A social, environmental and economic assessment of Galmoy and Lisheen Mines

Final Report

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1. Executive Summary

This report was commissioned by the *Exploration and Mining Division* (EMD) of the *Department of Communications, Climate Action and Environment (DCCAE)*, and is an independent assessment of two mines which have ceased production in the last number of years. The mining operations of the Galmoy Mine in Co. Kilkenny and Lisheen Mine in Co. Tipperary are examined. They were the first mines in Ireland to be opened, operated and closed under a new regulatory regime with planned closure and associated financial provisions; a practice which has since been incorporated and refined into the environmental legislation.

This report is intended to offer a critical perspective of the effects of mining on these communities, and assesses the social, environmental and economic effects of each mine on the area in which it was located. This assessment considers the baseline, construction, production and closure stages over the life cycle of each of the mines. It also considers the effects of the closure and rehabilitation plans implemented for each mine, as well as the longer-term impacts of the existence of the mines for their respective local communities and the environment in which they operated.

Given that the assessment of the two mines is concerned with evaluating a range of social, environmental and economic effects, the study was framed using a 'Capitals' approach. A capitals approach is based on the concept that there are several types of capital from which people derive the goods and services they need to improve quality of life, not limited to financial capital or flows of money. Six capitals include:

Type of Capital	
Social	corresponding to assessment of social effects, as measured by trust and relationships between people and communities
Human	corresponding to assessment of social effects, as measured by employment, health and safety, skills
Intellectual	corresponding to assessment of social effects, as measured by knowledge and innovation; changes to processes
Natural	corresponding to an assessment of environmental effects
Manufactured	corresponding to an assessment of economic effects, as measured by the construction of buildings and infrastructure
Financial	corresponding to an assessment of economic effects, as measured by the monetary flows resulting from the mines

The **social assessment** of effects is closely linked and sometimes overlaps with the economic assessment. Some of the key effects observed at the two mines are components of **human, social and intellectual capital.**

Employment is perhaps the most significant effect on human capital. During construction, the use of national and international specialist construction firms by both mines meant that local employment was limited. This changed at the ensuing stages of mine activities. During the time that mining took place, Galmoy mine had an average of 213 direct employees; 80 per cent of whom lived within 30km of the mine. Operations at Lisheen were on a larger scale, with 350 people employed during the mining phase, 74 per cent of who lived within 30km of the mine. Both mines also supported nearly 800 additional jobs in the wider economy.

Following closure of the mine, employees at both mines were given redundancy payments which enabled them to transition into new employment. In the case of Lisheen, some ex-workers set up their own training/services companies which provided additional direct jobs in the local area. Both mines had positive impacts on employee's education and training, providing upskilling programmes in preparation for closure and displaying good corporate social responsibility towards their workers in their transition out of employment at the mines. These efforts meant that, in general, there were low levels of long-term unemployment in the area after the closure of the mines.

The industrial sector (which includes mining) has the third-highest rate of injuries in Ireland, behind agriculture, forestry and fishing, and public administration and defence. Due to the potential for fatalities and serious injuries, mines in Ireland are required to adhere to strict health and safety regulations and standards. While both mines provided certified hours of health and safety training to their workers every year, this did not prevent all health and safety incidents. There was one fatality and one serious injury in Galmoy. The mine was later fined €100,000 for breaches of health and safety legislation in relation to the death of one of its workers. There were four fatalities and one serious injury at Lisheen over its lifetime, several lost time injuries and a number of near-miss incidents.

In terms of some significant effects on local community health, safety and wellbeing, Galmoy mine received several complaints each year relating to noise and vibrations, although it should be noted that these complaints were found to have occurred within legal noise limits. Similarly for Lisheen, local residents complained about noise and vibration, although annual compliance to licence requirements was between 96 and 100 per cent.

There were two major land subsidence events at Galmoy. The first occurred when cracks appeared in a local road following the collapse of a stope in the mine in 2002, leading to temporary closure of that section of road. The second occurred in 2014, when a sinkhole appeared on the farm of a local landowner after a period of heavy rainfall. While there were no injuries in both cases, remediation works were required and carried out.

In terms of positive community effects, the mines resulted in local service and infrastructure improvements, including road improvements, telecommunication upgrades, a replacement water supply scheme (providing free, high quality water for local residents), and upgrades of the power supply to the sites. These infrastructural improvements led to direct benefits for local residents and persisted beyond the mines' operational lifetimes. They also enabled other businesses and industries to establish on the sites following closure. There was also evidence of a small local sponsorship programme in Galmoy, although the effects of this were short-term and were not considered significant. However, Lisheen mine invested approximately €1.5 million in sponsorship of local sports, club and community facilities, and many of these upgrades remain today. The construction of a wind farm at Lisheen initially galvanised the community who were against the development at planning phase, but it has left a positive legacy of renewable energy generation at the site.

Regarding the **environmental assessment** of **natural capital**, both mines were subject to strict regulation, meaning that Galmoy, Lisheen and their local environments were subject to extensive environmental monitoring as part of their licence conditions. Both mines were also required to develop Closure, Rehabilitation and Aftercare Management Plans (CRAMP) during their planning phases outlining the rehabilitation works that would be carried out during closure, and funding was set aside during operations for that purpose. The Closure Bond ensured that the funds were available to meet the cost of these 'known liabilities', and although these closure plans were dynamic and were revised to take account of evolving closure practices or local needs, it was topped up where necessary.

There were two significant changes in terms of land use at both sites. Firstly, the development of two large mine sites meant that there was a long-term change of use of land: pastureland was converted to industrial land, leading to a loss of agricultural output during this period. However, both sites have been largely rehabilitated to grazing land post-closure, and trials carried out during the closure process confirmed the sites' suitability for grazing. Secondly, a wetland was constructed at the Tailings Management Facility at Galmoy. This resulted in positive effects on water quality and biodiversity and earned Galmoy Mine the 'International Green Apple Award for Environmental Best Practice'. During the closure phase at Lisheen, operators also created wetlands to trap excess run-off at discharge points taking run-off from the Tailings Management Facility.

Monitoring of water quantity, water quality and fisheries was undertaken over the lifetime of both mines, in accordance with the Integrated Pollution Control Licence that is required for all metal mines in Ireland. Dewatering of the mine had significant effects on groundwater during operation phases of both mines, although measures were put in place to mitigate any negative effects on local water supply. At Galmoy, a replacement water supply scheme was built prior to operations, to compensate for the dewatering that occurred as a result of mining, while at Lisheen, there was investment in the Moyne Group Water Scheme for residents in the surrounding area.

There were mixed results in terms of water quality, and although the mine license requires robust monitoring of water conditions, it was often not possible to isolate the direct effects of the mines on water quality from other influences. Several existing water quality issues were identified during the pre-mining baseline at both mines, and environmental influences in the catchment that were not monitored may have had an effect on water quality independent of mining activities. At Galmoy for example, surface water quality was poor at the baseline and remained intermittently poor throughout operation. While there was a generally a reduction in the quality of surface waters within 3km of Lisheen mine from the operation phase until its closure, the overall impact of this change was not deemed to be significant. However, in both cases, authorities and management took swift corrective action where significant issues were detected.

Underground mining requires significant amounts of energy and electricity. Galmoy mine consumed over 40,000 megawatt hours (MWh) worth of electricity from the national grid and fuel each year, which is the equivalent to the annual energy consumption of over 2,000 households. This led to the emission – either directly through fuel use, or indirectly through electricity generation – of an average of 26,409 tonnes of carbon dioxide (CO_2) each year; 422,500 tonnes over its lifetime. Lisheen consumed more than three times the amount of energy than Galmoy, primarily consisting of electricity from the national grid as well as fuel oil. The electricity use per annum was equivalent to the amount of energy used by 6,600 households, making it one of the largest users of energy in the country at the time. A wind farm was commissioned and constructed on the mine site at Lisheen, which was expanded to include a total of 30 turbines, which now produces enough energy to fully power 14,200 homes. The turbines at Lisheen offset some of the emissions that were used for mining.

Extraction and processing of minerals constitutes the development and depletion of non-renewable natural capital assets. An average of 135,000 tonnes of zinc and lead concentrates was extracted at Galmoy per year over the course of the 12–year operation of the mine. The corresponding figure for Lisheen was around 300,000 tonnes of zinc and lead concentrates extracted each year. While largely positive from an economic perspective, from a natural capital and ecosystem service perspective, the use of non-renewable resources reduces the resources and choices available for future generations.

The **economic assessment** showed the effects on financial and manufactured capital.

The total turnover from the companies that extracted ore from Lisheen was estimated at €2.76 billion. This resulted in €1.276 billion of Gross Value Added (accounting for 11 per cent of Gross Value Added for the Mining and Quarrying sector). In comparison, Galmoy accounted for 3 per cent of Gross Value Added. The Mining and Quarrying sector was small relative to the overall Irish economy, with the entire sector accounting for just 0.5 per cent of Irish GDP during this period.

Galmoy exported its concentrate through New Ross Port, which was dependent on the mine for nearly all of its exports. This had a positive impact on the Port in generating revenue and supporting jobs. The partial closure of the mine in 2009 therefore had a negative impact on its performance, and was noted as having contributed to a fall in revenue and loss of jobs experienced at the time. Concentrate from Lisheen was exported through the Port of Cork. While this was positive for the Port, concentrate represented an overall small proportion of its total exports and trade, and the closure of the mine had only a minor impact on economic activity at the Port of Cork.

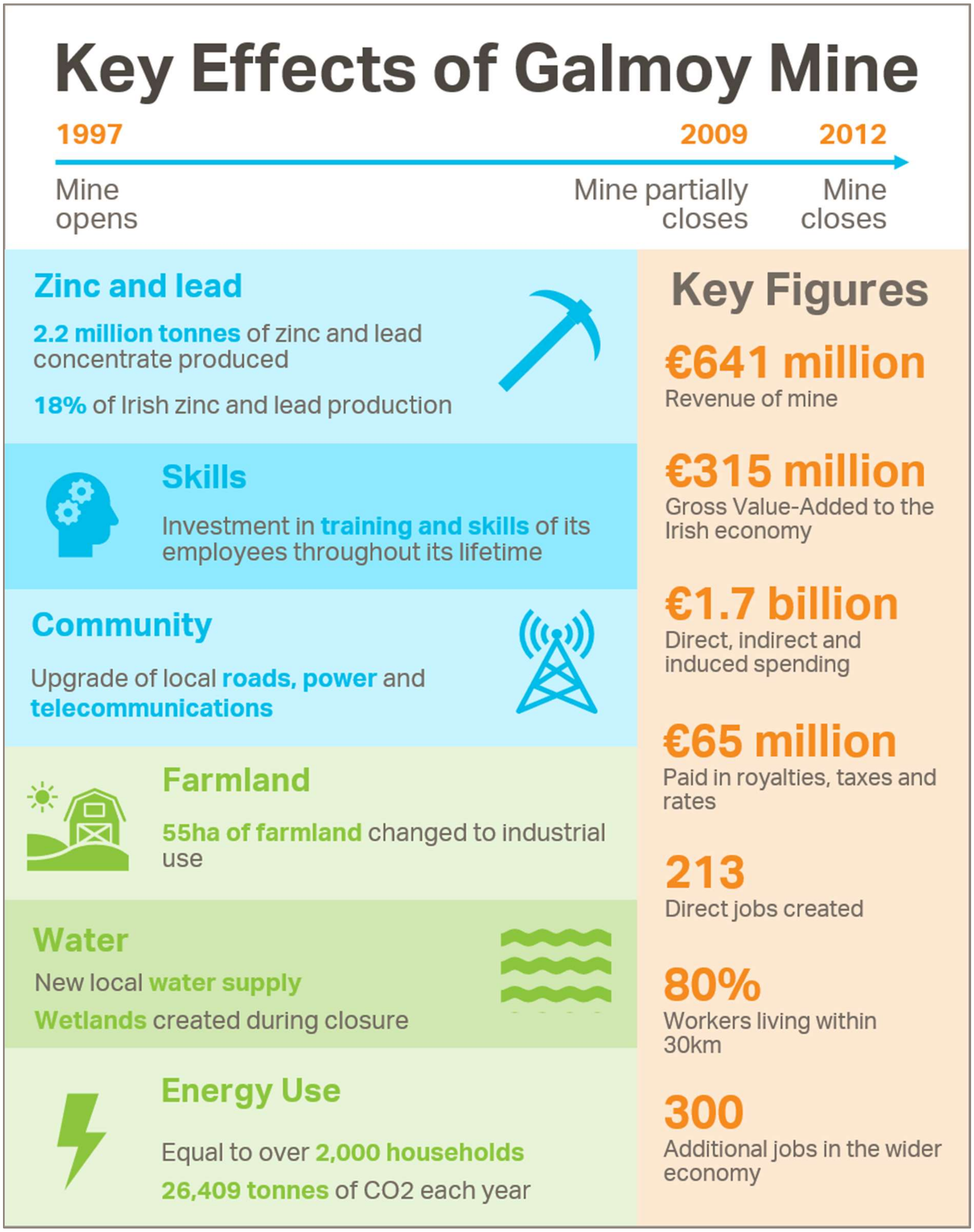
€676 million was spent directly by Galmoy's mining companies during the construction and operations phases, which resulted in indirect expenditure (by suppliers to the mine) of €560 million and an estimated induced expenditure (effect of spending wages) of €465 million. The effects of mine expenditure were felt by businesses and workers throughout the Irish economy. The operations at

Lisheen were much greater, and nearly €2.29 billion was spent directly during its construction and operations phases, which resulted in indirect expenditure of €1.97 billion by suppliers to the mining industry, and induced expenditure of €1.57 billion by employees spending their wages. Both mines contributed to public finances, including royalties, corporation tax, PRSI and PAYE. Galmoy contributed over €60 million, while contributions from Lisheen were much higher, at over €250 million over the duration of the mining activities.

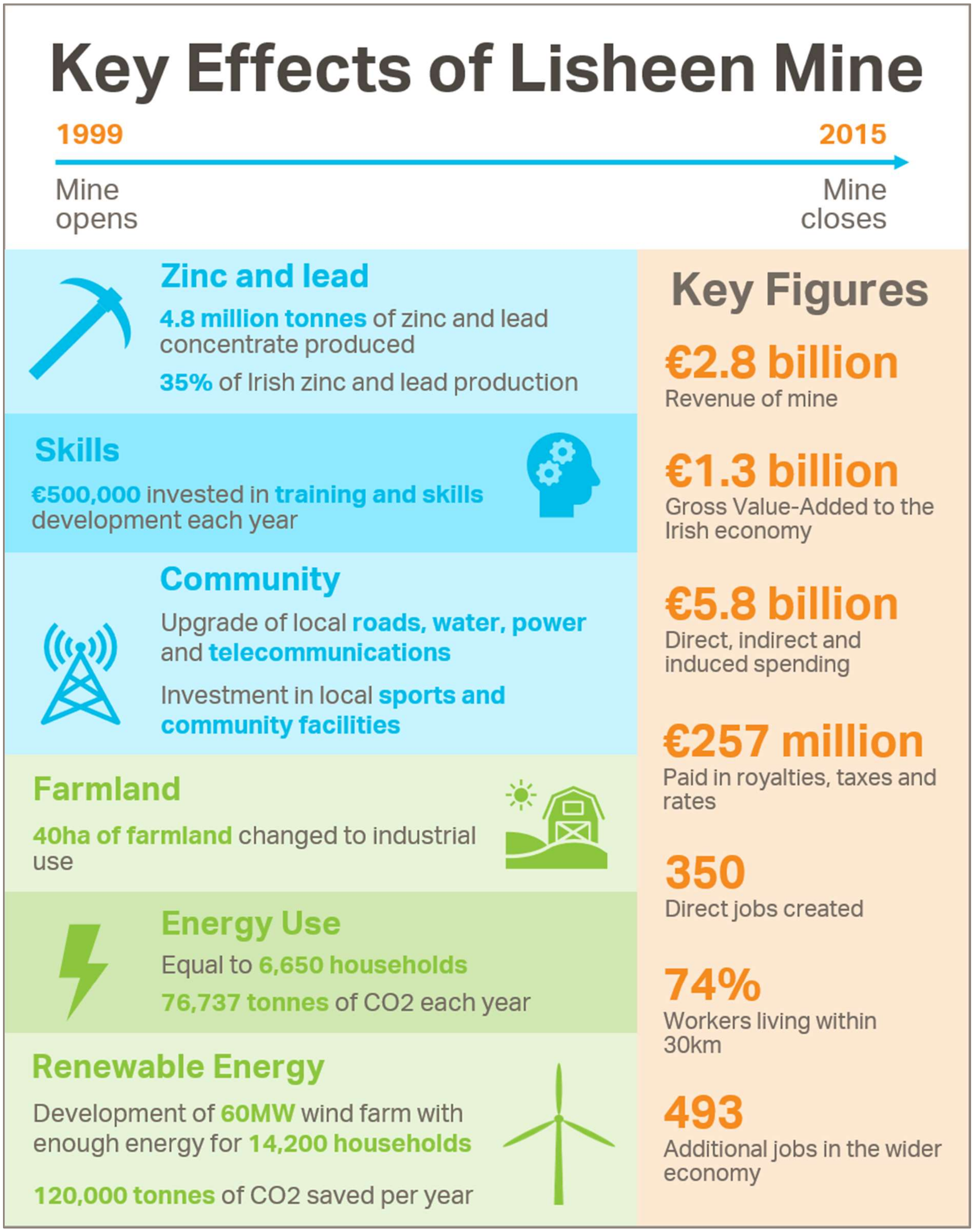
While some buildings have since been demolished, the buildings and infrastructure that remain on site represent a permanent manufactured capital asset that facilitates continued economic activity on the site. At Galmoy, the former administrative buildings are currently used by an environmental waste services company, while Lisheen has since been redeveloped as the National Bio-economy Campus.

Approximately €13 million was also paid into a closure bond by Galmoy and €24 million by Lisheen. This was paid in over their respective operational lifetimes, and most has been spent on planned closure works. While a small amount was set aside for risk and contingency, temporary gaps in the financial provisions for the aftercare period have been identified that are being addressed by the authorities. It is important that any financial provisions for the cost of risks and unknown liabilities during this period are underpinned by a risk transfer mechanism to ensure that sufficient funding is readily available.

Infographic of key social, environmental and economic effects of Galmoy Mine



Infographic of key social, environmental and economic effects of Lisheen mine



2. Glossary of Acronyms

ABP	An Bord Pleanála
AER	Annual Environmental Report
CRAMP	Closure, Restoration and Aftercare Management Plan
DCCAE	Department of Communications, Climate Action and Environment
EIA / EIS	Environmental Impact Assessment/Statement
ED	Electoral Division
EMD	Exploration and Mining Division
EPA	Environmental Protection Agency
GDP	Gross Domestic Product
GVA	Gross Value-Added
HSE	Health Service Executive
IPCL	Integrated Pollution Control Licence
KCC	Kilkenny County Council
LML	Lisheen Milling Limited
LMP	Lisheen Mine Partnership
NTCC	North Tipperary County Council
PAYE	Pay As You Earn
PRSI	Pay-Related Social Insurance
RWSS	(Galmoy) Replacement Water Supply Scheme
SEAI	Sustainable Energy Authority of Ireland
TMF	Tailings Management Facility
WFD	Water Framework Directive

3. Introduction

This report presents the findings of *a social, environmental and economic analysis of Galmoy and Lisheen Mines.* AECOM was commissioned to carry out the study by the Exploration and Mining Division (EMD) of the Department of Communications, Climate Action and Environment (DCCAE).

3.1 Background and purpose

Ireland has a rich history with respect to mining and mineral exploration, dating back to the Bronze Age (2000 BC)[1]. However, mining did not begin to flourish until the late Industrial Revolution of the 18th and 19th centuries, by which time nearly every county had at least one metal mine in production. Mining has evolved through the decades and remains a small but important part of the Irish economy, with zinc and lead mining alone contributing a direct Gross Value Added (GVA) of €100 million to the Irish economy in 2016[2] along with providing employment in rural areas. Ireland is internationally known as a major zinc and lead producing country and was the largest producer of zinc in the EU for many decades[3].

Due to the nature of mining and its associated activities, Ireland has developed a strong regulatory framework for the mining sector. While mines in Ireland are operated by the private sector, mining and mineral exploration is regulated by the Exploration and Mining Division of the Department of Communications, Climate Action and Environment (DCCAE), under the Minerals Development Acts 1940-1999. The regulations set out in these Acts cover procedures for compensation, fees, applications and other legal requirements. In July 2017, a new Minerals Development Act was enacted, with the aim to consolidate and modernise the Minerals Development Acts 1940-1999. The Minerals Development Act 2017 provides clear regulatory and fiscal frameworks for exploration, mining and mine closure. The 2017 Act will regulate the development of mines, provides for the regulation of payments to the State for rents, mining fees and royalties. In addition, it also provides for the rehabilitation of former mine sites similar to the provisions of the Energy Miscellaneous Act of 2006.

The regulations set out under these and other relevant Acts are critical for the health and security of surrounding communities and the local environment. It is necessary to ensure that the mining industry complies with regulations to avoid potentially harmful environmental impacts such as surface and ground water contamination, biodiversity loss, soil erosion, and air pollution. There are potentially adverse social implications associated with mining that also require oversight and regulation. For that reason, a mine requires planning permission from the Local Authority, an Integrated Pollution Control Licence from the EPA and a State Mining Lease/Licence from DCCAE before it can start development.

This report was commissioned by DCCAE, but the study is an independent assessment of the mining industry. It is intended to offer a critical perspective of the effects of mining on communities, with due regard to social, environmental and economic factors.

To do this, the study reviews the mining operations of the Galmoy and Lisheen mines which were the first mines in Ireland to be opened, operated and closed under a new regime introduced in the early 1990s with planned closure and associated financial provision. This regime was initially developed by Exploration and Mining Division and Kilkenny County Council for Galmoy. This practice has now been incorporated and refined into the national environmental legislation.

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[1] Department of Communications, Climate Action and Environment, accessed online: https://www.dccae.gov.ie/en-ie/natural-resources/topics/Minerals-Exploration-Mining/historic-mine-sites/Pages/Historic-Mine-Sites.aspx

[2] Indecon International Economic Consultant (2017) “An Economic Review of the Irish Geoscience Sector”, p. 52. Accessed online: https://www.gsi.ie/documents/Indecon_Economic_Review_of_Irish_Geoscience_Sector_Nov2017.pdf

[3] Minerals Ireland, Exploration and Mining Division, accessed online: http://www.mineralsireland.ie/MiningInIreland

This study aims to assess the social, environmental and economic effects associated with the Galmoy and Lisheen mines from a societal, environmental and economic perspective. The specific objectives of the study are to:

- Compile relevant information for each of the phases in the life cycle of the Galmoy and Lisheen mines. This social, environmental and economic data includes information gathered from planning applications, feasibility studies, Environmental Impact Assessment (EIA) studies, post mine closure chemical and biological sampling, Environmental Protection Agency (EPA) compliance reports, census data, annual financial reports, local newspaper articles and other available data sources.
- Assess the social, environmental and economic effects of each mine on the area in which it was located. This assessment considers the baseline, construction, production and closure stages of the life cycle of each of the mines. It considers the effects of the closure and rehabilitation plans implemented for each mine, as well as the longer-term impacts of the existence of the mines for their respective local communities and the environment in which they operated.

3.2 Report structure

This report is structured as follows:

- Section 2 sets out the approach and methodology for undertaking the study;
- Sections 3 and 4 present the assessments of the social, environmental and economic effects of the Galmoy and Lisheen mines, respectively; and
- Section 5 summarises the key findings of the study including recommendations for further research.

The main body of the report is followed by a series of supporting appendices including:

- Appendix A which presents the detailed step-by-step methodology for the study;
- Appendix B which presents supporting evidence for the assessment of effects at Galmoy mine;
- Appendix C which presents supporting evidence for the assessment of effects at Lisheen mine;
- Appendix D which presents the full list of documents reviewed as part of this study.

4. Approach and methodology

This section presents the overall approach to the study, including the precise methodology followed, and is structured in three sub-sections:

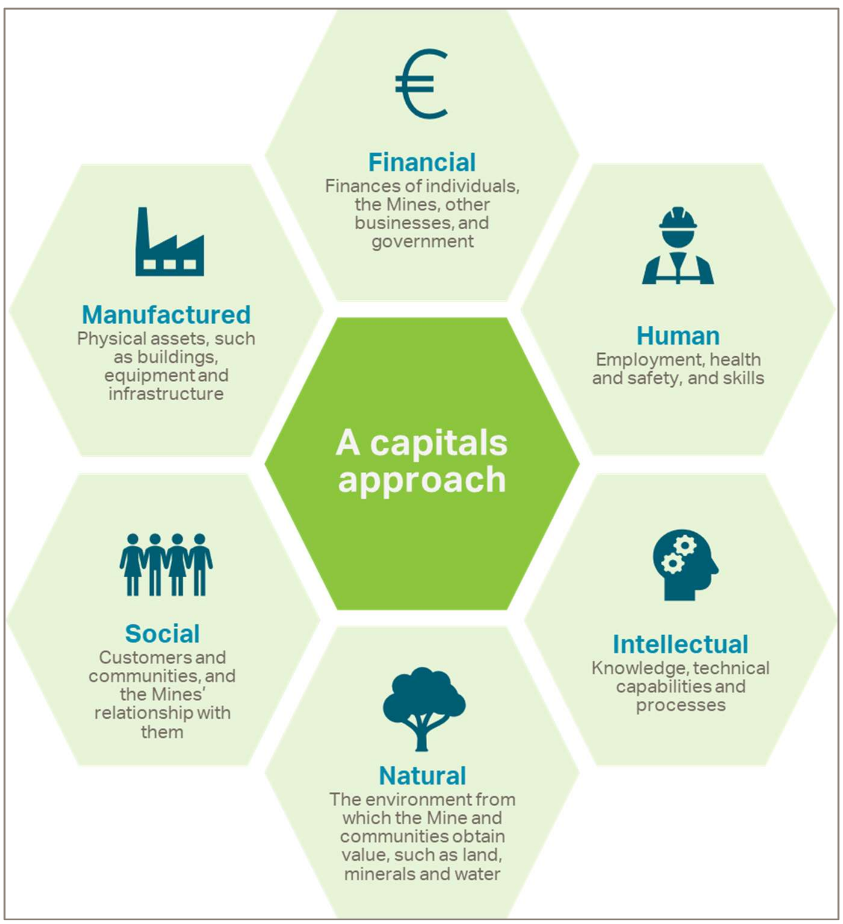
- The use of a capitals approach to frame the study;
- The overarching conceptual framework for the study; and
- The step-by-step methodology that was employed to meet the study objectives.

4.1 'A capitals approach'

Given that the assessment of the two mines is concerned with evaluating a range of social, environmental and economic effects, a decision was taken to frame the study using a capitals approach. A capitals approach is based on the concept that there are several types of capital from which people derive the goods and services they need to improve quality of life.

A capitals approach provides a means to identify the potential range of impacts and dependencies that an organisation might have on different 'capitals'. Figure 4.1 below illustrates six types of capital and provides examples of impacts and dependencies that could be considered.

Figure 4.1: Capitals approach



Source: AECOM

There are various internationally recognised guidelines for the assessment of impacts and dependencies on different capitals, including the Capitals Coalition's Natural Capital Protocol, and Social and Human Capital Protocol.[4]

In the context of this study:

- The assessment of social effects aligns with social, human and intellectual capital;
- The assessment of environmental effects aligns with natural capital; and
- The assessment of economic effects aligns with financial and manufactured capital.

In practice, there is often overlap between the different capitals, and a capitals approach can help to identify where trade-offs between different capitals might exist. For example, the construction of a link road to a mine might enable better transportation and enhanced connectivity which could, in turn, deliver economic and social benefits. However, it would also necessitate land take which would affect existing natural capital assets (habitats) and the benefits ('ecosystem services') they deliver. These trade-offs can be helpfully revealed when a capitals approach is adopted.

4.2 Study methodology

Table 4.1 presents the step-by-step methodology for the project which follows the conceptual framework set out above. The methodology was used to ultimately determine the social, environmental and economic effects of the mines and subsequently identify which of these were significant. Appendix A sets out the methodology in more detail.

Table 4.1: Study methodology

Step	Description
Literature review	Review of over 200 documents to assist in identifying the effects of the mines in qualitative terms and physical terms where possible The review included applications for planning permission, Integrated Pollution Control Licence (IPCL), State Mining Facility status, Closure, Restoration and Aftercare Management Plans (CRAMP), and Annual Environmental Reports.
Interviews	Series of interviews with targeted stakeholders to augment and ground-truth the literature review. Stakeholders interviewed were chosen to represent a wide range of different perspectives, and included mine executives, employees, land owners and community members, as well as representatives from regulators, local authorities, local economic development agencies and public health bodies
Identifying and screening social, environmental and economic effects	Effects identified following literature review and interviews Screening of effects based on criteria set out in Section 4.3.5 Significant effects characterised following approach set out in in Section 4.3.5
Measurement and valuation	Physical measurement of significant effects based on evidence from literature and interviews Monetary valuation of effects where relevant and possible using existing valuation evidence from literature Synthesis of findings and recommendations

The following two sections focus on the assessment of significant social, environmental and economic effects of the Galmoy and Lisheen mines respectively.

[4] See https://naturalcapitalcoalition.org and www.social-human-capital.org.

4.3 Assessment of Effects

This sub-section sets out the conceptual framework that was developed for the assessment of effects. This includes outlining an illustrative evaluation logic model which helps structure the results of the project. The definition of the spatial scope, time-based scope, and significance of effects, which supports the approach to characterising effects, is also covered.

4.3.1 Evaluation logic model

While the study is not focused on conducting a formal policy evaluation, the review and collation of evidence to assess the social, environmental and economic effects of the two mines is captured by a range of indicators which can be usefully presented in terms of the broad steps of an evaluation logic model.

An illustrative example of how an evaluation logic model could look is shown in Table 4.2. For the purposes of the study, the steps in the evaluation model were used as a checklist when considering the range of possible, social environmental and economic effects of the two mines. The logic model spells out how an action by a mine might be expected to affect its external environment, and provides indicators or evidence for determining to what extent this effect materialised.

Note ‘impacts’ are, from hereon in, referred to as ‘effects’ due to the after the event nature of the study.

Table 4.2: Illustrative evaluation logic model

Evaluation step	Corresponding question	Example answer
Effect	**How did the mines affect a certain sector, environment, group of people, or area?**	***Effect of employment***
Inputs	What was originally put in by the mines that lead to this effect? Inputs are generally resources, such as capital or labour, but can also include policies or practices.	*Employee Wages*
Activities/Outputs	What was done or produced with these inputs, or what was the direct result of these?	*Mining jobs are provided in the local community*
Intermediate outcomes	What does the beneficiary do with the activities or outputs provided?	*Employees receive wages and other social and economic benefits from employment*
Wider outcomes	What are the wider social, environmental and economic effects of this, or what does this mean from a broader policy perspective?	*Higher levels of employment results in social and economic benefits for the local community*

The evaluation logic model outlines how an effect is *expected* to occur as a result of actions of the mine, and where available, evidence or measurement of whether/how this effect *actually* occurred is provided in physical or monetary terms. When expressed in monetary terms, figures – unless otherwise stated – have been converted into 2018 values.

4.3.2 Spatial scope

Generally, the spatial scope of the study considers the locations and sectors that were affected by the mine. The footprints of the two mines, which include the plant sites and Tailings Management Facilities (TMF), form a minimum boundary. The spatial scope is additionally guided by the evidence that was identified and reviewed as part of the evidence review stage of the study. This includes evidence related to:

- Ireland overall
- The counties of Kilkenny, North Tipperary[5] and Laois
- The Electoral Divisions (EDs) of Galmoy and Moyne
- The Ports of New Ross and Cork.

The exact focus of the spatial scope varied for the social, environmental and economic assessments.

4.3.2.1 Social Assessment

For the **social assessment**, the spatial scope was focused on the population impacted by the social effects of the mines. This is termed the 'social area of influence', taking into account the Social and Human Capital Protocol. In some cases, the impacted population related only to people living in close proximity to the mine while, in other cases, a broader scope was required for considering social effects. This approach recognises the fact that people and social groups are connected by a range of networks and dimensions and, because of this, social effects are not necessarily limited to specific areas or decrease in intensity depending on their distance from the site. For example, the impacted population may consist of employees who live in different residential areas, or it could consist of other members of the local population that experience environmental effects (direct and indirect) from the mines.

4.3.2.2 Environmental Assessment

For the **environmental assessment**, the spatial scope was defined in two ways:

The first component of the spatial scope relates to the effects of mining on the stock of natural capital assets (i.e. habitat types) in terms of their extent and condition (quantity and quality). For the purposes of this study, changes in the extent of natural capital were considered within the footprint of the mine where possible. This is because it is not possible to determine whether changes in the stock of natural capital outside the footprint of the mine are in fact due to mining activities, unless the evidence suggests otherwise e.g. with the creation of an integrated constructed wetland. Changes in the condition of natural capital are considered within 3 km of the footprint of the mine. This allows changes to surrounding land as a result of mining activities to be considered, but also avoids an overlap between the two mine sites which are around 7 km from each other (from their mid-point).

The second component of the spatial scope relates to the effects of mining on the flow of ecosystem services (benefits) delivered by natural capital assets. For the purposes of this study, changes in the provision of ecosystem services are considered based on the availability of evidence. The assessment of these changes is undertaken relative to the impacted population, much like the social assessment. This is consistent with Natural Capital Protocol and the general principles of assessing changes in ecosystem services provided by natural capital assets from an anthropocentric perspective[6].

4.3.2.3 Economic Assessment

For the **economic assessment**, the spatial scope was focused primarily on the mines themselves as productive entities that generate direct economic activity. The assessment was framed in terms of the economic sectors and industries that are implicated by economic activity. This is based on how expenditure in one sector of the economy impacts and flows to other industries[7]. Economic effects are considered as they occur within the economy as follows:

[5] Refers to North Tipperary County Council, which was merged into Tipperary County Council in 2014.

[6] Anthropocentrism is a belief set which interprets or regards the world in terms of human values and experiences, discussed extensively within environmental and ecological ethics.

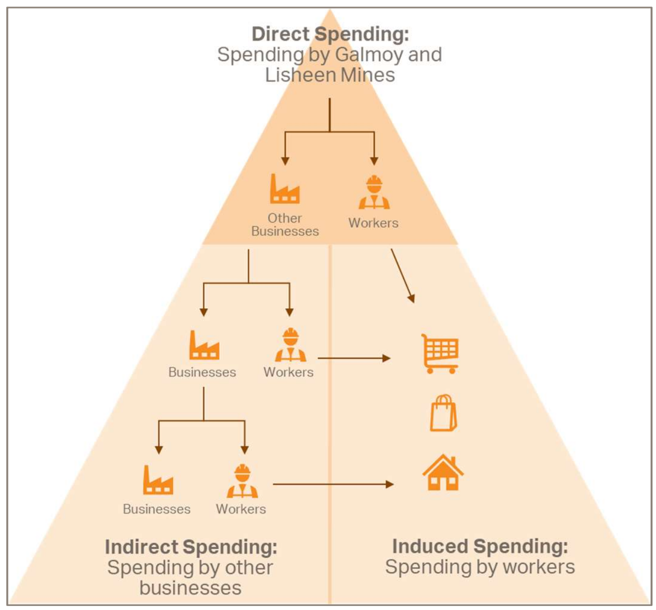
[7] This is done via input-output analysis based on the Supply and Use Tables released by the Central Statistics Office.

- **Direct effects** relate to the expenditure and investment that can specifically be attributed to the mining companies and mining activities.
- **Indirect effects** arise from changes in the level and value of sales for suppliers of goods and services to the mining industry. For example, a manufacturer of machinery might increase its spending on metal or tools in order to produce the machinery required by Galmoy or Lisheen. These effects are represented by Type I multipliers within economics, which measure the combined direct and indirect effects of expenditure.
- **Induced effects** refer to increases in spending by households as a result of increased wages and salaries. As production increases for the mining company and its suppliers, the resulting employment and wages earned will cause an increase in consumer spending in the wider economy. Type II multipliers measure the combined direct, indirect and induced impacts of expenditure.

Indirect and induced effects are calculated using economic multipliers. Type I and Type II multipliers can be calculated for each sector of the economy using national 'Input-Output Tables', which are published by the Central Statistics Office. Input-Output tables demonstrate the linkages between sectors in the economy, and can identify the wider impacts of expenditure in a certain sector.

Multipliers were calculated for the construction industry in order to identify the indirect and induced impacts of expenditure during the construction phase[8], while separate multipliers for the mining and quarrying industry were applied to expenditure during the operations phase[9].

Figure 4.2: Direct, indirect and induced spending



Source: AECOM

The size of each multiplier depends on several factors. Type I multipliers are influenced by the proportion of spending in other Irish businesses, meaning that a sector that uses a lot of Irish-produced inputs will typically have a higher multiplier than one which does not or which relies on imports. On the other hand, Type II multipliers are heavily influenced by how labour-intensive an industry is. If a sector hires a large number of workers, then the effects of these workers' spending will also be higher. Generally, heavy industries like mining will have larger Type I multipliers than services, meaning that much of their economic impact is felt in terms of spending in other businesses.

The downstream use of ore in subsequent production processes is not considered in this study. The effect of the mines on investors or pension schemes is also not considered with the scope of the study.

[8] Type I (1.58) and Type II (2.29) multipliers for the construction industry have been calculated by AECOM using CSO Input-Output (IO) tables. It is important to note that IO tables are not available for the year in which construction occurred.

[9] Type I (1.91) and Type II (2.59) multipliers. Indecon, 2013. *'Assessment of Economic Contribution of Mineral Exploration and Mining in Ireland.'*

4.3.3 Time-based scope

The time-based scope of the assessment, i.e. the time horizon over which effects have been considered, is presented in Table 4.3.

Table 4.3: Time-based scope of assessment

Mine	Baseline	Construction	Operation	Closure
Galmoy	1986 – 1994	1995 – 1997	1997 – 2012[10]	2009 – present
Lisheen	1990 – 1997	1997 – 1999	1999 – 2015	2015 – present

The time-based scope for the study is based on the different stages of the mining process, namely:

- The pre-construction **baseline** which begins with the discovery of zinc and lead deposits in each of the mine sites. From the time of discovery of deposits, the mining companies initiated a planning and evaluation process in the pre-construction phase, involving, among other things, an assessment of likely impacts of proposed activities and mitigation measures to avoid negative effects.
- The **construction** phase which begins once permission for construction of the mine is granted by its local authority or An Bord Pleanála (ABP) and/or the Integrated Pollution Control Licence and State mining lease/licence is obtained.
- The **operation** phase which begins with the extraction and processing of ore.
- The **closure** phase which is implemented in stages beginning with remediation processes while the site is still operational. Closure plans require the mine and the TMF site to be left in a condition ensuring public health and safety, minimising the risk of contamination and, where possible, allowing productive use of the land. Once mining production ceases, closure involves an 'active care' phase for five years, involving a rigorous monitoring programme. This is followed by a 'passive care' phase for a subsequent approximate 30 years, performance based.

Given that the study reviews existing evidence regarding the social environmental and economic effects of the mines up to the present day, anticipated future effects captured within the closure phase of the mines are discussed qualitatively, where the evidence allows.

4.3.4 Identification of effects and Data Availability

There were multiple steps in identifying whether an effect of mining activities is significant, including:

1. Whether a certain effect of mining activities is expected (in theory) to occur at this stage of the Mine's development;
2. Whether there is evidence, in the literature that was reviewed to demonstrate that these expected effects actually occurred;
3. Whether there is data to assess the significance of the effect; and
4. Whether there is enough evidence to attribute a causal link between this effect and mining activities.

Effects were identified from theory and the evidence review, and were initially evaluated against these criteria. In many cases, there may be data for 1-3, but not enough evidence to determine a causal link between the mines and the effect. Where this occurs, the effect or evidence is generally noted in the text or appendices, but not taken forward or screened for significance.

Table 4.4 shows how effects were identified and screened for data availability.

[10] While processing ceased and the closure process began in 2009, Galmoy continued to mine ore until 2012. The period between 2009 and 2012 is therefore considered as a 'partial closure' phase

Table 4.4: Identification of effects

Symbol	Meaning
✓	An effect is hypothesised or expected at this stage, with sufficient data/information available to assess for significance
✗	An effect is hypothesised or expected at this stage, with insufficient data/information available to assess for significance
N/A	An effect is not hypothesised or expected to occur at this stage

4.3.5 Characterisation of significant effects

Based on the sources reviewed in Section 4.2 and the effects identified in Section 2.3.4, the evidence generated through the study was used to determine *significant* social, environmental or economic effects. Whether an effect is significant is a function of:

- **Duration of an effect:** Effects were categorised as short-term, medium-term, long-term or permanent based on how long it persisted *after the activity that led to this effect*. This is described in more detail in Table 4.6.
- **Receptor Sensitivity:** How sensitive people, resources or organisations (receptors) are to that effect. When considering the impacted population from a social, environmental or economic perspective, receptors were conservatively considered to be highly sensitive in the absence of alternative evidence.

Generally, there was a degree of professional judgment used in determining significant effects, particularly as the receptors included different units of analysis e.g. individuals, social groups, communities, organisations, sectors, habitat types etc. Where quantitative information regarding the size of the effect is available, this can be used in the determination of significant effects (e.g. to determine if certain regulatory thresholds for environmental pollutants have been breached thereby creating a significant effect).

Table 4.5 presents the significance criteria, which includes both duration and receptor sensitivity. This is based on guidance provided by the sources outlined in Section 4.2.

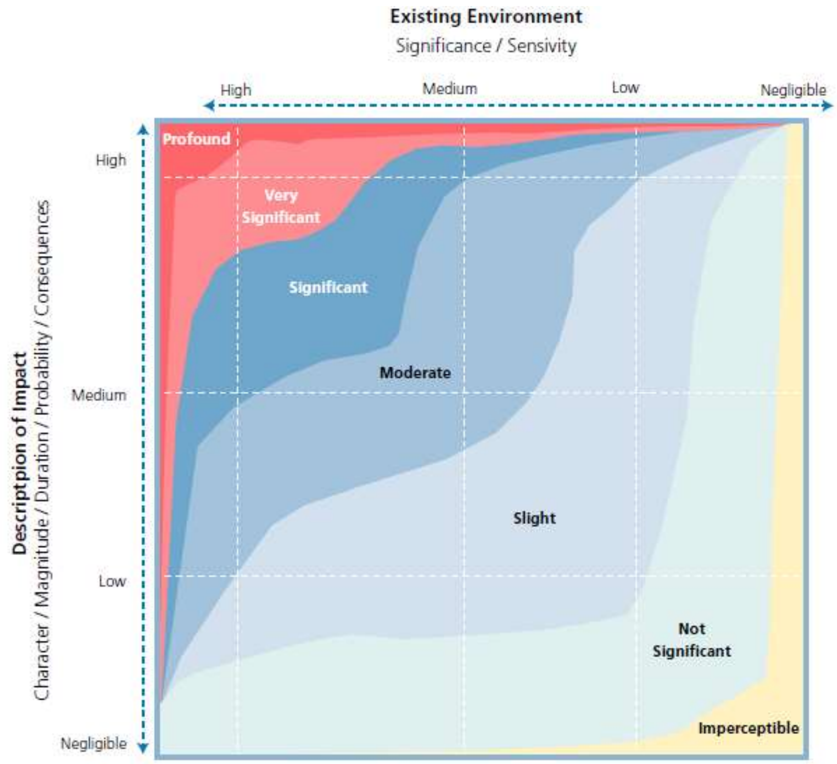
Table 4.5: Significant effects as a function of duration and receptor sensitivity

Duration of effect	Receptor* sensitivity			
	High	Moderate	Low	Negligible
Permanent	High	High	Moderate	Low
Long-term	High	High	Moderate	Low
Medium-term	Moderate/High	Moderate	Low	Low
Short-term	Moderate/High	Moderate	Low	Low

Notes: Receptors are the people, resources or sectors impacted by the social, environmental or economic effects of the mines.

The matrix in Table 4.5 is consistent with Figure 4.3 below which is taken from the EPA's guidelines for reporting environmental impact assessments.

Figure 4.3: Typical classifications of the significance of impacts



Source: Environmental Protection Agency (2017) Guidelines on the information to be contained in Environmental Impact Assessment reports.

For the purposes of the study, where a social, environmental or economic effect was considered to be *significant in at least one mining stage*, it was presented as part of the assessment of that mine with the information in Table 4.6.

Table 4.6: Characterisation and assessment of significant effects

Category		Description per mining stage
Asset affected		For the environmental assessment, natural capital assets are habitat types e.g. freshwater, wetlands and floodplains; enclosed farmland; etc. For the social assessment, assets include employees, health and safety, and community For the economic assessment, assets include sectors and economic agents e.g. local businesses, the mining sector, etc.
Description of effect		For the environmental assessment, this would be in terms of ecosystem services e.g. fresh water, habitat for wildlife, etc. For the social assessment, this would be in terms of social effect e.g. with respect to employment, education, skills development, health and safety etc. For the economic assessment, this would be in terms of economic effect e.g. economic output, exports, GVA, etc.
Link to intervention logic		Specifies whether the effect is related to an input, activity, outcome and wider outcome with reference to the intervention logic in Section 4.3.1
Receptor		For the social and economic assessments, the receptor is the population that is affected by this change to an asset, while for the environmental assessment, this is a combination of the impacted habitat and population
	Negative	An adverse change from the baseline, or represents a new undesirable factor

Category		Description per mining stage
Nature of effect	Positive	An improvement to the baseline or represents a new desirable factor
Type of effect	Direct	Resulting from a direct interaction between the mine and the receiving environment
	Indirect	Resulting from the mine but at a later time or at a remote distance or which may occur as a secondary effect
Duration of effect	Short-term	Effect lasts only for a limited period but ceases on completion of the activity that led to the effect, or as a result of mitigation / reinstatement measures and natural recovery of the receptor/resource, typically within one year of the activity's completion
	Medium-term	Effect lasts only for a medium period after the activity that led to the effect is completed, typically one to five years
	Long-term	Effect continues over an extended period, typically more than five years after the activity's completion
	Permanent	Effect occurs during the life cycle of the mine which causes a permanent change in the affected receptor/resource that endures substantially or indefinitely beyond the mine's lifetime
Scale of effect	Site-specific	Occurs on-site
	Local	Affects locally important resources or is restricted to a single asset/resource
	Regional	Affects regionally important resources or is experienced at a regional scale as determined by administrative boundaries
	National	Affects nationally important resources, or an area that is nationally important / protected or has macro-economic consequences
Receptor sensitivity	High	When considering the impacted population from a social and economic perspective, the receptors are in most cases conservatively considered to be highly sensitive in the absence of alternative evidence When considering the impacted natural capital assets, the receptors are considered to be highly sensitive if they are attributes of high quality and rarity on a regional or national scale. This could include surface waters that have high Water Framework Directive (WFD) status, European wildlife sites (SACs, SPAs), high grade agricultural land, etc.
	Moderate	Only relevant for natural capital assets that are considered to be attributes of high quality and rarity on a local scale. This could include surface waters that have good WFD status or species protected under habitat legislation etc.
	Low	Only relevant for natural capital assets that are considered to be attributes of medium quality and rarity on a local scale. This could include surface waters that have moderate WFD status, non-EC designated fishery or site of local conservation status, lower grade agricultural land, etc.
	Negligible	Only relevant for natural capital assets that are considered to be attributes of low quality/rarity on a local scale. This could include surface waters that have poor WFD status, common habitat with no conservation status, poorly productive aquifers and groundwaters, low grade agricultural land (Grade 5), etc.
Significance of effect	High	An effect that is capable of causing sufficient change to part or most of a sensitive aspect of the natural and/ or human environment to the extent that it fundamentally affects the status, potential productivity or usage of the environment
	Moderate	An effect that is capable of causing change in the natural and/ or human environment, but does not fundamentally affect the status, potential productivity or usage of the environment or in a manner that is consistent with existing and emerging baseline trends
	Low	An effect which is either too small to be measured or, even if quantifiable, does not give rise to any material change in the natural and/ or human

Category		Description per mining stage
		environment. This effect does not have significant consequences or does not affect the sensitivity of the receptor.
Physical measure		If the effect is significant, the physical measurement of the effect is provided at each of the mining stages (in separate columns).
Monetary value		If data is available for physical measurement, then the study explores whether a suitable monetary valuation approach and evidence are available to value the effect in monetary terms.

