Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Office of Climate, Licensing and Resource Use

Inspector's Report on a Licence Application

TO:	DIRECTORS
FROM:	Brian Meaney - Environmental Licensing Programme
DATE:	12 June 2014
RE:	Recommendation to refuse an application for an Industrial Emissions licence from **Murphy Environmental Hollywood Limited** in relation to an integrated waste management facility, including landfill, at Hollywood Great, Nag's Head, Naul, Co. Dublin, **Licence Register W0129-03.**

1 Recommendation to refuse the grant of a licence

At the outset of this report, it is appropriate to state that refusal of this licence application is recommended. In coming to the conclusion that this is the appropriate recommendation to make, the opinion of two external experts has been drawn upon, as follows:

- Geosyntec Consultants provided an expert report on the geological and hydrogeological aspects of the proposed installation. The report is attached as Appendix 1; and
- Deloitte provided an expert report on the financial aspects of the fit and proper persons assessment. The report is attached as Appendix 2.

These expert reports will not be described in detail in this report and should be themselves read for a full understanding of the experts' opinions and recommendations.

2 Application details

Type of facility:	Integrated waste management facility including landfill for inert waste, non-hazardous waste and hazardous waste
Categories of activity under the First Schedule of the EPA Act 1992, as amended:	11.1, 11.2(b), 11.4(a)(iv), 11.5, 11.6

Categories of activity under Annex I of the Industrial Emissions Directive (2010/75/EU) - IED:	5.1, 5.3(a)(iv), 5.4, 5.5
Classes of activity under Annexes I and II of the Waste Framework Directive 2008/98/EC:	Annex I Disposal Operations: D1, D5, D9, D15 Annex II Recovery Operations: R4, R5, R13
Quantity of waste proposed for authorisation:	500,000 tonnes per annum (as currently permitted under existing waste licence for inert landfill).
Classes of Waste:	Inert waste, non-hazardous waste, hazardous waste
Licence application received:	17 December 2010
Third Party submissions:	85
EIS Required:	Yes
Article 14 notices: Waste Management (Licensing) Regulations 2004	Sent: 26 July 2011 23 March 2012 Response: 9 August 2011 30 May 2012 22 August 2012
Article 16 notices: Waste Management (Licensing) Regulations 2004	Sent: 23 March 2012 3 May 2012 (clarification) 11 July 2012 18 July 2013 Response: 23 April 2012 1 May 2012 8 June 2012 22 August 2012 18 February 2013 17 May 2013 22 May 2013 14 August 2013 18 October 2013
Notice under section 76A(3) of the Waste Management Act 1996, as amended: (To transition the application to IED, i.e. from the Waste Management Act to the EPA Act)	Sent: 18 February 2014 Response: 18 March 2014
Date of compliance with Regulation 9 of the European Communities (Industrial Emissions)(Licensing) Regulations 2013:	18 March 2014
Site Inspections:	16 February 2011 6 December 2011
Meetings with applicant:	16 May 2012 5 July 2012

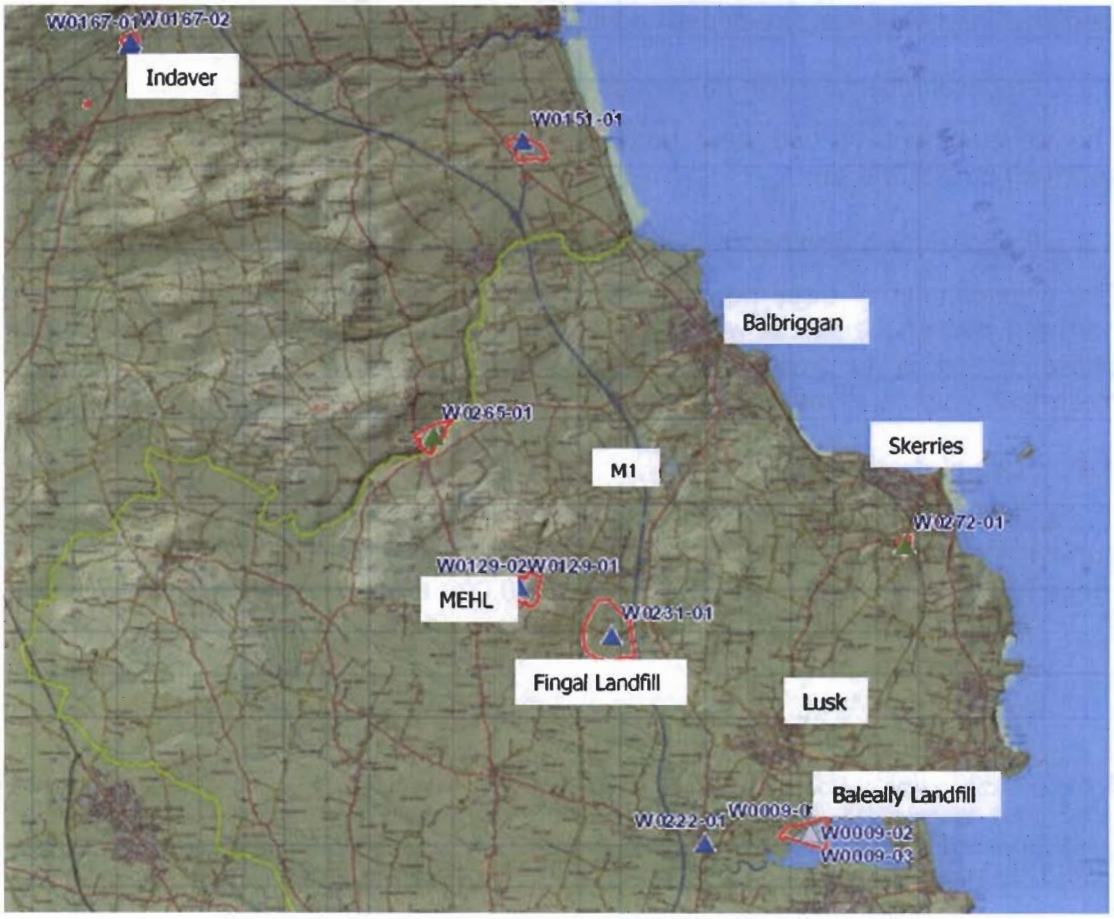
3 Facility

This Industrial Emissions licence application is for development of a new integrated waste management facility. The existing activities at the facility are authorised as an inert landfill under waste licence register number W0129-02. Murphy Environmental Hollywood Ltd (MEHL) has operated an inert landfill at this location since 2002. The landfill is located in a former quarry from which limestone and shale was extracted. The landfill is located 2.5km west of the M1 motorway and 32km north of Dublin city centre.

A quarry operated at the site between the late 1940s and 2007. The first waste licence for an inert landfill was granted to Murphy Concrete Manufacturing Ltd in 2002. The licence was reviewed in May 2008 (W0129-02) and transferred to MEHL in October 2008. MEHL's ownership at the site extends to 54.4 hectares. The area proposed for the Industrial Emissions licence is 39.8 hectares. The proposed new development is to employ up to 15 people full-time (plus 50 temporary construction jobs). Construction of the facility as proposed will cost an estimated €20m.

Application for planning permission as strategic infrastructure development was made to An Bord Pleanála on 10 December 2010 (ref. 06F.PA0018). Planning permission was granted on 16 June 2011 following an oral hearing, subject to 22 conditions.

The map below illustrates the location of the facility and its surroundings. The proposed Fingal landfill (W0231-01), some 1.5km away, will not now be developed. The Indaver incinerator (W0167-02) at Duleek, a potential source of incinerator ash for disposal at the landfill, is approximately 26km by road (via M1) from the MEHL site.



4 Reason for licence application and description of activities

MEHL applied for an Industrial Emissions licence[1] to:

- redevelop (and retain) the existing inert landfill;
- develop a new non-hazardous waste landfill;
- develop a new hazardous waste landfill;
- develop a new hazardous waste treatment (immobilisation) facility to pre-treat certain wastes for the hazardous waste landfill; and
- install leachate, surface water and other landfill management infrastructure.

The proposed development will also involve the construction of a new administration building and ancillary infrastructure, a new facility entrance and access road and landscaped wetland and biodiversity areas.

One of the objectives of the development is to provide a strategic long-term all-island solution for the management of hazardous waste.

The development, filling and restoration of landfill cells is projected to take place on a phased basis over the projected 25-year operational lifetime of the facility. The planning permission provides for landfilling operations up to end-2036.

4.1 Redevelopment of existing inert waste landfill

Seven inert landfill cells have been developed since December 2002. The applicant proposes that the existing inert cells on the western part of the site will be re-engineered and re-oriented to create space for new developments and in particular the hazardous waste cells. This will involve excavating some of the previously landfilled inert waste and re-depositing it in new inert landfill cells.

4.2 Proposal for a new non-hazardous waste landfill

The development of two new non-hazardous landfill cells is proposed for the southern part of the site.

4.3 Proposal for a new hazardous waste landfill and associated treatment plant

The development of three new hazardous landfill cells is proposed for the central-northern part of the site. A waste stabilisation plant is proposed to be developed in phase 1 and is to treat any hazardous wastes, including incinerator flue-gas treatment residues (flyash), that require treatment prior to deposit in the landfill.

4.4 Scale of development

The existing licence allows the deposition of up to 500,000 tonnes of inert waste per annum and this maximum is sought in a new licence. MEHL state that the actual range likely to be accepted is 200,000 to 300,000 tonnes per annum. Despite the

[1] The application was originally made for a waste licence to be granted under the Waste Management Act 1996 as amended. On 30 September 2013, in accordance with section 76A of the Waste Management Act which was inserted by the European Communities (Industrial Emissions) Regulations 2013, the application became an application for an Industrial Emissions licence.

anticipated intake, MEHL wish to retain the greater allowance to provide capacity in case of unusual events such as unexpected peaks in contaminated soil generation or accidents or natural disasters that require the type of facility proposed by MEHL. An estimated 6.8 million tonnes of waste would be expected over the lifetime of the facility.

4.5 Environmental impacts

Leachate is the greatest potential long-term threat to the environment posed by this development. Three different landfill lining systems are proposed for containment of leachate – one type each for the inert, non-hazardous and hazardous waste landfills.

Mitigation measures would be required in a licence for storm water, dust, odour, litter and noise emissions to ensure no environmental pollution or nuisance is caused. There are no major emission points to air proposed.

No biodegradable waste is proposed to be landfilled and no landfill gas infrastructure is proposed.

5 Landfill liners and site operations

Each of three landfill types proposed for the facility will be lined in a different way.

5.1 Inert landfill liner

The existing inert cells are lined in conformance with the existing licence. No change to this lining standard is proposed for existing and new inert cells.

5.2 Non-hazardous landfill liner

A proposed composite clay and geomembrane liner is to be constructed on the base and sidewalls of the non-hazardous cells as follows:

- a geotextile filtration layer
- a leachate collection layer (500mm thick stone layer with a hydraulic conductivity $>1x10^{-3}$m/s with a herringbone system of leachate collection pipework)
- non-woven polypropylene geotextile (protection layer)
- welded HDPE geomembrane (2mm) liner
- a compacted mineral layer equivalent to a 1m thick layer with a hydraulic conductivity less than or equial to $1x10^{-9}$m/s
- an additional bentonite-enhanced soil (BES) mineral liner, 1m thick with a hydraulic conductivity less than or equal to $6.6x10^{-10}$m/s

  (this is an additional mitigation measure recommended in the EIS due to the placing of the non-hazardous cells in the south of the site where the Loughshinny aquifer is vulnerable)
- a prepared formation layer to accommodate the construction.

5.3 Hazardous landfill liner

A dense asphaltic concrete (DAC) containment system is proposed as a liner for the hazardous cells. DAC has been used in landfills in the UK and other countries in

Europe and has also been used in rail, road, tunnel, dam and reservoir construction. The following construction of the DAC liner is proposed (illustrated in Figure 1):

- a geo-textile filtration layer
- 500mm thick leachate collection layer (stone with a hydraulic conductivity greater than $1x10^{-3}$m/s with a herringbone system of leachate collection pipework)
- a thin layer of mastic sealant
- 80mm thick dense asphaltic concrete with a hydraulic conductivity no less than $1x10^{-12}$m/s
- 60mm thick asphaltic binder layer (relatively low permeability)
- 200mm thick granular stabilising sub-base (relatively low permeability) (also acting as leak detection layer)
- 500mm thick compacted mineral layer with a hydraulic conductivity less than or equal to $1x10^{-9}$m/s (under the cell base and extended 3m up the sidewalls)
- a prepared formation layer to accommodate the construction.

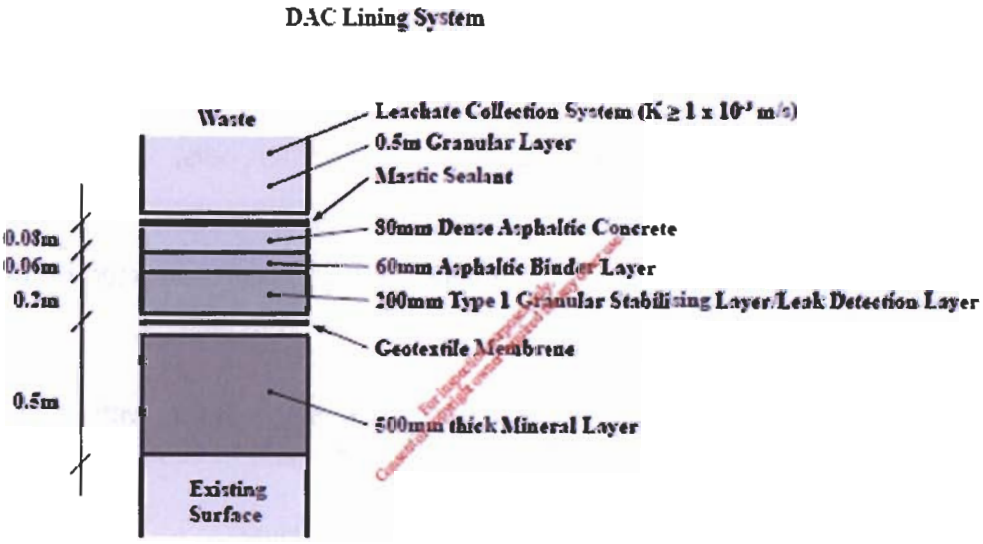


Figure 1 DAC lining system (source, EIS)

The 500mm compacted mineral layer (lowest part of the lining system) would not normally be proposed as part of a DAC installation but is to be included in this instance due to the requirements of the Landfill Directive, as discussed in more detail in the following paragraphs. The 200mm thick granular stabilising sub-base would not normally be used as a leak detection layer but is proposed in this instance as an additional safeguard and an early-warning system in the event of the DAC liner leaking. The applicant has stated that on-site testing at other sites shows that dense asphaltic concrete installations have achieved a hydraulic conductivity of $1x10^{-15}$m/s – i.e. complete containment.

5.4 Commentary on the hazardous cell liner and BAT

BAT for landfills is defined by the Landfill Directive. The Directive requires, for hazardous landfills, "a mineral layer which satisfies permeability and thickness requirements with a combined effect in terms of protection of soil, groundwater and surface water at least equivalent to the one resulting from the following requirements:

- permeability (K) $\leq 1.0 \times 10^{-9}$m/s; thickness $\geq$ 5m."

The Directive goes on to say that "where the geological barrier does not naturally meet the above conditions it can be completed artificially and reinforced by other means giving equivalent protection. An artificially established geological barrier should be no less than 0.5 metres thick."

The applicant has proposed that an entirely artificial barrier is installed at the landfill, as described above, there being no naturally occurring mineral layer[1]. Geosyntec in their report to the Agency (see Appendix 1) suggest that the text of the Directive does not state that the geological barrier can be completely absent. They emphasise that the alternative offered by the Directive relates to a situation where the geological barrier can be *completed* artificially and *reinforced* by other means, not *completely replaced* by an artificial construction.

The Agency should be sympathetic to this position in this instance if for no other reason than the artificially completed geological barrier proposed is itself under risk from groundwater rebound (as described in more detail in sections 6.1 and 11 and Appendix 1) and could in time find itself saturated and below the water table. If this occurs, then the geological barrier no longer fulfils its design function of providing a barrier to protect groundwater and attenuate contaminants. This being the case, the proposed manner of artificially completing the geological barrier, and the liner system as a whole unit, cannot satisfy BAT (i.e. the Landfill Directive).

5.5 Waste acceptance

5.5.1 Inert waste for disposal to landfill

It is proposed that the existing waste acceptance criteria are maintained with minimal amendment in a new licence. These criteria have been agreed by the Agency.

5.5.2 Non-hazardous waste for disposal to landfill

A non-exhaustive list of non-hazardous wastes proposed for acceptance is provided in the application and includes:

- bottom ash, boiler ash and other ash/dust from power stations, combustion plants and energy-from-waste facilities;
- soils (low-level contamination) from construction/development sites;
- dredge spoil and drilling muds;
- plaster waste from ferrous casting;

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[1] Albeit that the applicant has inferred that the Namurian shale beneath the location of the hazardous cells will act like a naturally occurring mineral layer. However, this inference cannot be accepted by the Agency. See section 6 below for discussion of this matter.

- sludges from water and wastewater treatment plants;
- light fraction and dust from shredding of end-of-life vehicles and white goods;
- fines from inert waste processing; and
- other compatible waste streams subject to waste acceptance criteria.

5.5.3 Hazardous waste for disposal to landfill

Up to 122,600 tonnes of hazardous waste per annum are anticipated by the applicant. A non-exhaustive list of hazardous wastes proposed for acceptance includes:

- spent activated carbon from energy-from-waste facilities;
- bottom ash (if deemed hazardous) from energy-from-waste facilities;
- fly ash, boiler ash and other ash/dust from power stations, combustion plants and energy-from-waste facilities;
- dredge spoil and drilling muds;
- contaminated soils from construction/development sites;
- filter cakes, sludges and residual waste from industrial-type processes and treatment processes;
- light fraction and dust from shredding of end-of-life vehicles and white goods; and
- other compatible waste streams subject to waste acceptance criteria.

The applicant does not propose accepting asbestos waste. The acceptance of waste at the landfill will be subject to waste acceptance criteria in accordance with Council Decision 2003/33/EC. The waste acceptance criteria will provide for assessment of the need to stabilise and solidify incoming hazardous waste streams before deposition in the hazardous cells.

5.6 Hazardous waste treatment (solidification) facility

The solidification of flue-gas treatment residues is to take place in a dedicated building. An adjacent building is to be used to store the solidified waste while it cures over a period of several weeks.

The solidification process is as follows: Incoming ash (and other hazardous waste) will be pumped from road tankers into stainless steel storage silos. From there it will be pumped to the mixing unit where cement (and/or other binders), hydrochloric acid (to control pH) and water (in the form of leachate from the landfill) are added at a controlled rate. Other binders such as ash (such as incinerator bottom ash) can act as a binding agent depending on their pozzolanic (cementitious) properties. The mixing ratios and the use of alternatives to cement are adjusted to meet waste acceptance criteria at the landfill cell. The mixed material is formed into metre-cubed blocks and moved to the curing building.

The proposed capacity of the solidification plant is 50,000 tonnes per annum. A mechanical air extraction system is to be employed with filters preventing dust emissions.

5.7 Leachate management

The existing licence requires no active management of leachate at the inert landfill. The inspector's report for the existing licence states that leachate can be pumped out and recirculated over the landfill cells or disposed of. At the time of that licence application (2007), it was proposed that any excess build-up of leachate would be treated on-site or removed for treatment elsewhere.

Leachate from the proposed non-hazardous and hazardous cells is to be collected, each in separate holding tanks, and used as process water in the hazardous waste solidification process. Leachate from the hazardous cells will be used preferentially (to use it up first) and it is anticipated that the solidification process will use all such leachate. Excess leachate from the hazardous and non-hazardous cells (not used in the treatment process) is to be transported off-site for disposal at a waste water treatment plant.

5.8 Commentary on the nature of the proposed non-hazardous and hazardous wastes and their degradation products including gas and leachate

The wastes proposed for acceptance and disposal can, for the purposes of this discussion, be split into two principal categories (from the listings above):

- those that will degrade over time; and
- those that will not.

The former category, despite the applicant's intention not to accept biodegradable waste, are likely to contain at least minor organic constituents (e.g. sludges, dredge spoils). The acceptance of waste with organic constituents, however small the content, could result in gas generation in the body of the landfill as the waste degrades biologically. No gas infrastructure is proposed at the landfill.

The latter are principally inorganic in their constituents. Sealed in a landfill cell, they will have little potential to degrade chemically and will remain hazardous for the lifetime of the landfill and a considerable period thereafter.[1] The inorganic constituents of some wastes will, at least theoretically, continue to leach indefinitely. They will not, as might be expected in a landfill for municipal (organic) waste, present a "declining source" of leachate as the waste degrades and stabilises over several decades. In municipal landfills, in time the waste will, to all intents and purposes, be unable to pose a significant ongoing risk of water pollution. In the MEHL proposal, the waste is more likely to present a "constant source" of contaminants to be leached out over a considerably longer period of time, in all likelihood extending far beyond the proposed 30 year aftercare and monitoring period proposed by the applicant to be covered by the financial provision model (see section 7). This leaves doubt as to the fate of the landfill after this 30 year period. There will remain no funds put aside by the applicant and no commitment to continue to manage and maintain the landfill and, in particular, any ongoing leachate generation within the cells.

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[1] Note that whilst incinerator fly ash will be solidified, other wastes will only be treated if waste acceptance criteria so dictate. Therefore some wastes will not benefit from any stabilisation/immobilisation offered by encasement in concrete.

Over the long term, post-aftercare and without ongoing management, there is increased potential for cap and/or liner failure (or a change in groundwater levels) that could result in hazardous substances being released into groundwater, thereby causing a failure of the objective to prevent the input of hazardous substances into groundwater. The absence of natural protection provided by subsoil could result in the direct discharge of substances into groundwater. Direct discharges are prohibited under the Groundwater Regulations and should be avoided where alternative options exist.

6 Groundwater

The Geosyntec report (see Appendix 1) provides a detailed commentary on the geological and hydrogeological setting at the facility.

6.1 Groundwater vulnerability

The applicant infers that the Namurian shale that is below the proposed area of the hazardous landfill is similar to a clay deposit or a non-aquifer and therefore it should not be afforded the same level of protection as other aquifers. However, the Namurian, like all bedrock aquifers in Ireland, has the potential to yield water for drinking water supplies and contribute to the flow in rivers and therefore has been classified as a groundwater body for the Water Framework Directive. Therefore, fundamentally, it does not meet the definition of an aquitard in the Irish context.

Where the hazardous cells are to be located over the Namurian, an additional 0.5 metre mineral layer is proposed below the main liner structure with a minimum permeability of $1x10^{-9}$m/s as additional protection to groundwater. The applicant proposed that the tens of metres of Namurian shale (acting as an aquitard) would provide protection to groundwater in the underlying Loughshinny aquifer. However, in addition to it not being an aquitard (see preceding paragraph), the Namurian is heavily faulted, is not confined and has moderate to good hydraulic conductivity with the Loughshinny. The proposed non-hazardous and hazardous landfill cells are positioned directly above major fault zones that act to a degree as zones of preferential groundwater movement and not, as contended by the applicant, as barriers to flow.

It is acknowledged by the applicant that the groundwater in the Loughshinny is vulnerable to contamination. Over the Loughshinny, where the non-hazardous cells are to be located, an additional 1 metre depth of bentonite-enhanced soil is proposed with a minimum permeability of $6.6x10^{-10}$m/s.

Groundwater levels are currently no more than a number of metres below the proposed formation levels of the landfill and are predicted to rise if the Bog of the Ring groundwater abstraction diminishes or ceases. See section 11 and Appendix 1 for further elaboration on this matter.

In the context of groundwater vulnerability, the aquifers at the facility are classified as having extreme vulnerability.

6.2 The Groundwater Protection Response for Landfills

The Groundwater Protection Response Matrix for Landfills is provided in Appendix 3 of this report.

The applicant contends that the aquifer beneath the landfill is locally important and moderately productive only in local zones (Ll) and is moderately vulnerable, leading to a R2[1] score on the matrix.

Geosyntec's analysis that finds that the setting is not R2[1] but is actually R3[2] because the aquifer is classified by the GSI as a locally important aquifer, generally moderately productive (Lm) with an extreme vulnerability rating and not an Ll aquifer. An R3[2] score on the matrix says that a landfill is:

> Not generally acceptable, unless it can be shown that:
>
> - there is a minimum consistent thickness of 3 metres of low permeability subsoil present;
> - there will be no significant impact on the groundwater; and
> - it is not practicable to find a site in a lower risk area.

This application fails on all three counts. First, there is no subsoil present despite the applicant's inference regarding the Namurian shale providing the equivalent function. Although an artificially completed barrier (as proposed instead) might be an adequate substitute in another setting, it is not adequate as equivalent protection for groundwater in this setting. Second, it has not been demonstrated that the landfill can have no significant impact on the groundwater. Third, it is inconceivable that there is no alternative suitable site in a lower risk area of the State.

It is noted that the applicant contends that the Groundwater Protection Responses have been superseded by the Landfill Directive.

7 Financial Provision

In 2013, the applicant provided a report entitled *Preliminary ELRA, CRAMP and Financial Provision for Proposed Integrated Waste Management Facility (W0129-03), May 2013*, in which were identified total costs for CRAMP and ELRA. In May 2014, an updated document was provided. The new document provided more detail on financial provision and in particular on its phasing and funding over the lifetime of the development. The ELRA and CRAMP were, in the updated document, prepared in accordance with the new Agency *Guidance on Assessing and Costing Environmental Liabilities* (2014).

CRAMP

The following summarises the main points of the CRAMP[1]:

- The CRAMP is on the basis of full restoration of the landfill site, decommissioning of plant and equipment and aftercare monitoring at the facility.
- Closure, capping and restoration of individual cells will be completed as they are filled and completed over the 25-year lifetime of the landfill.
- Drawdown of restoration funds will take place as needed to effect part closure, capping and restoration as the development progresses.

