be 60 m^3.

7.5 Pathways

The primary pathways for hazards to the environment is through the atmosphere (emissions to air), overland (emissions to surface water or land) or through the ground (emissions to the soil or groundwater). These pathways are described in detail in the EIS and WLA. These media are both pathways (carriers) and receptors of contaminants (hazards).

Air and Emissions to Air– see Chapter 9 of the EIS and Attachment I.1 of the WLA

Surface water and Emissions to the Surface water- see Chapter 15 of the EIS and Attachment I.2 of the WLA

Soils/Geological formations and Groundwater and Emissions to the land and groundwater - see Chapter 14 of the EIS and Attachment I.4 and I.5 of the WLA. The main pathways are through the:

- landfill lining systems on the base and side slopes of the three types of engineered landfill;
- unsaturated geological materials beneath the landfill base and adjoining the side slopes of the landfill; and
- saturated geological materials beneath the landfill base and adjoining the side slopes of the landfill.

7.6 Environmental Receptors

The primary receptors of the identified environmental hazards include groundwater, surface water and the atmosphere. The secondary receptors of the environmental hazards would include humans, flora, fauna and agricultural lands.

In order to ascertain the potential impacts posed by the identified hazards, it is necessary to undertake a review of the receiving environment. To this end an assessment of the environmental receptors surrounding the facility was undertaken by MEHL and its consultants. The results of this assessment are described in the EIS and the WLA.

Groundwater

The groundwater that may potentially receive contaminants is described in the EIS, Chapter 14 and in the WLA Attachment I.4. It is our opinion that the site conceptual model of the hydrogeological conditions at the site is questionable, overly simplified and flawed for a number of reasons such as:

- 3D models of the top surfaces of the shale and limestone strata and the water levels in the shale and limestone were not constructed to allow a more complete representation and interpretation of the geological and hydrogeological conditions beneath the site;

- Only one 2D schematic cross-section of the geology is presented in a north south direction – there are no scaled orthogonal cross sections through the boreholes on the site;

- data appears to have been ignored, for example the water level data in BH8 – the report is not clear if this is a deep or shallow borehole as conflicting information is presented;

- the water levels in two adjoining boreholes BH12 and BH13 clearly show groundwater level higher in the shallower well, in the shale, than the deeper well, in the limestone, suggesting downward hydraulic gradients;

- the water levels in BH19 (in the shale) and BHs 17 and 20 (in the limestone) suggest that the water level in the shale is higher than in the underlying limestone so it is not possible that there are upward gradients from the limestone to the shale - the water level data suggests the opposite – downward gradients;

- the formation level of the landfill base was lowered by the designer on the basis that the water table is below 102.5mOD but no information is given on the position of the water table beneath the entire landfill base;

- there are water levels in the shale strata that are above the proposed base of the landfill and the shale water level data has not been contoured;

- there are no boreholes in the shale strata beneath the non hazardous waste landfill cells

- 3 No. geotechnical boreholes BH21, BH22 and BH23 were drilled and no groundwater monitoring devices were installed – this appears to have been a lost opportunity to determine the water table beneath part of the site; and

- The water strikes in trial pits TP10 and TP11 at about 100mOD and the water strikes in TP13, TP16 and TP17 at between 103mODand 105mOD are not discussed or reconciled with respect to the conceptual model.

Further to the above listed deficiencies, the EIS does not provide comprehensive quantitative justification for the re classification and downgrading of the importance of the limestone aquifer from LM to Ll. There is no justification for decreasing the vulnerability of the aquifer by assuming the shale strata would act in the same manner as overburden, as described in the GSI/EPA/DoE vulnerability mapping guidance document, *Groundwater Protection Schemes 1999*.

Further issues with the groundwater assessment include:

- There is an insufficient number of boreholes to develop a robust conceptual model particularly in the southwestern part of the site;

- There is a lack of information on the position of phreatic or potentiometric surface in the overburden and shale strata;

- There is no information provided on vertical gradients between the overburden, shale and limestone strata or horizontal gradients in the shale strata;

- There is no commentary on whether the ground water levels will rise with time at the site in response to the discontinuation of the dewatering of the quarry; and

- There is no commentary on the impact of climate change on ground water levels beneath and adjacent to the site.

Surface Water

The Surface Water that may potentially receive contaminants is described in the EIS, Chapter 15 and in the WLA Attachment I.2.

Air

The Local Air that may potentially receive contaminants is described in the EIS, Chapter 9 and in the WLA Attachment I.

Flora and Fauna

The Flora and Fauna that are potential receptors are described in the EIS Chapter 13.

Humans, Businesses, Agricultural Lands etc

The Local Population and Land Uses that are potential receptors are described in the EIS Chapter 7 and 17, respectively.

7.7 Identification and Assessment of Mitigation Measures

Mitigation measures are used to eliminate or reduce the risk of a hazard from having a negative impact on a receptor. Mitigation measure may be physical (engineered) or management controls. The EIS and WLA documents provide an extensive outline and description of the existing and proposed mitigation measures.

The most important engineered mitigation measures in relation to ameliorating the potential impacts of potential hazards are discussed briefly in the sub-sections which follow.

7.7.1 Lining Systems

The basal and side slope lining systems for the three classes of landfill (as described in Appendix B Table 1 of Council Decision 2003/33/EC i.e. inert Class A, non hazardous Class B1a and hazardous Class C) have been described in the WLA Attachment D.3, and on Drawings which accompanied the WLA. However, leakage rates under various leachate heads have not been provided for any of the proposed lining systems.

Furthermore the suggested equivalency/superiority of the proposed lining system for the hazardous waste cells as compared to the lining systems prescribed by the

EPA and the Landfill Directive has not been supported by any quantitative data e.g. leakage rates, attenuation capacity etc. in the application documents. In fact White Young Green, the appointed engineering consultant has presented a proposal to the EPA dated 28 June 2010 requesting that the DAC liner be considered BAT for a hazardous waste landfill. This request which is presented in Appendix D.3.2 of the WLA actually misrepresents the Landfill Directive requirements in respect to the lining system for hazardous waste landfill and provides no supporting quantitative information to support the assertion of equivalency/superiority of the DAC lining system over the prescribed liner system in the EPA manual on Landfill Design or the Landfill Directive. To carry out a robust environmental liability risk assessment leakage rates should be provided and carefully considered.

The proposed basal lining systems for the inert and non hazardous cells satisfy the requirements specified in the Landfill Directive. It is noted that part of the base of the inert and non hazardous waste cells will overlie the deep rock quarry that has been flooded, probably reflecting the groundwater level in the limestone. No information could be found in the application documents in relation to the methodology for filling the deep quarry for example how the water will be handled, what materials will be placed in the hole, what the degree of compaction will be, whether or not the subgrade for the liner is expected to settle.

It is noted, that the basal lining/leachate collection systems for the hazardous and non hazardous waste cells includes a geotextile layer on the surface of the leachate collection drainage layer. The rationale for inclusion of this layer is not provided in the application documents other than it is described as a filtration layer. This geotextile layer is not prescribed in the Landfill Directive or the EPA manual on landfill design. The usefulness of this layer, in the long term is questionable in so far as the filtration characteristics of this layer may be compromised by clogging due to biological and/or mineral matter (i.e. silt or clay sized particles). If this layer clogs there is a strong likelihood that it will act more like a barrier than a filter and in that case leachate will 'perch' on its surface and render the leachate collection system less effective.

