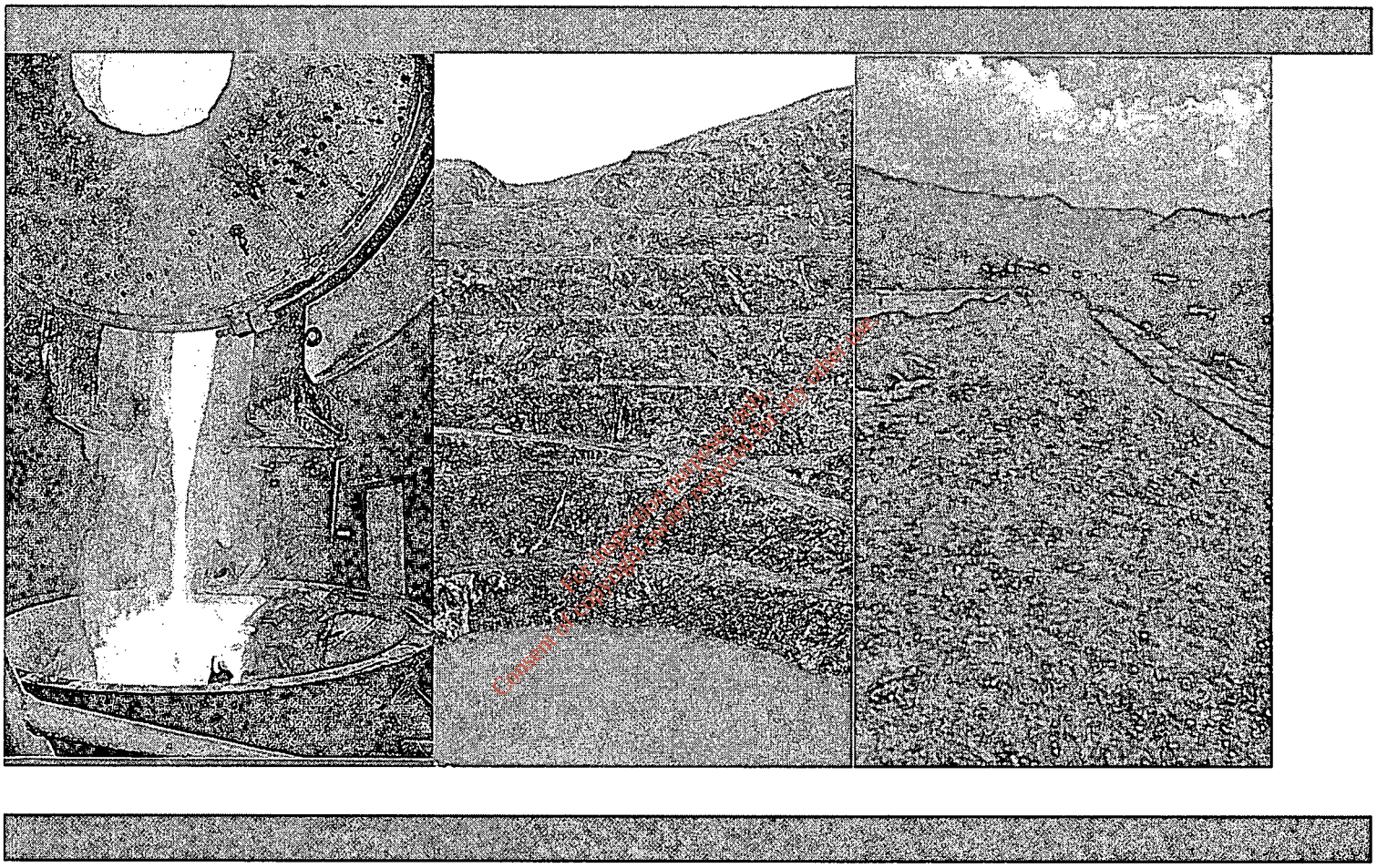
Assessment of Lisheen Mine TMF Adjoining Cell
CQA Plan and design
Environmental Protection Agency of Ireland



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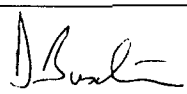
Author	David Buxton		
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1. INTRODUCTION

AMEC was selected as first ranked tenderer for the provision of technical assistance and advice to the Environmental Protection Agency (EPA) on mines, extractive waste and related work (OEE-12-WLTU003-Framework).

AMEC was appointed under this framework contract by the EPA for an "Assessment of the submitted Cell CQA Plan and Design for compliance with the licence and to ensure the proposals will achieve the design aims and be fit for purpose." The Scope of Work included the following requirements:

1. *Assessment of the relevant documents inter alia the following tasks:*
   - a) *Critically analyse each of the key items individually and collectively as a whole in respect of achieving the design aims and prevention of environmental pollution in the short or longer term.*
   - b) *Highlight any items or considerations omitted or potential errors.*
   - c) *Seek clarification from Lisheen Mine / Golder Associates where necessary*
   - d) *Compose a request for information letter to be sent by the EPA where necessary*
2. *Production of a detailed report. This is to include an overall recommendation on the making a decision to approve or otherwise the proposed Cell CQA Plan and Design.*
3. *Further review of amended documents (if necessary).*

The assessment will provide expert opinion and recommendations to the Agency. This report discusses the assessment and makes recommendations for future action.