[1] Closure, Restoration and Aftercare Management Plan

- The final end-use envisaged is amenity/nature usage.
- During aftercare, monitoring will continue *inter alia* of leachate wells, leak detection, drainage systems and groundwater and surface water media.
- A 5-year active aftercare management period is proposed, followed by a 5-year passive aftercare management period. Additional periods will be added as necessary depending on results of ongoing environmental performance.
- Criteria to evaluate the success of closure, restoration and aftercare are proposed.
- Closure costs are estimated at €5,487,396 and aftercare costs at €421,108, a total of €5,908,504. Aftercare costs provide for monitoring and reporting for a period of 30 years post-closure.
- Closure costs provide for decommissioning and removal of leachate tanks.

ELRA

The following summarises the main points of the ELRA[1]:

- The ELRA provides for environmental liabilities (costs) associated with incidents and unexpected events.
- The ELRA was costed on the basis of the plausible worst case scenario – in this case identified as the failure of hazardous cell liner, release of leachate and pollution of surface water/groundwater.
- Two options were examined under this scenario, both with an identified cost of €5,672,390.

Financial Provision

The total combined cost for CRAMP and ELRA is €11,580,894.

The applicant has proposed that financial provision would be put in place prior to commencement of activities to which a particular CRAMP or ELRA costing might relate, to be triggered for example by the seeking of SEW approval for individual cell construction. In order to ensure that there are adequate funds to pay for the CRAMP at the appropriate time (and principally in phase 4 when the greatest drawdown will be required to cover final decommissioning, closure etc), it is proposed to front-load the funding of the financial provision over phases 1 to 3 by means of a levy on each tonne of waste accepted at the facility.

For CRAMP costs, a combination of cash-based account and bond is proposed. Over time, the cash account will increase (from the levy on waste accepted) and the bond will be allowed to decrease in parallel. At all times their total combined value will match the agreed amount of financial provision required for each phase.

For ELRA, insurance is proposed for 95% of the identified cost with the balance funded initially by bond but from phase 2 by cash.

The Agency's Legal Services Team conducted a preliminary examination of the financial provision proposals and stated the following:

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[1] Environmental Liabilities Risk Assessment

- Insurance, in respect of the ELRA, is not normally accepted by the Agency as an adequate means of covering unexpected incident costs.
- A bond is proposed to cover the entire CRAMP costs. A cash deposit will gradually displace the value of the bond. The cash deposit is proposed to be funded by means of a levy on each tonne of waste accepted at the installation. This funding model is not normally accepted by the Agency. Instead, a schedule for deposit of fixed cash amounts is preferred.

8 Fit and proper person (financial) assessment

Deloitte were commissioned by the Agency to provide an opinion as to whether the applicant:

- has the ability to meet the calculated financial commitments or liabilities (with reference to CRAMP and ELRA costs); and
- can be deemed a fit and proper person for the purpose of section 83(5)(xi) of the EPA Act 1992 as amended, in particular with section 84(4) which deals with the financial aspects of the fit and proper person assessment.

Deloitte used publicly available information in its review, as well as information provided in the licence application.

The following are some of the principal points raised by Deloitte:

1. The applicant (MEHL) reported a loss of over €563,000 in 2011 and €1.2m in 2012. Their net asset position reduced significantly over the 3 years to 2012. The auditors in the 2012 accounts questioned the directors' valuation of the company's land assets.
2. The auditors in the 2012 accounts included an "emphasis of matter paragraph" referring to future material uncertainty and the necessity for the company to negotiate financial support.
3. MEHL's accounts for 2011 and 2012 state that the continuing trade of the company is on the basis that a licence will be granted by the Agency.
4. MEHL's debt was transferred to NAMA during 2011. No further update on this debt is available, nor the business plan submitted to NAMA. Therefore no commentary on the future of the company or its future financial position is possible.
5. The 2012 accounts state that NAMA hold a fixed and floating charge over the company's assets with a specific charge over the company's land. In case of crystallisation (upon appointment of a receiver or liquidator), the EPA would not be a preferential creditor and would rank below the priority given to NAMA and Revenue.
6. MEHL's bank borrowings are guaranteed by its parent company Murphy Concrete Manufacturing Ltd. The latter, according to its filed accounts for 2011 and 2012, does not appear to have sufficient assets to satisfy this guarantee should it be called upon.
7. The current financial position of MEHL is weak and is a poor starting point regarding the commitment to fund any shortfall in the levy on waste accepted proposed to fund the CRAMP.

8. No details are provided by the applicant on how the proposed bond (to fund the balance of the CRAMP while its fund builds up) will be paid for.
9. The 2013 accounts were filed with the Companies Registration Office on 9 May 2014 but have not been reviewed and registered by the CRO and remain inaccessible[1]. The 2011, 2012 and 2013 accounts were all filed late, which is a contravention of Irish company law. The auditors, in the 2011 and 2012 accounts stated that they did not obtain all the information and explanations that they considered necessary for the purpose of their audit.

In relation to item 5 above, this is taken as meaning that any outstanding contributions to financial provision would not likely to be forthcoming in such instance. In relation to item 7, in the context of financial provision instruments, it is noted that this might affect the Agency's preferred approach of a schedule for deposit of fixed cash amounts mentioned in section 7 above.

Section 84(4) of the EPA Act states that "a person shall be regarded as a fit and proper person if, 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 have been, or will be entered into or incurred by him in carrying on the activity to which the licence or revised licence relates or will relate, as the case may be, in accordance with the terms thereof or in consequence of ceasing to carry on that activity."

Deloitte expressed the opinion that "on the basis of our review we are unable to conclude that MEHL has evidenced its ability to meet the financial commitments or liabilities that can reasonably [be] considered will be entered into by carrying on the activity to which the licence application relates."

Deloitte also stated that they "are unable to conclude that the company [MEHL] can meet liabilities for ELRA and CRAMP."

9 Submissions

There were 85 submission made in relation to this application. They came from:

- Private individuals (49)
- Nevitt Lusk Action Group (17)
- Hollywood and District Conservation Group (12)
- Inland Fisheries Ireland (2)
- Health Services Executive (2)
- Greenstar (2)
- Fingal County Council (1)

There are a number of common themes addressed in the submissions. The vast majority expressed opposition to the proposed development and its authorisation by licence. A request for oral hearing is made in some submissions. However oral

[1] This is updated information provided to the Agency by Deloitte on 11 June 2014, which post-dates their final report to the Agency.

hearings can only be held after a Proposed Decision is issued, not before, so these requests cannot be accommodated.

The following are some of the main topics addressed in the submissions:

- site selection, location and scale;
- environmental pollution (surface water, groundwater, dust, vibration, noise, fumes);
- impact on local farms and contamination of food supplies;
- human health impacts (local community impacts principally through contamination of local wells, air quality impacts and heavy traffic on unsuitable roads, including impacts on the local primary school);
- landfill flaws (liner technology);
- leaching of waste into groundwater;
- groundwater and Bog of the Ring water abstraction scheme;
- fit and proper persons and financial provision;
- doubts over the financial viability of the project and the applicant;
- financial impact of future pyrite claims against the applicant and parent company;
- potential presence of pyrite at the facility and its potential impact on landfill construction;
- landfill fires and combustibility of waste;
- national waste policy, waste management plans and Strategic Environmental Assessment;
- devaluation of property;
- Agency interaction with An Bord Pleanála;
- Environmental Impact Assessment and the roles of An Bord Pleanála and the Agency; and
- Agency procedures.

The recommendation to refuse the licence application will negate the need for further discussion on many of the issues raised in the submissions because as technical issues they no longer arise. Certain questions on geology, hydrogeology and financial aspects are dealt with in this report and more so and in greater detail in the appendices.

Regarding Agency procedures, it was noted by the Nevitt Lusk Action Group that the applicant did not comply with due dates specified in article 14 and 16 notices[1] and expressed the opinion that late responses should be returned to the applicant and the application refused on the basis of there being insufficient information. It is also stated that meetings held between the applicant and the Agency[2] have created a

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[1] Issued under the Waste Management (Licensing) Regulations 2004.

[2] Two meetings as noted in section 2 above and one meeting held between the Director and the applicant.

perception of bias towards the applicant. The Agency responded by correspondence at the time (11 July 2012, published to EPA website) but the Hollywood and District Environmental Group remained of the opinion that the Agency was showing bias towards the applicant.

10 Cross Office Liaison

The following Agency staff contributed to the assessment of this licence application:

- Dr Matthew Craig, Office of Environmental Assessment, on geology and hydrogeology.
- Ms Isobel Walsh, Office of Environmental Enforcement, on the applicant's proposal for financial provision.

11 Recommendation

In preparing this report and the Recommended Decision I have consulted with Agency technical and sectoral advisors as set out above as well as external experts employed to advise on specific aspects of the application.

I have considered all the documentation submitted in relation to this application and commissioned by the Agency and recommend that the Agency refuse the licence application for the reasons set out below and in the attached RD.

Reason 1 The Groundwater Protection Responses for Landfills (GSI, 1999) state that the installation of a landfill in this geological setting is not generally acceptable.

The Groundwater Protection Response for Landfills indicates an R3[2] score for the proposed facility in this setting which says that a landfill is:

not generally acceptable, unless it can be shown that:

- there is a minimum consistent thickness of 3 metres of low permeability subsoil present;
- there will be no significant impact on the groundwater; and
- it is not practicable to find a site in a lower risk area.

This application fails on all three counts.

Reason 2 The groundwater beneath the landfill is vulnerable to contamination from leachate.

The waste proposed for disposal in the landfill presents a constant source of leachate generation. This is particularly an issue post-aftercare management of the landfill when leaks might begin to appear in the landfill cap and/or the liner and could go undetected for a considerable period of time. The groundwater vulnerability under the site is extreme and the applicant is relying entirely on an engineered solution for attenuation of contaminants and groundwater protection. The landfill liners and the artificially completed geological barriers provide an inadequate level of protection to underlying groundwater.

Reason 3 There is an unacceptable risk of discharge of hazardous substances to groundwater which is prohibited under the Groundwater Directive.

As described above, the leaching potential of waste deposited in the landfill will not significantly degrade over time and there remains the long-term risk of discharge of leachate from the landfill. This is unacceptable under article 6(1)(a) of the Groundwater Directive which, along with article 9 of the European Communities Environmental Objectives (Groundwater) Regulations, 2010, states that hazardous substances must be prevented from entering groundwater.

Reason 4 The influence of the Bog of the Ring (public water supply) on groundwater levels beneath the landfill brings a risk of groundwater "rebound" in the event that drinking water abstraction ceases.

Water levels at the landfill and the Bog of the Ring show evidence of hydraulic connection in the sense that, as the groundwater levels at the Bog of the Ring rise and fall depending on pumping (abstraction) rates, so do the groundwater levels at the MEHL site. Groundwater level patterns at the two sites (as they rise and fall) have tracked each other quite closely according to data from 2003 to date. As abstraction has decreased, groundwater levels at the MEHL site have increased. Therefore groundwater levels would be close to the base of the landfill (within a few metres) if constructed. In the event that the Bog of the Ring abstraction ceases, groundwater in the vicinity will return to pre-abstraction levels. A rebound will likely be seen at the MEHL site and there is a risk that recovered groundwater levels will rise to, or higher than, the engineered mineral layers comprising the lower parts of the landfill liners, or possibly higher than the main impermeable lining elements themselves. This will negate entirely the purpose of the geological barriers and mineral layers beneath the liners – the purpose being to provide protection to groundwater and attenuation of contaminants in the event of a leachate leak.

Reason 5 The absence of risk of contamination by leachate of the water supply at the Bog of the Ring has not been proven

It appears unlikely that contaminants, if present in groundwater beneath the landfill, would travel preferentially in the direction of the Bog of the Ring drinking water abstraction scheme. The matter remains unproven however.

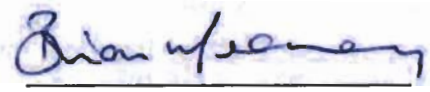
Reason 6 The dense asphaltic concrete (DAC) landfill liner, in this setting, is not BAT.

Whilst a dense asphaltic concrete liner could potentially be regarded as BAT in a different setting, in this setting it cannot provide the level of protection to groundwater that is envisaged in the Landfill Directive. According to the Directive, "the geological barrier is determined by geological and hydrogeological conditions below and in the vicinity of a landfill site providing sufficient attenuation capacity to prevent a potential risk to soil and groundwater." The 0.5m thick artificially completed geological barrier proposed for the hazardous cells is inadequate to provide sufficient attenuation capacity in the event of an undetected DAC liner leak (particularly in the post-aftercare phase), and might, should groundwater rebound occur, become saturated itself.

Reason 7 The applicant is not a fit and proper person as defined in section 84(4) of the EPA Act 1992 as amended and cannot therefore satisfy the Agency in relation to section 83(5)(xi) of the Act.

The applicant has not demonstrated an ability to meet the financial commitments or liabilities (e.g. the calculated costs for CRAMP and ELRA) that will be entered into or incurred in carrying on the activity to which the application relates.

Signed



Brian Meaney

Procedural Note

In the event that no objections are received to the Proposed Decision on the application, the licence application will be refused in accordance with Section 83(1) of the Environmental Protection Agency Acts 1992, as amended.

Appendix 1

Geosyntec report on geological and hydrogeological aspects of the application, June 2014

Geosyntec consultants

engineers | scientists | innovators

Review Report on an IED Waste Licence Application by MEHL with focus on geological and hydrogeological aspects

Prepared for

Environmental Protection Agency (EPA), Ireland

Prepared by

Geosyntec Consultants Ltd.
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Project Number GCU0146033

June 2014

Geosyntec
consultants

Project Title:	2014 Review of an IED Waste Licence Application by MEHL (Draft) with focus on geological and hydrogeological aspects
Project No:	GCU0146033
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	Name	Signature	Date	Position
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Unless otherwise stated in this report, the assessments made assume that the site and facilities will continue to be used for their current purpose without significant change. The conclusions and recommendations contained in this report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested. Information obtained from third parties has not been independently verified by Geosyntec, unless otherwise stated in the report.

Where assessments of works or costs required to reduce or mitigate any environmental liability identified in this report are made, such assessments are based upon the information available at the time and may be subject to further investigations or information which may become available. It is therefore possible that cost estimates, where provided, may vary outside stated ranges. Where assessments of works or costs necessary to achieve compliance have been made these are based upon measures which, in Geosyntec's experience could normally be negotiated with the relevant authorities under present legislation and enforcement practice, assuming a pro-active and reasonable approach by site management.

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1 GENERAL INTRODUCTION

1.1 Introduction

The subject MEHL site is currently authorised to operate an inert landfill under license (WO129-02). MEHL has applied for a review of their existing license, and this application has been assigned register number WO129-003, and is currently before the EPA (and is the subject of this proposed review). The application for a license review is to seek authorisation to operate an integrated landfill facility to include the following elements (1) redevelop and retain the existing inert landfill, (2) develop new non-hazardous and hazardous waste landfills, (3) develop a hazardous waste pre-treatment (immobilisation) facility to pre-treat waste for the hazardous waste landfill, and (4) install leachate, surface water and other landfill management infrastructure.

In addition, the development will include the construction of a new administration building, car park, access road and ancillary infrastructure. The development is to include landscaping, wetlands and a biodiversity area. The operational life of the integrated landfill is expected to be 25 years, including restoration. The landfill is located in a former quarry from which limestone and shale was extracted. It is located 32km north of Dublin city centre.

On 23 April 2013, the Industrial Emissions Directive (2010/75/EU) was transposed into Irish law by way of a number of statutory instruments. An amendment to the Waste Management Act 1996, as amended, in the form of a new section 76A of the Act, provided for transitional arrangements for waste license applications for activities that are deemed to be industrial emissions (IE) activities (as set out in the newly amended First Schedule to the EPA Act 1992, as amended in 2013). The activities that are the subject of the license review application on hand are IE activities and, from 30 September 2013, the application has been dealt with under the EPA Act 1992, as amended and related IE licensing regulations. The application is no longer being dealt with under the licensing provisions of the Waste Management Act and associated Waste Management (Licensing) Regulations 2004.

1.2 Project background

Geosyntec previously reviewed geological and hydrogeological data for the inert landfill site, on behalf of the EPA, in late 2009. It then undertook a more comprehensive review of geological and hydrogeological information presented in support of the original application for an integrated landfill facility in 2011 and 2012. The site has been found to be quite geologically and hydrogeologically complex. Following detailed review in 2011/12, which included a meeting with the Licensee and its consultants, that was led by Geosyntec, the Agency issued two formal Article 16 notices in 2012 requesting additional information in support of the application. The main issues identified in our previous hydrogeological review at the time can be summarised as follows:

1. **Potential Vulnerability of the site**. The proposed landfill development will be within the base of the quarry where there is exposed bedrock. There was concern about the use of bedrock classification, vulnerability and response matrix for landfills. Bedrock appeared

more vulnerable than implied by Licensee resulting in what appeared to be insufficiently conservative response matrix allocations for Namurian and Loughshinny ($R2_1$ versus $R2_2$; and $R2_2$ versus $R3_2$);

2. **Influence of the Major Fault line that passes through the site.** There was a lack of full consideration of the potential influence major fault feature(s) that pass through the site (one is visible in the wall of the quarry) may be expected to have had on local fracturing and interconnectivity between Namurian and Loughshinny. Proximity to a fault zone is typically proportional to degree of bedrock fracturing. As such site bedrock is likely to be particularly fractured. The question remains is the fault a barrier to or a conduit for groundwater flow, potentially to the north. If acting as a pathway, then a more direct route to the Bog of the Ring public water supply well field to north would be inferred. The major fault appears to be directed N-S beneath the proposed hazardous and non-hazardous waste cells.

3. **Site Piezometry and temporal variation in the water table.** Insufficient detailed assessment of groundwater levels (past and present), head gradients and flows. Firstly, it was represented that there was an upward head gradient between the Loughshinny and the overlying Namurian, which did not appear to be supported by site data. Secondly, related to item 2, the representation of the groundwater divide may be too simplistic given the potential influence of faulting, combined with abstraction (Bog of the Ring supply). It is possible that the fault acts as a preferential pathway allowing discrete flow to the north from the site resulting in an anomaly in the groundwater divide. Falling yields could mean more wells have to be installed and used in the future, including ones nearer the subject site, creating further potential risk of future landfill related impacts on this groundwater supply. Thirdly, and counter to the previous scenario, it is also important to understand whether the Bog of the Ring abstraction has caused the water table to fall beneath the subject site already, as a second potential scenario is that future declining abstraction (declining yields or needs) could cause groundwater rebound beneath the MEHL site and a need for greater groundwater management at the landfill site in the future (possibly in perpetuity);

4. **Adequacy of Modelling.** There was considered to be a potential need for more sophisticated modelling of groundwater flow regime to predict future potential impacts on groundwater from the proposed landfill cells

Finally, it has previously been reported that Inland Fisheries Ireland has highlighted their concerns about the sensitivity of the local water courses bordering the site and the Corduff (Ballough) River, which represents a highly significant salmonid catchment, supporting a small but biologically significant population of North Atlantic salmon and sea trout, as well as resident brown trout.

1.3 Objectives of the 2014 Review

The Agency required an expert consultant to advise on the geological and hydrogeological aspects of the application, and to specifically advise the EPA in relation to the content and adequacy of the applicant's submissions and provide a professional opinion as to whether the information provided by the applicant can be deemed to satisfy the Agency in relation to the technical requirements of relevant legislation that governs the license application assessment process.

The main activities undertaken to meet the overall objectives are described below.

1.4 Scope of Works

The scope of work that the Agency required to be completed to fulfil project objectives can be summarised as follows:

1. Review and assess documents related to the additional geological and hydrogeological investigations and assessments carried out by the applicant.
2. Review and assess relevant[1] parts of documents related to the design, construction and operational stages of the proposed landfill cells.
3. Identify and advise the Agency on any relevant issues arising of an environmental, engineering, operational or safety nature arising from the application that should be of concern to the Agency in the context of granting a licence and, in particular, in the context of section 83(5) of the EPA Act 1992, as amended.
4. Where possible, advise on whether particular concerns can adequately be addressed by conditions in a licence.

The main work has involved our detailed review and assessment of new documents provided in the Licensee response to the Article 16 requests by the Agency, re. geological and hydrogeological investigations and assessments carried out by the applicant. Documents were available on the EPA website. They included the licence application documentation, further information provided by the applicant, and submissions from third parties where they relate to geological and hydrogeological aspects of the proposal. This was considered in the context of previous findings of our review of information that was supplied in 2009, 2011 and 2012, and the specific concerns and comments previously raised and made.

Previous information included the original application documentation, the accompanying EIS and the An Bord Pleanála Inspectors report. It is noted that the previous Fingal County Council (FCC) landfill application, which was subject to 2 oral hearings (one with the EPA), was flagged in the past by MEHL as being seen as key to the Agency's consideration of their own application for a licence. This FCC site, which was granted a licence but not progressed, is located only about 1.5km to the east-southeast of the MEHL site. However, it is at a significantly lower topographic height and associated with quite different geology, so is not

[1] Relevant is taken to mean those parts relating to geology and hydrogeological aspects and interest.

considered particularly relevant to the subject site review (each site has to be judged independently on its own merits).

The main new documents that were available for detailed review included:

- February 2013 Arup Report. Assessment of Hydrogeological Isolation (between the Bog of the Ring and the MEHL site), which was used to define the extent of subsequent investigations at the subject site. This included some detail on groundwater piezometry over time linked to the Bog of the Ring abstraction array, more information on regional and site geology, hydrogeology and hydrology, including the potential for increasing or decreasing abstraction at the Bog of the Ring;
- May 2013 Further Site Investigation Plan (Arup). Key consideration is how this compared to the scope we envisaged necessary to fill all important data gaps identified previously and summarised above;
- October 2013 Arup Report – Response to EPA Article 16 (Groundwater). This includes answers to specific questions in the Article 16 notifications, presentation of the results of the additional investigations, an updated CSM and QRA. It included a number of additional appendices, as follows:
    - QRA Appendices
    - Waste Stream specific data
    - Historic borehole logs
    - New Monitoring wells
    - Groundwater monitoring data
    - Down hole geophysics
    - Palaeontology
    - Pumping test
- October 2013 Patel Tonra Ltd revised Non-Technical Summary Report (64 pages)

As requested in the terms of reference, in undertaking this review Geosyntec has also attempted to identify and advise on relevant issues that may arise of an environmental, engineering, operational or safety nature that should be of concern to the Agency in the context of granting a licence.

It is understood that the Agency will make a proposed decision (determination) on whether to grant a License in mid-2014. Therefore our work will not include consideration of what additional information should be requested, rather, if appropriate to do so, the Agency will address specific concerns via the inclusion of specific conditions in the licence, if granted.

Geosyntec has prepared this expert report to provide summary and conclusions of important, relevant matters coming out of our technical review. It is designed to draw clear conclusions on the usefulness (validity) of the geological and hydrogeological information provided in answer to

the Article 16 requests and whether or not, from a geological and hydrogeological standpoint, the site appears suitable or not for the proposed waste management facility. This final report concludes by providing a clear recommendation to the Agency (including outline license condition options, as considered necessary and appropriate).

1.5 Additional Works Undertaken by MEHL (post July 2012 meeting)

The main scope of work that MEHL (using Arup, plus other technical sub-consultants or contractors) conducted, designed to address the data gaps previously identified, can be summarised as follows:

- November 2012: Arup commissioned Robertson Geologging Ltd (specialist contractor) to perform a down-hole geophysical survey on a proposed subset of 8 of 18 site boreholes (some boreholes decommissioned) to improve understanding and interpretation of site geology and vertical sequence. Work completed in January 2013. Not all of these wells could be surveyed. It included gamma-ray density, natural gamma, induction and fluid temperature-conductivity. Results and a revised CSM were appended to a MEHL letter to the Agency of 15th May 2013;
- Assessment of the hydraulic isolation of the MEHL site in the wider context of the Bog of the Ring area (submitted in February 2013); document by Arup (reviewed by Eugene Daly);
- Additional site investigation programme, based on the above work. It was reported to be designed to fulfil the stated requirements of the Agency, based on Geosyntec previous review, and included confirming fault block specific geology, characterisation of Loughshinny Formation hydrogeology, establish whether the fracture/faulting system is acting as a barrier or conduit to flow, and establish vertical gradients (if any). New wells were to be geophysically logged also.
- The new investigation proposal included 8 new boreholes/wells BH24-BH30 plus a new pump test well. Some were part cored (apparently to target the Balrickard Formation and its interface with the underlying Donore Formation). It is noted that in the end existing BH17 was used for the new pump test, rather than installing a new purpose designed (Loughshinny) well;

In an Agency letter to MEHL, dated 3rd May 2012, it was stated that the originally proposed scope of investigation was not ideal and some changes were recommended. The final scope was changed but did not provide all the information being sought (refer to Section 2.1). This has limited our ability to provide clear and unambiguous conclusions regarding the ultimate suitability of the subject site, and meant we have had to rely more heavily on our own professional judgement in this respect.

2 MAIN FINDINGS OF OUR REVIEW

2.1 General Introduction – Adequacy of Additional Site Investigation Programme

In a letter to the Agency, dated 16th March 2012, Geosyntec stated that there was insufficient supporting data for the Agency to accept the licence application as it stood. There were considered to be two ways MEHL could address this and these were a combination of better use of all existing information, plus the undertaking of additional site investigation and assessment. New site investigation work was expected to include:

1. Additional Namurian and Loughshinny bedrock well pairs (comprising one well screened in Namurian and a second close-by well screened in the Loughshinny Formations). Where one suitable well already existed the second could be installed close to it (within say 5m). Such well pairs were expected to be needed within each of four fault blocks created by the N-S fault and E-W fault that transect the site (refer to Figure 1 which shows schematically the fault blocks and proposed new well locations shared with MEHL and the actual locations where wells were installed). In the EPA clarification letter to MEHL dated 3 May 2012 it was stated that the initially proposed locations were not ideal and that well pairs should be located in each of the 4 apparent fault blocks, all within 100-200m of each other, as follows (note some of the new well references were changed by the Applicant):
    (i) New well to be located next to BH20 (NW fault block) where Loughshinny expected to be encountered at depth;
    (ii) New well pair to be located close to BH22/22A (NE fault block), to target the Namurian and Loughshinny, respectively;
    (iii) New well next to BH18 (SW Fault Block), both wells expected to be screened in Loughshinny in this location
    (iv) New well pair to be positioned close to BH23 (SE Fault Block) to target Namurian and Loughshinny, respectively.