In regard to side slope lining, the proposed system for the hazardous waste cells includes the 0.5m thick clay layer that is also the lowest layer in the base lining system to a height of 3m above the base of the landfill. The side slopes of the hazardous waste cells will be battered at 1V:2H. The application documents do not explain why this layer is terminated at this level and why it is not carried up to the full height of the landfill side slope as would be expected to meet the requirements of the Landfill Directive.

The side slope lining system for the non hazardous waste landfill cells is similar to the base liner except it will be constructed on a 1V:3H batter except for the southern perimeter. All layers will be carried to full height of the slope on the 1V:3H batter. On the southern side of cell NH1 slope a more complicated system of steep slope lining will be constructed against the very steep rock face. This steep wall lining system has been used in the UK including Northern Ireland but has not been used in the RoI. So this will be a first of its kind if approved by the EPA. Construction of the clay backing layer to the polystyrene blocks a minimum of 1metre thick with a co-efficient of permeability of $1x10^{-9}$ m/sec may prove to be difficult to construct due to physical and safety constraints and uneven rock surfaces. The steep wall system will use a drainage geo-composite instead of the 500mm thick layer of drainage stone that will be placed on the base of the landfill. No information is provided on the stability of this system or how, crucially, this ties into the adjoining 1V:3H batters at either end of the steep wall.

The side slope liner for the inert cells will comprise compacted clay placed in a bund against the perimeter walls as per current practice.

7.7.2 Capping System

The proposed capping systems for the three Landfill areas have been developed considering the requirements of the EPA's Landfill Manual – Site Design and the Landfill Directive. However, none of the capping systems include a gas collection layer. Capping works will be carried out progressively during the projected 25 year operating life of the facility.

The proposed capping system of the inert landfill will be the simplest, comprising only two layers: topsoil and subsoil totalling 1metre thick.

The capping system of the hazardous waste landfill cells will be the most complex with the following layers starting at the waste surface and working upwards from the waste surface to the completed restored surface:

- 600mm thick compacted mineral layer ($K<1x10^{-9}$ m/sec);
- 1mm LLDP geo-membrane, with a co-efficient of permeability of no less than $1x10^{-9}$ m/s or similar, laid on the clay mineral layer;
- Granular drainage layer, or a geo-composite membrane with a minimum hydraulic conductivity of 1x10-^{4} m/s, or similar, laid on the LLDPE;
- Subsoil 850mm thick laid on the granular or geo-composite drainage layer; and

- Topsoil 150mm thick laid on subsoil, so that the thickness of subsoil and topsoil is at least 1 metre.

The capping system for the non hazardous waste cells is similar to that proposed for the hazardous waste cells except the lower 600mm thick layer of compacted mineral layer is excluded.

7.7.3 Landfill Gas Management system

There is no landfill gas management system in place and one is not currently proposed.

7.7.4 Leachate Management System

This system is described in detail in Attachment D.4 of the WLA. A leachate management system will be employed and maintained as long as required to ensure that the leachate does not pose a source of the environmental pollution, in compliance with the waste licence.

It appears that this will be in perpetuity for the hazardous waste cells and also possibly for the inorganic non hazardous wastes. The quantity of leachate in the future is currently not known. The disposal location for any excess leachate not used in the solidification process during operation is not known and the disposal location of any leachate collected in perpetuity is not known.

7.7.5 Surface water management system

Surface water from the new hardstand reception areas will be collected and passed through an interceptor and silt trap prior to being discharged to an attenuation basin which will drain into an existing field ditch flowing easterly at the south east corner of the landfill facility. The interceptor and silt trap will be cleaned and maintained in accordance with the manufacturer's specifications. The quality of the surface water discharging to the ditch will be monitored on a quarterly basis.

Surface water from the capped landfill areas will be managed by a perimeter and internal drainage system that will take clean run-off from the restored landfill surface. The perimeter drainage systems will be a shallow swales ditches, formed in the restoration layers. The swales/ditches will be lined with a geotextile and graded stone to avoid erosion. The outlet for such perimeter swales will be directly to the existing surface water settling pond which will be decommissioned in due course and then eventually to the new settling pond and wetland area that will be located at the north-east corner of the site.

Surface water collecting in the quarry that has not been in contact with waste will be pumped from sumps in the quarry to the existing and then the same proposed wetland located at the north-eastern corner of the site.

7.8 Identification and Assessment of Operational Control Measures

7.8.1 Environmental Management System

MEHL operates in compliance with *ISO 14001 Environmental Management System – Specification with Guidance for Use*. The Company's management system was certified in December 2005 by SGS Register Number IEO5/66145.The system ensures continual improvement of site operations through a process of internal audit, management review and the setting of target and objectives relating to environmental hazards.

7.8.2 Waste Acceptance Procedures

Waste acceptance at the Hollywood site is carried out and is proposed to be carried out in compliance with the requirements of Council Decision 2003/33/EC on establishing criteria and procedures for the acceptance of waste at landfills, and pursuant to Article 16 and Annex II of Council Directive 1999/31/EC (the Landfill Directive). Waste acceptance at the facility comprises waste characterisation, compliance testing and on-site verification.

7.9 Emergency Response Procedures

MEHL has developed site specific emergency response procedures. These procedures outline the actions that are required to be undertaken in the event of an emergency and cover both general and specific emergency situations.

7.10 Conclusion

Considering the hazard, pathway and receptor model for the facility and in light of an assessment of current and proposed mitigation measures employed/to be employed at the Landfill, Table A1 (Appendix A) outlines the potential environmental risks that have been identified at the Facility.

This table is not intended to be a comprehensive list of all potential environmental liabilities associated with the development, operation, closure and post closure phases of the Landfill. The table considers those environmental liabilities that have the potential to have significant financial implication on the operational and post closure phases of the Landfill, both in terms of the cost associated with the repair of

infrastructure and the cost arising from the environmental remediation that may be required if the incident was to occur

To this end, it is considered that there are no short, medium or long term environmental liabilities caused from the potential nuisances (i.e. noise, litter, and odour emissions) associated with Landfill activities. These potential nuisances are considered to represent minor risks and are subject to Condition 5.1, Schedule B, 6.12, 6.15, and 6.17 of Waste Licence W0129-02 or similar conditions in a revised licence, if granted.

8.0 ENVIRONMENTAL RISK ASSESSMENT

Environmental risk may be assessed by considering the probability (likelihood) of occurrence of a defined hazard and the magnitude (severity) of the consequences of that occurrence.

To characterise and assess the risks identified, (see Table A1), the risk assessment model set out in the EPA's *Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision (2006)* has been employed. The results of the risk assessment are outlined in Table A1. Appendix A.

The risk scores presented in Table A1 are based on the risk assessment methodology contained in Appendix A, Table A2.1 and A2.2 while the basis for the likelihood and severity ratings of the hazards is presented in Appendix A, Table A1.

These assessments have been undertaken in light of the findings outlined in this ELRA.

9.0 FINANCIAL PROVISIONS – COSTS FOR ENVIRONMENTAL LIABILITIES

The financial provision requirements for the Facility have been assessed in relation to known liabilities and unknown liabilities. The costs of development and operation of the currently proposed integrated waste management facility over its proposed life are not considered in the discussion below.

