THE LISHEEN MINE

CLOSURE, RESTORATION & AFTERCARE MANAGEMENT PLAN - C.R.A.M.P

April 2016

Statement from Management

The following statements are taken from the Lisheen Mine Sustainability Report, 2014 – 2015, and highlight the commitment from Vedanta Resources and the General Manager at Lisheen Mine towards a successful Mine Closure.

Deshnee Naidoo - Chief Executive Officer Zinc International

"As an extension of Vedanta's commitment to Environment, we consider it our duty to conduct our operations without compromising the essentials of nature. Restoring the Mine site to a Greenfield site and managing the tailings facility scientifically and ensuring no damage to the environment tops our Mine closure agenda. Our aftercare plans for the Mine will continue for the next 30 years as we intend to restore the land to the best possible level, for use in the coming years.

As we approach Mine closure, we are committed more than ever to 'securing our future' for the local community. We want to make sure that all our employees continue being safe, and, in line with our life after Mine vision, we empower the local community to sustain themselves economically. Our outplacement programme intends to leave the community empowered for future employment and economic development. Our goal is to leave behind a positive legacy in all aspects of the triple bottom line and we intend for the Lisheen Mine to be a benchmark in sustainable Mine closure."

Alan Buckley, General Manager, The Lisheen Mine

"Our priorities towards securing the environment lie with successful rehabilitation of the Tailings Management Facility (TMF) and restoration of the sites engaged in mining activities. Approximately 62% of the TMF has been successfully rehabilitated so far, as a part of phased approach. We will continue to oversee restoration of the TMF. Simultaneously, we are geared up for the environmental aftercare responsibilities and implementing planned and measured steps to reach our overall goal for green belt transformation. Whilst our closure plans are in full swing, we continue to adhere to environmental compliances and maintain the required standards.

Post closure, ensuring sustainable employment opportunities is a priority for us. Our outplacement programme is a multifaceted programme that was developed to assist employees with their transition into new employment after their time at Lisheen ends. We are also exploring possible employment opportunities at the restored Mine site and we are in discussion with a number of companies that have potential new sustainable businesses for our site. Our community understands the situation that we are in and they appreciate the efforts we are taking to ease the situation and create opportunities for them. We are proud of

leaving something positive behind, in terms of sustainable employment and successful progressive restoration. Our dedicated team of experts will continue to oversee restoration of the Tailings Management Facility (TMF) and fulfil all aftercare responsibilities. This is going to be a world class Mine closure that will become a benchmark for other mines to follow."

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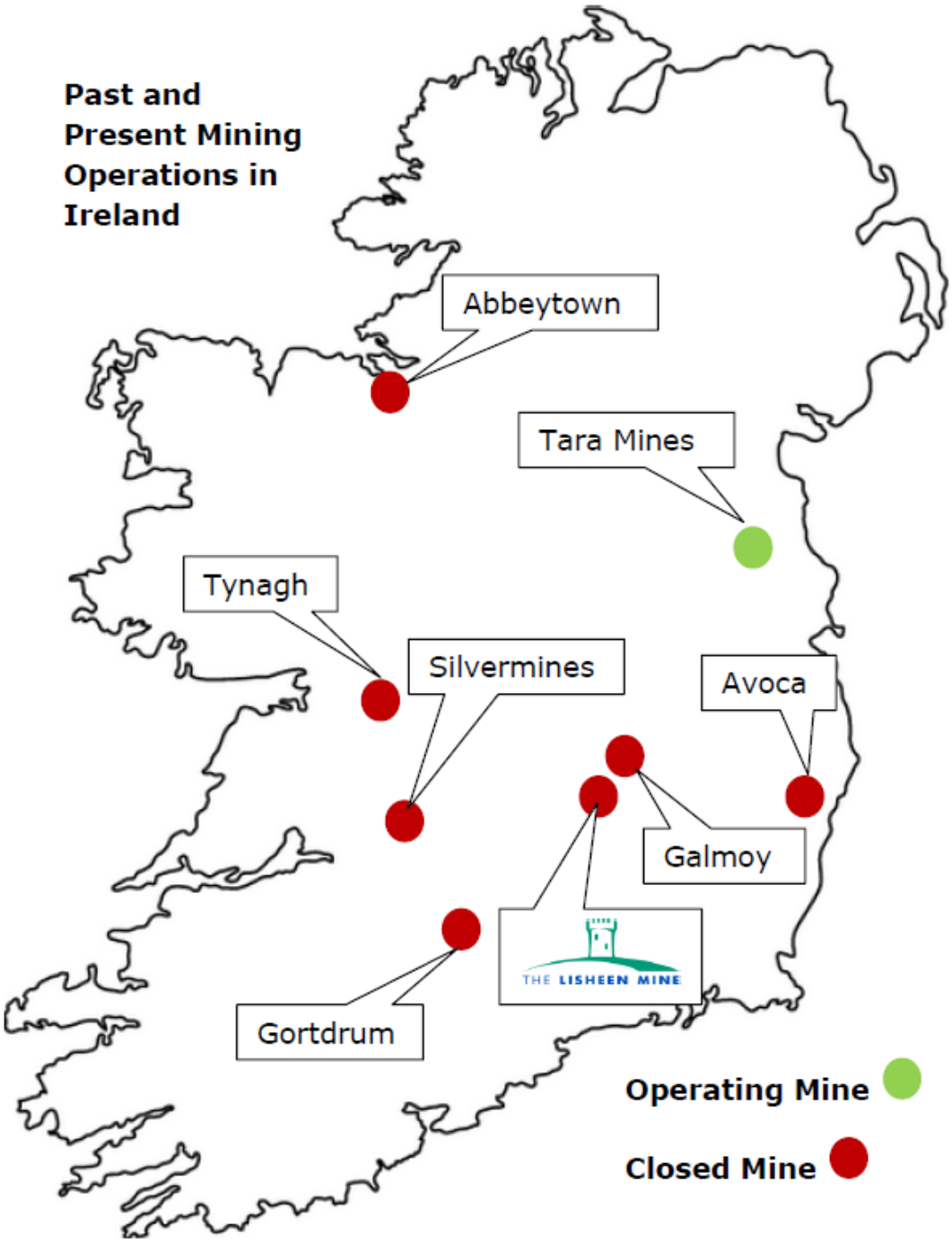
CHAPTER 1 – INTRODUCTION

CHAPTER 1 - INTRODUCTION

1.1 BACKGROUND

The Lisheen Mine is located some 14 km to the north east of the town of Thurles, and some 6 km to the south west of Templetouhy, in Co. Tipperary.



The Lisheen Mine exploited an ore deposit hosted in Carboniferous Waulsortian limestone. Development of the Mine started in 1997 with the construction of the main decline and main site facilities with production starting in 1999, producing an average of 300,000 MT per year of zinc in zinc concentrates and 35,000 MT of lead in lead concentrates.

The ore was crushed underground and brought to surface on an enclosed conveyor via a 1.5 km decline tunnel. The ore entered the surface stockpile and from there was fed to the processing plant. The zinc and lead concentrates were loaded onto specially designed trucks for transport to Cork Port on route to various smelters across the world.

The waste material from the process plant is called 'tailings', this is sent to the Tailings Management Facility, TMF, located on the eastern part of the site. In January 2008 a new tailings discharge system using conventional spigots was implemented and in May 2008 construction of a 'demonstration cell' commenced. This demonstration cell marked the start of the chosen capping system. Approval for the capping methodology was achieved and the demonstration cell was extended to form Phase 1 of the TMF rehabilitation programme. A portion of the tailings was also pumped back underground as paste backfill to fill the mined out areas and provide support. The backfill plant, which was commissioned in 2004, catered for production and distribution of the paste backfill.

Other site facilities include two water treatment plants, several dewatering storage ponds, and other infrastructure for Mine water management, maintenance areas and the administration building.

A wind farm capable of generating 36 megawatts of power by means of 18 turbines was constructed and commissioned on the Mine site in 2009. The Lisheen Wind Farm became operational in August of 2009 and is currently maintained and operated by Brookfield Renewable and will be operational on the site post cessation of the Mine.

Lisheen Mine ceased operations at the end of 2015 and responsible Mine closure is the core focus for Lisheen and Vedanta. Achieving this is a complex task, which has been planned over many years.

Successful closure of the Mine requires rehabilitation and restoration of land affected by mining operations, careful management of social aspects, and securing the long term management of land within the Lisheen Mine land holding. Success criteria have been laid out and will be used as a framework for validation of restoration performance.

The Closure, Restoration and Aftercare Management Plan, CRAMP, has been developed in order to facilitate Mine closure. This plan ran continuously during

operations, and will continue through active and passive closure and then into aftercare. All CRAMP documentation will be reviewed annually and updated as required.

The process followed for the Lisheen Mine CRAMP and the structure adopted for its presentation aims to demonstrate compliance with key requirements of statutory and non-statutory best practice, the application of competent methods of assessment and analysis, and the use of quality information in Mine closure decisions.

The plan identifies and prescribes the actions required to ensure that the Mine and its facilities are rehabilitated and restored to agreed environmental levels, at optimal cost, and to reduce, where possible, the socio-economic impact of Mine closure on the region.

The closure process must be effective, efficient and sustainable. Lisheen Mine has addressed this challenge with an extended programme of expert consultations and workshops to develop a closure plan framework.

As stated, Phase 1 of TMF rehabilitation has been completed in recent years and comprehensive testing of water, soil, grass and air quality is ongoing. All monitoring data demonstrates ongoing success of areas we have rehabilitated. Livestock has been farmed on these areas as part of this process. All animal test results have been well within acceptable levels with certification received from Bord Bia for our farm.

The different stages of Mine closure and the timeframes are set out below:

Closure Stages	***Dates**
Active Mine Closure	April 14 – March 18
Passive Mine Closure	April 18 – March 20
Aftercare Period	April 20 – March 50

**These are indicative time lines. Actual timelines are dependent on factors outside of the control of Lisheen. E.g. the rainfall over the coming years will directly affect the rate at which the Mine re-waters.*

The Lisheen Mine Closure Team will ensure that the Mine closure project is executed and that all success criteria are achieved.

The Company organisation chart through Mine Closure is as follows:-

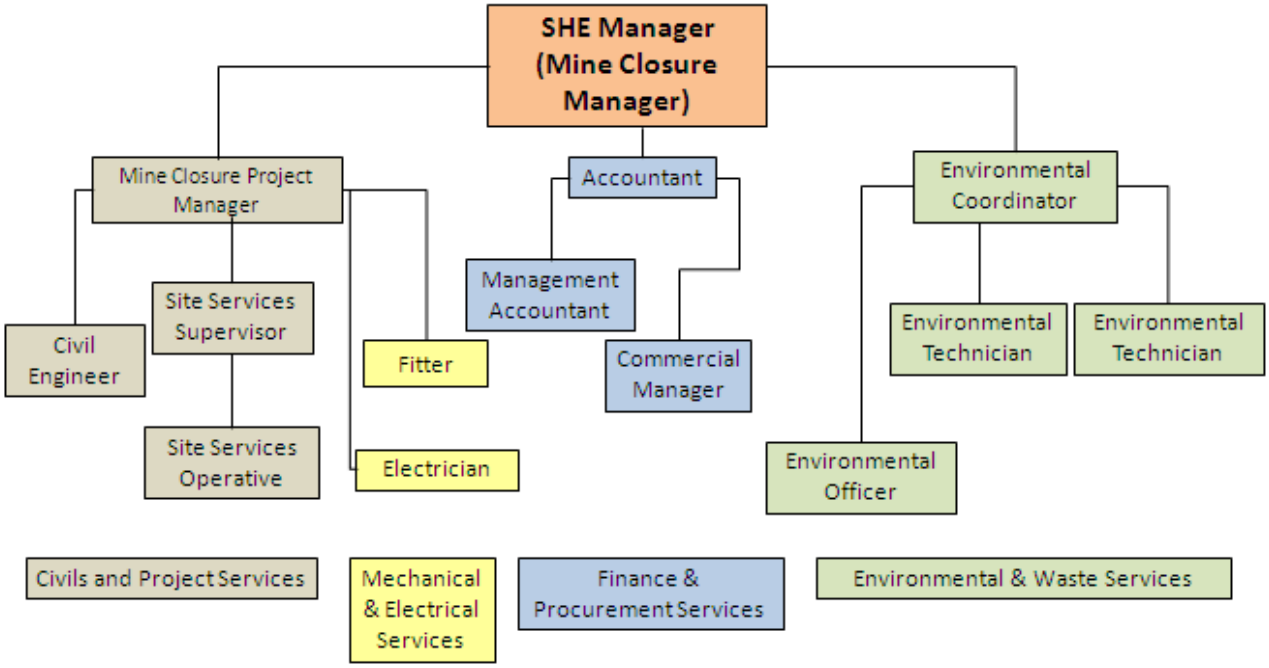


Figure 1.1: Organisational chart for Mine Closure as of March 2016 (subject to review)

Manpower is kept under review and is subject to change over the course of implementation of CRAMP.

Further details of the Mine Closure Team job descriptions can be found in Appendix 1.1.

A MULTI DISCIPLINE PROJECT

The original Mine Closure plan was produced by Enviroplan Services Ltd and submitted as part of the Environmental Impact Statement, EIS, submitted in December 1995 as part of the Planning Permission application to develop the Mine.

Lisheen Mine, along with the assistance from the Regulators and a number of consultants, initiated an updated plan in 2006.

The initial CRAMP was approved by the Regulatory Authorities in 2011. Please refer to Appendix 1.2 for a copy of the approval letter.

This 2016 version of the CRAMP has been updated and reviewed by the Lisheen Mine Team throughout 2015 and 2016. A number of consultants were also utilised once again:

- Golder Associates
- Ecological Planning, Design and Management (EPDM) Consultant
- Schlumberger Water Management Consultants (SWS)
- C3 Projects – Quantity Surveyors/Project Management
- Enrich Environmental Limited
- Sweeney Consultancy
- Tobin Consultancy
- FH Wetland Systems Ltd

1.2 CRAMP STRUCTURE

This section describes the structure adopted for presentation of the 2016 Lisheen Mine CRAMP. The structure comprises a series of separate components that are mostly presented as separate CRAMP chapters. This structure supports a flexible approach for delivery of the plan, enabling periodic review and revision of specific CRAMP components.

The principal components of the CRAMP structure are described below:

Chapter 1, Introduction and Terms of Reference

This chapter provides background information on The Lisheen Mine, details on terms of reference, environmental impact management, schedule of activities, risk assessment and the success criteria. This chapter also provides an overview of the entire Lisheen Mine CRAMP. It sets out the legal framework under which the CRAMP was written and as such aims to demonstrate that the site is in compliance with all permits issued by the State.

Chapter 2, **Mine Rewatering**

This chapter includes a detailed Hydrology Model to support Mine Closure. This model predicts the rate of groundwater recovery, the likely chemistry within the flooded areas, a plan to protect groundwater users and how to minimise the potential impact on the local rivers. The report also includes a post closure water balance of the TMF and a plan for discharging surface water runoff along with a water monitoring plan.

Chapter 3, Site and Underground Decommissioning and Restoration

This chapter describes the physical decommissioning and final restoration scheme for the Mine site following the cessation of mining operations. This includes the underground workings and the main surface operational complex of the Mine. Consideration to the risk of, and monitoring of, surface subsidence is also considered in this chapter. The Mine site area will be returned to a standard fit for industrial / commercial after use, as per the County Council Master Plan Policy. This chapter also includes the surface water monitoring programme.

Chapter 4, TMF Rehabilitation and Restoration

This chapter describes a final restoration and rehabilitation strategy for the TMF. The strategy includes detail on the method of dry capping that has been adopted, which uses geotextile, rock and soil in order to return it to agricultural grassland. The objective is to support and consolidate the environmental protection function of TMF rehabilitation, and to place the TMF in a suitable condition to accommodate long term, sustainable after use.

Chapter 5, Financial Provisions

This chapter describes the financial measures, funds and mechanisms provided for the physical closure, rehabilitation, restoration and aftercare of the Lisheen Mine site in accordance with Articles 7, 8 & 9 of the European Union Council Directive 2004/35/EC on Environmental Liability. The chapter also details the Annual Review Procedure which is the overriding mechanism for the distribution of the Mine closure funds once approval by the regulatory authorities is achieved.

Chapter 6, Interested and Affected Parties

This chapter focuses on a review of the approach and general procedure that is adopted by the Mine, demonstrating a socially responsible approach to Mine Closure and includes the Stakeholder Management Plan.

Chapter 7, Aftercare

This chapter describes the aftercare plan that will ensure a long-term sustainable closure of the Mine site following the closure and restoration phases. This chapter also includes the 2016 updated financial considerations.

1.3 SUCCESS CRITERIA

The Lisheen Mine closure strategy is underpinned by a set of success criteria, and these will be used as a framework for validation of restoration performance.

The criteria are specific, measurable, achievable, realistic and time related, SMART, and will be used as indicators to determine whether closure objectives have been met.

The achievement of these success criteria will be verified through a monitoring process and will subsequently lead to sign off and approval from Regulatory Authorities.

A copy of the success criteria which includes the closure objectives, measurement tools, validation criteria and person responsible in order to achieve the success criteria can be found in Appendix 1.3.

1.4 HAZARD IDENTIFICATION AND RISK ASSESSMENT

Identifying the hazards, assessing the risks and implementing appropriate action is an important factor in minimising negative consequences of Mine closure.

The identification and assessment of risks was carried out in accordance with our Risk Assessment Procedure, LM 025. The areas of potential risk covered include surface and underground decommissioning, Mine re-watering, TMF activities, the environment and the Port of Cork.