2. Improved well data for the proposed non-hazardous waste cell and new inert cell. In some of the southern area (southwest quadrant specifically) there appeared to be insufficient well points. As only the Loughshinny is present only one additional well point was expected to be needed. Where it could not be demonstrated that suitable monitoring wells already existed then additional ones were expected to be needed. Geosyntec highlighted one important location (see Figure 1);

3. It was seen as key to have a new deep well to the north, specifically targeting the fault zone in this area of the site (BH24), which could be monitored in detail during the pump test;

4. New pump test well in the southwest fault zone, screened solely in the Loughshinny (close to original pump test well BH17 which was screened across both the Namurian and Loughshinny). The Applicant's first proposal was to use the BH25 well location (Figure 1) but in the Agency May 3rd letter our preferred location was affirmed (it was concluded by Geosyntec that possible use of a packer isolation system in BH17, designed to maximise

pumping of groundwater from the Loughshinny Formation, would not be a possible option due to the multiple screen design of this well).

As part of preparation for the additional investigation programme consideration needed to be given to the benefit of undertaking coring of certain boreholes and use of down hole geophysical logging to maximise understanding of lithology, fracture distribution and orientation, etc.). The Applicant agreed to partial core select boreholes (see copy of their April-13 Figure 1).

Following the additional investigation programme there was to be a new (7 day) pump test programme. This test was expected to allow better interpretation of the main aquifer zone properties and its hydraulic connectivity to the overlying Namurian. The Geosyntec proposed monitoring well configuration was expected to allow a much better assessment of groundwater flow across fault structure and vertically between the Namurian and Loughshinny, and consideration of potential flow long fault zones, during pump testing.

The actual site investigation and well installation programme completed by the Applicant in 2013 had some limitations (refer to Figure 1 also for actual locations), some of which are expected to have compromised overall understanding, data collection and conceptual site model (CSM) development. The main points we would make can be summarised as follows:

1. NW Fault Quadrant: Request to have installed a second well to generate a well pair in the northwest faulted bedrock quadrant not met. New BH26 has not been installed across the Loughshinny as requested, rather to 24mbgl in Namurian. BH20 is also at the base of the Namurian to 43mbgl. The EPA request was to have a second deeper well installed here (BH20 was to have been the shallower of the pair);
2. NE Fault Quadrant: Installed BH29 (drilled to 58m; screened @34-39m) and BH30 (Screened at base @58.7-61.7m). Arup reportedly may have only just tagged the uppermost Loughshinny Formation in this location. Potentially, it may be the case that the shaly limestone (confirmed via palynology in Arup Report 'Groundwater' Oct-13, Appendix G), which BH30 is screened across, is more representative of the transitional Donore Formation than the Loughshinny. As the Donore Formation is regarded as somewhat of an erosional boundary between the Loughshinny and overlying Namurian, groundwater levels reported for this well may not be truly representative of that within the Loughshinny aquifer. Based on this, there could be uncertainty over the reported ~0.95m upwards hydraulic gradient (from the Loughshinny to Namurian) noted between the well pair BH29 & BH30 in this location, as there certainly appears to be a general downwards hydraulic gradient of ~0.5-1.0m from Namurian to Loughshinny across the rest of the site;
3. SE Fault Quadrant: Request to have a well pair in the southeast faulted bedrock quadrant not met. Only one additional monitoring well BH28 screened within the Namurian Formation (screen 35-40mbgl) was installed, some 200m from the requested position. There is only one existing Loughshinny Formation monitoring (well BH15) in this quadrant, some 200m to the southwest of this new BH28;

4. SW Fault Quadrant: BH27 installed into Namurian with screen 9-14mbgl. BH25 was installed further south in this block in the Loughshinny;

5. North End of N-S Fault: Single well BH24 installed within Namurian Formation only, rather than a well pair within Namurian and Loughshinny towards the north end of the proposed hazardous waste cell adjacent to N-S fault. This prohibits comprehensive understanding of groundwater interconnectivity within this key region of site, specifically at depth in the Loughshinny. In addition this well was terminated at 48.2m and was only screened between 44.2-47.2m depth, due to coring difficulties. The reason given, that only one well was installed, was that progression of drilling was extremely slow due to the degree of vertical fracturing in proximity to the N-S trending fault. This locally extreme horizontal and vertical fracturing was noted on the borehole log below about 40m, in Namurian (possibly Walshestown) in which the well was screened (44.2-47.2m; TD=48.2m). On the borehole log, under "water strike details", all that was stated at this depth was "no yield estimate possible". There were reported to be "flush losses" between 40-48.2m whilst coring. The initial borehole was reported to become "very unstable between 12-40mbgl with complete collapse" (had to be re-drilled). The well was developed and yielded ~15m^3/day (yield may have been limited due to single short 3m screen section);

6. The Applicant did not replace BH17, even though they indicated they would (originally proposed a new pump test well to the south of the area). The BH17 well casing is screened at three intervals within the succession (25-27mbgl: Namurian; 32-37mbgl & 42-48mbgl: possibly Loughshinny), with gravel pack shown throughout he well annulus between screen intervals from 23-54m depth. Drawdown in the well during testing could be due to groundwater lateral movement from any of these horizons and therefore the pump test has limited value. The focus of the pump test was expected to be to pump from the deeper Loughshinny and to independently assess the effect on groundwater levels in the Loughshinny and the Namurian (hence degree of vertical interconnectivity).

2.2 The Bog Of The Ring Abstraction

The Bog of the Ring groundwater abstraction scheme was developed by Fingal County Council (FCC) and came into operation in July 2003. It comprised a well field of 4 wells from which a maximum of about 4,000 m^3/day was abstracted. It is situated 2-2.5km to the north of the MEHL site. The potential hydraulic relationship between the two sites is considered important as both are underlain by the Loughshinny aquifer and a major fault passes through the MEHL site oriented north-south (N-S), which is considered likely to be linked to a major fault that extends through the Bog of the Ring well field and beyond.

It was reported by the Applicant that the groundwater divide can be expected to be 0.5-1km north of MEHL. This makes sense from a topography and local surface water divide standpoint. However, when aquifers are locally stressed due to large scale abstraction the groundwater regime may be expected to vary from this simple model. The GSI 2005 work to consider the zone of contribution and source protection zone for the Bog of the Ring well field predicted the position of the groundwater divide. Since then there have been a number of reports linked to pressures on groundwater which include the Bog of the Ring supply.

This includes CDM 2009 for the Eastern river Basin District and Dublin City Council. This showed hydrographs for 3 monitoring wells in the Bog of the Ring well field, in each case, over a 5-6 year period to 2006, water levels were declining gradually but steadily, lending evidence to over abstraction. Groundwater levels dropped steadily by about 10m in the mid- to late- July 2003 through to January 2006 period.

The Applicant has also continued to use a simple approach to try and demonstrate that the MEHL site must be isolated from the Bog of the Ring well field. This is that as it was previously agreed that the separate FCC Nevitt site, which secured planning and then a WML from the EPA, is not hydraulically connected to the well field, then neither can be the MEHL site. It was reported that as the MEHL site lies in the same surface water and groundwater catchment as the Nevitt site it naturally follows the same lack of connectivity exists. However, the two sites are of the order of 1.5km apart and the Nevitt site is at a much lower topographic level, would have had a minimum of 10m of low permeability clay containing sub-soils overlying the bedrock (after excavation of the landfill footprint down to a maximum of 10m), and does not have a major fault passing beneath it. As such it is quite different to the MEHL site in many ways.

Having said the above, if there is an effective groundwater divide (approximately mimicking surface water and topographic divide) between the MEHL/Nevitt sites and the Bog of the Ring well field, under current and predicted future abstraction regimes, taking into account local geological controls, then migration in this direction would not be possible. What needs to be determined, on a site specific basis, is whether the site specific geology and hydrogeology beneath and to the north of the MEHL site creates a different set of circumstances that allows an anomaly to be present in the "to-be-expected" groundwater divide's linearity and position.

The second important aspect to consider, linked to the Bog of the Ring well field, is how the abstraction has influenced groundwater levels regionally, including beneath the MEHL site. Even if there is a groundwater divide that prevents groundwater beneath the MEHL site to have a northerly component of flow, the abstraction could have depressed overall groundwater levels regionally, given its scale, moving the groundwater divide to the south (towards MEHL) and reducing groundwater levels in this direction. The Applicant does not seem to have recognised this potential risk (in Section 2.2 of the report entitled Assessment of Hydrogeological Isolation (Bog of the Ring and the MEHL site) it is specifically inferred that groundwater levels to the south of the divide would not have changed).

Under a scenario that the Bog of the Ring abstraction diminishes or even ceases a rebound in groundwater levels would occur that could propagate to the MEHL site. Arup stated in their Bog of the Ring report (Section 4) that recent monitoring reports have suggested that the regional water table had not reached steady state by the end of 2005 and was in long term decline. In an EPA 2011 WFD Groundwater Monitoring Programme report for Bog of the Ring PW3 it was stated that overall abstraction was down to 3,500 m^3/day. Additional information was received from the EPA, after the 28th May review meeting, and this revealed an average abstraction of just below 2,500 m^3/day for the well field in 2011 and

2012. It also suggested that in 2013 the average abstraction increased again to nearly 3,500 m3/day, which is supported by the hydrograph for OW2 (see below).

The Applicant was asked to supply hydrometric data for MEHL (other) site wells from pre-2003 when the Bog of the Ring abstraction started, to allow assessment of this risk. Given site wells ICBH1-12 (1989) and BH1-11 (1998-2001) were all installed before development of the Bog of the Ring this should have been possible. However, in Section 2.6 of their Bog of the Ring report Arup state that groundwater levels have been monitored at the MEHL site since 2003. This seems at odds with the existence of monitoring wells before this.

The Applicant also stated that an examination of the hydrography over this 2003+ period shows a gradual decline in groundwater level between July 2003 and September 2006. They put this down to the historical dewatering activity at the MEHL site which was taking place in both the northern and southern sections of the site until late 2006 (Bog of the Ring report; section 8.2.2.3). Abstraction continued beyond 2006 in the southern area (Loughshinny). They have provided no indication of how much groundwater was being abstracted to facilitate the necessary dewatering. They go on to state that "any potential impact of the Bog of the Ring abstraction at the MEHL site would be minimal, if detectable, and would be hidden by the effect of dewatering at the MEHL site (noteworthy that this appears to cut across statements made elsewhere that there could be no influence).

Clearly on-site abstraction at the MEHL site may have masked expected relatively limited, drawdown impacts from the Bog of the Ring well, which started full production in July 2003. Geosyntec has plotted some available data for Loughshinny and Namurian wells at the site (see Figure 2). One of the main things one can draw out of this data is that the hydrographs for onsite Namurian wells (dotted lines) are very similar in profile to Loughshinny wells. This suggests reasonably good hydraulic connection between the two (not isolation or separation because the Namurian is an aquitard rather than an aquifer). In addition groundwater levels in the Loughshinny and Namurian do not appear distinct (i.e., represented by two groups of hydrographs on Figure 2). Typically Namurian water levels (dotted lines) appear higher than for Loughshinny, indicative of an overall downward head gradient (not upward or artesian condition in the Loughshinny as previously suggested by the Applicant). Head gradient data is discussed in more detail in section 2.6.

Finally it is noteworthy that the monitoring well hydrographs of drawdown within the Bog of the Ring well field from the July 2003 start-up (also shown on Figure 2) follow a remarkably similar trend to MEHL monitoring wells (which may be more than a coincidence, based on the limited Arup reported data). Arup put this down to on-site abstraction which reportedly partially ceased in late 2006 (in the northern site area; P36 of Bog of the Ring report). Arup also state that groundwater levels in recent monitoring rounds have been observed to be increasing, to them indicating that levels may be rebounding following cessation of dewatering at the quarry. However, we also know that the Bog of the Ring abstraction dropped to around 2,500 m^3/day (as an average) by 2011, down from an average of >3,500 m^3/day in 2006 and probably 2007.

As only limited data has been supplied for site groundwater levels (only covering the period 2003 to present), and no detail about the former site abstraction regime, our ability to assess this further is limited. BH5 hydrograph (included on Figure 2) suggest rebound after about 2006 and recovery to above 2003 levels in this well at the northern end of the site. This suggests on-site abstraction was an important influence. However recovery appears to have taken at least 3 years so there may have been other controlling factors.

Increased rainfall in the mid to late 2000s could have played its part. However falling abstraction at the Bog of the Ring supply in this period might be an additional factor. EPA reported that since 2011 the abstraction has been reduced to about 2,500 m^3/day which seems to be a sustainable yield from the well field. As a result pumping well water level rose by >10-15m, as highlighted by a hydrograph for monitoring well OW2 (Figure 2). This rise in water level took place over a 4 year period between late 2008 and late 2012. The rise in water levels in MEHL site monitoring wells took place over the period mid-late 2006 to the end of 2012 and was a similar magnitude (10m). Whilst it may be expected that the early part of this MEHL site rise would have been due to cessation of on-site abstraction (in late 2006 in the northern area; abstraction regime unreported by the Applicant), the regional changes associated with rebound to the north could have been a factor by as early as 2007/08.

The OW2 hydrograph suggests 2013 was a year of increased abstraction again in the Bog of the Ring well field, with OW2 groundwater levels temporarily dropping through the year by >10m. MEHL site monitoring wells show a slight downward kick in water levels from early-mid 2013 with a deflection of 1-2m. This also suggests possible significant influence from the abstraction at the Bog of the Ring on MEHL site groundwater levels.

The lack of data leads to residual uncertainty and therefore potential risk that:

- The potential for future losses from MEHL site operations and landfill (including long term integrity failure) could lead to contamination of groundwater which ultimately has some impact on the Bog of the Ring supply via a fault zone induced preferential pathway.
- the Bog of the Ring supply could have unduly influenced MEHL site rest water levels (caused regional decline) making the site vulnerable to future groundwater level rises to the detriment of the waste management facility integrity given water levels are close to surface anyway (Figure 2 shows the proposed landfill base), if the abstraction continues to decline;

2.3 Influence Of The Fault On The Groundwater Divide

It has been reported by the Applicant that the groundwater divide can be expected to be 0.5-1km north of the MEHL site based on topography (GSI Bog of the Ring SPA report). However, as outlined above, groundwater divides are not always simple and easy defined features and can move based on external influences such as large-scale groundwater abstraction (Bog of the Ring well field) and have anomalies in them due to preferential flow

paths (such as along faults). This abstraction was reported not to be at steady state in late 2005 when the SPZ assessment was done by the GSI, 2 years after it came into use (i.e., expanding radius of influence and cone of depression).

The Arup Bog of the Ring report provides some useful discussion on why the fault may not be expected to be permeable. The MEHL site is located on the southern limb of the more regional WNW-ESE trending syncline which means that the Loughshinny Formation is dipping to the north and therefore becomes more deeply seated in this direction. Furthermore, the Loughshinny appears to have been downthrown significantly by the site located EW trending fault (refer to Figure 1) so that beneath the north of the site there is reported to be over 60m of Namurian deposits above it (also shown on Bog of the Ring Figure 10 – included in Appendix A).

The Hollywood Fault is reported to be near vertical and vary from 2 to 3.5m in width, and where exposed is relatively fresh and appears to be quartz filled. It is stated that there is a significant down throw to the east this may amount to some tens or even hundreds of metres. This is probably a continuation of the fault that the GSI shows on Sheet 13 (McConnell et al 2004) immediately north of the Hollywood site (Conodate, 2009).

Importantly the Applicant believes that the fault identified beneath the MEHL site is unlikely to be connecting the MEHL site to the Bog of the Ring, stating that faults tend to have variable linear continuity along their length. They tend to have limited linear continuity where mudstone/shale is in contact and also where sandstone is in contact with mudstone and shale (Daly et al, 1980), as is the case particularly to the north (increased thickness of Namurian bedrock due to the structural controls previously mentioned). Whilst this may be expected to be the case, in theory, site specific (specifically hydrogeological) data is needed to support this argument.

It is agreed that it seems, due to structural controls, the Loughshinny quickly becomes quite deep seated between the MEHL site and Bog of the Ring (due to a synclinal structure and faulting). Therefore this potential aquifer pathway to the north is not that direct. Also the Loughshinny may be expected to have lower hydraulic conductivity (K) and be less transmissive at depth.

However, both the Bog of the Ring and MEHL site areas have highly yielding aquifers. It was noted during the original MEHL site pump test (in BH17) some 605 m^3/day of groundwater was abstracted with only <3m drawdown in the Q-well. During drilling an estimated yield of >15,000 gph (>70m^3/hour equivalent to 1,680 m^3/day was reported. This is indicative of a highly productive aquifer system below the MEHL site (BH17 screened within Loughshinny and Namurian strata). It is further noted that the Bog of the Ring well field (n=4 wells) to the north produces 3,000-4,000 m^3/day from the Loughshinny. As such, potential connectivity between the two areas is seen as critical to understand.

All the above, combined with local topography[2], suggests the main potential risk driver for possible groundwater movement between the MEHL site, under the influence of the Bog of the Ring abstraction, is preferential movement along the fault zone. This fault zone is known to exist and site data has shown that it is associated with a much more fractured and broken bedrock zone. If this fault zone is laterally extensive and relatively high K, then the two areas could be preferentially hydraulically connected and a discrete component of groundwater flow directed north, from below the subject site.

Figure 6 of the Arup Bog of the Ring report (included in Appendix A) highlights the MEHL site in relation to regional geology and structural features. The major fault immediately north of the MEHL site is directed north for some 3-4km (note the Arup figure has an incorrect scale bar). This takes it through the Bog of the Ring well field (shown separately on Arup Figure 3 and Figure 8, from the same report - included here also in Appendix A). Whilst Arup has not shown the MEHL site fault on any of these figures, by reference to our Figure 1 (in the figures section of this report) it can be seen that this site-specific fault is likely to connect into and be part the major fault network. We have annotated the copy of Figure 6 (Appendix A) to simply show this. The main question therefore is whether this fault zone is relatively permeable (high K).

In the Arup Bog of the Ring report (Section 8.2.1.1) the major fault that approximately parallels the route of the M1 locally is discussed. This fault (refer to Bog of the Ring Figure 8 in Appendix A) is some 2-3km to the east of the MEHL site fault line. It is stated that "it is reported by the GSI 2005 that the low groundwater gradient observed within this fault zone is indicative of high transmissivities." It is wholly arguable that the abstraction achieved in the MEHL site pump test, with only 7m drawdown including well losses (which were not estimated) and a 600 m^3/day abstraction over 7 days, plus the ~1,700 m^3/day reportedly achieved during initial testing during drilling and installation, is indicative of a similar high transmissivity fault zone beneath the MEHL site.

It is also stated that K.T.Cullen (1994) carried out a drilling and testing programme linked to their Bog of the Ring trial wells and highlighted the aquifer as having structural deformation associated with a fault. This particular fault runs in a WNW-ESE direction. The aquifer was conceived to be a corridor along the fault. It was also noted that the Carboniferous limestones, on the south side of the fault, were deformed and fractured by the faulting and had become cavernous with large weathered fissures.

The next section on the MEHL pump testing serves to consider fault line preferred flow in more site specific detail.

2.4 Pump Testing Results For The MEHL Site

BH17 was previously drilled as a pump test well, roughly in the centre of the site and within the area of the proposed hazardous cell. Significant water ingress and drilling fluid losses

[2] Knockbrack located about 1km NNE of the site boundary is at 176 mAOD; with a NW to SE flowing stream from this hill acting as a local surface water catchment divide. However the 100 mAOD contour, although variable, runs from the NE corner of the MEHL site to the NE. Therefore there is less topographic influence east of this line, which also might be reflected in natural groundwater gradients beneath this same area.

are noted in the drilling log, even in the Namurian strata. It was drilled to 53m depth through Namurian strata (shales) and into Dinantian strata (Loughshinny Limestone). It has multiple screened intervals, in both the shales and limestone, with continuous gravel pack in the well annulus from 23-54m depth.

In June- 2010 a 48 hour pumping test of BH17 was conducted. As reported previously a drawdown of <3m was observed in BH17 after 48 hours of pumping at a rate of ~600 m^3/day. Drawdown in water levels observed in wells completed in Namurian strata, due to pumping in BH17 indicated hydraulic connection (leakage) from the overlying to the underlying strata.

Repeat aquifer (pump) testing, of longer duration (7 days), formed part of the EPA required follow-on work at the site. It took place in 2013. A new purpose designed well was expected (and planned). The Applicant ultimately decided to re-use BH17 instead which, as stated above, was not ideal, being screened at three intervals within the succession (25-27mbgl: Namurian; 32-37mbgl & 42-48mbgl, both thought to be Loughshinny). The overall drawdown within the well of ~7mbgl will be directly influenced by both the Namurian and Loughshinny water bearing zones. This makes the expected data analysis to derived aquifer specific hydraulic parameters more difficult and does not allow ready separation of Namurian and Loughshinny aquifer responses (a key objective of the testing). On this basis, the pump test conducted did not meet the requirements set out by the EPA.

One further possible complication may be the discharge of abstracted water to a settlement pond on the northern edge of the site (location not shown in the report). Whilst the Namurian is thickest here and the pond is reported to simply overflow to the stream, possible associated recharge might have influenced results in this particularly important northern location towards the Bog of the Ring and close to the fault.

Whilst the drawdown results obtained have been to some degree useful, it is considered unfortunate that the Applicant, for whatever reason, did not choose to site pressure transducers within some of the most important monitoring wells (rather opt to use occasional manual dips on these wells) such as BH19, BH20, BH24 & BH26. All of these key wells are close to the N-S fault line for which interrogation of its hydraulic controls were a key focus of additional investigations. The main potential limitation is linked to the collection of robust early data (initial response time) which can best illustrates relative connectivity. Some of plots suggest problems with manual dipping (as examples BH24 and BH26 plots show erroneous double drawdown data suggestive of a change in measurement technique or equipment).

Geosyntec has tried to assess the distribution of early well groundwater level responses (from the Arup curve analysis plots) to the 7-day pump test and this has been summarised as part of Figure 3. Early responses (<100 minutes) were seen close to the pump test well, to the east of the main fault and just north of the secondary west-east fault, to the south close to the main north to south fault line and in BH5 up in the northwest corner (all shown by an encircled 1 in Figure 3). This early data suggest the faults matters and are associated with a preferential hydraulic connection.

The BH5 result (overall nearly 1m of drawdown reported in this well located >300m to the north of the pump test well) suggests a linear connection north-south that is out with the main site N-S fault zone but perhaps more aligned to the regional fault. Other peripheral site wells typically had the slowest response, as to be expected, however it is noteworthy that of these peripheral wells BH8, located west of the pump test well, had the earliest response and this is located along the apparent line of the west to east fault (has been given a 2 response time; refer to Figure 3).

The Applicant only used the BH17 pump test data to assess aquifer hydraulic properties. This provided the following estimates:

- Transmissivity (T) = 214-221 m^2/day
- Storage Coefficient ~0.1
- Hydraulic conductivity (K) ~ 4.5 m/day (using 50m aquifer thickness for this well)

With reference to the drawdown curves available, it is apparent that the local site hydrogeology is influenced by flow within the faults and their associated induced fractures, with a quick response to pumping noted in both Namurian and Loughshinny formations. The Arup report states that, based on the distance drawdown analysis (see Graph 2 from the Appendix F Pumping Test - included herein Appendix A) and their curve analysis, data from none of the monitoring wells which demonstrated drawdown during the pump test, could be used, because of the influence of the two main faults and also because of the fractured and broken area of rocks which are skewing the drawdown data. This seems to be a roundabout way of stating that the fault matters and strongly influences groundwater levels and flows.

However, a Geosyntec schematic of the inferred 'steady state' drawdowns across the quarry towards the end of the 7 day pump test is provided (also in Figure 3). Whilst it appears clear that the fault zones exert influence on aquifer hydraulics, with propagation of the drawdown appearing most pronounced along their route, there is also general propagation of drawdown across it (most notably in BH28-BH30). Overall drawdown to the south is less marked, as might be expected given this area has Loughshinny close to or at surface.

Whilst Figure 3 does suggest the fault zone acts more as a conduit for groundwater than a barrier to it, the pump test 7 day piezometry (Figure 4) also suggests relatively radial flow to the pump test well (BH17) for a fracture flow system (i.e., the aquifer is not that anisotropic). The groundwater level decline in BH17, which does not appear to have been corrected for well losses, is shown in Graph 5 of the Arup Appendix H Pumping Test document (included here-in within Appendix A). It suggests the drawdown had not stabilised after 7 days, indeed there was an increase in drawdown again after about 1000 minutes. This suggests a boundary effect coming into play, perhaps linked to a preferential groundwater source or flow zone (perhaps the fracture zone) becoming somewhat depleted. If this was illustrative of the fault zone then it may suggest it is limited in the context of being a preferential pathway.

Given the above, whilst some preferential flow along fault zones can be expected, it may not be laterally extensive enough to actually dominate the hydraulic regime more regionally. Therefore, on balance, it would seem reasonably unlikely that the groundwater divide, which under natural and relatively homogeneous conditions would be expected to be considerably to the north of the MEHL site, will have a sufficient anomaly in it to allow significant discrete groundwater flow to the north from the MEHL site. However this remains unproven by the data supplied by MEHL and the presence of such an anomaly remains conceptual possibility. The BH5 result (early response and total drawdown of nearly 1m), however, does suggest there may be a second fault zone, perhaps more directly aligned to the regional N-S fault to the Bog of the Ring.