9.1 Cost of Known Environmental Liabilities

Introduction

The known liabilities associated with the landfill facility relate to the foreseen liabilities/costs associated with its life cycle management, i.e. the cost of (i) infrastructure development; (ii) operation and maintenance; (iii) closure and restoration; and (iv)aftercare.

Only the order of magnitude estimates of the cost of item (iii) closure and restoration and item (iv) after care are included in this report. The development and operation costs are not included in the cost estimates.

A Closure Restoration and Aftercare Plan (CRAMP) was developed for the MEHL Hollywood site in 2010 and further information on proposed closure, restoration and aftercare management plans has been provided for the proposed facility in the 2010 EIS and WLA documents.

The 2010 EIS/WLA documents and accompanying Figures/Drawings outline the proposed phasing of the development and closure of the facility. The application documents also describe plans for restoration and subsequent aftercare.

The May 2010 CRAMP report submitted to the EPA included a breakdown of the costs associated with closing, restoring and aftercare management of the inert landfill. These costs have been reviewed and updated and further costs have been added to reflect the significantly modified nature of the wastes and landfill now proposed.

Key factors in the estimation of the total future costs are the duration that the costs will be incurred, the rate of inflation and a discount rate (i.e. an interest rate) to take into account the time value of money. Based on the requirement for perpetual care for a hazardous landfill, as indicated in the recently published EPA Draft BAT Guidance Note, expenditures for aftercare costs will occur for a very long time following closure of the landfill (in this case closure will be after 25 years of operation) as described in the application documents.

Closure and Restoration Costs

Indicative costs of some of the potential closure, and final restoration activities at the landfill, based on 2012 costs, are presented in Table B1. Also indicated in Table B1 are projected costs in year 2038, the assumed year that these activities will take place, (assuming a start of the proposed landfilling activities in 2013 and a 25 year operating life), based on a representative rate of inflation of 2% per annum compounded over those 25 years. The indicative computed sum for closure and restoration activities in terms of 2038 euros is **€5.4 million**. This sum of money will need to be available (i.e. a Financial Provision) at the end of the operating life (i.e. after 25 years) to pay for these works. A sinking fund will need to be set up where by a sum of money is set aside each year to build up this sum of money.

Recurring Aftercare Costs

Indicative annual costs for aftercare activities, based on 2012 costs are presented in Table B2. Also indicated in Table B2 are projected costs in year 2038, the assumed year that these activities will commence, (assuming a start of the proposed landfilling activities in 2013 and a 25 year operating life), based on a representative rate of inflation of 2% per annum compounded between 2012 and 2038. The total of these annual expenditures in terms of 2038 euros is circa **€1.22 million.** These annual aftercare expenditures will increase over time after 2038 in line with annual inflation rates.

In accordance with the requirements of EU and Irish legislation an aftercare fund (i.e. a Financial Provision) will need to be provided for the future expenditures. The size of the after care fund will depend on 4 variables: the expected annual cost; the rate of inflation; the rate of interest on the money (discount rate); and the time over which the future expenditures will occur.

Also, if maintaining low infiltration rates through the landfill cover/cap are part of the risk management strategy then it must be assumed that the capping system needs to be replaced at some frequency over the aftercare period because the capping system has a time limited service life. An additional cost for replacing the entire capping system would need to be included in the estimate of future expenditures. The frequency of replacement would need to be determined and justified. A frequency of every 50 years may be required.

All future annual and recurring expenditures at some other frequency would need to estimated considering inflation and then discounted back to the base year in which the fund (Financial Provision) is required. In this case this would be year 2038. As

noted earlier, the costs will continue for a very long time (i.e. in perpetuity) and this would have to be taken into account.

Summary Comments

The closure, restoration and aftercare costs (i.e. future expenditures) will depend very much on the rate of landfilling. If it is at a lower rate than proposed in the application documents the closure date of the landfill will be further in the future thus the costs will be higher, assuming inflation continues over the operating life of the landfill.

Closure, restoration and aftercare cost estimates are site-specific to the risk profile and design of the applicant's proposal. The indicative estimates presented herein are for illustration purposes and were prepared in the absence of adequate information in the EIS and should in no way replace the applicant's obligation to provide the necessary cost estimates and associated ELRA.

9.2 Costs of Unknown Liabilities

Unknown liabilities relate to those liabilities associated with the environmental incidents described in Table A1 that may arise from the operation of the facility and the unknown liabilities that may prevail or arise in the active aftercare period of minimum 30 years for the non-hazardous bottom ash waste cells or the perpetual aftercare for the hazardous wastes cells.

The costs associated with the unknown liabilities of the Facility have been generated with reference to the Risk Register presented in Table A1 and the EPA's document; *Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision, (2006)*.

The unknown liabilities associated with potential environmental incidents at the facility during the operating phase of the proposed landfill and the estimated costs that would be required to remediate that incident, are outlined in Table B3.1. The costs outlined in Table B3.1 have been generated by multiplying the median and highest likelihood of the environmental risk occurring, by the median and highest estimated value of the costs of remediation of the incident, should it occur. The median and maximum costs are circa **€68 million and €102 million** (in terms of 2012 euros), respectively. Table B3.2 presents the potential median and highest estimated value of costs to remediate incidents that potentially could occur post closure. Table B4 presents the maximum likely costs for remediation and/or mitigation of the effects of the hazard. Some of these unknown liabilities will cease to exist upon closure. However, some of the potential risks will continue and the

cost of remediation measures to address any incidents will increase over time in line with annual inflation rates.

These cost estimates are site-specific to the risk profile and design of the applicant's proposal. This estimate is prepared in the absence of adequate information in the EIS and should in no way replace the applicant's obligation to provide the necessary costings and associated ELRA.

9.3 Summary Comments - Costs of Unknown and Known Liabilities

Financial provisions need to be provided by the applicant as demanded by EU and Irish legislation. Section 53A of the WMA requires that the gate fees charged take into account full life cycle costs.

Costs of Unknown Liabilities

The costs of the unknown liabilities will need to be catered for through appropriate pollution indemnity insurance or a bond or some other suitable financial instrument to be made available to the Agency. Based on the exercise carried out as part of the assessment presented herein the expenditures relating to unknown liabilities if they all arose could range up to circa **€102 million** during the operating life. Some of these unknown liabilities will not exist upon closure. However, some will continue and the cost of remediation measures will increase over time in line with annual inflation rates between now and when the costs arise.

In the aftercare period the potential liabilities to remediate the liabilities, if they all arose, may be circa **€69 million** in terms of 2012 euros in the aftercare period. Some of these liabilities may be less or more severe and the potential costs may be lower or higher depending on the further information that the Agency should seek and the applicant should provide, in relation to a number of matters, as highlighted above and, as discussed in more detail in this report. The applicant is obliged to prepare a fully costed ELRA and make a proposal for the financial provisions to be put into place to cater for the potential unknown liabilities some of which will exist in perpetuity.

Costs of Known Liabilities

The known liabilities include capital expenditures to develop the facility, operating expenditures during the active landfilling life of the facility, expenditure for final closure /restoration activities and ongoing expenditures potentially into perpetuity for aftercare including the cost of the premium of any pollution indemnity insurance or bond for the unknown liabilities.