2. BACKGROUND

Vedanta Lisheen Mining Ltd operates a lead/zinc mine under IPPC Licence No. P0088-03 (hereafter referred to as the 'licence') near Thurles in County Tipperary, Ireland.

Under Section 90(2) of the EPA Acts 1992 to 2011 Lisheen Mines is licensed to carry on the following activity:

- The extraction and processing (including size reduction, grading and heating) of minerals within the meaning of the Minerals Development Acts 1940 to 1999, where an activity involves
  - a) a metalliferous operation; or
  - b) any other operation where either the level of extracted or processed minerals is greater than 200,000 tonnes per annum or the total operational yield is greater than 1,000,000 tonnes,
- and storage of related mineral waste.

The Tailings Management Facility (TMF) falls within the scope of Directive 2006/21/EC on the management of waste from the extractive industries. The TMF is a Category A waste facility under the terms of the Directive.

The licence sets out in detail the conditions under which Lisheen Mines, will operate and manage this installation.

Lisheen Mine have submitted for EPA approval, proposals for a new impoundment structure of 6 ha in area adjoining the existing 63 ha TMF. The initial proposal under the agreed Closure Plan was that the footprint would be used for installation of a wetland to treat final runoff from the vegetated cap of the TMF. However, Lisheen Mine are also progressing to acquire authorisation from the EPA to use the same structure for the deposition of tailings should capacity run out on the existing TMF. Therefore, the EPA requires assessment of the new cell with a view to it being potentially used as a tailings deposition cell.

All detailed modifications and engineering works proposed for any part of the TMF are subject to sub conditions under condition 6.18 of the current licence and sub conditions under condition 6.18 in Technical Amendment A to the licence.

3. INITIAL INFORMATION RECEIVED

In October 2013, AMEC reviewed the following documents:

- Lisheen Mines Ltd, Additional Tailings storage capacity, Letter to the EPA, 14th August 2013, including appendices with correspondence between OEE and Lisheen Mine, NTS for the proposed modification (Golder Associates, August 2013)
- Lisheen Mines Ltd, New Adjoining Cell Crest Elevation 131.5 CQA Plan, Golder Associates, Report No. 11514150166.500/A.0 September 2013

The initial review discussion and comments are presented in the following section.

4. DISCUSSION OF INITIAL INFORMATION RECEIVED

4.1 TMF Adjoining Cell Construction Quality Assurance Plan

The TMF Cell 3 CQA Plan provides the information required to ensure quality of construction. The review of the CQA plan included information on the design, though the plan does not include discussion of the design philosophy and logic (which forms part of the design report). AMEC requested a copy of the design report to understand the basis for the design and asked the following questions that related to the CQA and the design:

- The curved embankment adds to the complexity of the lining installation and could increase the likelihood of flaws. Can the reason for using a curved embankment be provided?
- An above liner drainage system (located at the base of the tailings to assist in consolidation and to reduce hydrostatic pressure on liner) was not observed on the drawings, though drainage is mentioned in the section on completion

reports. Are there details of the drainage, or can the reason for not providing drainage be provided?

- The function of the two geotextile layers above and below the liner, together with the use of double textured (as opposed to single sided textured) was not immediately obvious. Can further information on this be provided?

- The drawings show proposed monitoring boreholes. Can a drawing showing the location of existing boreholes, borehole depths/profiles and groundwater contours for the proposed TMF be provided?

The drawings presented in the CQA plan provided sufficient information to assess the works. However, in terms of ensuring accuracy (quality) of lines and levels, setting out points (co-ordinates) for the embankment and other features were not observed on the drawings. How is this information passed to surveyors for setting out? What are the requirements for accuracy of lines and levels?. How is this checked by the Engineer's Representative?

Material specifications are a key factor in ensuring quality of works. AMEC request a copy of the specification issued to the Contractor to review and have noted the following in the CQA plan:

- Section 3.3.4 notes "carbon rich 500 g/m2" geotextile. Can this be specified in terms of an appropriate national standard that can be checked by the Engineering. Representative,. e.g. EN 12224?

- Section 3.3.4 notes "suitable rope with a minimum life of 4 years". Can the required breaking load be provided and specified with an appropriate national standard e.g. BS EN ISO 2307 (Testing) or BS EN ISO 9554 (Specification)?

- Section 5.2.4 notes "type D material will be compacted with a suitable non-vibratory smooth roller, to be agreed with the engineer, passing 4 times over the material". Can the CQA be updated to include performance specifications such as required relative densities, trial embankments, CBR (California Bearing Ratio) for road surface material) etc.

- Section 6.2.3 discusses conformance testing. Can consideration be given to including for additional testing if there are changes in supply e.g. different manufacturers and/or different batches?