The broader extent of groundwater drawdown across the quarry within the Namurian, suggests that drawdown is not just restricted close to the fault lines themselves i.e. there appears to be broader hydraulic connectivity between the Namurian and Loughshinny across site. This is likely a consequence of the identified broader fracturing and weathering of the Namurian across the base of the quarry as a result of various fault offset occurrences. This is in contradiction to the Applicant's view (detailed below) that drawdown under such stressed pumping situations is restricted to the fault lines and that grouting of these faults would be a potential longer term solution to such interconnectivity. Furthermore, the Applicant has a strong view that the Namurian should be best considered an aquitard with general low permeability - this view is not well founded given borehole logs of the encountered strata combined with pump test findings.

2.5 Potential Vulnerability Of The Site

There is no doubt that this site, which has been quarried, with a proposed footprint for the landfill cells currently associated with exposed, relatively permeable, bedrock, has a vulnerability about it. This is compounded by the shallow groundwater table, the presence of fault zones running centrally through the site and the presence of a major public water supply scheme (Bog of the Ring) to the north.

The Applicant has stated that the Namurian (Balrickard and Walshestown) is an aquitard unit which could be equated to low-permeability subsoil. On this basis they state that there is a minimum of 10m of, and up to at least 60m of, moderate to low permeability shale (typically weathered to clay) dominated material present across the northern part of the site and this offers protection to groundwater in the aquifer and in-line with GSI guidelines can allow the vulnerability to be redefined as Moderate.

The Loughshinny and immediately overlying Donore is reported to be the only aquifer. It is stated that this aquifer is classified by the GSI as a Locally Important Aquifer and the so-called aquitard as a Poor Aquifer. This is correct but the Locally Important Aquifer status of the Loughshinny is as Generally Moderately Productive (Lm), not a Locally Important aquifer which is Moderately Productive only in Local Zones (Ll)" as previously suggested by the Applicant.

Due in part to its local fractured/broken/jointed character the Loughshinny can be expected to be generally moderately productive. It is reported that regional well records highlight yields of >100 m^3/day, with typical Specific Capacity of 5-150 m^3/day and Transmissivity (T) up to 1000 m^2/d. For two thirds of the variable head tests performed on Loughshinny strata wells there was no drawdown (high K) reported, indicative of high K. Both onsite pump tests were associated with yields of 600 m^3/day.

As a fractured system, with proven interconnectivity between the Namurian and Loughshinny bedrock, it is not considered plausible to describe the Namurian as an aquiclude. The Namurian can be expected to be very fractured/broken/jointed due to local faulting. Secondary porosity and permeability will dominate (as indicated by the Applicant). Such structural controls would be expected to enhance interconnectivity between the various Namurian strata and the underlying Donore and Loughshinny. Variable head tests for Namurian strata wells provide hydraulic conductivity (K) estimates of $K=5.7*10^{-4}$ to $1.1*10^{-6}$ m/s (0.1-49m/day), which cannot be equated to an aquiclude.

Based on the above we can consider the Response Matrix for Landfills (copy of which included in Appendix B). The Loughshinny is classified by the GSI as **Lm** and this appears wholly applicable to the MEHL site given pump test results and other data. The Namurian is not considered to act as an aquitard (which would greatly restrict recharge and protect the Loughshinny) again based on the Applicant's own pump test and piezometric data, so this would point to Extreme Vulnerability (E) given bedrock is at surface in the quarry floor where the landfills are to be cited. Therefore the site setting would fit under $R3^2$ (not generally acceptable unless it can be shown that (i) there is a minimum consistent thickness of 3m of low K subsoil present, (ii) there will be no significant impact on groundwater, and (iii) it is not practical to find a site in a lower risk area. The presence of Namurian bedrock overlying the Loughshinny in the northern part of the site does not change this classification because in Ireland bedrock cannot be counted as a protective layer, due to its high degree of secondary porosity and permeability (fracturing), which is certainly the case at the MEHL site.

It is noted that the Applicant makes the point that the Landfill Directive is the legal basis for the provision of environmental protection linked to landfill sites, and this supersedes the requirements of the GSI Groundwater Protection response for Landfills document and the above Response Matrix requirements. They go on to quote the Directive Annex 1 "Where the geological barrier does not naturally meet the required condition (to provide sufficient attenuation capacity to prevent a potential risk to soil and groundwater) it can be completed artificially and reinforced by other means giving equivalent. The Annex 1 wording can be interpreted differently in our opinion.

Annex 1 Clause 3 (on the Protection of soil and water) 3.1 states that protection of soil, groundwater and surface water is to be achieved by the combination of a geological barrier and a bottom liner during the operational phase (etc.). Whilst 3.2 ends by stating that "where a geological barrier does not naturally meet the above conditions it can be completed artificially and reinforced by other means giving equivalent protection. Nowhere does it

state the natural barrier can be absent altogether (and thus be wholly substituted for by an artificial means).

2.6 Other notes on Overall Groundwater Piezometry and Flow Regime

Previously reported data lacked good differentiation between the shallow (Namurian) and deeper (Loughshinny) groundwater flow regimes (and the vertical head gradient). The Applicant depicted an upward head gradient between the Loughshinny Formation and overlying Namurian Formation (Figure 13 Schematic Conceptual Model in their EIS submission). Geosyntec review of the data in 2012 concluded there appeared to be a downward head gradient for the majority of the site (northeast area aside), including where proposed landfill cells were located. This was one of the reasons why the installation of monitoring well pairs (each one of a pair screened either in Namurian or Loughshinny Formations) was requested, the best way to accurately assess vertical head gradients at the site.

In the Article 16 response on groundwater, dated 16 October 2013, the Applicant included information on piezometry and groundwater flow. They did not superimpose the fault lines on the site plan used, which was a limitation of the figure, given the focus on its potential influence. However the plans and the data can still be used for interpretation.

- Arup Figure 4 (from Article 16 Groundwater report included herein within Appendix A) shows groundwater levels and inferred contours for the Loughshinny (08-07-2013). Data (n=8) is limited given the fault blocks that exist. The depicted flow direction within the southern portion of the site (that to the south of the local W-E Fault line) is shown as approximately south-easterly. There is only one groundwater elevation point, BH30, for the Loughshinny, within the northern half of the site, given its depth. Furthermore, there is some uncertainty over the veracity of BH30's groundwater level relative to that within the Loughshinny (the borehole at best only tagged the top of this aquifer);
- Arup Figure 5 shows groundwater levels and inferred contours for the Namurian (08-07-2013). Data (n=12) is quite limited but better than for the Loughshinny. It is noted that whilst the Applicant has correctly stated (within their report) that groundwater levels for BH8 & BH13 on the western quarry margin are representative of a perched system, above that within the Namurian, they have still proceeded to plot these within their inferred Namurian flow field. These should be excluded from such an inferred flow field plot unless it can be proved that the groundwater within the shallow overburden and Namurian formation are in hydraulic continuity in this location. The Arup Figure 5 (included in Appendix A) suggests flow to the east not southeast, although the hydraulic low in the NE corner (BH11A) seems erroneous data point (always reported to be around 98.5 mAOD);
- Vertical head gradients can be assessed but there is still a relative lack of well pairs. Where they exist the following relative water levels have been noted (L = Loughshinny; N = Namurian):

- BH17 (L & N); BH18 (L) and BH27 (N), reported water levels of 102.37 mAOD, 102.44 mAOD and 102.54 mAOD, respectively, all very similar but slight downward gradient if anything
- BH19 (N), BH26 (N) and BH20 (L & N), reported water levels of 103.37 mAOD, 103.26 mAOD and 102.80 mAOD, respectively, all quite similar but slight downward gradient if anything (latter well having the lowest level)
- BH29 (N) and BH30 (possible L), reported water levels of 101.01 mAOD and 101.96 mAOD, respectively, suggesting an upward head gradient at this location

- The above interpretation of vertical head gradients, given the lack of data points, can only be limited, but suggests some variability and limited differences between the Namurian and Loughshinny (Figure 3 serves to illustrate site well data in some detail). The Applicant's discussion on vertical hydraulic gradients beneath the site appears somewhat confused. For example, they contradict their view that there is an upwards hydraulic gradient from the Loughshinny to Namurian by saying that 'Groundwater levels in the overlying Namurian strata are more variable and are elevated in relation to those in the underlying aquifer' (on page 31). This indicates levels are higher in the Namurian with a downward head gradient the result. Overall, data suggests interconnectivity more than separation, and this might be expected given the presence of the local major fault system. Geosyntec plotted hydrographs (refer to Figure 3) suggest interconnectivity and not strong vertical head gradients (either way).

2.7 Groundwater And Contaminant Modelling (Landsim)

In 2012 our main comments with respect to the LandSim modelling exercise, was that the report generally lacked detail, with a number of potential limitations and/or requirements for points of clarification. The Applicant has rejected the suggested need for more sophisticated modelling, mainly linked to their believe that the geological and hydrogeological condition is too complex to model. It is complex, and this complexity is one of the main reasons why we have concerns about the site. Given other findings and the fact that a decision is now needed, there is little point in revisiting this aspect of the work done.

2.8 Main General Comment On Proposed Facility

Geosyntec has the following general comments on the proposed facility.

Waste Types: The following wastes are proposed to be accepted (Appendix H.1.1 of Applicant's submission contains full details of EWC waste codes and waste descriptions):

- Fly/boiler ash (other ash) to be pre-treated on site by MEHL prior to landfilling;
- Dredge spoil and drill muds;
- Contaminated soils;
- Waste treatment residues from mechanical treatment;

- Spent activated carbon;
- Bottom ash and slag;
- Filter cakes, sludges and residual wastes from industrial processes.

The above categories of wastes could contain a large variety of contaminants. For example, sludges and dredgings could include degradable organic matter; contaminated soils may contain hydrocarbons including PAHs, trace metals and metalloids, some of which will be priority (Hazardous/List 1) substances. To ensure unsuitable waste types are not accepted, the site licence should specify prohibited materials.

Leachate Generation: Geosyntec has not seen a water balance for the site. It is not known whether or not a detailed a water balance for the site, including both operational and post-restoration phases, has been conducted. A detailed water balance is critical in predicting the volume of leachate which is likely to be generated (both during operation and post closure), and in establishing a management programme for leachate, during operation of the landfill and following site restoration. The nature of the wastes to be deposited will differ from municipal waste, and will have lower capacity to absorb rainwater infiltrating into the wastes. Thus proportionally more leachate is likely be generated at an early stage than would be expected at a landfill accepting municipal wastes.

During the operational phase, it is noted that leachate is proposed to be removed, stored in an on-site tank and used in the on-site waste solidification process. As there is no water balance it is not known if likely and maximum volumes of leachate generation have been established, and if the proposed leachate management infrastructure and procedure is sufficient to deal with the volume of leachate which could be generated. The Applicant describes proposed use of tarpaulin covers to capture and divert rainwater run-off during the operational phase, during times when wastes are not being deposited into the waste cell (e.g., outside working hours) to reduce rainwater infiltrating to wastes. This is an unusual technique and the Applicant will need to guarantee that clean surface water run-off from the surface of the tarpaulin remains uncontaminated.

We understand that surplus leachate, not used in the process, will be tankered for off-site disposal and treatment at a water treatment works. It would seem that further information on leachate production and management is required to ensure leachate collection and storage infrastructure is sized sufficiently to cope with likely peak leachate production events and if required (under maximum leachate production) there is sufficient capacity at the off-site plant to receive leachate.

Following site closure and restoration, there is no such requirement for leachate use, but leachate will still require to be managed. The stated permeability of the basal DAC liner of 10^{-12} m/second is significantly lower than that for the surface cap. Over time, it can be expected that some deterioration of the cap will occur, leading to increased rainwater ingress into the hazardous waste cell. Assuming that the base liner remains intact leachate will continue to accumulate within the lined cell.

The proposed design of the boundary between the hazardous waste cell and the inert waste cell is indicated in a series of figures (some included herein as part of Appendix A). The DAC liner extends along the top of bund between hazardous cell and inert cell, but not to the top of the waste cell. Therefore there remains a potential connection between the hazardous waste cell and the inert waste cell (for example, long term accumulation of leachate may result in leachate migrating across the top of the internal bund between the cells and draining into the inert waste cell).

There is also potential for perched leachate horizons to develop, with potential for perched leachate to seep into the adjacent inert waste cell. There is potential for leachate to accumulate over time, fill the cell and seep from the surface of the lined cell. Given the predominantly non-degradable nature of deposited wastes, the composition of leachate will remain reasonably consistent over time, as will its pollution potential.

The post-closure water balance for the site needs to consider generation, fate and potential impacts of leachate post closure, and describe for what time frame active leachate control measures will be required, to ensure long term containment of leachate, and how this will be achieved and funded. Given the nature of some wastes very long term management is to be expected to be needed to protect underlying groundwater in particular.

Leachate Composition: In response to EPA Query 5.6 "More proposed-waste-streams-specific data should be obtained if possible (from say other similar sites or proposed source sites) to ensure the modelled suite of potential contaminants is comprehensive enough. Bench-scale testing of some of the more significant waste streams proposed may be appropriate to demonstrate that unacceptably high leaching is not going to happen") MEHL has used data from other sites taking incinerator residue waste as an indication of likely leachate quality. MEHL recognise that data is not directly comparable to leachate which will be generated at the MEHL site, since the composition of residues from different incinerators in different countries will exhibit some differences.

It does not appear that the composition of leachate, likely to be representative of combined wastes deposited (including, for example, drill muds, filter cakes, sludge), has been considered. There is potential for waste sludge, dredgings and contaminated soils to contain degradable organic material and a variety of other contaminants of potential concern, which may influence leachate composition. The plan for leachate management includes removing leachate and using it as a source of water in the on-site waste treatment process, and it is not clear what constraints on leachate quality attach to its use in the waste treatment process.

It is proposed to tanker residual leachate off-site to a waste water treatment plant. The off-site plant is likely to impose restrictions on leachate quality and volume which will be acceptable at the plant.

Degradation and Gas Production: Although the site will be permitted to accept only inorganic wastes there remains potential for gas to be produced (for example, see comment above on possible acceptance of sludges and dredgings). Although the bio-degradable components of total wastes is likely to be small, the likelihood of gas production from

potentially bio-degradable materials has not been assessed and need for gas control has not been considered (or it has been demonstrated that gas control will not be required).

The main reactions that may generate gaseous products in a landfill with a high proportion of inorganic wastes can be considered in three main classes:

- chemical reactions resulting in hydrogen formation (mainly from corrosion of metals);
- other chemical reactions that could generate gaseous species
- microbial gas generation in environments with low proportions of organic materials.

The report includes consideration of gas production from deposit of combustion residues, where there is potential to generate hydrogen (this point also arose in the Planning Enquiry).

It is not clear if potential gas generation and associated risks have been subject to assessment as part of the landfill design and the need for any specific gas control and monitoring considered, or whether safety assessment as part of the Seveso Lower Tier site designation has included potential gas production within the waste cells as a possible risk factor.

Lining Systems: Designs of proposed lining for hazardous waste and inert waste cells are illustrated in various figures (some included in Appendix A). Lining for the hazardous waste cell includes a granular layer below the DAC liner and above the engineered clay. We understand that this granular zone is proposed to be used for leak detection. However, from the drawings it is unclear as to how the leak detection system would operate (drawing shows detection in shale, rather than within gravel layer above the mineral liner). It is noted that the OD of the leak detection side riser pipe is shown as 250mm, which is larger than the thickness of the granular leak detection layer of 200mm.

In theory, the lining system will control seepage of leachate from the waste cells. However, the liner will only be effective if it is installed in the correct manner, rigidly following QA/QC procedure, and leachate levels are not allowed to rise above the specified limit. Details of the line testing have been provided by the Applicant how some detail appears missing, including:

- Proposed hours of DAC-cell construction are 06.00 to 21.00 Monday to Saturday. It is possible that some of these times will occur during the hours of darkness. Since laying of the liner must be subject to rigid QA/QC control, strong assurance will need to be provided that the same level of A/QC can be applied during the hours of darkness;
- Process to be followed if a section of liner fails QA/QC testing. For example, will the section be removed, and replaced with a new section; will a new section be placed over the top of the section which has failed?
- In addition to the query over design of the proposed leak detection system mentioned above, the methodology for establishing whether or not a leak has occurred after wastes have been emplaced is not clear, nor the procedure to be followed should a leakage be suspected. If the DAC liner does leak, retrospective repair will not be feasible, and there may be a long term (decades +) on-going requirement to remove and treat leachate from the drainage layer underlying the DAC liner.

There is limited information on the long term performance of DAC landfill lining systems, although DAC appears to be the lining material of choice for incinerator residues in mainland Europe. Leachate generated within the hazardous waste cell will be caustic, and high pH levels (possibly of the order of pH 12) may be sustained for many years. The long term performance of the DAC liner under such extreme pH conditions is not known, and assurance is needed that the DAC liner will not deteriorate as a consequence of long term exposure to caustic leachate.

Structurally, DAC lining is more resistant than other membrane liners (such as HDPE) and has sufficient resistance to allow plant and equipment to operate directly on the liner surface. The main risk of potential liner failure is likely to arise from inadequate QA/QC procedure during liner production (we understand the DAC liner will be manufactured on site) and its installation.

3 SUMMARY AND CONCLUSIONS (GEOLOGICAL AND HYDROGEOLOGICAL)

Unfortunately it appears to be that the 2013 investigation and aquifer testing has not come close to fully answering the main questions, linked to assessing (i) site vulnerability due to the known absence of bedrock cover and therefore the degree of vertical hydraulic connectivity between the Namurian and Loughshinny, (ii) temporal changes in groundwater levels associated with the Bog of the Ring abstraction, and (3) degree of preferential groundwater movement along the fault zone(s). Such uncertainty makes it difficult to conclude and therefore have confidence to accept the site as suitable for landfill development, as is proposed by the Licensee.

Given the proposed landfill facility is a former quarry with exposed bedrock forming its base, with a water table near surface, groundwater is vulnerable to pollution. The arguments that have been put forward to suggest the site is not as vulnerable as it appears seem poorly founded.

The GSI general description for the Namurian is a poor aquifer, not an aquitard. The presence of a major fault zone running centrally through the property and beneath the proposed hazardous and non-hazardous waste cells has undoubtedly caused the bedrock to be more broken (fractured and fissured) that normal. Various hydraulic tests suggest the Namurian has reasonable to even reasonably good hydraulic conductivity (permeability). The Loughshinny is a Locally Important aquifer which is Generally Moderately Productive (Lm). There is no doubt that this description is wholly applicable in the subject area given the local well yields (Bog of the Ring) and site pump test results.

Hydrographs for site monitoring wells suggest similar responses in both the Loughshinny and Namurian indicative of reasonably good to good hydraulic connection between the two. It had also been claimed that a vertical, upward, head gradient between the Loughshinny and the Namurian, was present below the site, which would have suggested hydraulic separation and afforded a greater level of protection of the main aquifer. However, there is no conclusive evidence that this is the case.

Based on the above the site appears to fall within in the R3[2] category using the GSI Response Matrix for Landfills, that is not generally acceptable unless it can be shown that (i) there is a minimum consistent thickness of 3m of low K subsoil present, (ii) there will be no significant impact on groundwater, and (iii) it is not practical to find a site in a lower risk area. The MEHL site platform for development has No remaining subsoil cover and the proposed hazardous and non-hazardous cells at positioned directly above major fault zones that act to a degree as zones of preferential groundwater movement (the proposed hazardous cell appears to be actually underlain by 3 separate faults – see Figure 1).

Whilst the Applicant makes the point that the Landfill Directive states "Where the geological barrier does not naturally meet the required condition (to provide sufficient attenuation capacity to prevent a potential risk to soil and groundwater) it can be completed artificially and reinforced by other means giving equivalent, this Annex 1 wording can be interpreted differently in our opinion. Clause 3.1 states that protection of soil, groundwater and surface water is to be achieved by the combination of a geological barrier and a bottom liner during the operational phase (etc.). Clause 3.2 ends by stating that "where a geological barrier does not naturally meet the above conditions it can be completed artificially and reinforced by other means giving equivalent protection. Nowhere does it state the natural barrier can be absent altogether (and thus be wholly substituted for by an artificial means) and the word meet implies the natural barrier is there but is inadequate by itself.

There is a considerable amount of local evidence that faults are relatively permeable and act more as conduits than barriers. This includes third party reports on nearby fault zones and the onsite pump test findings. Drilling of BH24 in the fault zone highlighted highly broken bedrock. In their pump test report the Applicant stated that none of the monitoring wells which demonstrated drawdown during the pump test, could be used for pump test analysis purposes, because of the influence of the two main faults and also because of the fractured and broken area of rocks which are skewing the drawdown data. This is a way of stating that the fault matters and strongly influences groundwater levels and flows. So whilst the Applicant has made the point that major faults in shale/mudstone dominated sequence can often be quite low permeability zones, the local evidence suggest otherwise.

Having said the above, and having our hands tied by the relative lack of good pump test analysis and related investigation data (and reported interpretation thereof), our hunch is that the site fault zones, although important due to being relatively permeable, are probably unlikely to allow significant groundwater flow to the north from the site. However there is insufficient data to absolutely support such a conclusion and some pump test data (e.g., BH5 may suggest more than one zone of connectivity to the north exists.

It is important to note here that an absence of actual groundwater flow to the north due to an anomaly in the groundwater divide associated with the fault zone(s), does not mean that groundwater levels cannot be affected by abstraction to the north at the Bog of the Ring well field. Such major abstractions can cause regional changes to the water table and fall in groundwater levels on both sides of a groundwater divide (because the groundwater divide elevation drops). Therefore whilst the main concern has been the risk of groundwater

pollution linked to chemical (leachate) releases from the site potentially impacting this supply, a second alternative important scenario may matter.

This is that groundwater levels onsite have been influenced (depressed) by the Bog of the Ring abstraction and future changes to the abstraction regime (possible declining yields) could mean water levels rise at the MEHL site. Given the landfill base is only a matter of a few metres above the level of groundwater a further water level rise would be expected to cause problems with site operation, management and aftercare noting the design base for the landfill has already been revised upward by 2m because of concerns about the shallow water table.

The vulnerability of groundwater in its own right is very important to take account of. Groundwater (others water) is protected by law. The entry of hazardous substances (formerly termed List 1) should be prevented absolutely, and in the case of non-hazardous substances their entry should be limited, both linked to Groundwater Directive requirements. Unless this landfill site is expected to be managed essentially in perpetuity, as part of the aftercare programme, then significant releases of hazardous substances to groundwater will happen by design with time, post closure and restoration (landfills eventually fail). Water impacts could also happen during the operational life of the landfill, if accidental losses (of say leachate) occur or the fabric of the landfill cells becomes damaged. The operational life of the integrated landfill facility is expected to be 25 years, including restoration.

4 RECOMMENDATIONS

Geosyntec has been asked to advise the Agency in relation to the content and adequacy of the applicant's submissions and provide a professional opinion as to whether the information provided by the applicant can be deemed to satisfy the Agency in relation to the technical requirements of relevant legislation that governs the license application assessment process. Overall the data supplied has not been adequate and the interpretation of that data provided by the Applicant quite limited. This is in spite of the Agency providing clear direction on important data gaps and recommendation of the scope of proposed drilling and testing. There continues to be an overreliance on non-site specific matters and previous decisions (e.g., linked the Nevitt site) whereas any site must be judged on its individual merits.

Even if the Agency could secure a financial provision vehicle that facilitates very long term (essentially in perpetuity) management of the facility, designed to address all foreseeable requirements for control measures, including future groundwater management, this cannot be expected to stop pollution of groundwater occurring, at least locally, which in the case of hazardous substances is prohibited. Given the environmental sensitivity of the site and specifically groundwater vulnerability, this could happen during the operational life of the proposed waste management facility and can certainly be expected, at some point in the future, post closure if the site were not to be actively (proactively) managed.

Therefore, it cannot be recommended that this site be licensed as an integrated waste management facility to include hazardous and non-hazardous waste disposal, due to its high vulnerability, particularly from a groundwater standpoint, based on the following set of circumstances:

- The proposed integrated waste management facility is in a former quarry where bedrock limestone and shale is exposed throughout the proposed landfill footprint and a major fault line is present (and indeed visible) in the quarry floor and side walls;
- Groundwater is at surface below the southern extremity of the site (in the form of a small lake) and is close to surface (within a few metres) beneath the rest of the proposed development area. Groundwater levels have risen and could rise further;
- The southern part of the site lies directly on the Loughshinny, a Locally Important aquifer which is generally moderately productive. This aquifer is used locally for a major groundwater supply scheme (Bog of the Ring supply) to the north, and has good productivity at the MEHL site;
- There appears to be a good connectivity between the Loughshinny aquifer and overlying Namurian, which is present at surface in the northern area of the site. The Namurian strata cannot be considered an aquitard, as the Applicant has suggested (no such term for bedrock in Ireland, all bedrock having some form of aquifer status), but rather a Poor aquifer which is Moderately Productive only in Local Zones (Pl). It appears to be at least moderately productive at the subject site;
- The aquifer system below the site has been proven to have moderate to high hydraulic conductivity and transmissivity, for which there is good site specific and local regional data. Such properties have been enhanced by the presence of major faults directly underlying the site, three of which appear to directly underlie or be immediately adjacent to the footprint of the proposed hazardous waste cell. Site drilling records and pump test data suggest the subject site area is underlain by an aquifer system of similar hydraulic properties to the Bog of the Ring aquifer to the north;
- Whilst it has been claimed that the Loughshinny is confined aquifer, protected by the overlying Namurian with an upward head gradient, the data provided suggested this is not the case, with an overall downward head gradient. Further, pump test data provided by the Applicant gave a Storage Coefficient of 0.1, which is representative of an unconfined not confined aquifer system;
- Site investigations and pump testing in support of the application have failed demonstrate that a major N-S fault underlying the site is not relatively (excessively) permeable with some level of interconnectivity to the Loughshinny to the north in the Bog of the Ring well field area. Linked to this it also has not been demonstrated that regional groundwater levels did not originally fall significantly and in response to the Bog of the Ring abstraction, including below the subject site. They may have

rebounded since and could rebound further in the future if the Bog of the Ring well field abstraction is reduced further. If further rebound occurred on-site this could leave groundwater very close to if not touching the proposed landfill cell base.