Estimation of the capital (development) and operating expenses were beyond the scope of this report. These need to be estimated by the applicant and taken into consideration in relation to fulfilling the requirements of Section 53A of the WMA, 1996 as amended.

An indicative closure/restoration cost in year 2038 in terms of 2038 euros assuming an inflation rate of 2% per annum from 2012 to 2038 is **€5.4 million**.

The cost of aftercare requirements in perpetuity depends on inflation and interest rates. The size of the aftercare fund to be available in 2038, the assumed year aftercare commences, could be in the order of **€70 million and €135 million** based on a present value computations assuming the net real discount rate is between 1 and 2 percent. These funds will need to be built up in a sinking fund over the operating revenue generating life of the facility. A financial instrument such as cash, a trust fund or an escrow account will need to be provided by the applicant/licensee and available to the EPA to cater for the aftercare expenditures.

APPENDIX A
ENVIROMENTAL RISK TABLES

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R1a	Deterioration and/or cracking of the DAC lining system (constructed in haz waste cells) due to issues such as sub-grade settlement, slope instability, stabilising layer containing potentially damaging pyritic materials, incompatibility of leachate with liner materials, and aging in perpetuity. This results in discharge of leachate to shallow groundwater in the overburden or underlying fractured and faulted Namurian strata and then discharge into surface features or in shallow local domestic wells downgradient, to the east and southeast of the site.	Effect is - pollution of shallow groundwater and local surface water streams feeding salmonid waters. Further if there are downward hydraulic gradients between the shale and the limestone aquifer deterioration of the quality of groundwater in the locally important aquifer may occur.	**6**	**Very Likely** The EPA requires aftercare to be in perpetuity for a hazardous waste landfill. There is no experience to suggest that the liner will exist forever. As there is an absence of information on pyritic materials in the sub- formation the stability of the liner, leachate/liner compatibility, and the effect of long term aging on the DAC liner, the starting assumption is that this hazard will develop and environmental effect will likely occur.	**5**	**Very Severe** If leachate escapes there will be an impact on surface water and local domestic wells possibly up to 500m from the ownership boundary.	**30 Extreme Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R1b	Deterioration and/or cracking of the composite clay/HDPE constructed (non haz bottom ash waste cells) due to issues such as exothermic reactions during curing of the incinerator bottom ash (IBA) in situ, sub-grade settlement, slope instability, incompatibility of leachate with liner materials, and aging during the 25 year operating life and a minimum 30 year aftercare period. This results in discharge of leachate to shallow groundwater in the overburden or underlying fractured and faulted Namurian strata and then discharge into surface features or in shallow local domestic wells downgradient, to the east and southeast of the site.	Effect is - pollution of shallow groundwater and local surface water streams feeding salmonid waters. Further if there are downward hydraulic gradients between the shale and the limestone aquifer deterioration of the quality of groundwater in the locally important aquifer may occur.	**6**	**Very Likely** The EPA requires aftercare of at least 30years for a non haz biodegradable waste landfill. The contaminating life span of the IBA wastes may be greater than the 30 year aftercare. There is no experience to suggest that the composite liner will last under the adverse conditions listed in column 2. On this basis the starting assumption is that this hazard will develop and environmental effect will likely occur.	**5**	**Very Severe** If leachate escapes there will be an impact on surface water and local wells possibly up 500m from the ownership boundary.	**30 Extreme Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R2	Coupled with R1 an insufficient site investigation has been carried out which puts in question the assessment of the hydrogeological conditions and as such it is possible that the geological formations beneath the landfill base are in fact saturated (rendering the Landsim2.5 model inappropriate) and downward hydraulic gradients exist through the overburden and /or Namurian strata (not upward as suggested in the HQRA). The result is downward migration of leachate into the groundwater in the locally important aquifers (the underlying limestone strata) and then laterally south easterly towards water supply wells serving the nationally important horticultural/agricultural enterprises in north County Dublin.	Effect is - pollution of water supply wells serving the nationally important horticultural/agricultural enterprises in north County Dublin.	**6**	**Very Likely** Nested monitoring piezometers have not been installed. There are insufficient BHs in the southeast part of the site. Available groundwater level data suggest downward gradients. The EPA requires aftercare in perpetuity. There is no experience to suggest that the DAC or composite liner will exist forever . There is no assurance that the capping systems will maintained for ever. There is a perceived very high likelihood that this hazard exists and environmental effect will occur.	**6**	**Massive** If leachate escapes there will be an impact on a locally important aquifer and important agricultural water supply wells. The severity may relate more to perception than fact but never-the-less the impact could be massively negative on the economy of the region.	**36** **Extreme Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R3	Coupled with failure or cracking of the liner, the zone of influence of the landfill (i.e. the potential spread of contaminants that are released at any time in the future (in perpetuity) on ground water in the limestone formations) has not been delineated. To do so contemporaneous water levels in all groundwater boreholes in the region including wells to the east in the Bog of the Ring Source Protection Zone and to the southeast in the environs of the proposed Nevitt landfill would need to be recorded and mapped to determine hydraulic head contours and indicative deep groundwater flow directions. The hazard is leachate discharging into deep groundwater flowing towards the Bog of the Ring water supply well catchment	Irrespective of mapping of a surface catchment boundary between the subject site and the Bog of the Ring source protection zone there is a risk of a potential hydrogeological connection with and thus pollution of Bog of the Ring wells.	**5**	**Very High** In sufficient information is available, presented or interpreted to provide assurance that there is no deep groundwater flow from the site towards the eastern zone of the Bog of the Ring well field. Due to lack of information there is a perceived very high chance that these wells may be polluted.	**6**	**Massive** If leachate escapes there will be an impact on a locally important aquifer and important commercial and public water supply wells over an area potentially greater than 500m from the ownership boundary.	**30 Extreme Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R4	Leachate pumps fail or are switched off sometime in the future and leachate overtops the liner in the hazardous waste cells on the north or east side of the site and discharging into the overburden or shallow fractured bedrock or surface ditches or the surface stream that borders the north side of the site. Depending on the assumed porosity of the wastes , the net rainfall and the extent of capping, there is a risk that leachate overtopping the side slope liner would occur (within a matter of years if the landfill is uncapped and several decades if the landfill is capped) after pumps are shut off or sooner if there is perching of leachate within the waste body.	Effect is - pollution of shallow groundwater and local wells and surface water feeding salmonid waters occurs.	**5**	**Very High** There is no assurance given that the pumps will be maintained and operated for hundreds and hundreds of years so there is a perceived very high likelihood that there will be leachate break out at this site.	**5**	**Very Severe** If leachate escapes there will be an impact on surface water and local wells possibly up 500m from the ownership boundary.	**25 Very High Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R5	Leachate breakout occurs due to perching in the waste body during the 25 year operations due to low permeability material being placed, such as contaminated soils and solidified wastes.	Effect is - pollution of shallow groundwater and local wells and surface water feeding salmonid waters occurs.	**6**	**Very Likely** The nature of the proposed wastes is conducive to perching to ccurring.	**3**	**Moderate** Impacts are likely to be contained within 150m of the ownership boundary.	**18 High Risk**
R6	Wastes quantities do not arrive at the site as proposed in the licence application thus not allowing landfill activities to take place in a way that will allow details shown on Drawings PP_WLA22_02 and PP_WW23_02 to be built. The complex interdependency of the filling and capping plans for each of three landfill types results in a risk that the landfill will not be fully capped and closed in a systematic manner. The result is additional quantities of leachate require management and/or leachate breakout from uncapped parts of various landfill types mixes with leachate in adjoining landfill areas.	The effect of these events is additional engineering, capex and opex costs to manage leachate.	**6**	**Very Likely** It is not possible for the operator to predict waste generation in Ireland and intake rates over the next 25 years with any degree of accuracy therefore the starting assumption is that the filling, capping and restoration plans will not occur as indicated.	**4**	**Severe** Large areas of the landfill may remain uncapped for years thus generating much larger quantities of leachate as compared to if the landfill being capped systematically cell by cell.	**24 Very High Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R7	The quantities of leachate that will be generated on the site during operations and post closure in perpetuity have not been stated or characterised in the application documents and due to this lack of information there is a risk that there will be large quantities of leachate that cannot be reused in the solidification process or re-circulated on site. As a result there is a risk that significant quantities of leachate will need to be handled, tankered off site and disposed of at a municipal waste water treatment plant (WWTP).	