5. Galmoy mine

5.1 Overview

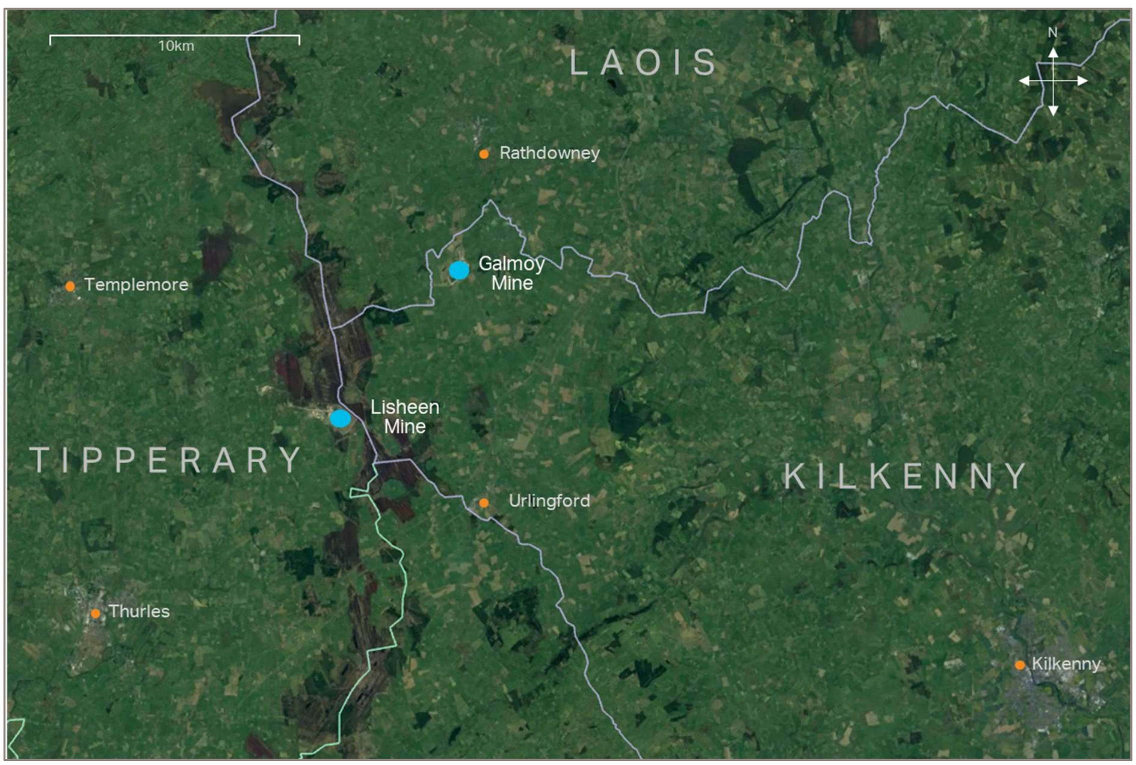
5.1.1 Geographic Context

The Galmoy zinc, lead and silver mine is located in north-west Co. Kilkenny, on the border of Counties Laois and Tipperary, within the townlands of Castletown, Garrylaun, Whiteswall, Rathreagh and Rathpatrick. This is rural area with lands surrounding the mine site predominantly used for livestock grazing. The nearest major villages and towns include:

- **Galmoy village:** A small settlement which had approximately 12 households when mining activities began.
- **Rathdowney, Co. Laois:** The nearest settlement with commercial services, located 8 kilometres north of Galmoy Mine.
- **Urlingford, Co. Kilkenny:** 11 kilometres south on the old Dublin to Cork road (R639)
- **Thurles, Co. Tipperary:** 20 kilometres south-west of Galmoy, with a population of 8,000 people
- **Kilkenny, Co. Kilkenny:** The nearest city, located approximately 30 kilometres to the south-east, with a population of 26,510 people.

The mine lies within the administrative boundaries of Kilkenny County Council.

Figure 5.1: Location of Galmoy Mine



Source: Google Earth

5.1.2 Discovery and Planning

Zinc and lead deposits at Galmoy were first discovered in 1986 by Conroy Petroleum and Natural Resources Plc. The deposits are located on what is now known as the Rathdowney Trend which stretches 40 kilometres between the towns of Abbeyleix (Co. Laois) and Thurles (Co. Tipperary), and led to the later discovery of deposits at Lisheen along the same Trend. These initial deposits were situated relatively near the surface at a depth of between 50 and 90 metres, and are hosted in basal Waulsortian (Lower Carboniferous) “Reef” mudbank limestones.

The mine was initially developed by ARCON International Resources PLC., an Irish-registered mining and minerals exploration company. Statutory planning for development of the mine began in the late 1980s. A planning application to Kilkenny County Council was lodged in late 1992, required for all parts of the operation, accompanied by the required Environmental Impact Statement[11]. The underground mine was separated into different zones, or orebodies, and Environmental Impact Statements for the so-called zones ‘G’ and ‘CW’ in Galmoy were published in 1992. The zone ‘K’ deposit was discovered circa 1993.

In order to obtain planning permission, Galmoy was required to produce an initial plan for the mine’s closure. This outlined designs for the Tailings Management Facility (TMF), which was the facility in which leftover materials from the extraction of concentrate would be stored; as well as plans and funding commitments for the progressive rehabilitation of the site.

Despite this, the development of Galmoy Mine still encountered significant local resistance. A Galmoy Awareness Group was formed, with much of the concern at the time over the TMF and potential impacts on groundwater and neighbouring properties. Although planning permission was granted by Kilkenny County Council in 1993, this was appealed to An Bord Pleanála, and final permission was granted in 1994 following an oral hearing in which many of these concerns were addressed. The first State Mining Licence was issued in 1995 and construction of the mine and mill began on the site the same year.

5.1.3 Operations

Construction lasted two years and the mine began commercial operations in May 1997. The mine itself was fully underground and used mobile underground machinery, consisting of rigs, loaders, trucks and service gear. The extraction methods used were ‘room and pillar’, drift and fill and long hole stoping. In addition, the mine operated a milling facility on the surface which processed ore into concentrate. Concentrate from Galmoy was transported by truck/road to New Ross Port, Co. Wexford, located 80 kilometres from the mine. From there it was loaded onto ships for transport to smelters, in various European locations and globally[12]. Exploration and drilling continued during operations, leading to the discovery of new orebodies, including zone ‘K’ in 1993, zone ‘K2’ deposits in 1997 and ‘R’ in 2002.

The mine produced an average of 135,000 tonnes of concentrate each year. Media reports on business activities of ARCON International Resources document that the company struggled to return a profit in the early years of operation, and the company’s Annual Returns for Galmoy Mine show that the company ran at a loss until 2004.

Operations lasted between 1997 and 2012, and several incidents occurred over this period, including:

- A worker’s strike in 1998 closed the mine for fourteen weeks. Another thirteen-week strike at a maintenance contractor disrupted production in 2003, as well as industrial action from one union in 2007.
- In 2002, a road was closed in the vicinity of the mine site due to an initial three-inch subsidence in the road. Another subsidence event occurred in 2014, after the mine closed, in which a 10m x 16m sinkhole appeared on neighbouring property.

[11] The new system of pollution control was introduced by the Environmental Protection Agency (EPA) Act, 1992, transferring the issuing of licences for air and water discharges from the Local Authorities to the Environmental Protection Agency in the form of the Integrated Pollution Control Licence (IPCL) from 1994.

[12] There are no smelting facilities in Ireland.

- An Integrated Pollution Control Licence (IPCL)[13] was introduced from October 2002, covering the plant site, lands over the orebodies (excluding the 'K2' zone) and the TMF.
- In 2005, ARCON became a subsidiary of Lundin Mining Corporation, a Canadian-registered company.
- In 2007, there was one fatality after a worker fell from a height. Galmoy Mines Ltd. was later fined €100,000 for breaches of health and safety legislation in relation to the accident.

5.1.4 Closure

Mining and processing continued until 2009, when the mine partially closed due to a slump in zinc prices. While underground mining continued on site on a smaller scale, processing ceased at Galmoy and ore was sent to Lisheen to be processed into concentrate. Mining fully ceased in 2012 and the mine closed, with the cessation of over 200 jobs.

While progressive rehabilitation of the TMF began during operations, the Mine Closure Plan was implemented in 2009, when processing stopped at Galmoy. Galmoy Mine was the first in Ireland to be opened, operated and closed with a Closure, Restoration and Aftercare Management Plan (CRAMP) and associated funding in place. (It opened with a precursor of the now established CRAMP). Galmoy was required to set aside approximately €12 million in a closure bond to pay for the expected closure and rehabilitation works, as well as undertake a risk analysis of unknown liabilities (i.e. issues that may arise during the closure/aftercare period). This bond was held under the control of the joint authorities of Kilkenny County Council, the Environmental Protection Agency and Exploration and Mining Division of DCCAE.

The CRAMP is a dynamic document, and Galmoy's CRAMP was revised as required and in accordance with CRAMP protocol which included financial adjustments if necessary, taking account of lessons learned or adapting to issues encountered during operations and closure. Mine management put significant effort into conducting trials, such as testing the suitability of grass species and monitoring the effects on cattle grazing. The results of these trials also fed into later revisions of the closure plan. There was a significant degree of institutional learning surrounding Galmoy's closure, and many of the practices and lessons from Galmoy, particularly in relation to the design and management of the TMF, became an example of best-practice for mines in Ireland and beyond. These would later influence Lisheen mine's closure plan several years later.

The mine underwent a period of 'Active Care' between 2010 and 2015, followed by period of 'Passive Care' between 2015 and 2020, and will enter the 'Stable Phase' of up to 20 years from 2020.

AQS Environmental Solutions, an environmental waste services company, currently operates from the former mine offices. In 2018, plans were announced to potentially reopen Galmoy Mine with the creation of 50 jobs, and these plans are still ongoing as of the publication of this report.

[13] Registration number P0517-01

5.2 Social effects

The social assessment considers the social and human capital issues of relevance to each stage of the mine's lifecycle. Social impacts (or dependencies) were initially identified from best practice social impact assessment (SIA)[14] in the mining sector and are considered in relation to the classification of social and human capital issues outlined in the Social and Human Capital Protocol. These include:

- Employment: job creation, local employment, and local supplier contracts
- Education and skills: training, education, or the creation and dissemination of intellectual capital
- Health and safety: employee health and safety and local community health, safety and well-being
- Community: population change, infrastructure, services, support to local community and social cohesion.

The effects identified across these categories relate to the following types of receptors: mine employees and members of the local community.

The data used to inform the analysis of each mine's social impacts was gathered from the evidence review and stakeholder interviews (See Appendix D for a complete list of references). All relevant data was assessed qualitatively, using the criteria developed and described in the method section of this report, including: the type, duration and scale of the effect, and the receptor sensitivity. This checklist supported the conclusion regarding the significance of the effect which then helped to determine if the impact would be included in the assessment. Some subjective assertions were required in this process and justifications are provided in each individual impact's section. Where assets were determined to be significant and data was available, the impacts were ascribed monetary values.

5.2.1 Identifying and screening effects

Table 5.1 presents a list of the range of social effects that were identified through the literature review and interviews. The table also indicates where data is available to screen impacts. Where data is not available to screen effects, it is also not possible to subsequently assess them for their significance.

The significance of the effects that were taken forward are screened in Table 5.2 based on the criteria established. Of the effects that were screened, 9 were found to be of high significance, 6 were of moderate/high significance and 1 was of low significance. Where the 'significance of effects' was determined to be moderate/high, the 'duration of effects' was examined next. If the duration was long-term, the effect was taken forward to the assessment, while short-term effects were screened out. A total of 9 effects were deemed to be highly significant and were therefore taken forward to the final assessment, which is detailed below. Where quantitative data for an effect is missing, it is described qualitatively using the evidence available.

[14] See IAIA guidance (2015) 'Social Impact Assessment: Guidance for assessing and managing the social impacts of projects'. Social Impact Assessment (SIA) is a process for the identification, analysis, assessment, management and monitoring of the social impacts of a project, both positive and negative. The social impacts of a project are the direct and indirect impacts that affect people and their communities at all stages of the project lifecycle.

Table 5.1 Data availability for social effects for Galmoy mine

Asset Affected	Description of effect	Availability of data by mine phase		
		Construction	Operation	Closure
Employees	Employment: direct job creation	✓	✓	✓
	Employment: indirect and induced job creation	✘	✓	✘
	Education and skills: upskilling workforce and improved employability	✘	✓	✓
	Employee health and safety: training	✘	✓	✘
	Employee health and safety: incidents	✘	✓	✘
	Employment: local employment[15]	✘	✓	✘
	Local community health, safety and well-being: noise and vibrations	✘	✓	N/A
	Local community health, safety and well-being: subsidence events	✘	✓	✓
	Community infrastructure: road investment	✓	✓	✘
	Community infrastructure: telecommunications	✓	✓	✘
	Community infrastructure: energy	✓	✓	✘
	Community services: water	✓	✓	✓
	Change in societally significant intellectual capital	✘	✘	✘
	Community support: sponsorship	✘	✓	✘
	Social cohesion	✘	✓	✘
	Population change	✓	✓	✓

[15] While information from interviews indicates that there was at least a degree of local employment at all stages, data is only available to quantify this for the operations stage.

Table 5.2 Significance of social effects for Galmoy mine

Asset Affected	Description of effect	Who is affected (receptor)	Phase of the mine	Duration of effect	Scale of effect	Receptor sensitivity	Significance of effect	Included in assessment
Employees	Employment: direct, indirect and induced job creation	Employees	Construction	Short-term	National	High	Moderate/High	No
			Operation	Long-term	Regional	High	High	Yes
			Closure	Short-term	Regional	High	Moderate/High	No
	Education and skills: upskilling workforce and improved employability	Employees	Operation / Closure	Long-term	Regional	High	High	Yes
	Employee health and safety: training	Employees	Operation	Long-term	Local	High	High	Yes
	Employee health and safety: Incidents	Employees	Operation	Permanent	Local	High	High	Yes
Local community	Employment: local employment	Local community	Operation	Long-term	Local	High	High	Yes
	Local community health, safety and well-being: noise and vibrations	Local community	Operation	Medium-term	Local	High	Moderate/High	Yes
	Local community health and safety: subsidence events	Local community	Operation / Closure	Medium-term	Local	High	Moderate/High	Yes
	Community infrastructure: road investment	Local community	Construction / Operation	Permanent	Local	High	High	Yes
	Community infrastructure: energy	Local community	Construction / Operation	Permanent	Local	High	High	Yes
	Community services: telecommunications	Local community	Construction / Operation	Permanent	Local	High	High	Yes
	Community services: water	Local community	All	Permanent	Local	High	High	Yes
	Community support: sponsorship	Local Community	Operation	Short-term	Local	High	Moderate / High	No
	Social cohesion	Local community	Construction	Short-term	Local	High	Moderate/High	No
	Population Change	Local community	All	Long-term	Local	Negligible	Low	No

5.2.2 Employment

During the **baseline** period, unemployment levels throughout Ireland were high (15.4%). The unemployment rate within the local area was lower during these years (7.3%) compared to the regional and national rates (13.3% and 15.4% respectively). A review of the literature suggests that this is likely due to out-migration of working age people from the local area, rather than due to greater employment opportunities within the local area.

While there was a peak of 370 jobs during **construction**, it is likely that there were less full-time equivalents (FTE). In terms of local employment, the evidence review revealed that the use of national and international construction firms meant that there was relatively little local employment, and the effect was not considered significant as a result. However, interviews indicate there was an increase in local economic activity at the time, and the effects of construction expenditure are considered separately in the economic assessment.

While the number employed at Galmoy varied during **operations**, there was a long-term effect in the employment of an average of 213 workers. Many of these came from the local community, resulting in significant positive effects as shown in Table 5.3.

Table 5.3: Effects of employment at Galmoy Mine

Effect:	**Job creation and local employment during operations**					
Asset Affected	Mine Employees					
Receptor	Mine employees and local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operations	Direct	Long-term	Regional	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Employee Wages		Money spent on wages and salaries			€141 million
Activities / Output	Mining jobs are provided in the local community		213 direct jobs • 32% live within 10km of Galmoy • 80% within 30km			-
Intermediate Outcomes	Employees receive wages and other social and economic benefits from employment		No available data			-
Wider Outcomes	Higher levels of employment results in social and economic benefits for the local community and additional indirect and induced job creation		196 indirect jobs 104 induced jobs			-

Source: Galmoy Mines Ltd. Annual Financial Returns, Census 2006 POWSCAR data

During the **closure phase** of the mine, while there was a minimal amount of jobs related to rehabilitation, the majority of jobs at the mine were lost. Unemployment undoubtedly represents a negative effect for its employees, particularly when it occurs in the middle of an ongoing recession, as was the case for Galmoy. However, the overall social effect of unemployment on the local community in comparison to the baseline was not considered to be significant given its relatively short-term nature. Firstly, workers were given redundancy packages of 6.75 weeks per year of service, with an estimated total of €15.8 million paid out to ex-employees[16]. Secondly, the evidence review suggests

[16] Based on provision for redundancy made in Galmoy mine company's Annual Financial Returns from 2008 to 2012.

that there weren't high levels of long-term unemployment resulting from the mine's closure, with many workers being re-employed by other mines, returning to full-time farming, or entering retirement. Some jobs were also created with the post-closure re-use of the site by an environmental waste services company, although this is a relatively low number.

As there are resources left at Galmoy Mine, there were discussions in 2018 to reopen the mine, with the potential creation of around 50 jobs. However, this is still ongoing as of the publication of this report.

5.2.3 Education and skills

During the **baseline**, the majority of the workforce in the local area specialised in agricultural work (57%), with a small percentage of residents working in the industrial sector (15%) and within services (28%). In contrast, jobs within the agricultural sector were the least common across County Kilkenny and the whole of Ireland. At the regional and national level, a larger share of the population worked within the service sector and around 30% of people worked in the industrial sector. These trends indicate that prior to the development of the mine, agricultural knowledge, experience and skills in the local area was higher than regional and national averages, while industrial and service knowledge, experience and skills may have been lacking in and around Galmoy.

No information from the evidence review was available to suggest any education and skills effects during the **construction** phase of the mine. During **operations**, upskilling of the workforce occurred to equip employees with the skills necessary to work in the mine. Training was also put in place prior to **closure** in order to prepare employees for closure, and there was evidence that this resulted in significant positive effects on employability, as outlined in Table 5.4.

Table 5.4: Effects of education and skills at Galmoy mine

Effect:	Upskilling workforce and Improved Employability					
Asset Affected	Employees					
Receptor	Mine employees					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operation / Closure	Direct	Long-term	Regional	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Education and training for mine employees		Education and training programmes for mine employees			-
Activities / outputs	Upskilling of employees Qualifications to work in mine operations		Skills and qualifications gained by workers, e.g. machinery operation			-
Intermediate Outcomes	Employees better qualified to gain future employment in the local area		Transferable skills from mining operations			-
Wider Outcomes	Higher levels of re-employment following closure of the Mine		There is no available data for physical measurement, however evidence concludes that there were relatively high levels of re-employment of ex-employees at other mines (particularly at Lisheen and Tara Mine) following closure of Galmoy.			-

Source: Interviews conducted as part of this assessment

5.2.4 Employee Health and Safety

There was no information regarding health and safety effects on employees during the **construction** phase of the mine.

During **operations,** there were significant positive effects for employees due to health and safety training. The company ensured that 2,000 to 4,000 certified hours of health and safety training was completed during each year of operation, and provided employees with health and safety courses.

However, this did not prevent all incidents, and negative effects on employee health and safety were observed in health and safety incidents during the **operations** phase. There was one fatality during this period, in 2007, when an employee fell from a height after a guardrail gave way. Galmoy Mines Ltd. was later fined €100,000 by the Health and Safety Authority (HSA) for breaches of the Safety Health and Welfare at Work Act, 2005 in relation to this.

While the HSA does not provide statistics for the mining sector specifically, the injury rate for the industrial sector (which includes mining, manufacturing and utilities supply) is above the national average for all sectors. In 2017, the industrial sector had a rate of 20 injuries per 1,000 workers, compared to the national average of 15. This is the third-highest of 12 sectors, after agriculture / forestry / fishing and public administration / defence[17].

The effects on employee health and safety are summarised in Table 5.5 below.

[17] Health and Safety Authority, 2018. 'Summary of Workplace Injury, Illness and Fatality Statistics, 2016-2017'.

Table 5.5: Effects on employee health and safety

Effect:	Employee Health and Safety: Training					
Asset Affected	Employees					
Receptor	Mine Employees					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operation	Direct	Long-term	Local	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Health and safety training provided to employees		• 2000-4000 certified hours of health and safety training per year of operations. • A four-day external training course on safety awareness for 72 employees • Eight external health and safety training sessions for 154 employees • Mine rescue team (Affiliated to the Irish Mine Rescue Committee and operated to the Irish Mine Rescue Standard)			-
Activities / outputs	Improved health and safety of employees		No available data			-
Intermediate Outcomes	Improved quality of life due to improved physical and mental wellbeing of employees		No available data			-
Wider Outcomes	Positive effects of improved wellbeing on the local community e.g. reduced stress on healthcare		No available data			-
Effect:	**Employee Health and Safety: Incidents**					
Asset Affected	Employees					
Receptor	Mine Employees, families and communities					
Characteristics	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Operation	Direct	Permanent	Local	High	High
	Logic Model		**Physical Measure**			**Monetary Value**
Input	Insufficient consideration of employee health and safety		Safety lapses and breaches of health and safety legislation: Prosecution by HSA (2010)			-
Activities / outputs	Employee health and safety incidences		• Fatality: One fatality in 2007 • Injuries: One serious injury (loss of hand), no data on total lost-time injuries • Injury Rate: No available data			-
Intermediate Outcomes	Fatality, injury or reduced mental/physical wellbeing of employees		No available data			-
Wider Outcomes	Negative effects on families, friends and the local community e.g. greater pressure on healthcare or emotional impacts on employee's family		No available data			-

5.2.5 Local Health, Safety and Well-being

The main effects on local health, safety and well-being identified during the evidence review were the effects of noise and vibrations, and those of subsidence events.

5.2.5.1 Noise and Vibrations

Prior to the commencement of mining activities at Galmoy, during the **baseline**, there were no reports of adverse health and safety effects or unusual epidemiological data from the surrounding local area. The principal sources of noise in the local area were road traffic, livestock and agricultural activity. The baseline level of noise surrounding the mine was considered to be typical for a rural area with no major roads or flight paths. At night, equivalent continuous noise levels were 34 dB(A) to 40 dB(A), and during the day, equivalent continuous noise levels were 47dB(A) to 55 dB(A).

During the **construction** phase of the mine, changes in the level of noise experienced by the community were a likely outcome; however, there was no information available regarding the level of this effect.

Noise and vibration levels within the immediate vicinity of the mine increased during the **operations** phase of the mine, impacting upon local community health and wellbeing. This was largely due to the increase in road traffic (to and from the site) and blasting activities which occurred at set times during the day.

During operation of the Galmoy mine, noise was regularly monitored and noise complaints were investigated (see Appendix B.1.4 regarding noise pollution for more detailed information on the complaints registered). Based on the literature review and interviews conducted for this study, all registered noise complaints (from 2005 – 2009) were investigated and found to be within legal licence limits.[18][19] Despite this, the welfare and quality of life of the affected population that submitted complaints and those living nearby may have still been impacted by noise events, and complaints were submitted for several years. As such, the effect of noise and vibrations on the local community is considered to be significant and is assessed in Table 5.6.

[18] ARCON Mines Limited 2004, Annual Environmental Report 2004

[19] Galmoy Mines Ltd, Annual Environmental reports 2006, 2007, 2009

Table 5.6: Noise and vibrations at Galmoy Mine

Effect:	Noise and vibrations					
Asset Affected	Health and well-being					
Receptor	Members of the local community					
Characteristics	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Operation	Direct	Medium term	Local	High	High
	Logic Model		**Physical Measure**			**Monetary Value**
Input	Mining activity (blasts and other transport-related noise)		Noise from blasts and transportation during mining operations			-
Activities / outputs	Increase in noise levels		Compliance with legal noise limits: 100 per cent of incidents that sparked complaints were compliant with legal noise limits			-
Intermediate Outcomes	Negative impacts of noise levels on nearby residents, such as annoyance or hypertension		Number of noise complaints: 2 to 3 per year			-
Wider Outcomes	Loss of welfare due to negative impacts of noise levels		No available data			-

5.2.5.2 Subsidence Events

Negative effects on the local community were also observed in the form of two subsidence events which occurred as a consequence of mining activities at Galmoy. Subsidence events and sinkholes pose potential risks to health, safety and well-being, and can cause damage to infrastructure used by the community.

In 2002, during **operations**, there was a subsidence event in which cracks appeared in a local road following the collapse of a stope. Although there were no injuries to members of the public, it did require remediation leading to the temporary closure of that section of road.

Following **closure**, a second subsidence event occurred with the appearance of a sinkhole on a local farm. This sinkhole was a major concern for the landholder, who was active on that land daily, and while this was later filled, a small portion of the field was planted with trees and remains unused for regular farming activities.

The effects of these events are summarised in Table 5.7.

Table 5.7: Effects of subsidence events

Effect:	Local Health and Safety: Subsidence Events					
Asset Affected	Land and Infrastructure					
Receptor	Members of the local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Operation / Closure	Direct	Medium-term	Local	High	High

	Logic Model	**Physical Measurement**		**Monetary Value**
		2002	**2014**	
Input	Mining activities that impact the stability of local land	Collapse of stopes	Dewatering, coupled with other natural factors	-
Activities / outputs	Appearance of sinkholes and other subsidence events	Cracks appearing in a section of the Whiteswall Road.	Appearance of a 10x16m sinkhole on private farmland	-
Intermediate Outcomes	Reduced mental/physical wellbeing of those immediately affected	No injuries or loss of life.	No injuries or loss of life, but landowner reported reduced mental wellbeing	-
Wider Outcomes	Remediation works and loss of economic and social benefits provided by infrastructure or property	Temporary closure of the road for repair works.	Infill and planting of trees on site sinkhole, and loss of that area of land for farming.	-

5.2.6 Community

During the **baseline**, the local area was largely residential and sparsely dispersed throughout the area. The roads within the local area were typically country roads, and traffic in the area was limited (e.g. baseline flows of the R435 Johnstown to Rathdowney road only ever reached 25% of the available capacity).

The community services provided to the local area / region included public transport, one railway station, four primary schools, two secondary schools, five health centres, two district hospitals in Abbeyleix and Castlecomer, two general hospitals in Portlaoise and Kilkenny, single phase electricity (for residential and agricultural purposes), and telecommunication services (for domestic use). Prior to the construction of the mine, particular services, including telecommunication and electricity required improvements, and additional facilitates were necessary to meet the needs of the local community.

As a result of upgrades required for mining activities, there was clear evidence of a number of significant positive effects on local community infrastructure and services during **construction, operations** and **closure** (see Table 5.8). Of note was the Replacement Water Supply Scheme, constructed as a means of providing an alternative potable water supply in the Galmoy area to mitigate against the lowering of the water table caused by mining the orebodies. The scheme consisted of establishing: a production well; a reserve well; a chlorination plant and a reservoir. The Galmoy-Rathdowney Public Water Supply (PWS) was originally a private supply referred to as the Galmoy Replacement Water Supply Scheme. The water treatment plant (WTP) was constructed in 1995 and was operated, monitored and serviced by Galmoy Mines until the WTP was taken in charge by Irish Water in July 2016.[20]

While there was some evidence of sponsorship activities during operations such as donating computers to a local school, they were not considered to be significant due to their short-term nature.

[20] EPA (2016) Drinking Water Audit Report Galmoy/Rathdowney Public Water Supply 1500PUB1025

The Table below summarises the significant effects regarding community services and infrastructure over the lifetime of the mine.

Table 5.8 Community at Galmoy mine

<table>
<tr><td>Effect:</td><td colspan="7">Improved Community Water Services</td></tr>
<tr><td>Asset Affected</td><td colspan="7">Water Services</td></tr>
<tr><td>Receptor</td><td colspan="7">Members of the local community</td></tr>
<tr><td>Nature</td><td>Stage</td><td>Type</td><td>Duration</td><td>Scale</td><td>Sensitivity</td><td colspan="2">Significance</td></tr>
<tr><td>Positive</td><td>All</td><td>Direct</td><td>Permanent</td><td>Local</td><td>High</td><td colspan="2">High</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="3">Physical Measurement</td><td colspan="2">Monetary Value</td></tr>
<tr><td>Input</td><td colspan="2">Investment in Galmoy Replacement Water Supply Scheme (RWSS)</td><td colspan="3">Construction of Galmoy Water Treatment Plant and other upgrade works</td><td colspan="2">-</td></tr>
<tr><td>Activities / outputs</td><td colspan="2">Production of water
Extension of scheme to the Galmoy Public Group Scheme</td><td colspan="3">No data available</td><td colspan="2">-</td></tr>
<tr><td>Intermediate Outcomes</td><td colspan="2">Recipients received a reliable and clean source of water</td><td colspan="3">641 properties connected to the scheme benefitted from high quality free water for at least 12 years</td><td colspan="2">-</td></tr>
<tr><td>Wider Outcomes</td><td colspan="2">Social and economic benefits of improved water supply e.g. improved well-being and reduced water bills.</td><td colspan="3">No data available</td><td colspan="2">-</td></tr>
<tr><td>Effect:</td><td colspan="7">Improved Local Infrastructure</td></tr>
<tr><td>Asset Affected</td><td colspan="7">Local Infrastructure</td></tr>
<tr><td>Receptor</td><td colspan="7">Local community and businesses</td></tr>
<tr><td>Characteristics</td><td>Stage</td><td>Type</td><td>Duration</td><td>Scale</td><td>Sensitivity</td><td colspan="2">Significance</td></tr>
<tr><td>Positive</td><td>Construction / Operation</td><td>Direct</td><td>Permanent</td><td>Local</td><td>High</td><td colspan="2">High</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="3">Physical Measure</td><td colspan="2">Monetary Value</td></tr>
<tr><td>Input</td><td colspan="2">Expenditure on infrastructure</td><td colspan="3">No data available</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">Activities / outputs</td><td colspan="2" rowspan="3">Infrastructure development and improvements</td><td colspan="3">Roads: Improvements to R435 and other roads</td><td colspan="2">€1.49 million (in 2018€ equivalent)</td></tr>
<tr><td colspan="3">Telecommunications: Upgrades to telecommunications infrastructure</td><td colspan="2">-</td></tr>
<tr><td colspan="3">Energy: Provision of a three-phase power supply</td><td colspan="2">-</td></tr>
<tr><td>Intermediate Outcomes</td><td colspan="2">Direct impacts on residents and businesses within the local community</td><td colspan="3">Evidence concludes that community members benefitted from improved infrastructure</td><td colspan="2">-</td></tr>
<tr><td>Wider Outcomes</td><td colspan="2">Wider social and economic impacts of infrastructure</td><td colspan="3">Evidence concludes that the local infrastructure enabled other businesses to move onto the site post-closure.</td><td colspan="2">-</td></tr>
</table>

Source: Interviews conducted as part of this assessment and Irish Water

5.3 Environmental effects

The environmental assessment considers the stock of natural capital assets that are relevant to the evaluation of the mine's environmental effects, as well as the flow of ecosystem services or benefits they deliver.

The Natural Capital Committee defines natural capital as the elements of nature that directly and indirectly produce value or benefits to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions (Natural Capital Committee, 2014). Natural capital assets are identified on the basis of the classification of broad habitat types provided by the UK National Ecosystem Assessment (UK NEA, 2011).[21] To support the assessment, spatial analysis using CORINE Land Cover data has been undertaken as part of the study to determine the breakdown of land in the mine footprint by broad habitat type. This allows changes in the extent of natural capital as a result of the mine to be identified. The principal habitat within the footprint of Galmoy mine is enclosed farmland.

When it comes to changes in the condition of natural capital, these are considered within 3 km of the footprint of the mine. This allows changes to surrounding habitats as a result of mining activities (such as freshwater) to be considered, but also avoids an overlap with Lisheen mine which is around 7 km from Galmoy mine (from their mid-point).

It should be noted that definitions of natural capital include mineral deposits. As such, in addition to the habitat types within the footprint of the mine, minerals are considered separately with respect to the mine's operational stage. Air quality is considered as a cross-cutting environmental impact as it affects all habitat types.

The flow of ecosystem services delivered by natural capital assets is considered in terms of provisioning, regulating and cultural services. Supporting services are not covered in the assessment as they constitute intermediate rather than final ecosystem services which, when valued with other final services, can lead to double counting of environmental effects. The classification of ecosystem services draws on the UK National Ecosystem Assessment (2011) and the Millennium Ecosystem Assessment.

This section summarises the key findings of the environmental assessment, with all supporting information for Galmoy reported in Appendix B.2.

5.3.1 Identifying and screening effects

The following table presents a list of the range of environmental effects that were identified through the literature review and interviews. The table also indicates where data was available to assess or screen effects. Where data was not available, the effect was screened out and no valuation was applied.

There are 13 possible types of effects that could occur across the three stages of the mine (i.e. 39 possible effects in total). Of the 39 effects, five are taken forward and 34 are screened out due to a lack of data availability to assess them or determine a causal link between the mine and the effect. The significance of the five effects that were taken forward was determined based on the criteria set in Table 5.10 below.

[21] UK National Ecosystem Assessment (2011). The UK National Ecosystem Assessment: Synthesis of the Key Findings. UNEP-WCMC, Cambridge.

Table 5.9: Data availability for effects at Galmoy mine

Asset Affected	Description of effect	Availability of data by mine phase		
		Construction	Operation	Closure
Enclosed farmland	Change in agricultural output due to change in extent or condition of pastureland	✗	✓	✓
Freshwater, wetlands and floodplains	Change in water quantity	✗	✗	✗
	Change in water quality at surface waterbodies within 3 km of mine	✗	✗	✗
	Change in water quality at groundwater bodies within 3 km of mine	✗	✗	✗
	Change in fishery populations Change in water quality at surface waterbodies within 3 km of mine	✗	✗	✗
	Change in access and opportunities for recreational angling Change in water quality at groundwater bodies within 3 km of mine	✗	✗	✗
	Change in flood risk	✗	✗	✗
	Creation of wetland area	N/A	✗	✓
Ambient air quality	Air pollutant emissions due to blasts	✗	✗	N/A
	Air pollutant emissions due to mine-related transport emissions	✗	✗	✗
Minerals	Extraction of ore and processed zinc and lead	N/A	✓	N/A
Energy	Energy consumption and greenhouse gas emissions	✗	✓	✗

*Note: N/A indicates that effect is not expected to occur at this stage

Changes in the quality of freshwater and groundwater within 3 km of the mine are listed as effects in the table below where the data indicates there was a change (improvement or deterioration) in the Water Framework Status (WFD) of waterbodies during the lifetime of the mines. Ultimately, these effects are screened out due to a lack of evidence to link changes in WFD status to mining activities specifically.

Of the effects that were screened, 3 were found to be of high significance, and 1 was found to be of moderate/high significance. Where the 'significance of effects' was determined to be moderate/high, the 'duration of effects' was examined next. As the duration was long-term, the effect was taken forward to the assessment. The screening of effects is included below. Where quantitative data for an effect is missing, it is described qualitatively using the evidence available.

Table 5.10: Significance of environmental effects for Galmoy mine

Asset Affected	Description of effects	Who is affected? (receptor)	Mine phase	Duration of effects	Scale of effects	Receptor sensitivity	Significance of effects	Included in assessment?
Land cover	Subsidence events leading to loss of land	Pastureland and land owner	Closure/	Medium-term	Local	Medium	Moderate	No
Enclosed farmland	Change in extent or condition of farmland	Pastureland, farmers and consumers of agricultural output	Operation	Long-term	Site specific	High	High	Yes
Freshwater, wetlands and floodplains	Creation of wetland	Wetland, user and non-user population	Closure	Long-term	Local	Moderate	Moderate/High	Yes
Minerals	Minerals extraction	Minerals and mine operators	Operation	Permanent	Site specific	High	High	Yes
Energy	Energy Consumption and Greenhouse Gas Emissions	Atmosphere and environments affected by climate change	Operation	Long-term	National	High	High	Yes

5.3.2 Land cover

Prior to the mine's development, during the **baseline**, the area around Galmoy mine was largely pastureland, with some areas for rough grazing, as well as hay and silage production. Cattle and sheep farming were the predominant agricultural use in the area. Prior to the mine there were no particularly distinctive features apart from Knockdrinnia Hill to the west and the occasional views to the distant hills on the southern and eastern horizons.[22]

As outlined in the social assessment, there were two significant subsidence events in the mine's lifetime: one during the mine's **operation**, and another during **closure**. While these were considered significant from a social perspective, they were remediated within a couple of years and resulted in a minimal long-term loss of land. For this reason, they were not considered to be significant from an environmental perspective.

5.3.3 Enclosed farmland

Land is a finite resource. When land is taken to establish a mine or when there is a significant change in use, the benefits provided by the mine must be weighed against the opportunity cost of that land; or the loss of natural capital and ecosystem services provided by existing uses of land.

Prior to the mine's development, during the **baseline**, the majority of land within the footprint of the mine (almost 100%) was pastureland suitable for grazing. There is no information which indicates the quantity of pastureland lost within the footprint of the mine during **construction,** though it is clear that the loss of pastureland began during this phase of the mine. CORINE data shows that during the **operation** phase there was long-term loss of around 55ha of pastureland within the footprint of the mine. While rehabilitation of the TMF began during operations, and grazing trials were conducted towards the end of this period, this constituted a long-term change of use from farmland to industrial use.

The literature review and interviews did not provide information regarding any additional effects of the **closure** of the mine on enclosed farmland. CORINE land cover data indicates that this overall loss of pastureland persisted during the closure phase of the mine, although the evidence from the interviews conducted as part of this assessment reveals that grazing does occur on some parts of the site. The effect of this pastureland loss is detailed in

Table 5.11 below.

[22] Eolas (1992): EIA Receiving Environment

Table 5.11: Enclosed farmland at Galmoy Mine

Effect:	Change in extent or condition of farmland					
Asset Affected	Enclosed Farmland					
Receptor	Pastureland, farmers and consumers of agricultural output					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Operation / Closure	Direct	Long-term	Site-specific	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Mine activities		Type of mine activities requiring land, including mine site and the TMF.			-
Activities / outputs	Land take to enable mine operation		55 ha of land based on spatial analysis of CORINE land cover data from 2000 – 2018.			-
Intermediate Outcomes	Loss of pastureland		Loss of 55 ha of farmland based on spatial analysis of CORINE land cover data from 2000 – 2018.			-
Wider Outcomes	Loss of agricultural production capacity		Loss of potential agricultural output estimated at 41,076 kg of lamb and beef each year[23] and the lifetime value of lost output.			€1.16 million

5.3.4 Freshwater, wetlands and floodplains

Baseline water monitoring was undertaken during the planning process, and continued throughout operation and closure as part of the licence and planning conditions. However, it should be noted that although monitoring was able to determine whether a change in the status of water bodies occurred, in many cases, it was not possible to determine whether mining activities were the cause of that change. The following section assesses only those effects on water that were directly attributable to mining activities, with more detailed information on monitoring provided in the Appendices for Galmoy Mine.

5.3.4.1 Water quantity

During the **baseline** stage, the water supply for the nearby town of Rathdowney was sourced from two sources: the Whiteswall Stream (in the Erkina system) at a point near to the mine site, and the Glasha Stream. Total consumption of water for the area varied between 409 and 545 m^3/ day. The Goul and Erkina river systems were also used as a source of water for stock, crops and spraying. Moreover, the River Nore was a major source of water for a number of domestic, potable and industrial abstractions.

There was insufficient information from the evidence review to suggest that were any significant impacts on water quantity during the **construction** phase of the mine.

Mining operations require significant amounts of water, however the mitigation measures put in place by the mine reportedly prevented any negative impacts on local water supply from occurring. Evidence showed that the mine treated the water it used and returned it to waterbodies to restore their flow. The water used by the mine was expected to have a negative effect on existing water supplies for local households and businesses, therefore the mine set up a Replacement Water Supply

[23] Based on average stocking rates, gross margins and depreciation estimates from the Agriculture and Horticulture Development Board (AHDB) and the Agricultural Budgeting and Costing Book. Full calculations are outlined in Appendix B.2.2.

Scheme (RWSS) to provide a replacement source of water to the community. The scheme provided good quality water to affected households, and the social effects of this scheme are outlined in Section 5.2.6.

5.3.4.2 Surface water quality

The **baseline** surface water quality of the Erkina and Goul Rivers and their tributaries is described as generally good and typical of Irish lowland rivers in limestone areas, with consistent high hardness values. However, a number of water quality issues were identified in Galmoy's baseline *Environmental Impact Statement*, including municipal, industrial and agricultural discharges; maximum concentrations of lead, zinc, potassium, ammoniacal nitrogen and phosphate in the Glasha Stream that exceeded interim guideline values; and seasonal eutrophication in slow-moving sections of the rivers.

There was insufficient information from the evidence review to suggest that there were any significant effects of mining on surface water quality during the **construction, operation** and **closure** phases of the mine. For example, there was limited data in the baseline to establish a comparison between the baseline and subsequent years, and of the three water bodies for which WFD status was available, quality was poor or moderate in 1995 and remained intermittently poor/moderate throughout the lifecycle of the mine. This lack of a substantial change over the mine's lifetime suggests that other activities in the catchment, such as those issues identified during the baseline, were having an effect on water quality independent of mining activities.

5.3.4.3 Groundwater quality

During the **baseline**, the chemistry of Galmoy groundwaters was found to be typical of the area in terms of calcium bicarbonate concentrations. Exceedances in copper, iron, manganese, nickel and zinc were assumed to be due to the natural geochemistry of the subsoil deposits or shallow bedrock or the possible presence of organic waste.

The status of groundwater bodies within 3km was good throughout operations and closure, and there was insufficient evidence from the evidence review to suggest that there were any significant impacts on groundwater quality from mining activities during the **construction, operation** and **closure** phases of the mine.

One of the issues surrounding water quality data which was reviewed for this study (particularly for larger water bodies and systems) was that water quality was simultaneously being affected by factors outside of the mine's and EPA's monitoring remit. There was extensive monitoring of the groundwater, as part of the mine licence. However, certain factors which were not necessarily monitored at these sites to the same extent as mine emissions, such as agricultural or municipal run-off, also likely had an impact on the overall water quality of these waterbodies. Based on our interviews and evidence review, this often led to debate over the cause of water quality issues, although it is noted that authorities and mine management generally were proactive, and took action regardless of certainty over the cause in these cases.

5.3.4.4 Fisheries

During the **baseline**, the Goul and Erkina river systems were an important component of salmon spawning in the Nore system and of considerable importance for trout spawning. In particular, the main channel of the Erkina after the confluence with the Goul is of particular angling importance.

There was insufficient evidence from the evidence review to suggest that there were significant impacts on fisheries from mining activities during the **construction, operation** and **closure** phases of the mine.

5.3.4.5 Wetlands

During the **baseline**, there were two groundwater-fed wetlands located within close proximity of the mine, the Whiteswall Bog and Galmoy Fen.

There was no information from the evidence review to suggest that there were significant impacts on wetlands during the **construction** and **operation** phases of the mine.

During the **closure** phase, a significant positive effect on natural capital was identified from the construction of an integrated constructed wetland (ICW) during the rehabilitation of the TMF. The ICW had positive effects on water quality and biodiversity as detailed in Table 5.12 below, and has been noted as 'best-practice' in the metal mining industry[24]. In addition, it was awarded the International Green Apple Award for Environmental Best Practice, from *The Green Organization,* in relation to the restoration of the TMF and development of an engineered wetland (2016)[25].

Table 5.12: Wetlands at Galmoy Mine

Effect:	**Creation of wetland**					
Asset Affected	Freshwater, wetlands and floodplains					
Receptor	Wetland, user and non-user population					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Closure	Direct	Long-term	Local	Moderate	Moderate / High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Activities to construct wetland		Construction activities, such as flooding and construction of four ponds			-
Activities / outputs	Creation of new wetland area		Integrated constructed wetland (ICW) measuring 8.29ha			-
Intermediate Outcomes	Ecosystem services delivered by wetlands, for example, flood risk benefits, biodiversity, improved water quality, carbon sequestration.		Improvement in water quality Increased biodiversity, including increase in migratory bird species including threatened birds (as per Annex 1 of the European Commission's Birds Directive) and 34 species of lichen			-
Wider Outcomes	Social and economic benefits from ecosystem services, for example improved wellbeing from better water quality and improved aesthetics and recreational value of the area.		No available data			-

Source: Devoy, C, et.al. (2018). 'Former Galmoy Mines tailings restoration'

5.3.5 Air quality

Data regarding **baseline** levels of air quality in the local area prior to the development of the mine indicate that air quality was good, and levels of airborne sulphur dioxide, suspended particulate, and dust deposition were typical of rural areas.

During **construction** and **operation**, levels of dust deposition, deposited metals and airborne metals, and ambient air quality were 100% compliant and below the legal limits. Therefore, evidence would

[24] Devoy, C, et.al. (2018). 'Former Galmoy Mines tailings restoration'

[25] Lundin Mining (2016) Lundin Mining 2016 Sustainability Report. Sourced from: https://www.lundinmining.com/site/assets/files/7992/lmc_csr16.pdf

suggest that there were no significant adverse effects regarding air quality during the construction and operation of the mine.

Finally, there was no evidence to suggest that there were any significant impacts on air quality during the **closure** phase of the mine. Air quality monitoring was carried out during closure, but was wound down after several years in the absence of noticeable effects. Interviews with public health officials corroborated this finding.

5.3.6 Minerals

The evidence suggests that during the **operation** phase of the mine, planned production of raw ore was expected to be around 650,000 tonnes per year which would result in 170,000 tonnes of concentrate. In practice, the evidence suggests that an average of 135,000 tonnes of concentrate was produced, which resulted in the production of 70,000 tonnes of zinc and 19,000 tonnes of lead in each year of operation.

While this is considered to be a positive effect from an economic perspective as it promotes economic activity and growth, from an environmental perspective, it is considered negative, as it constitutes an extractive use of non-renewable natural capital assets (see Table 5.13), and reduces the resources and choices available for future generations. The dual nature of this effect demonstrates the utility and need to assess effects from different perspectives, using a holistic framework such as a capitals approach.

Table 5.13 Minerals at Galmoy Mine

Effect:	Minerals Extraction					
Asset Affected	Minerals					
Receptor	Minerals and mine operators					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Operation	Direct	Permanent	Site-specific	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Mine activities to exploit minerals		Types of activities to exploit minerals including digging, blasts, remediation etc.			-
Activities / outputs	Extraction and processing of minerals		Extraction and processing of 500,000 tonnes of raw ore per year			-
Intermediate Outcomes	Processed zinc and lead concentrates		Average of 135,000 of zinc and lead concentrate per year			-
Wider Outcomes	Permanent loss of non-renewable resources (from the site)		Permanent loss of non-renewable resources (noting that the lead itself is a metal that is highly recycled and re-used)			-

5.3.7 Energy and Greenhouse Gas Emissions

Mining, milling and activities such as grinding, drilling and pumping of water, require significant amounts of energy. Galmoy consumed over 40,000 MWh of energy each year during **operations** - the equivalent of over 2,000 households - with most of this consisting of electricity from the national grid.