It is considered that there must be a more appropriate, less sensitive, sites in Ireland to locate such an integrated waste management facility. The site setting (linked to the presence of the Loughshinny aquifer) would fit under R3[2] under the Response Matrix for Landfills, not generally acceptable unless it can be shown that (i) there is a minimum consistent thickness of 3m of low K subsoil present, (ii) there will be no significant impact on groundwater, and (iii) it is not practical to find a site in a lower risk area. It would seem the site either fails or has potential to fail on all three counts. Under the Landfill Directive it states that where a geological barrier does not naturally meet the required conditions it can be completed artificially and reinforced by other means giving equivalent protection, however nowhere does it state a natural barrier can be absent altogether (and thus be wholly substituted for by an artificial means) which is the case at the subject site due to the former quarrying activity.

Geosyntec Consultants trust the information and discussion contained in this report meets all your immediate requirements. Please do not hesitate to contact the undersigned if you have any further comments or questions about any aspect of the work.

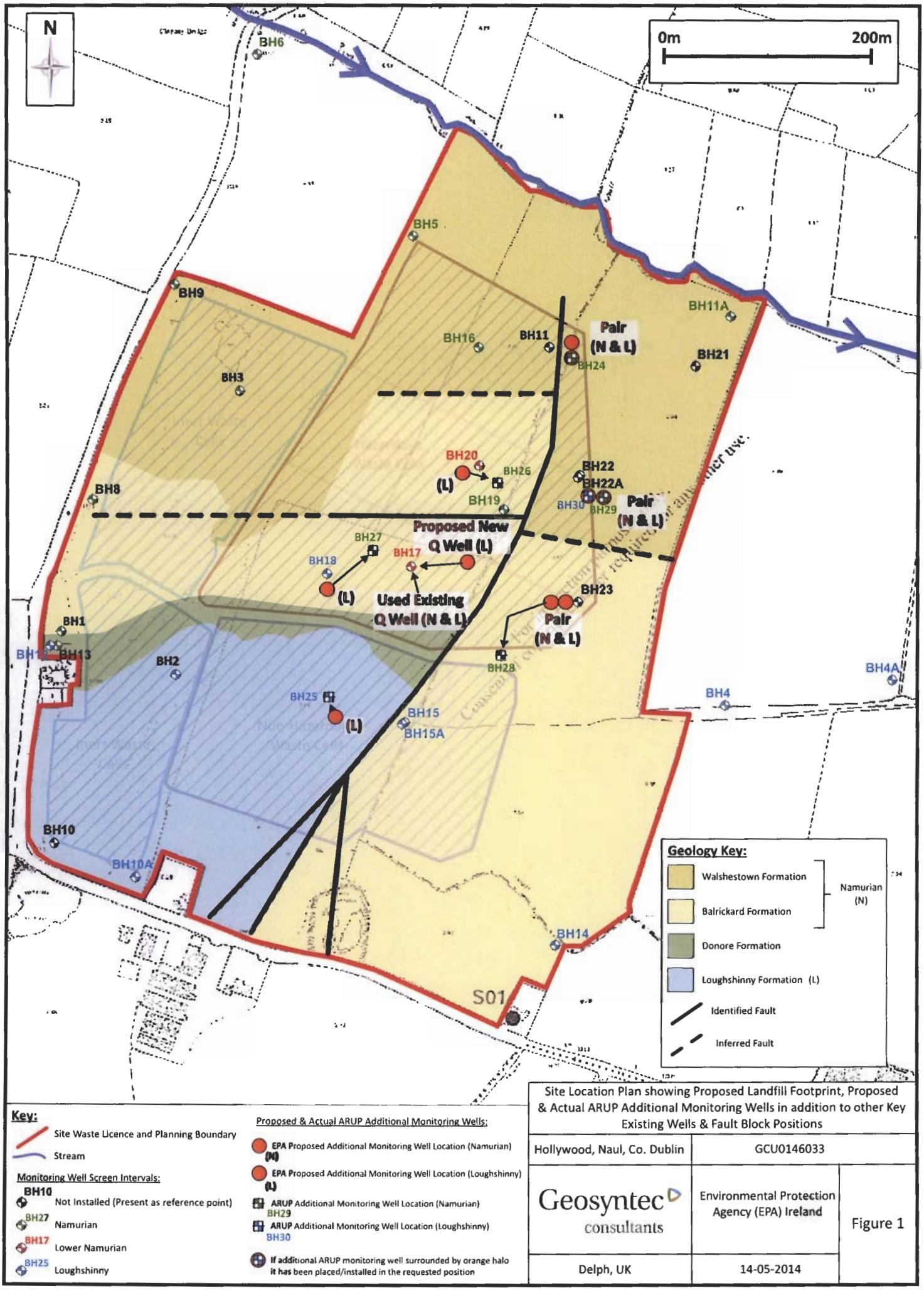
Respectfully submitted

On behalf of Geosyntec Consultants

Dr. Marcus Ford

Lead Consultant

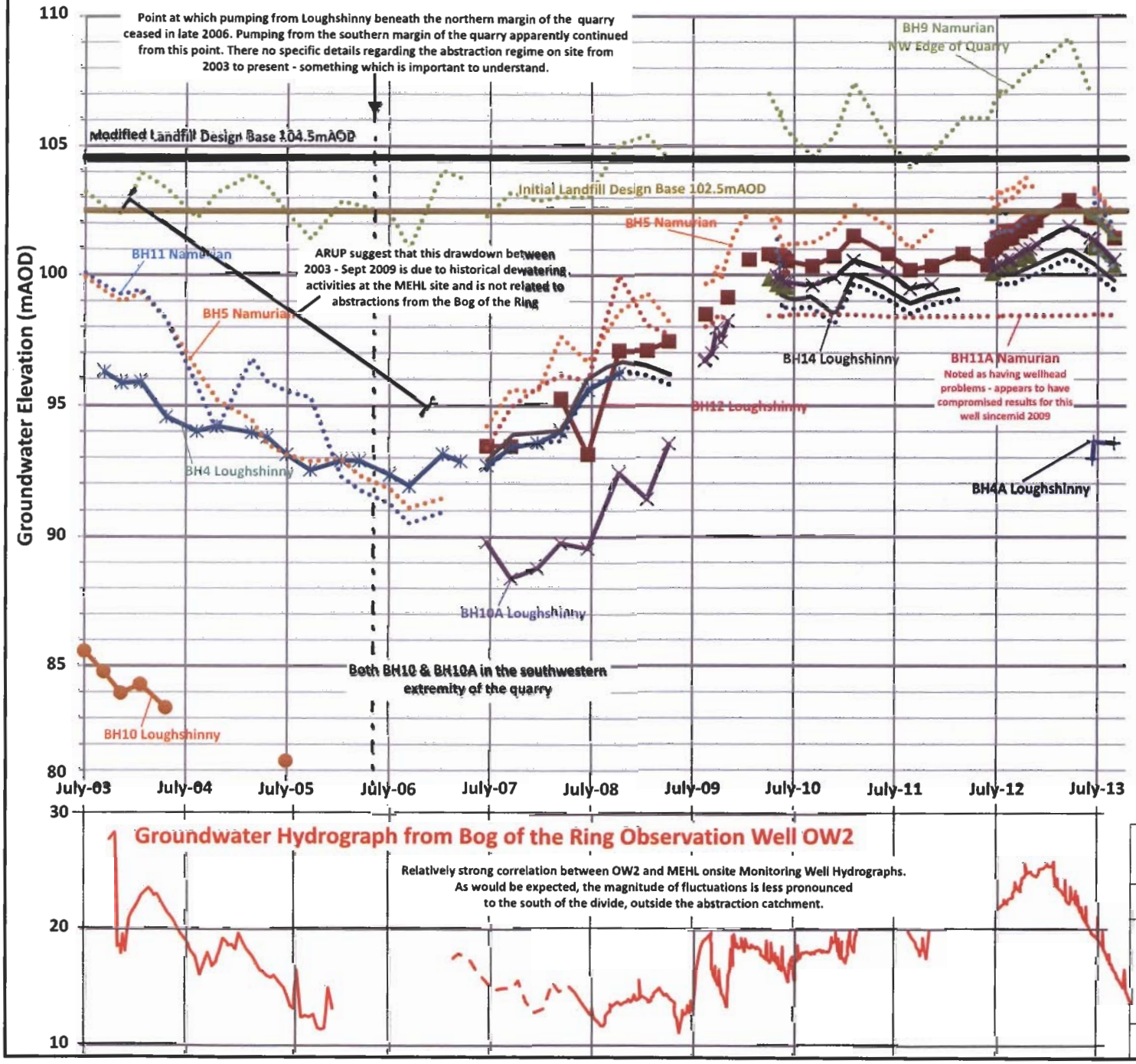
FIGURES



Site Location Plan showing Proposed Landfill Footprint, Proposed & Actual ARUP Additional Monitoring Wells in addition to other Key Existing Wells & Fault Block Positions

Hollywood, Naul, Co. Dublin	GCU0146033	
Geosyntec consultants	Environmental Protection Agency (EPA) Ireland	Figure 1
Delph, UK	14-05-2014	

Groundwater Hydrographs MEHL Site 2003 - 2013



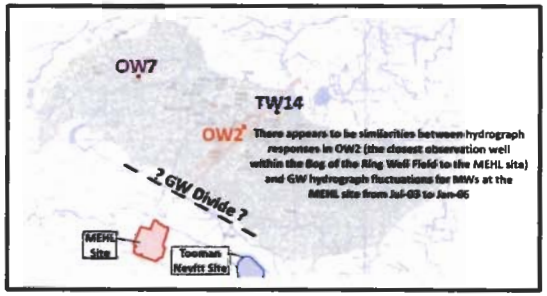
Key

Monitoring Wells Screened Across Namurian:

- BH5 Nam
- BH11 Nam
- BH11A Nam
- BH9 Nam
- BH17 Nam
- BH19 Nam
- BH24 Nam
- BH26 Nam
- BH27 Nam
- BH29 Nam
- BH20 Nam

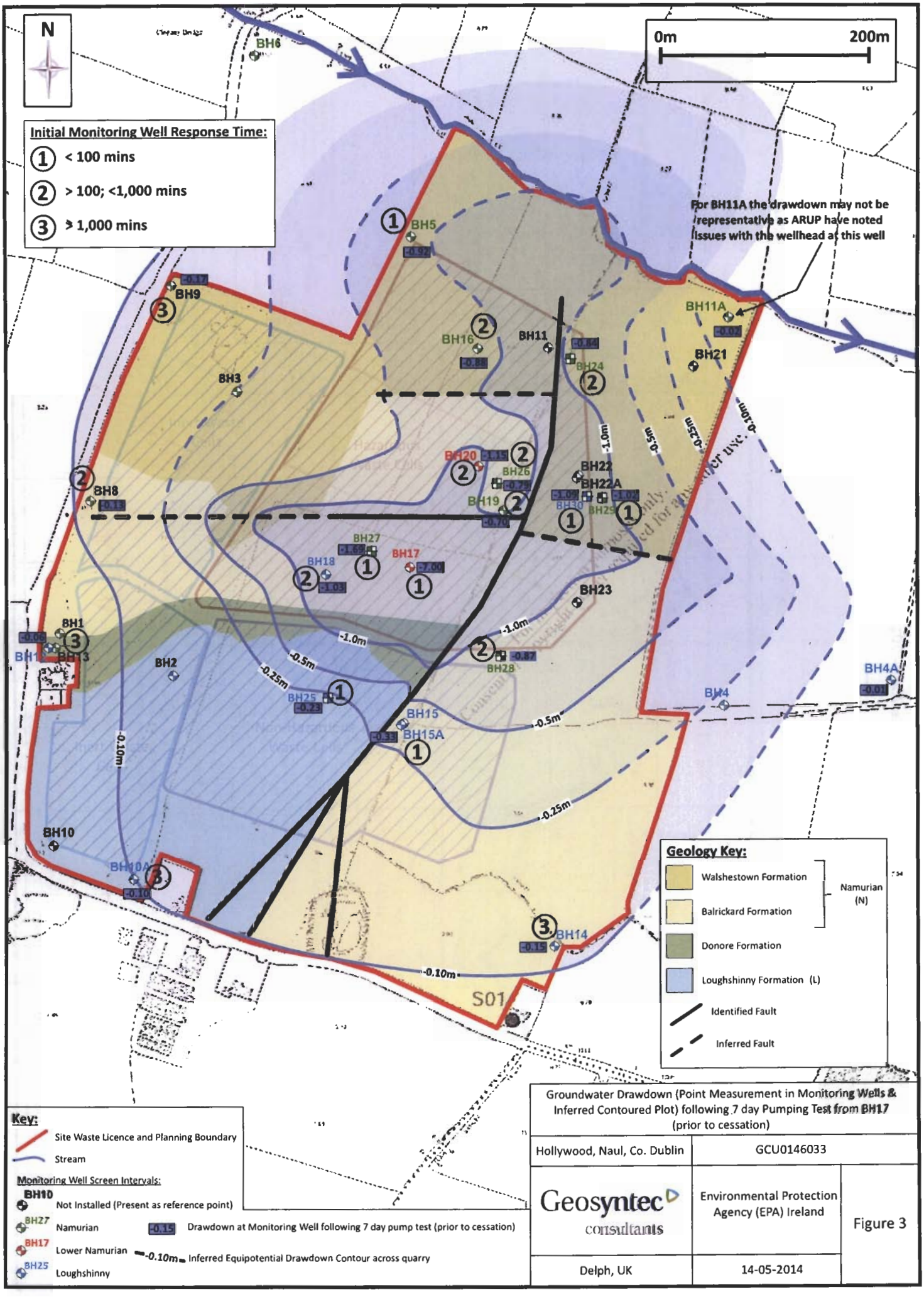
Monitoring Wells Screened Across Loughshinny:

- BH14 LS
- BH12 LS
- BH15 LS
- BH10A LS
- BH4 LS
- BH10 LS
- BH4A LS
- BH18 LS
- BH25 LS
- BH20 Nam



Collation of key Monitoring Well Groundwater Hydrographs (mAOD) at the MEHL site and those within the Bog of the Ring (mbgl) between 2003 - 2013

Hollywood, Naul, Co. Dublin	GCU0146033	
Geosyntec consultants	Environmental Protection Agency (EPA) Ireland	Figure 2
Delph, UK	14-05-2014	



Groundwater Drawdown (Point Measurement in Monitoring Wells & Inferred Contoured Plot) following 7 day Pumping Test from BH17 (prior to cessation)

Hollywood, Naul, Co. Dublin	GCU0146033	
Geosyntec consultants	Environmental Protection Agency (EPA) Ireland	Figure 3
Delph, UK	14-05-2014	

APPENDIX A

COPIES OF THIRD PARTY FIGURES

APPENDIX A

COPIES OF THIRD PARTY FIGURES

Source 1 – MEHL Response to EPA Article 16: Groundwater (October 2013)

Figure 1 – All sites investigations to date (1989 – 2013)

Figure 4 – Groundwater levels and contours: Loughshinny Formation (8th July 2013)

Figure 5 - Groundwater levels and contours: Namurian Formation (8th July 2013)

Source 2 – MEHL Assessment of Hydrogeological Isolation (Bog of the Ring and the MEHL site) (February 2013)

Figure 3 - Bog of the Ring Site Bore Location Plan (GSI, 2005)

Figure 6 – Regional Geology (Arup, 2010) with Geosyntec Annotations

Figure 8 – Cross Section position and Geological Map (RPS, 2006) (MEHL and Nevitt sites)

Figure 9 – Cross-Sections (RPS, 2006)

Figure 10 – MEHL Site Cross Section (MEHL Brief of Evidence, 2011)

Source 3 – MEHL Response to EPA Article 16: Appendix H Pumping Test

Graph 2 - Corrected distance drawdown after 7 days pumping

Graph 5 - BH17 Constant Rate Test 2 (separate drawdown and recovery graphs)

Other Information

EPA Summary Sheet on GSI Guidelines on groundwater protection responses for landfills (so-called Response Matrix for Landfills)

MEHL Waste Management License Application

Typical Cross Section - Hazardous Cell (Through Basal Liner)

Typical Cross Section – Leak Detection System

A3

Legend

- MEHL Proposed Planning and Waste Licence Boundary
- 1989 boreholes
- 1995 monitoring wells
- 2001 monitoring wells
- 2007 monitoring wells
- 2008 monitoring well
- 2010 monitoring wells
- 2010 geotechnical boreholes
- 2010 trial pits
- 2013 monitoring wells

Issue	Date	By	Chkd	Appd
P1	23-08-13	CB	RL	RL

Metres
0 50 100 200

ARUP

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Dublin 4
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www.arup.com

Client
MEHL

Job Title
EPA Waste Licence Application W0129-03.
Response to EPA Article 16: Groundwater

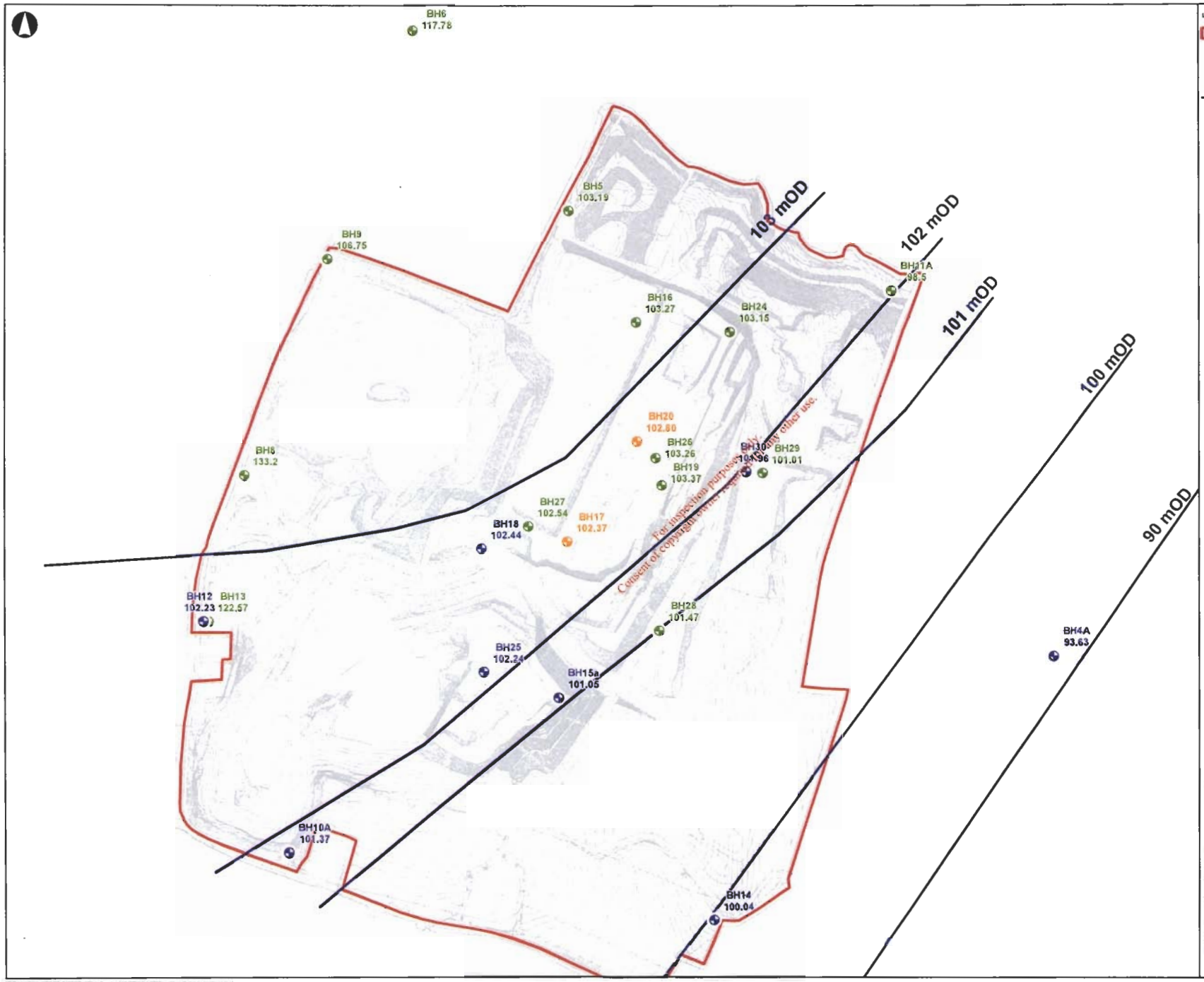
Figure 1.
All site investigations to date
(1989 - 2013)

Scale at A3
1:3,625

Job No	Drawing Status
326877.01	Final

Drawing No	Issue
001	P1

A3



Legend

- MEHL Proposed Planning and Waste Licence Boundary
- Monitoring wells in the aquifer (Viseen: Loughshinny Fm)
- Monitoring wells in the aquitard (Namurian aged formations)
- Wells screened in aquifer and aquitard
- Loughshinny Fm contours

Issue	Date	By	Chkd	Appd
P1	23-08-13	CB	RL	RL

Metres

0 45 90 180

ARUP

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Client

MEHL

Job Title

EPA Waste Licence Application W0129-03,
Response to EPA Article 16: Groundwater

Figure 4.
Groundwater levels and contours:
Loughshinny Formation
8th July 2013

Scale at A3

1:3,500

Job No	Drawing Status
326877.30	Final

Drawing No	Issue
004	P1

A3

Legend

- MEHL Proposed Planning and Waste Licence Boundary
- Monitoring wells in the aquitard (Namurian aged formations)
- Wells screened in aquifer and aquitard
- Namurian groundwater contours

Issue	Date	By	Chkd	Appd
P1	23-08-13	CB	RL	RL

Metres
0 45 90 180

ARUP

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www.arup.com

Client
MEHL

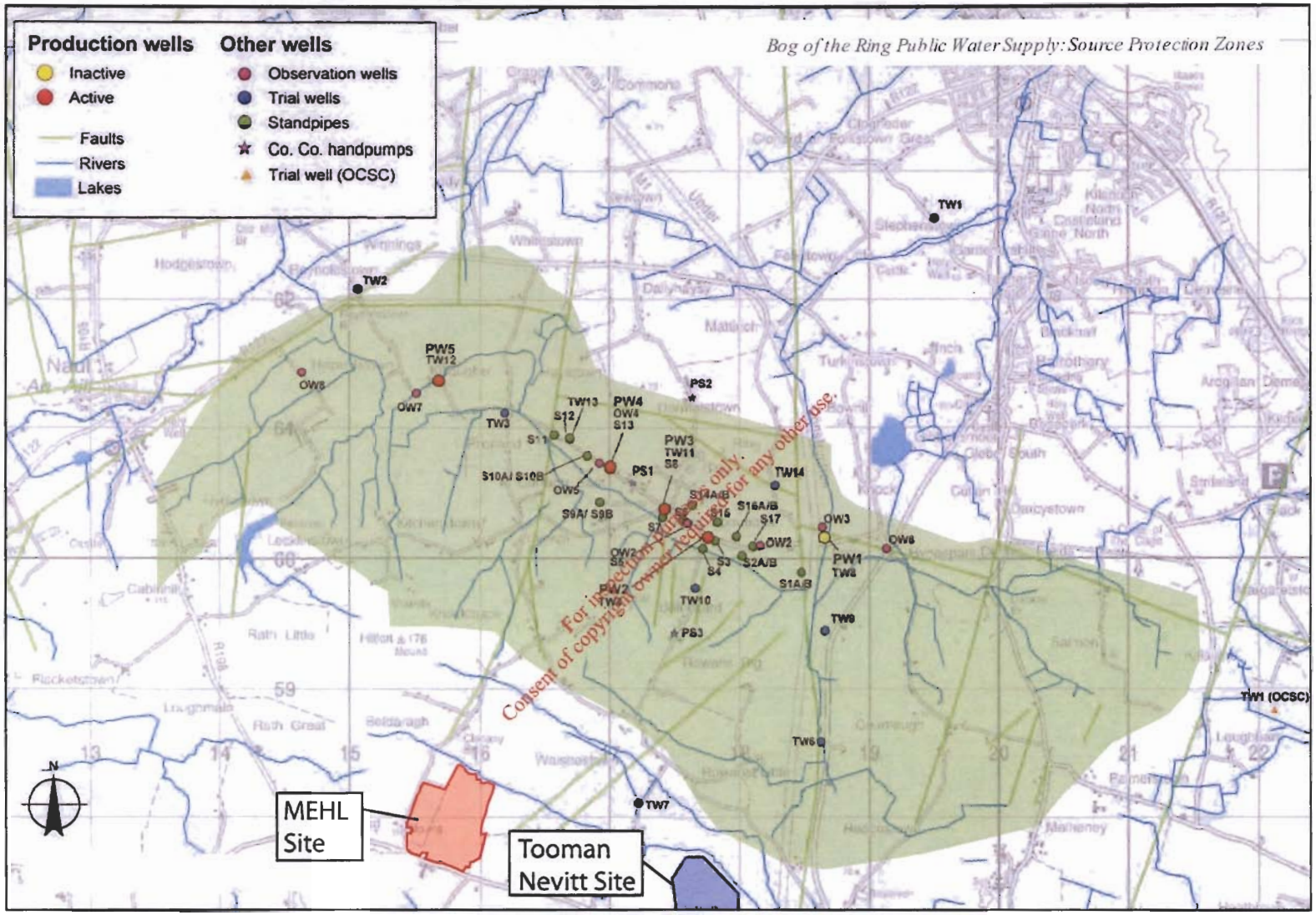
Job Title
EPA Waste Licence Application W0129-03.
Response to EPA Article 16: Groundwater