Additional trucking of leachate will impact on the road network and the available capacity of the WWTP which may require expansion or retrofitting. Otherwise an on- site treatment plant may need to constructed and operated. The environmental effects of additional trucking, and/or expansion or retrofitting an existing WWTP have not been assessed by the operator. One effect will be additional cost to mitigate or remediate the situation.	**3**	**Medium** The quantities of leachate can be readily estimated using climatological information and engineering experience before operations commence and observed during the initial years of operation. The likelihood of unpredicted large quantities being generated is judged to be moderate.	**5**	**Very Severe** If there are very larger quantities of leachate requiring trucking or treating the annual cost could be comparatively large. The cost of retrofitting a WWTP could be very large.	**15 Medium Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R8	Due to the lack of definition on the quality and quantity of leachate there is a risk that no treatment plant will be available to accept the leachate for the long periods of time that will be required if this site is to be managed in perpetuity. If there is no disposal location for the leachate there is a risk of the landfill being used to store leachate.	If leachate is stored in the landfill to depths greater than the proposed 1 metre there will be greater to leakage of leachate through the liner and/or overtopping of the liner may occur and/or there is a risk that an on-site plant may need to be built	**3**	**Medium** The quantities of leachate can be readily estimated.	**5**	**Very Severe** If groundwater is polluted or a new treatment plant is required the cost of mitigation of the impact of this risk could be very high	**15 Medium Risk**
R9	There is a breach of the landfill's DAC and composite lining system due to accidental damage by construction or waste placement plant and equipment and this breach leads to leakage of leachate into the underlying shallow groundwater.	Effect is - pollution of shallow groundwater and local wells and surface water feeding salmonid waters occurs.	**2**	**Low** This can occur but full time inspection during construction and filling operations will make this occurrence less likely.	**2**	**Minor** This impact should be discovered and addressed when the landfill is operational so the impact should not be widespread.	**4 Low Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R10	Deterioration and cracking of the capping system due to issues such as subgrade settlement, slope instability, erosion of surface layers, and aging in perpetuity. As a result there will be an increase in infiltration through the cap which will lead to an increase in leachate generation rate iwhich may lead to higher leachate head in the landfill or a larger quantity of leacahte to remove from the landfill..	Effect is - higher leakage rates through the landfill liner and/or overtopping of the landfill liner and/or larger quantities of leachate to pump, handle, store and dispose of at a WWTP. Higher leakage rates or overtopping could lead to pollution of shallow groundwater, domestic wells and surface water feeding salmonid streams.	**5**	**Very High** There is no evidence to suggest that geomembrane in capping systems will last forever. Thus the effect will occur if the capping system is not maintained and/or replaced. The likelihood is judged to be High to Certain in the context of aftercare in perpetuity.	**5**	**Very Severe** If there are larger quantities of leachate requiring trucking or treating the annual cost could be comparatively large. If surface water and/or groundwater are polluted the costs of remediation will be large.	**25 Very High Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R11	NMVOC landfill gases exist in the landfilled non solidified hazardous wastes in cells, as suggested by the SKM-Enviros 2010 Report and in the non hazardous waste contaminated soils, and no physical control measures are installed considered or proposed to be put in place.	Effect is unacceptable emissions to air during operations requiring a complex retrofitted gas collection and treatment system.	**5**	**Very High** There are scientific reports that indicate this possibility therefore the likelihood is judged to be high to certain that NMVOCs will be present.	**5**	**Very Severe** As no gas generation estimates have been provided the nature and extent of the impact and gas collection system remediation systems are difficult to predict. Public and third party perception could be wide spread and thus there could be a very severe impact on the economy of the area.	**30 Extreme Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R12	Deterioration and cracking of landfill lining system due to various factors referred to in R1 and no gas control system in place during operations.	Effect is - unacceptable emissions of landfill gas to sub-soils which may migrate to service trenches and under buildings.	**2**	**Low** The likelihood of the liner cracking during the 25 years operating period is considered to be low.	**2**	**Minor** Any impacts will be detected in local monitoring boreholes and thus the impacts will be confined, making the cost of remedial work relatively low.	**4 Very Low Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R13	Deterioration and cracking of the capping system due to issues such as subgrade/waste settlement, slope instability, erosion of surface layers, and aging in perpetuity.	Effect is uncontrolled release of NMOC landfill gas to the atmosphere in the absence of any gas control measure being installed.	**5**	**Very High** There are scientific reports that indicate this possibility therefore the likelihood is judged to be high to certain that NMVOCs will be present. Unless the capping systems are maintained or reconstructed regularly in perpetuity cracking is judged to be a high likelihood.	**3**	**Moderate** The impact of these emissions are judged to relatively localised and noticed within 150m of the ownership boundary.	**15 Medium Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R14	During operations the non solidified hazardous waste (amounting to a minimum of 60% of the wastes to be disposed of in the hazardous waste cells), and/or the non hazardous soils etc and/or bottom ash dry out.	Dust forms and there are uncontrolled dust emissions of potentially hazardous dust particles which migrate downwind to the southeast in the direction of nationally important horticultural enterprises and impact on the quality of the products and the livelihood of many businesses and people.	**5**	**Very High** Evidence from other facilities where bottom ash is being handled suggests that dust emissions are highly possible. No scientific reports or air modelling studies have been produced by the operator to address potential dust emissions or eliminate this as a possibility.	**5**	**Very Severe** The immediate impacts of dust may be localised but the perception of this issue as potentially damaging the quality of agricultural products may be more regional in context.	**25 Very High Risk**
R15	During operations a fuel/chemical (acid) storage tank or pipe or bund leaks during operations	Soils and/or surface water and/or shallow ground water on site are contaminated.	**2**	**Low** Experience would suggest that this is unlikely in a well engineered and constructed facility.	**2**	**Minor** Damage will be localised as there will be daily inspections.	**4 Very Low Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R16	Waste vehicle tips over.	Shallow soils and/or surface water in site ditches are contaminated	**2**	**Low** Experience would suggest that this is unlikely in a well engineered and constructed facility.	**1**	**Negligible** Damage will be localised as there will be daily inspections.	**2 Very Low Risk**
R17	Leachate tank overflows or leaks.	Shallow soils and /or groundwater and/or surface water in streams is contaminated.	**2**	**Low** Experience would suggest that this is unlikely in a well engineered and constructed facility.	**3**	**Moderate** Damage will be localised if the tanks are above ground as there will be daily inspections but if the tanks are buried the damage could be moderate to very severe.	**6 Low Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R18	Fire in solidification plant or in the fuel storage area or in the offices.	Fire water needs to be contained, shallow soils, shallow groundwater and surface water in site ditches becomes contaminated.	**2**	**Low** Experience would suggest that this is unlikely in a well engineered and constructed facility	**2**	**Minor** Damage will be localised as there will be daily inspections	**4** **Low Risk**
R19	Dust from the solidification plant.	Fly ash blows downwind and impacts local agricultural lands, flora and fauna or residents	**2**	**Low** Experience would suggest that this is unlikely in a well engineered and constructed facility.	**2**	**Minor** Damage will be localised as there will be daily inspections.	**4** **Low Risk**
R20	Foul waste water treatment system malfunctions.	Shallow ground water and/or surface water in site ditch becomes contaminated.	**2**	**Low** Experience would suggest that this is unlikely in a well engineered and constructed facility.	**2**	**Minor** Damage will be localised as there will be daily inspections.	**4** **Low Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R21	An unquantified large volume of groundwater and ponded surface must be extracted from the base of the quarry. Large quantities of unknown materials will be placed below the water table in inert cell IN1 and NH1 to fill the deep excavation to liner formation level.	The effects are two fold: (i) there is an unknown effect on unknown receptors of the ponded water (possibly surface water and flora and fauna along the surface water features, that must be pumped and (2) there is an unknown effect on the groundwater quality in the limestone because no information is provided in relation to the nature of the materials to be used to fill the deep hole.	**5**	**Very High** As no detailed description of this process and any mitigation measures that will be in place are provided it is assumed that this likely could happen.	**5**	**Very Severe** The extent of the potential damage is unclear but it could be beyond the ownership boundaries.	**25 Very High Risk**
R22	During excavation of the 534,500m^3 of inert/lightly contaminated soil waste landfill excessive dust, odours, and leachate arise and are not controlled. As this operation is not described in the EIS or the WLA this activity represents a hazard.	The effects are two fold: (i) dust and odour nuisances for workers on site and local residents and (ii) if the contaminated runoff is not controlled or is just pumped to surface water bodies there may be a risk to the local surface water features adjoining the site.	**5**	**Very High** As no detailed description of this process and any mitigation measures that will be in place it is assumed that this likely could happen.	**5**	**Very Severe** The extent of the potential damage is unclear but it could be beyond the ownership boundaries.	**25 Very High Risk**