With much of Ireland’s electricity generated by fossil fuels, particularly in the early years of Galmoy’s operations, this resulted in the emission of significant quantities of CO_2, as shown in Table 5.14. This constitutes a negative effect in terms of its contribution to climate change, and the cost to society of those emissions has been estimated at €8.45 million.

Table 5.14: Energy use at Galmoy Mine

Effect:	**Energy Consumption and Greenhouse Gas Emissions**					
Asset Affected	Energy					
Receptor	Atmosphere and environments affected by climate change					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Operation	Direct	Long-term	National	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Consumption of electricity and fossil fuels		Average annual consumption of 37,958 MWh of electricity and 3,760 MWh of fossil fuels directly[26]			-
Activities / outputs	Mining activities requiring energy		Grinding, drilling, milling, dewatering, vehicles			-
Intermediate Outcomes	CO_2 released into atmosphere from fossil fuels used to produce electricity		26,409 tonnes per year[27] Total of 422,545 tonnes over operations			-
Wider Outcomes	Contribution to climate change, and associated negative effects		Total lifetime cost to society estimated by Shadow Price of Carbon of €20 per tonne[28]			-€8.45 million

[26] Based on analysis of Energy Use between 2003 and 2012 contained in Annual Environmental Reports

[27] Based on annual CO2 intensity between 1997 and 2012 (Energy in Ireland, 1990 to 2011)

[28] 2019 Shadow Price from *Public Spending Code: Central Technical References and Economic Appraisal Parameters.*

5.4 Economic effects

The economic effects of Galmoy Mine primarily correspond to financial and manufactured capital within the integrated framework outlined in Section 4.1. The mine's effect on the financial capital of businesses and the Exchequer are explored in terms of revenue, expenditure and taxation, royalty and dead rent payments while its effects on manufactured capital are examined in the post-closure use of the site by other businesses.

Economic effects were screened according to the methodology outlined in Section 4.2. Data was obtained from a variety of sources, including company annual returns, interviews, and other public sources. These sources are detailed further in Appendix B.3. In order to assess the lifetime impact of the mine, and for comparison purposes, all values (unless stated otherwise) have been adjusted to 2018 euro values.

5.4.1 Identifying and screening effects

The following table presents a list of the range of economic effects at different phases that were identified through the literature review and interviews. The table also indicates where data is available to screen impacts. In some cases, even where an effect may be known or expected, a lack of available data means that it is not possible to estimate and subsequently assess them for their significance. Of the effects in Table 5.15, all are taken forward.

Table 5.15: Data availability for effects at Galmoy Mine

Asset Affected	Description of effect	Availability of data by mine phase		
		Construction	Operation	Closure
Galmoy Mine	Sale of zinc and lead concentrate	N/A	✓	N/A
New Ross Port	Export of concentrate	N/A	✓	N/A
	Loss of concentrate exports	N/A	N/A	✓
Businesses	Direct, indirect and induced effects of expenditure	✓	✓	✘
	Re-purposing of manufactured capital	N/A	N/A	✓
Mine Closure Bond	Mine Closure Bond	N/A	✓	✓
Public Finances	Royalties and dead rent	✓	✓	✓
	Corporation Tax	✘	✓	✘
	PRSI	✘	✓	✘
	PAYE	✘	✓	✘
Local Authority Finances	Commercial Rates	✘	✓	✓
	Development Contributions	✓	✘	N/A

The effects that are taken forward are screened to determine if they are significant (based on the criteria set out). Of the effects that were screened, 5 were found to be of high significance, and the remaining 5 were of moderate/high or moderate significance. For Galmoy, all economic effects are included in the final assessment, as per the table below.

Table 5.16: Screening of significant economic effects for Galmoy Mine

Asset	Description of effect	Receptor	Mine phase	Duration of effect	Scale of effect	Receptor sensitivity	Significance of effect	Included in assessment
Galmoy Mines Ltd.	Sale of zinc and lead concentrate	Company owners and shareholders	Operation	Short-term	International	High	Moderate/ High	Yes
New Ross Port	Export of concentrate	New Ross Port and its employees	Operation	Short-Term	Regional	High	Moderate/ High	Yes
	Loss of concentrate exports		Closure	Long-term	Regional	High	High	Yes
Businesses	Direct, indirect and induced effects of expenditure	Other businesses, employees and local community	Construction	Short-term	National	High	Moderate / High	Yes
	Direct, indirect and induced effects of expenditure	Businesses and employees	Operation	Long-term	National	High	High	Yes
	Re-purpose of manufactured capital	Other businesses and local community	Closure	Permanent	Local	High	High	Yes
Closure Bond	Mine closure bond	Environment and communities	Closure	Long-term	Site-specific	High	High	Yes
Kilkenny County Council Finances	Commercial Rates	North Tipperary Communities	Operations / Closure	Short-term	Regional	High	Moderate/ High	Yes
	Development Contributions	Local Communities	Construction	Long-term	Local	High	High	Yes
National Public Finances	Royalties and taxes	Irish public	Operation	Short-term	National	High	Moderate/ High	Yes

5.4.2 Sales and Gross Value-Added

The primary impact of turnover is on the financial capital of the mining company and shareholders; how the mining company manages their costs and returns a profit for the company and dividends for shareholders. While the focus of this report is not on benefits to the mining company, turnover can provide context regarding the significance of Galmoy Mine to the mining industry and to the Irish economy.

Galmoy was the smallest of Ireland's three operating zinc and lead mines. Production reports show that Galmoy produced on average 135,000 tonnes of zinc and lead concentrate annually, and was responsible for around 18% of Irish zinc and lead production at its height[29]. However, production varied significantly from year-to-year due to regular production interruptions, such as strikes in 1998 and 2007, and problems with backfill in 2008. Milling ceased during 2009, and any ore mined between 2009 and 2012 was processed at Lisheen mine.

Over its lifetime, Galmoy generated total turnover of €641m (in 2018 prices). The significance of this relative to Ireland's national economy can be expressed in terms of Gross Value-Added (GVA). GVA is a measure of the productivity of a firm or industry and is used in the calculation of Ireland's Gross Domestic Product (GDP). GVA is defined as the value of sales minus "intermediate consumption"[30]; where intermediate consumption refers to the cost of goods and services that are consumed during the production process. In the mining industry, various inputs are used up in extracting the ore and creating a finished product that can then be sold. Electricity, fuel and tools are all examples of items likely to be consumed during the production process for zinc and lead ore, and must be taken into account when estimating the value-added amount generated by the mining industry.

Drawing on company accounts, total GVA for Galmoy between 1997 and 2012 has been estimated to be €315m. This compares to a GVA of €10.78 billion for the mining and quarrying sector between 1997 and 2012, indicating that Galmoy was responsible for 3 per cent of total GVA by the sector[31].This is also small relative to the national economy, as mining and quarrying accounted for just 0.5 per cent of Irish GDP during this period.

However, it is also important to note that while GVA provides an indication as to the size of Galmoy in relation to the Irish economy, it is not a suitable indicator of economic well-being. The economic effects associated with GVA and turnover largely benefit the owners of the mine, and other indicators will be evaluated in later sections to better capture to effects of the Mine on the local and national economy.

The effects of the sale of concentrate are summarised in table 3.17.

[29] Based on average production from 1997 to 2005. Department of Communications, Climate Action and Environment, 2016. http://www.mineralsireland.ie/files/2016_ZincAndLeadInIreland.pdf

[30] Eurostat: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Gross_value_added

[31] It should be noted that this sector also includes around 350 commercial quarries, such as limestone and gypsum. While data is not provided by the CSO for just the mining sector, it is likely Galmoy is responsible for a significantly larger proportion of the sector's GVA

Table 5.17: Effects of the sale of zinc and lead concentrate

Effect:	Sale of Zinc and Lead Concentrate					
Asset Affected	Galmoy Mine					
Receptor	Company owners and shareholders, including ARCON (1993-2005), Lundin Mining Corporation (2005-2017).					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operation	Direct	Short-term	International	High	Moderate / High

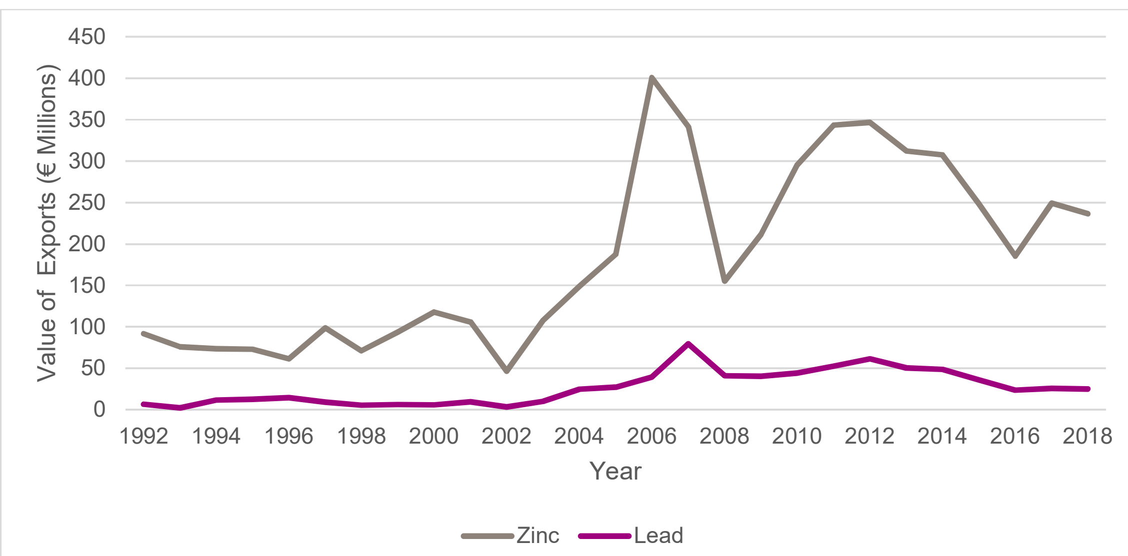
	Logic Model	Physical Measurement	Monetary Value
Input	Zinc and lead concentrate from Galmoy	Approximately 135,000 tonnes of zinc and lead concentrate per year	-
Activities / outputs	Concentrate sold to smelters in Europe and around the world	Approximately 2.2 million tonnes of concentrate over its lifetime	-
Intermediate Outcomes	Revenue is earned for the mine	Lifetime Sales Revenue	€641 million
Wider Outcomes	Increase in Ireland's Gross-Domestic Product (GDP)	Lifetime Gross Value-Added (GVA) of the Mine	€315 million

Source: Analysis of Galmoy Mines Ltd. annual financial returns

5.4.3 Exports

Most of this concentrate was exported to smelters overseas, and the value of total Irish zinc and lead exports is shown below. The value of exports varied significantly as a result of volatile zinc/lead prices and euro-dollar exchange rates, although Galmoy generally accounted for between 10 and 20 per cent of the value of exports during this period.

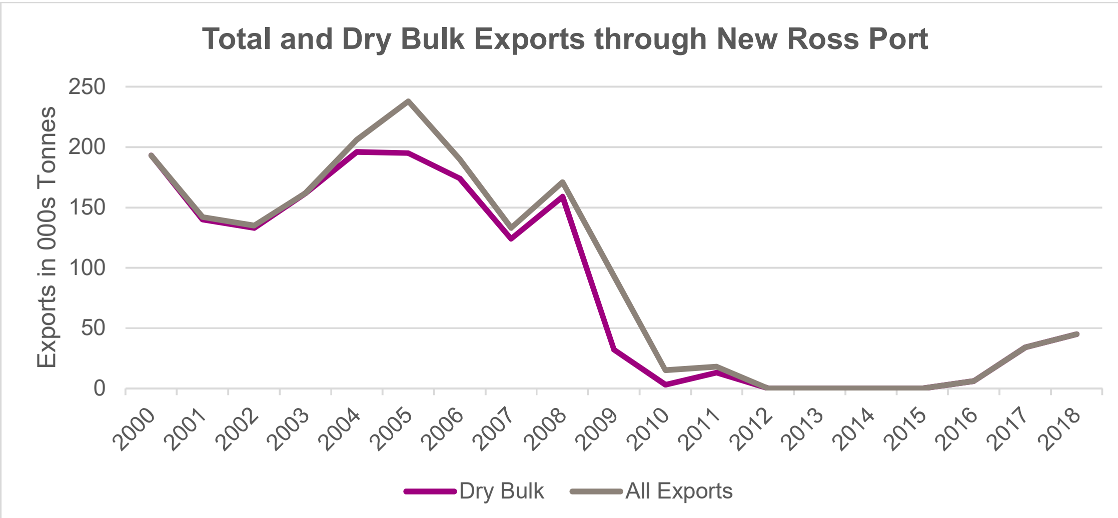
Figure 5.2: Value of Irish lead and zinc concentrate exports at original prices, 1992-2018



Source: United Nations Statistics Division – Commodity Trade Statistics Database

Galmoy exported its ore through the New Ross Port, and the dependency of New Ross Port on activities at Galmoy are apparent. Figure 5.3 shows total and dry bulk goods (which includes concentrate) exported from New Ross Port. With dry bulk cargo representing 90-100 per cent of total exports from the Port, the significance of Galmoy is evident. After Galmoy announced its closure and began to send its remaining ore to Lisheen for processing in 2008, dry bulk exports declined sharply from over 150,000 tonnes in 2008 to zero by 2012. This likely contributed to a 78 per cent drop in operating profit from 2008 to 2009[32], while an economic recession and the cessation of most liquid fuel imports in 2010 at the port also compounded these challenges in the following years[33].

Figure 5.3: Total and dry bulk exports through New Ross Port, 2000-2018



Source: Central Statistics Office Maritime Statistics

The number of people directly employed in the New Ross Port fell from sixteen people in 2001 (including 11 full-time equivalents) to five in 2012[34], however it is not known whether this was related directly to Galmoy's decrease in activity or if there were other contributory factors at that time. Additional workers were employed by hauliers and private stevedores, but it is not known how these workers were affected. The Port was subsequently purchased by Wexford County Council and while there has been some recovery in export figures, they remain well below pre-2010 levels.

Table 5.18 below summarises the effects of exports on New Ross Port.

[32] New Ross Standard (newspaper), 3/5/2011. 'An uncertain future for New Ross port'. https://www.independent.ie/regionals/newrossstandard/news/an-uncertain-future-for-new-ross-port-27506387.html
[33] Oireachtas, 2012. https://www.oireachtas.ie/en/debates/debate/joint_committee_on_transport_and_communications/2012-09-27/2/
[34] Oireachtas, 2012. https://www.oireachtas.ie/en/debates/debate/joint_committee_on_transport_and_communications/2012-09-27/2/

Table 5.18: Effect of exports of zinc and lead concentrate

Effect:	Export of Concentrate through New Ross Port					
Asset Affected	New Ross Port					
Receptor	New Ross Port and its employees					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operation	Direct	Short-term	Regional	High	Moderate / High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Zinc and lead concentrate from Galmoy		Approximately 135,000 tonnes of zinc and lead concentrate per year (between 1997 and 2009)			**-**
Activities / outputs	Concentrate is exported through New Ross Port		Approximately 1.6 million tonnes of concentrate between 1997 and 2009			-
Intermediate Outcomes	Increase in revenue and profit at the Port		No data available			-
Wider Outcomes	Jobs supported at the Port		16 workers employed in 2001			-
Effect:	**Loss of Exports at New Ross Port**					
Asset Affected	New Ross Port					
Receptor	New Ross Port and its employees					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Closure	Indirect	Long-term	Regional	High	Moderate / High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Closure of Galmoy		The mine ceased processing ore in 2009, and fully closed by 2012.			-
Activities / outputs	Ore is processed in Lisheen; and exports largely cease at New Ross		From 2009 to closure, Galmoy transported ore to Lisheen, resulting in a loss of exports for New Ross			-
Intermediate Outcomes	Total exports through New Ross fall		Fall in exports from 100,000 to 200,000 tonnes per annum to zero			-
Wider Outcomes	Contributes to a fall in profit and reduction in jobs		78% fall in operating profit from 2008 to 2009			€289,000 to €65,000

Source: CSO Maritime Statistics

5.4.4 Mine Expenditure

Every euro directly spent by a business will have an impact in the economy beyond the business. If a company spends money on purchasing supplies or hiring workers, those suppliers and employees will increase their own spending in response. This is known as the multiplier effect, and these expenditure impacts can be broken down into direct, indirect and induced expenditure effects. These are explained in greater detail in Section 2.3.2.3.

€165 million was spent on the construction of Galmoy Mine, resulting in indirect expenditure of €96m and induced expenditure of €117m. Construction is a labour-intensive industry and is also linked to other labour-intensive industries, such as real estate, security and financial services, meaning that expenditure during the construction phase, although short-term, had significant induced effects. However, construction of Galmoy was carried out by a combination of national and international firms, meaning that the impact of indirect and induced expenditure – particularly on the local area - may be lower.

Table 5.19: Effects of direct, indirect and induced expenditure

Effect:	Direct, Indirect and Induced Effects of Construction Expenditure					
Asset Affected	Businesses / the Construction Industry					
Receptor	Other businesses, employees, local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Construction	Direct, indirect and induced	Short-term	National and International	High	Moderate / High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Purchase of construction services		Goods and services used in the construction of the mine			-
Activities / Output	Revenue generated in suppliers' businesses		Total direct expenditure			€165 million
Intermediate Outcomes	Suppliers to the industry increase their own spending in response to increased demand		Indirect expenditure by other businesses			€96 million
Wider Outcomes	Workers spend their wages in other businesses, generating additional economic activity		Induced expenditure by workers			€117 million

Source: Analysis of annual financial returns

The mine directly spent €511m over its **operations** stage. Spending occurred across three main categories: capital goods, such as buildings and machinery; other non-labour inputs, such as supplies, utilities and administration costs; and employee salaries. This resulted in indirect expenditure of €465m and induced expenditure of €347m in the wider Irish economy. The size of these indirect and induced effects reflect the significant proportion that the mining sector spends on Irish goods and services, such as electricity and land transport services. These are detailed further in Appendix B.3.

Table 5.20: Effects of operations expenditure

Effect:	Direct, Indirect and Induced Effects of Operation Expenditure					
Asset Affected	Businesses					
Receptor	Other businesses, employees, local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operations	Direct, indirect and induced	Long-term	National	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Purchase of labour, capital and other non-labour inputs		Capital goods: e.g. equipment / vehicles			€43.6 million
			Wages and salaries			€141 million
			Non-labour inputs: e.g. supplies, utilities			€326 million
Activities / outcomes	Money spent in other businesses and on workers		Total direct expenditure			€511 million
Intermediate Outcomes	Suppliers to the mine increase their own spending in response to increased demand		Indirect expenditure by other businesses			€465 million
Wider Outcomes	Money spent in other businesses and on workers		Induced expenditure by workers			€347 million

Source: Analysis of annual financial returns

Capital expenditure during **operation** had two distinct effects: not only did the flow of money increase the financial capital of businesses and workers, but the increase in manufactured capital in the form of buildings and infrastructure created a permanent and enduring asset for local businesses. This has allowed portions of the site to be repurposed post-closure, such as the former mine offices. The effects of this are assessed in the table below.

Table 5.21: Effects of manufactured capital

Effect:	Re-use of manufactured capital					
Asset Affected	Manufactured Capital					
Receptor	Galmoy Mine, other businesses and the local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Closure	Indirect	Permanent	Site-specific	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Office space and infrastructure built during operations		1,400 sqm of office space Improved road, power and water infrastructure			-
Activities / outputs	Buildings and infrastructure retained following closure of the mine		Improved road, power and water infrastructure Office buildings and car park retained			-
Intermediate Outcomes	Post-closure use by other businesses		AQS, an environmental waste service company, now operates from the site			-
Wider Outcomes	Continued local employment and economic activity		No data available			-

Source: Interviews, Planning Applications

The mine spent €12.9 million during the **closure** phase for site rehabilitation activities; provision for which was made during operations in the form of a bond[35]. Approximately €15.8 million was also spent on redundancy payments, although the effects of this are considered in the social assessment.

The closure bond represented a positive effect on financial capital, as it provided sufficient funds to carry out the works necessary to close the mine and to restore the environment of the site to the requirements of the three relevant authorities of the Kilkenny County Council (KCC), EPA and EMD. According to interviews conducted, the closure plan was revised where necessary and any funding shortfalls were topped up to ensure implementation of the agreed closure plan.

Galmoy also undertook an Environmental Liability Risk Assessment (ELRA) as part of the CRAMP to quantify the risk of 'unknown liabilities', which are the potential risks and liabilities separate to the standard mine closure process. This ELRA was an independent assessment of the expected cost of 'worst case scenarios' during the closure and aftercare periods, and the mine was required to put in place suitable financial provisions to ensure that funds would be available to meet these liabilities if they occurred. According to the EPA, these financial provisions must be secure, sufficient to cover all of the licensee's obligations, and available when required, and five types of financial instruments are deemed to be acceptable in principle: secured funds, on-demand performance bond, a guarantee from the parent company, a charge on property, and environmental impairment liability insurance[36]. While Galmoy used a bond to cover the known closure costs which was, based on the evidence reviewed, suitable for this purpose, there is currently a temporary gap in the financial provisions for the aftercare period which is being addressed by the authorities.

Of these five types of financial instruments, only insurance provides the necessary guarantee of sufficient and readily-available funding to cover the cost of unknown liabilities. ELRAs are calculated on the basis of expected values of the plausible 'worst-case scenario' (i.e. if a risk has a 10% chance of occurring and the cost of that remediating that risk would be €10,000, the expected cost of that risk

[35] The value of the Mine Closure Bond was €12.9 million by the end of December 2009

[36] Environmental Protection Agency, 2015. 'Guidance on Financial Provision for Environmental Liabilities'.

to each operator is €1,000). However, from the perspective of a single operator, any risk will either occur or it will not. This means that a single operator who self-insures by saving this expected cost into a bond or account would still face significant funding shortfalls if the risk did eventually occur. By transferring risk and payments over a larger population, insurance / risk transfer mechanisms provide greater certainty that funds are available to cover the costs associated with these risks if they occur.

The effects of the mine closure bond are summarised in Table 5.22.

Table 5.22: Effects of mine closure bond

Effect:	Mine closure bond					
Asset Affected	Mine closure bond					
Receptor	Local environment and communities					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operations / closure	Direct	Long-term	Site-specific	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Funds paid in during operations		Total size of closure bond (2009)			€12.9 million
Activities / outcomes	Use of funds to pay for planned closure and aftercare works		Estimated cost of works required			€12.9 million
Intermediate Outcomes	Rehabilitation of site to the requirement of KCC, EPA and EMD		Works carried out, including: • Mine closure and capping of the shafts • TMF capping, seeding and grazing • Cleaning of site and demolition of buildings • Construction of wetlands			-
Wider Outcomes	Funding to cover the risk of potential unknown liabilities		Environmental Liability Risk Assessment to calculate expected value of these risks. However, in the absence of insurance or a risk transfer mechanism, there may be funding shortfalls in the event of unknown liabilities			-

Source: Galmoy Mine CRAMP 2005, Analysis of Galmoy Mines Ltd. Annual Financial Returns

5.4.5 Local public finances

Like any business, Galmoy paid development contributions and commercial rates to the local authority, Kilkenny County Council, to reflect the cost of doing business on a local level. During **construction**, development contributions were used for upgrades to local road infrastructure, and some significant improvements to road infrastructure were carried out as a result. While commercial rates were paid during **operations**, they fed into Kilkenny County Council's overall budget, meaning that it is not possible to identify any specific outcomes. The full effects of Galmoy on local authority finances are shown in Table 5.23.

Table 5.23: Galmoy contributions to Kilkenny County Council

Effect:	Commercial Rates					
Asset Affected	Kilkenny County Council (KCC) finances					
Receptor	Kilkenny Communities					
Nature	Stage	Type	Duration	Scale	Sensitivity	Significance
Positive	Operations / Closure	Direct	Short-term	Regional	Moderate	Moderate
	Logic Model		Physical Measurement			Monetary Value
Input	Rates paid to KCC		Rates paid to KCC over lifetime			€3.2 million
Activities / outputs	Increase in income for KCC					€3.2 million
Intermediate Outcomes	Investment into Kilkenny County Council services		As commercial rates are not ring-fenced, there is no specific data available			-
Wider Outcomes	Economic and social benefits for Kilkenny communities		No data available			-
Effect:	Development Contributions					
Asset Affected	Local Road Infrastructure					
Receptor	Galmoy Mine, local businesses and local community					
Nature	Stage	Type	Duration	Scale	Sensitivity	Significance
Positive	Construction	Direct	Permanent	Local	High	Moderate
	Logic Model		Physical Measurement			Monetary Value
Input	Development Contributions		Development Contributions paid for road improvements			€1.49 million
Activities / outputs	Investment in upgrading local roads		Upgrade to the R435 Minor works to other roads			-
Intermediate Outcomes	Ability to accommodate higher traffic levels from mine		100 trucks per week from the mine during operations			-
Wider Outcomes	Improved access for other businesses and local community		No data available			-

Source: Kilkenny County Council Planning Decision (1993), Interviews

5.4.6 National public finances

The primary contribution of Galmoy Mine to national public finances consisted of four flows:

- **Royalties and dead rent**: Royalties and dead rent are paid by the mining company to the state as a percentage of annual revenue. These are negotiated on a case by case basis taking into account if the minerals are State or privately held. Rates of between 1.5% and 3% applied to Galmoy. The minerals at Galmoy were predominantly privately-owned, and the company also compensated the owners in addition to providing royalties to the State. Dead rent is also paid regardless of turnover, during construction and closure.

- **Corporation tax:** Companies pay corporation tax as a percentage of their profits. The mining industry is taxed at the higher rate of 25% and Galmoy was liable to pay corporation tax at this rate. As with other industries, companies can write off capital expenditure and previous years' losses against corporation tax, meaning Galmoy Mines Ltd. paid little corporation tax[37].
- **Employer's PRSI:** Galmoy paid Pay-Related Social Insurance (PRSI) on behalf of their employees.
- **Income Tax / PAYE:** Pay-as-you-earn (PAYE) is the main source of income tax for the state, and was paid by Galmoy Mine's employees as a percentage of their salaries.

While the mine would have paid other direct and indirect taxes, such as Value-Added Tax (VAT), a lack of publicly-available data means that it is not possible to quantify the amount.

Table 5.24 shows the main direct contributions of Galmoy Mine to national public finances.

Table 5.24: Effect of Galmoy Mine on national public finances

Effect:	**Taxes paid to the State**					
Asset Affected	National Public Finances					
Receptor	Irish Public					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operations*	Direct	Short-term	National	Low	Moderate
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Taxes paid by the mine and employees to the Exchequer (*Royalties include dead rent paid during construction and closure)		Royalties and dead rent			€12.8 million
			Corporation Tax			€0.6 million
			Employer's PRSI			€14.9 million
			PAYE paid by employees			€30.9 million
Activities / outputs	Increase in revenue for the government		Lifetime tax revenue			€59.2 million
Intermediate Outcomes	Increase in current or capital government expenditure		No data available			-
Wider Outcomes	Economic and social benefits for the Irish public		No data available			-

Source: Department of Communications, Climate Action and the Environment (Royalties), analysis of Galmoy Mines Ltd. Annual Returns (Corporation Tax, PRSI)

5.5 Summary

The following section summarises the key findings and significant effects from the social, environmental and economic assessments of Galmoy Mine. The breadth and depth of the assessments is driven by the availability of evidence from the literature review and interviews to identify effects, determine their significance, and assess them in quantitative and monetary terms.

The **social assessment** of effects is closely linked and sometimes overlapping with the economic assessment. Some of the key effects are components of human, social and intellectual capital, as follows:

[37] Only corporation tax paid by Galmoy Mines Ltd. was analysed. It is possible that corporation tax was paid by Irish-registered parent companies

- Employment was perhaps the most significant social effect of Galmoy Mine. During construction, up to 370 jobs provided, although the use of national and international construction firms meant that local employment was limited. During operations however, the mine had an average of 213 direct employees; 80% of which lived within 30km of the mine. The mines also supported an additional 300 jobs in the wider economy as a result of its spending, the spending of its suppliers, and the spending of workers' wages

- Evidence suggests that the mine had positive impacts on employee's education and training. Training provided during operations and closure allowed employees to upskill, and enabled them to seek future employment in other mines and industries following the closure of Galmoy.

- In terms of health and safety, the mine provided 2000-4000 certified hours of health and safety training per year. However, this did not prevent all health and safety incidents, and there was one fatality and one serious injury over the course of the mine's lifetime. The mine was later fined €100,000 for breaches of health and safety legislation in relation to the death of one of its workers.

- The mine had two significant effects on local community health, safety and wellbeing; the first being noise and vibrations. The mine received several complaints each year relating to noise and vibrations, although it should be noted that these were found to have occurred within legal licence limits, this may have still affected those who lived nearby and those who made complaints.

- In addition, there were two major subsidence events. The first occurred when cracks appeared in a local road following the collapse of a stope in the mine in 2002. This required remediation works and led to the temporary closure of that section of road. The second occurred in 2014, when a sinkhole appeared on the farm of a local landowner. This was later infilled, but trees were planted on the site and this led to a longer-term loss of that portion of the field.

- In terms of community effects, the mine had an overall positive impact on local services and infrastructure, including road improvements, telecommunication upgrades, a Replacement Water Supply Scheme (providing free, high quality water for local residents), and a three-phase power supply on site. These infrastructural improvements led to direct benefits for local residents, and allowed other businesses to establish on site following closure. There was also evidence of a small local sponsorship programme, although the effects of this were short-term and were not considered significant.

The **environmental assessment** of effects considers how Galmoy Mine affected the stock of natural capital assets and the ecosystem services provided by these assets. The key findings include:

- During the construction, operation and closure of the mine, there was a long-term loss of pastureland to facilitate the development of the mine site. While some grazing continued on certain parts of the site, this constituted a long-term loss of around 55 ha of farmland during construction and operation, resulting in a significant loss of agricultural production capacity during this time. The TMF was remediated to agriculture use.

- Following closure, the mine constructed an integrated constructed wetland (ICW) over part of the TMF during its rehabilitation. This had significant positive effects on water quality and biodiversity, and the company was later awarded the 'International Green Apple Award for Environmental Best Practice' for these works.

- Monitoring of water quantity, water quality and fisheries was undertaken over Galmoy's lifetime. The mine developed a Replacement Water Supply Scheme prior to operations to compensate for the dewatering that occurred as a result of mining, meaning there were no significant effects on water supply. In terms of water quality and fisheries, it was not possible to separate the effect of the mine from that of other activities in the catchment, meaning that there was insufficient evidence to suggest any significant effects from mining activities.

- Extraction and processing of minerals was estimated at an average of 135,000 tonnes of concentrate per year over the course of the 12–year operation of the mine. While this could be considered positive from an economic development perspective, this constitutes an extractive use of the environment that would exploit and deplete non-renewable natural capital assets.
- The mine was a large consumer of energy and consumed over 40,000 MWh worth of electricity and fuel each year, which is equivalent to the annual energy consumption of over 2,000 households. This led to the emission – either directly through fuel use, or indirectly through electricity generation – of an average of 26,409 tonnes of CO_2 each year; 422,500 tonnes over its lifetime. The lifetime cost of these emissions to society is estimated at €8.45 million.

The **economic assessment** of effects of Galmoy demonstrates the effect that the mine had on components of manufactured and financial capital, as follows:

- The mine produced on average 135,000 tonnes of zinc and lead concentrate each year, and accounted for around 18 per cent of national production at its peak. The total turnover of Galmoy Mines Ltd. was estimated at €641 million between 1997 and 2012. The mine's value to the Irish economy in terms of gross value-added was €315 million over its lifetime.
- Activities in Galmoy mine were responsible for 3 per cent of GVA for the Mining and Quarrying sector. However, this sector is small relative to the overall Irish economy, and the entire sector accounted for just 0.5 per cent of Irish GDP during this period.
- The mine exported concentrate through New Ross Port and was responsible for nearly all of the Port's exports at the time. However, the closure of the mine had a negative effect on the Port, and exports fell significantly in the following years. This likely contributed to a fall in revenue and loss of jobs experienced at the time.
- The effects of mine expenditure were felt by businesses and workers throughout the Irish economy. €676 million was spent directly by ARCON and Lundin mining companies during the construction and operations phases, which resulted in additional indirect expenditure (by suppliers to the mine) of €560 million and an estimated induced expenditure (effect of spending wages) of €465 million.
- Approximately €12.9 million was also paid into a closure bond by the time of closure, with most of this spent on planned closure works. While a small amount was set aside for risk and contingency, there is not currently a risk transfer mechanism in place for unknown liabilities.
- Galmoy mine contributed to public finances in several ways, including €12.8 million paid in royalties and dead rent, €0.6 million in corporation tax, €14.9 million in employer's PRSI, as well as €30.9 million in PAYE by workers. It also paid commercial rates to Kilkenny County Council in the region of €3.2 million, and development contributions for local road upgrades of about €1.49 million. In addition, the Replacement Water Supply Scheme provided a replacement source of water to the local community.
- While some have since been demolished, the buildings and infrastructure that remain on site represent a permanent asset that facilitates continued economic activity on the site. In terms of manufactured capital, the administrative buildings and car park are currently used by an environmental waste management company, who bought the site. The buildings are a legacy effect of mining activity, and enabled the continued use of the site for commercial purposes, albeit with lower numbers of people employed there compared to when the mine was operational. As there are some mineral resources remaining, there have been discussions in recent years to reopen the mine, with the potential creation of 50 jobs.

6. Lisheen Mine

6.1 Overview

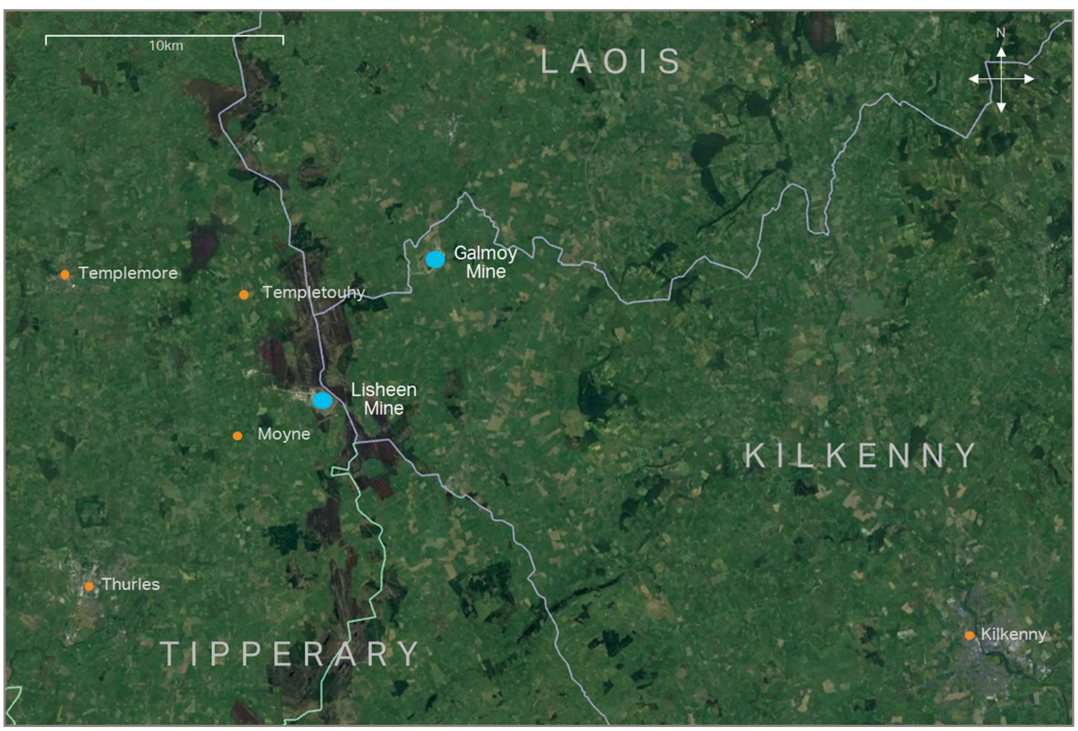
6.1.1 Geographic Context

The Lisheen mine is located in North Tipperary, on the border of Counties Laois and Kilkenny below parts of the townlands of Derryville, Killoran, Ballyerk, and Barnalisheen. Lisheen is located on the edge of the Derryvillle raised bog, in a predominantly rural agricultural area. Most dwellings in the immediate vicinity are isolated farmhouses, with the nearest towns and villages including:

- **Moyne, Co. Tipperary:** A small village and ED located 3km south-west of the Mine, with a population of 552 people in 2016.
- **Templetuohy, Co. Tipperary:** A slightly larger village located 5.5km north-west of the mine, with a population of 816 people.
- **Templemore, Co. Tipperary:** The nearest town, located 12km from Lisheen, with a population of 1,939 people.
- **Thurles, Co. Tipperary:** The nearest large town, located 12.5km from Lisheen, with a population of 6,814.
- **Kilkenny, Co. Kilkenny:** The nearest city, located 30km from Lisheen, with a population of 26,510 people.

Lisheen was located within the local authority of North Tipperary County Council (NTCC) until 2014, when the county was abolished and merged into Tipperary County Council.

Figure 6.1: Lisheen Mine geographic context



Source: Google Maps

6.1.2 Discovery and Planning

The Lisheen zinc and lead deposit was discovered in sedimentary limestone rock in 1990 by Ivernia West, a Limerick-based Irish-registered resource company. The deposit consisted of two main ore bodies that lay at a depth of 170 metres, and followed on from the discovery of deposits at Galmoy four years previously along the same geological trend.

Planning began in the early 1990s, when an Environmental Impact Statement (EIS) was produced. After compiling an EIS in the early 1990s, Ivernia West PLC and Minorco Lisheen Ltd. initiated the statutory planning process in 1995 and applied for an Integrated Pollution Control Licence in July 1996, with Minorco as managers and operators of the project. North Tipperary County Council approved the development in August 1996. An IPCL[38] was issued to Minorco Lisheen Ltd in June 1997.

Planning permission was granted by ABP in June 1997, after receiving just five objections – four of which were from local people on environmental grounds and one objection from the applicant itself who appealed against the condition of contributing $_{1996}$IE£4.1 million for road and infrastructure upgrades[39].

There was no oral hearing in the case; something that mine managers attributed to lessons learned from Galmoy's planning difficulties two years previously. As the first mine to go through the planning process since Tara Mines, Galmoy had encountered significant opposition when it initially applied for planning permission; opposition which had resulted in appeals, an oral hearing and an overall long and protracted planning process. The mine developers and their advisers at Lisheen took account of these experiences, and made efforts to pre-empt any objection by the local authority and communities by engaging in additional dialogue with stakeholders. Many questions and concerns were already answered during the planning process at Galmoy, and given the close proximity of the two mines, the community were aware of the issues, when planning was sought.

6.1.3 Operations

Construction of the mine began in 1997 and lasted for two years. Production in the mine began in October 1999 and ran for 17 years, concluding in 2015. Lisheen was an underground mine and the deposits were accessed via a 1.5 kilometre decline. The extraction methods used were 'room and pillar', 'drift and fill' and 'long hole stoping' techniques.

Operations were primarily undertaken by two subsidiary entities: Lisheen Mine Partnership (LMP), an unincorporated partnership which mined the raw ore; and Lisheen Milling Ltd. (LML), which processed it into zinc and lead concentrate. However, overall ownership of Lisheen mine changed several times over its lifetime. Ivernia West Plc partnered with the South African-registered mining company, Anglo-American PLC, before selling their portion of shares to Anglo-American. Vedanta Resources (registered in India) acquired Lisheen mine in February 2011, and the mine became Vedanta Lisheen Mining Ltd.

Overall, the mine produced on average 300,000 tonnes of zinc and lead concentrate each year, which was mostly exported and sold to smelters in Europe and globally through Tivoli Docks at the Port of Cork. The mine employed between 360 and 400 personnel.

6.1.4 Closure

Lisheen mine closed in 2015 resulting in the loss of nearly 400 jobs. As closure was known in advance, a Mine Closure Committee featuring relevant stakeholders, Lisheen mine, Tipperary County Council, Environmental Protection Agency and Exploring and Mining Division of DCCAE, was established to plan for and oversee the closure process. Two years before the closure of the Lisheen

[38] P0088

[39] This was reduced by around £600,000 by An Bord Pleanala in its decision.

mine, Vedanta Zinc International began an outplacement programme, providing staff with upskill and training programs and helping to re-employ staff at other Vedanta operations.

Lisheen mine closed under an IPCL and CRAMP. Lisheen had set aside about €24 million in bonds as required by its licensing conditions, including €19.5 million for closure and rehabilitation works, €3.3 million for aftercare monitoring by the EPA, and €1.1 million for potential compensation to landowners.

By the time Lisheen mine closed, Galmoy was a few years into its own closure process, and there was reportedly significant institutional learning by management and authorities from Galmoy in terms of closure practices. For example, while the original designs for capping the TMF specified a wet closure, the design was changed to a dry closure concept similar to Galmoy to reflect what was seen as best-practice. A dry closure of the TMF was undertaken between 2015 and 2019, and it now contains 12 million tonnes of mine tailings.

In addition to the Closure Committee, a Taskforce for Jobs was established, featuring ex-mine management, County Council officials and representatives from other agencies. Their remit was to explore alternative uses for the site to replace the jobs lost at the mine. Over its lifetime, there were significant improvements to road, water and energy infrastructure at Lisheen, and the Taskforce recognised the potential value of the site and its facilities to other businesses. A masterplan to develop the site as a National Bio-economy Campus was launched, and the first phase opened in 2018[40].

6.2 Social effects

For detailed information regarding the approach to Lisheen's social impacts review, please see the social effects, introduction section of Galmoy.

6.2.1 Identifying and screening effects

Table 6.1 presents a list of the range of social effects that were identified through the literature review and interviews. The table also indicates where data is available to screen impacts. Where data is not available to screen effects, it is also not possible to subsequently assess them for their significance.

The significance of the effects that were taken forward are screened in Table 6.2 based on the criteria established. Of the effects that were screened, 12 were found to be of high significance, 4 were of moderate/high significance and 1 was of low significance. Where the 'significance of effects' was determined to be moderate/high, the 'duration of effects' was examined next. If the duration was long-term, the effect was taken forward to the assessment, while short-term effects were screened out. A total of 9 effects were deemed to be highly significant and were therefore taken forward to the final assessment, which is detailed below. Where quantitative data for an effect is missing, it is described qualitatively using the evidence available.

[40] http://www.bioeconomyfoundation.com

Table 6.1: Data availability for social effects for Lisheen mine

Asset Affected	Description of effect	Availability of data by mine phase		
		Construction	Operation	Closure
Employees	Employment: job creation (direct)	✓	✓	✓
	Employment: job creation (indirect and induced)	✘	✓	✘
	Education and skills: training and upskilling	✓	✓	✓
	Education and skills: improved employability	✘	✘	✓
	Employee health and safety: training	✓	✓	✘
	Employee health and safety: incidents	✓	✓	✘
Local community	Employment: local employment	✘	✓	✘
	Local community health, safety and well-being: noise and vibrations	✘	✓	✘
	Community infrastructure: road investment	✓	✘	✘
	Community services: water (negative)	✓	✘	✘
	Community services: water (positive)	✘	✓	✘
	Community infrastructure: energy	✘	✓	✓
	Change in societally significant intellectual capital	✘	✘	✘
	Community support: Sponsorship of community infrastructure and organisations	✘	✓	✘
	Social cohesion	✘	✓	✘
	Population change	✓	✓	✓

Table 6.2: Significance of social effects for Lisheen mine

Asset Affected	Description of effect	Who is affected (receptor)	Mine phase	Duration of effect	Scale of effect	Receptor sensitivity	Significance of effect	Included in assessment
Employees	Employment: Job creation	Employees	Construction	Medium-term	National	High	Moderate/High	Yes
			Operation	Long-term	Regional	High	High	Yes
	Redundancy and job creation	Employees	Closure	Long-term	Regional	High	High	Yes
	Education and skills: training and upskilling	Employees	All	Long-term	Local	High	High	Yes
	Education and skills: improved employability	Employees	Closure	Long-term	Regional	High	High	Yes
	Employee health and safety: training	Employees	Construction / Operation	Long-term	Local	High	High	Yes
	Employee health and safety: incidents	Employees	Construction / Operation	Permanent	Local	High	High	Yes
Local community	Employment: local employment	Local community	Operation	Long-term	Local	High	High	Yes
	Local community health, safety and well-being: noise and vibrations	Local community	Operation	Medium-term	Local	High	Moderate/High	Yes
	Community infrastructure: road investment	Local community	Construction	Permanent	Local	High	High	Yes
	Community services: water (negative)	Local community	Construction	Short-term	Local	High	Moderate/High	No
	Community services: water (positive)	Local community	Operation	Permanent	Local	High	High	Yes
	Community services: energy	Local community	Operation	Permanent	Local	High	High	Yes
			Closure	Permanent	Local	High	High	Yes
	Sponsorship of community infrastructure and organisations	Local community	Operation	Permanent	Local	High	High	Yes
	Social Cohesion	Local community	Operation	Short-term	Local	High	Moderate/High	No
	Population Change	Local Community	All	Long-term	Local	Negligible	Low	No

6.2.2 Employment

During the **baseline**, unemployment levels across Ireland were high. In comparison, there were lower levels of unemployment within the region surrounding the proposed site prior to the mine's development. Given the rural nature of North Tipperary, this trend is likely due to emigration of people of working age from the local area, rather that due to local job opportunities.

A peak of 700 people were employed in **construction** of the mine, although it is likely that less were full-time equivalents. As with Galmoy, construction was undertaken by a combination of national and international firms, although there were reports of local construction and service companies being used as well in this time. As such, there was a greater amount of local employment during construction than there had been at Galmoy, as well as some employees that stayed to work in the mine following construction. The effects of construction employment are outlined below.

Table 6.3: Construction employment at Lisheen mine

Effect:	**Employment and job creation during construction**					
Asset Affected	Construction Employees					
Receptor	Construction Employees and contractors					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Construction	Direct	Medium-term	National and International	High	Moderate / High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Employee wages		Money spent on the overall construction of the Mine, a portion of which relates to wages			-
Activities / outputs	Construction jobs are provided		A peak of 700 jobs, although it is likely that there were less full-time equivalents. The use of specialised national/international construction companies meant that most workers were not from the local area			-
Intermediate Outcomes	Employees receive wages and other social and economic benefits from employment		No available data			-
Wider Outcomes	Higher levels of employment results in social and economic benefits for the local community and additional job creation		Evidence review suggests that several employees who had come to the area during construction later stayed to work in the mines.			-

Source: Interviews conducted as part of this assessment

Within the **operations** phase of the mine, significant effects also occurred in terms of job creation and local employment with the employment of 350 workers (see Table 6.4).

Table 6.4: Employment during operations at Lisheen mine

Effect:	Local employment and job creation during operations					
Asset Affected	Mine Employees					
Receptor	Mine employees and local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operations	Direct	Long-term	Regional	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Employee Wages		Money spent on wages and salaries			€352 million
Activities / Output	Mining jobs are provided in the local community		350 direct jobs, many of which are local: • 36% live within 10km of the Mine • 74% live within 30km[41]			-
Intermediate Outcomes	Employees receive wages and other social and economic benefits from employment		No available data			-
Wider Outcomes	Higher levels of employment results in social and economic benefits for the local community and additional job creation		322 indirect jobs 171 induced jobs			-

About 350 jobs were lost when the mine closed. While there were negative effects of job losses during the closure phase, these effects were somewhat buffered by the redundancy payments received by workers. A redundancy scheme of 6.75 weeks per year of service was agreed (between mine management and Trade Unions) and put in place during the operations phase. The scheme paid out approximately €43.6 million to former employees[42]. Not only did this mitigate some of the potential negative effects of unemployment, significant positive effects occurred following the mine closure, in the form of indirect job creation through a technical services company established by ex-Lisheen employees (see Table 6.5).