Figure 5.
Groundwater levels and contours: Namurian Formations
8th July 2013

Scale at A3
1:3,500

Job No	Drawing Status
326877.01	Final

Drawing No	Issue
005	P1



Client: Murphys Environmental Hollywood Ltd	Drawing Title: Bog of the Ring Site Bore Location Plan (GSI, 2005)		
Project Title: Assessment of Hydrogeological Isolation (Bog of the Ring and the MEHL Site)	Job No: 326877-40	Date: 28/01/2013	Figure: 3

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Tel: +353 (0)1 2334455
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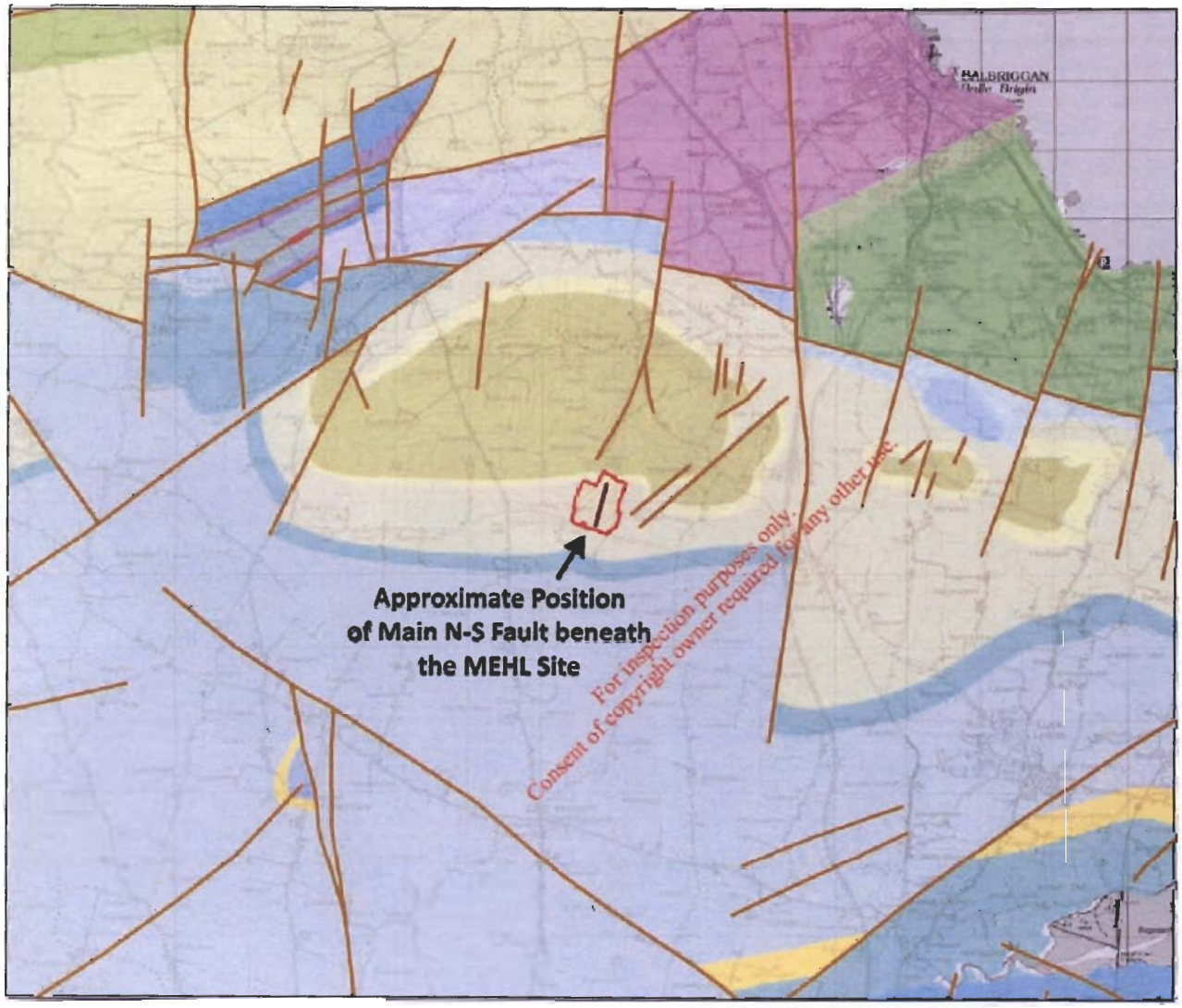

0 metres 600

Scale 1:15,000

Legend

- MEHL Proposed Planning and Waste Licence Boundary
- Faults

GSI Bedrock Geology (1:100,000)

- WL - Walshestown Formation
- BC - Balrickard Formation
- LO - Loughshinny Formation
- NA - Naul Formation
- LU - Lucan Formation

ARUP

wyg

patel tonra

Mahadar Planners

Murphy Environmental Hollywood Ltd

MEHL Integrated
Waste Management Facility
Hollywood Great, Nags Head, Naul, Co Dublin

GSI Geology Map

December 2010

Client	Drawing Title		
Murphys Environmental Hollywood Ltd	Regional Geology (Arup, 2010)		
Project Title	Job No	Date	Figure
Assessment of Hydrogeological Isolation (Bog of the Ring and the MEHL Site)	226877-40	28/01/2013	6

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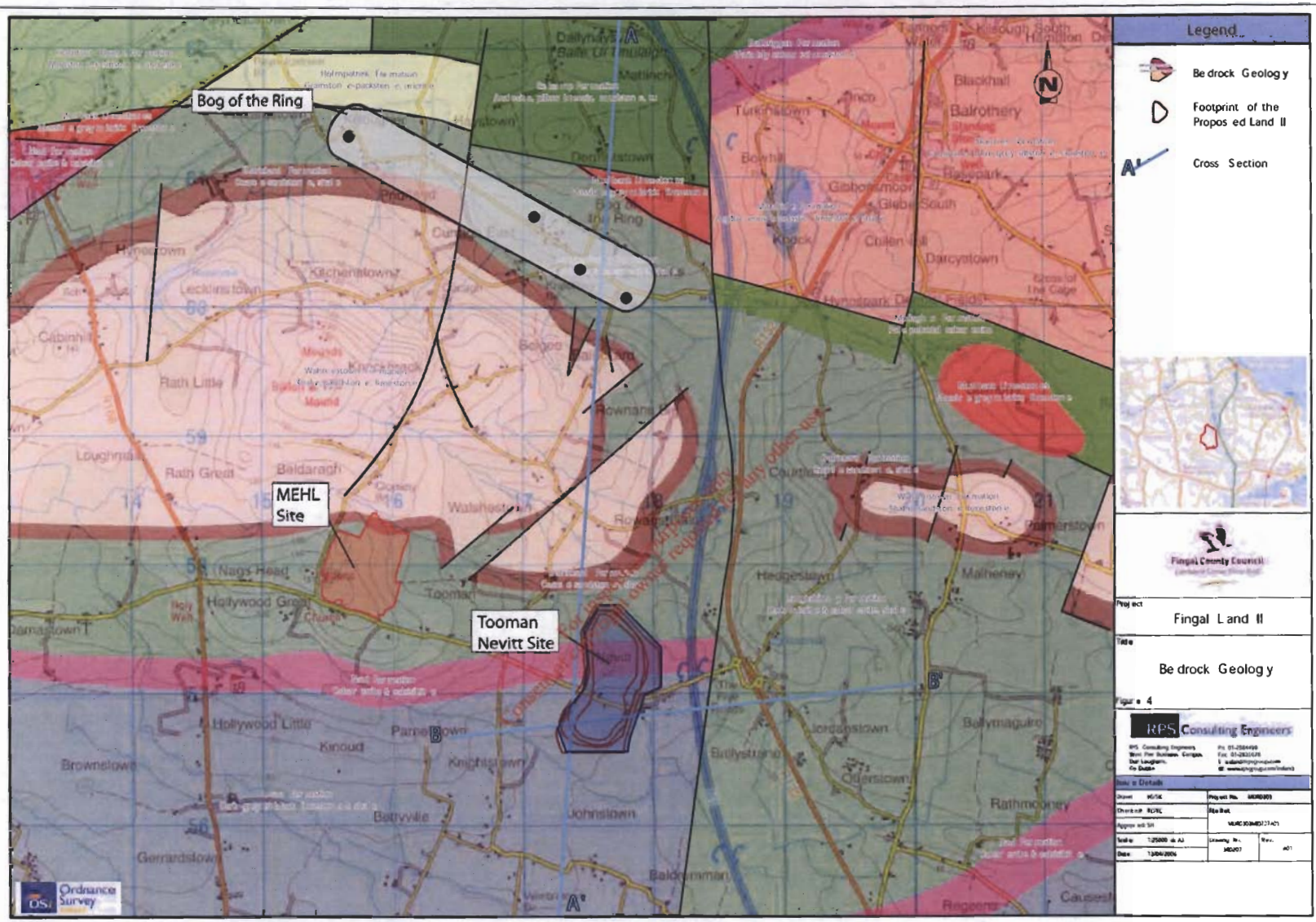

Client: Murphys Environmental Hollywood Ltd	Drawing Title: Cross Section Position and Geological Map (RPS, 2006)		
Project Title: Assessment of Hydrogeological Isolation (Bog of the Ring and the MEHL Site)	Job No: 326877-40	Date: 28/01/2013	Figure: 8

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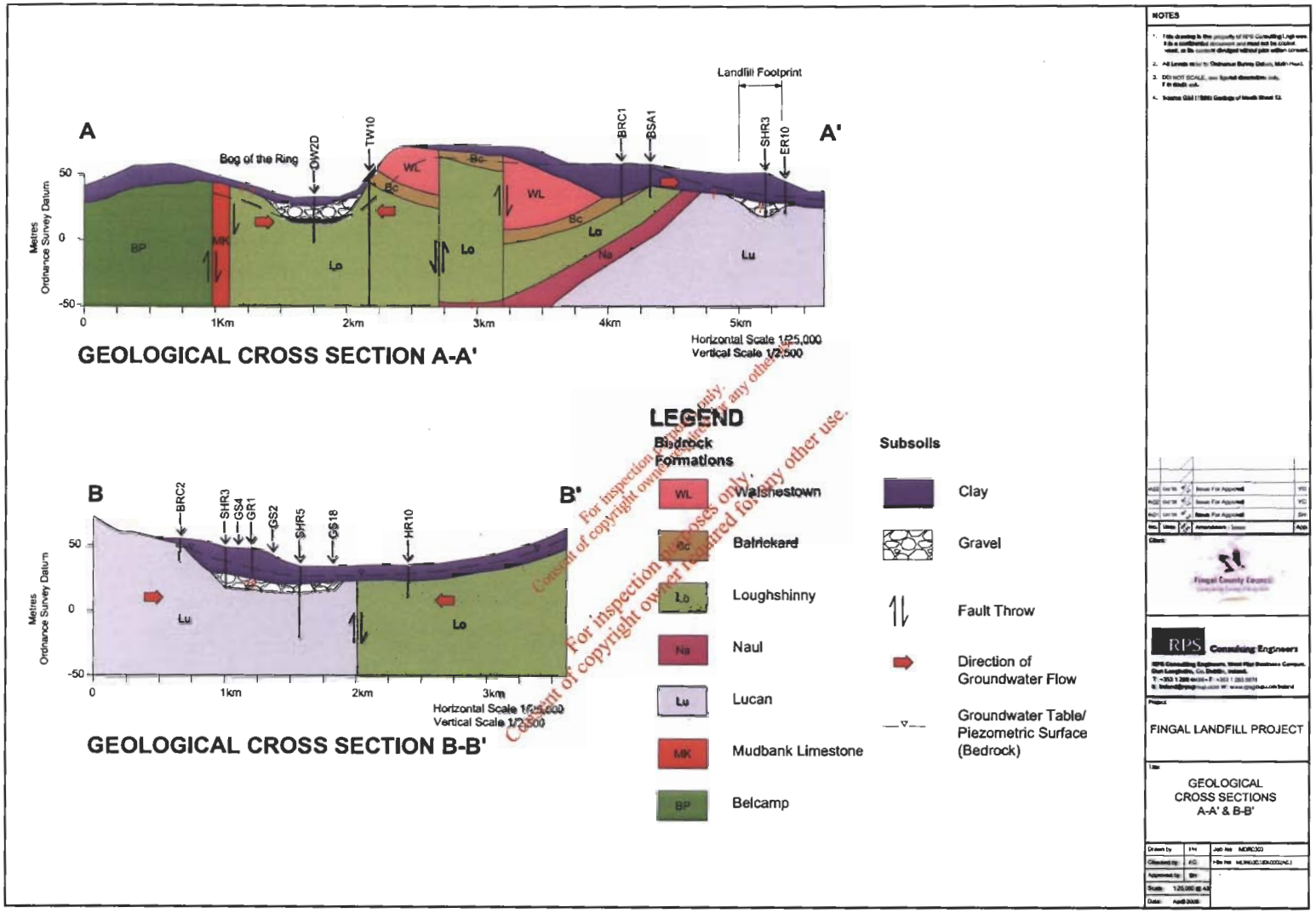

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Project Title: Assessment of Hydrogeological Isolation (Bog of the Ring and the MEHL Site)	Job No: 326877-40	Date: 28/01/2013	Figure: 9

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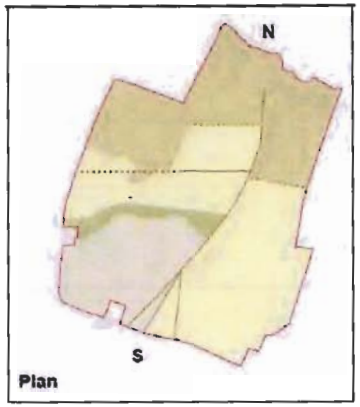

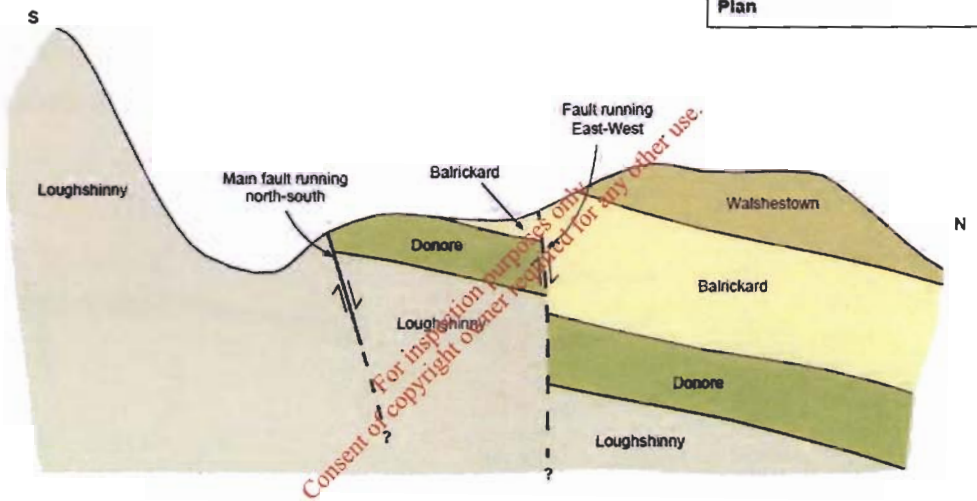

Cross Section

Murphy Environmental Hollywood Ltd

I.S. EN ISO 14001 Certified by Certification Europe Ltd

Client: Murphys Environmental Hollywood Ltd	Drawing Title: MEHL Site Cross Section (MEHL Brief of Evidence, 2011)		
Project Title: Assessment of Hydrogeological Isolation (Bog of the Ring and the MEHL Site)	Job No: 326877-40	Date: 28/01/2013	Figure: 10

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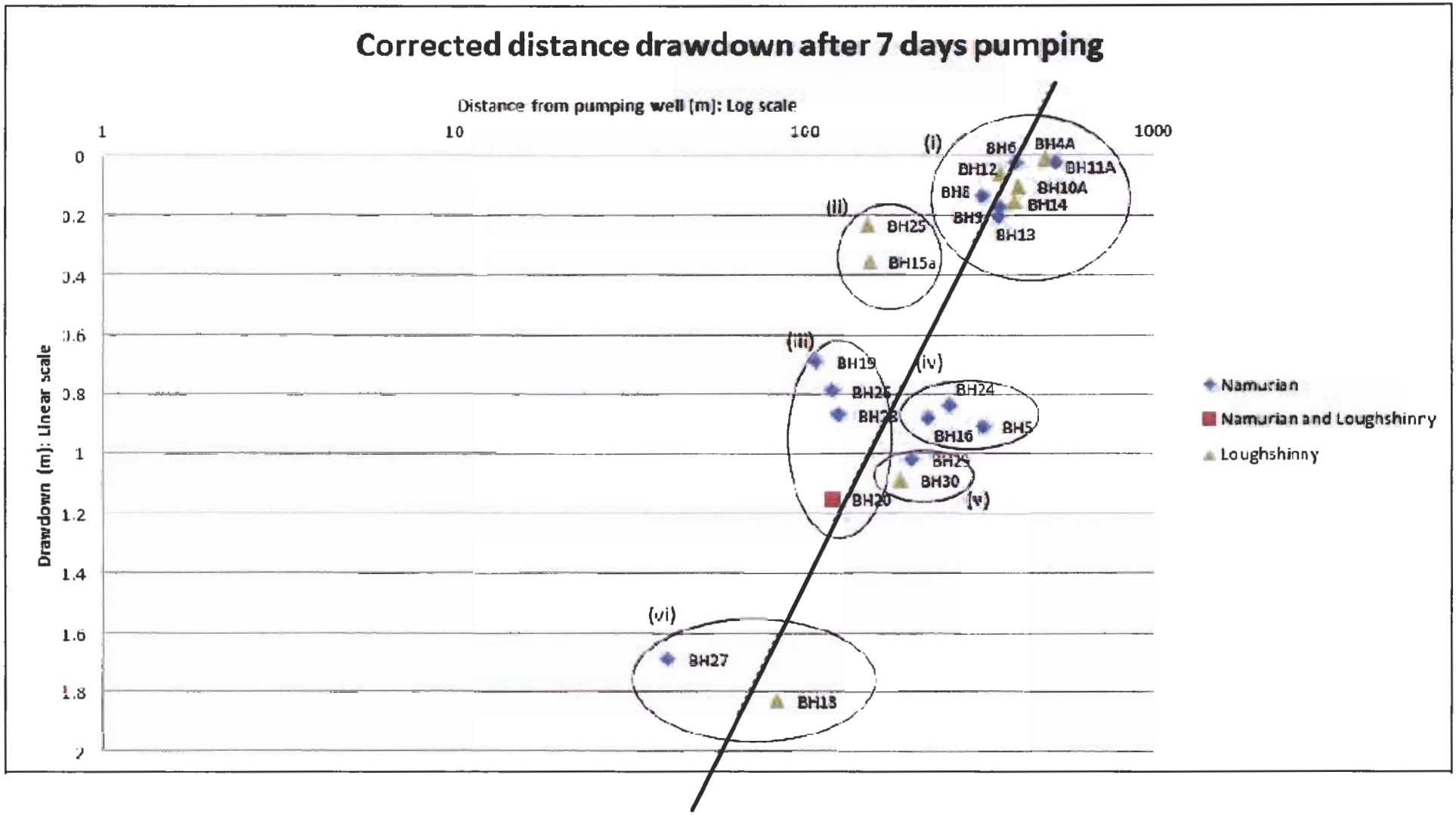
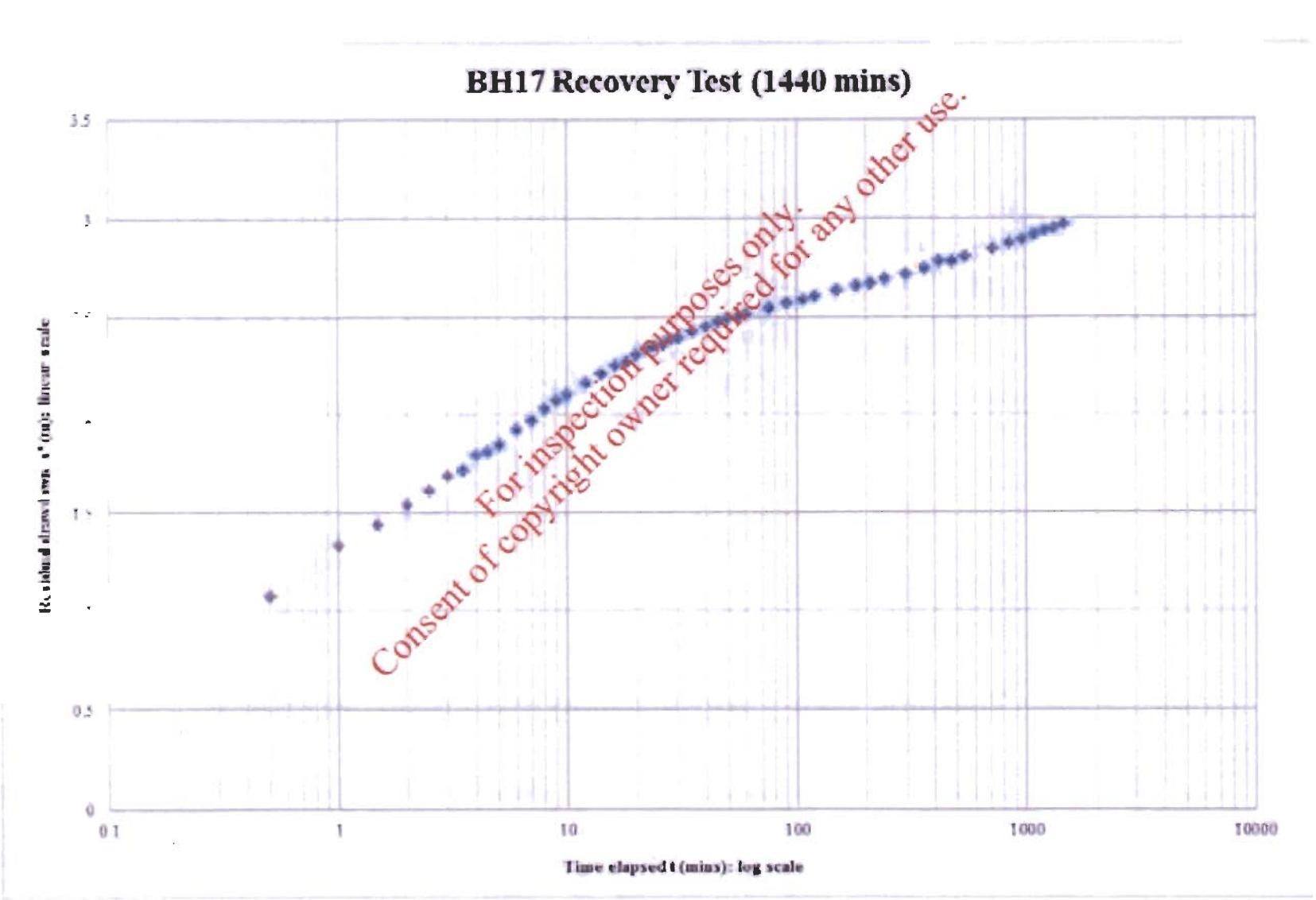
Taken from Appendix H Pumping Test (MEHL Response to EPA Article 16 Report)

Graph 2: Corrected distance-drawdown graph



Taken from Appendix H Pumping Test (MEHL Response to EPA Article 16 Report)

Graph 5. Semi-log plot of recovery observed in pumping well



Groundwater Protection Responses for Landfills – Summary

Response Matrix for Landfills

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

In all cases standards prescribed in the *EPA Landfill Site Design Manual (EPA 1999)* or conditions of a waste licence will apply.

R1 Acceptable subject to guidance in the EPA Landfill Design Manual or conditions of a waste licence.

R2[1] Acceptable subject to guidance outlined in the EPA Landfill Design Manual or conditions of a waste licence

- Special attention should be given to checking for the presence of high permeability zones If such zones are present then the landfill should only be allowed if it can be proven that the risk of leachate movement to these zones is insignificant Special attention must be given to existing wells down-gradient of the site and to the projected future development of the aquifer.

R2[2] Acceptable subject to guidance outlined in the EPA Landfill Design Manual or conditions of a waste licence

- Special attention should be given to checking for the presence of high permeability zones. If such zones are present then the landfill should only be allowed if it can be proven that the risk of leachate movement to these zones is insignificant. Special attention must be given to existing wells down-gradient of the site and to the projected future development of the aquifer.
- Groundwater control measures such as cut-off walls or interceptor drains may be necessary to control high water table or the head of leachate may be required to be maintained at a level lower than the water table depending on site conditions.

R3[1] Not generally acceptable, unless it can be shown that:

- the groundwater in the aquifer is confined; or
- there will be no significant impact on the groundwater; and
- it is not practicable to find a site in a lower risk area.