The top 12 risks are tabulated below:

Risk Assessment - Top Risks								
No.	Operation / Hazard	Aspect with potential for impact	Potential Incident (Unwanted Event)	Current Controls	Consequence	Likelihood	Risk Rank	Possible New Controls
1	Emissions to surface water	Environment	Sulphate and metal in discharge waters exceeding IPCL limits	Compliance with IPC licence. Treatment of dirty water / dilution.	3	5	20	A groundwater well is to be installed to supplement to site water, (mostly TMF catchment water), for the purpose of augmenting the Rossestown River (a planning permission requirement). This groundwater will also have the potential to provide blending water for the site water discharge and ensure there is no impact on receiving environment. Review IPCL to justify more appropriate ELV's
2	Plugging of vent raises including the preparation works (underground barricades)	Safety	Injury / environmental release	Method statement, risk assessments, use of appropriately qualified staff and contractors	5	2	19	
3	Demolition of surface buildings and structures (including residential)	Safety	Injury	Manual handling, method statements, risk assessments, use of appropriately qualified staff	4	3	18	
4	Retrieval of last items UG at Pit Bottom	Environment	Risk is the management of water and ventilation	Method statement, risk assessments, use of appropriately qualified staff	4	3	18	
5	Final weeks of UG activity	Environment	Risk of loss of control re water management - i.e. poor segregation and significant non-compliances.	Monitoring / assessments and plans to be made at the time (TMF capacity).	4	3	18	
6	Assurance of water quality (risk to groundwater and surface water via springs)	Environmental / health / social	Impact of regional groundwater quality.	Regular monitoring	4	3	18	
7	Demolition of buildings and structures	Safety	Injury	Manual handling, method statements, risk assessments, use of appropriately qualified staff	4	3	18	
8	Failure to get completion cert	Regulatory	Failure to meet Success Criteria set out in the CRAMP	Success criteria plan in place	4	3	18	
9	Insufficeinet augmentation water to make up for loss of springs in Rossestown river.	Regulatory / Environmental	Loss of water on stretches of Rossestown resulting in fish kills.	Manage site water. Install groundwater well to suplement site water.	3	4	17	
10	Sediment build up in rivers	Environment	Environmental	Monitoring plan. Potential sediment removal from rivers with agreement with the IFI.	2	5	16	
11	Complaints from the Community	Social	Poor media coverage, reputational risk for the Company & Management	Complaints procedure in place, all investigated and closed out.	2	5	16	
12	Legal Claims	Legal / Regulatory	Costs of claims / Poor media coverage, reputational risk for the Company & Management	Investigations / reviews with legal team. Extensive and comprehensive monitoring records in place.	2	5	16	

Please refer to Appendix 1.4 for a copy of the risk assessment.

1.5 THE ENVIRONMENT

Lisheen is committed to mitigating and minimising our environmental footprint from the point of Mine closure and beyond. Being compliant to the EU laws on the environment, we also comply with the Environment Protection Agency (EPA) Ireland, for regular monitoring of our environmental footprint.

Lisheen was the first zinc and lead Mine in Ireland to be granted an Integrated Pollution Control License in 1997 and is currently on its' forth revision, P0008-04. This licence is governed by the EPA and Lisheen is subject to audits by the EPA against all conditions.

An integrated environment management system has been implemented based on ISO14001. Lisheen attained accreditation to the ISO14001 standard in November 2002 and has retained it since. The National Standards Authority of Ireland, NSAI, who are the accrediting body, audit Lisheen on an annual basis.

All environmental parameters are measured including quality and ecological status of surface water, groundwater, soil and vegetation, and air emissions at our dedicated Environmental Centre. The Environmental Centre is open to the public and information about our environmental footprint as well as our mitigation processes are freely available at the centre.

Lisheen meets with its key stakeholders on a regular basis to present environmental data and discuss environmental issues.

1.5.1 ENVIRONMENTAL IMPACT MANAGEMENT

Many environmental management issues require consideration during the closure phase of a Mine. An Environmental Management System has been developed to help identify, manage and control activities that have an environmental impact.

The operation of Lisheen Mine is characterised by a regime of constant environmental protection. The terms of reference for this regime were initially defined through EIS work undertaken to support the original Lisheen Mine planning application of the mid 1990s. Subsequent on-going environmental management has been achieved by the adoption and implementation of a site wide Environmental Management Programme (EMP). Implementation of the EMP has been supported by a continuous programme of intensive environmental monitoring and control. The EMP is submitted to the EPA as part of the Annual Environmental Report.

The closure phase of a Mine has the potential to create an array of environmental impact scenarios. In addition to the management of potentially significant adverse environmental effects the Mine closure process creates the opportunity

to recognise long term beneficial effects of Mine operations. These include progressive simplification of potential impact pathways as specific mining activities are brought to a close. In addition, many of the most substantial beneficial effects of Mine restoration such as environmental enhancement and biodiversity conservation are realised through Mine closure activities.

Environmental impact management during the Mine closure phase is achieved by an extension of the same impact prediction rationale that has underpinned environmental management activities throughout operation of the Lisheen Mine.

A copy of the Safety, Health and Environmental Policy and the Closure Policy can be found under Appendices 1.5 and 1.6.

1.6 BIODIVERSITY

Physical closure at Lisheen Mine includes a series of plans for rehabilitation and restoration of the above ground Mine site where a number of valuable and important biodiversity locations are present within the surrounding areas.

The Lisheen Mine is located within a relatively low-lying area of the Irish midlands, with the area defined by extensive peat land, agricultural land and widespread areas of woodland and forestry.

Lisheen has structured a Biodiversity Action Plan, BAP, to identify the key opportunities for Mine closure to secure continued biodiversity conservation benefits. This BAP is compliant to the Vedanta Biodiversity Management Plan and aligned to the existing BAP frameworks for Ireland and Tipperary County Council.

The BAP identifies the key areas of potential interest for post-closure biodiversity conservation benefits at Lisheen and outlines the anticipated benefits for specific biodiversity conservation targets. In particular, they comprise the following areas at Lisheen Mine:

- Lisheen Mine site
- Lisheen Tailings Management Facility
- TMF Wetland
- Carrick Hill Borrow Pit

There is the potential for a variety of habitat types and wildlife opportunities to develop within each of these areas. The combined effect of these nature conservation features will be to create an area of considerable biodiversity interest following closure at Lisheen Mine.

Please refer to Appendix 1.7 for a copy for the 2016 BAP.

1.7 VEDANTA SUSTAINABILITY FRAMEWORK

As part of the Vedanta Group, we follow the Vedanta Sustainability Framework. This Framework provides a clear, structured guidance on how to manage our business sustainably. It comprises of a full set of policies, technical and management standards and supporting guidance notes aligned to international standards like International Finance Corporation (IFC), The International Council on Mining and Metals (ICMM), and The Organisation for Economic Co-operation and Development (OECD) guidelines.

By using the Vedanta Sustainability Assurance Programme Lisheen ensures compliance of the Framework through an audit of our business and processes. A gap analysis is conducted annually to identify the gaps between our existing management systems and the Framework. We implement any additional requirements needed to match the Framework, if required.

1.8 HEALTH AND SAFETY AT LISHEEN MINE

Health and safety of the employees has been, and remains, the highest priority as Lisheen Mine has progressed into closure. Lisheen Mine follows all local and international standards essential for maintaining a safe working environment.

Lisheen Mine has been accredited to OHSAS 18001 since 2005. The NSAI audit Lisheen on an annual basis against this standard.

Risk Assessment is at the core of Lisheen Mine's management of Health and Safety. Each task requires a specific risk assessment to be carried out prior to commencement. All employees are trained to identify hazards and assess risk. A system of audits and reviews are in place to ensure that the key risks are managed and all controls are in place and operational.

Lisheen Mine ensures that only 'fit for purpose' equipment is used on site and preventative maintenance plans are in place.

The Mine has a comprehensive occupational health programme in place. Basic health screening is done based on medical reports consisting of details of Cholesterol, Blood Pressure etc. Advice on nutrition based on this health screening is suggested. A Drug & Alcohol Policy is in place, and the use of substances such as drugs and alcohol is strictly prohibited by the Company.

Lisheen Mine won the Overall Regional President's award at the NISO Health and Safety Awards in 2015 which recognises excellence in health and safety practices.

1.9 SCHEDULE OF ACTIVITIES

A substantial number of projects are required throughout the closure process. A programme of closure activities has been defined to ensure that progressive closure is achieved and managed. These activities include surface and underground decommissioning and rehabilitation. Note that the timeframe for these activities will be subject to change and will be agreed through the annual review process.

The full programme can be found in Appendix 1.8.

1.10 TERMS OF REFERENCE

Mine closure is an explicit reference within a variety of Planning Permissions and regulatory licenses. In addition, Mine closure considerations are included within a series of statutory and non-statutory legal and policy frameworks and guidance notes. Mine closure is also a primary discussion topic in stakeholder consultations held by the Mine with a variety of community and business interest groups.

This section describes the primary issues that must be addressed through development and implementation of the Lisheen Mine CRAMP as a key part of the Mine closure process. Specific Mine closure considerations were described within the original Planning Permission that has guided operation of the Mine throughout its life. In addition; Mine closure has been an explicit component of the various regulatory permissions issued by:

- The Department of Communication, Energy & Natural Resources
- The Environmental Protection Agency
- North Tipperary County Council (now Tipperary County Council)

These statutory and non-statutory considerations combine to define the minimum requirements for delivering Mine closure at Lisheen. In general, they derive from the following primary sources:

- Mine Lease including Supplemental Indentures
- Mine Closure and Rehabilitation Agreement
- IPC License conditions
- Planning Permissions
- Legislative Frameworks

- Supplementary Guidance
- Consultations

These considerations define the primary Terms of Reference for Mine closure at Lisheen, and compliance with them is an important requirement of successful CRAMP delivery. The following review identifies key items from the Lisheen Mine CRAMP terms of reference and describes specific measures that demonstrate provisions for satisfying these requirements through Mine closure at Lisheen.

1.10.1 DCENR MINE LEASE & SUPPLEMENTAL INDENTURES

Lisheen Mine operated in accordance with the Mine Lease as issued by the Department of the Marine and Natural Resources in October 1997. The Mine also operated in accordance with the Mine Lease Supplemental Indentures of December 1997, August 2004 and March 2007.

The Lisheen Mine fully complies with the Mine Lease.

1.10.2 MINE CLOSURE AND REHABILITATION AGREEMENT

A Mine closure and rehabilitation agreement has been signed by Lisheen Mine, Tipperary County Council, The Minister for Communications, Energy and Natural Resources and The Environmental Protection Agency. The amended agreement is dated 02nd December 2015 and principally concerns administration of financial provisions made to support effective Mine closure at Lisheen. As such, key provisions of the Agreement are taken into account through arrangements for funding Mine closure described in Chapter 5 of the Lisheen CRAMP.

Lisheen prepares and submits an annual review document to support specific requirements set out in the agreement and to provide a single source document to assist the Regulators in the annual review process.

The Lisheen Mine fully complies with the Mine Closure and Rehabilitation Agreement.

Please refer to Appendix 1.9 for a copy of this agreement.

1.10.3 P0008-04, IPC LICENSE CONDITIONS

The April 2014 EPA License, P008-04, provides authorisation and describes environmental regulation priorities for on-going mining and ore processing at Lisheen. The April 2014 license supersedes all prior IPPC and IPC licenses.

The license also refers to an impact screening exercise undertaken in respect of the potential for operation of Lisheen Mine to adversely affect a number of Special Areas of Conservation, designation in accordance with the EU Habitats and Species Directive. The license concludes that operation of the Mine is unlikely to result in significant adverse effects on Special Areas of Conservation.

A review was undertaken focusing on specific conditions of the IPCL that relate to Mine closure and aftercare. License conditions reviewed in this schedule do not concern environmental management aspects of production activities at Lisheen Mine.

The Lisheen Mine fully complies with the conditions of the IPCL that relate to Mine closure and aftercare.

A copy of the 2014 IPC Licence can be accessed through the EPA website.

1.10.4 LISHEEN MINE PLANNING PERMISSION

Following the planning decision of An Bord Pleanála dated 30th May 1997, Planning Register reference no PLC / 17663 & PL 22.212637, permission was granted to construct and operate the Lisheen Mine. The Planning Permission is administered by Tipperary County Council and includes certain conditions that are specific to the closure of the Mine.

The Lisheen Mine fully complies with the conditions of the Mine Planning Permission.

1.10.5 Other Planning Permission granted to Lisheen Mine

Tivoli Dock Permission

Planning Permission for the operation of a Zinc / Lead concentrate handling facility at Tivoli Dock, Cork was granted by Cork Corporation on 5th March 1998. The Planning Permission contains one condition that concerns closure planning issues at Lisheen Mine.

The Lisheen Mine fully complies with the condition of the Planning Permission.

Derryville Island Development Area Permission

Planning Permission for the development of a new ore body within the Derryville Island area was granted by North Tipperary County Council, NTCC, on 23rd March 2013. The NTCC Planning Permission contains one condition that concerns closure planning issues at Lisheen Mine.

The Lisheen Mine fully complies with the condition of the Planning Permission.

TMF Cell Extension

Planning Permission for the development of a supplementary TMF cell at Lisheen was granted by NTCC on 2nd October 2013. The application was supported by an EIS that was published during August 2013. Both the NTCC Planning Permission and the EIS contain conditions and measures that concern closure planning issues associated with operation, rehabilitation and restoration of the supplementary TMF cell.

The Lisheen Mine fully complies with the conditions of the NTCC Planning Permission and the TMF Supplementary Cell EIS Conditions**.**

1.11 LEGISLATIVE FRAMEWORK

This section considers the legislative framework that contributes to the terms of reference for Mine closure at Lisheen. Mine closure is not an explicit reference in any of the statutes, but a number of statutory provisions are relevant to specific aspects of the closure process such as environmental protection, the regulation of waste management and the protection of valuable biodiversity.

Legislative frameworks operate at international and national levels. The international context is principally defined by European Union Directives. The array of relevant statutes is complex and extensive.

All relevant EU Directives require delivery at member state level by transposition into national law through the creation of appropriate Statutory Instruments. Implementation of the Lisheen Mine CRAMP will be underpinned by a constant review of relevant national legislation from the Irish Statute Book. This will enable a clear understanding of legislative requirements that must be supported through CRAMP delivery.

1.11.1 Supplementary Guidance

In addition to legislative frameworks, formal decisions on matters pertinent to Mine closure such as environmental regulation and sustainability are often made within a context of supplementary guidance. This typically comprises non-statutory statements that are intended to supplement statutory requirements, often providing valuable guidance on interpretation and implementation of legal requirements. As non-statutory items there is no legal duty to follow the guidance contained within these statements, but they are typically accepted as core components of best practice and as such generally describe the preferred approach for both general and specific aspects of the Mine closure process.

The principal elements of non-statutory guidance relevant to preparation and delivery of the Lisheen CRAMP are as follows:

- EPA Guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision.
- IMEG Closure Process.
- ICMM Planning for Integrated Mining Closure Toolkit, 2011.

Key aspects of these guidance frameworks are reviewed below, with comments on how they have been reflected in the Lisheen Mine CRAMP.

1.11.2 EPA Guidance

This item of supplementary guidance comprises EPA guidance on implementation of the European Union Council Directive 2004/35/EC on Environmental Liability. Published in 2006, the EPA guidance includes a section dealing with CRAMP preparation.

A review of the guidance demonstrates that the Lisheen Mine CRAMP fully complies with EPA supplementary guidance on closure planning to support objectives of European Union Council Directive 2004/35/EC on Environmental Liability.

1.11.3 IMEG Closure Process

Irish Mining and Exploration Group is a business interest group that mainly comprises key representatives of the Irish mining sector. The group has an environment sub-committee that is concerned with establishing a consensus view on best practice for Mine closure. Core topics focused on within IMEG discussions include physical closure, Mine closure and the environment, social closure, regulatory authorities, closure costs and financial provision, and aftercare.

Against these concerns, IMEG states the importance of adopting best practice and strongly recommends the definition of performance criteria to help with the identification of practical closure for Ireland's mines. Lisheen Mine fully supports the IMEG objectives on Mine closure. As such, the Lisheen CRAMP has been developed in line with IMEG objectives for responsible Mine closure.

1.11.4 ICMM Planning for Integrated Mining Closure Toolkit, 2011

The International Council on Mining and Metals developed the Planning for Integrated Mining Closure: Toolkit. This is based on 10 principles reflecting the industry initiative and outlines a broad framework for developing a Mine closure plan.

The Lisheen Mine follows steps outlined in the Guidance.

1.11.5 Vedanta Technical Standard, Site Closure, TS17

Lisheen is required to follow the Vedanta Sustainability Framework. This is made up of management and technical standards. Technical standard 17, Site Closure, considers sustainability issues before, during and after site closure and this is referred to while reviewing the CRAMP.

The Lisheen Mine fully complies with the conditions of TS17.

Please refer to Appendix 1.10 for a copy of the technical standard 17.

1.11.6 Consultations with stakeholders

Close consultations have been undertaken with a variety of stakeholder groups throughout the operation of Lisheen Mine. These include organisations that represent the local and regional business community, the local residential community and the community of employees at the Mine.

Consultation meetings that have been held with these organisations have raised a diverse array of issues, including a number that concern Mine closure. Examples include an interest from the business community in opportunities for

adoption of the Lisheen Mine site after closure as a location for commercial development.

The principal stakeholder consultation groups are as follows:

- Lisheen Mine Community Engagement Forum
- Lisheen Mine Community Engagement Forum (Closure sub-committee)
- Moyne Group Water Scheme Committee
- Lisheen Mine Task Force
- Lisheen Mine Environmental Monitoring Committee
- Trades Unions

Observations raised by these groups over Mine closure have been considered and integrated into detailed plans made for closure of the Mine.

CHAPTER 2 – MINE REWATERING

CHAPTER 2 – MINE RE-WATERING

2.1 INTRODUCTION

This chapter includes a detailed Hydrology Model to support Mine Closure while Lisheen implements the plan for re-watering the underground workings. This model predicts the likely rate of groundwater recovery, the likely chemistry within the flooded areas, a plan to protect groundwater users and how to minimise the potential impact on the local rivers.

The report also includes a post closure water balance of the TMF and a plan for discharging surface water runoff along with a water monitoring plan.

The full hydrogeological report is available in Appendix 2.1.

Available hydrogeology and geochemistry data was used to provide an assessment of:

- The likely rate of groundwater recovery in the workings and dewatered areas
- The final groundwater table on completion of flooding
- The likely water chemistry within the flooded workings
- An analysis of the post closure groundwater system, including the fate and transport of the water within the flooded workings
- How best to protect other groundwater users that may be effected by closure
- How best to minimise the potential for impacts to the Drish and Rossestown Rivers

Following the shutting off of the pumps the groundwater levels began to rise and the Mine workings started to flood. The initial rate of recovery has been rapid and should progressively decrease with time. As recovery progresses the rate of water level rise will become increasingly controlled by the varying amounts of rainfall and recharge.

During the initial recovery period the water level rise in the lower part of the individual mining zones may be independent. However as the mining zones are interconnected the rising water level will equilibrate between the zones – the water level will be uniform over the entire Mine area as the recovery will occur at the same rate.

The re-watering model for Mine predicts that the dense sulphate rich water in the Mine will stratify and create a chemocline; whereby the mineralised water will remain at the elevation of the Mine workings and less saline clean water, which recharges the Mine is less dense and will in essence ‘float’ on top of this denser

Mine water. It is predicted that there will be very little groundwater movement at the depth of the Mine workings and therefore minimal risk of mobilisation of any metal rich mineralised water. The aquifer is active in the epikarst, which is found in the top 30 to 50 m below ground level, this water will be clean, good quality water.