[41] Central Statistics Office, 2011. Place of Work, School or College Census of Anonymised Records (POWSCAR)

[42] Based on provision for redundancy made in 2015 Financial Returns.

Table 6.5: Redundancy at Lisheen mine

Effect:	Redundancy and job creation during closure					
Asset Affected	Employees					
Receptor	Ex-Mine employees and local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive and Negative	Closure	Direct and Indirect	Long-term	Regional	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Redundancy and Pension Payments		Spending on redundancy payments			€43.6 million
Activities / Output	Jobs lost on closure of the mine		350 jobs lost			-
Intermediate Outcomes	Employees use redundancy payments to assist in their transition to new jobs or retirement		Evidence review suggests that most employees were able to secure new employment			-
Wider Outcomes	Some workers establish their own businesses, and employment in these businesses		20 direct jobs for the local area from a training company set up by ex-employees of the mine			-

Source: Interviews conducted as part of this assessment, analysis of LML Annual Financial Returns

6.2.3 Education and skills

During the **baseline**, the local area had a higher percentage of the workforce within the agricultural sector compared to regional and national averages. However, there was notably a lower proportion of Moyne residents working within the manufacturing, building and construction sector, and the professional services sector. Importantly, the local area had a higher percentage of the workforce already working within the mining, quarrying and turf sector, compared to regional and national levels. These trends indicate that within the surrounding area of the proposed mine, mining knowledge, experience and skills were higher than regional and national averages, while professional services knowledge, experience and skills were lacking in and around Moyne.

No information from the evidence review was available to suggest any education and skills effects during the **construction** phase of the mine. During **operations**, upskilling of the workforce was considered the most significant effect within the education and skills category (see Table 6.6). Not only did this have a positive effect on employees through improved qualifications, but there were observable benefits for mine owners. For example, owners Vedanta frequently sent Lisheen employees to train workers in its other operations around the world.

Table 6.6 Education and skills: training and upskilling

Effect:	Training and Upskilling					
Asset Affected	Employees					
Receptor	Mine employees					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	All	Direct	Long-term	Local	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Education and training for mine employees		Two full-time employees dedicated to upskilling, and initiatives such as: • Graduate training programme run for junior staff • International skills sharing workshops • Payment of third-level fees and study leave for employees			€420,000 to €500,000 per year
Activities / outputs	Upskilling of employees Qualification to work in mine operations		Skills and qualifications gained by workers, such as machinery operation or management			-
Intermediate Outcomes	Company benefits from skilled workforce		Owners Vedanta sent Lisheen employees to train and share skills with employees in their other mines around the world			-
Wider Outcomes	Employees better qualified to gain future employment		No data available for physical measurement, although evidence concludes that there were high levels of re-employment of ex-employees at other mines following closure of Lisheen, as well as some ex-employees starting their own businesses.			-

Improved employability was identified as the main significant education and skills effect during the **closure** phase of the mine. In addition to the education and training outlined above, the mine ran a two-year outplacement programme with workshops and personal coaching from HR specialists and career coaches, and encouraged workers to build a portfolio of skills to aid them in securing employment following closure. Based on the evidence reviewed as part of this assessment, this resulted in benefits for employees in terms of improved employability (see

Table 6.7).

Table 6.7: Education and skills: improved employability

Effect:	Improved Employability					
Asset Affected	Employees					
Receptor	Mine employees					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Closure	Indirect	Long-term	Regional	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Education and training for mine employees prior to closure		Two-year outplacement programme with two full-time staff, including initiatives like: • Creation of skills portfolios • Training grants of €750 per employee • A 'Start Your Own Business' course • CV and interview preparation			-
Activities / outputs	Future employment opportunities for mine employees following closure		No data available for physical measurement, although evidence concludes that there were high levels of re-employment of ex-employees at other mines following closure of Lisheen, as well as some ex-employees starting their own businesses.			-
Intermediate Outcomes	Employees continue receive wages and a range of other social and economic benefits from employment		No available data			-
Wider Outcomes	Higher levels of employment results in a range of social and economic benefits for the local community		Interviews conclude that while there were generally high levels of employment following closure, many workers were required to travel further for work, such as to Tara Mine, or to larger towns like Kilkenny and Clonmel.			-

Source: Interviews conducted as part of this assessment

6.2.4 Employee Health and Safety

During **construction** and **operations**, health and safety training was provided to employees in the form of mine safety inductions and regular health and safety training based on 'Zero Incidence Performance'. The positive effects of health and safety training are outlined by Table 6.8.

Table 6.8: Employee health and safety: training

Effect:	Health and Safety Training					
Asset Affected	Employees					
Receptor	Mine Employees					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Construction / Operation	Direct	Long-term	Local	High	High
			Physical Measurement			**Monetary Value**
Input	Health and safety training provided to employees		• Mine safety inductions for all employees • Regular external and internal safety training courses • Mine rescue team (joint with Galmoy)			-
Activities / outputs	Improved health and safety of employees		No available data			-
Intermediate Outcomes	Improved quality of life due to improved physical and mental wellbeing of employees		No available data			-
Wider Outcomes	Positive effects of improved wellbeing on the local community e.g. reduced stress on healthcare services		No available data			-

Despite this, there were several serious health and safety incidents during **construction**, **operations** and **closure**.

- It was reported that were four fatalities over the course of the mine; one during construction and three during operations[43].
- In addition, a number of injuries were recorded during operations. Based on analysis of injuries recorded between 2002 and 2006, there was a rate of 11.6 injuries per million hours worked at Lisheen, which is below the national average of 14 for the sector at this time.
- Lisheen mine was prosecuted by the HSA in 2008 in relation to a separate incident in which there were no injuries or fatalities. A backfill barricade failed, releasing liquefied fill into the surrounding tunnels[44].

Any injury or fatality has a highly significant effect not only on the victims, but on family, friends and other members of the local community. The negative effects of these incidents are outlined in Table 6.9.

[43] Two separate underground incidents in 2011 and 2013 killed two workers. According to interviews conducted as part of this assessment, there was a drowning in the TMF occurred in the early 2000s as well as one fatality during construction c. 1999.

[44] https://www.hsa.ie/eng/Topics/Inspections/Prosecutions/Prosecutions_2008/#top

Table 6.9: Employee health and safety: incidents

Effect:	**Health and Safety Incidents**					
Asset Affected	Employees					
Receptor	Mine Employees, families and communities					
Characteristics	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Construction and Operations	Direct	Permanent	Local	High	High
	Logic Model		**Physical Measure**			**Monetary Value**
Input	Insufficient consideration of employee health and safety		Safety lapses and breaches of health and safety legislation: One charge by HSA (2008: not in relation to an incident with injuries or fatalities)			-
Activities / outputs	Employee health and safety incidences		• Fatalities: One fatality during construction, three fatalities during operation • Injuries: 48 lost-time injuries between 2002-2006, One serious injury (facial damage) • Injury rate: 11.1 injuries per million hours worked • Near misses: 636 'near misses' reported in 2005			-
Intermediate Outcomes	Fatality, injury or reduced mental/physical wellbeing of employees		• Lost worker days: 107 in 2013-2014 due to work-related injuries			-
Wider Outcomes	Negative effects on family and the local community e.g. emotional impacts, greater pressure on healthcare etc.		No available data			-

Source: Lisheen mine Annual Sustainability Reports

While the HSA does not provide statistics for the mining sector specifically, the injury rate for the industrial sector (which includes mining, manufacturing and utilities supply) is above the national average for all sectors. In 2017, the industrial sector had a rate of 20 injuries per 1,000 workers, compared to the national average of 15. This is the third-highest of 12 sectors, after agriculture / forestry / fishing and public administration / defence[45].

6.2.5 Local Health, Safety and Wellbeing

During the **baseline**, the level of noise surrounding the mine was known and judged to be typical for a rural area with no major roads or flight paths.

During **construction** and **operations,** the only significant negative effect on local community health, safety and well-being was that of noise and vibrations from mining activities, with several complaints from local community members relating to noise and vibration from blasting between 2005 and 2015. While the mine's compliance improved during this period, there were still complaints from local community members due to noise and vibration from blasting, particularly when blasting occurred at night. It is not possible to determine what effect noise and vibrations had on health and wellbeing and

[45] Health and Safety Authority, 2018. 'Summary of Workplace Injury, Illness and Fatality Statistics, 2016-2017'.

it should be noted that the mine mostly complied with its licence conditions, but this effect was considered significant from a social perspective, and is outlined in Table 6.10 below.

The information from the evidence review indicates that there were no health and safety effects during the **closure** phase of the mine nor were there any noteworthy effects on noise in the area. There were however two complaints made against the mining company during the **closure** phase: one relating to subsidence (which went to Court but the judgement was found in the mine company's favour) and the second case regarding water saturation of land following groundwater return (it was demonstrated that this impact was not related to the mine).

Table 6.10: Local health, safety and wellbeing: noise and vibrations

Effect:	Noise and vibration incidents					
Asset Affected	Health					
Receptor	Members of the local community					
Characteristics	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Operations	Direct	Long-term	Local	High	High
	Logic Model		**Physical Measure**			**Monetary Value**
Input	Mining activity (blasts and other transport-related noise)		Noise from blasts and transportation during mining operations			-
Activities / outputs	Increase in noise levels		Number of noise / vibration complaints: Between 0 and 14 per year.			-
Intermediate Outcomes	Negative impacts of noise levels, such as annoyance or hypertension		Compliance with licence conditions: 96-100%			-
Wider Outcomes	Loss of welfare due to negative impacts of noise levels		No data available			-

Source: Lisheen Mine AERs

6.2.6 Community

In addition to employment and skills, Lisheen mine had several significant effects on the local community. Due to the multidimensional impacts of community, significant effects have been split into infrastructure and services, and community support.

6.2.6.1 Infrastructure and Services

During the **baseline**, the road infrastructure within the local area needed realigning and resurfacing, with the exception of the N8. Traffic flows in the local area were typical of those expected in a rural area, with higher flows on the national primary and secondary roads. The area around the mine had a number of local community services, including rail links between Thurles and Templemore and either Cork or Dublin and buses run by Bus Éireann as well as private services. Housing and properties in the area were connected to the electricity grid, but not all were connected to the main water supply or sewage schemes. There were several domestic wells, but the water was considered to be of poor quality.

During **construction** of the mine, there was disruption to water supply in local wells, however given the short-term nature, the effect was not identified as significant. In addition, there were some improvements to road infrastructure. During **operations** and **closure**, there were several significant positive effects of local infrastructure and services (see Table 6.11).

Table 6.11: Local infrastructure and services

Effect:	Local Infrastructure and Services					
Asset Affected	Local Infrastructure and Services					
Receptor	Members of the local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Mostly Positive	Construction and Operation	Direct	Permanent	Local	High	High

		Physical Measurement	Monetary Value
Input	Expenditure on infrastructure and services	**Roads:** Expenditure on local road upgrades	€5 million
		Water: Expenditure on water upgrades	€2.5 million
		Energy: Expenditure on energy upgrades	-
Activities / outputs	Improvements to infrastructure and services	**Roads:** Investment from the mine and County Council into local road improvements	-
		Water: Upgrading of the existing Moyne-Templetuohy Group Water Scheme. The Group Water Scheme was managed by a committee independent of the mine, but the mining company paid for improvements to local water supply while the mines were operational.	
		Energy: Construction of 18-turbine windfarm with installed capacity of 36 MW Later extension to 30 turbines, with installed capacity of 60 MW	
Intermediate Outcomes	Direct effects on residents and businesses within the local community including improved transport links, water security, etc.	**Roads:** No data available	-
		Water: 260 households, 105 farms and 4 businesses on the scheme received good quality water	
		Energy: Wind power for mine during operation phase, and subsequently enough for 14,200 households Some local opposition to turbines due to concerns regarding potential effects on property prices, health and flickering.	
Wider Outcomes	Wider social and economic effects such as better connections to jobs, improved welfare due to water security, etc.	Improved infrastructure contributes to further businesses moving into the area, such as the establishment of a National Bio-economy Campus following the Mine's closure	-

Source: Interviews conducted as part of this assessment

6.2.6.2 Community Support

The Lisheen mine company gave significant support to the local community during the **operations** phase. The mine owners developed a Community Engagement plan to manage relations with the local community. While the mine met on a quarterly basis with the Moyne Community Engagement Forum as part of this, it also maintained an 'Open Door' policy, meaning that any community member with an issue or grievance could contact management directly.

Central to this plan was Lisheen’s sponsorship programme. According to the evidence reviewed, the Community Engagement Forum was influential in lobbying for the mine’s support of local projects and initiatives, which led to several significant community investments in the final 5-6 years as outlined in Table 6.12.

Table 6.12: Community support and sponsorship

Effect:	Sponsorship of community infrastructure and organisations					
Asset Affected	Local Clubs and Community Organisations					
Receptor	Members of the local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operations	Direct	Permanent	Local	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Community engagement		• Mine Sponsorship Committee • Stakeholder Engagement Plan and ‘Open Door’ Policy • Lobbying from the Moyne Community Engagement Forum			-
Activities / outputs	Funding given to local organisations to support their activities and infrastructure		Current and capital investment in community infrastructure, including: • Redevelopment of community halls in Moyne and Templetuohy • New running track at Moyne Athletics Club • Improvements to local GAA clubs Other community outreach activities, such as: • Environmental awareness competition for schools • Donations to schools • Mine Open Days			€1.5 million (in last 5-6 years)
Intermediate Outcomes	Benefits to recipients of sponsorship through improved infrastructure and equipment etc.		Improved infrastructure			-
Wider Outcomes	Benefits to the local community through increased community participation etc.		No data available on participation, but improved social infrastructure such as community halls.			-

Source: Interviews conducted as part of this assessment; news reports

6.3 Environmental effects

For detailed information regarding the approach for identifying and screening Lisheen's environmental effects, please see Section 3.3 above, as the same methods were used for both mines.

6.3.1 Identifying and screening effects

The following table presents a list of the range of environmental effects that were identified through the literature review and interviews. The table also indicates where data is available to screen effects. Where data is not available to screen effects, it is not possible to subsequently assess them for their significance. There are 13 possible types of effects that could occur across the three stages of the mine (i.e. 39 possible effects in total). Of the effects in Table 6.13, 10 are taken forward and 29 are screened out due to a lack of data availability to assess them or an inability to determine a causal link between the mine and the effect.

The significance of the 10 effects that were taken forward was determined based on the criteria Table 6.14 below. Changes in the quality of freshwater and groundwater within 3 km of the mine are listed as effects in the table below where the data indicates there was a change (improvement or deterioration) in the WFD status of waterbodies during the lifetime of the mines. Ultimately, most of these effects are screened out as there is no evidence to link changes in WFD status to mining activities specifically, as outlined further in the Appendix C in relation to Lisheen Mine

Of the effects that were screened, 4 were found to be of high significance, and the remaining 4 were of moderate or moderate/high significance. Significant effects are taken forward to the final assessment, which is detailed below. Where quantitative data for an effect is missing, it is described qualitatively using the evidence available.

Table 6.13: Data availability for effects at Lisheen mine

Asset Affected	Description of effect	Availability of data by mine phase		
		Construction	Operation	Closure
Mountains, moors and heaths (peatland)	Change in extent or condition of peatland	✓	✓	✓
Enclosed farmland	Change in agricultural output due to change in extent or condition of pastureland	✗	✓	✓
Freshwater, wetlands and floodplains	Change in water quantity	✗	✗	✗
	Change in water quality at surface waterbodies within 3 km of mine	✗	✓	✓
	Change in water quality at groundwater bodies within 3 km of mine	✗	✗	✗
	Change in fishery populations	✗	✗	✗
	Change in access and opportunities for recreational angling	✗	✗	✗
	Creation of wetland area	N/A	✗	✓
Ambient air quality	Air pollutant emissions due to blasts	✗	✗	✗
	Air pollutant emissions due to mine-related transport emissions	✗	✗	✗
Minerals	Extraction and processing of zinc and lead ore	N/A	✓	N/A
Energy	Wind power generated by wind farm	N/A	✓	✓
	Energy Consumption and Greenhouse Gas Emissions	✗	✓	✗

Table 6.14: Significance of environmental effects for Lisheen mine

Asset	Description of effect	Receptor	Mine phase	Duration of effect	Scale of effect	Receptor sensitivity	Significance of effect	Included in assessment
Mountains, moors and heaths	Change in extent or condition of peatland	Peatland	All	Long-term	Local	Low	Moderate	No
Enclosed farmland	Change in agricultural output due to change in extent or condition of pastureland	Pastureland, farmers and consumers of agricultural output	Operation	Long-term	Local	High	High	Yes
Freshwater, wetlands and floodplains	Change in water quality at surface waterbodies within 3 km of mine at Drish River	Surface water, user and non-user population	Operation	Long-term	Local	Low	Moderate	No
			Closure	Long-term	Local	Low	Moderate	No
	Wetland creation	Wetland, user and non-user population	Closure	Long-term	Local	Moderate	Moderate / High	Yes
Minerals	Extraction and processing of zinc and lead ore	Minerals and mine operators	Operation	Permanent	Local	High	High	Yes
Energy	Wind power generated by wind farm	Atmosphere and wind power users	Operation / Closure	Long-term	National	High	High	Yes
	Energy Consumption and Greenhouse Gas Emissions	Atmosphere and environments/areas affected by climate change	Operation	Long-term	National	High	High	Yes

6.3.2 Peatland

Prior to the mine's development, during the **baseline**, 40% of land within the mine footprint was peatland. Peatland in the area was already being worked by Bord na Móna, and was already degraded as a result of having been drained and worked or planted with conifers. It is not clear whether the peatland was in good condition prior to this.

No further information on changes to the extent or condition of peatland was provided for the **construction** phase of the mine.

Over the **operation** phase, there was long-term loss of over 67 ha of peatland within the footprint of the mine. However, as this land had already been significantly degraded prior to development of the mine, it is not clear that mining activities had any direct effect on peatland beyond what had already occurred. For this reason, it was judged to have low sensitivity in relation to mining activities.

During the **closure** stage of the mine, the TMF was rehabilitated and an area of grassland was created. This was a dry closure and the cap on the TMF was a mix of peat (sourced locally) and boulder clay. Given the recent nature of these actions within the closure stage, it is not possible to determine the extent to which rehabilitation actions have offset the long-term loss of peatland during the operation phase of the mine.

6.3.3 Enclosed farmland

Prior to the mine's development, during the **baseline**, the majority of land within the footprint of the mine (57%) was pastureland suitable for grazing, followed by peatland (40%) (as above), and woodlands and scrub (3%). There was no information provided within the **construction** phase for the mine to indicate how the area of pastureland within the footprint of the mine changed.

However, during the **operation** phase, there was long-term loss of 42 ha of pastureland within the footprint of the mine[46]. The opportunity cost of this change of land use during operations, as measured by the value of potential agricultural output, is outlined in Table 6.15. During the **closure** stage of the mine, the TMF was rehabilitated to an agricultural end-point by 2018[47].

[46] It should be noted that although the overall footprint of the Lisheen mine site is significantly larger than that of Galmoy, a significant proportion of the land used by Lisheen mine was originally peatland. This means that there was overall less farmland lost at Lisheen than at Galmoy.

[47] Lisheen Mine Closure Committee, 2018.

Table 6.15 Farmland at Lisheen mine

Effect:	Change in extent or condition of enclosed farmland					
Asset Affected	Enclosed Farmland					
Receptor	Pastureland, farmers and consumers of agricultural output					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Operations and Closure	Direct	Long-term	Local	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Mine activities requiring land		Type of mine activities requiring land including the mine site, the TMF, etc.			-
Activities / outputs	Land take to enable mine operation		Land take to enable mine operation on 42 ha of land based on spatial analysis of CORINE land cover data from 1990 – 2018.			-
Intermediate Outcomes	Loss of pastureland		Loss of 42 ha of farmland based on spatial analysis of CORINE land cover data from 1990 – 2018.			-
Wider Outcomes	Loss of agricultural production capacity		Loss of potential lamb and beef output estimated at 31,400kg of output each year (based on rearing cattle and lamb)[48] and the lifetime value of lost output			€0.94 million

6.3.4 Freshwater, wetlands and floodplains

6.3.4.1 Water quantity

While it is known that abstraction and pumping of treated water took place during the lifetime of the mine, there is a lack evidence to determine whether this impact is significant based on river flows and groundwater levels in the baseline.

During the **baseline**, the Suir River and its tributaries were not utilised as a raw water source for drinking water production. Downstream of the proposed mine site, abstraction pipes were recorded in the Drish River as well as from the Suir River, downstream of the town of Thurles. Additionally, the Drish, Rossestown and Suir rivers were being extensively utilised through surface water abstractions to support the watering of livestock. There were also 176 private wells identified within 5 km of the proposed mine, most of which supplied individual households with a few major abstractions associated with group schemes and agri-business. The groundwater sampled at this site was characterised as having particularly high potassium, iron, manganese and ammonia levels, all above Drinking Water Standards.

During the **construction** phase, to compensate for mine dewatering, treated mine water was discharged to both the Drish River and the Rossestown River. There were a number of wells impacted by mine dewatering. Due to the impact of mine dewatering on groundwaters that supplied water to the community, the mine paid for upgrades to the Moyne Templetuohy Group Water Scheme, which served residents of Kylmakill and Barnalisheen. In 2003, the scheme was supplying water to 260 households, 105 farms and 4 businesses. The Lisheen mine also contributed to North Tipperary County Council to extend the Templemore water supply scheme to Templetuohy, meaning

[48] Based on average stocking rates, gross margins and depreciation estimates from the Agriculture and Horticulture Development Board (AHDB) and the Agricultural Budgeting and Costing Book.

that a greater catchment was served by remedial schemes than the one initially affected by the mine dewatering.

Final dewatering pumps were switched off in December 2015 and during the **closure** period, groundwater levels were considered to have fully recovered around two years later. The closure plan for the mine stated that groundwater would be monitored from six regional wells surrounding the mine site area twice a year for up to three years into aftercare, falling to once a year thereafter, as aftercare progresses. The Moyne Group Water Scheme committee continued the management of the scheme while they reassumed responsibility for operational costs in early 2018, once the mine ceased its financial obligations to the scheme.

6.3.4.2 Surface water quality

Generally, there was a reduction in the quality of surface waters within 3 km of the mine from the operation phase until the closure of the mine. However, in some cases it was not possible to isolate the effect of mine activities on surface water quality from other factors, such as agricultural activities. In other cases, the WFD status of affected waterbodies was already on the lower end of the spectrum, which meant they were deemed to not be sensitive receptors, and the impact of the mine was therefore deemed relatively less significant.

In the **baseline**, water within the Drish River was described as very hard with low suspended solids at the time of sampling, iron concentrations in exceedance of the Drinking Water Standard, nitrite at the limit for Salmonid Waters, moderately elevated nitrate concentrations and extremely low heavy metal concentrations.

Water quality within the Rossestown River was described as being affected by treated sewage effluent outfall upstream of the mine site, with extremely high ammonia concentrations, elevated biological oxygen demand levels, elevated iron, manganese, nitrate and phosphate concentrations and low heavy metal concentrations, with the exception of barium.

The baseline water quality of the River Suir upstream of the Drish and Rossestown confluences, exhibited locally elevated concentrations of suspended solids, ammonia and nitrite concentrations in exceedance of the Salmonid Regulations and low heavy metal concentrations, with the exception of aluminium, barium and iron. Apart from the high ammonia concentrations, the baseline water quality of the River Suir was considered to be relatively good for a major river which drains rich agricultural land and passes through a number of large towns.

The literature review and interviews did not identify evidence to determine any effects on surface waters in the **construction** phase. However, data from the EPA is available for waterbodies within 3 km of the mine and shows that two waterbodies within the Drish River saw a drop in their WFD status from the baseline to the construction phase. One of these waterbodies[49] saw its status drop from moderate to bad during construction, with information relating to the operation phase of the mine confirmed that this was likely linked to the Lisheen mine.

During the **operation** phase (1999 – 2015), surface water quality (in terms of WFD status) within Drish River did not improve for the most part, with the exception of one waterbody, which in 2011 improved from poor to good status. The waterbody in which toxic elements were found during construction remained at poor status until the closure of the mine. There was also a decrease in water quality within the Rossestown River from 2009 until the closure of the mine. It is not clear whether other factors, aside from the operation of the mine, contributed to this situation.

A survey of water quality, undertaken in 2006, identified concentrations of arsenic, cadmium, copper, lead, mercury and zinc within the stream sediments immediately downstream of the mine discharge points. These exceeded environmental limits set by the EPA. Following this survey, Lisheen mine conducted clean-up operations on both rivers during 2007 and 2008, removing any sediments containing elevated metal concentrations. In 2010, Lisheen mine received permission from the EPA to

[49] DRISH_030

install abatement at the emission points as to provide further mitigation. River sediments were routinely monitored since the issue was first raised.

As part of mine **closure** plans, the affected river stretches were dredged and upgraded in the summer of 2016. Aftercare monitoring undertaken between 2016 and 2018 indicated that sulphate and ammonia concentrations at the remaining outfall to the Drish River, SW1, were below compliance limits set in the IPC licence. Nickel and zinc concentrations remain above the IPC limit. As of November 2018, three of the four mine surface water discharges had been decommissioned. Meeting notes from a Lisheen Mine Closure Committee Meeting indicate that concentrations of zinc and nickel at SW1 were consistently above the IPC licence limits. Whilst elevated concentrations are in breach of the IPC licence, monitoring in the Drish River immediately downstream of the SW1 emission point show metal concentrations are below the limit and therefore that the emissions are reportedly not causing any negative impact to the Drish River.

The main residual impacts for Lisheen are related to the Tailings Management Facility (TMF) which is expected to comply with environmental limits within 7 years of covering, i.e. by 2025. According to interviews conducted as part of this study, there were residual issues recently with a small level seepage into an area adjacent to the Lisheen TMF following a period of heavy rainfall. It is a small level of seepage, and is actively controlled, while water is now being pumped back into the TMF. The company are investigating the cause of the seepage and are actively remediating where required.

6.3.4.3 Groundwater quality

Generally, it is accepted that mine activities are likely to impact on the quality of groundwaters. However, in some cases it was not possible to isolate the effect that mine activities would have had on groundwater quality, given the role of other factors.

In the **baseline**, water quality data was not available for the four groundwaters within 3 km of the mine. In the baseline, groundwaters in the Lisheen area had been largely contaminated by a combination of septic tank effluent and agricultural activities, with nearly 80% of wells sampled recording some level of contamination. However, levels of heavy metals, such as arsenic, cadmium, copper, lead, mercury and zinc were noted to be within Drinking Water Standards within the unpolluted wells sampled. Information regarding the quality of groundwaters during the **construction** phase was limited.

During the **operation** phase, groundwater quality was monitored at an extensive network of monitoring boreholes and private wells around the mine site and TMF. Numerous concentrations of ammonia, nickel, sulphate and zinc in groundwater were found to exceed water quality standards. However, data from the EPA indicates that all groundwaters within 3 km of the mine had good status from 2007-2012 and 2010-2015. In the absence of baseline data about the status of these waterbodies, it is not clear whether the mine had an impact on groundwater quality within 3 km of its footprint

6.3.4.4 Fisheries

In the **baseline**, surveys of the Drish River confirmed that trout and pike were the principal angling species present. The trout and pike in the Drish were found to be fast growing and similar to those in comparable rivers in the Irish midlands. Almost all of the fish encountered were in excellent condition. The Suir, Drish and Rossestown rivers were found to have salmon and brown trout. The Central Fisheries Board identified the Suir and Drish Rivers as important for tourism generated through angling.

During the **operation** phase of the mine, a survey of fish populations was undertaken as part of continued monitoring. It concluded that the overall fishery potential of the Drish and Rossestown Rivers was limited based upon low population densities for brown trout and salmon. Notably low fish populations were recorded around the discharge points. Due to other predator species and poor nesting habitats at these locations, it is not clear whether these findings resulted from mine discharge. Samples taken from fish tissue suggested that mining discharge was introducing elevated levels of arsenic, cadmium, chromium, copper, lead and mercury which were being bioaccumulated within fish populations. It is noted that the amounts in various tissues were below the recommended limits.

According to the 2007 sustainability report for the mine, an ecotoxicity report concluded that while there was negligible impact of suspended solids in water discharge on fish, livestock and humans, there was some impact on river invertebrates. According to the interviews conducted as part of this study, the Fisheries Board called an emergency meeting when it became apparent that there was an impact to macroinvertebrate and gammarid populations. Electrofishing surveys were carried out to count population and continued until the issue was identified. The stream sediment was removed, and the discharge was adjusted to remove sediment before the outfall at Lisheen. The EPA and ecologists assessed the results of this work and noted that the situation generally improved thereafter.

According to Inland Fisheries Ireland, during the **closure** phase of the mine, operators allocated funds for the rehabilitation of the River Drish in conjunction with North Tipperary County Council. The project involves installing deflectors and other fishery structures. The mine operators undertook some dredging and upgrading works were undertaken along the river in the summer of 2016 as part of the remediation actions required to meet planning conditions. This was noted to be complete in November 2018.

6.3.4.5 Wetlands

During the closure phase of the mine, operators created a wetland to trap excess pollutants at discharge points. The wetland took run-off from the TMF, making it less likely that nutrients escaped. Wetland areas were also installed at Carrick Hill Borrow Pit, which is a site that was used to source construction materials during operation and closure. These effects are outlined in Table 6.16 below.

Table 6.16: Wetlands at Lisheen mine

Effect:	Wetland Creation					
Asset Affected	Freshwater, wetlands and floodplains					
Receptor	Wetlands					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Closure	Direct	Long-term	Local	Moderate	Moderate / High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Activities to construct wetland		Construction activities required for wetland creation including flooding area, etc.			-
Activities / outputs	Creation of wetland areas		• Restoration of Carrick Hill Borrow Pit • Wetland at TMF			-
Intermediate Outcomes	Ecosystem services delivered by wetlands, for example, flood risk benefits, biodiversity, improved water quality, carbon sequestration		Ecosystem services, including flood risk benefits, biodiversity, improvement in water quality, carbon sequestration. The magnitude of the changes in these ecosystem services is not known and are tied to the extent and condition of the wetland area created.			-
Wider Outcomes	Social and economic benefits from ecosystem services, for example improved wellbeing from better water quality and improved aesthetics and recreational value of the area.		No available data			-

6.3.5 Air quality

In the **baseline**, dust deposition in the area of the then proposed mine was low and typical of other similar rural locations in Ireland. Monitoring of air lead concentrations before construction began indicated that the ambient levels at the nearby villages of Moyne and Templetouhy were well below the EC Directive limit value for lead. During the **construction** phase, dust deposits that formed on vegetation and vehicles in the area due to emissions from the mine's return air shafts were reportedly a major concern to the local population. However, similarly to the baseline, the literature review and interviews did not provide further data on air quality levels during the construction phase.

Environmental management systems and IPC licence requirements were in place to ensure that the mine operators undertook rigorous air quality monitoring during its **operation** phase. In 2004 and 2005, the mine was 100% compliant with IPC licence limits. In 2006, 99.67% air quality compliance with licence conditions was achieved.[50] Information regarding compliance, or otherwise, in other years of the mine's operation is limited.[51] During **closure,** there is no evidence of changes in air quality as a consequence of Lisheen mine.

6.3.6 Minerals

The evidence suggests that during the **operation** phase of the mine, planned production of raw ore was around 1.4 million tonnes per year. This corresponds to the production of on average 300,000 tonnes of zinc and lead concentrate each year. This corresponds with other evidence, which suggests that approximately 6,300 tonnes of ore grade material was transported from the mine to the surface daily via a conveyor system. Note that this effect is considered to be negative from an environmental perspective as it constituted an extractive use of a non-renewable natural capital asset. From an economic perspective, this would, however, be considered a positive effect as it promoted economic activity. The dual nature of this effect demonstrates the utility and need to assess effects from different perspectives, and using a holistic framework such as a capitals approach.

[50] 2007 SD report

[51] 2005 Anglo American Sustainability Report

Table 6.17 Minerals for Lisheen mine

Effect:	Minerals Extraction					
Asset Affected	Minerals					
Receptor	Minerals and mine operators					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Operation	Direct	Permanent	Site-specific	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Mine activities to exploit minerals		Types of activities to exploit minerals including digging, blasts, remediation etc.			**-**
Activities / outputs	Extraction and processing of minerals		Extraction and processing of an average of 1.4 million tonnes of raw ore per year			-
Intermediate Outcomes	Processed zinc and lead concentrates		Average of 300,000 tonnes of zinc and lead concentrate per year			-
Wider Outcomes	Permanent loss of non-renewal resources (from the site)		Permanent loss of non-renewable resources (noting that the lead itself is a metal that is highly recycled and re-used)			-

6.3.7 Energy and Greenhouse Gas Emissions

The mine consumed large amounts of energy, which primarily consisted of electricity from the national grid as well as fuel oil. Lisheen consumed approximately 123,000 MWh of electricity each year, the equivalent of 6,600 households, as well 1.3 million litres of fuel oil, making Lisheen one of the largest users of energy in the country.

Regardless of source, CO_2 emissions represent a negative externality, and impose a cost to society in terms of its contribution to climate change. The effects of Lisheen's energy consumption and greenhouse gas emissions are described in Table 6.18.

Table 6.18: Energy consumption at Lisheen Mine

Effect:	Energy Consumption and Greenhouse Gas Emissions					
Asset Affected	Energy					
Receptor	Atmosphere and environments/areas affected by climate change					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Negative	Operations	Direct	Long-term	National	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Consumption of electricity and fossil fuels		Average annual consumption of 123,000 MWh of electricity and 1.3 million litres of fuel oil[52]			-
Activities / outputs	Mining activities requiring energy		Drilling, dewatering, vehicles etc.			-
Intermediate Outcomes	CO_2 released into atmosphere from fossil fuels used to produce energy		Average of 76,737 tonnes per year[53] Total of 1.2 million tonnes over operations			-
Wider Outcomes	Contribution to climate change, and associated negative effects		Total lifetime cost to society estimated by Shadow Price of Carbon of €20/tonne[54]			-€24.56 million

Source: Analysis of Lisheen Mine's Annual Environmental Reports

However, during the **operation** phase of the mine, in 2009, a wind farm was constructed on the mine site comprising 18 wind turbines. This was extended in 2013 by another private company on adjoining land, with the addition of 12 new turbines with installed capacity of 24 MW, making a combined installed capacity of 60 MW. The wind farm supplied electricity to the mine in its later years, and continues to supply enough electricity to fully power 14,200 homes.

While there was some initial local opposition, the wind farm is considered to represent a positive effect from an environmental perspective in terms of its effect on greenhouse gas emissions, with each MWh of energy produced estimated to displace 0.46 tonnes of CO_2[55].

[52] Based on analysis of Energy Use between 2001 and 2015 contained in Annual Environmental Reports

[53] Based on annual CO_2 intensity between 1997 and 2012 (Energy in Ireland, 1990 to 2011)

[54] 2019 Shadow Price from *Public Spending Code: Central Technical References and Economic Appraisal Parameters.*

[55] Based on a net displacement intensity by wind generation of 0.46 tonnes CO_2/MWh (SEAI, 2012)

Table 6.19 Energy generation at Lisheen mine

Effect:	Wind power generated by windfarm					
Asset Affected	Energy					
Receptor	Atmosphere and environments affected by climate change; communities receiving wind power					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operation / Closure	Indirect	Long-term	National	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Construction of wind farm		Construction of 30 wind turbines, with combined installed capacity of 60MW			**-**
Activities / outputs	Electricity generation through wind power		Average generation of 213,000MWh per year; 2.3 million MWh between 2009 and 2019[56]			-
Intermediate Outcomes	Wind power distribution to households and businesses		Wind power for mine operations and subsequently the town of Thurles. Enough electricity to power 14,200 homes[57]			-
Wider Outcomes	Reduction in CO_2 emissions due to displacement of fossil fuels		1,075,903 tonnes of fossil fuels displaced between 2009 and 2019[58]			€21.52 million[59]

Source: Lisheen Mine AERs; CO_2 estimates based on data from the SEAI

[56] Based on annual load factor of 0.5

[57] Based on average household energy use of 18.5 MWh (SEAI, 2018)

[58] Based on CO_2 displacement factor of 0.46 tonnes/KWh

[59] Value based on shadow price of carbon of €20 per tonne

6.4 Economic effects

This section analyses the economic effects of Lisheen mine, and the structure of this section follows that of Section 5.4 (for Galmoy mine). In order to assess the lifetime impact of the mine, and for comparison purposes, all values (unless stated otherwise) have been adjusted to 2018 euro values.

6.4.1 Identifying and Screening Effects

The following table presents a list of the range of economic effects that were identified through the literature review and interviews. The table also indicates where data was available to screen effects. Where data is not available screen effects, it is also not possible to subsequently assess them for their significance. Of the effects in Table 6.20, all are taken forward for screening.

Table 6.20: Data availability for effects at Lisheen mine

Asset Affected	Description of effect	Availability of data by mine phase		
		Construction	Operation	Closure
Lisheen Mining Partnership Lisheen Milling Ltd.	Sale of zinc and lead concentrate	N/A	✓	N/A
Port of Cork	Export of Concentrate	N/A	✓	N/A
	Loss of Concentrate Exports	N/A	N/A	✓
Businesses	Direct, indirect and induced effects of expenditure	✓	✓	✓
	Re-purposing of manufactured capital	N/A	N/A	✓
Closure bond	Closure bond	N/A	N/A	✓
Public Finances	Royalties and dead rent	✓	✓	✓
	Corporation Tax	✗	✓	✗
	PRSI	✗	✓	✗
	PAYE	✗	✓	✗
Local Authority Finances	Commercial Rates	✗	✓	✗
	Development Contributions	✓	✓	N/A

The effects that are taken forward are screened to determine if they are significant (based on the criteria set out). Of the effects that were screened, 4 were found to be of high significance, 8 were of moderate/high, and 2 of moderate significance. The screening of significant effects and their inclusion in this analysis is outlined below:

Table 6.21: Screening of significant effects for Lisheen mine

Asset	Description of effect	Receptor	Mine phase	Duration of effect	Scale of effect	Receptor sensitivity	Significance of effect	Included in assessment
Lisheen Mining Partnership and Lisheen Milling Ltd.	Sale of zinc and lead concentrate	Company owners and shareholders	Operation	Short-term	National / International	High	Moderate / High	Yes
Port of Cork	Export of concentrate	Port of Cork and its employees	Operation	Short-Term	Regional	Low	Moderate	No
	Loss of concentrate exports		Closure	Long-term	Regional	Low	Moderate	No
Businesses	Direct, indirect and induced effects of expenditure	Businesses, local community, employees	Construction	Short-term	National	High	Moderate / High	Yes
		Businesses, local community, employees	Operation	Long-term	National	High	High	Yes
		Businesses, local community, employees	Closure	Short-term	Local	High	Moderate / High	No
	Re-purpose of manufactured capital	Businesses and local community	Closure	Long-term	National	High	High	Yes
Closure bond	Closure bond	Environment and communities	Closure	Long-term	Site-Specific	High	High	Yes
North Tipperary County Council	Commercial rates	North Tipperary communities	Operation	Short-term	Regional	High	Moderate / High	Yes
	Development contributions	North Tipperary communities	Operation	Long-term	Local	High	High	Yes
National Public Finances	Royalties and taxes	Irish public	All	Short-term	National	High	Moderate / High	Yes

6.4.2 Sales and Gross Value-Added

The primary impact of turnover is on the financial capital of the mining company and shareholders; how the mining company manages their costs and returns a profit for the company and dividends for shareholders. While the focus of this report is not on benefits to the mining company, turnover can provide context regarding the significance of Lisheen to the mining industry and to the Irish economy.

Lisheen typically produced on average 300,000 tonnes of zinc and lead concentrate each year, and was responsible for about 35 per cent of Irish concentrate production[60] when it was operational. This generated total turnover of €2.76 billion between 1999 and 2015 (in 2018 prices).

Lisheen's Gross Value-Added (GVA), which measures how much value it added to the economy, amounted to €1.276 billion over this period. This compares to total GVA of €11.97 billion for the mining and quarrying sector between 1999 and 2015, indicating that Lisheen was responsible for 11 per cent of GVA for the sector. Although this is quite large relative to the sector, it is small relative to the overall Irish economy, as the entire sector accounted for just 0.5 per cent of Irish Gross Domestic Product (GDP) during this period. However, the combination of the three mines in operation during this period placed Ireland as the largest producer of zinc and lead at this time, meaning that Lisheen was significance to international metals markets.

Table 6.22: Sale of zinc and lead concentrate

Effect:	**Sale of Zinc and Lead Concentrate**					
Asset Affected	Lisheen Mining Partnership (LMP) and Lisheen Milling Ltd. (LML)					
Receptor	Company owners and shareholders, including Anglo-American and Vedanta					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operation	Direct	Short-term	National / International	High	Moderate / High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Zinc and lead ore is mined by LMP and sold to LML for processing		Average of 1.4 million tonnes of ore each year 22.4 million tonnes over its lifetime			-
Activities / outputs	Concentrate sold to smelters in Europe and around the world		300,000 tonnes per year 4.8 million over its lifetime			-
Intermediate Outcomes	Revenue is earned for the LML.		Lifetime Sales Revenue			€2.76 billion
Wider Outcomes	Increase in Ireland's GDP		Lifetime GVA by the Mine			€1.276 billion

Source: Estimates from analysis of Lisheen Milling Ltd. Annual Returns

6.4.3 Exports

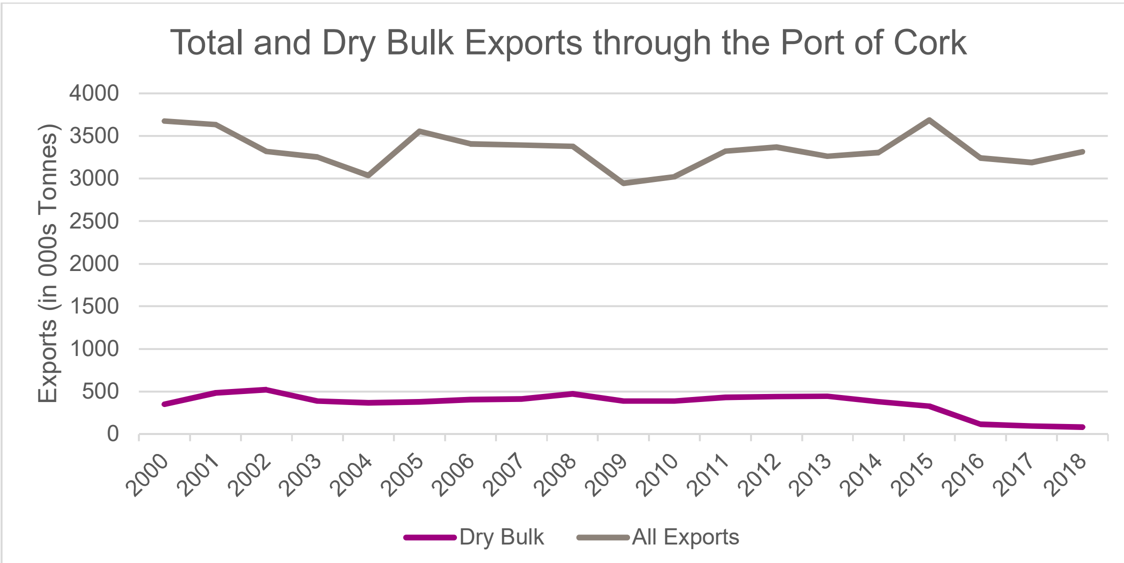
Lisheen accounted for approximately 35% of overall zinc and lead concentrate production during this period, with most of this exported. However, the value of Irish exports of zinc and lead concentrate varied significantly from year-to-year as a result of fluctuating metal prices and euro-dollar exchange rates, meaning that Lisheen mine's annual share of the *value* of exports also varied.

[60] Based on average production from 1999 to 2005. Department of Communications, Climate Action and Environment, 2016. http://www.mineralsireland.ie/files/2016_ZincAndLeadInIreland.pdf

While exports generally represent a flow of goods and money, rather than an effect itself, this assessment considered the potential effects on the Port of Cork; through which ore was exported to smelters in Europe and beyond. The Mine maintained dedicated facilities at Tivoli Docks, and employed 3 to 4 staff at the Port.

Figure 6.2 shows total and dry bulk (which includes metal concentrate) exports from the Port of Cork. Although there is an observable drop in dry bulk exports in 2015 following the mine's closure, these represent just 10% of overall exports through the Port of Cork.

Figure 6.2: Exports through the Port of Cork, 2000-2015



Source: Central Statistics Office Maritime Statistics

As this was low relative to overall exports and trade, it did not have a significant impact on the Port, and this loss was largely compensated for by steady imports and cruise ship arrivals[61]. This data suggests that as a larger port, it was better able to absorb the loss of exports than a smaller Port like New Ross, and the effects were therefore not considered to be overall significant in the context of this study.

6.4.4 Mine Expenditure

Every euro directly spent by a business will have an impact in the economy beyond the business. If a company spends money on purchasing supplies or hiring workers, those suppliers and employees will increase their own spending in response. This is known as the multiplier effect, and these expenditure impacts can be broken down into three components: direct, indirect and induced expenditure effects. These are explained in greater detail in 4.3.2.3

€347m was spent on the **construction** of Lisheen mine, resulting in indirect expenditure of €201m and induced expenditure of €247m. Construction is a labour-intensive industry and is also linked to other labour-intensive industries, such as real estate, security and financial services, meaning that expenditure during the construction phase, although short-term, had significant induced effects.

The effects of mine expenditure during operations and closure is detailed in Table 6.23.

[61] https://afloat.ie/port-news/port-of-cork/item/34744-9-2m-tonnes-of-trade-handled-through-port-of-cork

Table 6.23: Effects of construction expenditure at Lisheen mine

Effect:	Direct, Indirect and Induced Effects of Construction Expenditure					
Asset Affected	Businesses / the Construction Industry					
Receptor	Other businesses, employees, local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Construction	Direct, indirect and induced	Short-term	National and International	High	Moderate / High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Purchase of construction services		Goods and services used in the construction of the mine			-
Activities / output	Revenue generated in suppliers' businesses		Total direct expenditure			€347 million
Intermediate Outcomes	Suppliers to the industry increase their own spending in response to increased demand		Indirect Expenditure by other businesses			€201 million
Wider Outcomes	Workers spend their wages in other businesses, generating additional economic activity		Induced Expenditure by workers			€265 million

Source: News Reports

The mine directly spent €1.94 billion over its **operations** stage. Spending occurred across three main categories: capital goods, such as buildings and machinery; other non-labour inputs, such as supplies, utilities and administration costs; and wages and salaries. This resulted in indirect expenditure of €1.77 billion and induced expenditure of €1.32 billion in the wider Irish economy. Much of these effects were felt locally: according to the Mine[62], 31% of non-labour spending was with businesses within the local region, while 80% was with businesses based in Ireland. The effects of expenditure during the **operations** stage is detailed in Table 6.24 below.

[62] Lisheen Mine 2013-14 Sustainability Report

Table 6.24: Effects of operations expenditure by Lisheen

Effect:	Direct, Indirect and Induced Effects of Operations Expenditure					
Asset Affected	Businesses					
Receptor	Other businesses, employees, local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operations	Direct, indirect and induced	Long-term	National	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Purchase of labour, capital and other non-labour inputs		Capital goods: e.g. equipment / vehicles			€107 million
			Wages and salaries			€352 million
			Non-labour inputs: e.g. supplies, utilities			€1.484 billion
Activities / Output	Money spent in other businesses and on workers		Total direct expenditure			€1.943 billion
Intermediate Outcomes	Suppliers to the Mine increase their own spending in response to increased demand		Indirect Expenditure by other businesses			€1.768 billion
Wider Outcomes	Workers spend their wages in other businesses, generating additional economic activity		Induced Expenditure by workers			€1.321 billion

Source: Estimates from analysis of Lisheen Milling Ltd. Annual Returns

During **closure**, the mine made provision for €23.2 million of spending in relation to the rehabilitation works required under its Closure, Rehabilitation and Management Plan (CRAMP). This represented a positive effect on financial capital, as it provided sufficient funds to carry out the works necessary to close the mine and to restore the environment of the site to a state as stipulated by the relevant authorities.