- Section 6.5 discusses geophysical leak detection. Can details of what, who, method and acceptance criteria be provided?

4.2 Water management and treatment

Even though water management itself is beyond the scope of the review of the CQA Plan and Design, due consideration should be given to consequences of the changed use of the area that was previously planned to be a wetland, and the consequences of the increased storage capacity on water management in general:

- With the larger storage capacity and area, more water may potentially need to be treated, especially in a high stormwater scenario. Section 4.0 of the NTS (Golder Associates, August 2013) is rather general in this respect. However, it states that "optimisation of the existing treatment of the water discharging from the Lisheen Mine is required and additional treatment is recommended".

- There seems to be sufficient treatment capacity available, however, the capacity appears to be oversized (35,000 m^3 per day vs. 165 m^3/day new)? Clarification would be appreciated.

- It is noted that the area originally earmarked for a constructed wetland (or water impoundment facility) will now be used for additional tailings storage. Apart from very general statements, no specific information on the constructed wetland is contained in the documents reviewed.

- What are the consequences for the post-closure water treatment? Where will the wetland be situated (Figure 2.8 of the NTS shows a location but it is unclear if the size if sufficient)?

- What are the treatment targets of the wetland, and can they be met under the new configuration?

- It is also noted that the surface runoff will be around 10% higher than for the previous wetland design (6 ha in addition to 60 ha surface). Is sufficient space available to accommodate the increased wetland size?

5. REPSONSES AND FURTHER REVIEW

5.1 TMF Adjoining Cell Construction Quality Assurance Plan

The comments and questions in Section 4 were presented to Lisheen Mine who provided the following information:

- Lisheen Mines Ltd, "AMEC questions to Lisheen Mine regarding new TMF Cell CQA Plan and Design", Letter to the EPA, 13th November 2013, including attachments 1 to 5
    - Attachment 1 - CQA Report, Design Report, Specification for the wetlands cell, Stage 2 Design Report
    - Attachment 2 - Golder TMF Audit 2012
    - Attachment 3 – TMF Groundwater Contour Map
    - Attachment 4 – Setting Out Survey Points
    - Attachment 5 – Golder Equipment Manual

The above documents were reviewed by AMEC in December 2013 and were considered by AMEC to be a thorough response to the questions raised.

5.2 Water management and treatment

AMEC has requested clarification on the current and future water treatment capacity, including the planned wetland. This clarification was prepared by Golder Associates, Lisheen's consultants. In regard of water treatment, Attachment 1(c) "Specification of wetland cell" of Golder's response is relevant.

With respect to the achieving the design aims and prevention of environmental pollution in the short or longer term, as per AMEC's scope of work, the following conclusions can be drawn:

- There is currently sufficient water treatment capacity available in the MWTP and RWTP to treat up to 35,000 m³/day. Approximately 85% of the treated water is mine water which will not need to be treated in the active and passive closure phase. Another substantial flow arises from the positive water balance of the TMF. During and after closure of the TMF, this flow will be reduced by an order of magnitude, to 10-20% of current treatment needs. In their response, Golder Associates have not provided a quantitative basis, neither regarding the expected flow rates nor regarding expected water qualities. There is no risk of environmental pollution as the conventional water treatment plant is clearly oversized.

- Location and footprint (area) of the planned wetland have been clarified by Golder Associated. No details are provided in regard to the details of wetland design, treatment technology (internal structure and plant species of the wetland, inflow and discharge water quality, expected treatment efficiency). Golder Associates clarified that some information required for final design will only become available as the TMF is progressively capped in 2015/16.

- There is sufficient land available to develop the wetland. In addition to the currently planned area in the NW corner of the TMF, conditioning ponds that are phased out during closure will become available.

- The conventional (non-passive) on-site water treatment system will be operated as backup should the wetland fail to function as planned. This ensures that no untreated, or insufficiently treated, water is discharged into the environment.

- Golder Associates assume that "in less than five years virtually all the flow from the TMF rock fill cap will be clean water (i.e. rain water)". Should this assumption turn out to be incorrect, passive water treatment may be required over a longer period, and potentially require back up by the conventional water treatment plant. While technically there is no risk of environmental pollution, the existing uncertainties may have a significant impact on the required financial guarantees for the closure and aftercare periods. It is therefore recommended that the closure and aftercare funds contain sufficient contingencies.

6. SUMMARY AND RECOMMENDATIONS

AMEC has reviewed the "TMF Adjoining Cell CQA", other relevant documents and presented questions to Lisheen Mine. The responses to those questions were thorough and considered to be satisfactory.

To summarise in terms of the scope for this appointment, AMEC considers that the "TMF Adjoining Cell CQA" will ensure that the design aims are achieved and that the TMF will be fit for purpose. AMEC also believes that the design will achieve the aim of preventing environmental pollution.

AMEC recommends that the EPA approve the CQA plan and recommends that sufficient provision is made in the closure and aftercare funds for the uncertainty of prolonged requirement of water treatment.