Table A1: Potential Hazards, Environmental Effects and Risk Scores – Integrated Waste Management Facility, including a hazardous waste landfill Hollywood, Co. Dublin

Risk Register No.	Potential Hazard At Hollywood Site	Environmental Effect At Hollywood Site	Occurrence Rating [Note 1]	Basis of Occurrence Rating	Severity Rating [Note 2]	Basis Of Severity Rating	Risk Score [Note 3]
R23	Leachate breakout from inert landfill	Clean surface water may become impacted as the leachate from the inert wastes may be 3 times the WAC criteria in Council Decision 2003/31/EC33	**2**	**Low** Experience would suggest that this is unlikely in a well engineered and constructed facility.	**2**	**Minor** Damage will be localised as there will be daily inspections.	**4** **Low Risk**
R24	Dust from inert landfill	Nuisance impact on local agricultural lands, and residents	**2**	**Low** Experience would suggest that this is unlikely in a well engineered and constructed facility.	**2**	**Minor** Damage will be localised as there will be daily inspections.	**4** **Low Risk**

Note 1 Occurrence Rating is based on Risk Assessment Table A2.1

Note 2 Severity Rating is based on Risk Assessment Table A2.2

Note 3 Risk Score is determined by multiplying the occurrence rating by the severity rating. The relationship between likelihood, severity and overall risk is shown in Table A2.3.

Table A2.1: – Risk Classification Table – Occurrence

Rating	Category	Description	Likelihood of Occurrence (%)
1	Very Low	Less than 5% chance of hazard occurring.	0-5
2	Low	Low chance of hazard occurring.	5-25
3	Medium	Medium chance of hazard occurring.	25-50
4	High	High chance of hazard occurring.	50-75
5	Very High	Vey High chance of hazard occurring	75-90
6	Very Likely	Near certain chance of hazard occurring	90-100

Note

The Risks are assessed in the context of a certain unplanned event/occurring at least once during one or more of the following time frames:

- Time Frame A: – the event occurs during the proposed 25 year active operating life of the facility (i.e. the period during which wastes will be accepted and deposited in the three proposed types of landfill for inert wastes , non hazardous [non biodegradable] wastes and hazardous wastes.)

- Time Frame B: - the event occurs during a 30 year aftercare period. This applies to the inert and non-hazardous waste landfill cells.

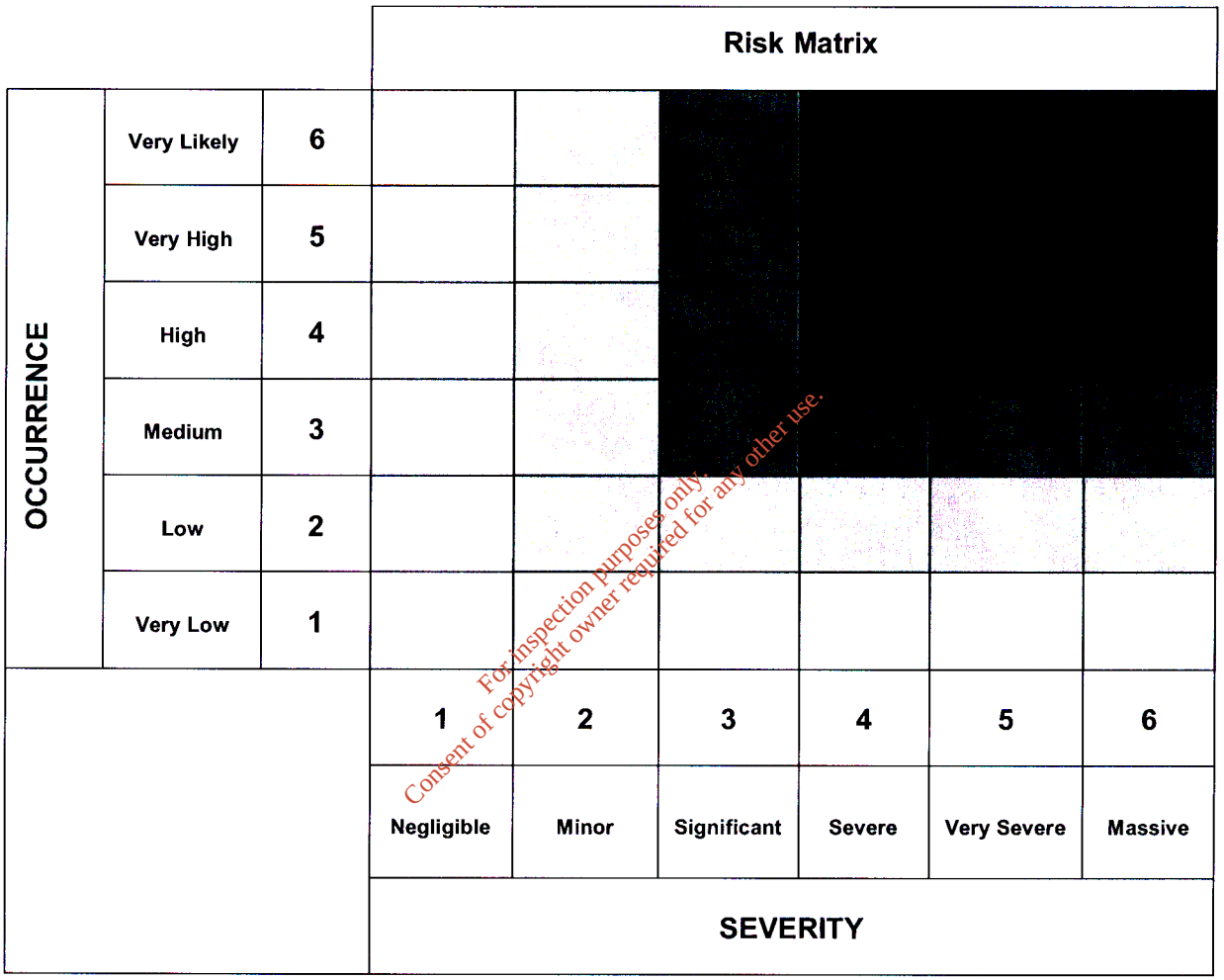
- Time Frame C: - the event occurs during a perpetual aftercare period. This applies to the hazardous waste landfill cells.