Similar to Galmoy Mine in Section 5.4.4, Lisheen was required to produce an independent Environmental Liability Risk Assessment (ELRA) to quantify the risk of unknown liabilities that were separate to the planned closure process. While there was a certain level of contingency set aside in the CRAMP, the EPA has also identified a temporary gap in the financial provisions for the aftercare period that is being addressed as a matter of urgency.

The effects of this **closure** expenditure are described below.

Table 6.25: Effects of the mine closure bond

Effect:	Mine closure bond					
Asset Affected	Mine Closure bond					
Receptor	Local environment and communities					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Closure	Direct	Long-term	Site-specific	High	High
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Funds paid in during operations		Total size of closure bond (2016)			€24.17 million
Activities / outcomes	Use of funds to pay for planned closure and aftercare works		Estimated Cost of works required (2016)			€23.23 million
Intermediate Outcomes	Rehabilitation of site as stipulated by the relevant authorities, TCC, EPA and EMD		Works carried out, including: • Mine closure and shaft capping • TMF capping, seeding and grazing • Cleaning of site and demolition of buildings Construction of wetlands			-
Wider Outcomes	Funding to cover the risk of potential unknown liabilities		Environmental Liability Risk Assessment to calculate expected value of these risks. However, in the absence of insurance or a risk transfer mechanism, there may be funding shortfalls in the event of unknown liabilities			-

The construction of buildings and infrastructure is also a permanent addition to the manufactured capital of the area. While some have since been demolished post-closure, others remained, allowing other businesses and industries to repurpose the site. In the case of Lisheen, this effect was of national significance with the opening of a ‘National Bio-Economy Campus’ post-closure. This opened in 2018, and employs approximately 50 people at present. However, there are plans for investment by several companies in new bio-economy facilities, meaning that there is the potential for additional jobs to be created in the coming years.

The effects of manufactured capital during **closure** are detailed in Table 6.26.

Table 6.26: Effect of manufactured capital at Lisheen mine

Effect:	Re-purpose of manufactured capital					
Asset Affected	Manufactured Capital					
Receptor	Other businesses and the local community					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Closure	Indirect	Permanent	National	High	
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Office space and infrastructure built during operations		Office buildings Improved road, power and water infrastructure			Residual value of buildings and infrastructure estimated at €80 million[63]
Activities / outcomes	Office buildings retained following closure of the Mine		Office buildings retained			
Intermediate Outcomes	Post-closure use by other businesses		Redevelopment of the site as the 'National Bio-Economy Campus'			
Wider Outcomes	Continued local employment and economic activity		Investment from Glanbia, CMP International 50+ jobs created			-

Source: Interviews conducted as part of this assessment; news reports

6.4.5 Local public finances

Like any business, Lisheen mine paid development contributions and commercial rates to the local authority, North Tipperary County Council (NTCC) to reflect the costs of doing business on a local level, such as providing appropriate infrastructure. Lisheen mine paid development contributions during **construction** to pay for road upgrades required, as well as commercial rates throughout **operations**. The effects on local authority finances are shown in Table 6.27.

[63] http://www.bioeconomyfoundation.com/About.html

Table 6.27: Effect of Lisheen mine on local authority finances

Effect:	Commercial Rates					
Asset Affected	North Tipperary County Council (NTCC) finances					
Receptor	North Tipperary Communities					
Nature	Stage	Type	Duration	Scale	Sensitivity	Significance
Positive	Operations	Direct	Short-term	Regional	High	Moderate/High
	Logic Model		Physical Measurement			Monetary Value
Input	Rates paid to NTCC		Rates paid to NTCC over lifetime			€16.5 million
Activities / outputs	Increase in income for NTCC		Rates paid to NTCC over lifetime			€16.5 million
Intermediate Outcomes	Investment into North Tipperary County Council services		As commercial rates are not ring-fenced, there is no specific data available			-
Wider Outcomes	Economic and social benefits for Tipperary communities		No data available			-
Effect:	Development Contributions					
Asset Affected	Kilkenny County Council (KCC) finances					
Receptor	Local Communities					
Nature	Stage	Type	Duration	Scale	Sensitivity	Significance
Positive	Construction	Direct	Long-term	Local	High	Moderate/High
	Logic Model		Physical Measurement			Monetary Value
Input	Development Contributions		Development Contributions paid for road improvements			€6.58 million
Activities / outputs	Investment in upgrade of local roads		Upgrades to local road infrastructure			-
Intermediate Outcomes	Ability to accommodate higher traffic levels from mine		No data available			-
Wider Outcomes	Improved access for other businesses and local community		No data available			-

Source: Interviews, news reports

6.4.6 National public finances

Lisheen mine's direct contribution to national public finances mainly consisted of three flows:

- **Royalties and lease fees:** Royalties are paid to the state as a percentage of annual revenue, with the percentage rates negotiated at the beginning of a mining licence/lease on a case-by-case basis. The minerals at Lisheen were state-owned, meaning that the state received a greater share of revenues. Lisheen paid royalties at rates of between 1.5 per cent and 3.5 per cent.
- **Corporation tax:** Companies pay corporation tax as a percentage of their profits, the mining industry is taxed at the higher corporation rate of 25 per cent. Lisheen Mining Partnership (which mined the zinc and lead ore) paid tax at 25 per cent rate, while Lisheen Milling Limited (which processed the ore) paid tax at 12.5 per cent. This is currently under examination by the Revenue

Commissioners. Mining is a capital-intensive industry, and as all companies can write off capital development and past losses against their corporate tax bill, Lisheen Milling Ltd. mostly paid corporation tax post-2006.

- **Employer's PRSI:** Lisheen paid Pay-Related Social Insurance (PRSI) on behalf of their employees.
- **Income Tax / PAYE:** Pay-as-you-earn (PAYE) is the main source of income tax for the state and was paid by Lisheen mine's employees as a percentage of their salaries.

The table below summarises the main contributions to national public finances made by Lisheen mine.

Table 6.28: Effect of Lisheen mine on national public finances

Effect:	**Taxes and Royalties paid**					
Asset Affected	National Public Finances					
Receptor	Irish Public					
Nature	**Stage**	**Type**	**Duration**	**Scale**	**Sensitivity**	**Significance**
Positive	Operations	Direct	Short-term	National	Low	Moderate
	Logic Model		**Physical Measurement**			**Monetary Value**
Input	Taxes paid by the Mine and employees to the State (*including dead rent during construction and operations)		Royalties and dead rent* paid by Lisheen			€65.3 million
			Corporation Tax by Lisheen Milling Ltd.			€55.3 million
			Employer's PRSI by Lisheen Milling Ltd			€36 million
			PAYE by employees			€77.4 million
Activities / outputs	Increase in revenue for the government		Tax revenue received			€234 million
Intermediate Outcomes	Increase in current or capital government expenditure		No data available			-
Wider Outcomes	Economic and social benefits for the Irish public		No data available			-

Source: Royalties from DCCAE; Corporation Tax and PRSI from Lisheen Milling Ltd. Annual financial returns; PAYE based on estimates from Revenue Commissioners Annual Report.

6.5 Summary

The following sub-section summarises the key findings from the assessment of social, environmental and economic effect for Lisheen mine. The breadth and depth of the assessments is driven by the availability of evidence from the literature review and interviews to identify effects, determine their significance, and assess them in quantitative and monetary terms.

The **social assessment** of effects is closely linked and sometimes overlapping with the economic assessment. Some of the key effects are components of human, social and intellectual capital, as follows:

- There were up to 700 jobs provided during construction of the mine, although it is likely that less were full-time equivalent jobs. However, the mine directly employed 350 during operations; 74% of which lived within 30km of the mine. Following closure of the mine, employees were given generous redundancy payments which enabled some ex-workers to set up their own training/services company which provided an additional 20 direct jobs for the local area.
- The mine invested heavily in education and upskilling employees, spending between €420,000 and €500,000 each year. Prior to closure, a two-year outplacement programme was implemented, consisting of CV and skills coaching, business workshops, and each employee being provided with €750 to attend external training programme of their choice.
- Despite the mine providing health and safety inductions, training and courses for all employees, and regular safety training courses (both internal and external), there were four fatalities, one serious injury, several lost-time injuries and a number of near-miss incidents over the lifetime of the mine. Injuries at Lisheen mine was at a lower rate than the national average and the average for industrial sectors for the time.
- The mine had a negative effect on local community health, safety and well-being through noise and vibration issues experienced by local residents, and received several complaints each year in relation to this.
- The mine had a positive effect on local services and infrastructure, including €5 million on road improvements, €2.5 million on upgrading local water schemes, and the construction of a 60MW wind farm.
- In addition to infrastructure, the mine invested about €1.5 million in local sports, club and community facilities. The Moyne Community Engagement Forum was reportedly influential in securing sponsorship, with the mine's systems of structured community engagement allowed for community members to lobby for support for different projects. This resulted in a long-term positive effect in terms of improved social infrastructure.

The **environmental assessment** of effects considers how Lisheen mine affected the stock of natural capital in terms of its extent and condition (quantity and quality) as well the benefits it provides (ecosystem services), as follows:

- The mine resulted in a long-term change of use from agriculture to industrial. This resulted in an overall loss of 42 hectares of pastureland within the footprint of the mine, which could have produced 31,400kg of output each year and which persisted through all phases of the mine. Following closure of the mine, the TMF was rehabilitated to grassland.
- While there was also a loss of peatland, the quality of this habitat was poor at the baseline as a result of prior peat production, meaning that the effect of mining activities was not considered to be significant.
- Generally, the mine had an impact on surface and ground waterbodies, and there was generally a reduction in the quality of surface waters within 3 km of the mine from the operation phase until the closure of the mine. In addition, issues with sediment were detected in the Drish and Rossestown River. However, in some cases it was not possible to isolate the effect that mine activities had on water quality, given the role of other factors. In other cases, the status of affected waterbodies at the baseline was on the lower end of the spectrum, which meant they

were deemed to not be sensitive receptors, and that the impact of the mine was therefore deemed relatively less significant. Where significant issues were detected however or where water quality exceeded limits set by the IPCL, authorities and the mining company took action to remedy this.

- During the closure phase of the mine, operators created a wetland to trap excess nutrients at discharge points which were removed during the closure of the mine. The wetland takes run-off from the TMF, making it less likely that nutrients can escape. As with Galmoy, these wetlands are expected to result in improvements to water quality and biodiversity, and is reportedly growing well.

- Production of ore during the mining operations was around 1.4 million tonnes per year, corresponding to around 300,000 tonnes of zinc and lead concentrates each year. This effect is considered to be negative from an environmental perspective as it constituted an extractive use of a non-renewable natural capital asset. However from an economic perspective, this would be considered a positive effect as it promoted economic activity.

- Lisheen was one of the largest users of energy in the country. It consumed an average of 123,000 MWh per year, and its annual energy consumption was the equivalent of that of around 6,650 households. This led to the emission of 1.2 million tonnes of CO_2 over its lifetime, with an estimated cost to society of €24.56 million. However, this impact was reduced by the construction of a wind farm on-site: its 30 turbines generated renewable electricity for the mine, and following closure, enough energy to fully power 14,200 homes.

The **economic assessment** of effects of Lisheen demonstrates the effect that the mine had on components of manufactured and financial capital, as follows:

- Lisheen mine produced an average of 300,000 tonnes of zinc and lead concentrate each year, and was responsible for about 35 per cent of national production at its peak. The total turnover from all the mine companies that extracted ore from Lisheen was estimated at €2.76 billion.

- This resulted in €1.276 billion of Gross Value-Added (GVA). Activities in Lisheen mine were responsible for 11% of GVA for the Mining and Quarrying sector. Although this is large relative to the mining and quarrying sector (which includes all extraction activities in Ireland, including non-mineral extraction such as aggregates and stone quarrying), it is small relative to the overall Irish economy, as the entire sector (Mining and Quarrying) accounted for just 0.5% of Irish GDP during this period.

- Zinc and lead concentrate was exported through the Port of Cork. While this was positive for the Port, concentrate represented an overall small proportion of its total exports and trade, and the closure of the mine had on a minor impact on economic activity.

- Nearly €2.29 billion was spent directly during its construction and operations phases, which resulted in indirect expenditure of €1.97 billon by suppliers to the mining industry, and induced expenditure of €1.57 billion by employees spending their wages. According to the mine[64], 31 per cent of non-labour spending was with businesses within the local region, while 80 per cent% was with businesses based in Ireland

- €24.17 million was also paid into a closure bond, with most of this spent on planned closure works, and small amounts set aside for contingencies. While this has covered the cost of these works, there is a temporary gap in the financial provisions for the aftercare period which is currently being addressed by the relevant authorities.

- When the mine was operational, it directly employed an average of 350 workers, and indirectly supported the employment of an additional 493 full-time equivalent workers through the

[64] Lisheen Mine 2013-14 Sustainability Report

businesses that supplied the mine and through jobs created by the goods and services that mine workers bought in the wider economy.

- Lisheen contributed to public finances in several ways, including about €65.3 million paid in royalties and dead rent, €55.3 million in corporation tax, €36 million in employer's PRSI and €77.4 million. It also paid commercial rates to North Tipperary County Council in the region of €16.5 million, and development contributions of €6.58 million.
- In terms of manufactured capital, improvements to infrastructure such as roads, power and water services that were made during the lifetime of the mine's operation are still in place. The buildings are a legacy effect of mining activity, and have enabled the continued use of the site for commercial purposes. These built facilities have been repurposed s the National Bio-economy Campus, which has attracted investment and the creation of around 50 jobs.

7. Conclusions and recommendations

The following section presents the conclusions and recommendations from the study.

7.1 Conclusions

For nearly two decades, the Galmoy and Lisheen mines operated in an area on the borders of Co. Kilkenny and Co. Tipperary. From before they opened to after they closed, this study has aimed to address the overarching question of whether and how they affected the communities and environments in which they operated.

This study has identified key social, environmental and economic effects of the mines using an integrated capitals approach, which provides a means to identify the potential range of effects and dependencies from a holistic perspective. Six capitals from which people and organisations obtain value were used to frame these effects: social, human, intellectual, manufactured, financial and natural. By using this process, it is possible to assess how one capital can be traded off against another. For example, mining and selling zinc and lead concentrate, which has a positive effect on financial capital, requires a large amount of energy, which represents a depletion of and negative effect on natural capital assets. Effects on these capitals were examined where they occurred, where they represented a significant change in these capitals, and where they could be directly attributed to the mines.

In terms of social effects, there were clear positive effects from jobs provided locally and the skills gained by employees. Mining jobs, by their nature, are rarely permanent: ore is finite, and the depletion of this resource will inevitably result in job losses and redundancies, which have the potential to significantly and negatively impact local communities when the mine closes. However, as closure was known in advance, both mines put in place training and up-skilling programmes to prepare former employees for alternative employment once the mine closed. Both mines displayed good social responsibility towards their workers in the transition out of employment at the mines

There is significant evidence that these programmes enhanced workers' employability and resulted in relatively high rates of employment among former workers. Many of the skills developed while working at the mines were transferable to other industries, while some workers found employment in other mines in Ireland, Northern Ireland and globally. While job losses in general are certainly a negative event, the evidence in the case of Galmoy and Lisheen suggests that the effects of unemployment on a community can be mitigated by well-planned training and up-skilling programmes. This is a significant finding not only for the mining industry, but for any industry based on the extraction of finite resources.

The nature of mining and the potential for injury means that mining operations are subject to strict health and safety regulations. While both mines invested in health and safety training, there were significant social impacts from workplace fatalities and injuries. There were five fatalities over the lifetime of both mines (four at Lisheen and one at Galmoy), as well as a number of other injuries and lost work-time. Any injury undoubtedly has a significant negative effect on the victims, their friends, family and communities. New regulations were introduced in 2018[65] for mining to consolidate existing legislation, and mine operators are required to develop rules and procedures regarding safety in a range of different areas and activities.

In any business, there is an opportunity to create additional social value by way of sponsorship and support to the local community. The evidence revealed significant differences between Galmoy and Lisheen in terms of these additional social effects. Although both mines maintained sponsorship programmes, Lisheen's sponsorship programmes were more significant in terms of the type and magnitude of projects supported, and its investment in local sports and community infrastructure

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[65] The Safety, Health and Welfare at Work (Mines) Regulations, SI 133 of 2018

resulted in benefits for local communities that persisted beyond the mine's operational lifetime. Galmoy's sponsorships, on the other hand, tended to be more short-term, meaning that the effects were more short-lived.

While Lisheen had more resources to input as a result of its size, the evidence suggests that the attitudes and actions of management were also influential in this support. Lisheen also had a more structured system of community engagement than Galmoy, a process that was improved following community concerns revealed by a socio-economic study in 2004. Management set up a stakeholder management plan, as well as quarterly meetings with a local Community Engagement Forum. The mine also implemented an 'Open Door' Policy, meaning that any community member with an issue or grievance could contact management with a view to resolving it. According to interviews conducted as part of this assessment, this policy allowed community members to draw the mine's attention to potential sponsorship projects, and was an important factor in creating the positive relationship between management and community.

In terms of environmental effects, changes to natural capital that could be directly attributed to mining activities were examined. There are historical cases in Ireland, such as Silvermines in Co. Tipperary which was mined for zinc until 1987, where mining-related legacies caused public health scares and left considerable environmental liabilities. Mining in Ireland is now subject to strict regulation, meaning that Galmoy, Lisheen and their local environments were subject to extensive environmental monitoring as part of their licence conditions.

Several positive and negative environmental effects were identified relative to the pre-mining baseline, some of which were considered to be significant. Both mines constituted a change of use from farmland to industrial use, and although some grazing continued on parts of the site at different points in time, this was considered to represent an overall loss of farmland and agricultural output during the time period in which they operated. However, as this loss is small relative to the increase in Gross Value-Added brought by the mines, the effect of this is considered to be minimal from an economic perspective. Much of the land has since been rehabilitated to an agricultural end-point. Similarly, while there was also a loss of peatland to enable Lisheen mine's development, it had already been degraded from being worked prior to development, meaning that the effect of the mine was not considered to be significant overall.

The mines were some of the largest users of energy in Ireland, and although energy use was tracked in annual environmental reporting, the consequences of this energy use in terms of CO_2 emissions was not. Although CO_2 emissions cause considerable long-term harm to the environment by way of their contribution to climate change, the effects of this energy use were perhaps not treated with the same level of detail or subject to the same requirements as other environmental effects. However, by investing in renewable energy in the form of a wind farm, Lisheen mine was able to offset its emissions in later years, and this wind farm continues to generate renewable energy.

Despite the wealth of information, it was not always possible to determine whether the mines had effects on their local environments, and in some habitats, such as water and peatland, it was not always possible to clearly separate the impact of mining activities from other environmental influences. However, water quality in particular was strictly monitored, and where significant issues did arise however, authorities and mining companies took action to remedy them and limit the impact on wider ecosystems.

Mining companies take on a long-term commitment to environmental rehabilitation. Both mines were required to produce a Closure, Restoration and Aftercare Management Plan (CRAMP) outlining their plans for post-closure rehabilitation of the Tailings Management Facility and the mine site in general, and were required to set aside money in a bond to pay for these works and for aftercare and monitoring required by the Local Authorities, EPA and EMD. While the plans and bond amounts were revised on a number of occasions to take account of design changes and additional funding required, based on our review of the available evidence, *AECOM* concludes that the rehabilitation works required by the CRAMP were carried out to a high standard and to the broad satisfaction of the authorities and local communities. As the first mine in Ireland to close under the EU Mining Waste Directive, the works carried out at Galmoy, such as the creation of new wetlands and resulting benefits for water quality and biodiversity, have been noted as examples of best-practice and fed into the closure plans of other mines, including Lisheen. In the case of Galmoy, it was awarded the 'International Green Apple Award for Environmental Best Practice' in relation to the restoration of the TMF.

The mines are still in their passive closure stages, meaning that while there is no evidence to suggest any significant residual effects, it is not possible to be conclusive about their ultimate environmental end-state or whether issues will arise in the future. Current regulations establish a strict liability for mining companies of at least 30 years, and the development of the CRAMP and financial provisions was designed to ensure that companies could not simply walk away from their obligations with regards to closing the mine and rehabilitating the site to more closely reflect the pre-mining environment/closure plan. Although financial provisions are therefore necessary to ensure that funds are available to cover the cost of any potential unknown liabilities during the 30-year aftercare period, the EPA has identified a temporary gap in the financial provisions for this period that is being addressed as a matter of urgency. Even so, there is uncertainty as to whether or what financial provisions are necessary for the period following the 30-year passive closure period.

The EPA specifies several types of acceptable financial instruments for these financial provisions, although the suitability varies depending on the stage. The use of bonds, while suitable for covering the known closure costs, is not sufficient for insuring against unknown liabilities in the absence of a risk transfer mechanism. Of the potential mechanisms for financial provisions for the aftercare period, insurance is the most viable in providing a guarantee of sufficient funds that are readily available to cover the cost of unknown liabilities if they arise.

In terms of the economic assessment, the two mines had overall positive effects on the local and national economies, generating billions of euro worth of spending in the local economies, hundreds of millions of euro worth of tax for the state, and adding to the size of Ireland's economy. In general, Lisheen had the larger economic impact of the two mines examined: it earned more revenue, had higher expenditures and paid more in taxation. While this was largely due to its size relative to Galmoy (Lisheen produced about twice as much concentrate as Galmoy), there is evidence of additional challenges faced by Galmoy, such as a protracted planning process and industrial disputes, that negatively impacted on its profitability. While the effects of profitability are mostly felt by mine owners and were not considered in this assessment, there were some implications for the state in terms of tax revenue (i.e. corporation tax being dependent on profitability).

As well as these more traditional economic metrics, one of the most significant economic effects examined was the increase in manufactured capital. There were substantial upgrades to local infrastructure on and around the mine site, particularly road, energy and water infrastructure. This resulted in positive social effects for members of the local community who benefitted from improved infrastructure and services, but it also represented a permanent asset for other businesses following its closure. Both mine sites have attracted additional investment and jobs, and in the case of Lisheen, a development of national significance on the site with the development of the National Bioeconomy Campus.

7.2 Recommendations

7.2.1 Reporting and Data

The evidence and literature review revealed several gaps in the way data was collected and published that limited the ability to assess the mine's impact on several indicators. For the purpose of future monitoring and mining policies, this section sets out several recommendations relating to reporting and data that will allow for a more comprehensive assessment of the effects of mining.

Recommendations regarding reporting and data	
1	**Integration of social and economic indicators into annual reporting requirements** A consistent log of social and economic indicators is required to fully evaluate the effects of mines on the economy and their local communities. While this is sometimes done on a company basis, such as Lisheen mine's *Sustainability Reports*, the data is not consistent in terms of the mine phases and metrics recorded. This could take the form of a short annual report listing key developments and relevant indicators, such as those contained in this report. Examples of social indicators include: employment, including local employment and profile of workers; training and skills development, including hours, types and expenditure; health and safety training, including hours and expenditure; health and safety incidents and lost-time injuries etc. Examples of important economic indicators include: revenue and GVA; expenditure on salaries, goods, services and utilities, including the use of local and Irish suppliers; taxes and commercial rates paid; expenditure on infrastructure and sponsorship etc.
2	**Health Data reporting** The interviews and the literature review revealed a general lack of monitoring and data of health outcomes, particularly at a small-area level. While data is published at a county level in County Health Profiles, there is opportunity for more proactive linking of the Health Service Executive (HSE) with the EPA and the Exploration and Mining Division of the DCCAE to allow for improved health data and monitoring at a small-area or ED level.
3	**CO_2 Emissions Reporting** The mines tracked energy use in their AERs, although this was generally not expressed in terms of tonnes of CO_2 equivalent. Although CO_2 does not have the same immediate impact on the local area as other effects that are contained in the AER, there is still a significant long-term environmental impact in terms of its contribution to Ireland's national CO_2 emissions and climate change. Annual CO_2 emissions, including from transport and land use, should be included in annual reporting for the purposes of monitoring, transparency and alignment with national policy.
4	**Land Cover Data** Provide improved land cover data to augment CORINE data, a programme which provides pan-European land-use and landcover mapping data, and enable the effects of mining on land use to be observed and tracked over time. The availability of such data would also enable the use of land cover data in other decision-making contexts, and in the development of national and organisational natural capital accounts in Ireland.

7.2.2 Governance

This assessment also highlighted several examples of good practice and governance that resulted in positive social, economic and environmental effects. This section provides recommendations for authorities, mining companies, and other stakeholders relating to governance and best-practice that may enhance the social value of mining.

Recommendations regarding governance	
1	**Stakeholder Management and Community Engagement** The evidence review revealed the benefits of structured engagement with the community, and highlighted several examples of good governance in terms of managing relationships between the mines and local communities. Consideration should be given to the establishment of formal systems of stakeholder engagement at all stages of a mining project's lifetime. These could take the form of a community forum or public consultations in which representatives from the local community and mine management meet on a semi-regular basis; thereby allowing management to provide regular updates regarding mine activities, and community concerns and issues to be directly raised and addressed. There is scope for DCCAE to play a role in initiating these forums by bringing sides together, although day-to-day running would be left to management and communities.
2	**Pre-closure training and upskilling** Both mines invested in training and upskilling employees in preparation for closure, such as training, the development of skills portfolios for former employees, entrepreneurship workshops etc. There were significant positive effects associated with this in terms of high levels of re-employment following the mines' closure. These practices should be highlighted and incorporated as part of the formation of future mine closure plans. This has relevance to sectors beyond mining, particularly in relation to industries which have finite lifespans, e.g. when the business/industry knows there is a closure date to activities. This may be particularly relevant to sectors highlighted in the Government's *Climate Action Plan 2019*; in line with objectives outlined therein of ensuring a 'Just Transition' for workers and communities affected by a shift from fossil fuels.
3	**Renewable energy generation** While Galmoy and Lisheen were some of the largest users of energy in the country, Lisheen was able to significantly reduce its impact on the environment by investing in renewable energy in the form of the wind farms. As (underground) mine sites generally have a large footprint of land, this suggests that there are opportunities for on-site renewable energy generation to reduce their consumption of fossil fuels.
4	**Financial Provisions in the Aftercare Period** Financial bonds on their own, while suitable for ensuring that there are sufficient funds for the known closure costs, are not suitable for insuring against unknown liabilities in the absence of a risk transfer mechanism. Of the potential financial instruments for the aftercare period, insurance or a central risk transfer mechanism integrated with the current bond system, are the most viable ways to provide a guarantee that sufficient and readily-available funds to cover the cost of potential unknown liabilities. However, there is still significant uncertainty regarding financial provisions for the post-aftercare period, and whether if an unexpected incident occurred in 50-years' time, for example, there would be a mechanism to ensure that those funds are readily available. There is need for clarity on who the insurer of last resort would be in such an instance.

Appendix A
Study Methodology

8. Appendix A. Study methodology

A.1 Note on choice of methodology

This study is neither a 'before-the-event' impact assessment which strictly follows impact assessment guidelines, nor is it a formal 'after-the-event' evaluation or fitness check for a particular policy (as required in Ireland when spending exchequer funding, under the Public Spending Code). As such, a conceptual framework for this study was developed which reflects a hybrid approach and draws on a range of best practice guidelines and standards. The review of these guidelines and standards focused on how various sources went about defining the spatial scope, time-based scope, significance of effects, and the general steps in an assessment. The sources reviewed included:

- The Irish EPA's guidelines for preparing Environmental Impact Assessment Reports (EIARs);
- The UK's HM Treasury Magenta Book for guiding project evaluations;
- The European Commission's guidelines for impact assessments and evaluations;
- The OECD's guidance on sustainability impact assessments;
- The International Association for Impact Assessments' (IAIA) guidance for Social Impact Assessment (SIA);
- The International Council on Mining and Metals' (ICMM) guidelines on the assessment of social impacts and opportunities; and
- The Capitals Coalition's Natural Capital Protocol and Social & Human Capital Protocol.

This section presents the step-by-step methodology for the project which follows the conceptual framework set out in Section 2.2 of the main report.

A.2 Phase 1: Literature review

Phase 1 of the study involved a review of documents with information recorded in a systematic way. The evidence review covered over 200 documents to assist in identifying the effects of the mines in qualitative terms and physical terms where possible. The full list of documents is presented in Appendix D.

In the current regulatory environment, a potential mine owner submits three applications for the necessary permissions to open a mine: (i) to the local planning authority for planning permission, (ii) to the Environmental Protection Agency for an Integrated Pollution Control Licence (IPCL), and (iii) to the Department of Communications, Climate Action and Environment for a State Mining Facility. An IPCL also requires a Closure, Restoration and Aftercare Management Plan (CRAMP) which is reviewed and updated annually to adapt to new information or changing circumstances. An Annual Environmental Report (AER) is submitted to the Environmental Protection Agency (EPA). These documents were made available by the EPA and DCCAE and were reviewed for this study. The mining companies' annual and occasional reports and annual financial accounts were also reviewed. Additional desk-based research was undertaken to gather local information pertaining to both mines including of a scan of local newspapers.

To facilitate the data review, an information-gathering template was developed. This allowed the research to be conducted in systematic and efficient way, promoting consistency with respect to the type of information and level of detail that was collated for each of the mines.

The guiding research questions during the document review process were:

- What is the change in the baseline, as defined by the absence of mining activity?
- What did the effect have an impact on?
- How significant was the impact?
- Was the impact temporary or lasting/residual?

Effects were considered relative to the baseline for each of the mine life cycle stages.
The focus was on:

- The effects of **operation** compared to what the environment would have been like in the absence of the mines;
- The effects of **closure** and **decommissioning** relative to how things were during operation; and
- The long-term effects of **rehabilitation** compared how things would have been if the mines had never been established.

Following the evidence review, the phases or stages in the life cycles of the mines were modified. It was found that the decommissioning and rehabilitation phases overlapped, and this phase was classified as 'closure' extending into the passive care phase.

A.3 Phase 2: Interviews

Following the evidence review, a selection of targeted stakeholder interviews was undertaken to supplement and verify the findings. Interview questions were designed to elicit testimony and opinion from stakeholders, via semi-structured telephone interviews. Interviewees were selected to cover a range of stakeholder groups and to ensure that different perspectives were captured, and included mine executives (general, sustainability, health and safety managers), mine employees, regulators (including the EPA), local authorities, community members, adjacent land owners, and local economic development agencies. In total, four stakeholders for Galmoy and six for Lisheen were interviewed, although given the small catchment area, many had knowledge of both mines. Additionally, four cross-cutting interviews with representatives from public bodies were also undertaken.

The topics covered in each interview varied, depending on the interviewee, and their relationship to the mine, but included exploring levels of skills required for the mines and training opportunities provided; governance within the mining companies and employment issues such as industrial disputes and preparation for mine closure; interaction between the mine companies and local communities, including sponsorship and philanthropy; employment effects of the mines, including the movement of employees after mine closure; legacy effects of mining activity on the local community; health impacts on the local community and health and safety within the mines.

A.4 Phase 3: Identifying and screening effects

The evidence collected through the literature review and interviews was synthesised and analysed to determine the social, environmental and economic effects of the two mines. The effects were then screened to determine significant effects based on the approach set out in Section 2.3 of the main report.

Note that given that the study is an ex-post assessment of effects, it focused on what happened, rather than what could have happened under different scenarios. For example, if environmental mitigation measures were implemented in a certain context, then the study considered the effects of mitigation rather than what might have happened in the absence of mitigation. Importantly, many of the changes in the status of local communities and the environment were related, not to mining, but to other factors, e.g. economic conditions. While the study attempts to determine effects that are related directly or indirectly to mining activities, in some cases it is not possible to definitively attribute changes to mining activities rather than external factors.

A.5 Phase 4: Measurement and valuation

After the significant effects were identified, they were assessed in terms of our ability to quantify and/or monetise these. In all cases, the nature (beneficial or adverse) and significance (negligible, low, moderate, high) of effects were described in qualitative terms before being quantified and valued where possible and appropriate. In cases where it was not possible to quantify effects, these were described in qualitative terms only. Monetary valuation of significant effects, where appropriate, considered the suitable valuation methods, including value transfer techniques (i.e. the process by which readily available economic valuation evidence is judiciously applied in a new context for which valuation is required - of relevance for ecosystem services, and effects on natural capital).

Appendix B
Supporting Evidence for Galmoy mine

9. Appendix B. Supporting evidence for Galmoy mine

B.1 Social effects

The information below sets out the data collected from the literature reviewed, external sources and interviews for Galmoy mine.

B.1.1 Population

Baseline

During the baseline, there was a 0.4% decrease in the overall population of Ireland. In comparison, the population in the wider area surrounding the mine increased by 0.6% during the same timeframe. Conversely, the population in the immediate local area to the mine (Galmoy Electoral District) declined by 5.5%. The heightened rate of population decline within the local area, compared to regional and national trends, can be attributed to large-scale outward migration from the area.

Construction

The local area experienced a 14.9% decrease in population during the mine's construction. This was the opposite trend to that experienced regionally and nationally, with both County Kilkenny and the whole of Ireland showing an average population increase of 2.3% and 2.8% respectively. Given the rural nature of Galmoy, it was very common for people throughout Ireland to move away into urban areas for greater employment opportunities during this time.

Operation

During the operational period of the mine, the population growth rate in Galmoy averaged 2.8%. It may be that the opportunities brought about by the mine encouraged a net in-migration of people to the local area. However, the population of the wider county and country also experienced an increase in population growth (both 8.2%), therefore this trend may reflect the growing population in Ireland during this time-period.

Closure

After the closure of the mine, regional and national population growth rates slowed to 3.9% and 3.8% respectively. Within the local area, the population growth averaged 2.6%, which is below the country and national averages for the same period. Compared to the previous phases of the mine, the rate of population change post-closure of the mine was closest to the regional and national averages.

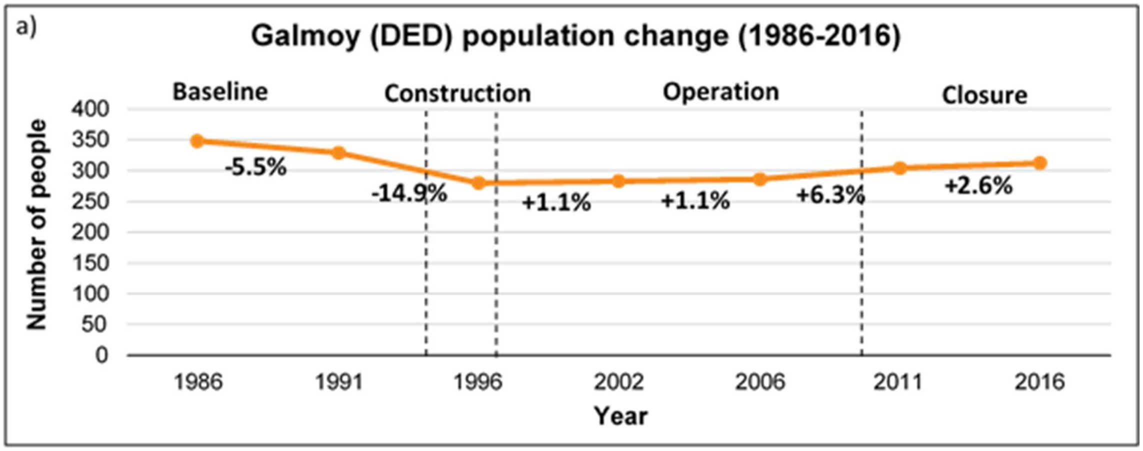
Over the lifetime of the mine, the population of the local area decreased during construction and increased during the operation and closure phases of the mine. However, it is difficult to isolate the effects of the mine on local population, given the wider social and economic changes in Ireland from 1986 to 2016. A summary of population change over the lifetime of the mine is provided in Table B.1.1 and Figure B.1.1 below.

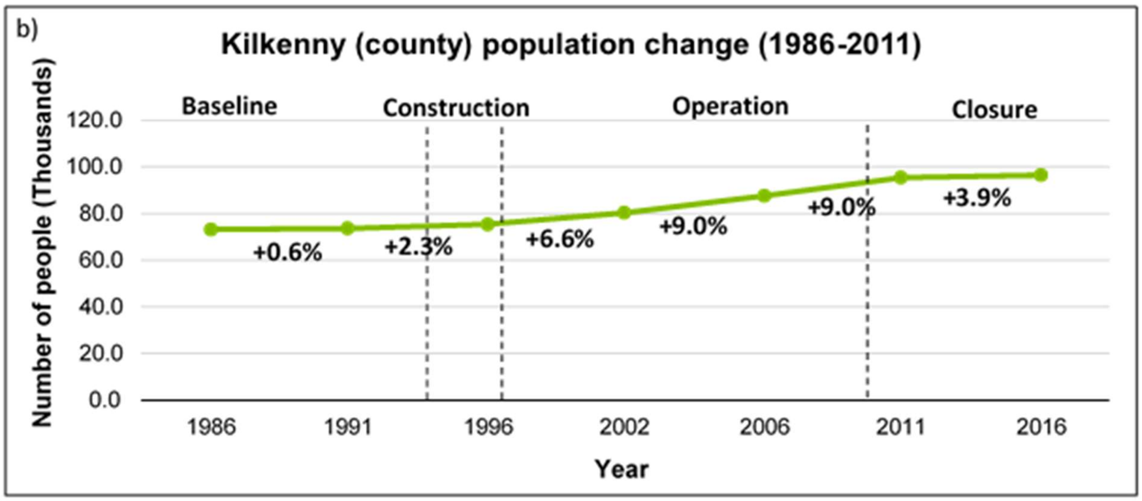
Table B.1.1: Average rates of population increase over the different phases of Galmoy mine

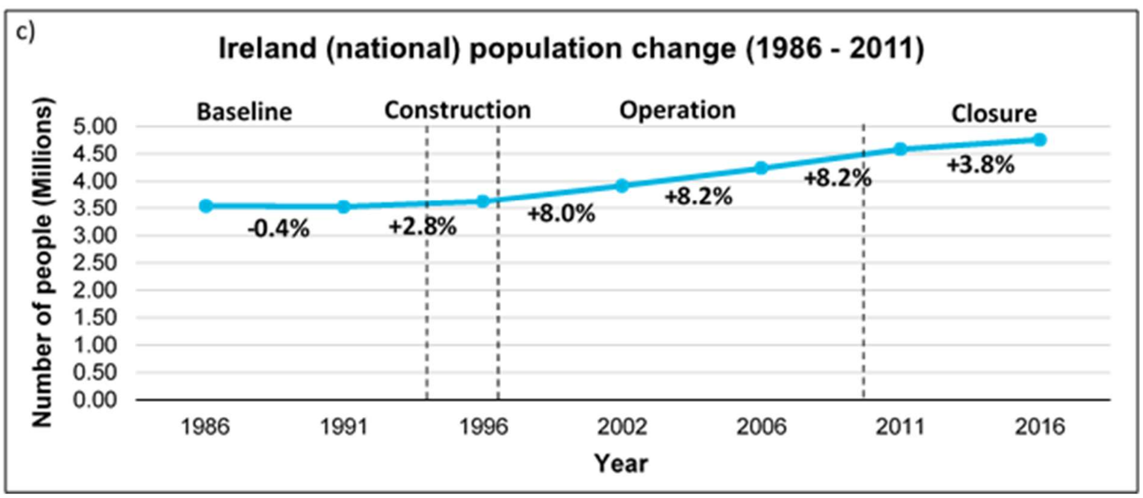
		Baseline	Construction	Operation	Closure
Average rate of population change	Galmoy DED	-5.5%	-14.9%	+2.8%	+2.6%
	County Kilkenny	+0.6%	+2.3%	+8.2%	+3.9%
	Ireland	-0.4%	+2.8%	+8.2%	+3.8%

Source: Central Statistics Office

Figure B.1.1: Population change within the a) local, b) regional and c) country areas, over the lifetime of Galmoy mine (1986-2016)







Source: Central Statistics Office

B.1.2 Employment

Baseline

During the baseline period, unemployment levels throughout Ireland were high, averaging around 15.4% (see Figure B.1.2). The unemployment rate within the local area was lower during these years (approximately 7.3%) compared to the regional and national rates (13.3% and 15.4% respectively). This is likely due to out-migration of working age people from the local area, rather than due to greater employment opportunities within the local area.

Figure B.1.2: Rates of unemployment across the whole of Ireland, over the lifetime of Galmoy mine (1986-2016)

Source: Central Statistics Office

Construction

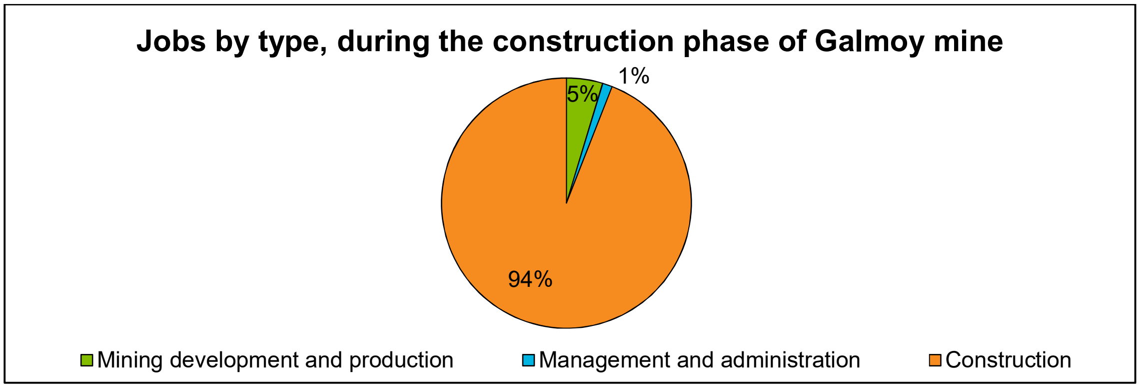
During construction, there were up to 370 people directly employed by the mine. Of these employees, 94% were involved in construction, 5% were involved in mining development and production, and only 1% were involved in management and administration (see Figure B.1.3). However, given the short-term nature of construction, it is likely that less were full-time equivalent workers.

In addition to the direct employment impact, it is estimated that there were 340 indirect[66] employees and 181 induced[67] employees during construction of the mine (see Figure B.1.5), although this would vary depending on the number of full-time workers.

[66] Indirect jobs are created by the mine purchasing goods and services from other businesses e.g. suppliers, contractors.

[67] Induced jobs are created by the mine employees using their salaries to purchases goods and services within the local community.

Figure B.1.3: Breakdown of the job types of employees during the construction phase of Galmoy mine



Unemployment rates throughout Ireland remained high during the construction of Galmoy mine, averaging 13.92% (see Figure B.1.2).

Due to a lack of data, it is difficult to determine the percentage of employees that came from the local area during the construction phase. Therefore, it is not possible to understand the full impact of the mine's construction on employment in the local community. The evidence review suggests that most construction employees were brought in from outside of Ireland (for example, many came over to Galmoy from Cornwall, UK). This transient workforce would have been unlikely to contribute positively to the local community, since a lack of hotel facilities in Galmoy meant they had to stay in larger towns such as Thurles or Kilkenny.[68]

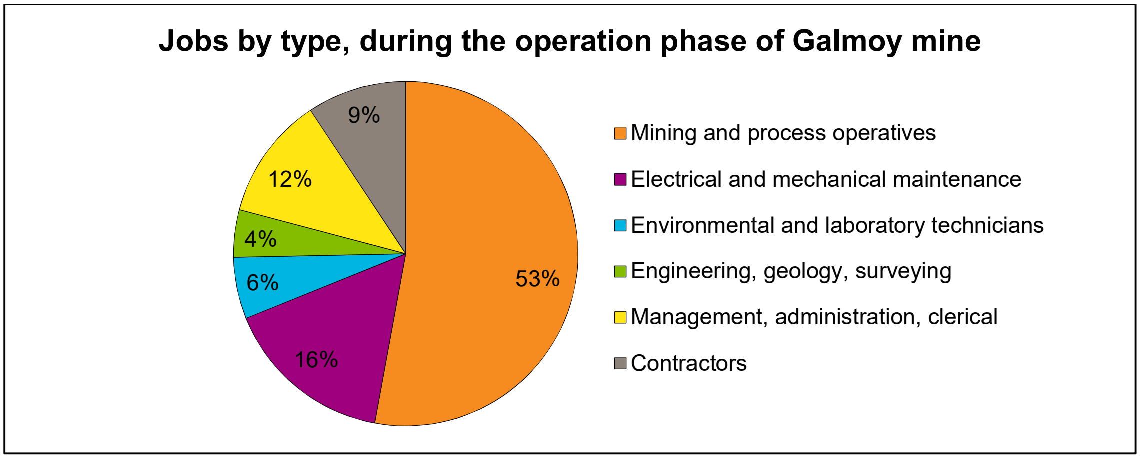
Operation

Throughout operation of Galmoy mine, there was an average of 213 people directly employed by the mine. As summarised in Figure B.1.4, the types of these jobs can be categorised as follows:

- Mining and process operatives (53%);
- Electrical and mechanical maintenance (16%);
- Environmental and laboratory technicians (6%);
- Engineering, geology, surveying (4%);
- Management, administration, clerical (12%); and
- Contractors (9%).
-

[68] Based on interviews conducted for this study

Figure B.1.4: Breakdown of the job types of employees during the operation phase of Galmoy mine



In terms of indirect employment, it is estimated that there were 202 people indirectly employed during the mine operation. Additionally, induced employment during this phase was estimated to be 107 people (see Figure B.1.5).

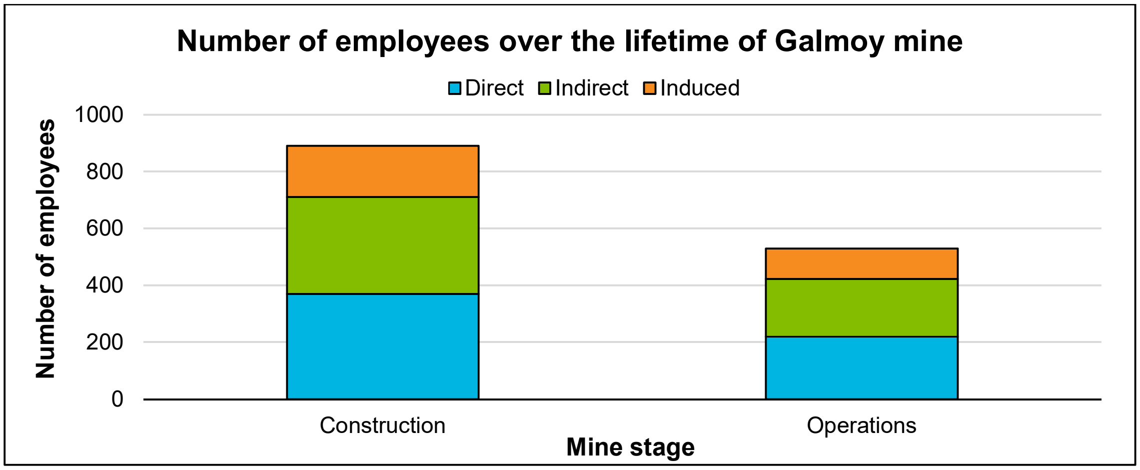
When the mine first opened in 1997, unemployment rates in Ireland were still relatively high, at around 10% (see Figure B.1.2). Therefore, the job opportunities brought by the mine would have had a positive impact on society. Over the years of operation, the national unemployment rates dropped to 3.9% in 2001 and remained low for most of its operational period. While this might ordinarily suggest that the need for job opportunities was relatively low during the operations phase, rural areas such as Galmoy often do not receive the same level of job opportunities compared to national levels.