It is expected that the groundwater levels will fully recover to pre-mining (baseline) levels throughout the entire area of the drawdown influence. The time it will take for this recovery to baseline conditions is not known. Models have been created by our hydrogeologists in order to try and predict the rate of recovery. For the base case model, using average recharge and porosity values, about 90% of the total recovery occurs within 18 months. The remaining 10% of the recovery period may take a further 30 months; meaning full recovery may take up to 4 years. It needs to be borne in mind that this is only a model and a possible recovery rate, the actual rate of recovery could take less or more time.

2.2 MONITORING SCHEDULE

Two new Groundwater compliance monitoring wells have been installed to monitor groundwater chemistry and these will be used to demonstrate success of the re-watering of the Mine.

As per the revised Hydrogeological Review 2015, submitted to the EPA on the 6th October 2015, Lisheen proposed "general compliance limits" to be used for contaminants of potential concern to provide overall groundwater quality targets for the Mine. However each monitoring location will be assessed with trend analysis of any change in water quality over time.

The general compliance values are presented in the table below:

Parameter	Unit	Proposed COPC	Groundwater Regulation[1]
Dissolved Arsenic	mg/L	0.01	0.0075
Dissolved Lead	mg/L	0.01875	0.01875
Dissolved Nickel	mg/L	0.02	0.015
Dissolved Zinc	mg/L	1 [2]	-
Sulphate	mg/L	250	187.5
Ammonia (as N)	mg/L	0.23	0.065

[1] S.I. No. 9 of 2010

[2] In the Hydrogeological Report submitted in October 2015, Lisheen proposed a limit of 3 mg/l for zinc. This has since been rejected by the EPA and a new limit value of 1 mg/l Zn has been proposed.

Analysis of the post closure groundwater will comprise of monitoring regional wells, boreholes directly in the Mine workings and two new Groundwater Compliance wells, one south-westerly to the TMF and the other South-westerly to Main Zone to capture active ground water flow which is most vulnerable to impact.

Details of the location of these wells are presented below:

Monitoring of Mine Workings		
Fogarty, DW14, MW21, LK1955, VS1 (until MW9 has recovered), I31 (until MW15 has recovered), New Ground Water Monitoring Wells		
Years following end of dewatering, December 2015		
Years	Parameter	Frequency
Year 1	Water level, Chemistry suite	Monthly
Years 2 +	Water level, Chemistry suite	Quarterly
Years following recovery		
Years	Parameter	Frequency
Years 0 - 3	Water levels	Monthly
Years 0 - 3	Chemistry suite	Bi-annually

Figure 2.1: Monitoring schedule of the Mine workings

Coordinates						
	Fogartys	DW14	MW15	MW09	MW21	LK1955
Easting	219018	219917	219699	220720	220988	222091
Northing	166602	167482	166707	166809	167979	167254

Figure 2.2: Coordinates of the wells sampled in the Mine workings

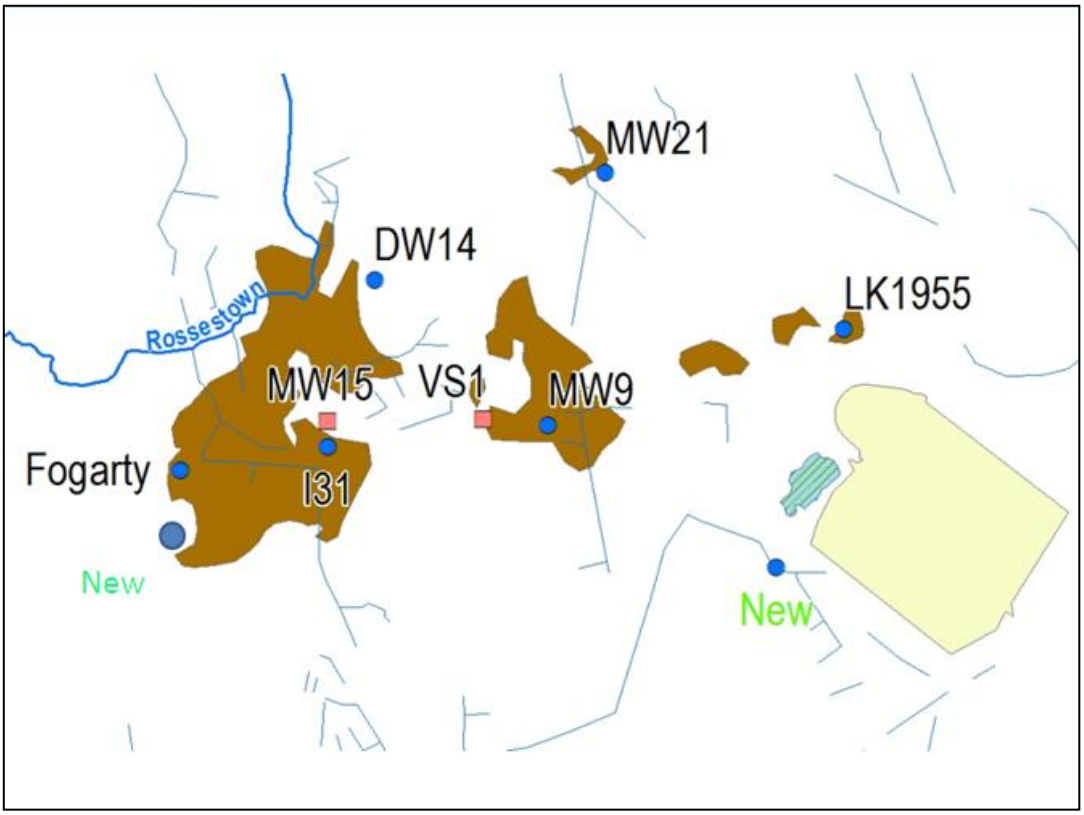


Figure 2.3: Map showing location of the wells in relation to the Mine workings

Regional Wells		
James Maher, Steve Hennessy, Martin Moore, Francis Cleere, Paddy Fogarty, Pat Healy's		
Years following end of dewatering, December 2015		
Years	Parameter	Frequency
Year 1	Water level, Chemistry suite	Monthly
Years 2 +	Water level, Chemistry suite	Quarterly
Years following recovery		
Years 0 - 3	Water level, Chemistry suite	Bi-annually

Figure 2.4 Monitoring schedule of the Regional wells

Coordinates						
Regional Well	Stephen Hennessy	Martin Moore	Francis Cleere	Jim Maher	Paddy Fogarty	Pat Healy
Area	Lisheen	Kilclonagh	Boulabeha	Cooleeny	Derrygrenagh	Derryfadda
Easting	217211	216710	219477	221019	222980	223032
Northing	166614	165005	163512	164747	167525	165848

Figure 2.5: Coordinates of the Regional wells

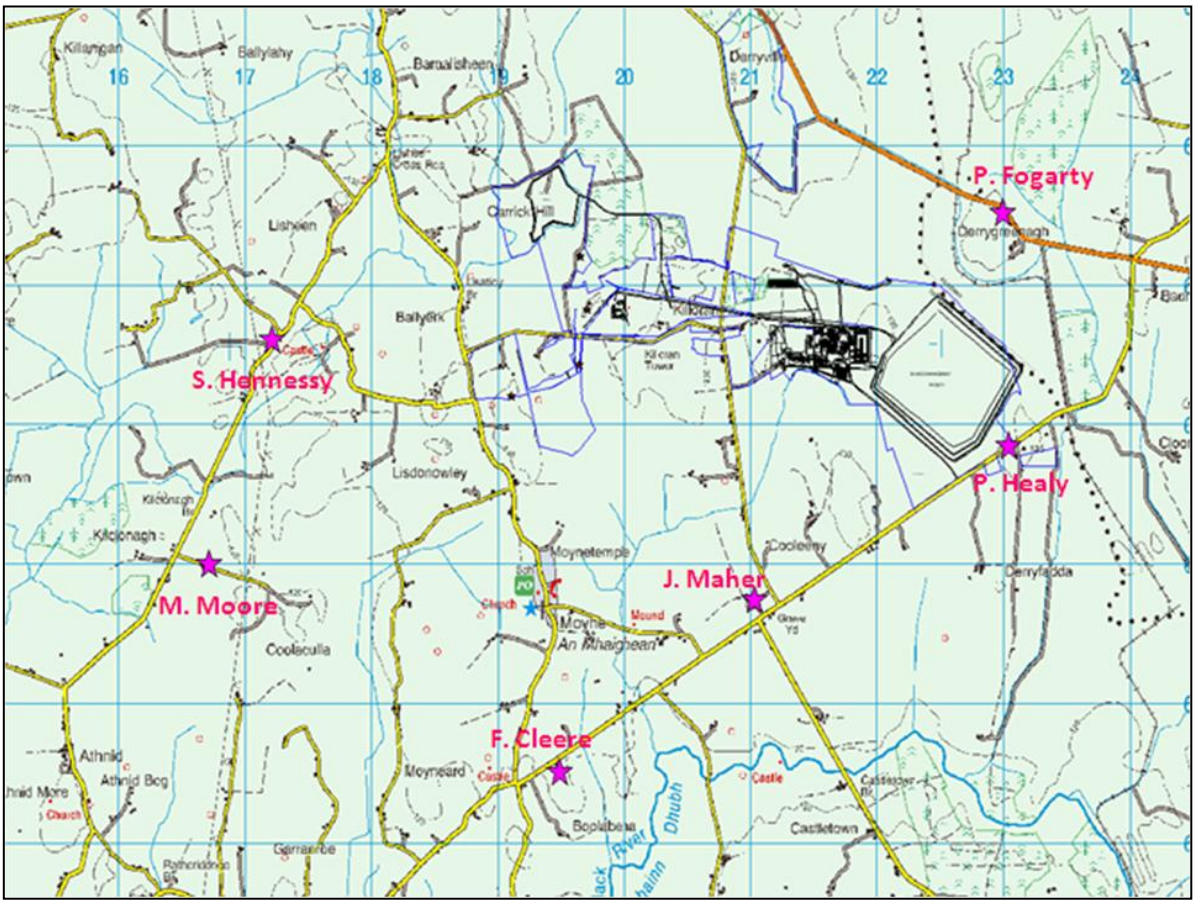


Figure 2.6: Map showing location of the Regional wells in relation to the Mine

CHAPTER 3 – MINE SITE AND UNDERGROUND DECOMMISSIONING AND RESTORATION

CHAPTER 3 – MINE SITE AND UNDERGROUND DECOMMISSIONING AND RESTORATION

3.1 INTRODUCTION

This Chapter of the CRAMP describes the physical decommissioning and restoration of the Mine site to a standard suitable for industrial / commercial land after use as per the County Council Master Plan Policy. It also includes the decommissioning of the Underground Mine following the cessation of mining operations.

The programme includes decommissioning of underground and surface plant, equipment, services and all associated elements within and backfilling of the Mine along with monitoring structural stability.

The drawing below includes the Mine workings (IPCL boundary and land holding is shown in green).

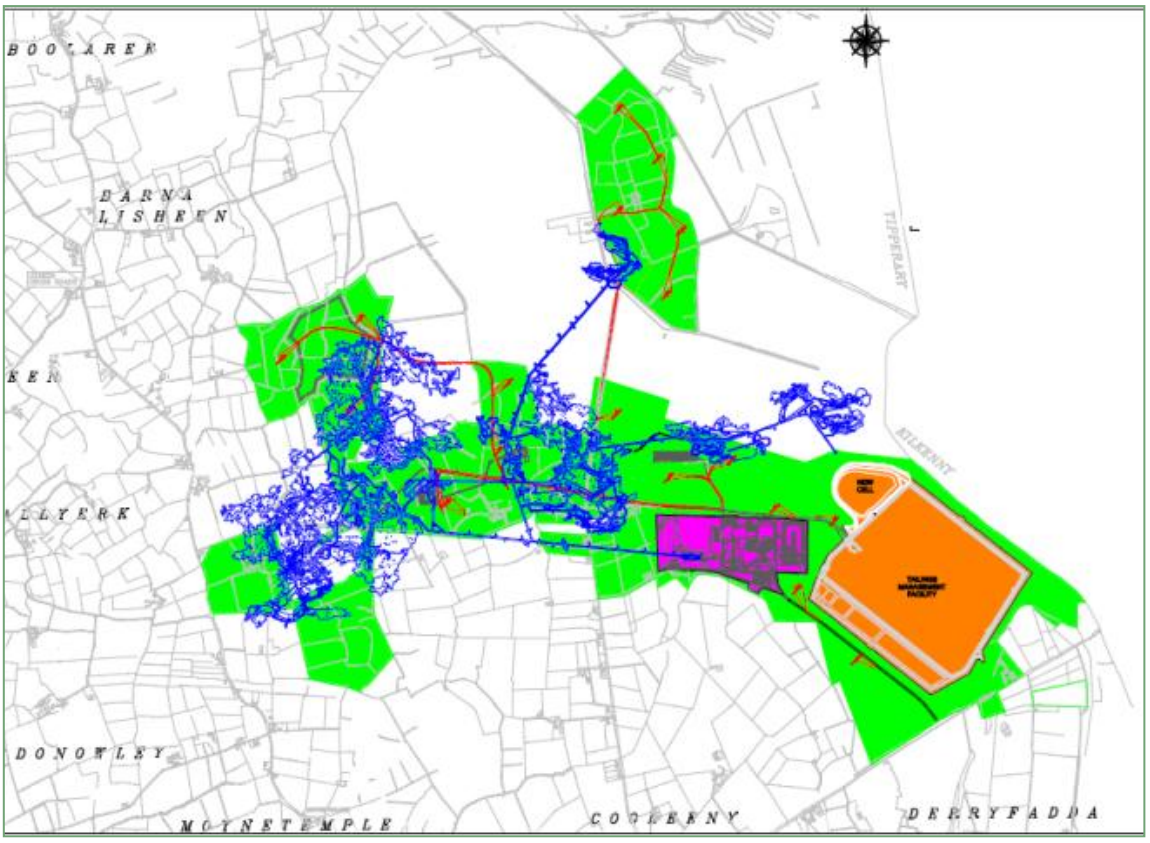


Figure 3.1: Overall site layout including Mine workings

It is planned that Lisheen will get permission, through a technical amendment of the IPCL, to reduce the site boundary significantly to only include the TMF. This will only be permitted by the EPA following an independent closure audit to demonstrate that there are no potential environmental issues remaining.

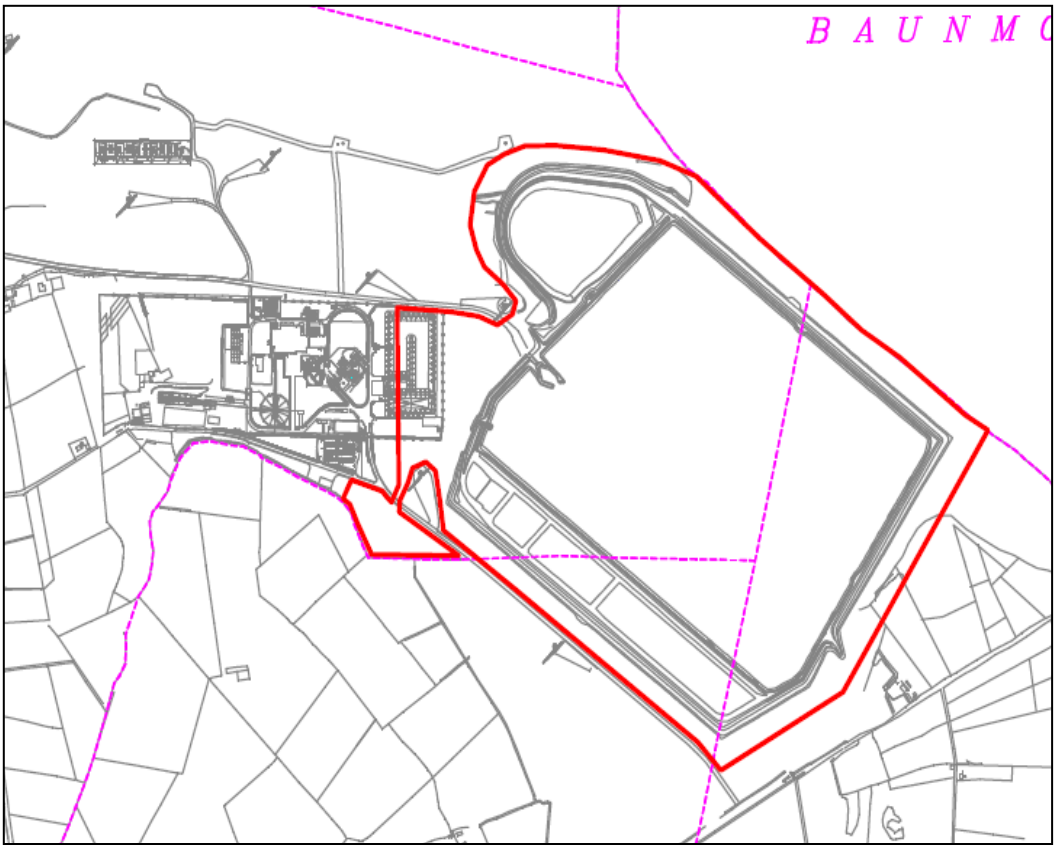


Figure 3.2: Predicted reduced IPCL boundary (in red) surrounding the TMF

The water management plan following closure is also contained in this chapter. This includes details on the proposed water reticulation system, receiving waters and monitoring schedule.

3.2 SURFACE DECOMMISSIONING

Please refer to Appendix 1.8 for a programme of the works required for the decommissioning and dismantling of all surface buildings, structures and fixed plant.

3.2.1 The Lisheen Wind Farm

The Lisheen Wind Farm became operational in August of 2009 and is currently maintained and operated by Brookfield Renewable and will be operational on the site post cessation of the Mine. The lands are leased from Lisheen Mine on which the turbines and other infrastructure necessary for the operation of the Wind Farm are located. This means that certain infrastructure will be retained on the Lisheen Site for the purposes of servicing the Lisheen Wind Farm. This includes the internal road network system and the ESB substation.

3.2.2 Retention of Surface Buildings for Appropriate Secondary Use

The Lisheen Mine Task Force is actively developing a project pipeline that is intended to replace mining activities on the Lisheen Mine site in whole or in part. The Task Force is made up of Lisheen Management, and a number of governmental and non-governmental organisations.

The prospect of future sustainable development will mean that some buildings and associated infrastructure may be retained on the Mine site for secondary use. The Wind Farm is considered the first such project. The administration building, the warehouse and workshops building and the large parking facility on site may also be retained for future industrial use.

3.2.3 Demolition or Dismantling of Surface Buildings and Structures

Redundant surface buildings, structures and fixed plant including tanks and pipes will be selected for either demolition, or dismantling for sale through the asset disposal process. The site will be returned to suitable land for future industrial / commercial after use by recovering any soil, subsoil or any waste materials that may result in environmental pollution. Assessment and validation by suitably qualified persons will be obtained to demonstrate all residual material has been removed to predetermined guideline levels.

Prior to demolition or dismantling, all services connected to buildings and other structures will be disconnected and removed.