Table A2.2 – Risk Classification Table – Severity

Rating	Category	Description (of environmental effect/impact caused by hazard)	Potential Geographic Extent of Impact (where applicable)	Cost of Remediation or Mitigation Measures (€ x 1,000) (in 2012 euros)
1	Negligible	No damage or negligible change to the environment	Within licence boundary	Very Low 1-100
2	Minor	Minor impact/localised nuisance	Within landholding of MEHL	Low 101-250
3	Moderate	Moderate damage to environment	0 to <150m from ownership boundary	Medium 251-1,000
4	Severe	Severe damage to the environment	0 to <250m from ownership boundary	High 1,001-5,000
5	Very Severe	Very Severe damage to a large area, irreversible in medium term	0 to <500m from ownership boundary	Very High 5,001-10,000
6	Massive	Massive damage of regional significance, irreversible in medium term	>500m from ownership boundary	Massive 10,001-20,000+

Table A2.3 – Risk Assessment – Risk Matrix and Score

The following risk assessment matrix is based the methodology proposed in the EPA's Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision (2006) Risks are assessed in terms of severity and likelihood of occurrence. A risk score is determined by multiplying the likelihood rating (Table A2.1) by the severity rating (Table A2.2). The matrix is designed to allow risks to be easily displayed and prioritised.



Risk Score= Occurrence Rating x Severity Rating

Classification	Score Range
Very Low Risk	1-5
Low Risk	6- 10
Medium Risk	11-15
High Risk	16- 20
Very High Risk	21-25
Extreme Risk	25- 36

APPENDIX B
FINANCIAL LIABILITIES – COSTS

Table B1: - Provisional Costs for Closure and Restoration Works – Integrated Waste Management Facility

No.	Item	Unit	Quantity	Unit Rate	Cost 2012	Cost 2038
1	**Decontaminate and remove all mobile plant**	PS	1	€5,000	€5,000	€8,367
2	**Decontamination**					
2.1	Removal of Waste oils etc associated with maintenance garage	PS	1	€5,000	€5,000	€8,367
2.2	Removal contaminated soils at garage and fuel storage dispensing	PS	1	€10,000	€10,000	€16,734
2.3	Emptying all silt tanks, oil interceptors, sumps in bunded areas,	PS	1	€10,000	€10,000	€16,374
3	**Demolition/decommissioning**					
3.1	Demolition/decommissioning of site buildings and all infrastructure	PS	1	€50,000	€50,000	€83,670
3.2	Waste Salvage, recovery and disposal	PS	1	€10,000	€10,000	€16,734
3.3	Surfaces removal - concrete, macadam	PS	1	€50,000	€50,000	€83,671
3.4	Phase I and II ESA	PS	1	€50,000	€50,000	€83,671
3.5	Supervision of decommissioning works	PS	1	€50,000	€50,000	€83,671
4	**Verification Audit/Certification & report to EPA**		1	€50,000	€50,000	€83,671
5	**Final Capping of landfill cell IN1 (see notes 1 and 2)**	m^2	30,000	€20	€600,000	€1,004,051
6	**Final Capping of landfill Cell NH2 (see notes 1 and 2)**	m^2	30,000	€25	€1,050,000	€1,757,089
7	**Final Capping of part of landfill Cell H3 (see notes 1 and 2)**	m^2	30,000	€40	€1,200,000	€2,008,102
8	**Final Landscaping and land drainage works**	PS	1	€100,000	€100,000	€167,342
	TOTAL				**€3,240,000**	**€5,421,875**

Notes: **1. Cap areas are provisional estimates. These will depend on the extent to which progressive restoration has been carried out during filling operations.**
2. Unit rates are provisional and will depend on the final design details and sources of materials. 3. PS = Provisional Sum

Table B2: - Provisional Aftercare Costs – Integrated Waste Management Facility – Hollywood Co. Dublin

No.	Item	Unit	Quantity	Unit Cost	Cost 2012 (Note 1)	Cost 2038 (Notes 1, 2)
9	Environmental Monitoring (must include periodic replacement of infrastructure	PS	1	€60,000	€60,000	€100,405
10	Leachate Management System Maintenance	PS	1	€40,000	€40,000	€66,937
11	Leachate Tankering and Disposal	tonne	1,150	€50	€57,500	€96,222
12	Landscape and drainage system maintenance	ha	23	€1,000	€23,000	€38,489
13	On going Security Costs - fencing etc	PS	1	€20,000	€20,000	€33,468
14	Replace capping system (every 50 year)	m^2	200,000	€35	€7,000,000	€11,713,927
15	Environmental Pollution Indemnity Insurance and Other	PS	1	€400,000	€400,000	€669,367
16	EPA Fees	PS	1	€50,000	€50,000	€83,671
17	Accounting, Legal, Administration and Management	PS	1	€50,000	€40,000	€66,937
18	Engineering Services	PS	1	€40,000	€40,000	€66,937
	TOTAL				€730,500	€1,222,432

Notes 1. All costs are annual expenditures except item 14 which will be an expenditure at a frequency assumed to be every 50years

2. Costs indicated in this column are based on an assumed inflation rate of 2% /yr starting in 2012 . All of these costs will increase over time in line with annual inflation rates.