Various news reports from early on in Galmoy's operational period suggest that there was disappointment at the low number of job opportunities available locally as employment opportunities were predominantly being offered to people from outside of the area. However, it was estimated that the mine brought good employment and well-paying jobs for the local community, with approximately 32% of operation employees living within 10km of the mine site, and 80% within 30km[69]. Therefore, it can be concluded that there was some positive employment impact on the local community during operation. However, interviews revealed that workers were not always satisfied, with incidences of sit-out strikes for a few weeks due to pay demands[70].

[69] Census 2006 Place of Work, School or College – Census of Anonymised Records (POWSCAR)

[70] Based on interviews conducted for this study

Figure B.1.5: Estimated number of employees during construction and operation of the Galmoy mine, broken down to direct, indirect and induced employees



Closure

After the mine was closed in 2009, over 200 full time jobs were lost from the area. This closure came in the context of the late-2000s Recession, and with national unemployment levels increased to approximately 12% that year, this would have had a negative on the employees that were made redundant, as well as on the employment opportunities available within the local community. However, in order to compensate for the loss of jobs once the mine was closed, relatively good redundancy packages were provided to employees. It was not possible to track the employment status of ex-employees after the mine closed; however, reports suggest that unemployment effects were minimal.

After the mine was decommissioned, AQS, an environmental waste services company, bought a section of the site. This new company could bring positive impacts on employment for the local area, to compensate the negative employment impacts experienced from the mines closure, although evidence from interviews conducted as part of this assessment concludes that the level of employment on the site currently is relatively small.

However, there is the potential to reopen Galmoy mine as there are some resources left. If this was to go ahead, employment benefits, particularly for individuals who had experience working in the mine previously, could be expected. It is estimated that up to 50 jobs could be created over a 5-year period[71], although this has yet to occur at the time of writing.

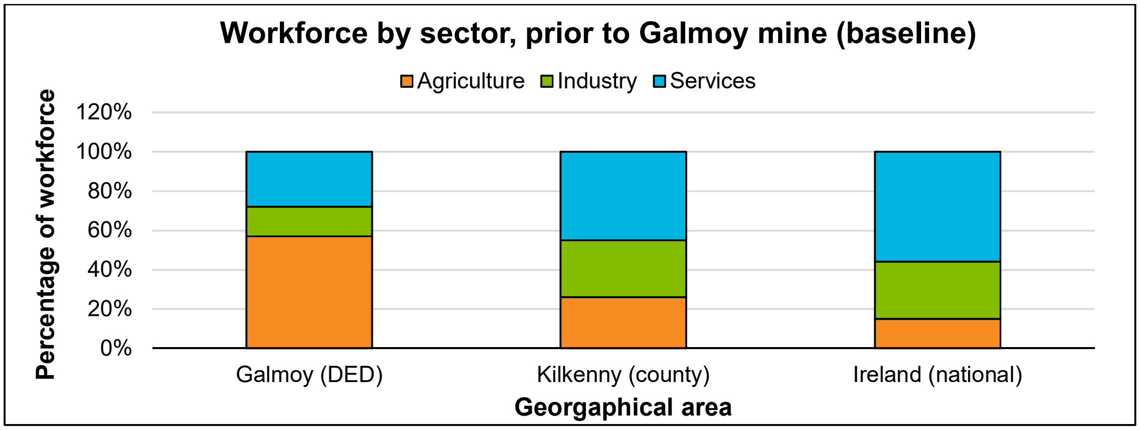
B.1.3 Education and Skills

Baseline

Prior to the development of the mine, the workforce of the local area specialised in agricultural work, with only 15% of residents working in the industrial sector and 28% working within services (see Figure B.1.6). In contrast, jobs within the agricultural sector were the least common across county Kilkenny and the whole of Ireland. At the regional and national level, a higher percentage of the population were working within the service sector and around 29% worked in the industrial sector. These trends show that within the local area of the proposed mine, agricultural knowledge, experience and skills were higher than regional and national averages, however industrial and service knowledge, experience and skills were lacking in and around Galmoy.

[71] Irish Mining and Quarrying Society, 2018. Available at: https://www.imqs.ie/news/cde-announces-new-mining-division-and-plant-expansion-2-2/

Figure B.1.6: Breakdown of the workforce by sector within the local, regional and country areas, prior to construction of Galmoy mine (baseline)



Construction

Most skills required during the construction of the mine were not present within the local community given the specialised nature of the work. Therefore, it can be concluded that many construction employees were external specialists and hence there were limited to no opportunities to upskill local people during construction. Additionally, given that no information was available on the skills development or training of employees, there is insufficient evidence to suggest any impacts on education and skills during this phase.

Operation

As a significant proportion of workers lived locally (Table 3.3), it is likely that the operation of the mine improved the skills levels of the local community. However, there was insufficient data regarding resources used by the mine for upskilling and training purposes to determine the level of effect that operations had on the skills and education of employees.

About 12 months prior to the mines closure, employees were given opportunities to take various courses in order to upskill for future employment. It is important to note that the inputs for this measure occurred in the operations phase of the mine, while the outcomes of the measure would have occurred post-closure of the mine, when employees had to find alternative employment.

Closure

There is some evidence that ex-employees of Galmoy mine were able to use the transferable skills that they gained during their time at the mine to gain employment at the nearby Lisheen mine and receive better pay as a result. Some workers also went on to work in Tara Mines, as well as in other mines in Northern Ireland and globally. Therefore, it can be concluded that after the Galmoy mine was closed, the employability of ex-workers improved.

B.1.4 Health and Safety

Baseline

Prior to the development of Galmoy mine, there were no reports of adverse or unusual epidemiological data from the surrounding local area.

Regarding noise and vibration levels, the principal sources of noise in the local area were road traffic, livestock and agricultural activity. At night, equivalent continuous noise levels were 34 dB(A) to 40 dB(A), and during the day, equivalent continuous noise levels were 47dB(A) to 55 dB(A).

Construction

In terms of employee health and safety, there were no fatalities, accidents, injuries or near misses reported during the construction phase. While all employees would have undertaken standard H&S training as part of their induction, there is no record of money or time spent on health and safety training for employees during the construction phase.

Though changes in noise and vibration levels experienced by the local community may have been a consequence of the construction of Galmoy mine, the literature review and interviews did not identify evidence to determine this.

Operation

Regarding the health and safety of the operation employees at the mine, the company ensured that 2,000 to 4,000 certified hours of health and safety training was completed during each year of operation. In addition to this, the company commissioned a four-day intensive training course on safety awareness hosted by an occupational health and safety firm. This course was attended by 72 employees, and eight additional sessions were held for a further 154 employees.

Despite these resources having a positive impact on employee health and safety, there were also negative effects during the operation phase, including the following serious incidents:

- In 2007, the collapse of a guardrail led to the death of one of its workers. Galmoy Mines Ltd. was later fined €100,000 for breaches of health and safety regulations in relation to this.
- One employee accident resulted in the loss of the employee's hand.

There was no data on injuries during operations, meaning that it is not possible to determine Galmoy's rate of injuries per million hours worked, or to comment on its health and safety performance relative to other mines.

During operation, the biggest complaint among residents was regarding the impacts of noise and vibration as a result of underground blasting. Residents noted that there was no damage to their properties as a result of the blasting, but that the vibrations were disturbing nonetheless[72]. Noise levels within the immediate vicinity of the mine increased during the operational phase of the mine. This is largely due to the increase in road traffic (to and from the site) and blasting activities which occurred at set times during the day. These blasts lasted over relatively short periods of time, were scheduled at specific hours of the day and were suspended on Sundays and public holidays[73]. The concentrator building incorporated noise control measures to ensure that noise levels at the nearest residence did not breach levels set in line with WHO Guidance. During operation of the Galmoy mine, noise was regularly monitored, and noise complaints were investigated:

- In 2005, noise impacts from the mine were considered to be minimal, as verified by the independent noise survey at four noise sensitive locations close to the mine site. Day and night time ELV[74] were exceeded at these stations but the events were not attributable to mining activities, but rather were found to be attributable to bird song, livestock and agricultural activities. In 2005 there was an absence of noise complaints from the general public [75].
- In 2006, there were three complaints related to noise and vibration, however all of these were investigated and found to be within licence limits. [76]

[72] Based on interviews conducted for this study

[73] EIS 2000, volume 2 section 10 (Vibration)

[74] Exposure Limit Value: The maximum amount of vibration an employee may be exposed to on any single day

[75] ARCON Mines Limited 2004, Annual Environmental Report 2004

[76] Galmoy Mines Ltd 2007, Annual Environmental report 2006

- In 2007, there were two complaints in relation to noise and vibration resulting from blasting, however these events were investigated by the environmental department and found to be within licence limits. [77]
- In 2008, blasting was carried out three times daily. Due to the proximity of the K2 orebody to residential dwellings, blasting in the K block only took place between 10am and 4pm.
- In 2009, there were two complaints in relation to noise and vibration resulting from blasting, however both were investigated and found to be within legal limits.[78]

With regard to local health and safety, there was one subsidence incident when cracks appeared on a section of the Whiteswall Road. While no one was directly affected or injured, it did lead to the temporary closure of that section of the road.

Closure

Following the mines closure, there was one occurrence of a sinkhole in February 2014. While the sinkhole did not result in any significant health and safety concerns for the general public, the sinkhole came as a shock to the landowner who reported took a long time to get over the stress of the incident[79]. As a result, mitigation and remedial measures were put in place to prevent any similar incidents happening in the future. The landowner received compensation from the mine, however had to hire a geologist to assess the impact of the sinkhole and potential for future risk and implemented additional measures (e.g. planting oak trees and evergreen trees) to reduce the risk of future incidents.

Though changes in noise levels may have been a consequence of the closure of Galmoy mine, the literature review and interviews did not identify evidence to determine this

Additionally, during the closure of the mine, there were no incidences of fatalities, accidents, injuries or near misses reported.

B.1.5 Community

Baseline

The community services provided to the local area prior to the construction of the mine are detailed below:

- Public transport along Rathdowney/Johnstown road comprised of twice daily private bus services between Urlingford and Portlaoise, via Rathdowney.
- Ballybrophy railway station, located 16km from the mine site by road, was on the main rail route to the south from Dublin.
- Primary schools were located in Galmoy, Crosspatrick, Johnstown, Rathdowney and Urlingford, and post primary schools were located in Johnstown and Rathdowney.
- Single phase electricity for agriculture and residential purposes was distributed at 10kV on overhead lines.
- Telecommunication services (designed for domestic use) were supplied on overhead lines.
- Health centres in County Kilkenny were located at Ballyragget, Castlecomer, Freshford, Johnstown and Urlingford.

[77] Galmoy Mines Ltd 2008, Annual Environmental report 2007

[78] Galmoy Mines Ltd 2009, Annual Environmental report 2009

[79] Based on interviews conducted for this study

- District hospitals were located in Abbeyleix and Castlecomer.
- General hospitals were located in Portlaoise and Kilkenny at which accident and emergency services were available.

It was noted that prior to the construction of the mine, particular services, including telecommunication and electricity needed improving and additional facilitates were required to meet the meets of the local community.

The area around the proposed mine site was largely residential and sparsely dispersed throughout the area.[80] The roads within the local area were typically country roads, about 3-4 metres wide, and traffic in the area, prior to the mine, was limited. It was estimated that on the R435 Johnstown to Rathdowney road, traffic levels were 50-100 passenger car units (car-1, Truck-2, Articulated truck-3) per hour (two-way flow). The free flow capacity of the R435 was calculated to be 550 passenger car units per hour, however baseline flows only ever reached 25% of the available capacity.[81] Thus, there was no major traffic disruption during the baseline stage of the mine. The condition of local roads did not change throughout the baseline period.

In terms of social cohesion, there was a general reluctance to introduce mining to the area initially. The local community was mostly involved in agricultural work and the general perception was that mining would not be a positive development in their area[82]. The main documented concern in the community was the potential impact on the local ground water supply[83]. Although the mine committed to replace the supply with a ring main for the communities, a group of residents participated in a legal challenge to stop the development. Social cohesion can be defined as communities coming together for a communal cause, strengthening the ties between people; and hence it can be concluded that during the baseline social cohesion levels were relatively high among the local community.

Construction

During construction, the mine contributed around £870,000 to Kilkenny and Laois County Councils for road improvements in the area[84], which amounts to approximately €1,488,586 in 2018 values. Following these modification works, road alignment in the area was substantially improved.[85]

In 1996, telecommunication infrastructure was significantly upgraded to facilitate the mines development, which benefited telecommunication users within the local community.

In order to compensate for the planned dewatering regime and the potential effects on local wells, the Mine invested in the Galmoy Replacement Water Supply Scheme (RWSS). This included the construction of a new water treatment plant in 1995[86]. The benefits of this scheme were fully realised throughout the operation and closure phases and are described in these sections.

While there was initial opposition to the mine, the mine paid compensation for land and mineral rights[87]. Aside from this, there was no evidence of the mines support to the local community during the construction phase.

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[80] Eolas (1992): EIA Receiving Environment

[81] Eolas (1992): Non-technical summary

[82] Based on interviews conducted for this study

[83] Based on interviews conducted for this study

[84] EIS 2000, volume 2 section 13 (transport infrastructure)

[85] EIS 2000, volume 2 section 13 (transport infrastructure)

[86] Irish Water (2016): Galmoy Rathdowney Public Water Supply Drinking Water Audit Report.

[87] Based on interviews conducted for this study

Operation

In comparison to the baseline, there were no changes to public transport, health and education services during the operation phase of Galmoy mine.

With regard to changes in traffic on local roads, the peak traffic to and from the mine resulted in an increased flow of 72pcu/day on the R435, which was below the 100pcu/day threshold. Local residents also stated that there was little additional traffic as a result of mining operation, with daily impacts being unnoticed. Therefore, increased traffic from the mine was not found to be a noteworthy effect during operations.

There were positive impacts on local water services as a result of the mine's Replacement Water Supply Scheme (RWSS). Initially established to compensate for the dewatering that would be required for mine operations, the RWSS provided an alternative potable water supply to the local area throughout operation. The scheme was extended to the Galmoy Group Scheme in 2004 as a gesture of goodwill, where water quality had been adversely affected by activities other than mining. The replacement water supply scheme improved local water supply by providing a high quality and reliable water supply for the local community[88].

In terms of supporting the local community, the mine provided very little sponsorship to the local community. One example was identified over the course of the evidence review (the mine sponsoring computers for the local school), however these resources were not considered to be significantly beneficial as they were of insufficient quality[89].

Throughout the mining operation, there was very little formal interaction between the mine and the local community. According to interviews, there the initial relationship between the local community and the mine was relatively poor; one that impacted the local elections in which two candidates on opposing sides ran for election. There were also several public complaints throughout the operation of Galmoy mine (the majority relating to water quality and noise and vibrations), which suggest that mining operations may have impacted social cohesion and relationships between members of the community. However, these negative social cohesion impacts were of relatively short duration, and the mine reportedly responded well to direct communication from local residents. It is important that the mine's closure was met by disappointment from much of the community who expressed their sadness with the loss of jobs and economic activity[90]. This suggests that the relationship between the mine and community had greatly improved over its operations phase.

Closure

Since the mine was closed, there has been no evidence to suggest that there were any effects on the road infrastructure of the local area. Additionally, there were no changes to public transport, health, education, water or telecommunication services during the closure phase of Galmoy mine.

The RWSS continues to supply water to the Galmoy Public Water Group Scheme, meaning that 641 households connected to the scheme, or 1,900 people, in the surrounding area benefited from high quality free water for at least 12 years[91].

In terms of electricity services, it should be noted that the improvements to local infrastructure enabled other businesses to move onto the site following closure, creating social and economic opportunities for the local area.

In terms of social cohesion, there were a number of public complaints throughout the decommissioning of Galmoy mine (the majority of which were regarding noise and vibration). These

[88] Based on interviews conducted for this study

[89] Based on interviews conducted for this study

[90] https://www.irishtimes.com/news/galmoy-mine-to-close-with-the-loss-of-220-jobs-1.941005

[91] EPA, 2016. *Drinking Water Audit of the Galmoy / Rathdowney Public Water Supply*.

complaints may imply that closure of the mine impacted social cohesion and relationships between members of the community.

B.2 Environmental effects

The environmental assessment considers the stock of natural capital assets that are relevant to the evaluation of the mine's environmental effects. This evaluation considers the stock of natural capital in terms of their extent and condition, as well as the flow of ecosystem services (benefits) they deliver. The Natural Capital Committee defines natural capital as the elements of nature that directly and indirectly produce value or benefits to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions (Natural Capital Committee, 2014).

Natural capital assets are identified on the basis of the classification of broad habitat types provided by the UK National Ecosystem Assessment (UK NEA, 2011).[92] To support the assessment, spatial analysis using CORINE land cover data has been undertaken as part of the study to determine the breakdown of land in the mine footprint by broad habitat type. This allows changes in the extent of natural capital as a result of the mine to be identified. The principal habitat within the footprint of Galmoy mine is enclosed farmland.

When it comes to changes in the condition of natural capital, these are considered within 3 km of the footprint of the mine. This allows changes to surrounding habitats as a result of mining activities (such a freshwaters) to be considered, but also avoids an overlap with Lisheen mine which is around 7 km from Galmoy mine (from their mid-point).

It should be noted that definitions of natural capital include mineral deposits. As such, in addition to the habitat types within the footprint of the mine, minerals are considered separately with respect to the mine's operational stage. Air quality is considered as cross-cutting environmental impact as it affects all habitat types.

The flow of ecosystem services delivered by natural capital assets is considered in terms of provisioning, regulating and cultural services. Supporting services are not covered in the assessment as they constitute intermediate rather than final ecosystem services which, when valued with other final services, can lead to double counting of environmental effects. The classification of ecosystem services draws on the UK National Ecosystem Assessment (2011) and the Millennium Ecosystem Assessment[93].

B.2.1 Land Cover

B.2.1.1 Baseline

The Galmoy mine is located in the northwest corner of County Kilkenny, Ireland. Galmoy Village is located nearest to the mine site and the townlands of Castletown, Whiteswall, Rathreagh, Garrylaun and Rathpatrick are also in close proximity. The landscape in which the mine was situated was predominantly agricultural in nature, mainly enclosed pasture, with some areas for rough grazing, as well as hay and silage production. Production of cattle and sheep was the predominant farming use in the area. Pasture existed on the ridges and hill slopes and poorer marshland grazing was present on the valley basins.[94] Prior to the mine there were no particularly distinctive features apart from

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[92] UK National Ecosystem Assessment (2011). The UK National Ecosystem Assessment: Synthesis of the Key Findings. UNEP-WCMC, Cambridge.

[93] Millennium Ecosystem Assessment (MEA), 2005. Ecosystems and Human Well-being: General Synthesis. Island Press, Washington, DC.

[94] Eolas (1992): EIA Receiving Environment

Knockdrinnia Hill to the west and the occasional views to the distant hills on the southern and eastern horizons. [95]

As part of the study, spatial analysis was conducted using the CORINE land cover data that is available for 1990, 2000, 2012, and 2018. Figure B.2.1 illustrates the spatial distribution of land cover for each year of available data. It is complimented by Table B.2.1 which presents the underlying land cover estimates. The total footprint of the mine had an area of around 100 ha in 1990, which corresponds to the baseline for Galmoy mine. All the land within the footprint of the mine was classified as pastureland.

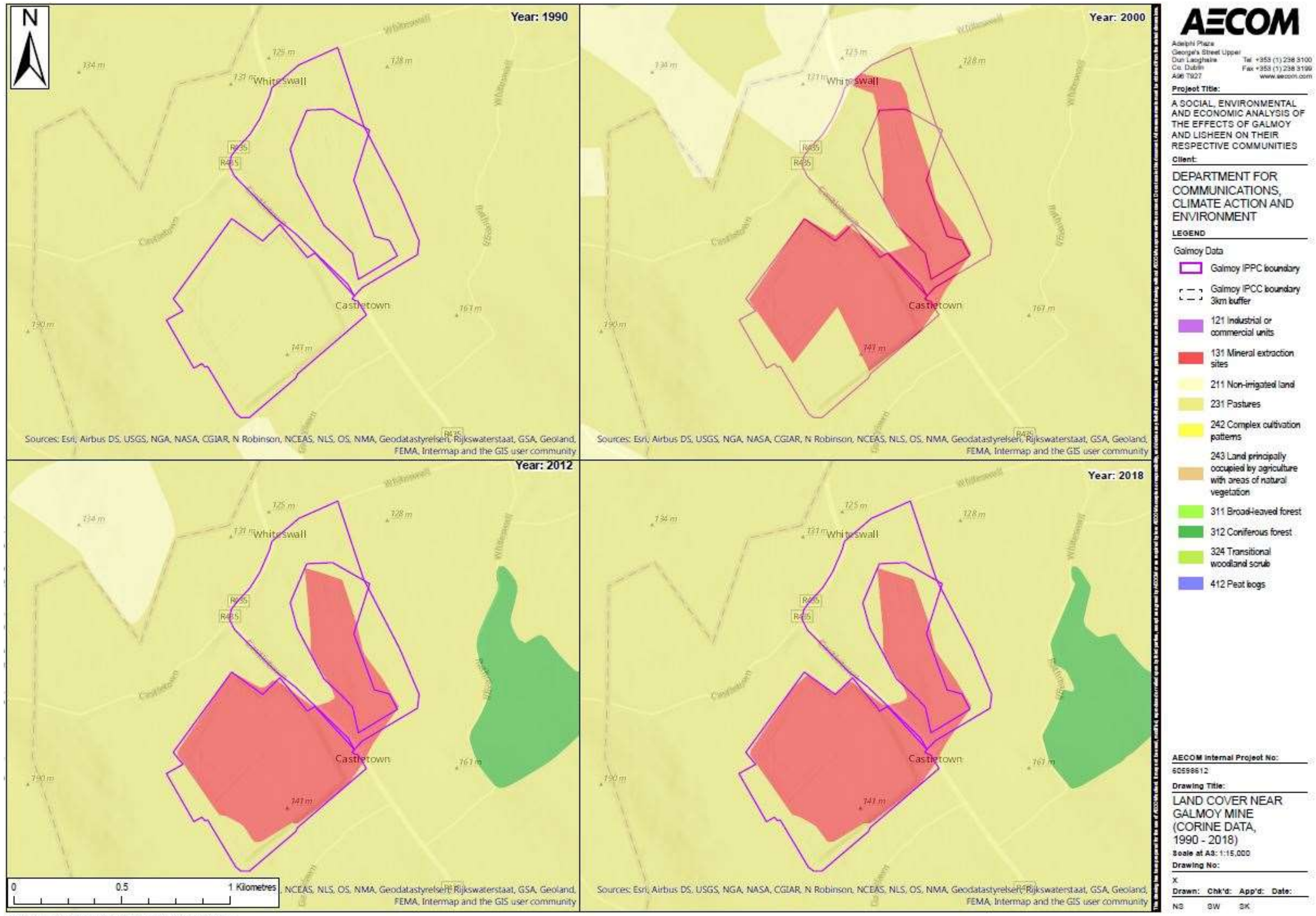
Table B.2.1: Historical land cover estimates within Galmoy mine footprint

Land cover type	Estimated area (hectares)			
	1990 (Baseline)	2000 (Operation)	2012 (Closure)	2018 (Closure)
Mineral extraction site	-	55	54	58
Non-irrigated arable land	-	0.4	-	-
Pasture	100	44	46	42
Total	**100**	**100**	**100**	**100**

Source: CORINE land cover data, 1990-2018

[95] Eolas (1992): EIA Receiving Environment

Figure B.2.1: Historical land cover within Galmoy mine footprint (CORINE data; 1990-2018)



Corine data provided by the European Environment Agency

According to the 1992 EIA which provided more detailed land cover data, the wider land cover types in the area included 90% grassland (40% improved pasture, 60% ordinary/poor pasture), 5% tillage, 3-5% woodland/scrub, 2-3% marshland.[96] There were no natural woods in the area, however there were small areas of woodland/ stands of mature trees nearby, including: Kyle wood, Ballinfrase Mill, Foulkscourt House estate, East of Bord na Mona Baunmore Works.[97] Shrub species located in the area primarily included: hawthorn, dog rose, bramble, hazel and elder with immature ash.[98] Baseline surveys conducted to inform the 1992 Environmental Impact Assessment noted that the hedgerows in the area were considered to be a potentially important habitat for nesting birds (wood pigeon, blackbird, song thrush, blue tit, great tit, wren, starling and yellowhammer) as there are no substantial woodlands in the area.[99] Other notable bird species in the area included: black-headed gulls, rooks, jackdaws and fieldfares, and various finches, skylarks, and pipits.

Most of the streams in the area were small and flowed through pasture lands and had little vegetation on their banks. There were some small stretches where the vegetation had not been cleared, willow, alder and hawthorn were common in these areas, as well as typical riverbank plants such as angelica, meadow-sweet and willow-herb. [100] A turlough, a small seasonal lake which floods in winter, was also present in the area. In terms of protected aquatic species, the white clawed crayfish and the freshwater pearl mussel were identified as being present in the area prior to the existence of the mine. It is not possible to determine from the materials reviewed what impacts, if any, mining activities may have had on these species.

The soil in the vicinity of the mine was found to have elevated values of zinc, and to a lesser extent lead and copper, within the vicinity of the proposed mine development.[101]

The 1992 Environmental Impact Statement identified a number of archaeological features within the area for proposed development including Cody Castle, a nearby rectangular earthwork in Castletown Townland, a circular earthwork in Rathreagh Townland, an earthen enclosure in Castletown Townland, a raised ringfort at Erke, and a possible *Fulacht Fiadh.*[102][103] Two of these monuments were situated within the boundary of the planning application area: Cody Castle and a potential site of oval enclosure. The nearest significant monument was Rathbane ringfort.[104] It is, however, not clear from the documentation reviewed to what extent the presence of the mine has affected the condition of, or access to, these features.

B.2.1.2 Construction

During construction of Galmoy mine several hundred acres, approximately 216 ha, of agricultural land was used for mining purposes. Much of the landscape, however, was maintained and grazing continued[105]. From 1995 onward into the operation phase of the mine there were minor changes noted in species composition and abundance within the wetland habitats. These changes were attributed to land management practices and weather patterns, as well as natural fluctuations in

[96] Eolas (1992): EIA Receiving Environment

[97] Eolas (1992): EIA Receiving Environment

[98] Eolas (1992): EIA Receiving Environment

[99] Eolas (1992): EIA Receiving Environment

[100] Eolas (1992): EIA Receiving Environment

[101] Eolas (1992): Non-technical summary

[102] Eolas (1992): EIA Intro and Project Description

[103] Eolas (1992): Non-technical summary

[104] EIS 2000, volume 2 section 3 (Archaeology)

[105] Based on interviews conducted for this study

species populations. Bird monitoring was discontinued in 1997, as there were no observed impacts of the mine on birds.

A baseline survey of soil geochemistry was carried out at the mine site as part of the 1992 EIS, with results falling within or close to the typical levels for elements in Irish soils.

Between 1996 (construction) and 2000 (operation), there were only minor changes to woodland vegetation, with no significant changes being attributed to a lower water table in Ballinfrase Wood. The majority of the changes have been attributed to cattle encroachment. There were no changes in soil moisture in Kyle Wood and plant species abundance was similar to the baseline. Therefore, mine dewatering did not have a major effect on the diversity of cover of flora at woodland sites.[106]

There were no significant changes in the hedgerows in terms of their overall species content, the structure of the hedgerows, their management and general appearance following mine construction and early production. Where there were differences in the frequencies with which species were observed, these have been attributed to management practices and natural fluctuations[107]. The general health and vigour of the hedges was not affected by mining operations and there were no signs of disease or stress due to drought or other factors recorded over the period. [108]

B.2.1.3 Operation

The literature review and interviews did not provide information about changes in land cover during the operation of the mine. However, spatial analysis was conducted as part of the study as shown in Figure B.2.1. The figure displays land cover data for the year 2000 which corresponds with the period during which the mine was operational (1997 – 2009). The map displayed on the top right quadrant of the figure shows that there was a long-term loss in pastureland (around 56 ha out of 100 ha total) due to the operation of the mineral extraction site. The minor changes in the split between land classified as pasture versus mineral extraction is likely due to the coarse resolution of the CORINE dataset. The loss of pastureland is a long-term loss of a formerly productive natural capital asset, which was a grazing ground for farm animals and likely provided other ecosystem services, including, carbon sequestration, biodiversity and others.

The mine company owned 300ha, of which 32 ha was developed including the mine plant site and tailings impoundment. Although the mine plant site and tailings impoundment became part of the landscape, both were designed to minimise visual intrusion. The area of the development was a mix of recently planted forestry and grazing fields and being some distance from roads or residential buildings, the mine had limited visual impact. [109]

An assessment undertaken in 2000 showed that the overall productivity of the monitoring farms compared well with regional and national data. Most soils fell within or close to the quoted typical levels for Irish unpolluted soils. Some herbage samples (from grasslands) revealed zinc concentrations outside of typical ranges, but this is not unusual for areas close to shallow mineralised deposits. There was no evidence of elevated levels of zinc or lead in milk and silage, and farm productivity compared well with regional/national data. No unusual diseases were found among animals and little change in animal health was reported from the baseline.[110]

As part of the mining operations, a Tailings Management Facility (TMF) was employed on site. The TMF was located immediately south west of the plant site in a broad relatively shallow valley and consists of three adjacent cells covering an area of approximately 31 hectares. During operation, the mine tailings were managed by either mixing the tailings with cement and pumping the cemented

[106] EIS 2000, volume 2 section 12 (Flora and Fauna)

[107] EIS 2000, volume 2 section 12 (Flora and Fauna)

[108] EIS 2000, volume 2 section 12 (Flora and Fauna)

[109] EIS 2000, volume 2 section 5 (Landscape)

[110] EIS 2000, volume 2 section 11 (Agriculture)

backfill underground as a high-density paste material for stability or fill, or by pumping the tailings directly to the TMF. The operator in Galmoy was prosecuted in relation to the handling of waste underground and the overtopping of the tailings facility. In both cases remediation action was taken by the company.

The mining methods employed at Galmoy and the associated dewatering were not predicted to have an impact on ground stability or surface subsidence. According to the AERs, a subsidence monitoring system was put in place in December 1997. Up to 3 subsidence surveys were carried out at the mine site and the TMF each year, the results of which were reported in the AERs. None of the results exceeded the defined Accepted Limits during this phase. However, in January 2002, a series of underground collapses occurred which resulted in surface subsidence. These events caused cracks to open on and the temporary closure of a local road (Whiteswall Road in Rathreagh), in addition to cracks in neighbouring fields and around some outhouses. There were no injuries or fatalities and remediation was carried out by the company.

Some of the monitoring stations for ground stability were lost and by August 2000, only two stations were capable of detecting and monitoring subsidence induced by mining in the central area of the mine. A subsidence survey undertaken in August 2001 noted a displacement of 84 mm at one of the monitoring stations and it was assumed that this occurred because of the collapses that had occurred underground in January and February 2001.

A *Report on the Underground Collapses of the CW Ore Body Stopes* commissioned by the Department of Marine and Natural Resources at the time, highlighted some gaps in mine procedures and the regulatory regime, which contributed to the collapse[111]. The report concluded that the surface monitoring systems to monitor subsidence were poorly implemented and managed, with important indicators leading up to the collapse not being recorded or recognised; the mining operations did not appear to reflect the permitted design with respect to backfill, room and pillar dimensions and percentage extraction; and the regulatory regime was uncoordinated such that the initial collapse event was neither reported nor investigated.

In 2008, Golder Associates reported that while the original mine design was for room and pillar excavations designed to be stable during and after mining without the use of backfill, it was recognised that for unfavourable ground conditions, particularly along the G Fault, backfilling was a necessity for long term stability[112]. The mine IPC licence P517-01 required that a minimum of 50% of the tonnage of tailings produced over the life of the mine be returned underground[113]. On announcement of the mine closure in 2008 a plan for the long term stability of the mine was agreed with the relevant authorities and implemented prior to the cession of mining in 2009.

A contamination assessment was later carried out at the mine site later in the operation phase of the mine, as part of the 2005 Mine Closure Plan (MCP). This identified concentrations of heavy metals and mineral oil in the subsoil deposits which had the potential to harm human health, animal and plant life. The actions required to minimise the impact on human health were identified. The criteria used to assess the results of both investigations does not appear to be consistent and therefore the impacts of mining activities and processes on soil chemistry are unclear.

B.2.1.4 Closure

Galmoy mine closed earlier than planned in a phased schedule and was the first mine in Europe to close under an Integrated Pollution Prevention Control (IPPC) licence and a Closure Rehabilitation and Aftercare Management Plan (CRAMP.)

[111] Knight Piesold (2002), Report on the Underground Collapses of the CW Ore Body Stopes

[112] Golder Associates (2008), The Current and Post-Closure Stability of the Galmoy Mine Underground Workings

[113] Environmental Protection Agency (2002), Industrial Emissions Licence P517-01

During the closure phase of the Galmoy mine, the mine site continued to occupy around 58 ha, as seen in B.2.1. Some of the wider land acquired by the mine was then sold back to community members following the mines closure and farming was resumed on those lands. Some of the land was forested and had deciduous trees planted on it and one interviewee noted that there is currently land from the mine site for sale, however, this land had topsoil taken off it for the tailings pond infill and therefore may not be in the best condition[114].

While the TMF remains, the mine rehabilitated it to such an extent that local farmers could once again graze cattle on the land; cattle which were proven to be safe for consumption. An interviewee from the EPA noted that the operators at Galmoy went "above and beyond" when testing the natural capital assets in the area (e.g. testing whether cattle grazing was possible). The lessons learned from Galmoy contributed to current guidelines, as well as to general guidelines for mine management and closure (e.g. Lisheen post-closure wetlands).[115] Other individuals interviewed noted that though the buildings and office on site was taken over and maintained by another entity, some (such as the milling facility) remain as an "eyesore".[116]

Following mine closure, an integrated constructed wetland (ICW) was constructed within the phase III cell which has had biodiversity benefits and in particular, has enhanced the environment for local and migratory bird species. Notably, the breeding density of curlews (IUCN Red List) has increased and a nesting Little Ringed Plover and a Glossy Ibis have been observed. [117] Additionally, a total of 34 species of lichen were recorded in the area. The presence of *Ramalina, Physcia* and *Xanthorian* species was indicative of a nutrient enriched site and the occurrence of *Parmelia perlata* and *Ramalina fraxinea* indicated that sulphur dioxide levels for the area are low. This success would later influence Lisheen mine's own CRAMP, and Galmoy was later awarded with the 'International Green Apple Award for Environmental Best Practice' in relation to these works.

However elevated biochemical oxygen demand (BOD) levels were recorded. The mining company advised that that relates to farm runoff from another area that flows through this area, but EPA requires continued monitoring. No major residual issues were noticed and there are some red listed bird species there now. Although the facility has a minor visual impact as it is about 15 metres high, it has a positive impact in terms the outcome on biodiversity. The footprint of the surface features of the mine are quite small in comparison to the underground footprint and overall the area was well landscaped according to interviewees[118].

The downstream stretches of the Erkina and Goul Rivers, east of the M8, were designated as part of the River Nore Special Protection Area (SPA) in 2010[119], in addition to the SAC and pNHA designations in previous years. In an AOS Planning report in 2010, it was noted that the pNHA formerly supported significant numbers of Greenland White-Fronted Geese but numbers of these and other wetland birds have dwindled in recent years[120], although this reflects a wider trend that is unrelated to mining activities[121].

[114] Based on interviews conducted for this study

[115] Based on interviews conducted for this study

[116] Based on interviews conducted for this study

[117] Lundin mining (2018) Galmoy ICARD presentation

[118] Based on interviews conducted for this study

[119] National Parks and Wildlife Service (NPWS) website accessed March 2019.

[120] AOS Planning (2010), Laois-Kilkenny Reinforcement Project Environmental Reports – Study Area Constraints Report – Flora and Fauna.

[121] https://www.independent.ie/regionals/newrossstandard/lifestyle/amo-a-problem-for-greenland-whitefronted-goose-35251695.html

In 2014, a sinkhole appeared on a nearby area of private farmland close to the mine. It appeared in a large field (circa 23 acres) after a period of heavy rain on the farm, and was described as a major concern for the landholders, whom were active on that land on a daily basis[122]. The mining company responded by saying that "it resulted from an unusual and unique set of circumstances" and that they were working on repairing the hole and investigating the possible causes. An investigation determined this event to be as a result of a unique set of circumstances involving the intersection of a significant fault ('the Main Fissure') and a paleo-karstic flow path reactivated by the lowering of the local water table, exceptional rainfall and the spreading of soiled water on the field immediately before the collapse. It was concluded that the flooding of the mine would provide support by way of hydro-static pressure to the underlying rock mass and that the probability of a sinkhole occurring again was no greater than pre-mining. The mine worked with the landholder to stabilise the site, and oak and evergreen trees were planted near the site. Follow up interviews with the landholder indicated that the sinkhole still remains a concern for them[123].

The Galmoy TMF was remediated to an agricultural endpoint[124], and to a land use compatible with the surrounding countryside, while creating an enhanced environmental for local and migratory bird species

The Galmoy Fen was designated a SAC in 2016, following the closure of the Galmoy mine[125]. This suggests that the dewatering and flooding of the mine did not have a significant impact on the conservation importance or status of this site during construction and operation.

B.2.2 Enclosed farmland

B.2.2.1 Baseline

In the baseline, nearly 100% of the proposed site for the mine was made up of pastureland based on spatial analysis conducted for this study (Table B.2.1). The literature reported that land supported eight sheep and their offspring per acre and the area had a reputation of producing early lamb. Over 20 farms, the average stocking rate was 1.8 livestock units per ha, which was considered to be above the national average at the time, suggesting intensive farming systems.[126]

B.2.2.2 Construction

The literature review and interviews did not provide information regarding effects of the construction of the mine on pastureland.

B.2.2.3 Operation

The literature review and interviews did not provide information regarding effects of the operation of the mine on pastureland. However, spatial analysis conducted as part of this study confirms that there was a decrease in the extent of farmland within the footprint of the mine from the baseline to the mine operation phase (see Table B.2.1 and Figure B.2.1). Based on CORINE land cover data for the year 2000, which corresponds to the operation phase of the mine, there was a decrease in the area pastureland by around 66% between 1990 and 2000. The area of more than 55 ha formerly classified as pasture was classified as a mineral extraction site in 2000, 2012 and 2018.

Farmland provides important benefits to people, notably agricultural output. The loss of agricultural output can be estimated based on the extent and condition of pastureland within the footprint of the

[122] Based on interviews conducted for this study

[123] Based on interviews conducted for this study

[124] Doyle, E. 2016. Ireland's rehabilitation policy eliminating risk and providing benefits. International Conference Sustainability of Mineral Resources and the Environment. Conference Proceedings, Ministry of Environment of the Slovak Republic, Bratislava.

[125] NPWS website accessed March 2019

[126] Eolas (1992): EIA Receiving Environment

proposed mine, as it was surveyed in the baseline. In the absence of the mine, the 55 ha (136 acres) of pastureland land could have otherwise been used to rear livestock animals.

A simple assumption is that land would have split equally between rearing lamb and cattle. Based on the evidence review, the area had a reputation of producing early lamb and the land typically support 8 sheep per acre. For the production of lamb, Table B.2.2 shows that the land could have generated around 29,354 kg of output each year worth over €48,000 each year. Similarly for the production of cattle, Table B.2.3 shows that the land could have produced beef output worth nearly €20,000 each year.

This equates to an annual opportunity cost of €68,221, or approximately €1.16 million over 17 years (from 1995 to 2012). However, this is just indicative, and the real opportunity cost would vary depending on agricultural prices, the split between lamb and cattle, and the proportion of land that remained intermittently available for grazing during operations.

Table B.2.2: Loss of agricultural output (from rearing lamb) due to loss of pastureland

		Estimate	Unit
A	Area of pastureland lost to rearing lamb	27.5	ha
B	Area of pastureland used for lamb production	68 = A * 2.471 acres/ha	acres
C	Average stocking rate for lamb (based on evidence review)	8	lamb/acre
D	Number of finished lamb (ready for market) for each lamb reared (based on early lamb production mentioned in literature)	1.42	finished lamb/reared lamb
E	Average weight of finished lamb	38	kg/lamb (live weight)
F	Kg of lamb lost due to loss of pastureland	29,354 = (B * (C * D)) * E	kg
G	Average gross margin from lamb rearing per acre (assuming finished lamb and wool production)	767.4	£/acre
H	Average depreciation from lamb rearing per acre (assuming finished lamb, store lamb and wool production)	121	£/acre
I	Value of lost output due to loss of pastureland	43,955 = B * (G – H)	£
J	Exchange rate	1.1042	€/£
H	Annual Value of lost output due to loss of pastureland	48,535 = J * K	€

Notes: Monetary values are reported in 2018 prices. Exchange rate sourced from European Central Bank for period 01/01/2018 to 31/12/2018. Other data sourced from Agriculture and Horticulture Development Board (AHDB) and Agricultural Budgeting and Costing Book. Note that gross margins are used, as it is not possible to estimate margins that are net of production costs without further information.

Table B.2.3: Loss of agricultural output (from rearing cattle) due to loss of pastureland

		Estimate	Unit
A	Area of pastureland lost	55	ha
B	Area of pastureland used for cow grazing	27.5 = A * 50%	ha
C	Average stocking rate	1.55	cows/ha
D	Average weight of 7-8 month old steers	285	kg/steer
E	Average weight of 7-8 month old heifer	265	kg/steer
F	Average weight of 7-8 month old calf	275 = (D + E) / 2	kg/cow
G	Kg of beef lost due to loss of pastureland	11,722 = (B * C) * F	kg
H	Average gross margin from calf rearing per ha	732.4	£/ha
I	Average depreciation from calf rearing per ha	84.1	£/ha
J	Value of lost output due to loss of pastureland	17,828 = B * (H – I)	£
K	Exchange rate	1.1042	€/£
L	Annual Value of lost output due to loss of pastureland	19,686 = J * K	€

Notes: Monetary values are reported in 2018 prices. Exchange rate sourced from European Central Bank for period 01/01/2018 to 31/12/2018. Other data sourced from Agriculture and Horticulture Development Board (AHDB) and Agricultural Budgeting and Costing Book. Note that gross margins are used, as it is not possible to estimate margins that are net of production costs without further information.

B.2.3.4 Closure

The literature review and interviews did not provide information regarding effects of the closure of the mine on pastureland. Analysis of CORINE land cover data indicates that the loss of pastureland continued during the closure phase of the mine.

B.2.3 Freshwater, wetlands and floodplain

This section considers the effects of Galmoy mine on freshwater, wetlands and floodplains. This broad habitat type comprises multiple sub-habitats including surface waters (standing open waters, lakes, ponds reservoirs, canals, rivers and streams), groundwaters, aquifers and wetlands.

These sub-habitat types did not feature within the footprint of the mine at the baseline. However, there are a number of waterbodies within 3 km of the mine and the wider catchment area. This 3 km radius around the mine allows changes in the condition of surrounding habitats as a result of mining activities to be considered, but also avoids an overlap between the two mine sites which are around 7 km from each other.

As part of this study, spatial analysis was conducted to determine the extent of waterbodies within 3 km of the mine. Table B.2.4 presents a list of surface and ground waterbodies within 3 km of the mine, as well as their total length and area respectively, while Figure B.2.2 shows a map of some of these nearby waterbodies.

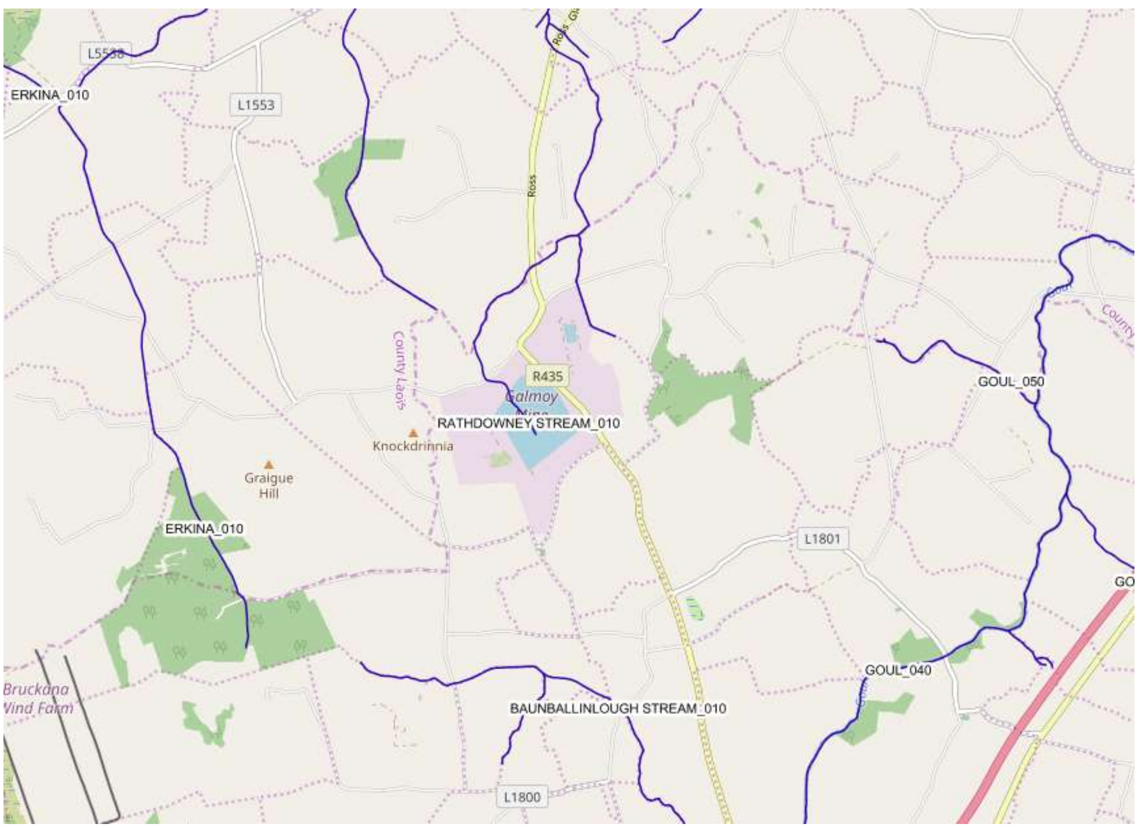
Table B.2.4: Waterbodies within 3 km of Galmoy mine

Name	European code	Type	Extent	Unit
BAUNBALLINLOUGH STREAM_010	IE_SE_15B120080	Surface water	6	km
ERKINA_010	IE_SE_15E010040	Surface water	9	km
ERKINA_020	IE_SE_15E010100	Surface water	11	km
GOUL_050	IE_SE_15G020360	Surface water	11	km
RATHDOWNEY STREAM_010	IE_SE_15R031100	Surface water	13	km
Rathdowney	IE_SE_G_114	Groundwater	520	km^2
Shanahoe	IE_SE_G_119	Groundwater	81	km^2
Thurles	IE_SE_G_158	Groundwater	127	km^2

Source: Catchments.ie

The following sub-sections report findings from the literature review and interviews regarding the effects of the mine on waterbodies. In many cases, these findings may extend beyond the 3 km radius from the mine, and are a reflection of the type of effects that were monitored during the mine phases and reported in the evidence base.

Figure B.2.2: Surface Waterbodies at Galmoy



Source: Catchments.ie

B.2.3.1 Baseline

Prior to construction of the mine, the water supply for the town of Rathdowney was sourced from the Whiteswall Stream (in the Erkina system) at a point near to the mine site, supplying 159 m^3/ day. A second take-off point was on the Glasha Stream (also in the Erkina system), supplying 545 m^3/ day. The total consumption of water for the area of Rathdowney in 1992 varied between 409 and 545 m^3/ day. The Goul and Erkina river systems were also used as a source of water for stock, crops and spraying. Moreover, the River Nore – into which both the Goul and Erkina drain - was a major source of water for a number of domestic, potable and industrial abstractions including Kilkenny City and Avonmore Creameries in Ballyragget[127].