Structural steelwork, all other steel items and metal cladding will be sold through the asset disposal process. Mass concrete will be crushed and separated from reinforcement, and the aggregate crushed and deposited in the TMF below the level of the geotextile layer

Items selected for demolition or dismantling for sale will be decommissioned, cleaned, decontaminated (if necessary) and either demolished and removed from the site if necessary by appropriately licensed contractors or dismantled into containers for ease of transport.

Waste water arising from the decontamination process will be discharged to the TMF. In the event that waste oils and sludge's arise for the decontamination process then these will be disposed by licensed waste contractors.

Demolition and dismantling will be carried out by specialists whose contract terms will require strict operation within the relevant quality, safety and environmental standards.

3.2.4 Removal of Infrastructure and Services

3.2.4.1 Roads, Hard standings and Car Park

The current access road will be retained as the primary access route into the restored Mine site. Sufficient parts of the internal network would be retained to provide access to the retained buildings. All site and access roads for the purposes of servicing the Lisheen Wind Farm into the future will be retained.

Other site roads and hard standings in the Mine site area will be removed to formation level and the construction material crushed and deposited in the TMF below the level of the geotextile layer. Uncontaminated hard standings will be similarly treated. Material containing base metals and substances involved in processing will be disposed of in the TMF. Surplus decontaminated material may be used for re-profiling the brown field site or for landscape features.

3.2.4.2 Fuelling Depot and Oil Storage Facilities

This will entail the removal of tanks and their associated distribution systems all of which will be carefully drained, desludged and flushed by specialist contractors who will be responsible for the disposal of oils. Contaminated materials will be removed from site and uncontaminated concrete or earth bunding will be used for filling sub geotextile void space in the TMF.

3.2.4.3 Water Treatment Facilities

Conditioning Ponds

All process sludge from the Conditioning Ponds will be disposed to the TMF by a contractor. Pond liners will be removed and made manageable by on-site shredding for on-site reuse as an additional geo grid layer when depositing materials into the TMF at greater depths beneath the geotextile layer or for off-site disposal, as appropriate, by licensed contractors. The bunded walls will be removed with this material to be used to fill the final sub geotextile void on the TMF. All concrete structures associated with the water ponds will be decommissioned and demolished and this material may also be used as fill material for the TMF.

Drish and Rossestown Wetland, chambers and pipelines

The Drish and Rossestown pipelines will in place as to remove them would be too disruptive to local landowners. Concrete structures will be decommissioned and demolished and this material may be used as fill material for the sub geotextile void on the TMF.

The Drish surface channel and wetland will be desludged and levelled with the sludge disposed to the TMF. Chambers from both the Drish and Rossestown reticulation systems will be desludged, with the sludge being transported to the TMF for disposal. The Rossestown wetland will be cleaned of any contaminated material and returned to pre determined industrial standards.

3.2.4.4 Wellfield Dewatering System

The old dewatering wells will be backfilled with clean limestone chippings to within 10m of the surface and the top filled with a cement grout plug to prevent the ingress of surface water. All redundant plant and structures will be removed as described above.

3.2.4.5 Carrick Hill Borrow Pit

The Carrick Hill Borrow Pit has been used for sourcing construction material throughout the life of Mine and for the completion of closure. The material sourced was primarily used for the construction of the TMF dam wall and the Lisheen Wind Farm and is also being used for closure rehabilitation and restoration works. Consequently a localised depression has been formed in the Carrick Hill area, much of which is lower than the original water table. The borrow pit area will be rehabilitated upon closure and as the cone of depression recovers this area will become flooded and will effectively form a water body. It is the intention that this area will form a natural habitat for indigenous flora and fauna species.

Figure 4 below shows the restoration plan for Carrick Hill.

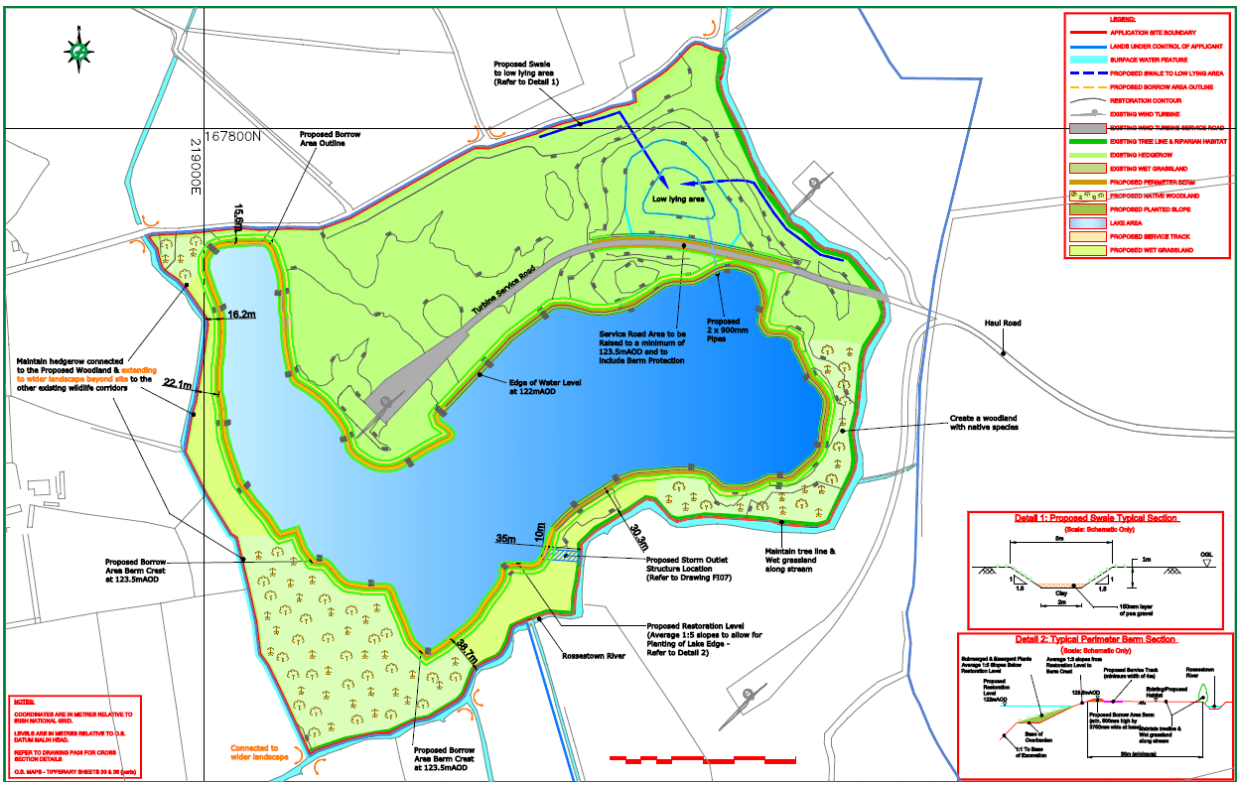


Figure 3.3: Rehabilitation plan for Carrick Hill Borrow pit

3.2.4.6 Developed Lands

All developed lands outside the main plant site will be restored to suit the conditions of the surrounding lands, unless identified for appropriate secondary use. Other farm buildings and dwellings within the landholding will be refurbished, made safe or demolished depending on their general state of repair.

3.2.4.7 Buried Services

Any buried services that are required for the wind farm or for potential secondary use upon cessation of the mining operations will be left in-situ. All other buried services which are not required post closure above plough level, (c. 300 mm), will be removed. All other buried services which are below plough level and not required, will be left in place as to remove them would potentially have adverse disruptive effects on the land.

3.2.4.8 Demolition of Structures and Equipment on the TMF

All redundant structures and equipment within the boundary of the TMF will be decommissioned and demolished by an appropriately qualified contractor. All HDPE pipe lines will be decommissioned and cleaned for sale or recycling. The Motor Control Centre, reclaim pumps and associated infrastructure will be

decommissioned and cleaned for sale as scrap or reuse depending on their state of repair upon closure of the Mine.

3.2.4.9 Cleaning and Disposal of Mineral Residue and Contaminated Material

A detailed risk assessment was completed by independent contractors, Tobin Consulting Engineers, to determine contaminated areas across the whole site. The obvious hot spots are localised at the Tepee, Mill, Workshops, Rossestown Wetlands, Fuelling Depot and Oil Storage Facilities. An excavation allowance has been made to remove all contaminated ground in these areas and the disposal of same into the TMF.

Once these works have been completed Tobin Engineers will be engaged to produce a Closure Audit report following another site inspection. This Closure Audit can be used to assist Lisheen in reducing the site boundary covered under the IPCL.

Please refer to Appendix 3.1 for a copy of the Risk Assessment

3.2 UNDERGROUND DECOMMISSIONING

Decommissioning of the underground facilities were completed once mining operations ceased.

A procedure was followed with appropriate personnel responsible for signing off each area. Before an area was rendered inaccessible all hazardous materials were removed and the sign off sheet was signed off in full.

Items that could pose a risk to the environment were removed. Any plant, equipment, tanks, and fuel containers remaining underground were drained down of all oils and fuels and stripped of rubber based components.

Fixed and mobile underground assets of value, and not required for underground withdrawal purposes, were brought to the surface to be sold as part of Lisheen Mines Asset Disposal Procedure.

The objective for Lisheen was to remove the maximum quantity of all material from the Mine; however it will not be possible to remove all material because of the retreat process and the infrastructure required for same (e.g. it will not be possible to remove all pumps and cables as there will be dewatering activities up until the end).

Please refer to Appendix 3.2 for a copy of the procedure LM-135 "Underground Clean up".

3.3.1 Ventilation Shafts

All vents will be stripped of infrastructure not required for post closure monitoring. The vent shafts will be plugged with a combination of rock fill and concrete and topped off with glacial till and a final layer of topsoil, peat or hardcore to blend in with its surrounding features. A detailed design and sections for each vent shaft is attached as Appendix 3.3.

3.3.2 Decline

Conveyor structures and services in the decline have been removed where practicable and all rubber based components were removed. All services have been stripped out for the entire length of the plug. The plug is a composite of rock fill and concrete grout to ensure a tight fill. A detailed design and section for the plugging of the decline is attached as Appendix 3.4.

3.3.3 Extent of Mine Workings at the end of LOM

Backfill

Paste backfill is comprised of tailings, cement (ordinary Portland cement) and binder (Ground-granulated blast-furnace slag). These are essentially mixed with water and then thickened in the backfill plant, to form a concrete. The paste was pumped underground and directed to mined out areas where it was used to fill or "backfill" voids. This process formed an integral part of the mining operations. It provides support to areas that have been mined out. The process also ensures that the overall volume of material disposed into the tailings management facility is reduced.

Waste rock is rock that has very low or no metal content and is not suitable for processing. This material is separated from the ore stream and was also used underground to fill voids and to provide localised support.

The extent of paste backfill on closure and the Mine workings is as indicated in below.

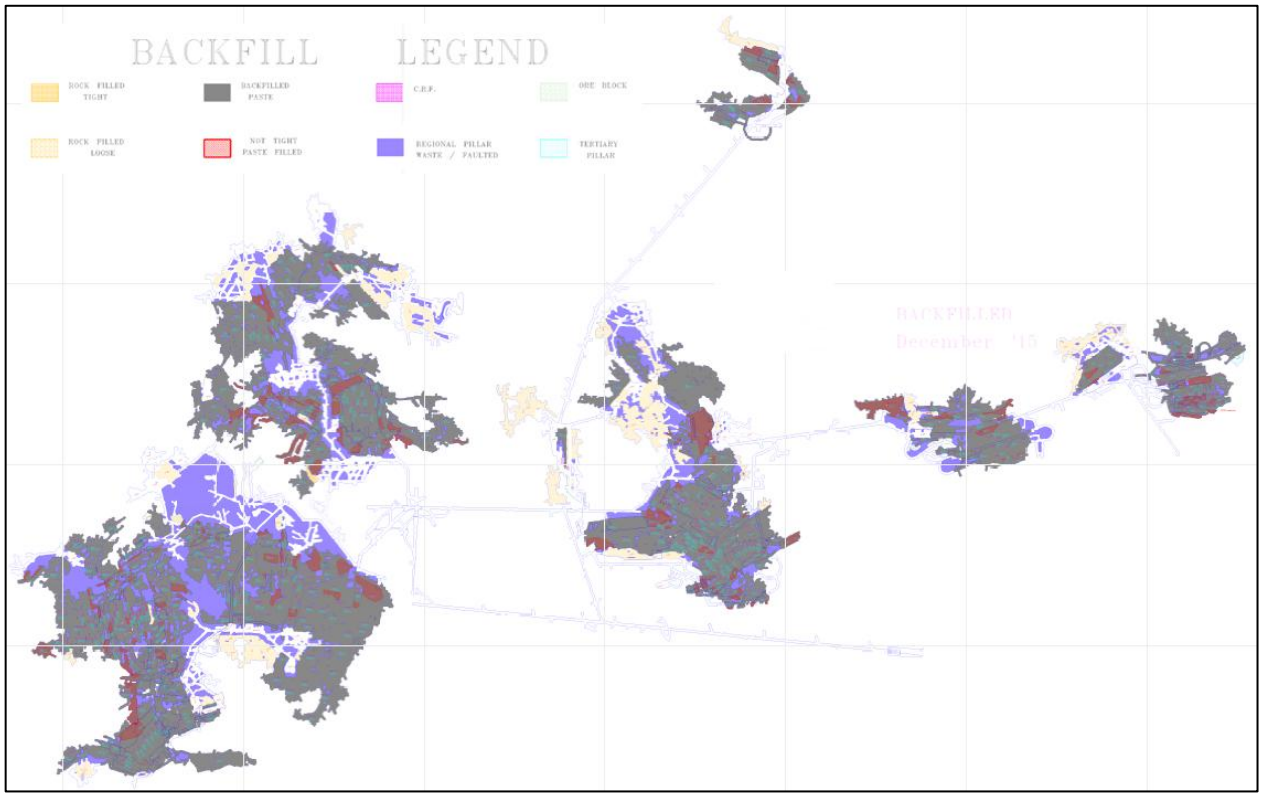


Figure 3.4: Complete backfill placement (December 2015)

3.3.4 Structural Stability and Support

Monitoring for regional settlement is carried out at the Lisheen Mine site on a quarterly basis. The monitoring station locations are illustrated in below.