Table B3.1: - Median and Maximum Cost Model for Unknown Liabilities during Operations

Risk Register No.	Occurrence Rating	Minimum Likelihood (%)	Maximum Likelihood (%)	Median Likelihood (%)	Severity Rating	Minimum Cost in Range (€ x 1,000)	Maximum Cost (2012) in Range (€ x 1,000)	Median Cost(2012) in Range (€ x 1,000)	Risk Score	Most Likely Cost(2012) (€ x 1,000) (Note 1)	Maximum Likely Cost (2012) (€ x 1,000) (Note 1)
R1a	6	90	100	95	5	5,001	10,000	7,501	30	7,125	10,000
R1b	6	90	100	95	5	5,001	10,000	7,501	30	0	0
R2	6	90	100	95	6	10,001	20,000	15,001	36	14,250	20,000
R3	5	75	90	82.5	6	10,001	20,000	15,001	30	0	0
R4	5	75	90	82.5	5	5,001	10,000	7,501	25	6,188	9,000
R5	6	90	100	95	3	251	1,000	626	18	594	1,000
R6	6	90	100	95	4	1,001	5,000	3,001	24	2,850	5,000
R7	3	25	50	37.5	5	5,001	10,000	7,501	15	2,813	5,000
R8	3	25	50	37.5	5	5,001	10,000	7,501	15	2,813	5,000
R9	2	5	25	15	2	101	250	176	4	26	63
R10	5	75	90	82.5	5	5,001	10,000	7,501	25	6,188	9,000
R11	5	75	90	82.5	5	5,001	10,000	7,501	25	6,188	9,000
R12	2	5	25	15	2	101	250	176	4	26	63
R13	5	75	90	82.5	3	251	1,000	626	15	516	900
R14	5	75	90	82.5	5	5,001	10,000	7,501	25	6,188	9,000
R15	2	5	25	15	2	101	250	176	4	26	63
R16	2	5	25	15	1	1	100	51	2	8	25
R17	2	5	25	15	3	251	1,000	626	6	94	250
R18	2	5	25	15	2	101	250	176	4	26	63
R19	2	5	25	15	2	101	250	176	4	26	63
R20	2	5	25	15	2	101	250	176	4	26	63
R21	5	75	90	82.5	5	5,001	10,000	7,501	10	6,188	9,000
R22	5	75	90	82.5	5	5,001	10,000	7,501	25	6,188	9,000
R23	2	5	25	15	2	101	250	176	4	26	63
R24	2	5	25	15	2	101	250	176	4	26	63
Total (in millions)										**€68,402**	**€101,675**

Notes 1. Costs have not been shown for potential remedial works to address Risk Register Nos. R1b and R3 to avoid double counting of costs.

Table B3.2: - Median and Maximum Cost Model for Unknown Liabilities during Aftercare Period

Risk Register No.	Occurrence Rating	Minimum Likelihood (%)	Maximum Likelihood (%)	Median Likelihood (%)	Severity Rating	Minimum Cost in Range (€ x 1,000)	Maximum Cost (2012) in Range (€ x 1,000)	Median Cost(2012) in Range (€ x 1,000)	Risk Score	Most Likely Cost(2012) (€ x 1,000) (Note 1)	Maximum Likely Cost (2012) (€ x 1,000) (Note 1)
R1a	6	90	100	95	5	5,001	10,000	7,501	30	7,125	10,000
R1b	6	90	100	95	5	5,001	10,000	7,501	30	0	0
R2	6	90	100	95	6	10,001	20,000	15,001	36	14,250	20,000
R3	5	75	90	82.5	6	10,001	20,000	15,001	30	0	0
R4	5	75	90	82.5	5	5,001	10,000	7,501	25	6,188	9,000
R5	6	90	100	95	3	251	1,000	626	18	594	1,000
R6	6	0	0	95	4	1,001	5,000	3,001	24	0	0
R7	3	25	50	37.5	5	5,001	10,000	7,501	15	2,813	5,000
R8	3	25	50	37.5	5	5,001	10,000	7,501	15	2,813	5,000
R9	2	5	25	15	2	101	250	176	4	26	63
R10	5	75	90	82.5	5	5,001	10,000	7,501	25	6,188	9,000
R11	5	75	90	82.5	5	5,001	10,000	7,501	25	6,188	9,000
R12	2	5	25	15	2	101	250	176	4	26	63
R13	5	75	90	82.5	3	251	1,000	626	15	516	900
R14	5	0	0	82.5	5	5,001	10,000	7,501	25	0	0
R15	2	0	0	15	2	101	250	176	4	0	0
R16	2	0	0	15	1	1	100	51	2	0	0
R17	2	5	25	15	3	251	1,000	626	6	94	250
R18	2	0	0	15	2	101	250	176	4	0	0
R19	2	0	0	15	2	101	250	176	4	0	0
R20	2	0	0	15	2	101	250	176	4	0	0
R21	5	0	0	82.5	5	5,001	10,000	7,501	10	0	0
R22	5	0	0	82.5	5	5,001	10,000	7,501	25	0	0
R23	2	5	25	15	2	101	250	176	4	26	63
R24	2	0	0	15	2	101	250	176	4	0	0
Total (in millions)										**€46,874**	**€69,400**

Notes
1. Costs have not been shown for potential remedial works to address Risk Register Nos. R1b and R3 to avoid double counting of costs.
2. Shaded rows are operational risks that will not occur during the aftercare period.

Table B4: - Maximum Likely Cost of Unknown Liabilities during Operations

Risk Register No.	Occurrence Rating	Maximum Likelihood (%)	Severity Rating	Maximum Cost in Range	Risk Score	Maximum Likely Cost (€) (See Note)
R1a	6	100	5	10,000	30	10,000,000
R1b	6	100	5	10,000	30	0
R2	6	100	6	20,000	36	20,000,000
R3	5	90	6	20,000	30	0
R4	5	90	5	10,000	25	9,000,000
R5	6	100	3	1,000	18	1,000,000
R6	**6**	**100**	**4**	**5,000**	**24**	**5,000,000**
R7	3	50	5	10,000	15	5,000,000
R8	3	50	5	10,000	15	5,000,000
R9	2	25	2	250	4	62,500
R10	5	90	5	10,000	25	9,000,000
R11	5	90	5	10,000	25	9,000,000
R12	2	25	2	250	4	62,500
R13	5	90	3	1,000	15	900,000
R14	**5**	**90**	**5**	**10,000**	**25**	**9,000,000**
R15	**2**	**25**	**2**	**250**	**4**	**62,500**
R16	**2**	**25**	**1**	**100**	**2**	**25,000**
R17	2	25	3	1,000	6	250,000
R18	**2**	**25**	**2**	**250**	**4**	**62,500**
R19	**2**	**25**	**2**	**250**	**4**	**62,500**
R20	**2**	**25**	**2**	**250**	**4**	**62,500**
R21	**5**	**90**	**5**	**10,000**	**10**	**9,000,000**
R22	**5**	**90**	**5**	**10,000**	**25**	**9,000,000**
R23	2	25	2	250	4	62,500
R24	**2**	**25**	**2**	**250**	**4**	**62,500**
Total						**€101,675,000**

Notes

1. Maximum likely costs in terms of 2012 euros are based on the maximum cost of remediation/mitigation indicated in A2.2 multiplied by the maximum likelihood (%) indicated in Table A2.1. In some cases where specific works would likely address one or more hazards, the maximum cost was indicated only once to eliminate double counting.

2. The highlighted risks would exist during operations only. During the aftercare period the total maximum likely cost of unknown liabilities would be approximately €69million according to the costs indicated in Table B3.2 and above.