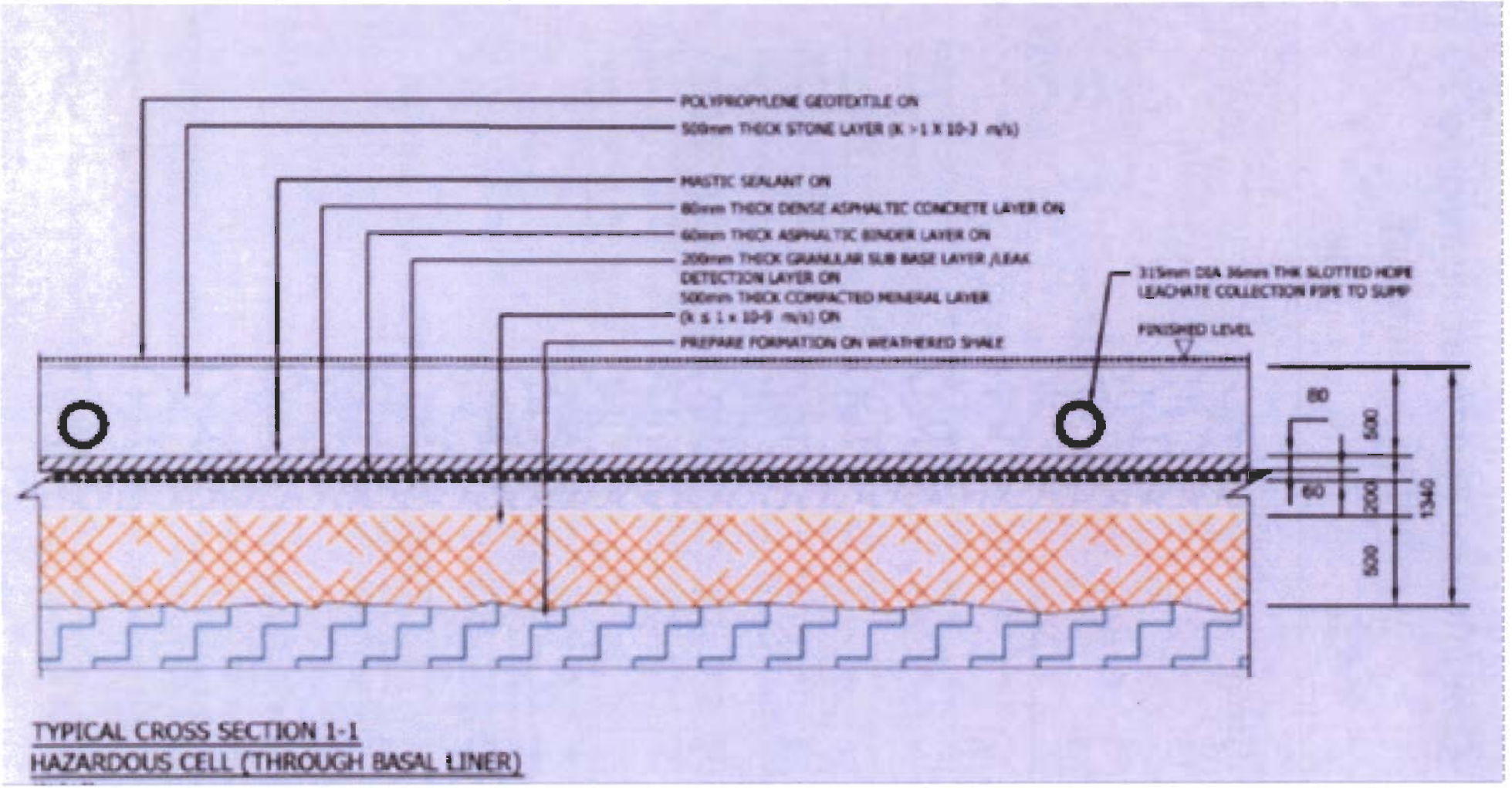
R3[2] Not generally acceptable, unless it can be shown that:

- there is a minimum consistent thickness of 3 metres of low permeability subsoil present,
- there will be no significant impact on the groundwater; and
- it is not practicable to find a site in a lower risk area.

R4 Not acceptable

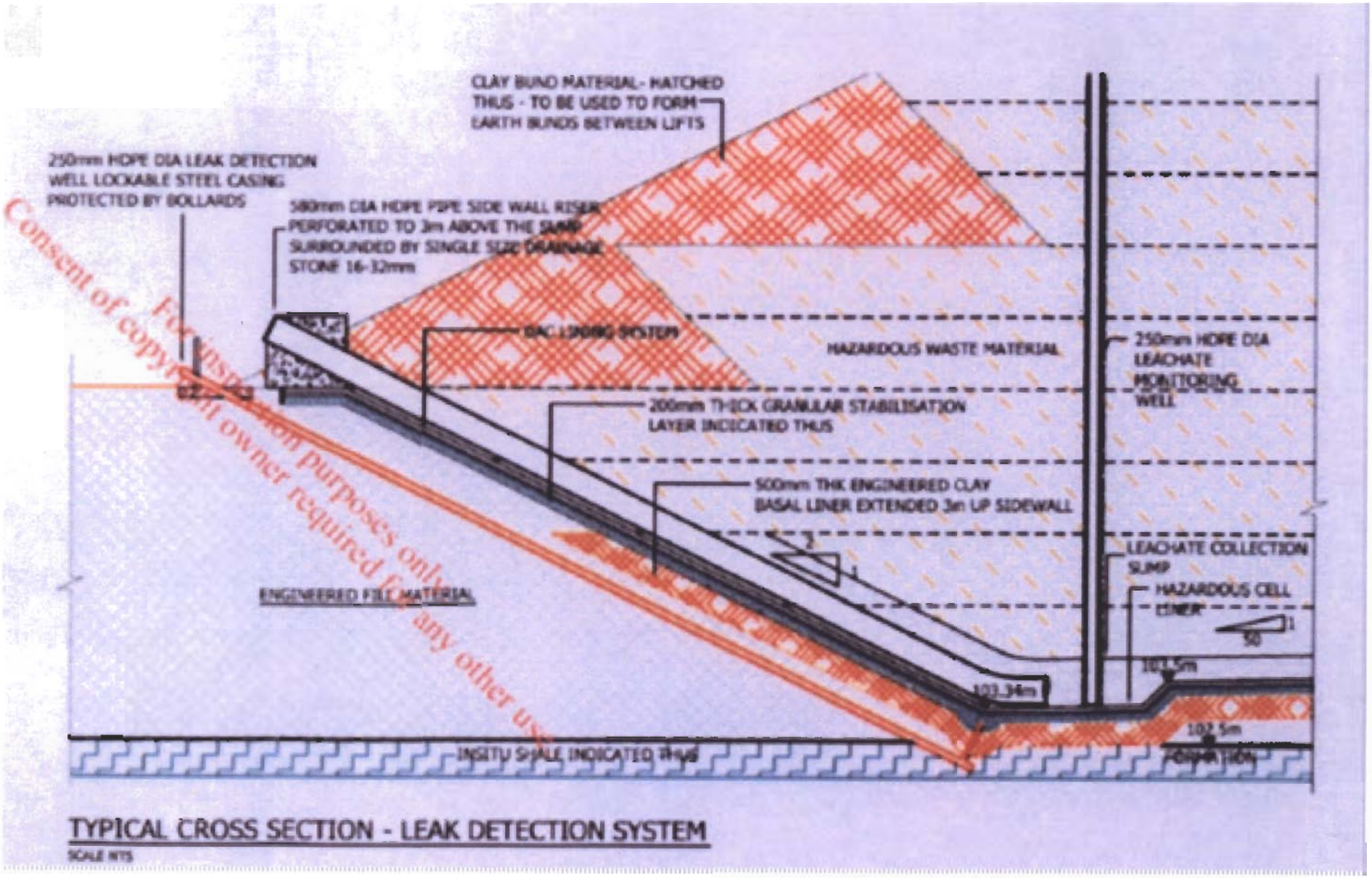
- This guidance is for the siting of landfills for non-hazardous wastes.
- New landfills should not generally be developed on regionally important aquifers.
- The siting, design, operation and monitoring of landfills must comply with the guidelines outlined in the EPA's Landfill manuals except where facilities hold a waste licence issued by the EPA.
- It is recommended that all landfills be located in, or as near as possible to, the zone in the bottom right hand corner of the matrix.
- Special attention should be given to checking for the presence of more permeable zones, such as faults, particularly in fractured bedrock.

Taken from MEHL Waste Management License Application



TYPICAL CROSS SECTION 1-1
HAZARDOUS CELL (THROUGH BASAL LINER)

Taken from MEHL Waste Management License Application



Appendix 2

Deloitte report on financial aspects of fit and proper persons assessment, May 2014

Deloitte.

Report for Environmental Protection Agency reviewing the financial position of Murphy Environmental Hollywood Ltd

Dated May 2014

Deloitte & Touche
Earlsfort Terrace
Dublin 2

Privileged and Confidential

Report for Environmental Protection Agency reviewing the financial position of Murphy Environmental Hollywood Ltd

May 2014

CONTENTS PAGE

APPENDIX

1 Sources of information

1 INTRODUCTION AND TERMS OF REFERENCE

1.1 Deloitte & Touche ("Deloitte", "we" and/or "us"), was appointed by the Environmental Protection Agency, (the "EPA" or "Agency" or "you") under the terms of the Agreement dated 7 April 2014.

1.2 The services to be provided, as included in the Environmental Protection Agency Standard Terms and Conditions of Engagement for Provision of Consultancy Services, are to:

- Provide an opinion as to whether the applicant (Murphy Environmental Hollywood Ltd) has the ability to meet the calculated financial commitments or liabilities, taking into account known and potential liabilities from other sources (creditors, pending or future court actions) that might impact on the ability of the applicant to so meet its commitments and liabilities. This analysis shall take into account the liabilities of Murphy Environmental Hollywood Ltd's sister and parent company or companies to the extent that any such liabilities can impact on the ability of Murphy Environmental Hollywood Ltd to meet its liabilities;

- Provide an opinion as to whether the applicant (Murphy Environmental Hollywood Ltd) can be deemed a fit and proper person for the purpose of section 83 (5)(xi) of the EPA Act 1992 as amended. This should include a detailed rationale for any opinions offered;

- Consider, in the context of the foregoing, relevant submissions made by third parties on the licence application. The inclusion or exclusion of certain submissions may be agreed where necessary with the EPA; and

- Consider any other relevant items.

Structure of this report

1.3 This report is set out as follows:

- In the remainder of this section 1, we set out the background to our work and the limitations on the use of this report;
- At section 2 of the report, we set out our Executive Summary;
- Section 3 sets out our detailed review of the financial position of Murphy Environmental Hollywood Ltd ("MEHL" or "the applicant");
- Section 4 comprises our review of the proposed Environment Liability Risk Assessment ("ELRA") and Closure, Remediation, Aftercare and Management Requirements ("CRAMP") financial provisions;
- Section 5 sets out the financial position of MEHL's related parties, Murphy Concrete Manufacturing Ltd ("MCM") and Seamus Murphy Properties and Developments Limited; and
- Section 6 details our review of third party submissions received by the Agency.

Background to our work

1.4 MEHL applied for a review of waste licence register number W0129-02. The application was assigned register number W0129-03. The existing waste licence (W0129-02) is for the operation of an inert landfill at a facility at Hollywood Great, Nag's Head, Naul, Co. Dublin. The application for a licence review is to seek authorisation to operate an integrated landfill facility including the existing inert landfill and also constructing new non-hazardous and hazardous landfill cells. These classifications of landfill are as per the Landfill Directive (1999/31/EC).

1.5 ELRA considers the risk of unplanned events occurring during the operation of a facility that could result in unknown liabilities materialising.

1.6 A closure plan or CRAMP details the liabilities a licensee will incur with site decommissioning and known liabilities for the facility at closure.

1.7 We have detailed in Appendix 1 the documentation and material we have used in preparing this report.

1.8 To complete our report we have reviewed publicly available information, including the financial statements filed with the Companies Registration Office ("CRO") by the company and its related parties MCM and Seamus Murphy Properties and Developments Limited.

1.9 We have also reviewed the relevant third party submissions made to the EPA. The Agency provided us with a short list of relevant third party submissions.

Limitations on the use of this report

1.10 We understand that the Agency is subject to the provisions of the Freedom of Information Act 1997 and all records created by the Agency or the Consultant in relation to the provision of the Services are therefore in principle available to the public save those which are commercially sensitive. The report may also be provided to MEHL.

1.11 As this report is based on publicly available information we do not believe any of the information reported on is commercially sensitive.

1.12 We cannot accept liability to any third party recipient of our report, including MEHL or any recipient under the Freedom of Information Act 1997. No party other than the EPA is entitled to rely on this report for any purpose whatsoever.

Limitations of the work performed

1.13 Our work comprises a financial review on behalf of EPA, as such we have not reviewed any technical submissions or assessed whether any relevant convictions made against the company and/or the directors might impact on whether MEHL can be considered a fit and proper person.

1.14 This report sets out our findings based on work performed up to 28 May 2014.

1.15 For the purposes of this report, we assumed that the publicly available information is reliable and complete. Whilst we have no reason to doubt the integrity of the information provided, this report should be considered in that

light and we cannot accept any liability for our findings being prejudiced if the publicly available information is incomplete or unreliable.

1.16 We have not discussed with the persons named or referred to in this Report our conclusions based on the publicly available information. Where those conclusions may be critical in nature, we have not given such persons the opportunity to respond to those criticisms in draft. We do not consider it appropriate to do so given the nature of the Report, but wish this to be clear to any subsequent reader.

1.17 This report should not be construed as expressing opinions on matters of law. However, it necessarily reflects our understanding thereof.

2 EXECUTIVE SUMMARY

2.1 This Summary should be read in conjunction with our detailed findings as set out in sections 3, 4, 5 and 6.

2.2 MEHL and MCM have breached Irish Company Law by not filing their financial statements on time with the CRO for the last three years. The 2013 financial statements, with a year end 31 March 2013 should have been filed by the deadline of 31 December 2013. These accounts have not been filed to date.

2.3 We have relied on the 2011 and 2012 filed financial statements for the purpose of our report.

2.4 MEHL reported a loss in both 2011 and 2012. The net current assets were broadly equal to the current liabilities of the company in both years.

2.5 The valuations of the tangible assets included in the financial statements for both years were completed by the company directors and may therefore be overvalued. Independent professional valuations should be completed as this will ensure the accounts accurately reflect the true value of the assets.

2.6 The filed financial statements of MEHL's related companies, MCM and Seamus Murphy Property and Development Limited, are showing the companies in a loss making position, with Seamus Murphy Property and Development Limited having a receiver appointed in 2014.

2.7 MEHL's debt was transferred to NAMA during 2011. No further update was provided in relation to the debt transferred to NAMA or the business plan submitted by the company to NAMA as such we cannot comment on the viability of the business plan and its impact, if any, on the future financial position of the company.

2.8 In 2011 and 2012 the auditors were not provided with adequate information to issue an opinion on the financial statements of MEHL. The auditors noted that the continuing trade of the company is on the basis the licence will be granted to the company by the Agency.

2.9 MCM has given a guarantee over the bank borrowings of MEHL. Our assessment of the position is that if MEHL is unable to obtain additional financial support or if the banks seek to recover the loans made to MEHL, there is a possibility the loan guarantee could be called upon. Based on the financial information which is publicly available MCM does not appear to have sufficient assets to satisfy the guarantee which is provided to MEHL.

2.10 The financial position of Seamus Murphy Property and Development Limited has no relevance to MEHL.

2.11 A report was submitted to the EPA in May 2014 detailing the ELRA, CRAMP and financial provisions to be put in place for the integrated waste management facility.

2.12 MEHL propose the CRAMP financial provisions will be covered by a cash-based account, funded by way of a levy, and a bond.

2.13 If the estimates are correct the levy could generate sufficient cash to meet the cash based element of the CRAMP provision. However as the current financial position of the company is weak the company is not starting the process with any surplus cash to meet any shortfall which may arise.

2.14 While a bond might be considered a sensible approach for funding the balance of the CRAMP financial provision, MEHL have not provided details of how they will fund the initial bond.

2.15 The ELRA provision will be covered by insurance. We cannot comment on MEHL's ability to receive adequate insurance cover for the ELRA as the company does not have environmental liability insurance in place for their current facility.

2.16 As part of our review of the financial position of MEHL we have reviewed a sample of relevant third party submissions, as provided by EPA.

2.17 The third party submissions highlight the issue of the outstanding pyrite claims, non-compliance of Irish Company Law and the financial position of MEHL and MCM as reasons why the licence should not be granted to MEHL.

2.18 On the basis of our review we are unable to conclude that MEHL has evidenced its ability to meet the financial commitments or liabilities that can reasonably

considered will be entered into by carrying on the activity to which the licence application relates.

3 FINANCIAL REVIEW OF MURPHY ENVIRONMENTAL HOLLYWOOD LTD

Background

3.1 MCM began quarrying at the Hollywood site in 1975 (the site has operated as a quarry since the 1940s). In 2003, Murphy Environmental was established as a trading division of MCM, to serve as the waste management division of the company, with responsibility for all aspects of the management and operation of the landfill and compliance with the Waste Licence.

3.2 MEHL was established on 1 October 2008 as a separate legal entity in the form of a limited company. On this date the EPA accepted the Transfer of Waste Licence W0129-02 from MCM to MEHL.

3.3 Seamus Murphy holds 100% of the ordinary shares in MEHL. We are not aware of the rights attached to these shares.

3.4 MCM hold 100% of the "A" Ordinary shares in both MEHL and Seamus Murphy Properties and Developments Limited. The shares held by MCM provide control to the shareholder over the composition of the board of directors. These shares are a different category to the ordinary shares held by Seamus Murphy i.e. the shares held by Seamus Murphy and by MCM are not the same and each shareholding provides different rights to the shareholders.

3.5 MCM is described as the parent company of MEHL and of another company Seamus Murphy Properties and Developments Limited.

3.6 As part of our work we were asked to review the financial positions of MCM and Seamus Murphy Properties and Developments Limited to assess whether their financial position has any impact on the ability of MEHL to meet its potential obligations under ELRA and CRAMP. Our work in this regard is detailed in Section 5 below.

3.7 MEHL applied for a review of waste licence register number W0129-02. The application was assigned register number W0129-03. The existing waste licence (W0129-02) is for the operation of an inert landfill at a facility at Hollywood

Great, Nag's Head, Naul, Co. Dublin. The application for a licence review is to seek authorisation to operate an integrated landfill facility including the existing inert landfill and also constructing new non-hazardous and hazardous landfill cells. These classifications of landfill are as per the Landfill Directive (1999/31/EC).

3.8 Rory Murphy and Emma Murphy are the current directors of MEHL. Rory Murphy is also the company secretary of MEHL.

3.9 The table below sets out the appointment and resignation dates of directors in the last seven years.

Table 3.1 MEHL appointment and resignation of directors

Director	Date of appointment	Date of resignation
Seamus Murphy	12 November 2007	3 April 2012[1]
Patricia Rooney	22 July 2008	25 June 2013
John Fortune	8 October 2012	11 April 2014
Rory Murphy	12 November 2007	n/a
Emma Murphy	25 August 2008	n/a

Financial Statements of Murphy Environmental Hollywood Ltd

3.10 MEHL has a financial year end of 31 March. Under Irish Company Law, a company must file its financial statements with the CRO nine months after its financial year end i.e. for a 31 March 2013 year end the statements should be filed by 31 December 2013.

3.11 A maximum penalty of €1,200 is applied to each late filed return.

[1] Seamus Murphy also resigned as secretary on this date.

3.12 As at 19 May 2014, the 2013 accounts were yet to be filed. MEHL is therefore not compliant with Irish Company Law.

3.13 For this review, in the absence of more up to date filed financial statements we have based our comments on the 2011 and 2012 financial statements. The 2011 accounts were filed with the CRO on 17 August 2012 and the 2012 accounts were filed on 21 February 2013, eight months and two months after the respective deadlines.

3.14 MEHL has filed abridged accounts with the CRO. A company is not required to file full annual accounts where they can satisfy two of the following three conditions:

- The balance sheet total does not exceed €7.62m;
- Turnover does not exceed €15.24m; and
- The company has no more than 250 employees.

3.15 Abridged accounts do not provide the same level of detail as full financial statements. Companies who qualify to file abridged accounts are not required to show their profit and loss account. However, it is possible to determine the profit/loss of a company based on the movement of the profit and loss account on the balance sheet each year.

3.16 Table 3.2 sets out the movements in the MEHL balance sheet from 2011 to 2012, with the significant issues detailed in the financial statements and the auditor's reports analysed below.

Table 3.2 MEHL movement on balance sheet from 2011 to 2012

	2012	2011	Movement
Fixed Assets	18,239,064	18,243,072	(4,008)
Current Assets	1,421,801	1,073,297	348,504
Current Liabilities	(1,446,748)	(1,093,863)	(352,885)

Long term Liabilities	(9,498,529)	(8,903,484)	(595,045)
Net Assets	**8,715,588**	**9,319,022**	**(603,434)**
Profit and loss account	(21,203,841)	(20,600,407)	(603,434)

2011 financial statements and Audit report

3.17 The company had net assets of €9.3m at 31 March 2011 which would indicate it was solvent on a balance sheet basis. However, the Company's net current assets (i.e. amounts receivable in the following year) were broadly equal to its current liabilities. The positive net asset position was based on the existence of significant fixed assets being property with a value of €18.2m

3.18 The company reported a loss of €563,247 in 2011 and a loss of €1.23m in 2010, due to *"difficult trading conditions in the current year as a result of the downturn in the construction industry"*.

3.19 The company auditors, Nexia, Smith and Williamson, included an emphasis of matter[2] paragraph in the 2011 audited accounts. This paragraph stated that the company continuing as a going concern[3] was dependent on the predictions within the cashflow projections being achieved and the directors being successful in negotiating necessary financial support.

3.20 In 2011 the directors had revalued the tangible assets of the company from €35m down to €18m. The basis for this revaluation has not been disclosed in the abridged financial statements and we have seen no evidence that an independent valuation was completed on the assets.

[2] An emphasis of matter paragraph indicates a significant or important matter where, although auditors agree with the position taken they believe should be brought to the attention of the reader.

[3] A going concern basis assumes that the company will continue in operational existence for the foreseeable future, which is taken to be a period of at least 12 months from the date on which the financial statements are signed.

3.21 Due to the lack of information surrounding the asset revaluation the auditors stated in their independent report that they *"have not obtained all the information and explanations that we consider necessary for the purpose of our audit; and we were unable to determine whether proper books of account have been kept by the company"*.

3.22 The 2011 accounts refer to the continuing trade of the company being based on a licence being granted by the EPA, which the directors believed there would be no issue in receiving.

2012 financial statements and Audit report

3.23 The auditors of MEHL were unable to form an opinion on the 2012 financial statements due to the limited evidence available to them as *"the ability of the company to realise the directors' valuation of €18,235,000 in respect of the company's land and buildings is subject to a number of significant uncertainties relating to the current economic environment."* Similar to 2011, the auditors stated that they did not receive all information and explanations they considered necessary.

3.24 For 2012 the auditor also included an emphasis of matter paragraph which stated that the company continuing as a going concern is based on the assumption *"that the company will be successful in its licence application"*.

Key issues raised in the 2012 financial statements

3.25 The auditors included an emphasis of matter paragraph which referred to future material uncertainty and to the necessity for the company to negotiate financial support.

3.26 The company has a net asset value of €8.7m for 2012. This is driven by a value of €18.2m being placed on the land, which has been questioned by the auditors. The auditors stated in their basis of audit opinion that *"the evidence available to us was limited... the ability of the company to realise the directors' valuation of €18,235,000 in respect of the company's land and buildings is subject to a number of significant uncertainties relating to the current economic*

environment". Other than tangible assets, the company has limited current assets with a value of only €1.4m which is offset by net current liabilities of €1.4m. The majority of short and long term creditors relates to NAMA held debt.

Debt facilities

3.27 During 2011 the company's debt facilities were transferred to NAMA. At the time of sign off of the accounts the company was awaiting NAMA's assessment of its business plan.

3.28 The 2012 accounts stated that NAMA hold a fixed and floating charge over all the assets of the company with a specific charge over the company's land.

3.29 A fixed charge is security over a particular asset. A floating charge constitutes a charge over all assets of the company. The company remains free to deal with its assets in the ordinary course of business. The charge only becomes a fixed charge upon crystallisation. Crystallisation occurs on the appointment of a receiver or liquidator and the floating charge fixes on all assets in the ownership of the company at that time.

3.30 A fixed charge provides NAMA with priority over preferential creditors. However with a floating charge the preferential creditors, such as Revenue, rank in priority to the floating charge, but after the fixed charge. The EPA would not be considered a preferential creditor and as such would rank below NAMA and Revenue.

3.31 NAMA also hold a letter of guarantee in respect of MEHL from MCM for €8.36m.

Losses reported

3.32 MEHL has made losses for the last three consecutive years and their net asset position has continued to reduce as detailed in table 3.3.

Table 3.3. MEHL net asset position and losses reported

	Net Assets	Loss for the year
2012	8,715,588	€696,000
2011	9,319,022	€563,000
2010	26,249,745	€1,226,000

Conclusion

3.33 MEHL has breached Irish Company Law by not filing their financial statements on time with the CRO for the last three years. The 2013 financial statements, with a year end 31 March 2013 should have been filed by the deadline of 31 December 2013. These accounts have not been filed to date.

3.34 We have relied on the 2011 and 2012 filed financial statements for the purpose of our report.

3.35 MEHL reported a loss in both 2011 and 2012. The net current assets were broadly equal to the current liabilities of the company in both years.

3.36 The auditors included an emphasis of matter paragraph which referred to future material uncertainty and to the necessity for the company to negotiate financial support.

3.37 The company has a net asset value of €8.7m for 2012. This is driven by a value of €18.2m being placed on the land, which has been questioned by the auditors. The auditors stated in their basis of audit opinion that *"the evidence available to us was limited... the ability of the company to realise the directors' valuation of €18,235,000 in respect of the company's land and buildings is subject to a number of significant uncertainties relating to the current economic environment"*. Other than tangible assets, the company has limited current assets with a value of only €1.4m which is offset by net current liabilities of €1.4m. The majority of short and long term creditors relates to NAMA held debt.

3.38 In absence of any update we are unable to conclude that the company can meet liabilities for ELRA and CRAMP.

4 ELRA/CRAMP

4.1 Patel Tonra Ltd, Environmental Solutions was commissioned by MEHL to assess the company's obligations in relation to ELRA, CRAMP and financial provisions. A report submitted to the EPA on 21 May 2013 detailed the financial provisions to be put in place for the integrated waste management facility based upon the EPA's *"Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision (2006)"*.