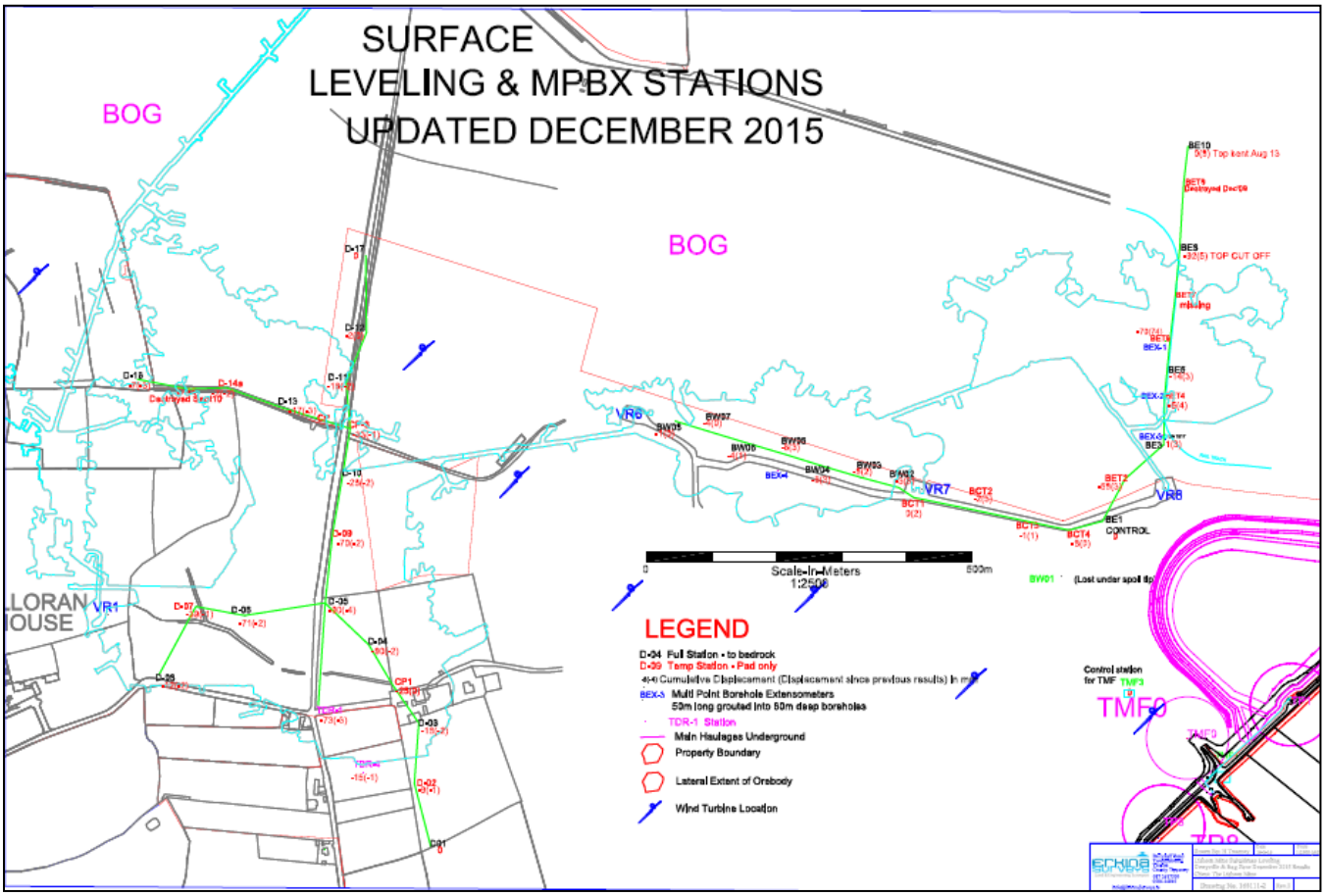


Figure 3.5: Settlement Monitoring Stations

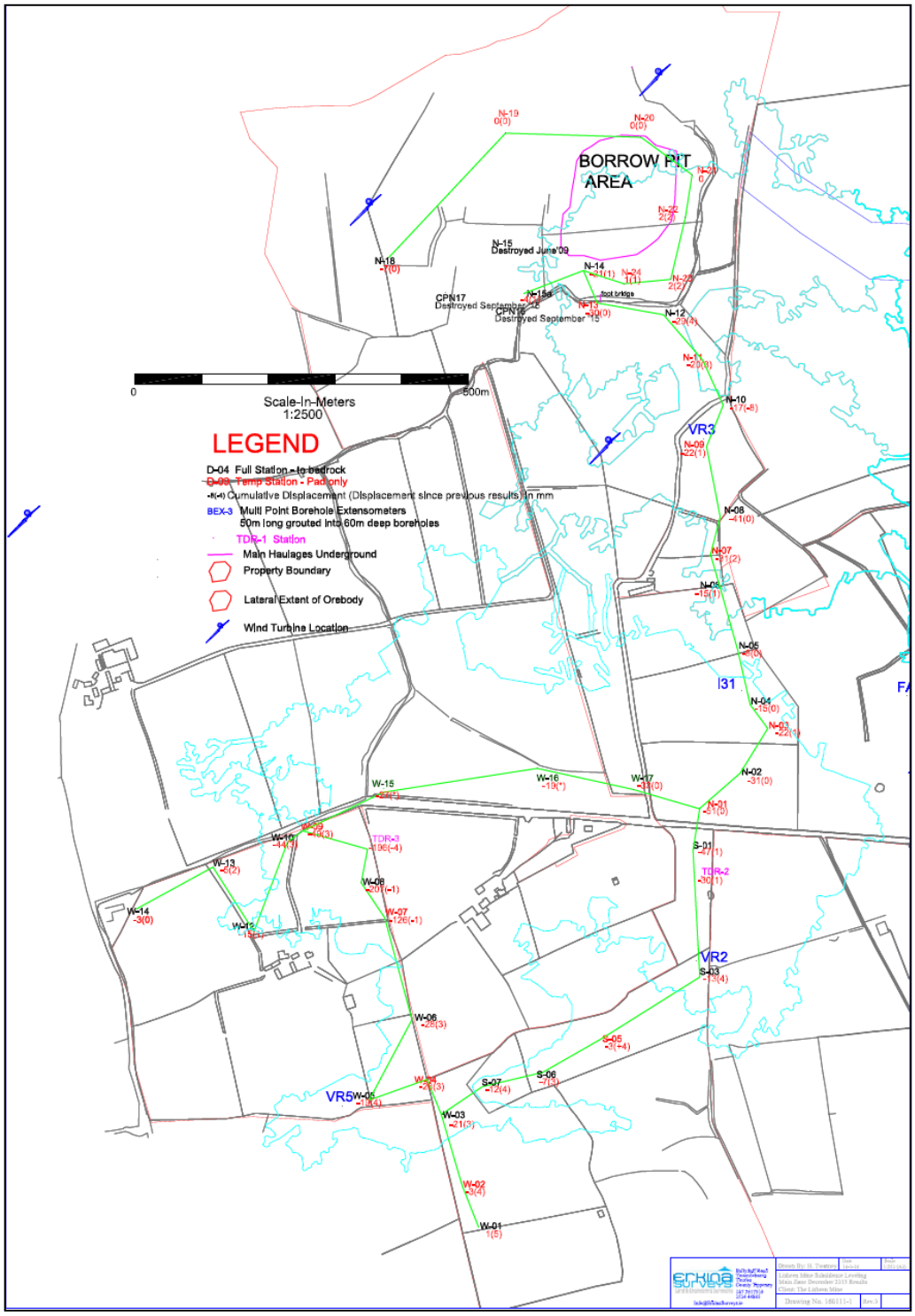


Figure 3.6: Settlement monitoring locations

Monitoring for settlement will continue into the aftercare period until sufficient data is collated to warrant a cessation of monitoring.

3.4 WATER MANAGEMENT

A detailed hydrology study has been carried out on the Lisheen Mine and can be found under Appendix 2.1. This indicates that it will take between 3 and 4 years for the cone of depression to fully recover.

The monitoring schedule will be implemented as detailed in the current IPC Licence, P0008-04, or subsequent updates. The schedule will continue until such time as the residual liabilities are reduced to a steady state to the satisfaction of the Lisheen Mine and the Statutory Authorities.

3.4.1 Phasing Out of Discharge to the Rossestown River

As per our Planning Permission Lisheen will continue to maintain a discharge to the PWE2 location on the Rossestown River, if required, until the groundwater levels and springs contributing to the river have recovered. It is anticipated that natural groundwater base flow to the river will become re-established at some point prior to completion of full recovery.

For the last number of years the volumes of water discharged at PWE2 have been in the region of 2MLD and at that flow there has been sufficient volume in the river at all times during the year. Therefore the volume of augmentation water discharged by Lisheen Mine is expected to be in the region of 2MLD (the site is currently licensed to discharge 20MLD and as such river recieving capacity is not an issue for 2MLD). Schlumberger Water Services have suggested that the flow in the Rossestown should be maintained at no lower than 0.04 m^3/S. The flow rate will be monitored and should it fall below this level, the river water will be compensated for as long as is required and until full groundwater level recovery has been demonstrated. Flow rate may be judged by an agreed river level (above Ordnance Datum) at a specific point in the river. The location and elevation in mAOD is to be agreed by Lisheen and IFI. As there is already a monitoring history at the bridge just downstream of the Lisheen Mine discharge (PWE2) this is the suggested location for monitoring flow / river level.

Two water sources will be used to provide augmentation to the Rossestown. The TMF basin is a catchment that collects water and this water can be used to augment the Rossestown river. A groundwater well will provide additional water to supplement the TMF water and this groundwater supply will also ensure that the sulphate concentration in the augmentation water is at an acceptable level.

The quality of water discharged from the Mine is in fact likely to improve the water quality downstream, as water upstream of the PWE2 discharge has elevated concentrations of certain parameters; notably ammonia.

3.4.2 Phasing out of PWE1 discharge

PWE1 discharge location has always discharged the largest volumes of water, approximately 80% of the total flow.

It had been previously stated that Lisheen would phase out the discharge from PWE1 over two winter seasons. The phasing out has now occurred gradually over a number of weeks. This earlier phasing out will expedite the rehabilitation of the PWE1 discharge and outfall allowing for a timely rehabilitation of the TMF which otherwise would have to remain operational to receive spoil from this area.

Mr Pascal Sweeney, of Sweeney Consultancy, who carries out biological sampling, states there are no unique habitats in the Drish River. His view is that water which is currently held back upstream of the discharge would quickly flow downstream. This may cause some fish and invertebrates to be displaced downstream. However, he believes the impact would be minor.

As a stretch of the river is within the cone of influence, the nearest monitoring well, known as Francis Cleere, will be used to show how the water table is recovering.

As a contingency the original PWE1 pipeline will remain in place in case the river levels fall significantly with a possibility of drying up. From the discussion that took place on the 14th of October with IFI, Lisheen is committed to providing a source of water that could be discharged to the Drish River during the summer of 2016 if there is a risk that the river may dry out in places. The IFI will be required to give Lisheen notice that the river is at risk and together both parties will establish a plan to augment the river.

3.4.3 SW1 Discharge

This location will become the main discharge location for site surface water into perpetuity.

All storm water that falls on site is currently pumped via a storm water system to the TMF and from there is it discharged from site. The storm water collection system will remain in place for a period of time until the main industrial site is rehabilitated. After the main site is rehabilitated, precipitation falling on this area will naturally find its way via existing water courses to the Drish River.

Precipitation falling within the catchment of the Tailings Dam (TMF) will need to be managed into perpetuity. This precipitation will undergo evaporation and evapotranspiration but this will not remove all water and there will be a discharge from the facility that will vary seasonally.

The discharge water will exit the facility via engineered spill ways towards a stilling box before entering the main wetland. It will then flow by an open channel to a final smaller wetland before discharge to the Clogheen stream, which is a tributary of the Drish River, via SW1. In order to ensure that the Clogheen is able to manage the runoff from site, works to remove growth have taken place, coordinated with local land owners and the IFI.

3.4.4 Management of TMF Surface Water

After the water cover is removed and the facility is rehabilitated, there will remain a requirement to manage water generated within the catchment of the facility. In the short term this TMF water catchment will provide much of the water required for augmentation of the Rossestown River.

The modeling completed by our hydro-geologists indicated that this water will be suitable for discharge without any treatment. However, a series of wetlands will be in place and will be planted with varieties of aquatic plants that are capable of providing attenuation. For a short period of time it may also be required to chemically treat the initial run-off water from the TMF. Treatment will be either via the existing water treatment plant or the water will be treated by a modified version of the existing water treatment plant.

In the modified water treatment arrangement the pH agent and coagulant is added at the beginning of the water abstraction pipeline and the pipe line essentially takes the place of the mixing tank.

Solids will settle in the conditioning ponds in place of the clarifier (the ponds have a retention time far in excess of the existing clarifiers). Any precipitate formed will settle out in the conditioning ponds.

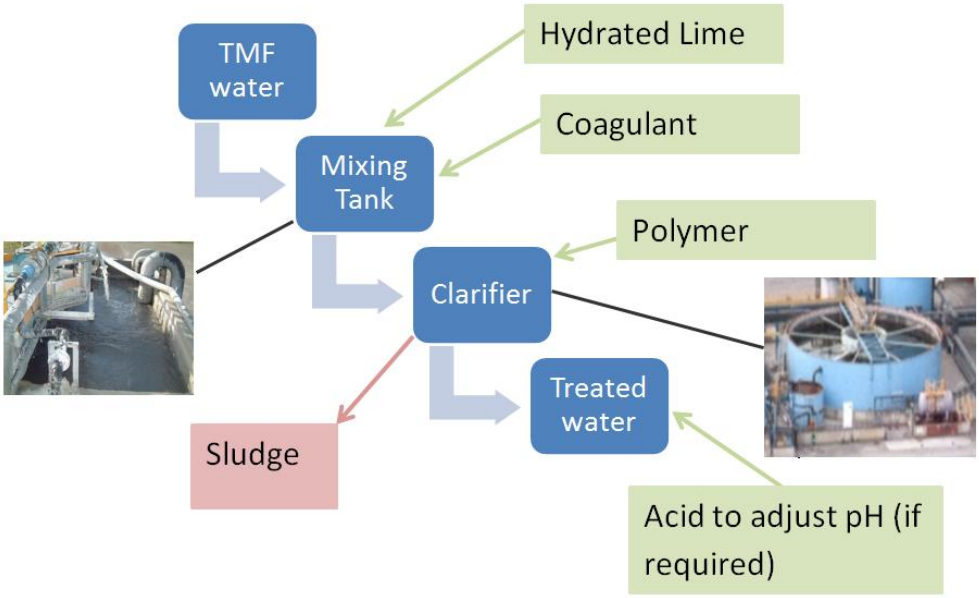
There are 3 distinct water ponds that make up the conditioning ponds.

It would be possible to add water in the first pond and batch release into the other ponds to ensure that solids were managed correctly.

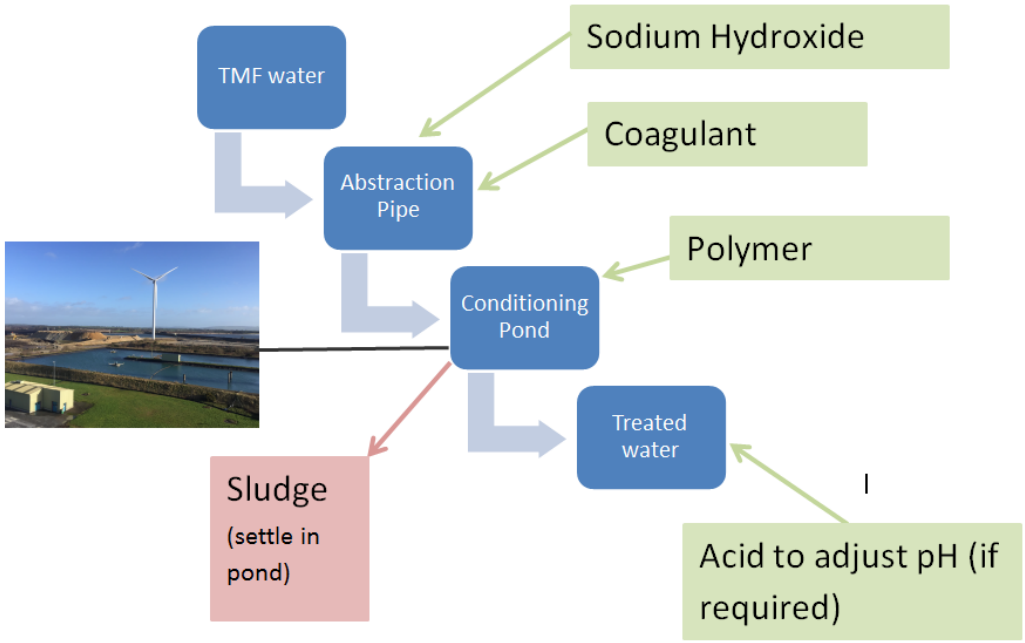
Pond 1	
Pond 2	
Pond 3	
Location A	Inlet location to Pond 1
Location B	Inlet location to Pond 3
Location C	Outlet locations from ponds
Red arrows	Direction of water flow

This water treatment arrangement will facilitate the batch treatment of the small volumes of water that will be generated. The existing water treatment plants are designed for continuous treatment of large water volumes.

Existing MWTP arrangement:



Proposed water treatment arrangement to facilitate batch treatment of TMF water:



Regular monitoring of the water quality will take place to ensure compliance is met prior to discharge.

3.4.5 Sediment Removal from the Drish and Rossestown Rivers

Now that the Mine has ceased discharging water to the Drish River via PWE1, a risk assessment will be carried out to determine if the river requires removal of any sedimentation relating to mining operations. The requirement for the removal of sediment from the Rossestown River will also be determined following a risk assessment. All the material removed from the rivers, (if required), as part of the works will be disposed of into the TMF. These works will have to be coordinated with the IFI and be completed in 2016 to ensure any arising's generated from the works can be deposited into the TMF.

3.4.6 Monitoring Schedule

The following is the current schedule for surface water monitoring:

SW1 IPCL Compliance Point	
(Discharge location to the Drish River)	
Parameter	**Frequency**
Chemistry suite	Daily as per IPCL conditions

Up and Down Stream on Drish River	
u/s Drish (2nd bridge Castletown) d/s Clogheen Pond before Drish d/s Drish (3rd Bridge Boolabeha)	
Parameter	**Frequency**
Chemistry suite	Monthly as per IPCL conditions

PWE2 IPCL Compliance Point	
(Discharge location to the Rossestown River)	
Parameter	**Frequency**
Chemistry suite	Daily as per IPCL conditions while discharging

Up and Down Stream on Rossestown River	
u/s Rossestown discharge d/s Rossestown (bridge) d/s Rossestown (Lisaticy)	
Parameter	**Frequency**
Chemistry suite	Monthly as per IPCL conditions

3.3 THE PORT OF CORK

The Lisheen Mine leases a facility that is used for exporting Zinc and Lead concentrate at the Tivoli Dock in Cork. It is expected the termination of lease will take place mid 2016.

Upon closure, the facility will be demolished by suitably licensed contractors under strict guidelines to the satisfaction of the Port of Cork Authorities and the Lisheen Mine. The concrete pad is to be retained along with a significant portion of the conveyor structure and ship loader which the Port of Cork may wish to sell or reuse at a later date.

All concentrate residues from the cleaning process will be collected, transported to the Lisheen Mine site and disposed of in the TMF. Any hydrocarbon residues will be collected and disposed of separately by an appropriate licensed contractor.

CHAPTER 4 - TMF REHABILITATION AND RESTORATION

CHAPTER 4 - TMF REHABILITATION AND RESTORATION

4.1 INTRODUCTION

This chapter of the CRAMP describes a remediation strategy for the TMF. The TMF contains over 12 million tonnes of tailings placed into two tailings lagoons, which are 64 and 6 hectares respectively at crest elevation.

The tailings contain significant quantities of pyritic minerals which have the potential through oxidation to liberate metals and sulphides into acidic drainage water. When present at high concentrations, both metals and sulphides can create problems for plants and animals and as such are a potential environmental hazard.

The management of this risk at Lisheen Mine has been the subject of considerable geochemical and geophysical test work and this has supported the development of a practical strategy for residual liability management through rehabilitation of the TMF.

4.2 Rehabilitation and restoration strategy

A programme of expert consultations and workshops held during early 2006 concluded that a complete wet closure concept for the Lisheen TMF was inappropriate in terms of residual environmental impact risk. The consequence of this conclusion has been the adoption of a dry closure concept for TMF rehabilitation and the development of a specification for capping the TMF. The approach that has been adopted draws from geochemical and geophysical laboratory test work, described in detail in previous revisions of the CRAMP, where the apparent oxidation lag and potential load-bearing characteristics of the Lisheen tailings suggest that dewatering the tailings surface ('beaching') prior to construction of an engineered cap is feasible.

During 2007 and 2008 a specification for capping and final restoration was developed, and incorporated into a Demonstration Cell Project for application to an initial (Phase 1) rehabilitation area. The Phase 1 TMF rehabilitation demonstration project has comprised two key elements (cap formation and final restoration treatments).

It is considered that the current progressive restoration approach to the rehabilitation of the Lisheen Mine TMF was more advantageous than starting the rehabilitation of the TMF when mining operations ceased and there are a number of reasons for this:

- It allows the Mine reduce the liability associated sooner rather than later.
- It is possible to avail of key staff to implement, test and review the process prior to the cessation of mining.
- It makes it possible to demonstrate to all stakeholders that the plans devised actually work and there is tangible evidence of this as starting the rehabilitation work early allows additional time for the collection of monitoring data that can be used to assess the performance of the rehabilitation methodology.

The approach that underpins the TMF restoration process includes the identification of the possible after use option, the definition of specific restoration objectives, the description of restoration methods and a review of longer term risks and responsibilities.

The final restoration concept for the Lisheen TMF is shown below depicting a landscape of pasture grassland.