In terms of fisheries, the Goul and Erkina river systems were important fishing tributaries of the River Nore, which itself was noted to be an important salmon and trout fishery. A baseline biotic monitoring programme concluded that both river systems had a wide diversity of habitats, including a high-quality salmonid nursery area with high productivity values typical of lowland, limestone enriched catchments. Both rivers were found to be an important component of salmon spawning in the Nore system and of considerable importance for trout spawning. In particular, the salmonid populations were found to be to be large and in excellent condition[128]. Additionally, the main channel of the Erkina after the confluence with the Goul is of particular angling importance.

In terms of flood risk, the Erkina and Goul Rivers and their tributaries were liable to flooding due to generally slow flows and shallow low-lying banks[129]. Significant drainage and realignment of the main channels and some of the tributaries was carried out from 1930, and continuing improvements were being carried out at the local level. The rivers converge at the Curragh (approximately 7km to the northeast of the mine site), which was an area liable to severe flooding.

The baseline surface water quality of the Erkina and Goul rivers and their tributaries was described as generally good and typical of Irish lowland rivers in limestone areas, with consistent high hardness values with very low average dissolved metal content[130]. However, the following water quality issues were identified:

- The river systems were receiving waters for a number of municipal, industrial and agricultural discharges;
- Maximum concentrations of lead, zinc, potassium, ammoniacal nitrogen and phosphate exceeded the EPA interim guideline values in the Glasha Stream, presumably under low flow conditions; and
- Eutrophication was occurring on a seasonal basis in the vicinity of Urlingford / Johnstown on the Goul (upstream of the mine site) and on the Erkina (downstream of mine site), which resulted in a number of fish kills in the Erkina. However, this was confined to sections of the rivers that are relatively slow moving and showed that during low water the rivers are near the limit of their ability to cope with nutrient enrichment from other sources, such as domestic sewage, industrial inputs and agriculture.

With regards to groundwater quality, the Galmoy groundwaters were found to be typical calcium bicarbonate water, characterised by a hardness level of 400 to 500 mg/l $CaCO_3$. [131] A number of groundwater samples were reported to contain metals at concentrations significantly above background levels. These exceedances were for copper, iron, manganese, nickel and zinc and were

[127] EOLAS (1992), Environmental Impact Assessment for Galmoy Mine

[128] EOLAS (1992), Environmental Impact Assessment for Galmoy Mine

[129] EOLAS (1992), Environmental Impact Assessment for Galmoy Mine

[130] Golder Associates (2010), TMF Rehabilitation and Closure Plan for Galmoy Mine.

[131] EOLAS (1992), Environmental Impact Assessment for Galmoy Mine

assumed to be due to the natural geochemistry of the subsoil deposits or shallow bedrock or the possible presence of organic waste[132]. Furthermore, the three production wells investigated at the mine site prior to development were found to have large inflows of groundwater. Finally, the groundwater in the dolomitized Waulsortian was of good bacteriological quality, with very similar chemistry to the local surface waters, and met the Drinking Water Standard, the Salmonid Regulations and EPA interim guideline values for all the 35 parameters tested, including zinc.

B.2.3.2 Construction

Workings to dewater the mine extracted a lot of water on a daily basis, which was treated and discharged to the Goul river. As higher quality water was being discharged following treatment, the overall quality of water in the river was improved. Sampling upstream and downstream of the mine discharge point on the River Goul between 1995 and 1997 showed no significant physicochemical impact on the water quality in the river.[133] Additionally, no impacts to the biological Q value assigned to the river or the diversity or distribution of the macroinvertebrate community were observed during this period. However, stream sediment sampling undertaken on the Goul and Glasha rivers, showed concentrations of zinc and lead to increase from 1995 to 1997. The mine discharge during construction was high in suspended solids (average suspended solids content of the discharge was 15.2mg/l) and some of these solids may have been deposited on the stream beds and contributed to the increase in lead and zinc in the sediments.

Table B.2. below summarises the WFD status of three of the five surface water bodies within 3 km of the mine for which information was available. During the construction period, two of the surface water bodies were found to have poor WFD status, and one was classified as having moderate WFD status.

Two groundwater fed wetlands were also identified as likely to be impacted by mine dewatering - the Whiteswall Bog or Galmoy Fen, and the Baun Turlough. While there were recorded fluctuations in the water level of Rathreagh Turlough, these were a result of changes in rainfall rather than mine dewatering.

In terms of fisheries, biotic monitoring, electro-fishing and analysis of fish tissues for heavy metal content was carried out in the Goul, Erkina and Glasha between 1995 and 1997 and revealed the following[134]:

- Reduced diversity of sensitive macroinvertebrate taxa in the River Goul as a result of a deterioration in water quality at Rathdowney. However, this deterioration was deemed to be a response to organic contamination which was not related to the mine.
- Substantial annual fluctuations in salmonids, most likely due to eutrophication and not related to the discharge of mine effluent.

[132] K.T. Cullen & Co. Limited (1992), Hydrogeology and Dewatering of the Galmoy Mine, Technical Report No. 1

[133] Arcon Mines (2000), EIS for Galmoy Mine Extension.

[134] Arcon Mines (2000), EIS for Galmoy Mine Extension

Table B.2.5: Historical surface water quality within 3 km of Galmoy mine

Name	European code	Total length of waterbody (km)	WFD status (based on EPA biological Q value)								At risk status (2010-2015)
			Construction	Operation				Closure			
			1995	1998	2001	2005	2007	2010	2013	2016	
BAUNBALLINLOUGH STREAM_010	IE_SE_15B120080	6	Poor	Moderate	Moderate	Poor	Moderate	Poor	Poor	Poor	At risk – Agricultural pressures
ERKINA_010	IE_SE_15E010040	9	-	-	-	-	Moderate	Moderate	Moderate	-	-
ERKINA_020	IE_SE_15E010100	11	-	-	-	-	-	-	-	-	-
GOUL_050	IE_SE_15G020360	11	Moderate	Good	Moderate	Good	Good	Moderate	Moderate	Moderate	At risk – Agricultural pressures
RATHDOWNEY STREAM_010	IE_SE_15R031100	13	Poor	Moderate	Poor	Moderate	Moderate	Moderate	Poor	Poor	-

Source: Catchment.ie

B.2.3.3 Operation

Stream sediment sampling undertaken on the Goul and Glasha rivers showed concentrations of zinc and lead to increase until 1998 and then decrease in 1999. From 2004 to 2009, sampling at the stream augmentation points revealed high concentrations of zinc and lead in stream sediments directly below the discharge point at Fertagh Bridge, located at approximately 3.5km south east of the mine site on the River Goul[135]. These concentrations did not exceed Irish guidelines but rather Probably Effect Levels (PELs) set for this location.

Surplus 'clean' water from the mine and treated water from the concentrator was piped into the River Goul. The mine discharge was licensed by Kilkenny County Council and the discharge limits were recommended as part of the 1992 EIS for the protection of salmonid fish and surface waters intended for human consumption. Sampling upstream and downstream of the mine discharge point on the River Goul between 1997 and 2010 showed no significant physicochemical impact on the water quality in the river. Additionally, no impacts to the biological Q value assigned to the river or the diversity or distribution of the macroinvertebrate community were observed.

In additional to surplus and treated water discharges, clean mine water was discharged to eight stream augmentation points between at least 2004 and April 2010, under IPC licence P517-01. This was for the purpose of mitigating the impacts of mine abstraction on stream flows. There were occasions when the clean water contained high levels of soluble zinc and suspended solids due to contamination of the clean water with dirty water or a fissure was intercepted with high levels of naturally occurring soluble zinc. On these occasions, the pump was turned off until the quality of the water was acceptable. Stream augmentation ceased in 2010 at the request of the Agency due to concerns over water quality.

Increases in annual average concentrations of total ammonia, arsenic, manganese, nitrite, nitrate, sulphate, sodium, potassium, nickel, total alkalinity and total hardness were recorded at the mines clean water borehole GW1 between 2006 and 2008. Therefore, the pumping of clean water from underground at GW1, ceased in 2008.

Table B.2. above summarises the WFD status of the five surface water bodies within 3 km of the mine. While there were slight improvements in water quality at the start of operations (compared to construction), the overall status of these waterbodies remained relatively stable during operations, with slight fluctuations. By the end of operations, the majority of the surface water bodies were classified as having moderate WFD status, however one was identified as having good WFD status.

The cone of depression or area in which groundwater levels were affected was less than predicted (2.5km from the mine, 40m below baseline position of the water table) and only five wells were impacted to such an extent that there was insufficient water for domestic/ agricultural use, with three of these being on Galmoy owned property.

An assessment of groundwater quality in 2009 found that all of the samples exceeded the Drinking Water Standard for lead, and most exceeded the Drinking Water Standard for zinc; however, these concentrations were considered to represent 'low levels of contaminants'.

The most useful metric against which to measure change from the baseline with respect to the overall condition of groundwater bodies are WFD status assigned by the EPA every 5 years. As shown in Table B.2. below, there were three ground water areas within 3km of the mine, all of which were classified as having good WFD status during operations (data is only available from 2007).

[135] Galmoy Mines, Annual Environmental Reports (2004 to 2017)

Table B.2.6: Historical groundwater quality within 3 km of Galmoy mine

Name	European code	Total area of waterbody (km2)	WFD status (based on EPA biological Q value)	
			Operation/Closure	Closure
			2007-2012	2010-2015
Rathdowney	IE_SE_G_114	520	Good	Good
Shanahoe	IE_SE_G_119	81	Good	Good
Thurles	IE_SE_G_158	127	Good	Good

Source: Catchments.ie

The rehabilitation of the TMF began in 2001 with the piloting of trial cells to mimic the conditions of the TMF at closure. No issues of concern were noted during operations for groundwater at the TMF.

As part of planning permission, the company was required to construct a stand-alone Replacement Water Supply Scheme (RWSS). From 1998, this scheme was run by the mine throughout operations, supplying potable water, which was supplied to the local community and the town of Rathdowny for the best part of 20 years, at no cost to the community or to the local government[136]. Concentrations of total ammonia and orthophosphate at the Replacement Water Supply Scheme remained below detection limits and below the Drinking Water Regulations 2007 throughout operations. Additionally, the water quality of the scheme was noted to be extremely good from a bacteriological perspective, as counts of coliform and E. Coli were generally below zero throughout operations.

A solute Model Monitoring Programme was established in 2003 to monitor water quality in 18 to 20 wells on a biannual basis prior to mine re-watering. The programme highlighted a significant number of water sources close to the mine site which were not producing water in compliance with the Drinking Water Standards, although this was not a result of mining activities. The residents affected were made aware of the issues with their water supplies, and many opted to connect to the Replacement Water Supply Scheme.

In terms of fisheries, biotic monitoring, electro-fishing and analysis of fish tissues for heavy metal content was carried out in the Goul, Erkina and Glasha between 1997 and 2000 and revealed the following[137]:

- Reduced diversity of sensitive macroinvertebrate taxa in the River Goul as a result of a deterioration in water quality at Rathdowney. However, this deterioration was deemed to be a response to organic contamination which was not related to the mine. The Fisheries Board called an emergency[138] and electrofishing surveys were carried out until the issue was identified.
- Substantial annual fluctuations in salmonids, most likely due to eutrophication and not related to the discharge of mine effluent.

In regard to flood risk, surplus water from the mine was to be used to augment the Glasha Stream and other local watercourses (7 in total) where flows were affected by mine dewatering. The maximum discharge rate from the mine was predicted to be less than 1% increase in the mean peak flow in the Glasha Stream and non-detectable. However, there is little information as to whether the modelled increase was observed and whether there was a residual impact on flood risk.

[136] Based on interviews conducted for this study

[137] Arcon Mines (2000), EIS for Galmoy Mine Extension

[138] Based on interviews conducted for this study

B.2.3.4 Closure

There was an increase in heavy metals at surface water monitoring points upstream and downstream of the mine discharge on the River Goul until 2011, which sharply decreased from 2012 onwards. However there remained some exceedances of the Salmonid Waters Regulations 1988 and Surface Water Regulations 2009 during this period for nitrite, sulphate, ammonia, lead, zinc and suspended solids.

The WFD status of the five surface water bodies within 3km of the mine following closure of the mine is summarised in Table B.2.6. One of the surface water bodies showed a decrease in WFD status (from moderate to poor) in 2010, and another showed a decrease in WFD status (from moderate to poor) in 2013. At risk status was only provided for two surface water bodies from the closure period (from 2010 to 2015). Agricultural pressure were identified as the only risk factor for these water bodies, therefore the closure of the mine is not suggested to have had an effect of local surface water quality.

Rehabilitation of the TMF continued with the construction of an integrated constructed wetland (ICW) in 2014 to treat surface runoff water and interstitial drainage from the TMF. Rehabilitation was completed in 2015 and discharge at the new discharge point on the Glasha Stream commenced. Monitoring data from the attenuation pond for the period 2015-2017 demonstrated the effectiveness of the ICW to treat ammonia, with a 99% reduction in ammonia and a 74-84% reduction in sulphate[139]. There were also significant reductions in lead and zinc in wetland discharge water, compliant with EPA requirements. There were no emission limit values assigned to the Glasha Stream discharge point; however, the annual average concentrations reported for 2015-2017 complied with the emission licence values for SW2, except for ammonia in 2017. Additionally, some non-compliances of the emission limit values at the mine discharge point on the Goul were reported in 2013, resulting from the mine closure works.

There were some water quality issues in 2018 where runoff from the TMF with elevated levels of Biological Oxygen Demand (BOD) was occurring[140]. While the mine company advised the EPA that these levels were related to farm runoff from another area that flows through the TMF area, the EPA has requested continued monitoring of this issue.

Following the cessation of mine dewatering in 2013, groundwater rebound was rapid and the water table had fully recovered to above pre-mining conditions by March 2014. From 2013 to 2017 groundwater quality within the mine workings met Drinking Water Regulations 2007 and that while sulphate, zinc, nickel and arsenic were elevated in underground workings, there were no adverse trends in water quality at any monitoring location. Additionally, a hydrogeological assessment carried out in 2015[141] concluded that there was no evidence that the flooding of the mine workings has created a contamination plume migrating from the site, and that the site was not impacting groundwater related receptors and there was a low risk of future impact. The assessment notes that the monitoring data demonstrates that the chemical status of the groundwater continues to be good.

As shown in Table B.2.6, the three groundwater areas within 3km of the mine, all remained in ‘good’ WFD status following the closure of the mine.

Residents and local abstractors connected to the RWSS remained so and did not revert back to using their private wells following the mines closure[142]. This scheme was transferred to Irish Water in June 2016 to support continuation of the reliable water supply to local users.

[139] Devoy, C, et.al. (2018), Former Galmoy Mines tailings restoration

[140] Based on interviews conducted for this study

[141] Lundin Mining (2015) Presentation on Mine Closure Update

[142] Golder Associates (2014), Investigation of the Possible Causes of the Sinkhole in the vicinity of the Galmoy Mine Workings and Recommended Remediation

According to the EPA online mapping service, there are no watercourses in the Goul and Erkina river systems currently being used for public drinking water purposes, designated as nutrient sensitive, designated as a Bathing Water location, or as being of importance with regard to the Salmonid Regulations S.I. No. 293[143].

Lastly in terms of fisheries, Salmon Ireland stated that the waters of the Goul River *"used to be excellent Salmon water, but that was prior to the 70s"* but *"still, the trout fishing here is really good"*[144]. No further information on fisheries for the decommissioning/ post-closure period was found during the literature review.

B.2.4 Air quality

B.2.4.1 Baseline

Data from the 1992 EIS that air quality in the local area prior to the development of the mine was good, and that levels of airborne sulphur dioxide, suspended particulate, and dust deposition were typical of rural areas.

B.2.4.2 Construction

During the construction period, annual average dust deposition rates ranged from 23-34mg/m^2/day, which is considered a low rate of deposition; well below the Integrated Pollution Control (IPC) licence dust deposition limit of 350mg/m^2/day and within the 'Not Noticeable' category of public response. The levels of deposited metals and airborne metals (Zinc, Lead, Thallium, Cadmium, Nickel) were also very low and fell well below the respective IPC limits.[145]

B.2.4.3 Operation

The dust deposition rates were 84.11mg/m^2/day from January to October 2007 which was within the range of hardly noticeable in rural areas, small towns and suburbs. Airborne concentrations were also well below the limits set. [146] Similarly, there was 100% compliance for all dust deposition measurements in 2004[147], 2009[148], 2010[149] and 2011. There was also 100% compliance of ambient air monitoring in 2009[150], 2010[151], 2011[152] and 2012[153].

B.2.4.4 Closure

Though changes in air quality may have been a consequence of the closure of Galmoy mine, the literature review and interviews did not identify evidence to determine this.

[143] Environmental Protection Agency website accessed March 2019.

[144] Salmon Ireland website accessed March 2019.

[145] EIS 2000, volume 2 section 8 (Air quality)

[146] EIS 2008, volume 2 section 8 (Air quality)

[147] ARCON Mines Limited 2004, Annual Environmental Report 2004

[148] Galmoy Mines Ltd 2009, Annual Environmental report 2009

[149] Galmoy Mines Ltd 2010, Annual Environmental report 2010

[150] Galmoy Mines Ltd 2009, Annual Environmental report 2009

[151] Galmoy Mines Ltd 2010, Annual Environmental report 2010

[152] Galmoy Mines Ltd 2011, Annual Environmental report 2011

[153] Galmoy Mines Ltd 2012, Annual Environmental report 2012

B.2.5 Minerals

Mineral extraction is only expected to occur during the operation of the mine, therefore this sub-section only relates to this phase of the mine. The evidence review suggests that planned production of raw ore was expected to be around 650,000 tonnes per year which would result in 170,000 tonnes of concentrate. In practice, the evidence suggests that around 500,000 tonnes of ore was milled, resulting in an average of 135,000 tonnes of zinc and lead concentrate each year. This produced approximately 70,000 tonnes of zinc and 19,000 tonnes of lead respectively. However, production varied from year-to-year.

Besides the production of minerals, evidence collected through a contamination assessment carried out as part of the 2005 MCP[154] recognised the potential harmful effects of arsenic, lead, cobalt, nickel, cadmium, zinc and mineral oil contaminants within the gravel and clay strata of the mine site. These contaminants were recognised to potentially harm human health, plant life and animals. Clean-up of these contaminants was completed during mine rehabilitation.

B.2.6 Energy

The mine had high energy consumption during the operation phase; most of which was drawn from public electricity grid. Based on analysis of Galmoy's AERs from 2003 to 2012, Galmoy consumed an average of 37,958 MWh of electricity and 3,760 MWh of other fossil fuels each year.

Given an average carbon intensity of public electricity of 0.66kg/Kwh CO2 between 1997 and 2012[155], Galmoy's average annual CO_2 emissions has been estimated at 26,409 tonnes per year. This means that over its lifetime, about 422,545 tonnes of CO_2 were emitted as a result of the mine's electricity consumption.

Using a Shadow Price of Carbon of €20 per tonne as stipulated by the Public Spending Code, the cost of these CO_2 emissions to society has been estimated at €8.45 million to society[156].

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[154] Wardell Armstrong International Limited (2005), Second Interim Closure and Rehabilitation Plan (SIMCP), Galmoy Mines Limited

[155] https://www.teagasc.ie/media/website/crops/crops/Energy_in_Ireland_1990_-_2011.pdf

[156] Shadow Price of Carbon of €20 from *Public Spending Code: Central Technical References and Economic Appraisal Parameters*. Department of Public Expenditure and Reform, 2019.

B.3 Economic effects

Galmoy mine operated between 1997 and 2012 (including a partial closure from 2009). It had a construction phase of approximately two years, prior to production. Over its lifetime, the Mine had significant impact on the mining industry, its local communities and the wider Irish economy. The economic impact of Galmoy mine has been assessed according to several economic indicators, and the summary of key indicators is presented below:

Table B.3.1: Summary of Key Economic Indicators for Galmoy and Lisheen Mines in 2018 € Values

Economic Indicator	Total
Sales and Turnover	
Value of Sales (Turnover)	€641,020,000
Share of total Irish zinc and lead production (over years of operation)	18%
Total Lifetime Expenditure Effect	**€1,700,967,680**
Direct Expenditure Effect*	€675,842,000
Indirect Expenditure Effect	€560,606,810
Induced Expenditure Effect	€464,518,870
Average Total Jobs Supported	**513**
Average Direct Employment	*213*
Average Indirect Employment	*196*
Average Induced Employment	*104*
Contribution to Public Finances	**€59,156,179**
Royalties	€12,756,179
Corporation Tax	€600,000
PRSI	€14,900,000
PAYE (paid by employees)	€30,900,000
Local Authority rates	€3,200,000
Development Contributions	€1,312,122
Gross Value-Added to the Irish Economy	**€315,220,000**

*Note: expenditure impacts are calculated for construction and operations phases only

The analysis undertaken for the economic assessment was compiled using a range of data sources. Direct effects were estimated primarily from data contained in annual financial returns. Where data was missing for certain years or periods, modelling based on the mine's lifecycle was employed to complement the available data.

In order to determine the wider economic effects, the annual financial accounts from the mining companies were used in conjunction with the economic multiplier analysis for the Irish mining industry, compiled by Indecon Consultants for DCCAE in 2013. Separate economic multipliers were calculated for the construction industry for construction spending.

In order to determine the lifetime impact of the Mine, and to provide a basis for comparison, all figures (unless stated otherwise) have been adjusted to 2018 values using the Consumer Price Index.

B.3.1 Sales and Exports

Value of Sales

The value of sales is measured by the annual turnover of Galmoy Mines Ltd. as contained in Annual Financial Returns to the Companies Registration Office, with the total and annual average turnover for Galmoy mine is shown below.

Table B.3.2: Value of Sales - Estimated Turnover in 2018 € Values

	Galmoy (1997-2012)
	€
Total Turnover	641,020,000
Average Annual Turnover	*40,060,000*

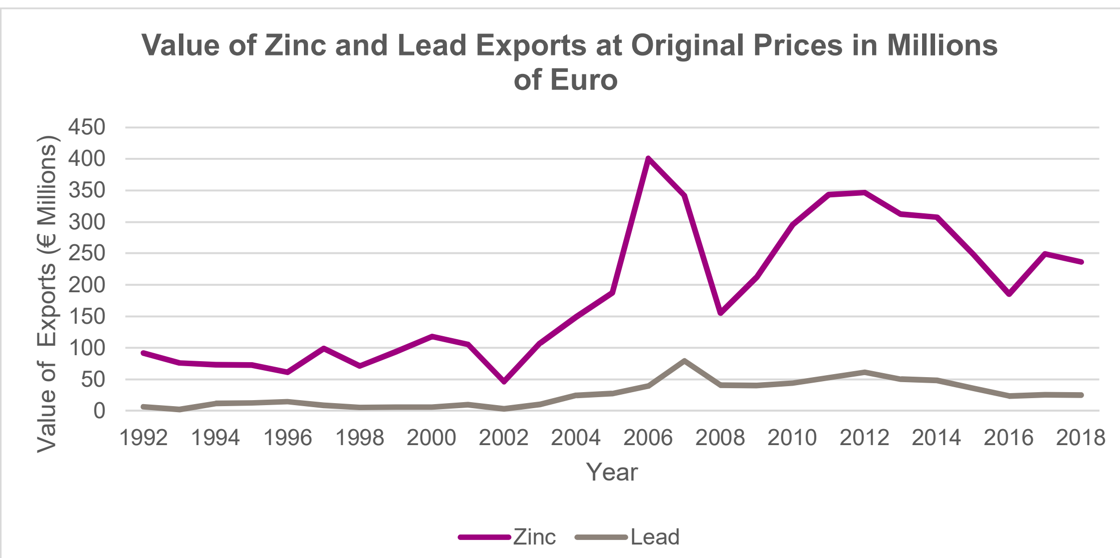
Source: AECOM Analysis of Annual Accounts

Galmoy had a lifetime turnover of approximately €640 million, with an average annual turnover of just over €40 million. However, annual turnover had significant variation due to volatile zinc and lead prices. External price changes had a two-fold effect on the value of sales turnover: not only did it affect the value of the metal produced by the mine, but the mines generally altered their production levels based on whether prices were high or low.

Value of Exports

The total value of Irish lead and zinc exports is shown below. While company data does not show the exact percentage of turnover that relates to exports, as there are no smelters in Ireland, it can be assumed that all of Galmoy's zinc and lead concentrate was sold abroad.

Figure B.3.1: Value of Irish Zinc and lead Exports (€ Millions) at Original Prices



Source: United Nations Comtrade Database – International Trade Statistics Database

However, the value of these exports is especially volatile from 2005 onwards due to producers' exposure to fluctuating metal prices and euro-dollar exchange rates. Mining firms react to these rapid changes in price by altering their production levels; making it difficult to get an accurate picture of their individual shares of Irish exports (see above). In addition, Galmoy experience frequent interruptions to production as a result of strikes and other events. However, at the height of production (between 2006 and 2007), Galmoy accounted for approximately 10% of the value of Irish lead and zinc exports.

Figure B.3.2: Zinc and Lead Prices, 2000-2015

Source: World Bank Commodity Price Data

Port Statistics

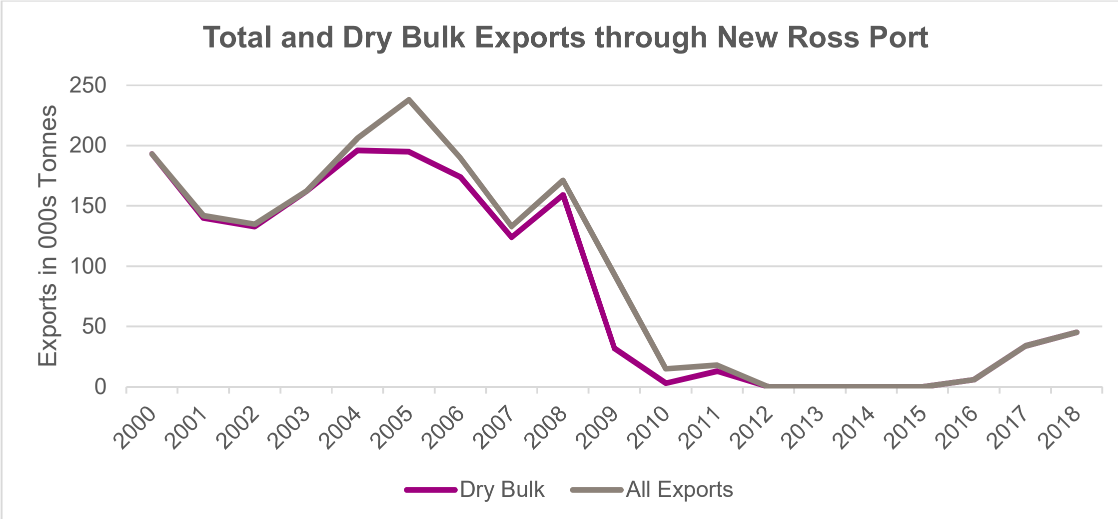
The Central Statistics Office port statistics provide an insight into the magnitude of concentrate (processed ore) exports, and the impact of the Galmoy mine on New Ross. Zinc and lead concentrate are classified as 'Dry Bulk', and dry bulk exports for New Ross and Cork ports are shown below.

Concentrate from Galmoy was largely shipped through New Ross Port. As Figure B.3.3 below shows, approximately 100,000-200,000 tonnes of dry bulk cargo was exported through New Ross each year between 2000 and 2008. After Galmoy announced its closure and began to send its remaining ore to Lisheen for processing in 2009, resulting in no more concentrate being trucked into New Ross, dry bulk exports decline sharply. By 2012, the year in which Galmoy mine fully closed, this falls to zero.

Dry bulk exports represented 90-100% of New Ross' cargo exports between 2000 and 2008, and the effect of Galmoy's closure on New Ross Port is evident in the Port's 78% drop in operating profit between 2008 and 2009; from €289,000 to €65,000[157].

[157] Irish Independent (newspaper), 3/5/2011. An uncertain future for New Ross port.

Figure B.3.3. Dry Bulk Exports (000s Tonnes) through New Ross Port, 2000-2018



Source: CSO Maritime Statistics

While it is clear that the closure of Galmoy contributed to the fall in profits experienced by the Ports, it is important to note that this came during a recession and at a time in which imports (another key source of revenue) were also volatile. As Figure B.3.4 shows, the two main categories of imports at New Ross during this period were dry bulk (mainly fertiliser and animal feed imports) and liquid bulk (i.e. fuel), and both categories have seen steady declines since 2003.

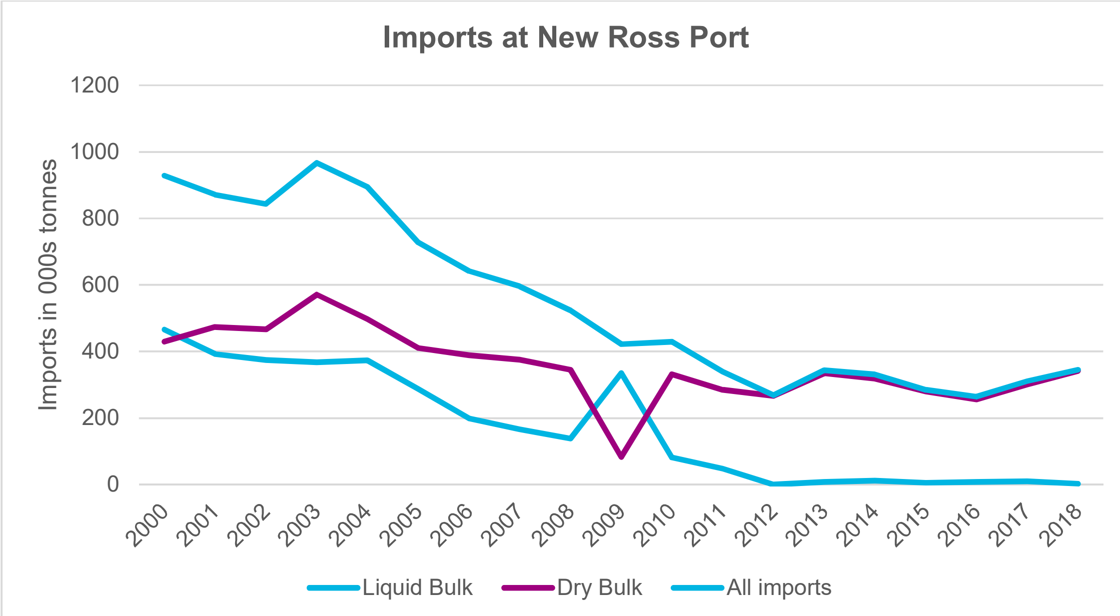
While this makes it more difficult to disentangle the effect of Galmoy's closure from other factors, the loss of 100,000-200,000 tonnes worth of exports is not insignificant, and this likely had an impact on this reduction in revenue and profitability. 2009 - the year in which Galmoy closed and the Port recorded a fall in operating profits by 78% - was a mixed year with regards to imports, and although dry bulk imports fell in 2009, this was balanced out by a rise in liquid bulk imports. This suggests that the loss of concentrate exports was a primary driver of the fall in revenue and profits seen that year, and the closure of Galmoy was described as one of several significant factors in the decline in the Port's fortunes at this time[158].

How this translates in terms of employment is less clear, although the long-term reduction in exports indicate that this may have had an effect. For a small regional port like New Ross, industries like Galmoy provide an important source of revenue and likely contributes to the creation of jobs. However, the loss of these exports can likewise have a significant effect on small ports.

While some supporting infrastructure was built at New Ross Port, such as a storage container and shiploader, most of these Galmoy-specific structures were removed during the closure period. It is not known whether there were any other improvements to the Port's infrastructure as a result of Galmoy mine, or whether these remain.

[158] https://www.independent.ie/regionals/newrossstandard/news/a-nightmare-if-port-is-joined-with-waterford-27507839.html

Figure B.3.4: Imports at New Ross Port, 2000-2018



Source: CSO Maritime Statistics

B.3.2 Mine Direct Expenditure

A mine's impact on the wider Irish economy largely depends on its spending. Spending for Galmoy mine was assessed over its lifetime, and direct expenditure is split into three main categories:

- **Capital and Development:** Spending on capital goods, such as buildings, vehicles and equipment
- **Non-Labour Inputs:** Spending on non-labour and non-capital inputs to the production process, including raw materials, supplies, services and general operating expenses. This figure is also used to calculate Gross-Valued Added (GVA).
- **Wages and Salaries:** All wages paid directly to employees. This also includes redundancy payments as part of the mines' closures.

All figures are estimated based on expenditure listed in the annual returns of Galmoy Mines Ltd. It is important to note that as this is an assessment of the economic impact of expenditure, only physical expenditure has been considered in this analysis. This means that certain flows that may otherwise factor into determining whether a business makes a profit or loss, such as disposals or changes in the value of assets, have been excluded.

Expenditure was further categorised according to whether it occurred during the construction, operations or closure/aftercare phases of the mine and the results are presented in the tables below. All expenditure has been converted to Euro (where necessary) and adjusted to 2018 Prices.

Galmoy had a total direct spend of nearly €676 million over the operational lifetime of the mine; including €165 million on construction and €511 million during operations**.** A full breakdown of direct expenditures is provided below.

Table B.3.3: Estimated Total Direct Expenditure at Galmoy Mine in 2018 € Values

	Construction (1995-1997)	Operations (1997-2012[159])	Closure and aftercare (2009- ongoing)	Total
Type of Expenditure	**€**	**€**	**€**	**€**
Capital and Development	164,877,000	43,599,000	-	**208,476,000**
Non-labour Inputs	-	325,800,000	-	**325,800,000**
Wages and Salaries	-	140,666,000	15,834,000	**156,500,000**
Site Remediation	-	900,000	12,010,000	**12,910,000**
Total Direct Expenditure	**164,877,000**	**510,965,000**	**27,844,000**	**703,686,000**

Source: AECOM Analysis of Galmoy Mines Ltd. Annual Accounts

B.3.3 Mine Direct Employment

Employment levels are key to understanding a mine's economic impact on both the Irish economy and local community.

Employment levels at Galmoy mine varied significantly over the lifetime of the mine, ranging between 81 and 241. During full operations, full-time employment averaged at 213 workers. Employment dropped significantly after 2008 when Galmoy mine announced its closure. While mining continued at Galmoy between 2009 and 2012, processing ceased and about 150 workers were made redundant.

Table B.3.4: Snapshot of Direct Employment at Galmoy Mine

	2000	2003	2006	2009
Total	172	217	241	81

Source: AECOM Analysis of Galmoy Mines Ltd. Annual Accounts

2006 POWSCAR[160] data for the electoral division in which Galmoy was located suggests that 32% of employees lived within 10km of the Mine and 80% lived within 30km. 36% came from Kilkenny while 38% came from Tipperary.

Up to 350 workers were employed during the construction phase of the mine[161], although it is likely that significantly less were full-time equivalent workers.

B.3.4 Contribution to Public Finances

Galmoy mine contributed financially to the respective local authorities and to the Exchequer in a number of ways: Royalties for the minerals extracted; Licence/lease fees ('Dead Rent') associated with the mining lease, paid regardless of whether minerals are extracted; taxation (corporate tax, pay related social insurance); and local authority contributions and rates.

Royalties and dead rent

Royalties are the state's primary direct source of income from mining. Royalties are paid to the State as a percentage of annual revenue, with the percentage rates negotiated at the beginning of a mining licence/lease, on a case by case basis. The minerals at Galmoy were primarily privately-owned and the company compensated the private owners of the minerals, in addition to the royalties paid to the state, which was taken into account when setting these rates. Dead rent was also paid in years in

[159] Partial closure in 2009; full closure in 2012.

[160] Place of Work, School and College – Census of Anonymised Records. Available from the Central Statistic Office

[161] The Irish Times, 1997. 'Mines a boost for Kilkenny'. https://www.irishtimes.com/business/mine-a-boost-for-kilkenny-1.129114

which Galmoy earned no revenue (i.e. construction/closure). In total, Galmoy paid about €12.8m in royalties and dead rent.

Table B.3.5: Royalties Rates at Galmoy Mine

Royalty Rates
1.5% of revenue until 31 August 2000; 2.25% from 1 September 2000 to 28 February 2001; 1.25% from 1 March 2001 to 30 June 2006; 1.75% thereafter.

Source: DCCAE, 2016. 'Fiscal Framework'

Taxation

In addition to royalties (which are charged on mining revenue), mining companies are also liable to pay corporation tax on profits. Different enterprises are taxed at different rates, with corporation tax for the mining industry taxed at 25% of profit. As with any company, corporation tax can be written off against losses from previous years and capital expenditure. Due to the capital-intensive nature of the mining industry, and well as frequent losses in its early years, Galmoy Mines Ltd[162] paid just under €600,000 in corporation tax between 2007 and 2012 according to its annual accounts. However, it is possible that greater amounts were paid by parent companies, such as Lundin Mining.

In addition, approximately €14.9 million was paid in Employer's PRSI, as estimated by Galmoy Mines Ltd. annual financial returns.

Approximately €30.9 million was paid in PAYE by employees, as estimated by the *Revenue Commissioners* Annual Reports for the period.

Commercial Rates

Mine operators also pay commercial rates to the relevant local authority, which was Kilkenny County Council in the case of Galmoy. Rates are paid to reflect the costs of doing business on a local level, such as providing appropriate infrastructure. During its lifetime, Galmoy paid €3.2m in local authority rates[163].

During construction, the company paid £870,000 in development contributions to Kilkenny County Council and Laois County Councils for upgrades required to local roads, which is the equivalent of approximately €1.49 million[164]. This was a requirement of Galmoy's planning permission.

B.3.5 Wider Economic Impacts

Gross Value-Added

Gross Value-Added (GVA) is defined as "output minus intermediate consumption"[165]; where intermediate consumption refers to goods that are consumed/used during the production process. In the mining industry, various inputs are used up in extracting the ore and creating a finished product that can then be sold. Electricity, fuel or tools are all examples of items that might be consumed during the production process for lead and zinc ore, and must be taken into account when estimating

[162] ARCON International Resources P.l.c. prior to c. 2005

[163] Source: Kilkenny County Council

[164] EIS 2000, Volume 2 (Transport Infrastructure)

[165] Eurostat: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Gross_value_added

the value-added amount. As GVA measures the *additional* value created by a firm or industry, it is a good indicator of the significance of Galmoy mine to the wider Irish economy.

At the firm level, GVA can be approximated with companies' annual accounts using the following formula, which was applied to both mines:

Turnover - Cost of Sales + Depreciation + Employee Costs + Amortisation[166]

As shown below, Galmoy mine added approximately €315 million of value to the Irish economy over its lifetime. Total GVA for the entire mining and quarrying sector was €10.78 billion between 1997 and 2012, indicating that Galmoy was responsible for 3% of gross-value added for the sector.

Table B.3.6: Estimated Gross Value-Added Contribution of Galmoy Mine in 2018 € Values

	Total
	€
Total Turnover	641,020,000
(Less Intermediate Consumption)	*(325,800,000)*
Gross-Valued Added	**315,220,000**

Source: AECOM Analysis of Annual Accounts

It's important to note that the mining and quarrying sector includes Tara Mines, as well as 350 commercial quarries[167] producing limestone, gypsum and dolomite (among other minerals). This means that although the Mines produced and exported significant amounts of lead and zinc in a national and international context, they accounted for a smaller proportion of GVA for the broader mining and quarrying sector in Ireland. The sector as a whole accounted for approximately 0.51% of Irish GVA between 1997 and 2012.

Expenditure Impacts

Every €1 directly spent by a business will have an impact in the economy beyond just that of itself. If a company spends money on purchasing supplies or hiring workers, those suppliers and employees will increase their own spending in response. This is known as the multiplier effect, and these expenditure impacts can be broken down into three components:

- **Direct Expenditure Impacts:** Relates to the expenditure that can be specifically attributed to the mine, or the initial amount spent by the mining company.
- **Indirect Expenditure Impacts:** Indirect impacts which arise as a consequence of changes in the level and value of sales for suppliers of goods and services to the mining industry. Type I multipliers measure the combined direct and indirect impacts of expenditure.
- **Induced Expenditure:** Relates to increases in spending by households as a result of increased earned income. As production increases in a firm and its linked industries, the resulting employment and wages earned can cause an increase in consumer spending in the wider economy. Type II multipliers measure the combined direct, indirect and induced impacts of expenditure.

Type I and Type II multipliers for the mining industry can be calculated using input-output tables from the Central Statistics Office (CSO), and have been estimated by *Indecon* at 1.91 and 2.59

[166] https://sp-bpr-en-prod-cdnep.azureedge.net/published/2018/2/23/A-Guide-to-Gross-Value-Added--GVA--in-Scotland/SB%2018-15.pdf

[167] https://www.irishconcrete.ie/backbone-sustainable-construction/quarries-and-aggregates/

respectively.[168] A Type II multiplier of 2.59 means that each additional €1 spent by the mining industry will cause an additional €2.59 in direct, indirect and induced spending.

These multipliers are high relative to other sectors for two reasons. Firstly, labour is a large component of mining companies' expenditure, and nearly 25% of national spend on inputs to the mining and quarrying in sector relates to wages and salaries. Secondly, the mining and quarrying sector spends significant amounts on Irish-produced inputs, with the largest suppliers to the industry including electricity and gas supply, land transport services, wholesale trade, and construction / construction works[169].

It is also important to consider the effect that the construction phase had on the wider Irish economy. Multipliers for the construction industry have been calculated by AECOM[170] in order to analyse the impacts of construction expenditure, and the Type I and Type II multipliers are 1.58 and 2.29 respectively. These multipliers have been applied to the construction and operations phase at Galmoy, to calculate the direct, indirect and induced expenditure impacts of the mine. These are shown in the tables below. Construction is a labour-intensive industry and is also linked to other labour-intensive industries, such as real estate, security and financial services, meaning that expenditure during the construction phase, although short-term, had significant induced effects.

At Galmoy, direct expenditure during the construction and operations phases was €165 million and €511 million respectively. These resulted in total lifetime expenditures of approximately €1.7 billion, made up of direct, indirect and induced expenditure as shown below.

Table B.3.7: Estimated Direct, Indirect and Induced Expenditure Impacts at Galmoy Mine in 2018 € Values

Job Function	Construction (1995-1997)	Operations (1997-2012)	Total Lifetime Expenditure Impacts
	€	€	€
Total Direct Expenditure	**€164,877,000**	**€510,965,000**	**€164,876,985**
Type I Industry Multiplier	*1.58*	*1.91*	
Total Indirect Expenditure	**€95,628,660**	**€464,978,150**	**€560,606,810**
Type II Industry Multiplier	*2.29*	*2.59*	
Total Induced Expenditure	**€117,062,670**	**€347,465,200**	**€464,527,870**
Combined Direct, Indirect and Induced Expenditure Impacts	**€377,568,330**	**€1,323,399,350**	**€1,700,967,680**

Source: AECOM Analysis of Annual Accounts

Employment Impacts

An increase in the number employed by the mining industry can have a knock-on effect in other industries and businesses. As with expenditure, indirect employment results from the employment generated by companies in the mines' supply chains, while induced employment is generated by

[168] Indecon, 2013. *'Assessment of Economic Contribution of Mineral Exploration and Mining in Ireland.'*

[169] Base on AECOM Analysis of 2011 Central Statistics Office Input-Output tables.

[170] Construction multipliers have been calculated from input-output tables supplied by the CSO

increased consumer spending; usually as a result of an increase in wages and salaries in the community.

Using average annual employment figures from Section B.3.3 and employment multipliers calculated by *Indecon*[171], the direct, indirect and induced employment impacts of Galmoy mine is shown in the table below.

Table B.3.8: Estimated Average Direct, Indirect and Induced Employment Impacts at Galmoy Mine

Job Function	Galmoy Average Employment
Direct Employment by Mines	213
Sectoral Type I Multiplier	*1.92*
Indirect Employment Impact	196
Sectoral Type II Multiplier	*2.41*
Induced Employment Impact	104
Combined Direct, Indirect and Induced Average Employment	**513**

Source: AECOM Analysis of Annual Accounts

Through direct, indirect, and induced employment effects, Galmoy mine supported an average of 513 direct and indirect jobs during its operational period.

While it is not possible to quantify the extent, it is likely that many of these indirect jobs were created in the local region. While certain specialist supplies may not have been available locally, local services are likely to have been used in the day-to-day operation of the mines, and a significant proportion of indirect employment would relate to local workers. Similarly, jobs resulting from higher levels of consumer spending are likely to have been created locally as workers spend their wages in businesses in the local community.

Other Financial Contributions to the Local Community

As part of their corporate social responsibility to the local community, Galmoy sponsored a local GAA club and purchased computers for a local school, but no evidence of wider sponsorship or community investment programme was found.

[171] Indecon, 2013. *'Assessment of Economic Contribution of Mineral Exploration and Mining in Ireland.'*

Appendix C

Supporting Evidence for Lisheen mine

Appendix C. Supporting evidence for Lisheen mine

B.4 Social effects

The information below sets out the data collected from the literature reviewed, external sources and interviews for Lisheen mine.

C.1.1 Population

Baseline

During the baseline, the local, regional and national populations were increasing by 1.7%, 0.3% and 2.8% respectively (CSO Census data). This shows that prior to the development of Lisheen mine, population growth levels were relatively consistent with that of the wider county and country.

Construction

While construction occurred between 1997 and 1999, population data is only available for 1996 and 2002. Within the local area, population levels decreased by around 1.6% during this time. Over the same time period, population levels increased by an average of 5.2% in County North Tipperary and 8% across the whole of Ireland. While there is a correlation between the mines construction and population decrease in the local area, it is not possible to conclude a relationship between the two. Given the rural nature of the local area, it was common for rural residents across Ireland to migrate to urban areas for greater employment opportunities during this time.

Operation

Throughout operation, the population of the local area increased by an average of 4.4%. It may be that the opportunities brought about by the mine, encouraged a net in-migration of people to the local area. However, the populations of the wider county and country also experienced an increase in population growth (5.4% and 6.7% respectively), therefore this trend may reflect a growing population in Ireland during this time-period.

Closure

After the closure of the mine, local, regional and national population growth rates slowed to 3.4%, 1.5% and 3.8% respectively. During this phase of the mines lifetime, the rate of population change in the local area was closest to the national average.