4.2 An updated report was submitted to the EPA on 9 May 2014 and this is the report we have reviewed and analysed for our report.

4.3 The May 2014 report has been completed with reference to the new EPA *"Guidance on assessing and costing environmental liabilities (2014)"*.

4.4 MEHL have categorised the liabilities based on six phases:

- Phase 0: Pre-licensing
- Phase 1: Year 0 – Year 4
- Phase 2: Year 5 – Year 12
- Phase 3: Year 13 – Year 23
- Phase 4: Year 24 – Year 25
- Aftercare: Aftercare stage

4.5 The aftercare programme is based on a five year active aftercare management period, followed by a five year passive aftercare management period and any additional periods based on performance assessments.

4.6 Unit cost rates have been used to prepare the ELRA and CRAMP calculations. We have not validated these rates but for the purpose of this report and analysis we assume they are reasonable.

4.7 MEHL are proposing financial provisions relating to CRAMP will be reported to the EPA at least annually.

4.8 MEHL propose financial provision of €11.58m broken down as follows:

Table 4.1 Proposed financial provision

Liability Type	**Amount (€)**
Financial provision for closure	5,487,396
Financial provision for aftercare	421,108
Sub-Total CRAMP liability	5,908,504
Financial provision for incidents (ELRA)	5,672,391
TOTAL	**11,580,894**

4.9 MEHL intend to cover CRAMP financial provisions of €5.9m using what they call a cash-based account and by putting bonds in place.

4.10 The ELRA financial provision of €5.67m will be covered 95% by insurance and 5% by a bond both of which will be in place from Phase 1.

4.11 We discuss the proposals for each of CRAMP and ELRA below.

Proposals for CRAMP and our comments

4.12 MEHL anticipate the majority of CRAMP costs will arise in Phase 4 (€3.7m) with *"Capping and drainage"* costs of €788k and €972k arising in Phase 2 and Phase 3, respectively.

4.13 Based on the high level of costs to be incurred from Phase 4, MEHL recommend that the Phase 4 CRAMP liability should be front-loaded over Phase 1 to 3, with the financial provision per phase being put in place prior to the commencement of the relevant phase.

4.14 The table below details the CRAMP financial provisions and the percentage covered by a cash account (€4.9m) or by a bond (€965k).

Table 4.2 Proposed funding of CRAMP financial provision

Phase	**Liability (€)**	**Cash-based**	**Bond**
Phase 0	0		
Phase 1	864,053	30%	70%

Phase 2	2,171,156	90%	10%
Phase 3	2,873,295	95%	5%
Phase 4	0	100%	0%
Aftercare Stage	0	100%	0%
Financial provision for closure and aftercare	**5,908,504**	**4,942,886**	**965,618**

4.15 MEHL intend to build up the cash account by imposing an "FP Levy" on users of the facility based on the tonnage of waste accepted during a given phase.

4.16 Table 4.3 details the estimated accepted tonnes, including hazardous non-hazardous and inert waste and levy per phase.

Table 4.3 Estimated tonnes and levy income per phase

	Phase 1	Phase 2	Phase 3	Phase 4
Tonnes per phase	732,433	2,538,894	2,599,719	630,261
FP Levy per phase	€2,535,309	€3,326,265	€847,138	€108,262

4.17 Although we are not reviewing the technical aspect of the submission we note in 2012 MEHL accepted 46,540 tonnes of waste and advised the Agency that it had total disposal capacity of 9.71m tonnes. The proposal details capacity of 6.5m. We believe the Agency should review the appropriateness of the level of estimated tonnes accepted at each phase included in the proposal to determine if it is a realistic estimate.

4.18 If the estimates are correct the levy could generate sufficient cash to meet the cash based element of the CRAMP provision. However, we consider that regular reporting to the Agency would be required to ensure the income is meeting the estimates.

4.19 While a bond might be considered a sensible approach for funding the balance of the CRAMP financial provision, MEHL have not provided details of how they will fund the initial bond. Given that the company has minimum funds in the bank, €10,733 at the end of 2012, this process may prove challenging.

Proposals for ELRA and our comments

4.20 MEHL proposes insurance to cover the ELRA provision but we understand that it currently has no environmental liability insurance in place for its current facility. We cannot confirm if this is due to no cover being requested or it not being provided. We have therefore seen no evidence that MEHL will have the required insurance cover for the new facility to meet the financial provision for ELRA.

5 RELATED COMPANIES

5.1 As part of our work we were asked to review the financial positions of MCM and Seamus Murphy Properties and Developments Limited to assess whether their financial position has any impact on the ability of MEHL to meet its potential obligations under ELRA and CRAMP.

Murphy Concrete Manufacturing Ltd

5.2 The MCM accounts for the year ended 31 March 2012 were submitted to the CRO on 13 March 2014. This was 15 months after the deadline and as such the company was in contravention of Irish Company Law.

5.3 The 31 March 2013 accounts are yet to be filed and are therefore overdue by almost five months.

5.4 In the absence of up to date financial statements we have examined the 2011 and 2012 financial statements.

2011 Financial Statements

5.5 The 2011 accounts for MCM advise through a note to the accounts that *"Due to lack of trading activities the directors have decided to cease trading on the 21 December 2011"*.

5.6 The auditors, Nexia, Smith and Williamson, were unable to form an opinion on the 2011 financial statements due to the uncertainty of the valuation made on the company's principal asset. The nature of the principal asset is not detailed in the accounts.

5.7 The company had net assets of €6m down from €11.5m in 2010. This was primarily due to the revaluation of the land values and the EPA licence which were written down by €4.115m in 2011.

5.8 The company's cash at bank and debtors, which makes up the majority of the company's current assets reduced by almost €1m from 2010 to 2011.

5.9 A note to the 2011 financial statements discloses a contingent liability for *"potential claims relating to the alleged supply of certain defective products to customers. Any liability alleged is denied. It is not possible to assess the validity of the claims, at this time"*. No reference is made to this claim in the 2012 accounts, however we understand from third party submissions that these claims relate to issues regarding pyrite claims and have not yet been settled.

2012 Financial Statements

5.10 The auditors were unable to form an opinion on the 2012 financial statements due to the inability to obtain sufficient appropriate audit evidence, information and explanations which they consider necessary for the purpose of their audit.

5.11 The company's net asset position reduced by €300k to €5.7m between 2011 and 2012.

5.12 MCM has given a guarantee over the bank borrowings of MEHL. MEHL's bank borrowings at 31 March 2012 were €9.5m. The directors of MCM state in their 2012 financial statements that they are of the opinion that MEHL will continue to receive financial support from their bank. However, as detailed in paragraph 3.25, it was stated in the 2012 financial statements that it was necessary for MEHL to negotiate financial support.

5.13 Our assessment of the position is that if MEHL is unable to obtain additional financial support, or if the banks seek to recover the loans made to MEHL there is a possibility the loan guarantee could be called upon.

5.14 Based on the financial information which is publicly available MCM does not appear to have sufficient assets to satisfy the guarantee which is provided to MEHL.

Seamus Murphy Properties and Developments Limited

5.15 Seamus Murphy Properties and Developments Limited is a wholly owned subsidiary of MCM. It is property development company with Rory Murphy and Seamus Murphy as directors.

5.16 The company filed their financial statements for the year ended 31 December 2011 on 20 December 2013, 15 months after the filing deadline.

5.17 No accounts for 31 December 2012 have been filed and are therefore overdue by eight months.

5.18 The 2011 accounts detail judgments in the amounts of €17m and €886k being registered against the company by banks and joint venture partners, respectively. The company was unable to meet these judgments.

5.19 The company had a loss of €2m in 2011 increasing from a loss of €1.02m in 2010.

5.20 The auditors, Nexia, Smith and Williamson, stated that the company could not be considered a going concern at the time of signing off the accounts.

5.21 A receiver was appointed to Seamus Murphy Properties and Developments Limited on 11 March 2014.

5.22 Although MEHL and Seamus Murphy Properties and Developments Limited are related parties we do not consider that the financial position of Seamus Murphy Properties and Developments Limited has any implication for the ability of MEHL to meet its potential liabilities under ELRA and CRAMP.

6 THIRD PARTY SUBMISSIONS

6.1 As part of our work on MEHL we have reviewed a sample of relevant third party submissions, as provided by EPA.

6.2 Below we have reviewed and summarised the third party submissions based on the main issues raised in the submissions which were deemed relevant to our work by the EPA. These are discussed below under the headings of general financial position, pyrite claims and other.

General financial position

6.3 A submission made by the Hollywood and District Conservation Group on 19 July 2012 raised the following issues in relation to the financial viability of MEHL:

- Cross guarantees are in place between company assets of MEHL and MCM; and
- No evidence has been provided that MEHL can guarantee the existence of €145m to cover aftercare landfill costs.

6.4 We have not seen any evidence of cross guarantees being in place between the companies. We have discussed the impact the guarantee MCM has given in respect of MEHL's loan in paragraph 5.14.

6.5 We have reviewed the issue of MEHL's ability to cover aftercare costs in section 4.

Pyrite Claims

6.6 All of the submissions reviewed raise the issue of the pyrite claims against MCM.

6.7 The Hollywood and District Conservation Group advised that a number of court cases have been filed for the alleged supply of materials containing high levels of pyrite to developers and contractors.

6.8 The Group's submission states that under current legal ruling by the High Court, is that the courts are holding the producers of the materials solely responsible for the costs. MCM is listed as a defendant in at least 15 cases, where the average cost of putting good any home constructed using materials containing high pyrite is in the region of €80k per dwelling, not including additional compensation.

6.9 The Group believes the EPA should not consider the application until all court cases pending against MEHL have been decided upon and all claims settled.

6.10 In a separate submission the Hollywood and District Conservation Group states that MEHL failed to inform the EPA of the potential contagion liabilities that their company is exposed to as a result of pyrite claims.

6.11 Submission 59 made by Greenstar to the EPA states that *"Given recent experiences of pyrite damage nationally and the most recent High Court Judgement in the is regard (James Elliot Construction Ltd –v- Irish Asphalt Ltd, May 2011) it would seem wise for any quarry proposing to host a hazardous waste landfill site to consider within their ELRA, CRAMP and Financial Provision Assessments the risk of the existence of pyritic materials on the site."*

6.12 Greenstar also state in this submission that assessment of such risks are essential in determining the financial provisions.

6.13 Whilst it is apparent that MCM faces existing claims from pyrite issues this submission appears to suggest a potential issue relating to MEHL's facilities. We consider this to be a technical issue for the EPA to consider whether such a provision should be incorporated within the ELRA or CRAMP provision.

Other

6.14 The following additional comments were made in the third party submissions:

6.15 Submission 55 received by EPA refers to two separate newspaper articles relating to MEHL director, Seamus Murphy:

- Irish Independent 21 February 2011 detailed a judgment for €886k made by Treasury Group against Mr Seamus Murphy for legal costs incurred; and

- The Irish Times on 7 July 2010 ran an article detailing ACC bank was pursuing Mr Seamus Murphy for judgment orders in the amount of €17m and that this case was transferred to the commercial court.

6.16 Our review has shown that as at 29 April 2014, the judgment made by Treasury Group, specifically Drocarne Ltd, had not been satisfied.

6.17 The Hollywood and District Conservation Group raised the issue of Mr Seamus Murphy resigning as a Director of MEHL on 3 April 2012 but remaining a majority shareholder. The submission questions the gap in expertise on the board the resignation creates.

6.18 As detailed above, Mr Seamus Murphy holds 100% of the ordinary shares in MEHL however we are unable to clarify what rights these shares hold. From a financial perspective this change should not have any impact.

6.19 The Group's submission also relayed the fact that the last set of accounts filed by MEHL to the CRO was 31 March 2010 and as such the company is not compliant with Company Law. We addressed this issue in Section 3.

APPENDIX 1

Sources of information

- Murphy Environmental Hollywood Ltd abridged financial statements for the years ended 31 March 2011 and 31 March 2012
- Murphy Environmental Hollywood Ltd Form B10 – Change of director or secretary details for 2012, 2013 and 2014
- Murphy Concrete (Manufacturing) Limited abridged financial statements for the years ended 31 March 2011 and 31 March 2012
- Seamus Murphy Properties & Developments Limited financial statements for the year ended 31 December 2011
- Murphy Environmental Hollywood Ltd Form E8 – Notice of appointment of receiver 2014
- Patel Tonra Ltd Environmental Solutions *"ELRA, CRAMP and Financial Provision Assessment for Proposed Integrated Waste Management Facility (W0129-03) May 2014"*
- Third party submission to the EPA: submission numbers 55, 59, 60, 70, 71, 75, and 78.

Appendix 3

Groundwater Protection Responses for Landfills - Summary

Groundwater Protection Responses for Landfills – Summary

Response Matrix for Landfills

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

In all cases standards prescribed in the *EPA Landfill Site Design Manual (EPA,1999)* or conditions of a waste licence will apply.

R1 Acceptable subject to guidance in the EPA Landfill Design Manual or conditions of a waste licence.

R2[1] Acceptable subject to guidance outlined in the EPA Landfill Design Manual or conditions of a waste licence.

- Special attention should be given to checking for the presence of high permeability zones. If such zones are present then the landfill should only be allowed if it can be proven that the risk of leachate movement to these zones is insignificant. Special attention must be given to existing wells down-gradient of the site and to the projected future development of the aquifer.

R2[2] Acceptable subject to guidance outlined in the EPA Landfill Design Manual or conditions of a waste licence.

- Special attention should be given to checking for the presence of high permeability zones. If such zones are present then the landfill should only be allowed if it can be proven that the risk of leachate movement to these zones is insignificant. Special attention must be given to existing wells down-gradient of the site and to the projected future development of the aquifer.
- Groundwater control measures such as cut-off walls or interceptor drains may be necessary to control high water table or the head of leachate may be required to be maintained at a level lower than the water table depending on site conditions.

R3[1] Not generally acceptable, unless it can be shown that:

- the groundwater in the aquifer is confined; or
- there will be no significant impact on the groundwater; and
- it is not practicable to find a site in a lower risk area.

R3[2] Not generally acceptable, unless it can be shown that:

- there is a minimum consistent thickness of 3 metres of low permeability subsoil present;
- there will be no significant impact on the groundwater; and
- it is not practicable to find a site in a lower risk area.

R4 Not acceptable.

- This guidance is for the siting of landfills for non-hazardous wastes.
- New landfills should not generally be developed on regionally important aquifers.
- The siting, design, operation and monitoring of landfills must comply with the guidelines outlined in the EPA's Landfill manuals except where facilities hold a waste licence issued by the EPA.
- It is recommended that all landfills be located in, or as near as possible to, the zone in the bottom right hand corner of the matrix.
- Special attention should be given to checking for the presence of more permeable zones, such as faults, particularly in fractured bedrock.

Appendix 4

Geosyntec letter to Agency dated 16 March 2012 (referred to on page 6 of the Geosyntec report in Appendix 2)

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16th March, 2012

Project 00146-014

Office of Environmental Enforcement

Environmental Protection Agency

PO Box 3000

Johnstown Castle Estate

Co. Wexford

Attention: Brian Meaney

Re. Apparent main data gaps and related concerns in the information provided by MEHL in their waste license application W0129-03

Dear Brian,

In following up to our January letter and our subsequent telephone discussion early this week FCG is pleased to present this letter which is designed to summarise the main points we believe the EPA should raise with MEHL, linked mainly to the geological and hydrogeological aspects of their license application W0129-03.

There is relatively limited site investigation (site specific geological and hydrogeological) data, which is currently insufficient to develop a robust conceptual site model (CSM), leading to full site assessment and support of the investigation, monitoring and modelling work that has been completed to date. The site is geologically and hydrogeologically complex including exposed bedrock and major faulting. Over and above this the site setting is sensitive with a local stream, underlain by a Locally Important aquifer, with an important public water supply scheme to the north (in the direction of the main north-south fault zone below the subject site), as well as other, possible, local users of groundwater. The application supporting information seems to down play the site environmental setting and sensitivity, linked to the status of the aquifer units underlying the site, their

vulnerability, hydraulic connection between the two main units, and potential for groundwater migration away from the site and in particular to the north where the Bog of the Ring groundwater public supply scheme is located.

Based on current insufficient data it is our opinion that the Agency cannot accept the licence application as it stands. There are considered to be two ways MEHL may be able to address this and these are a combination of better use of all existing information, plus the undertaking of additional site investigation and modelling. Key information to request and questions to ask, at this stage, are summarised below, with an outline of the expected requirement for additional site investigations provided at the end of the letter.

1. More previous data and information, where available, is required to improve the overall conceptual model for the site. For example, apparently missing or poorly presented information which includes:
    a. Detailed geological log for Dunne Drilling borehole "5668" drilled in November 2008. From Table 14.3 (p221) of the EIS it seems this borehole may be BH4A (but the log is not labelled as such), which is available, and if so it is important to confirm that the "black rock" described by Dunnes is in fact the Loughshinny Formation as outlined in Table 14.3;
    b. BHs 1-3 are expected to have been drilled on-site in the past and details about these (location, depth, borehole logs etc.) need to be presented;
    c. Appendix A14.4 states that borehole logs are not available for BH4, BH10 and BH11. However, the 1999 MEHL EIS does have a log for BH10, so appear to be problems with Arup's understanding of what is available and as a consequence their review is incomplete.
    d. Figures 14.2, 14.5 and 14.12 show most (not all) of the boreholes and trial pits that have been drilled or excavated on-site. This information should be all on one figure. It should include topographical detail for the area as a whole (including national grid coordinates), beyond the license boundary (to where off-site monitoring wells and water courses are located). Then all such information could be used to better consider overall complexity;
    e. Separate figures are needed showing the shallow (Namurian) and deeper (Loughshinny) groundwater flow regimes. Also groundwater flow in a regional context needs to be presented on a detailed figure, including site and off-site data, including a full inventory of householder/farm wells and the Bog of the Ring Water supply wells and trial wells (Figure 14 only shows the local site groundwater flow regime); and
2. Since the bases of the proposed landfill cells are expected to be only 2m above the current water table in places, much more consideration of past, current and potential future water levels and abstraction scenarios linked to the Bog of the Ring water supply scheme is required. It is necessary to illustrate the effect of the abstraction on groundwater piezometry and potential for change in the (yet to be fully characterised) groundwater divide between the site and the Bog of the Ring. For example, this would require analysis of groundwater level data for the MEHL site prior to commencement of pumping at the Bog of the Ring (water level data is available in the 1999 MEHL EIS), as well as in the more recent past. In addition, more regional groundwater level data is required (for example, this

might include local domestic well water levels, Bog of the Ring pumping/monitoring/trial well water levels, water level data from the Fingal County Council EIS, or the installation of additional wells to the north of the MEHL site). If insufficient off-site wells are found to exist to define the groundwater divide location, particularly if fault controlled groundwater movement to the north is an important factor, then this may be expected to have to be addressed

3. Data should be provided that proves the upward head gradient currently depicted between the Loughshinny Formation and overlying Namurian Formation in Figure 13 ("Schematic Conceptual Model"). The groundwater level data presented in the EIS suggests there may be an upward head gradient in the north-east of the site, but there appears to be a downward head gradient for the majority of the rest of the site, including where the proposed landfill cells are located. The installation and monitoring of well pairs (each one of a pair screened either in Namurian or Loughshinny Formations) in the areas where landfill cells are proposed appears to be the only way to accurately prove the issue of head gradients (see outline scope of work presented below)

4. Justification should be provided for using potential rainfall data from Dublin Airport - which although only an estimated 12 miles away is lower topographically - and for using the Penman method for potential evapotranspiration rates. This is not site specific data and it may underestimate site specific infiltration rates used in the LandSim modelling exercise. Whilst no other data may be available, the implication of use of remote data and how this has been accounted for in the site assessment and modelling must be provided for

5. With respect to the LandSim modelling exercise, the report generally lacks detail and a number of potential limitations and/or points of clarification are required. The modelling exercise may need to be refined, following additional site investigation and improvement to the CSM. The following points are made about the existing modelling exercise. There is a need for:

    a. Justification as to whether Landsim is appropriate to use for a site having exposed bedrock, a high water table and a fractured aquifer system directly beneath the proposed landfill development. Although Landsim is considered necessary for evaluating a landfill site generally, it is suggested that the results of the Landsim model may have to be combined with a more sophisticated numerical groundwater (contaminant transport) model, to consider the regional context and risk;

    b. More information is required on the assumptions and justification behind selection of the model leachate inventory and initial leachate concentrations. There appears to be no justification on which potential contaminants have/have not been progressed to risk assessment, only that they are "likely contaminants which may arise in leachate from the hazardous cell". More specific data from the "proposed waste-streams" is considered to be needed (e.g. from other similar sites) to ensure the modelled suite of potential contaminants is comprehensive enough. Bench-scale testing of some of the more significant waste streams proposed may be needed to demonstrate that unacceptably high leaching is not going to happen;

c. More information is required on the rationale behind the selection of a declining source term in the model, since much of the hazardous waste used is not expected to degrade with time and therefore may be expected to act as a constant source of potential leaching in the long term. This includes supplying information on what kappa values have been used (linked to the rate of predicted contaminant release from the waste);

d. Greater justification is required for the use of marker chemicals for certain potential contaminants present within the leachate inventory but excluded from the model simply because of an absence of Waste Acceptance Criteria data. Detailed information on the mobility and toxicity similarities between markers and the excluded contaminants they are supposed to represent is needed, under the expected geochemical conditions within the landfill;

e. Greater justification behind the use of a single clay mineral layer to represent the proposed DAC liner system; in particular why attenuation (adsorption) capacities are appropriate for the DAC system that is designed to act as a structural barrier, but if it fails will not be expected to have secondary attenuation mechanisms

f. Confirmation on whether the same vertical saturated pathway was used for all waste phases and cell types modelled (it appears a single "one-fits-all" model was used, which is conceptually simple relative to the varying pathway properties across the site as a whole, in both south to north, and east to west directions). Justification is required for not using multiple models to provide a cell specific assessment; and

g. Critically, information is required on the vertical saturated pathway hydraulic conductivity values used within the model, as they do not appear to have been provided.

6. A much stronger conceptual site model is required and should encompass all of the available data gathered by addressing the above requested data requests, plus the output from additional site investigation works that are also considered necessary and outlined under the last section of this letter. As well as explanatory text, this may result in a series of diagrams, including:

   a. A plan showing all site investigation to date (including additional investigations conducted as a result of this review), and topographic detail extending beyond the licence boundary to the limits of the monitoring points;

   b. A plan showing regional groundwater flow, based on measured water levels and including a more accurate depiction of the groundwater divide between the site and the Bog of the Ring;

   c. Two separate plans, one showing local groundwater piezometry in the Namurian Formation and one showing it in the Loughshinny Formation.

   d. A series of cross-sections (e.g. one N-S through the proposed waste cells, and perhaps two E-W through the proposed waste cells), that accurately show the geology derived from borehole logs and head gradients derived from monitored water levels in boreholes screened in different strata.

e. A Conceptual Site model diagram, showing the proposed development superimposed on one or more of the above cross-sections.

7. Even with the use of the above outlined information sources, there are likely to be weaknesses and/or significant uncertainty with respect to the CSM, in part linked to aquifer/bedrock status and properties, vertical head gradients (up or down) and flow across and/or along the major fault zones. In order to improve the landfill site element of the CSM, additional site investigation should be planned and implemented. This is expected to have to ensure there are groundwater monitoring wells within the footprint of the all proposed landfill cells and associated waste processing areas (if out with the landfill cell footprints). Specific consideration and requirements are expected to be:
    a. It is believed that where both Namurian and Loughshinny bedrock exist well pairs are needed (comprising one well screened in Namurian and one in the Loughshinny Formations). Where one suitable well already exists the second can be installed close to it (within 5m).
    b. Such well pairs are expected to be needed within each of four fault blocks created by the N-S fault and E-W fault that transect the site, allowing much better assessment of groundwater flow across fault structure and between the Namurian and Loughshinny, and consideration of potential flow long fault zones, during pump testing. As the proposed hazardous waste cell is located across all fault blocks and in an area where both formations exist (Namurian over Loughshinny), this will be the likely main area of focus
    c. There is also a need for good well data for the proposed non-hazardous waste cell and new inert cell. In some of the southern area (southwest quadrant) there appears to be insufficient well points, although, as only the Loughshinny is present only single well points are needed. Where it cannot be demonstrated to the EA's satisfaction, that suitable monitoring wells already exist then additional ones are expected to be needed
    d. Because previous pump test data may suggest flow along the fault zone (from our review) there is a need to have a well pair at the north end of the proposed hazardous waste cell on the line of the main N-S fault zone
    e. As part of preparation for the additional investigation programme consideration must be given to the benefit of undertaking coring of certain boreholes and downhole geophysical logging to maximise understanding of lithology, fracture distribution and orientation, etc.)
    f. Following the additional investigation programme new (expected 7 day) pump test and associated step test and recovery test. For such a complex and relatively sensitive site setting a 2 day test is considered too short. It is also suggested that the suitability of BH17 as a pump test well should be reconsidered, and a new well (or a packer in BH17) installed so that the pump test only draws water from the Loughshinny Formation. This will allow better interpretation of the main aquifer zone and the hydraulic connectivity to the overlying Namurian

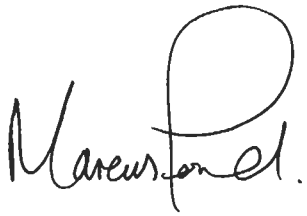
It is noted that if the further assessment of off-site (down gradient) groundwater levels and where the groundwater divide is located do not provide conclusive evidence then some off-site drilling may be expected to be needed to address this data gap in the CSM also.

It is understood that the difference in option between the classification of the bedrock units below the subject site and the groundwater vulnerability mapping classification will be taken up by the EA and you will make direct contact with the GSI and seek their considered opinion on such matters.

Should you have any queries regarding any aspect of this project, or any other matter then please do not hesitate to contact the undersigned.

Yours sincerely for

Ford Consulting Group Ltd



Dr. Marcus Ford

Project Director