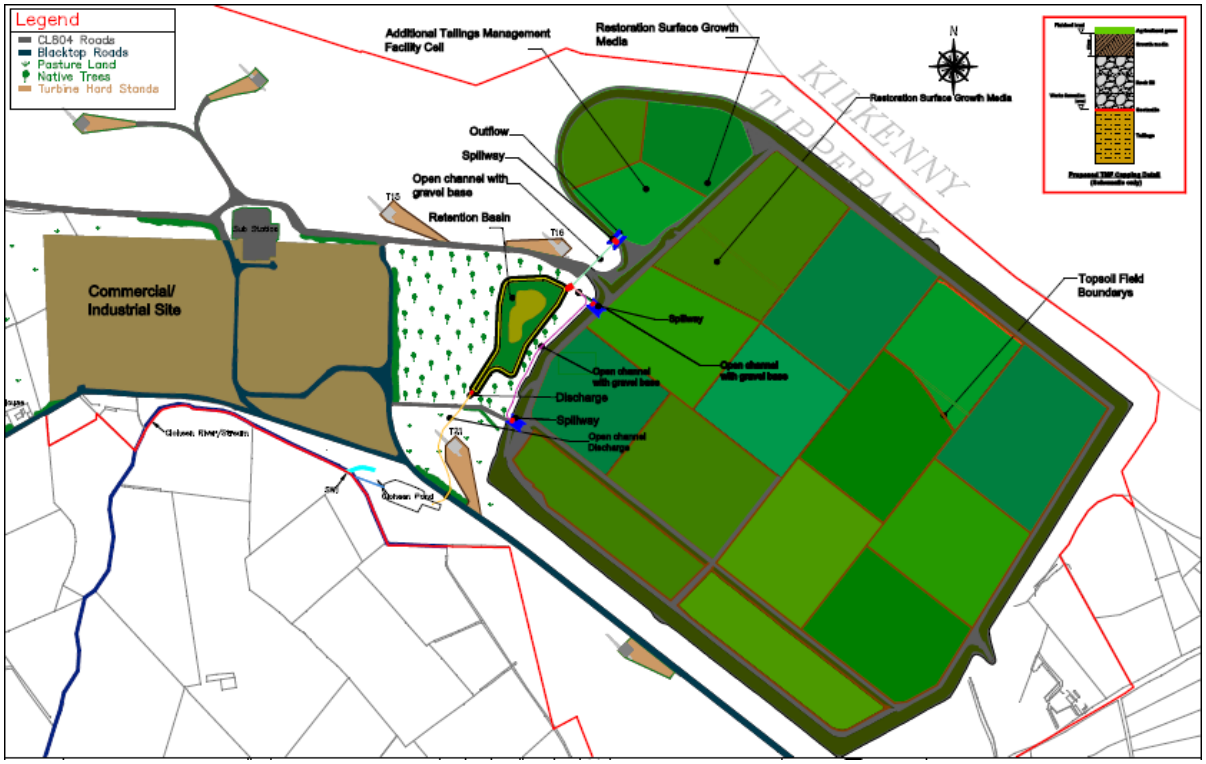


Figure 4.1: Final restoration plan for Lisheen

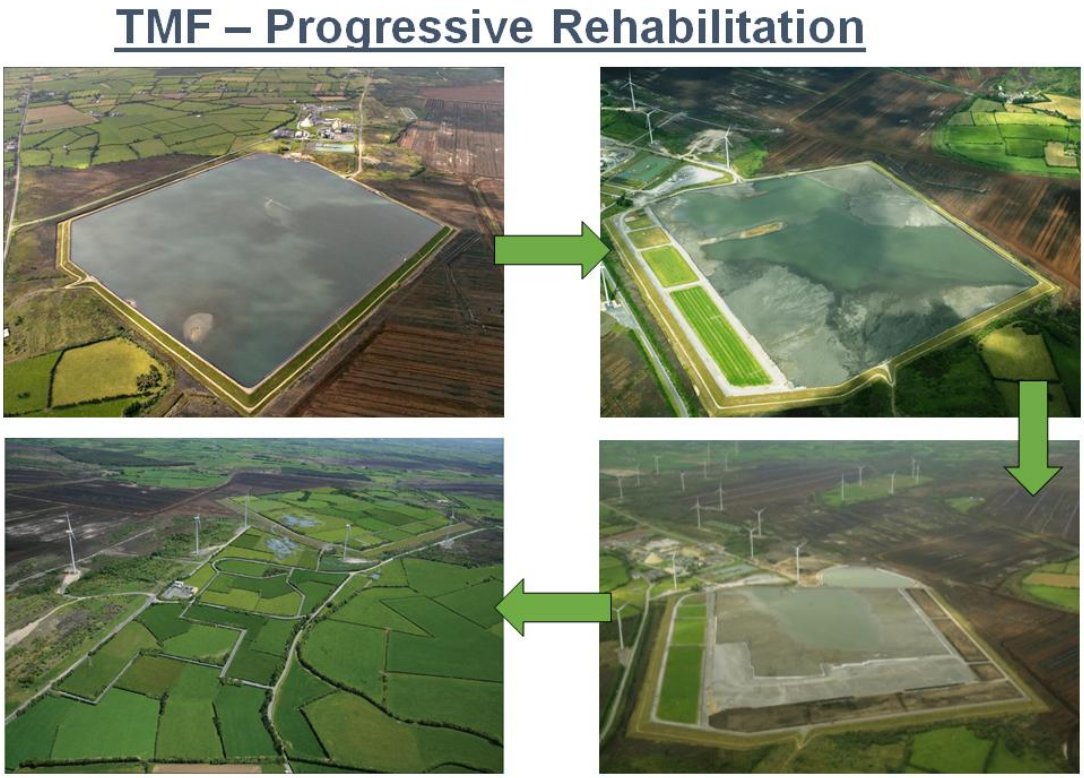
This concept will help to enrich the existing countryside that surrounds Lisheen Mine. When combined with restoration proposals for other parts of the Lisheen

Mine complex, the TMF restoration proposals will form a significant component of an extensive environmental enhancement programme.

Rehabilitation of the TMF is scheduled for completion by mid 2017, with progressive restoration implemented in discrete phases within this timeframe.

4.3 Progressive Rehabilitation Strategy

Progressive rehabilitation involves operating the TMF to fill specific areas of the facility to capacity with tailings in a systematic approach. Once the tailings in the filled area have dried and gained some strength the rock cap is installed. This rock cap provides a 'leading edge' from which tailings can be distributed thus ensuring the storage space in the TMF is maximised (i.e. if spigoting only took place from the perimeter walls the elevation of tailings in the centre of the TMF would be well below the optimum elevation). Maximising the placement of tailings also minimises the amount of rock that is required for capping (if tailings storage was not maximised, it would be necessary to place rock into the void created by the absence of tailings).



The progressive capping strategy commenced from the walls of the facility moving inwards and the direction of the water take off location (reclaim pumps). The reclaim pumps will be replaced by a spillway to an engineered wetland that will be created on the downstream side of the TMF dam.

4.4 DESIGN AND OPERATION OF THE TMF

4.4.1 Description

The TMF comprises a fully lined impoundment located on a peat bog adjacent to the main plant site. The TMF is enclosed within a perimeter earth embankment founded on glacial till. The upstream face of the embankment is lined with linear low density polyethelyene, LLDPE, overlying a geosynthetic clay liner, GCL, while the basin area is lined with LLDPE. The underlying peat forms a secondary barrier so the base of the TMF is also considered to have a composite liner.

The average ground conditions underlying the TMF comprise:

- Peat up to 5.5 m in thickness
- Glacial till varying from 0.5 to 3.1 m in thickness

- Bedrock of Waulsortian Limestone varying in thickness from 30-80m.

The main TMF, which occupies an external surface area of 78 ha and internal surface area of 64 ha at crest height, was initially developed in two stages. The peat layer has been removed from the area underlying the perimeter embankment and a layer of graded limestone rock fill was placed on the exposed glacial till. Finger drains are installed in the perimeter embankments in order to collect seepage water from consolidation of peat and to allow pore pressures within the peat to dissipate.

The TMF has been operated with a minimum depth of 0.5m of standing water above the tailings and maintains 1m of freeboard to allow for design flood events. However during rehabilitation works the water level above the tailings can be decreased to facilitate the capping process.

A yearly inspection and audit of the TMF is carried out by an independent dam engineer, Golder Associates. A subsequent report is prepared and issued to the Mine who present it to the EPA as part of the Annual Environmental Report and is available on request.

4.4.2 TMF Extension Project 2012

In May 2012 Lisheen Mine completed the TMF Extension Project. This involved a partial raise of the TMF to 136.5m AOD by using an upstream construction method. This method involved constructing directly on previously deposited tailings and the existing Stage 1 crest. No material was placed on the downstream side of the dam wall therefore the footprint of the TMF did not increase and this also removed the need to excavate peat. The upstream raise method also significantly reduced the amount of fill required for construction.

The TMF Extension incorporated a composite lining system which consisted of linear low density polyethylene geomembrane over a geosynthetic clay liner which was placed on sub grade inert limestone material with a maximum particle size of 20mm. The exposed LLDPE was covered with a carbon rich 500grms/m^2 non-woven geotextile for protection. The upstream raise was tied into the existing lining system. The main function of the composite lining system is to ensure that the facility remains watertight and to prevent untreated leachate from leaving the facility.

An open collector channel was constructed on the downstream toe of the upstream raise located on the cap in the southern dam wall to keep the area drained. A concrete sump and a submersible pump are located at the end of the drain on the western wall. Presently water is over pumped from the sump into

the TMF. At closure the sump will be removed and the drain will extend past the western wall where water will drain via a spillway from the TMF cap to a wetland located at the base of the TMF.

4.4.3 TMF - New Cell

The New Cell is an adjoining cell to the main TMF facility which was constructed between August and December 2013 and brought into operation in April 2014. It was constructed to a height of 131.5m AOD which is 5m below the height of the main TMF. The cell is a fully lined earth embankment facility. The embankments were constructed with grade limestone material. The lining system utilised in the construction of the facility includes a composite lining system which consists of; 1,000 g/m^2 non-woven polypropylene continuous needle punched geotextile over the entire internal area of the adjoining cell; a geosynthetic clay liner with a minimum dry mass content of 3,600 g/m^2 of sodium bentonite over the entire internal area of the cell; a fully welded 2 mm smooth HDPE geomembrane over the cell floor; a fully welded, including to floor geomembrane, 2 mm double textured geomembrane to the internal slopes of the New Cell area, including the face of the existing TMF; and 500 g/m^2 non-woven polypropylene continuous needle punched protection geotextile over the internal slopes of the New Cell; A separation geotextile (Terram T1000) was used to separate the Type B fill from glacial till and Type B1 rock fill from the Type D road surface material when constructing the lower perimeter road. Surface water from the New Cell will drain via a spillway to a wetland located at the base of the TMF.

All materials used for the construction of the facility were closely monitored and went through continuous CQA sampling and testing. Golder Associates provided full time independent CQA supervision for the duration of the project and also provided Lisheen with an independent CQA validation report upon completion of the works which was submitted to the EPA.

4.5 IDENTIFICATION OF PREFERRED AFTER USE OPTION – AGRICULTURAL GRASSLAND

Several potential after use options were identified and discussed in the previous version of the CRAMP. The options considered ranged from after uses with a commercial objective to those that are more concerned with non-commercial objectives such as environmental enhancement and recreational opportunity.

Following a review of these options, agricultural grassland has been chosen as the preferred option as it has been proven to be sustainable on the Phase 1 section of the already rehabilitated and restored TMF.

This will support the environmental protection objectives of TMF rehabilitation and it will also compliment the character of the countryside that surrounds Lisheen. Restoring to a grassland end point is also advantageous in that it does not impact on the development of other options into the future if there is a justification (e.g. energy crops, solar power etc).

The Phase 1 demonstration plots focused on the establishment of agricultural grassland for several key reasons:

- Successful delivery of agricultural grassland is likely to require participation of an independent farming interest. Involvement of an independent commercial organisation in this way would create the potential for handover of the restored TMF or parts of the restored TMF, contributing to a move towards closure of the Lisheen Mine facility.
- Ley grassland will comprise high productivity grassland supporting a silage crop.
- Agricultural grassland will comprise stock or horse grazing management and will require the provision and maintenance of moderate productivity agricultural land and the establishment of field boundary hedgerows.
- The grassland systems will require site conditions that would permit access for agricultural machinery to undertake soil preparation, seeding, fertiliser applications, silage crop harvesting etc.

4.6 TMF Cap Formation

The specification for cap formation across the TMF consists initially of tailings beach creation to provide a rehabilitation area, followed by formation of a rock cap across the rehabilitation beach.

The initial tailings beach creation is achieved by locally surcharging the tailings level by deposition from the TMF margin with a system of spigot pipes, as shown in Figure 1 below. The formed tailings beach is allowed to dry for up to nine weeks to dewater before rock cap construction. The drying time can vary depending on weather conditions and the time of year. The tailings beach is formed by tailings deposition to a maximum level of 1 metre below the dam wall crest height.

Figure 4.2 - Spigot pipe system

Figure 4.3 – Placement of geotextile

Figure 4.4 – Placement of rock cap

The rock cap specification as shown in Figure 4.4 comprises the following key elements:

- Terram 1000 or equivalent non-woven geotextile placed directly onto the dried tailings beach with a lap length of at least 750mm;
- 700mm deep layer of limestone rock with a maximum particle size of 300mm along its long axis;
- 300mm growth medium which is made up of a 50/50 blend of glacial till and peat.

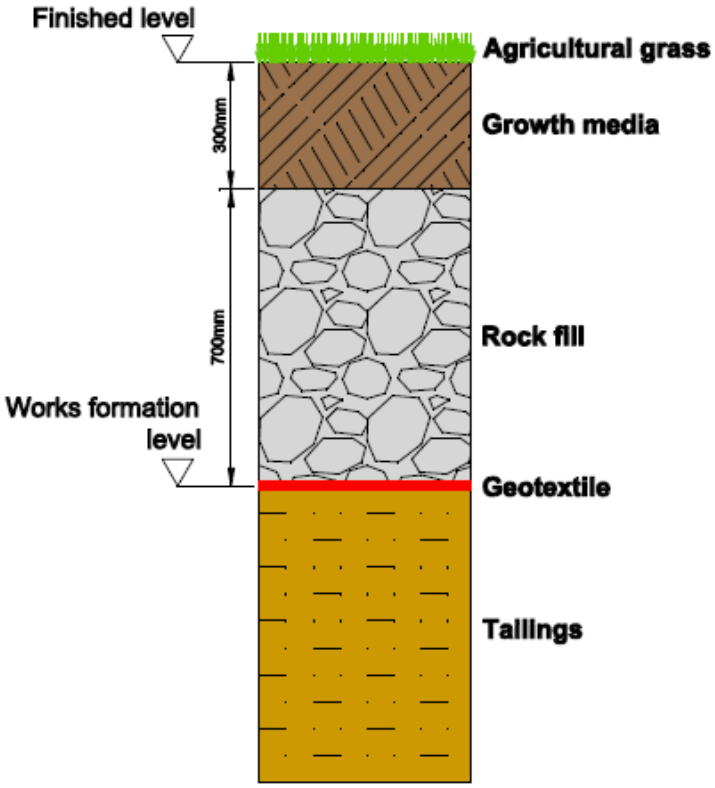
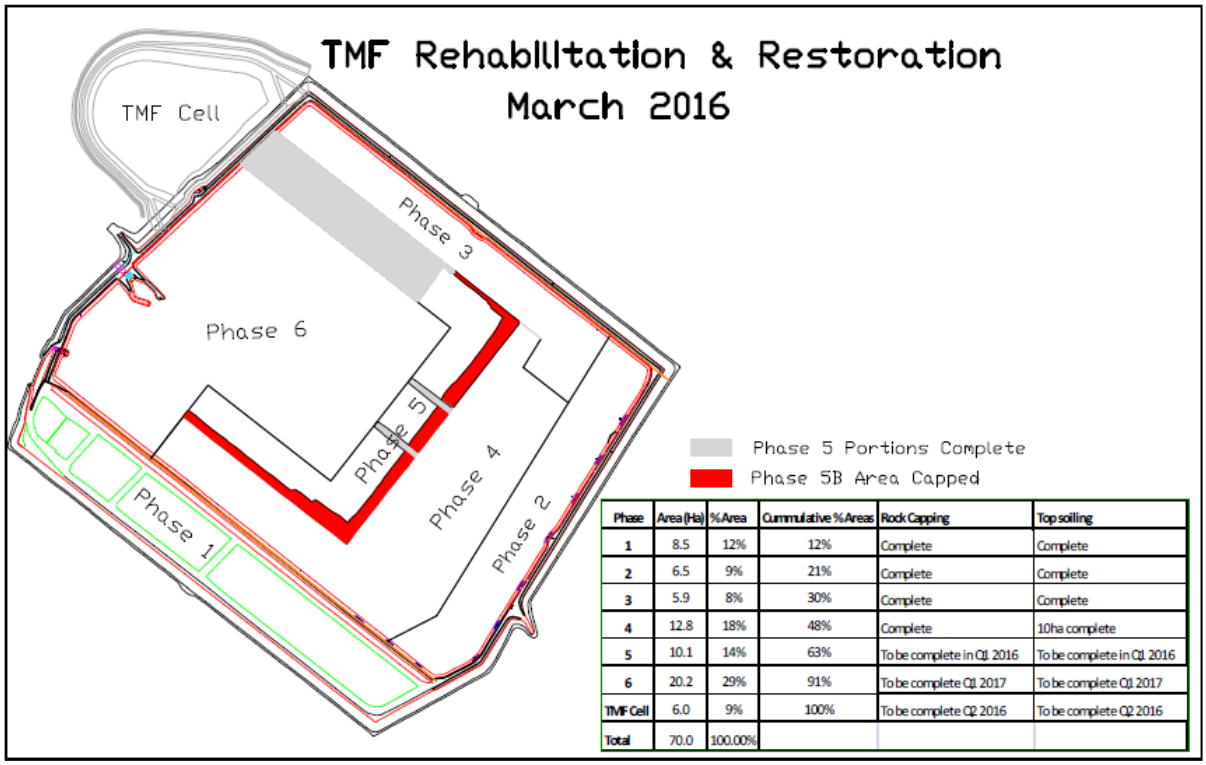


Figure 4.5 - TMF Cap Cross Section detail

When forming the cap along exposed liner the liner has to be protected from potential punctures. This is done by firstly placing a 500grm non-woven geotextile (or stronger) directly onto the liner, with a minimum lap length of 750mm, and extending this geotextile onto the tailings beach by 2m. A terram 1000 or equivalent non-woven geotextile, again with a lap length of 750mm, is then placed on the 500grm fabric and extended onto the exposed tailings beach. A 300mm layer of granular gravel material with a maximum particle size of 75mm is then placed on top of the dam wall prior to placement of the larger limestone rock and the advancement of the rock cap.

To date approximately 38 hectares of the TMF has been rock capped with approximately 29 hectares of this area been fully rehabilitated and restored to pasture grassland. All works have been carried out under separate contracts for the areas defined as Phases 1, 2, 3 and 4 which cover areas of 8.5, 6.5, 5.9, and 12.8 hectares respectively. Approximately 3.5 hectares of Phase 5 was completed before cessation of the Mine. The remaining portion of Phase 5 and Phase 6 and 7 will be completed post closure. 59% of the main TMF facility was rock capped prior to the closure of the Mine.



Phase	Area (Ha)	%Area	Cummulative %Areas	Rock Capping	Topsoiling
1	8.5	12%	12%	Complete	Complete
2	6.5	9%	21%	Complete	Complete
3	5.9	8%	30%	Complete	Complete
4	12.8	18%	48%	Complete	10ha complete
5	10.1	14%	63%	To be complete in Q1 2016	To be complete in Q1 2016
6	20.2	29%	91%	To be complete Q1 2017	To be complete Q1 2017
TMF Cell	6.0	9%	100%	To be complete Q2 2016	To be complete Q2 2016
Total	70.0	100.00%			

Figure 4.6: TMF Rehabilitation and Restoration Progress March 2016

Surface water from the facility will decant, via three engineered spillways, to a formed wetland prior to eventual discharge to the Drish River via the Clogheen surface pond and channel SW1, see Figure 4.1 above. Please refer to Appendix 4.1 for the spillway design.

Construction & demolition material from the plant site may be deposited in this area of the TMF prior to capping to occupy the void space not filled with tailings.

Additional Works

Figures 4.7 and 4.8 below depicted the additional works to be carried out as part of the completion of the TMF rehabilitation. These works include the following;

- Perimeter Road and drainage - creation of a cross fall and a drainage channel from the outer edge of the TMF

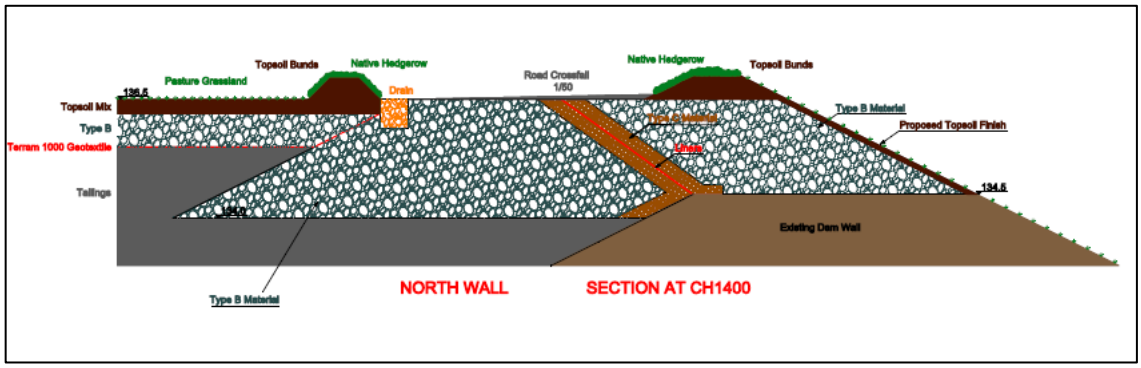


Figure 4.7:

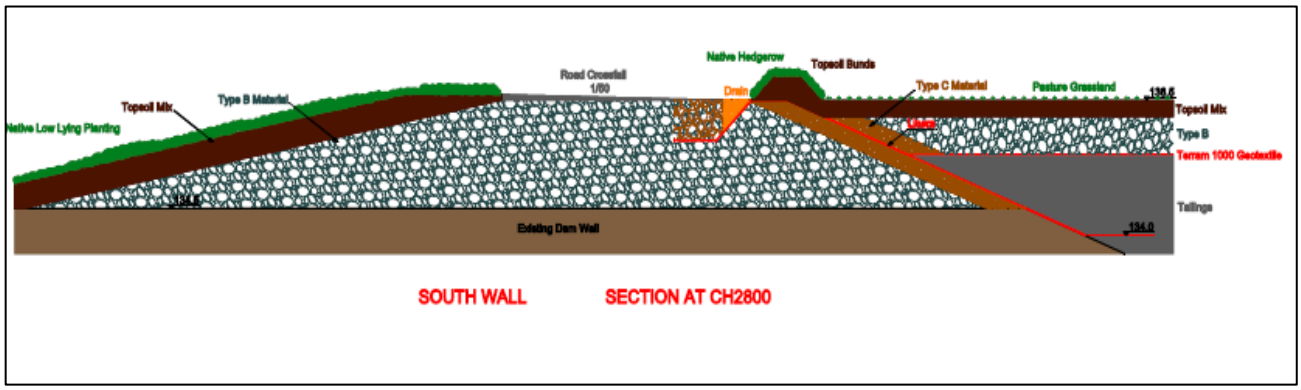


Figure 4.8:

- Remove Outer Rock Fill Bund - removal of the outer rock fill bund along the edge of the TMF
- Topsoil to Outer Embankment - installation of a top soil layer (including seeding) along the raised section of the main TMF
- Topsoil bund to Outer Embankment - installation of a top soil bund (including seeding) in-lieu of the removal of the rock fill bund
- Topsoil to south wall embankment - installation of a top soil layer (including seeding) to a depth of 500mm along the 850 metres of the raised section of the south wall
- Remove till bunds to the Phase 1 paddocks
- Remove Demo Wetland Cell
- Topsoil between existing TMF paddocks and areas on Phase 1 - installation of a top soil layer (including seeding) to a depth of 300mm between the existing TMF paddocks along Phase 1
- Hedge row planting - planting of native species to the TMF bund.

4.6.1 Restoration Substrates

The successful achievement of final restoration to agriculture grassland requires the provision of specific restoration substrate characteristics. The on-going approach being taken for the Lisheen TMF is to use two types of material and blend them together to make a final restoration substrate. This is made up of recovered peat and glacial till. The peat and glacial till is obtained from on-site stockpiles at the Mine which have been created during various construction projects throughout the LOM.

When combined, these materials create a substrate resembling a sandy loam soil, typically capable of supporting sustainable growth in a variety of vegetation types. Mixing peat and glacial till will utilise a power screener, mixing and blending using an excavator and a final mix using a disc harrow. This process will help to mix the two materials and to screen out debris and any large stones exceeding 75mm on their longest axis.

Utilising the peat is important, as it provides valuable soil moisture retention and a potentially viable nutrient capital that would be capable of supporting plant growth through nutrient cycling. The general aim of combining the two materials (peat and till) is to create a restoration substrate that has soil-forming potential. This will provide a strong basis for the development of sustainable agricultural grassland vegetation.

4.6.2 Vegetation Establishment

Two approaches to vegetation establishment were demonstrated within the Phase 1 TMF rehabilitation area: natural regeneration and seeding. Natural regeneration is often a preferred option for vegetation establishment in restoration schemes, providing a low-cost approach that will potentially result in vegetation that comprises plant species that are suitable to both the locality and the site, reflected in their successful colonisation. However, a natural regeneration approach has shown to be unsuitable for the establishment of a relatively exacting vegetation type such as the pasture grassland that is being carried out on the Lisheen TMF. The opportunity to contrast both natural regeneration and seeding within the Phase One scheme provided a valuable opportunity to demonstrate the relative effectiveness of both techniques.

A specific seed mix has been developed for the establishment of pasture grassland on the Lisheen TMF. The pasture treatment seed mix derives from an assessment of the existing composition of established agricultural grassland within a pasture reference site. This comprises an area of land adjacent to the TMF that would remain under pasture management throughout the duration of the rehabilitation and restoration of TMF. This will continue to be used as a control sample against which the performance of pasture treatments upon the TMF can be assessed.

4.7 FINAL RESTORATION

Both the BAP and a landscape management plan have been developed to implement final restoration proposals for the TMF following full restoration.

4.8 MONITORING AND INTERPRETATION

Restoration monitoring aims to observe indicators of successful establishment and formative development of grassland and hedgerow vegetation introduced as part of TMF restoration. In addition, monitoring will provide the mechanism to observe indications of restoration failure that may require intervention through remedial works.

A number of targeted monitoring activities would be required for specific elements of the TMF restoration scheme and are detailed in the success criteria found in Appendix 1.3 of the CRAMP.

4.8.1 Soil and Vegetation

Soil and vegetation tissue are analysed for metal concentration, concentrating on zinc, lead, arsenic and cadmium, and compared with equivalent measurements taken from a series of control sites as a benchmark.

All samples are sent to an external accredited lab for analysis.

In relation to soil there are Dutch Intervention and Target values in place which we follow, along with guidelines for Irish soils and unpolluted soils.

Both Pb and As guidelines for root and leaf tissue are set by the EU Directive 2002/32/EC. There are no guidelines for Zn and Cd in the root and leaf tissue.

Lisheen has also engaged an external consultant, Enrich, to carry out soil consistency and vegetation nutrient analysis and interpretation.

Vegetation analysis will be used to detect nutrient deficiencies.

When vegetation and soil analysis are looked at together a clear picture can be ascertained about the physical, chemical and biological status of the soil.

In addition to the testing phases outlined above site visits on a bi-monthly basis during the growing period will also be necessary to conduct regular visual and physical assessments of the site.

A full report on the results of testing and the visual inspections will be provided at the conclusion of each testing stage. This report will provide a comprehensive

interpretation of the test results and recommendations for any corrective actions required.

4.8.2 Groundwater

Groundwater levels around the TMF are recorded in piezometers within the embankment and in monitoring wells adjacent to the embankment.

Groundwater data has been collected from the end of September 1999. The monitoring wells are completed at different depths in the peat and underlying bedrock.

All monitoring is carried out under condition of our IPC Licence.

4.8.3 Monitoring Plan

TMF discharge	
Phase 1, 2 and 3 spillways	
Parameter	Frequency
Chemistry suite	Weekly for 3 months Monthly until chemistry has stabilised

Retention Basin	
Parameter	Frequency
Chemistry suite	Weekly for 3 months Monthly until chemistry has stabilised

TMF groundwater	
Monitoring wells and Piezometers	
Parameter	**Frequency**
Water level, Chemistry suite	Monthly as per IPCL conditions

Groundwater Compliance Point for TMF	
(To capture south-westerly groundwater flow)	
Parameter	**Frequency**
Water level, Chemistry	Monthly

SW1 IPCL Compliance Point	
(Discharge location to the Drish River)	
Parameter	**Frequency**
Chemistry suite	Daily as per IPCL conditions

TMF Plant and Soil analysis	
7 composite samples plus 3 control samples	
Parameter	**Frequency**
Main analysis for lead, zinc, arsenic and Cadmium.	Annually

4.9 Quality control / assurance

Golder Associates have been appointed to act as the Project Supervisor Design Process, PSDP, for the construction of the restoration capping system at Lisheen. Golder also provides Construction Quality Assurance, CQA, services along with the Lisheen team for the construction of the works.

Regular reports describing CQA activities used to manage the quality of the construction works at the site as well as providing compliance and site testing are submitted to the EPA.

All works are carried out in accordance with the design drawings and in support of all design assumptions. Construction works are carried out in accordance with industry best practice and to a high standard. Requirements to relevant conditions of the IPC License are satisfied.

CHAPTER 5 – FINANCIAL PROVISIONS

CHAPTER 5 – FINANCIAL PROVISIONS

5.1 INTRODUCTION

This chapter of the Lisheen Mine CRAMP describes the financial measures, funds and mechanisms provided for the physical closure, rehabilitation, restoration and aftercare of the Lisheen Mine site in accordance with Articles 7, 8 & 9 of the European Union Council Directive 2004/35/EC on Environmental Liability. Also, this document demonstrates compliance with conditions 42 & 45 of the 1997 Lisheen Mine Planning Permission, planning register reference number PLC 17663, with respect to the adequate provision of financial funds for the physical closure of the Lisheen Mine site.

A Closure Plan for the Lisheen Mine site was prepared and submitted as part of the original planning submission for the Mine. This included an estimate of IR £9.6 million or €12.2 million in 1997 value terms for the physical closure of the site.

This original estimate has been revisited in accordance with condition 42 of the Lisheen Mine planning register, to ensure that the estimate accurately reflects closure costs and that the funds provided by the Lisheen Mine are sufficient to cover such costs. The most recent review and update of the closure costs was carried out in December 2015 and subsequently updated in February 2016.

Lisheen Mine provides and maintains funds to cover the closure, restoration, rehabilitation and aftercare costs associated with the various areas of the Lisheen Mine site. The closure costs for the Lisheen Mine site are fully funded and cannot be reduced or accessed without the written consent of all of the respective parties, i.e. the Lisheen Mine, Tipperary County Council, the Environmental Protection Agency and the Department of Communications, Energy and Natural Resources.

5.2 COST OF PHYSICAL CLOSURE

The original estimate for the physical closure of the Mine has been revisited in accordance with condition 42 of the Lisheen Mine planning register reference number PLC 17663, to ensure that the estimate accurately reflects closure costs and that the funds provided by the Lisheen Mine are sufficient to cover such costs. The most recent detailed review of the closure cost estimate was completed in February 2016. This review included an updated estimate for the rehabilitation of the Lisheen Mine TMF following a review of the progressive rehabilitation work currently under way on the TMF. Phase 1 and 2 of the rehabilitation work on the Lisheen TMF was paid for out of the Lisheen Mine

operating costs (i.e. not funded by the restricted funds) and provided a robust basis for determining an overall cost estimate for the rehabilitation of the TMF.

In 2009 a detailed assessment of the demolition and site rehabilitation costs for the surface area of the Mine site was carried out. Some of the country's leading demolition contractors were invited to participate in a "market sounding" exercise to test the adequacy of the closure estimate. This involved a site visit by the respective contractors where they were each issued with a mini bill of quantities for the Mine Site (excluding the TMF and the underground workings). Each of the contractors submitted a quote for the demolition and remediation of the Mine site area. This exercise was overseen by C3 Projects. The results of this market sounding exercise were included in the 2009 revised estimate for Mine Closure and have been adjusted where necessary in conjunction with an updated market sounding estimate carried out in 2015.

A summary of the overall Mine Closure Estimate is outlined in table 5.1 below and full details of the revised estimate are included in Appendix 5.1.

Table 5.2 below also provides a summary of the Financial Funds provided by The Lisheen Mine. It is important to note that these funds were administered under financial bond arrangements.

5.3 DRAW DOWN AGREEMENT

The Mine Closure and Rehabilitation Agreement was formally agreed by Vedanta Lisheen Mining Limited (Killoran Lisheen Mining Limited & Lisheen Milling Limited), Tipperary County Council, The Minister for Communications Energy and Natural Resources and The Environmental Protection Agency in October 2013 and was subsequently amended in December 2015.

In compliance with the agreement, Lisheen Mine prepares an Annual Review Document which includes supplementary information to support the specific requirements set out in the Mine Closure and Rehabilitation Agreement. This provides a single source document to assist the statutory authorities in the annual review process.

5.4 REVIEW AND UPDATING

The Mine Closure Estimate will be reviewed and updated each year as part of the Annual Review Procedure as set out in Section 6 of the Mine Closure and Rehabilitation Agreement (Appendix 1.9).

5.5 COSTS

The following table provides a summary of the Mine Closure Estimate March 2016.

Item	Description	Unescalated Act/Forecast Amount March '16
I	**Plant Site**	
1	Tepee (Course Ore Storage)	€22,040.00
2	Workshop and Surface Storage	€0.00
3	Mine Water Treatment Plant	€144,794.00
4	Mill Building	€82,986.80
5	Backfill Plant	€10,470.20
6	ESB Sub-Station	€0.00
7	Conditioning Ponds	€176,233.50
8	Other Infrastructure	€372,689.82
9	Roads and Fencing	€109,585.54
10	Buried Services	€370,925.48
II	**Mine Facilities**	
11	Fixed Plant	€0.00
12	Mobile Plant	€0.00
13	Mine Portal	€201,289.62
14	Cleaning & Disposal of Contaminated Material	€531,206.50
III	**TMF**	
15	Demolition of Structures & Equipment in TMF	€12,100.00
16	Dry Closure of TMF	€8,999,402.63
IV	**Other Surface Facilities**	
17	Buildings & Structures	€1,078,845.09
18	Land Holdings	€350,000.00
V	**Shipping Yard Cork**	
19	Dredging of River	€100,000.00
20	Cleaning of all Facilities	€385,522.00
VI	**Miscellaneous**	
21	Landscaping	€196,945.00
22	Water discharge & power requirements	€1,899,181.00
23	Site Security	€517,892.00
24	TMF Water Treatment & Disposal	€974,707.22
25	Engineering Fees	€930,277.00
26	Allow for Sampling and Monitoring of Project	€187,387.00
27	Project Management Team	€3,292,738.00
28	Insurances	€801,521.81
29	IPC Licence	€135,000.00
30	Commercial rates	€0.00
31	Escalation	€0.00
VII	**Passive Validation Period**	
32	Passive Validation Costs	€347,519.94
	Estimated Mine Closure Total	€22,231,260.15
	Modelled Risk and Contingency	€1,002,407.00
	Mine Closure Grand Total	€23,233,667.15

Table 5.1: Overall Mine Closure Estimate

The following table provides a summary of the Financial Funds provided by the Lisheen Mine.

THE LISHEEN MINE		Closure Funds Deposit Accounts				1.0942					
29/02/2016	Original Bond Amount	Original Bond Amount	Indexed Bond Amount ########	Deposit Account Required	Current CASH DEPOSIT ########	Current CASH DEPOSIT 29/02/2016	% Collater-alised	Agreement Date	CSO Index	Basis	Parties to Funds
	IEP	€	€		€	US$					
Closure & Rehabilitation Fund	9,500,000	12,062,512	21,992,515	YES	19,577,165	21,421,334	100%		Wholesale Price Index - Building & Construction (Capital Goods)	To carry out all the works to comply with agreed Mine Closure Plan	(1) VLM / KLM / LML (2) North Tipp Co. Council (3) Minister for Communications Energy & Natural Resources (4) EPA
Compensation Fund	500,000	634,869	930,974	YES	1,104,664	1,208,724	100%		Consumer Price Index	To compensate landowners for any damage caused (S31 (3) Mins Dev Act 1940)	(1) VLM / KLM / LML (2) Minister for Communications Energy & Natural Resources
EPA Fund	1,200,000	1,523,686	2,735,547	YES	3,261,810	3,569,072	100%		Wholesale Price Index - Building & Construction (Capital Goods)	To comply with perpetual aftercare provisions of Condition 13 of IPC Licence	(1) VLM / KLM / LML (2) EPA
Moyne Group Water Scheme Fund	200,000	253,948	253,948	YES	226,549	247,890	100%		Not indexed	Costs relating to works required until ground water level returns to the baseline level	(1) VLM / LML (2) Moyne Group Water Scheme Ltd
	11,400,000	14,475,014	25,912,984		24,170,188	26,447,020					

Table 5.2: Summary of the Financial Funds provided by the Lisheen Mine

5.6 RISKS AND LIABILITIES

A Risk Management Report for the Mine Closure Estimate was compiled following a Risk Management Workshop for the Lisheen Mine Closure Project, held in February 2016.

The workshop identified the associated risks and then ranked and quantified these risks and put in place mitigation plans for controlling and monitoring these risks.

A copy of the Risk Management Report is included as Appendix 5.2.

CHAPTER 6 – INTERESTED AND AFFECTED PARTIES

CHAPTER 6 – INTERESTED AND AFFECTED PARTIES

6.1 INTRODUCTION

Closure of the Mine will affect a significant number of people, which presented the Mine with a complex social accountability challenge. This chapter of the Lisheen Mine CRAMP describes the general approach to managing the potential social consequences of Mine closure.

The Mine has been a significant employer and landlord since the late 1990's and has supported a considerable supply chain and operating process across a substantial landholding. In addition, the Mine operated a concentrate distribution facility within Cork harbour. An array of welfare and re-skilling measures were required to manage the social consequences of Mine closure, set within a framework of due process that is described by employment law and best practice approaches.

This chapter focuses on a review of the approach and general procedure that was adopted by the Mine, demonstrating a socially responsible approach to Mine Closure.

The Lisheen Mine Stakeholder Management Plan can be found in Appendix 6.1

6.2 STAKEHOLDERS

We believe that Stakeholders are key to the success of any business. Therefore we constantly strive to understand our stakeholders' needs and engage with them effectively to make a positive impact to both our business and their needs on Mine closure.

Our key stakeholders and their concerns are listed in the following table:

Stakeholders	Key Sustainability Concerns
Vedanta Resources Plc	Sustainability and Mine Closure performance
Government and Regulatory Bodies including: The EPA, The Department of Communications, Energy & Natural Resources, Tipperary County Council, Inland Fisheries Ireland and the Health and Safety Authority	Regulatory Compliances, Safety, Health Environmental and Closure performance
Employees	Preparing for closure and Health and Safety
Community engagement including: The Lisheen Mine Community Engagement Forum, The Mine Closure Sub Committee and local households	Mine closure Environmental performance Employment Community Welfare & Relations
Contractors and Suppliers	Policies, practices and wind down of the operation

Table 6.1: Key Stakeholders

6.2.1 Vedanta Corporate

A board-appointed Mine Closure Committee, MCC, has been put in place by Vedanta whose mandate and role is to monitor and review all aspects of Mine closure at Lisheen and to ensure standards applied reflect best practice and are compatible with all relevant laws and policies. The MCC supplements and gives support, advice and guidance on the effectiveness or otherwise of management's efforts in the planning and implementation of Mine closure.

6.2.2 Regulatory Authorities

The requirements of Authorities impose specific statutory duties on the Mine and are well understood as key elements of the terms of reference within which the Mine operates. The key Regulatory Authorities are as follows:

- The Department of Communication, Energy & Natural Resources
- The Environmental Protection Agency
- Tipperary County Council

The Lisheen Mine engages with the regulatory Authorities through the Lisheen Mine Environmental Monitoring Committee Process. This involves meetings where the Authorities listed above together with representatives from the Inland Fisheries Ireland are presented with recent monitoring data by the Lisheen Mine environmental department.

The Lisheen Mine also engages with the Statutory Authorities through the Mine Closure Committee. This involves meetings in relation to the Annual Review Process where Lisheen and the Authorities formally approve the Annual Review Statement for the coming year.

6.2.3 Employees

A Socio-Economic Assessment Toolbox process (SEAT) was conducted in 2006 and 2009 to fully consider various aspects of employment at Lisheen Mine.

This process revealed that Mine Closure was understandably a primary concern to employees. The SEAT process was used as the primary framework for identifying specific closure concerns to enable their systematic evaluation and management through the closure phase at Lisheen.

Each year Lisheen Mine produced a Life of Mine report which identified the mineral resource and reserve and projected the rate of mining required to adequately work the orebody. As such there has always been a good understanding of what the life of the Mine was and when the Mine and the processing plant were likely to close. Lisheen Mine management actively communicated the life of Mine plan to employees and at all times endeavoured to keep all employees fully aware of when the operations were likely to cease.

Having this understanding of when the operations were going to cease also gave management the opportunity to implement programmes well in advance of the closure date to help employees prepare for closure and to assist them with the transition into new employment.

While most of the employees have been made redundant at this time; Lisheen Mine continues to support a workforce engaged in a variety of managerial,

technical, mining, and administrative and welfare roles. Regular communication meetings are held with employees to ensure that they are made aware of any updates or amendments to the planned closure of the Mine.

6.2.3.1 Outplacement Programme

Lisheen Mine introduced an Outplacement Programme in December 2013. This was a comprehensive programme prepared with the assistance of employee unions and external consultants as well as Lisheen Mines internal HR Department. The emphasis of the programme was to ensure employee wellbeing throughout the closure period by helping employees prepare for the future. It covered how to cope with the transition and how to plan for the future. A significant amount of up skilling and training was made available to employees from ticket conversion for mobile plant, to IT, and a "start your own business" training course. All employees were also provided with a €750 grant that could be put towards any other additional training of the employee's choice. A professional counsellor was on site three days a week for the last two years of Mine life and was available to provide support and advice to employees.

6.2.4 Local Community

In order to ensure effective communication with the local community, the Lisheen Mine Community Engagement forum established a Mine Closure sub-committee to ensure that any issues or concerns about the closure of the Mine are addressed. This forum offers a mechanism for Lisheen to keep the community informed of all key steps and decisions that were being taken in the run up to and following Mine Closure.

Meetings between the Community and Mine management take place on a quarterly basis. These meetings have been and are expected to continue to be critical to community consultation with the Mine. In addition to reassurance regarding the environmental controls in place to ensure a safe restoration of the site the community have had a strong interest in the potential after use of the site and the possibility of future business and jobs on the Lisheen site. Lisheen has kept this committee fully aware of the activities of the Lisheen Mine Task Force that has been in place for over two years with a core function of attracting new businesses to the site.

6.2.5 Moyne Group Water Scheme

During the construction of the Lisheen Mine site the Moyne Group Water Scheme was expanded to provide a water supply to the general area affected by the cone of drawdown. The Scheme has proved very successful in providing the village of Moyne and the wider community with potable water. Upon closure it is intended that full responsibility for the Scheme will be borne by the Moyne Group Water Scheme Committee, and that the Scheme will continue to provide potable water into the future.

As well as on-going maintenance; substantial upgrades have been completed on the scheme by Lisheen to ensure that upon hand over the scheme is state of the art and able to meet the needs of the local community into the future.

6.2.6 The Port of Cork

The Lisheen Mine leases a facility from the Port of Cork for the purpose of temporarily storing and ultimately exporting zinc & lead concentrate products. Upon closure, the facility will be cleaned and rehabilitated by suitably licensed contractors to the satisfaction of the Port of Cork Authorities and the Lisheen Mine.

6.2.7 Contractors & Suppliers

Lisheen Mine maintains an extensive network of contractors and suppliers that support most areas of Mine operations. This ranges from the supply of goods and materials to the provision of technical and professional services. Mine closure has potential implications for the performance of these organisations through the loss of an important customer and client. The Mine was careful in ensuring that key suppliers and contractors were informed about plans for progressive Mine closure.

In October 2014 Lisheen Mine issued a letter to all its suppliers and contractors informing them that the Mine had progressed into the phased wind down of its operations. The intention was to provide sufficient advance warning of a reduction in business opportunities to enable suppliers and contractors to protect their business interests by taking appropriate action.

CHAPTER 7 – AFTERCARE PLAN

CHAPTER 7 – AFTERCARE PLAN

7.1 Introduction

The CRAMP has been designed and is being implemented to minimise and where possible eliminate the risk associated with the site post closure. However, Lisheen does recognise that the liability associated with the site cannot be eliminated completely. The most significant long term risk is associated with the c. 12million tonnes of mine tailings stored on site in the TMF and as such there will always remain a residual liability associated with the TMF. A monitoring plan will remain in place to monitor the water quality of both surface and ground water for the aftercare period, for a minimum of 30 years. A monitoring plan will also be in place to monitor regional stability to manage the subsidence risk.

The overall objective of the aftercare plan is to ensure a plan is in place post mine closure which will be able to demonstrate that the site is stable and the risk is contained.

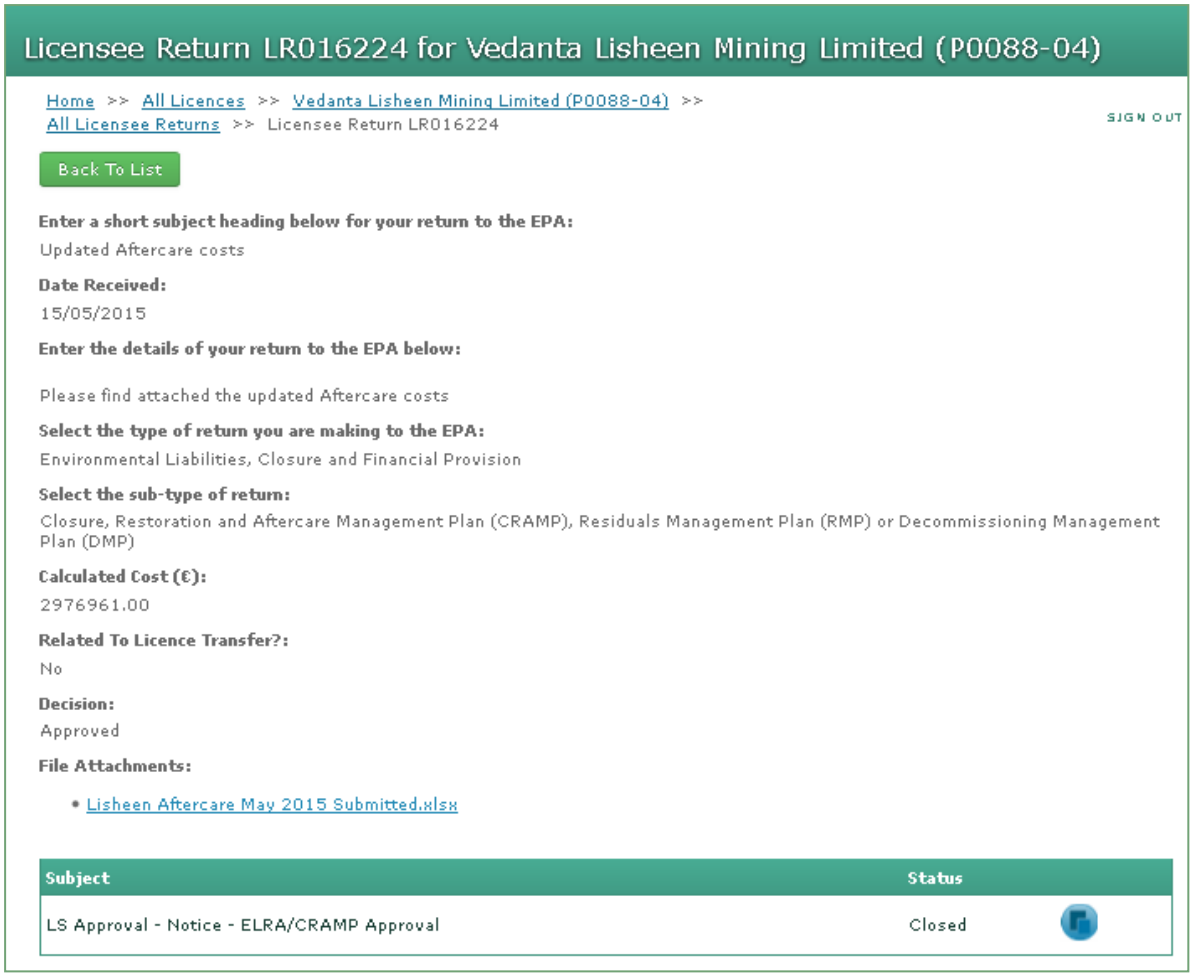
Responsibility of aftercare will lie with Lisheen for a minimum period of 30 years. The commencement of the aftercare period is subject to the completion of the active and passive periods of closure, at this time it is projected that aftercare will commence in April 2020. The responsibility for aftercare can only be transferred to another legal entity with the agreement of the EPA and would include the transfer of the IPC Licence.

Lisheen also recognises that the site has great potential for future value for the community and that key stakeholders may wish to take an active role in the implementation and oversight of aftercare management at Lisheen.

It is possible that a Trust may be an appropriate mechanism to manage aftercare at Lisheen. The Trust could be made up of representatives from the local community, the Lisheen Mine and Regulatory Authorities. Formation of a trust would be subject to agreement with all stakeholders.

The aftercare plan will be reviewed annually and updated as required.

The initial aftercare plan of the mine site was submitted and approval was granted from the EPA in October 2015:


Licensee Return LR016224 for Vedanta Lisheen Mining Limited (P0088-04)

Home >> All Licences >> Vedanta Lisheen Mining Limited (P0088-04) >>
All Licensee Returns >> Licensee Return LR016224

SIGN OUT

Back To List

Enter a short subject heading below for your return to the EPA:
Updated Aftercare costs

Date Received:
15/05/2015

Enter the details of your return to the EPA below:

Please find attached the updated Aftercare costs

Select the type of return you are making to the EPA:
Environmental Liabilities, Closure and Financial Provision

Select the sub-type of return:
Closure, Restoration and Aftercare Management Plan (CRAMP), Residuals Management Plan (RMP) or Decommissioning Management Plan (DMP)

Calculated Cost (€):
2976961.00

Related To Licence Transfer?:
No

Decision:
Approved

File Attachments:

- Lisheen Aftercare May 2015 Submitted.xlsx

Subject	Status
LS Approval - Notice - ELRA/CRAMP Approval	Closed

Figure 7.1: Approval from the EPA for Aftercare costs

Lisheen has since updated the Aftercare Plan, with slight alterations. Please refer to appendix 7.1 for the revised version of the aftercare costs which sets out how it is envisaged that the funds will be spent.

7.2 Financial Provisions

Lisheen has put aside a substantial financial provision to cater for the aftercare obligations that the mine has. This financial provision cannot be access by Lisheen without agreement from the EPA.

The aftercare plan covers ongoing monitoring of the TMF, ground and surface water quality, subsidence, IPCL fees, insurance and other costs totalling to approximately €2.1 million, with an NPV of €2,866,038 (07/04/2016). The aftercare provision account contains €3.2 million which leaves a surplus of €395,772 at present.

Summary of Aftercare Provisions (as of 07/04/2016)	
Balance in Aftercare Fund:	€2,085,764
NPV of costs (including VAT):	€2,866,038
Surplus	€395,772
Inflation Rate	2%
Interest Rate	0.50%
Discount Rate	0.50%

Table 7.1: Summary of aftercare provisions as of 07/04/2016

7.3 Monitoring Programme

The programme is predominately associated with monitoring and assurance reporting to demonstrate that the site is not having any impact on the environment. The data will act as an indicator of any additional improvement works that may be required.

Aftercare monitoring will proceed as presented in figures 7.2, 7.3 and 7.4 below. The frequency of testing and composition of the suite of analytical parameters will be subject to change with agreement of EPA.

Monitoring data recorded during active and passive closure periods may be used to justify changes to the monitoring programme that is currently set out in the aftercare plan.

Years 1 to 5					
	Year 1	Year 2	Year 3	Year 4	Year 5
	April 2020 - March 2021	April 2021 - March 2022	April 2022 - March 2023	April 2023 - March 2024	April 2024 - March 2025
Monitoring of water within regional wells 6 wells	Twice a year	Twice a year	Twice a year	Annually	Annually
Groundwater Compliance Wells, 2 wells	Twice a year	Twice a year	Twice a year	Annually	Annually
TMF Boreholes and Piezometers	Annually	Annually	Annually	Annually	Annually
Plant Chemistry	Annually	Annually	Annually	Annually	Annually
Soil Chemistry	Annually	Annually	Annually	Annually	Annually
TMF Embankment walls Settlement Survey	Annually	Annually	Annually	Annually	Annually
TMF audit	Every 2 years		Every 2 years		Every 2 years
TMF run off	Weekly	Weekly	Monthly	Monthly	Monthly
Rossestown Compensation Flow (if required)	20 weeks of flow	20 weeks of flow	20 weeks of flow		
Upstream and Downstream monitoring Rossestown River	As required (20 weeks)	As required (20 weeks)	As required (20 weeks)		
Discharge to Dish River	Weekly	Weekly	Monthly	Monthly	Monthly
Upstream and Downstream monitoring Dish River	weekly	weekly	Monthly	Monthly	Monthly
Maintenance (Wetland & TMF)	Annually	Annually	Annually	Annually	Annually
Subsidence Monitoring (ore bodies)	Annually	Annually	Annually	Annually	Annually

Figure 7.2: Monitoring programme, years 1 - 5

Years 6 - 15										
	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
	Mar-25	Mar-26	Mar-27	Mar-28	Mar-29	Mar-30	Mar-31	Mar-32	Mar-33	Mar-34
	Mar-26	Mar-27	Mar-28	Mar-29	Mar-30	Mar-31	Mar-32	Mar-33	Mar-34	Mar-35
Monitoring of water within regional wells 6 wells		Every 2 years		Every 2 years		Every 2 years		Every 2 years		Every 2 years
Groundwater Compliance Wells, 2 wells		Every 2 years		Every 2 years		Every 2 years		Every 2 years		Every 2 years
TMF Boreholes and Piezometers		Every 2 years		Every 2 years		Every 2 years		Every 2 years		Every 2 years
Plant Chemistry		Every 2 years		Every 2 years		Every 2 years		Every 2 years		Every 2 years
Soil Chemistry		Every 2 years		Every 2 years		Every 2 years		Every 2 years		Every 2 years
TMF Embankment walls Settlement Survey					Every 5 years					Every 5 years
TMF audit					Every 5 years					Every 5 years
TMF run off	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Rossestown Compensation Flow (if required)										
Upstream and Downstream monitoring Rossestown River										
Discharge to Dish River	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Upstream and Downstream monitoring Dish River	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Maintenance (Wetland & TMF)	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually
Subsidence Monitoring (ore bodies)					Every 5 years					Every 5 years

Figure 7.3: Monitoring programme, years 6 - 15

Years 16 - 30															
	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
	Mar-35	Mar-36	Mar-37	Mar-38	Mar-39	Mar-40	Mar-41	Mar-42	Mar-43	Mar-44	Mar-45	Feb-46	Feb-47	Feb-48	Feb-49
	Mar-36	Mar-37	Mar-38	Mar-39	Mar-40	Mar-41	Mar-42	Mar-43	Mar-44	Mar-45	Mar-46	Mar-47	Mar-48	Mar-49	Mar-50
Monitoring of water within regional wells 6 wells					Every 5 years					Every 5 years					Every 5 years
Groundwater Compliance Wells, 2 wells					Every 5 years					Every 5 years					Every 5 years
TMF Boreholes and Piezometers					Every 5 years					Every 5 years					Every 5 years
Plant Chemistry					Every 5 years					Every 5 years					Every 5 years
Soil Chemistry					Every 5 years					Every 5 years					Every 5 years
TMF Embankment walls Settlement Survey					Every 5 years					Every 5 years					Every 5 years
TMF audit					Every 5 years					Every 5 years					Every 5 years
TMF run off	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Rossestown Compensation Flow (if required)															
Upstream and Downstream monitoring Rossestown River															
Discharge to Dish River	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Upstream and Downstream monitoring Dish River	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Maintenance (Wetland & TMF)	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually	Annually
Subsidence Monitoring (ore bodies)					Every 5 years					Every 5 years					Every 5 years

Figure 7.4: Monitoring programme, years 16 - 30