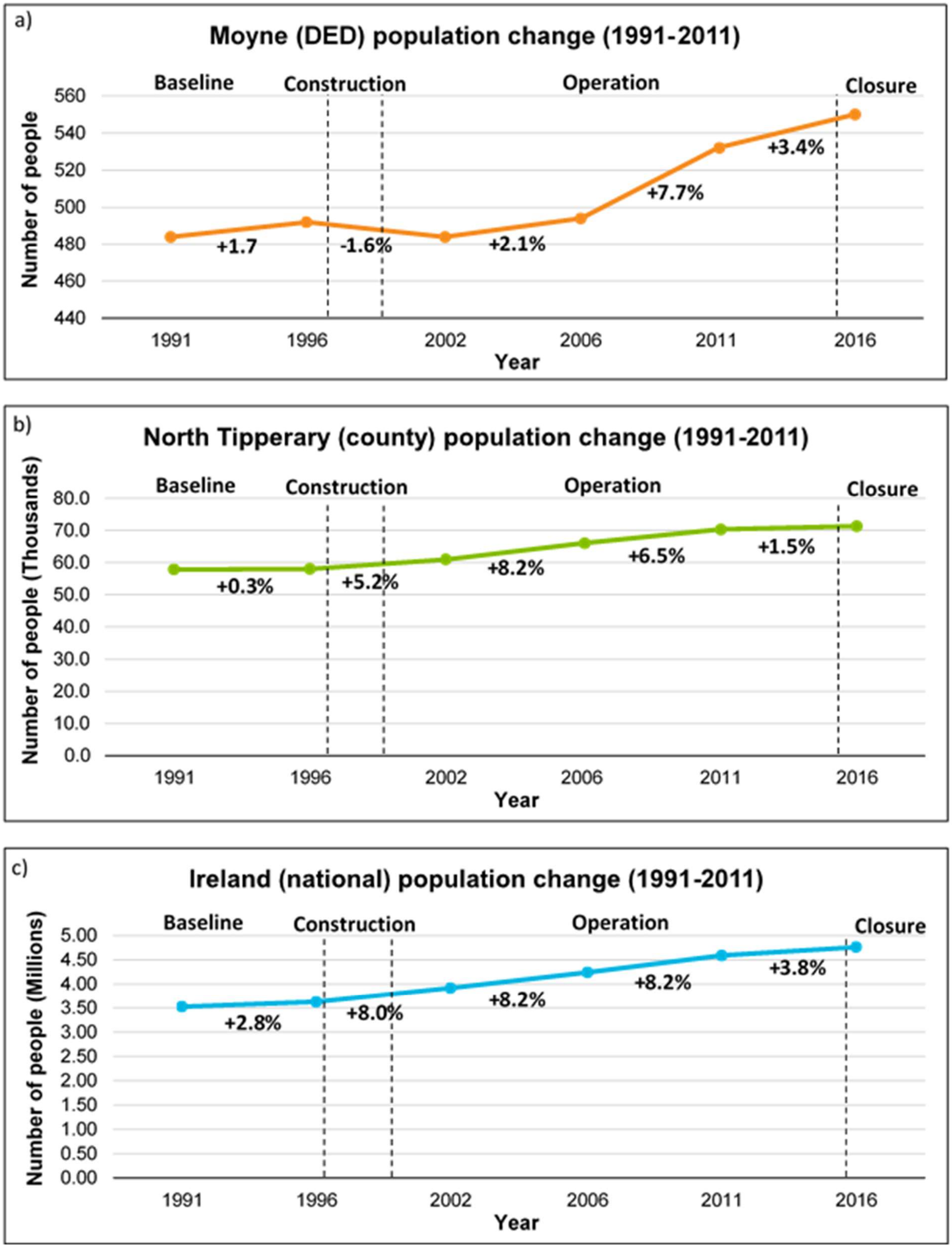
Over the lifetime of the mine, the population of the local area decreased during construction and increased during operation and closure. However, it is difficult to isolate the effects of the mine on local population, given the wider social and economic changes in Ireland from 1991 to 2016. A summary of population change over the lifetime of the mine is provided in Table C.1. 1 and Table C.1. 1 below.

Table C.1. 1: Average rates of population increase within the local, regional and national areas, over the different phases of Lisheen mine.

Average rate of population change	Moyne DED	+1.7%	-1.6%	+4.4%	+3.4%
	County North Tipperary	+0.3%	+5.2%	+5.4%	+1.5%
	Ireland	+2.8%	+8.0%	+6.7%	+3.8%

Source: Central Statistics Office

Figure C.1.1: Population change within the a) local, b) regional, and c) country areas, over the lifetime of Lisheen mine (1991-2016)



Source: Central Statistics Office

C.1.2 Employment

Baseline

During the baseline years, unemployment levels across Ireland were high, at an average of 14.05% (see Figure C.1.2). In comparison, County North Tipperary had an unemployment rate of 11% in 1996, showing that there were lower levels of unemployment within the region surrounding the proposed site prior to the mine's development. Given the rural nature of County North Tipperary, this trend is likely due to emigration of people of working age from the local area, rather than due to local job opportunities.

Figure C.1.2: Rates of unemployment across the whole of Ireland, over the lifetime of Lisheen mine (1991-2016)

Construction

During construction, there were up to 750 people directly employed by the mine. In addition to the direct employment, it is estimated that there were 644 indirect employees and 343 induced employees (see Figure C.1.). However, as with Galmoy, it is not possible to determine what proportion related to full-time equivalent workers, meaning that it is not possible to conclusively determine whether this indirect/induced employment occurred.

While unemployment rates throughout Ireland decreased during the construction of the mine, average unemployment rates were still relatively high at 10.3% (see Figure C.1.2). Therefore, the above employment impacts from the construction of the mine will have brought significant benefits to society given the relatively low number of available jobs throughout the country during that time-period.

However, much of the construction works were undertaken by specialist construction and mine construction companies, and although evidence from interviews suggest that there was some local employment during this phase, it is likely that most of the additional employment opportunities were not received by the local community. However, some of those involved in construction went on to work in the mine and live in the area, suggesting that there were some long-term effects.

Operation

Throughout the operation of Lisheen mine, there was an average of 350 people directly employed by the mine. The majority of these employees were employed by the mine on full time contracts for over two years, with the exception of local farmers who were hired under part-time contracts.

In terms of indirect employment, it is estimate that there were 322 people directly employed during the mine's operation. Additionally, induced employment during this phase was estimated to be 171 people (see Figure C.1.).

During the early years of operation, unemployment rates in Ireland were low, averaging around 4.8% from 1999 to 2008 (see Figure C.1.2). However, during the latter half of operation, national unemployment rates increased, peaking at 15% in 2012. During this time of high unemployment, the job opportunities brought about by the mine would have had a significant positive impact on the local area.

In the initial stages of operation, it was difficult to employ local people due to a lack of necessary training. Approximately 27 workers from the Philippines were employed after the mine opened due to their higher skill levels and international mining experience. These non-local employees were originally on short-term contracts to train and enhance the skill levels of local workers, however due to their positive impact on the workforce, their contracts were extended.

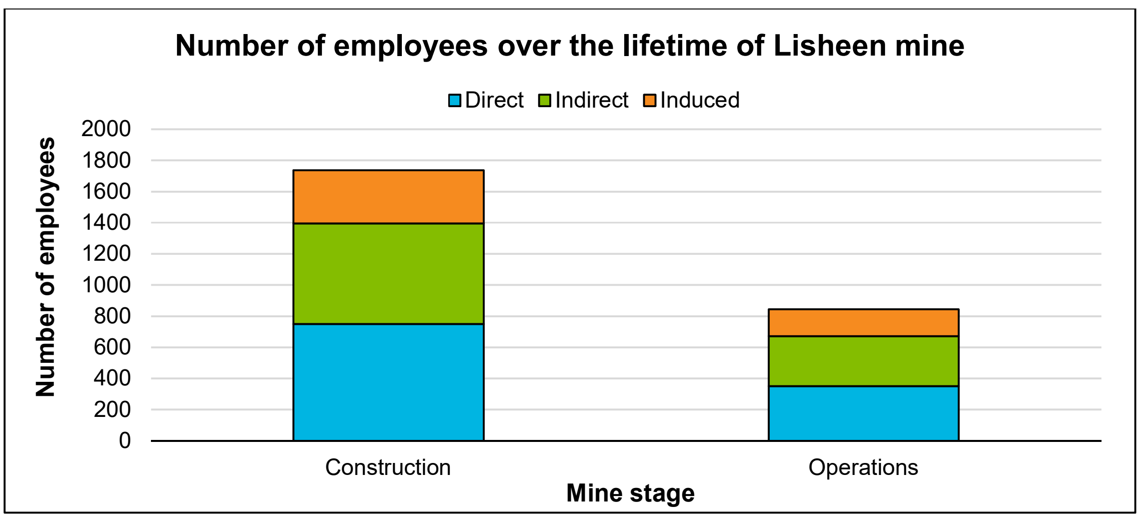
With the exception of specialist workers, such as geologists, the mine made a big effort to employ people from the local community. 2011 POWSCAR Data from the electoral division in which Lisheen is located indicate that 36% of workers lived within 10km of the Mine and 77% lived within 30km, which suggests a large proportion of local people in the workforce. Therefore, the mine had both employment benefits on the local community, as well as economic benefits due to wages being held and spent within the local area.

In addition to these local workers, approximately three to four graduates were recruited every year from Camborne School of Mines in the UK. While these employees were not from the local area, the mine brought in young, educated and skilled workers to a local community which was prone to high levels of out-migration. It is unclear how long these workers remained in the local area, therefore long-term impacts cannot be concluded.

Salaries for employees at Lisheen mine during operations were above average for the mining industry. Workers received performance-related bonuses through the mine's successful incentive programme. Generally, interviews with previous workers revealed that the Lisheen mine was considered to be a good place to work[172].

In terms of procurement contracts, the mine prioritised local sub-contractors wherever possible, with the exception of more specialised mining services which were provided by international providers.

Figure C.1.3: Estimated number of employees during construction and operation of the Galmoy mine, broken down to direct, indirect and induced employees



Closure

Building up to the mine's closure, approximately 400 employees were made redundant from 2009 to 2015. Despite this negative employment impact through a major loss of jobs, redundancy plans were in place a long time in advance and clear communication allowed employees to plan ahead. In addition, a total of approximately €43.6 million was paid in redundancy payments.

When the mine closed, unemployment levels across Ireland were decreasing, averaging at 9.8% in 2015. This national trend would have helped to reduce the extent of the negative employment impacts

[172] Based on interviews conducted for this study

from the mine closure, making it more likely for employees to secure new jobs. This, in combination with the training support provided by the mine (detailed in the Education and Skills section below) may have contributed to the high re-employment rate of ex-employees, which was estimated by one interviewee at 90% one year after closure. Many of these workers were offered full time employment within the mining industry, however had to take a reduction in wages, due to Lisheen paying above the industry average. In additional, around 15 ex-employees are still active consultants and some have set up their own businesses and companies following the mines closure. One particular group of employees formed a training company called Lisheen Technical & Mining Services, which now employees approximately 20 people from the local area.

When the mine closed, the Lisheen Mine Task Force was set up by former mine officials and representatives from local authorities and government bodies to market the site as a place to do business. In 2018, it was announced that the site would be redeveloped as the National Bioeconomy Campus, and several organisations have planned or announced investment in facilities at the site. The Irish Bio-economy Foundation (a non-profit) was awarded 4.6million euros to develop a new bio-economy innovation and piloting facility. The facility will be used by researchers, entrepreneurs and businesses. While this facility has the potential to create a job boost in the area and compensate against the negative employment impacts of mine's closure, few people are expected to be re-employed on the site, given that the facility is predicted to only have 35 to 40 employees. Additionally, Commercial Mushroom Producers recently announced the construction of a mushroom substrate facility on site, which has the potential to offer further job opportunities for the local community.

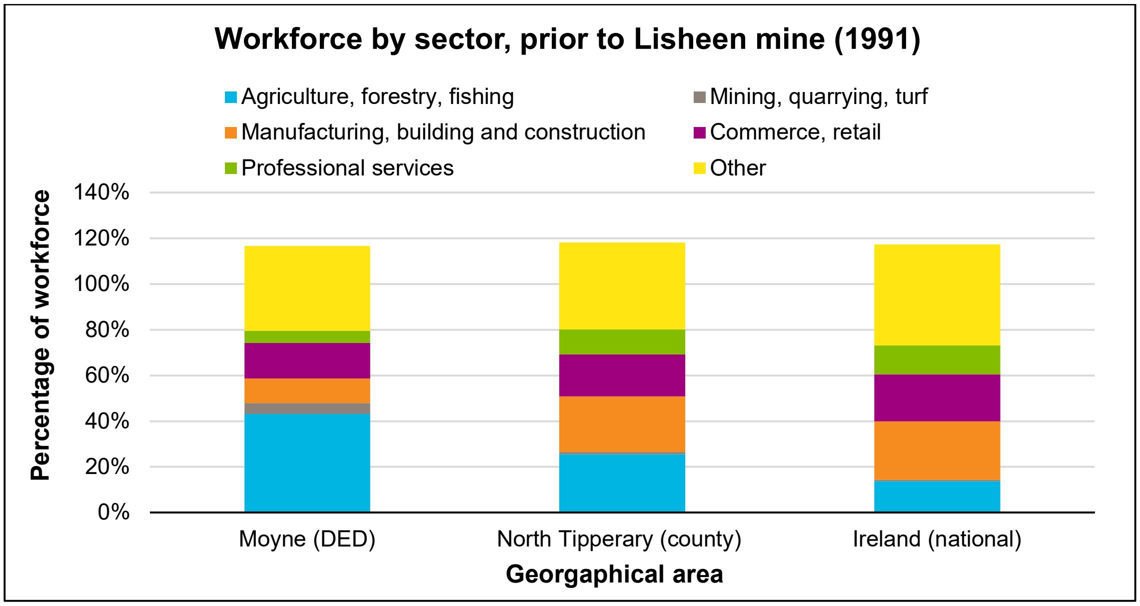
Finally, in terms of local suppliers, all procurement contracts were ended when the mine was closed. However, the mine gave sufficient notice to all suppliers to enable to them to plan for business changes after the mine's closure.

C.1.3 Education and skills

Baseline

As shown in Figure C1. 4, prior to the development of Lisheen mine, the local area had a higher percentage of the workforce within the agricultural sector (43%), compared to regional (26%) and national (14%) averages. However, there was a notably lower proportion of Moyne residents working within the manufacturing, building and construction sector, and the professional services sector. Importantly, the local area had a higher percentage of the workforce already working within the mining, quarrying and turf sectors (5%), compared to regional (1%) and national (1%) levels. However, it is likely that much of this related to the turf sectors, given that the presence of the Derryville Bog.

Figure C.1.4: Breakdown of the workforce by sector within the local, regional and national areas, prior to construction of Lisheen mine (1991)



Construction

As detailed in the employment section above, the majority of construction employees at Lisheen mine were external experts and hence there was no noteworthy upskilling of local people during construction. Additionally, given that no information was available on the expenses occurred for skills and training purposes among employees during the construction phase of the mine.

Operation

At the beginning of operation, international workers were brought in to train local mine employees, ensuring high quality skills transfer. Throughout the operation phase, a comprehensive training and development programme was implemented, covering all employees. The training department at the mine had two fulltime employees devoted to upskilling employees, along with an annual training budget of approximately 420,000 to 500,000 euros. These funds were available to all staff at the various levels of the mine and covered a wide range of skills, including machine operation, health and safety, underground truck driving and more. Up to two years of training was required for all employees to qualify as a skilled miner on the site and the mine provided training certificates to verify the skills learned while employed at Lisheen which could be used in future job applications. Support for further study (including payment of third level fees and study leave) was also provided to Lisheen employees so that they could gain relevant tertiary qualifications. Additionally, the mine also ran a graduate training programme that was aimed to support the development of skills of junior staff[173].

In 2014, a team of employees from the Lisheen mine were sent to India to oversee a training course at one of Vedanta's other mine operation sites[174]. Employees participated in a skills sharing workshop with mine employees from other parts of the world.

The training programmes provided by the mine were also intended to support workers following the closure of the mine site. Two-years prior to the mine's closure, an outplacement programme was set up with a workshop on CV development, personal coaching and more. Lisheen staff were offered €750 each to be used on a training programme of their choice. An HR specialist was brought in during

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[173] Based on interviews conducted for this study

[174] Based on interviews conducted for this study

mine closure to support the staff in preparing for their future professions[175]. Career coaches were made available to help workers to assess their skillsets and assets, which would be useful in their next career.

Closure

As the information in the operation overview demonstrates, Lisheen mine invested a significant amount of resources to support employees, ensuring that they find work post-closure. Based on the evidence of relatively high levels of post-closure employment, this suggests that ex-employees experienced improved employability from the new skills that they gained during their time at Lisheen mine.

C.1.4 Health and Safety

Baseline

Prior to the development of Lisheen mine, there were no reports of adverse or unusual epidemiological data from the surrounding local area.

In regard to noise and vibration, noise levels during the baseline were typically as follows:

- 36 to 41 dB LA90 day-time (0700-1900); and
- 33 to 37 dB LA90 night-time (1900-0700).

These levels are considered typical of a rural area with no major roads passing through and not beneath an aircraft flight path. They are also within the WHO Environmental Noise Guidelines.

Construction

With regards to the health and safety of the construction employees at the mine, it was mandatory for all workers to partake in a mining safety induction. Employees were then given regular safety training courses, which the company provided in addition to external training courses. Despite these resources having a positive impact on employee health and safety, there were also negative effects during the construction phase, including an incident which resulted in one fatality.

Expected noise levels for the construction phase of the mine, in the absence of mitigation efforts, were reported in four sub-phases from months 0-24 of construction and across three different construction sites (Table C.1. 2). The Environmental Baseline Report (1995) reported that a total of 36 dwellings had the potential to be impacted by construction traffic noise if no mitigation measures were adopted.

Table C.1. 2: Expected noise level without mitigation during mine construction

Construction site	Noise level (dBA)			
	Phase 1	Phase 2	Phase 3	Phase 4
Site 1	62	64	62	60
Site 2	61	62	60	60
Site 3	61	61	59	57

Given that these levels exceed 60 dBA, noise mitigation efforts would be required. The literature reported that after mitigation noise levels would be around 57-59 dBA. This was expected to decrease by around 10 dBA once construction went below the surface.

The literature review and interviews did not identify evidence about actual noise levels, compliance or exceedances during the construction phase.

[175] Based on interviews conducted for this study

Operation

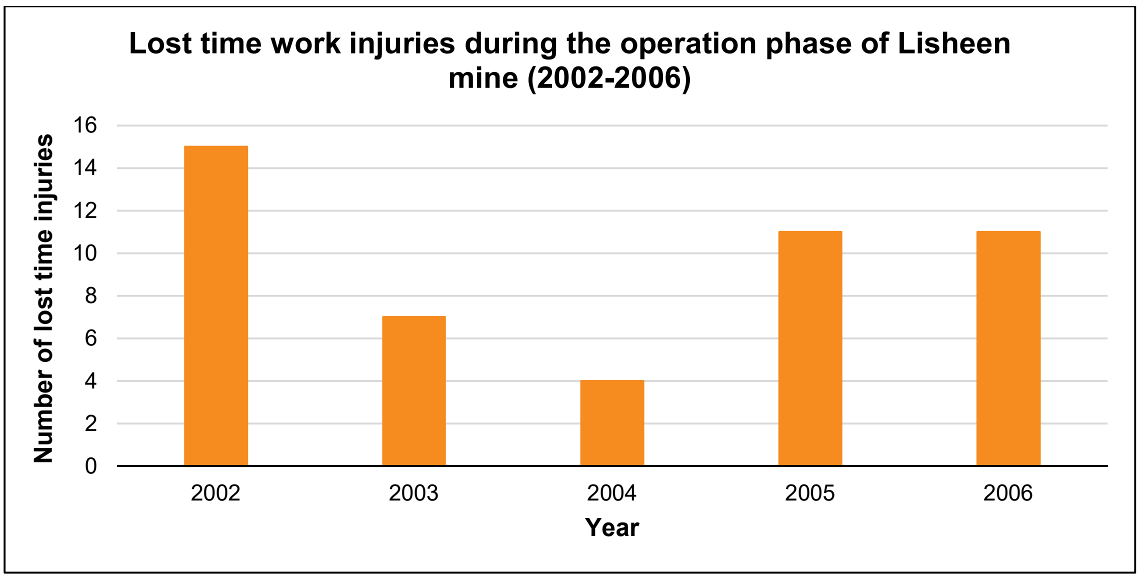
With regards to the health and safety of the operation employees at the mine, the company went beyond the basic health and safety hazard identification and risk assessment approach and implemented paper-based safety training based on Zero Incidence Performance.

While the resources invested in the process had a positive impact on employee health and safety, there were reports of several incidents over the operation phase of the mine. Occurrences of lost time work injuries (where employees were unable to complete their next shift) ranged from 11-12 at the start of operation to 1-2 towards the end of operation. Detailed annual data on these lost time work injuries is only available from 2002 to 2006 and are summarised in Figure C.1.5. Furthermore, 636 'near misses' were reported in 2005, and 107 worker days were lost in 2013-2014 due to work related injuries.

In addition to these injuries, there were several more serious incidences which are detailed below:

- One fatality in the early operations phase.
- One fatality and one serious facial injury following a mine explosion in 2011. In an inquest in 2013, this was determined to be a suicide.
- One fatality in 2013 due to a collapsed roof. This was investigated by the HSA and the company cleared of wrong-doing.

Figure C.1.5: Number of lost time work injuries recorded from 2002 to 2006, during the operation phase of Lisheen mine



Based on an average of 43 hours worked per week per employee[176], this translates to rate of injuries of 11.6 injuries per million hours worked, which is below the national average of 14 for this period (see Table C.1.3

[176] CSO Average Earnings, Hours Worked, Employment and Labour Cost of Mining and Quarrying Sector for all workers, 2008. Pre-2008 data is not available.

Table C.1.3: National injury rates for industrial and all sectors

Rate per million hours worked	2003	2004	2005	2006	Average (2003-2006)
Injuries (Sectors C-E)	17.4	10.4	14.3	14.0	**14.0**
Injuries (all sectors)	18.0	16.3	17.0	16.5	**17.0**

Source: Based on Analysis of Health and Safety Authority (HSA) Annual Statistics 2006, 2007.

In relation to noise and vibration impacts during the operation of the mine, Table C.1.4 summarises the evidence available regarding compliance and exceedance of noise levels between 2005 and 2015, based on the literature review. It shows the number of noise-related complaints, as well as the Mine's compliance with licence conditions in years for which this was available.

Table C.1. 4: Summary of evidence of noise compliance during operation phase (2005 – 2015)

Year	Compliance with Licence Conditions (%)	Number of complaints
2005	99.6%	• 12 (day time) • Unknown total
2006	96.65%	• 11 (due to vibration) • Unknown total
2007	-	• 14 (due to vibration) • Unknown total
2008	99.9%	• 4 (due to vibration) • Unknown total
2009	99.9%	• 6 (due to vibration) • Unknown total
2010	99.9%	• 4 (due to vibration) • Unknown total
2011	-	• 4 (night time) • Unknown total
2012	-	• 2 (due to vibration) • Unknown total
2013	99.9%	• 3 (due to vibration) • Total of 22
2014	-	• 1 (due to vibration) • 3 (due to blasts and car engines) • Unknown total
2015	-	• 0 (due to vibration) • Unknown total

Source: Annual sustainability reports for Lisheen mine.

While the mine's compliance improved during this period, there were still complaints from local community members due to noise and vibration from blasting, particularly when blasting occurred at night. Despite the mine largely complying with license conditions, the welfare of the affected population that submitted complaints (and others that did not submit complaints but may have still been affected) may have still been impacted by noise events due to potential sleep disturbance, annoyance, hypertension and related diseases. These effects are worth noting given that this study considers effects from a societal perspective, rather than from the perspective of the mine operators, and even if operators comply with conditions set by their licences, these activities still have the potential to cause annoyance or disturbance to local residents.

Closure

To date, there has been no evidence of any significant impacts on the health, safety or well-being of the local community, since the closure of the mine.

During the closure of the mine, there were no incidences of fatalities, accidents, injuries or near misses reported, and hence it can be concluded that closure of the mine did not have any negative impacts on employee or local community health and safety.

With regards to noise and vibration, noise disturbances may have occurred during the closure of Lisheen mine. However, the literature review and interviews did not identify evidence to determine this.

C.1.5 Community

Baseline

Prior to the development of Lisheen mine, all of the road infrastructure within the local area needed realigning and resurfacing, with the exception of the N8. Traffic flows in the local area were typical of those expected in a rural area, with higher flows on the national primary and secondary roads.

The area around the mine had a number of local community services, including rail links between Thurles and Templemore and either Cork or Dublin and buses run by Bus Eireann as well as private services.[177] Housing and properties in the area were connected to the electricity grid, but not all were connected to the main water supply or sewage schemes.[178] There were a number of domestic wells, but the water was considered to be of poor quality.

There were no clear impacts on the community identified during the baseline phase of the Lisheen mine.

Construction

During construction, there was no evidence of any impacts on community infrastructure, including local roads. In terms of community services, the only recorded effect was in regards to water services. Mine dewatering during construction effected water supply in approximately 70 wells used for farm and house purposes. This had a negative impact on those who used the affected wells however given the short duration of this effect, it was not concluded to be significant.

There was no evidence of support to the local community from the mine during the construction phase. Additionally, as there was no evidence of reported public complaints during construction, it can be inferred that there was no significant impact on social cohesion during the construction phase.

Operation

At the beginning of the mining operation, major investments in local infrastructure were undertaken, including the upgrading (realignment and resurfacing works) of a number of roads that link up with the N8.[179] A total of 5 million euros was spent on the development of local roads, with match funding from the Tipperary County Council who targeted their investment towards the local area surround the mine site.

To address surface and ground water quality concerns, approximately €2.5 million was spent upgrading local water schemes. While the Moyne-Templetuohy Group Water Scheme was managed by a committee independent of the mine, Lisheen Mine paid for several improvements to water supply and quality by replacing lines to improve pressure, installing sand filters, UV filters, an additional well, new booster station, and new treatment systems. The mine also upgraded a problematic section of

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[177] 1995 Minorco Environmental Baseline Report

[178] 1995 Minorco Environmental Baseline Report

[179] 1995 Minorco Environmental Baseline Report

the water main along the scheme ensuring good quality water for the community during mine operation.

While the mine used large amounts of energy, electricity provision within the local area was enhanced due to the construction of a wind farm, commissioned by the mine. In 2009, a total of 18 turbines were built at the site with installed capacity of 36 megawatts. At this production rate, the wind farm was capable of supplying all of the mines electricity needs as well as the town of Thurles, with additional power spilling over onto the grid, which demonstrates significant positive impacts to the local community. This led to the construction of another 12 turbines several years later. The wind farm continues to operate today, and now supplies enough energy equivalent of 14,200 households (see Section C.2.9)[180]. According to interviews conducted as part of this assessment, there was an initial lack of community consultation regarding the wind farms, and after members of the local community expressed concerns regarding the construction of the wind farm regarding potential effects on property prices, health and flickering, mine management made a more concerted effort to engage and inform local community members about the project.

The Mine had a Stakeholder Management Plan to manage its relationships with key stakeholders, including members of the local community. As part of this, they operated an 'Open Door' policy, meaning that any community member with an issue or grievance could express them directly to the mine management.

During operation of the Lisheen mine there were a number of community concerns regarding its impact. A 2004 socio-economic study found that the main four concerns regarding the mine were land issues, drinking water quality, surface water quality, noise and vibrations resulting from blasting and air pollution.

- **Land issues:** The local population felt that there was a discrepancy in the levels of compensation received by various households for exploratory drilling and that their properties had lost value due to their proximity to the mine. A number of community members felt that the compensation for the use of their land and the lack of access to lands owned by the mine was insufficient.
- **Drinking water quality:** Some community members felt that drinking water quality (taste, smell and appearance) had been worsened during the mine's operation
- **Surface water quality:** Some community members interviewed in the 2004 socio-economic study felt that the quality of the water in local water courses had deteriorated making the water unsafe for farm livestock.
- **Noise and vibrations:** The other major concern in the community was regarding blasting and vibrations, which were considered to be a noteworthy disturbance, particularly during the night as evidenced by a number of complaints throughout operation years. There were also complains relating to air pollution issues during operation of the mine. The community noticed dust-deposits forming on vegetation and cars due to emissions from return air shafts at the mine.

However, not all responses were negative:

- **Water:** The majority of respondents in the community believed that the mine, through investment in local water schemes, had improved water supply in the area. The community also acknowledged that drainage of land, due to the lowering of the water table, had made the land easier to farm.
- **Economic growth and jobs:** The participants acknowledged that: (i) mining operations contributed to prosperity in the area through provision of jobs and regular incomes to some households that previously relied solely on farming, (ii) the mine provided employment for local

[180] While this figure is based on the annual *energy* consumption of households, energy consumption both electricity and heating. Therefore, the exact number of households supplied by these wind turbines is likely significantly higher (depending on their heating sources), and evidence suggests that up to 30,000 households were supplied with electricity. The figure of 14,200 households is reported in order to given context to the energy generated by the wind turbines.

people who otherwise would have had to leave the area, and (iii) there has was a positive impact on small businesses locally.

- **Communication:** While in need of improvement in relation to noise and vibrations, the mine's 'Open Door' policy of community engagement generally allowed community members to express their issues/grievances, and to have those concerns heard by mine management.

However, it was acknowledged that greater communication regarding the quality of discharged air was needed, therefore following the complaints, the mine set up quarterly engagement meetings/forums to inform the public of their environmental and social performance.[181] It was largely agreed in interviews that these systems for dealing with complaints were good and the community found that the mine was responsive to their concerns, both environmental and social. While social cohesion may have been negatively affected during the initial stages of operation, improved communication and positive responses from the local community provide evidence that by the end of operation the mine had developed a good relationship with the local community, which is likely to have sustained social cohesion in the local area.

This had a particularly positive impact on sponsorship, as it allowed community members to directly lobby for the mine's support for a variety of local projects. The Mine had a sponsorship committee to examine and screen these requests, and at the beginning of operations around €50,000 to €100,000 a year was given in sponsorships across North Tipperary, including contributions to: The Rotary Club, Templetuohy GAA Club, Thurles Musical Society, Local schools, Local clergy, Templeree committee, and Moyne Voluntary Housing Association. These increased in the final 5 to 6 years, when the mine invested a total of €1.5 million in local facilities and projects, including:

- Community hall in Moyne (€350,000)
- Community hall in Templetuohy (€300,000)
- GAA Club (€300,000)
- Running track (€200,000)
- A stadium for the local football team
- A yearly local flagship programme

Other community initiatives which did not involve direct financial contribution included environmental awareness through 'Environmental Schools Competitions', the use of the mine's facilities to run computer courses for the local community, an annual Mine Open Day and participation in work experience programmes for pupils of local schools. The above investments, donations and volunteering time given by the mine during operation, demonstrate a long-term positive impact on the local community.

Closure

Since the mine was closed, there was no evidence to suggest that there were any impacts on the road infrastructure of the local area. This was also the case for community services, with the exception of water supply and electricity. The creation of a new water scheme during operation, ensured that the local community were left with a very high-quality chargeable water scheme, bringing about significant improvements post-closure of the mine, compared to the baseline. As part of the mine closure plans, the construction of an additional reservoir was planned and completed in 2014 at Taylor Cross in 2014. This construction of a reservoir in 2014 (during the end of operations) ensured a secure supply of quality water for the community after closure of the mine and had a positive legacy impact for the communities around Lisheen. In addition to the reservoir, the wind farm was extended resulting in improved capacity of the site to produce renewable electricity for the local community post-mine closure.

[181] The Lisheen Mine – Annual Environmental Report, Jan 2014 – Dec 2014 (AER)

Finally, due to closure of the mine, all contracts with local providers were ended. While this negatively impacted local supplies and services within the community, the mine was careful to give as much notice as possible to allow for these local providers to prepare for the closure of the mine.

B.5 Environmental effects

The environmental assessment considers the stock of natural capital assets that are relevant to the evaluation of the mine's environmental effects. This evaluation considers the stock of natural capital in terms of their extent and condition, as well as the flow of ecosystem services (benefits) they deliver. The Natural Capital Committee defines natural capital as the elements of nature that directly and indirectly produce value or benefits to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions (Natural Capital Committee, 2014).

Natural capital assets are identified on the basis of the classification of broad habitat types provided by the UK National Ecosystem Assessment (UK NEA, 2011).[182] To support the assessment, spatial analysis using CORINE land cover data has been undertaken to determine the breakdown of land in the mine footprint by broad habitat type. This allows changes in the extent of natural capital as a result of the mine to be identified. The principal habitats within the footprint of Lisheen mine are enclosed farmland and mountains, moors and heaths.

When it comes to changes in the condition of natural capital, these are considered within 3 km of the footprint of the mine. This allows changes to surrounding habitats as a result of mining activities (such a freshwaters) to be considered, but also avoids an overlap with Galmoy mine which is around 7 km from Lisheen mine (from their mid-point).

It should be noted that definitions of natural capital include mineral deposits. As such, in addition to the habitat types within the footprint of the mine, minerals are considered separately with respect to the mine's operational stage. Air quality is considered as cross-cutting environmental impact as it affects all habitat types.

The flow of ecosystem services delivered by natural capital assets is considered in terms of provisioning, regulating and cultural services. Supporting services are not covered in the assessment as they constitute intermediate rather than final ecosystem services which, when valued with other final services, can lead to double counting of environmental effects. The classification of ecosystem services draws on the UK National Ecosystem Assessment (2011)[183] and the Millennium Ecosystem Assessment[184].

C.2.1 Land cover

C.2.1.1 Baseline

The following sub-section reports evidence collected from the literature review and evidence review regarding land cover in the baseline (1990-1997) for the Lisheen mine. Land cover provides an indication of the extent and condition (quantity and quality) of natural capital assets that existed in and around the mine site.

The mine is located mid-way between the villages of Templetuohy to the north and Moyne to the south. It is situated amongst townlands of Ballyerk, Barnalisheen, Cooleeny, Derryfadda, Derryville and Killoran. It is located between 10-12 km from Thurles and Templemore which are the nearest population centres.

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[182] UK National Ecosystem Assessment (2011). The UK National Ecosystem Assessment: Synthesis of the Key Findings. UNEP-WCMC, Cambridge.

[183] UK National Ecosystem Assessment (2011). The UK National Ecosystem Assessment: Synthesis of the Key Findings. UNEP-WCMC, Cambridge.

[184] Millennium Ecosystem Assessment (MEA), 2005. Ecosystems and Human Well-being: General Synthesis. Island Press, Washington, DC.

The mine is located in an area of rolling countryside largely comprise of pastureland and peatland. The area of pastureland is mainly used for rural dairy farming. Grazing land was assessed and determined to be of good quality with swards for silage and hay more likely to be of poor to moderate quality. A few small settlements are located across the area, but most dwellings are in the form of isolated farmhouses. Metalled and unmetalled lanes cross the countryside landscape. There is very little tree and shrub cover, and the level topography and numerous hedgerows substantially reduce visibility of the mine site from roads and settlements. The large area of peatland is the most significant landscape feature, and these provide long distance views across the bog from the farmland at higher elevations.[185] By the time of the 1995 EIS, much of this area of peatland was being mechanically harvested by *Bord na Móna* and was observed to be generally degraded. It is not clear whether the peatland was in good condition prior to being stripped.

As part of the study, spatial analysis was conducted using the CORINE land cover data that is available for 1990, 2000, 2012, and 2018. Figure C.2. 1 illustrates the spatial distribution of land cover within the mine footprint for each year of available data. It is complimented by Table C.2. 1, which presents the underlying land cover estimates. The total footprint of the mine had an area of around 480 ha in 1990, which corresponds to the baseline for Lisheen mine. The majority of the land within the footprint of the mine was classified as pastureland (57%) followed by peatland (40%). Less than 3% of land was classified as woodland (coniferous and transitional woodland-shrub).

Table C.2. 1: Initial results of CORINE land cover analysis within Lisheen mine footprint (CORINE data; 1990-2018)

Land cover type	Estimated area (hectares)			
	1990 (Baseline)	2000 (Operation)	2012 (Operation)	2018 (Closure)
Industrial or commercial unit	-	42	42	-
Mineral extraction site	-	-	-	*108**
Non-irrigated arable land	0.2	20	1	-
Pasture	277	215	192	185
Agricultural land with areas of natural vegetation	-	-	44	48
Broadleaved woodland	-	-	-	29
Coniferous woodland*	6	*73**	*67**	0.1
Transitional woodland-shrub	7	7	8	2
Peat bogs	193	127	130	112
Total	483	483	483	483

*Note: CORINE appears to have erroneously categorised approximately 67 hectares of the Tailings Management Facility as coniferous woodland in 2000 and 2012 (see Section C.2.1)

The 1995 EIS did not identify any Natural Heritage Areas (NHAs) near the location of the mine. Three proposed NHAs were identified within a $10km^2$ radius of the Lisheen Mine area:

- Templemore Woods
- Ormond's Mill
- Cabragh wetlands

Of these, only Cabragh Wetlands were considered potentially affected by the mining, given a hydraulic connection with the site.

There are five Natura 2000 sites within a 15 km radius of Lisheen Mine including: [186]

[185] 1995 Minorco Environmental Baseline Report

[186] Natura Impact Statement – Modification of Water Impound Facility at Lisheen Mine, Co. Tipperary (2013) Golder Associates

- Galmoy Fen
- Cullahill Mountain
- Spahill and Clonmantagh Hill
- The Loughans
- Lower River Suir (an SAC River)

The abundance and richness of species recorded by baseline surveys was noted as being typical for Ireland. However ecological surveys conducted in support of the 1995 Environmental Baseline Report recorded a collection of significant species in the area including:

- Two widespread but protected aquatic species including the freshwater crayfish (Austropotamobius pallipes) and the otter (Lutra lutra);
- Several badger setts, notably a large active sett at Garrick Hill and one in the vicinity of Burrow Grove;
- One significant terrestrial invertebrate, the wood-ant Formica higubris which is relatively rare in Ireland, and virtually restricted to large woods on the Cork-Tipperary border; [187]
- Local natural heritage areas and special areas of conservation, namely the Galmoy Fen and the Loughans, are located approximately within 10 km, from the Lisheen mine. These biodiverse areas were not expected to be significantly affected by mining operations, as the construction activity and transport infrastructure would not be planned near to those sites[188].

A baseline survey of soil geochemistry in the vicinity of the mine was carried out as part of the 1995 EIS. The results identified the status of soil fertility in the study area as satisfactory with mean phosphorus concentrations double the national average suggesting excessive agricultural usage, which corresponds to the land covered estimates in the table above. Additionally, magnesium was very high and considered to result from the background limestone makeup. Copper, zinc and arsenic concentrations in near surface horizons fell within the normal ranges of Irish soils with no variation in depth. Arsenic concentrations within the peat soils were very high and concentrations were elevated in mineral soils around the bog perimeters. Metals levels in the soils sampled were generally satisfactory and within the normal range for Irish soils.

The area surrounding Lisheen is rich in Early Christian and medieval monuments with signs of human occupation dating back to the Bronze Age. There is also evidence of “well-organised prehistoric communities and their settlements” from the Iron Age.[189] During the environmental baseline study and the subsequent mine construction phase, various archaeological features were recorded near the proposed TMF. Following consultation with the Department of Arts, Culture and the Gaeltacht's heritage services, it was decided that a significant amount of mitigation work was required to record and preserve these features. Items of archaeological significance that were found at the site were extensively studied and preserved. The completed archaeological study was submitted to the Department of Arts, Culture and the Gaeltacht and is now held on record in the National Museum.[190]

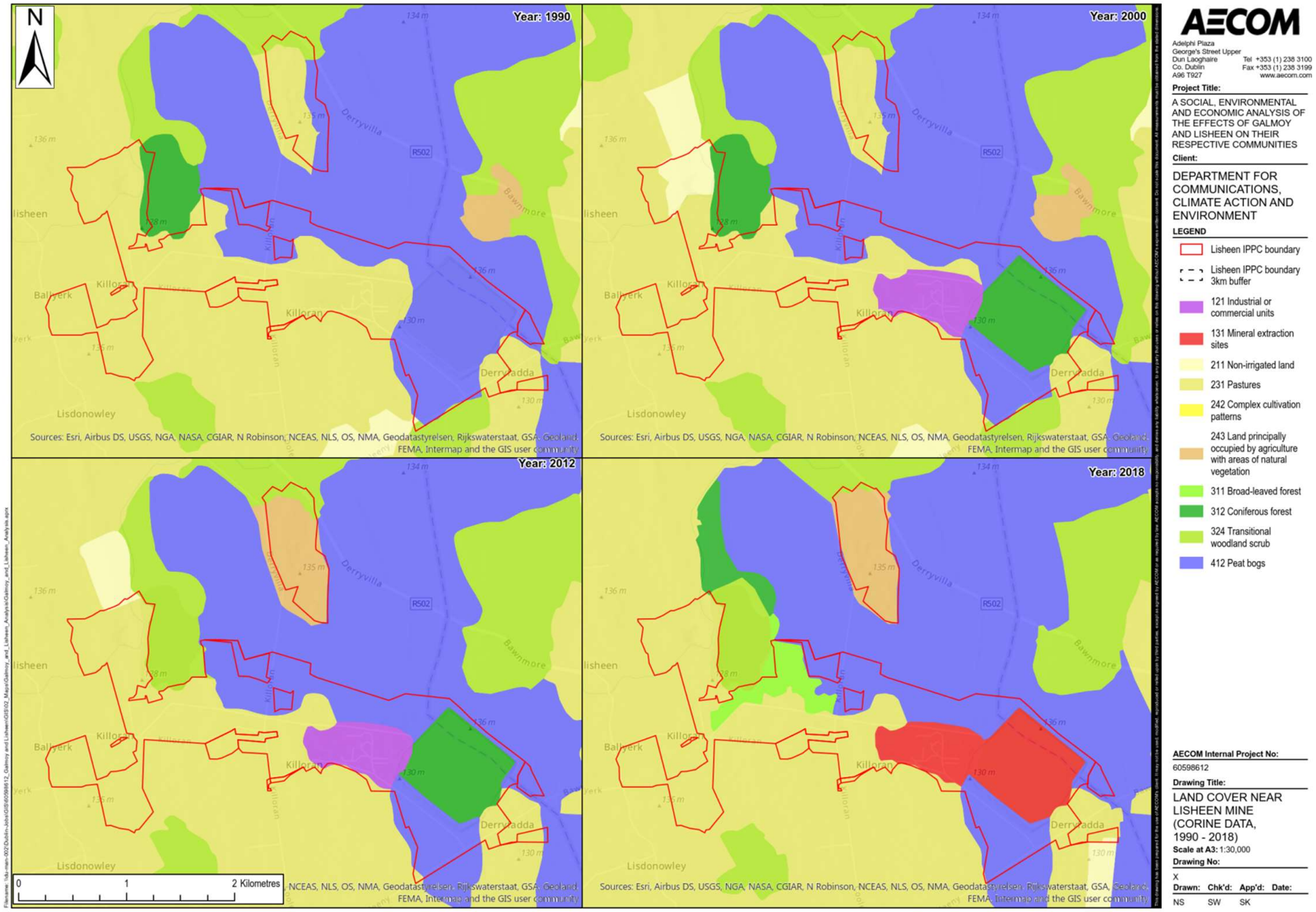
[187] 1995 Minorco Environmental Baseline Report

[188] 2014-15 Lisheen Mine Sustainability Report

[189] 1995 Minorco Environmental Baseline Report

[190] Anglo American (2005): ‘Lisheen Mine Sustainability Report 2005’

Figure C.2. 1: Historical land cover within Lisheen mine footprint (CORINE data; 1990-2018)



Note: CORINE appears to have erroneously categorised approximately 67 hectares of the Tailings Management Facility as coniferous woodland in 2000 and 2012 (see Section C.2.1)

C.2.1.2 Construction

The literature review and interviews did not provide information regarding the extent and condition of natural capital in and around the mine footprint.

C.2.1.3 Operation

As part of this study, spatial analysis was conducted using the CORINE land cover data that is available for 1990, 2000, 2012, and 2018. Figure C.2. 1 illustrates the spatial distribution of land cover within the mine footprint for each year of available data. It is complimented by Table C.2. 1, which presents the underlying land cover estimates. The total footprint of the mine was around 480 ha in 2000 and 2012, which correspond to years when the Lisheen mine was operational. Compared to land cover in 1990 (which corresponds to the baseline), the extent of pasture and peatland decreased between 2000 and 2012. The decrease in the area of pasture includes:

- Around 20 ha of land formerly classified as pasture in 1990 was classified as non-irrigated arable land in 2000, which the CORINE land classification defines as land for rain-fed agricultural use for annually harvested non-permanent crops, normally under a crop rotation system. This area was reclassified as pastureland in the 2012 and 2018 land cover data.
- Less than 44 ha of land formerly classified as pasture in 1990 was classified as 'land principally occupied by agriculture with areas of natural vegetation'. This area was reclassified as pastureland in the 2012 and 2018 land cover data.
- An area of more than 40 ha formerly classified as pasture was classified as an industrial or commercial unit in 2000 and 2012, which aligns with the fact that the mine was operational during this time. This a long-term loss which persisted over all stages of the mine.

When it comes to the decrease in the area of peatlands, the initial CORINE data indicates that this corresponds partly to a 67 ha increase in coniferous woodland. However, this finding is almost certainly erroneous, and reflects the relatively coarse resolution of the CORINE data. As shown in Figure C.2.1, the area incorrectly classified as coniferous woodland corresponds to the approximate area of the Tailing Management Facility. Furthermore, there are no references to effects on woodlands within the mine's environmental impact statements. It can therefore be concluded that the footprint of the mine site and Tailings Management Facility accounted for approximately 108 ha; corresponding to a long-term loss of approximately 67 ha of peatland and 42 ha of farm or pastureland.

The 2005 Sustainability Report also stated than an area of 57 acres was planted with hardwoods adjacent to Killoran House, which is within 1 km of the mine. Lands marginal to adjoining peatlands were partially afforested with predominantly indigenous species of trees and shrubs, preserved where possible and principal habitat for pheasant, hares, rabbits and other native birdlife.[191]

Within the footprint of the site, the TMF, which was constructed in 1999, is said to occupy an area of approximately 78 ha and the tailings surface area is approximately 64 ha.[192] The 1995 EIS states that the TMF was initially designed such that it may hold up to 10Mt of waste output and consisted of an engineered earth embankment forming a water-retaining dyke around an impoundment area. The TMF is situated upon peat deposits of the former Derryville Bog. These peat deposits are approximately 4m thick and act as a geo-liner due to their low permeability and metal absorption capability. The peat deposits sit on glacial till deposits and in turn, limestone bedrock. When loaded by the tailings, the peat compresses to become a natural liner with a permeability of less than 1x10-9 m/s, therefore qualifying it for use with a geomembrane to form a composite liner. The tailings were delivered to the TMF as a slurry containing approximately 65% water and finely ground waste rock with elevated concentrations of zinc, lead and other minerals. A drainage system was installed on the

[191] Anglo American (2005): 'Lisheen Mine Sustainability Report 2005'

[192] 2007 Lisheen Tailings Management Facility

inner perimeter and at the base of the peat, to capture water realised from the peat and any seepage water from the tailings.

It was reported that the TMF was built to the highest international standards, with the mine reporting to the EPA four times a year regarding the condition of this site. In 2005, 448,326 tonnes of tailings were disposed of in the TMF. This is a 62.5% reduction on the 2004 figure due to the new Backfill Plant. According to the 2005 Sustainability Report, subsoil material was removed from the area of Derryville Island, located immediately north of the TMF site, for use in raising the TMF impoundment walls[193]. This area has subsequently been rehabilitated into areas of grassland and small wetlands and has since become inhabited with local flora and fauna. Similar works were also carried out in the Carrick Hill Borrow area, which is now reported to be fully rehabilitated (see Figure C.2.2).[194]

Figure C.2.2. Rehabilitation of Carrick Hill Borrow Pit

Source: Lisheen Mine Closure Committee, November 2018.

The literature provided information about ground stability within and around the footprint of the mine during the operation phase. By November 2004, no major instabilities had been identified during mineral extraction. The most significant problems were associated with mining in new underground areas whereby major north-west fault systems were exposed, leading to water inflows and instability. These problems were mitigated through operational procedures. From late 2004 until 2015 (closure), the underground workings were considered stable and did not require any additional support. There was, however, an underground roof collapse in 2013 that resulted in one fatality. A miner was crushed by a fall of rock from the roof while mucking out a stope (ore production area). The Health and Safety Authority investigated the incident and no prosecution was taken against the company. This effect is considered as part of mine employees' health and safety within the social assessment.

A geotechnical review of the mine was undertaken by Avoca Geotec Ltd. in 2015. The review put forward a design for the abandonment and closure of the main decline at Lisheen following the

[193] Anglo American (2005): 'Lisheen Mine Sustainability Report 2005'

[194] Anglo American (2005): 'Lisheen Mine Sustainability Report 2005'

cessation of workings. It is considered that the upper section of the decline, extending 188m underground, whilst well supported would cause caving to the surface if failure occurred. To mitigate this scenario, the section was fully backfilled between 2015 and 2018 as part of the rehabilitation of the site, as recommended by the 2015 study. Following a review of the backfilling of the decline by the Department of Communications, Climate Action and Environment, a limited section of land above the decline was required to be fenced off. In addition, the authorities required the company to place a burden on the land property folio to exclude this limited area from any future planning consent. This was due to concern over the possibility of a localised crown hole forming above a re-muck bay.

Information reviewed also covered the topic of soil quality and contamination. Tobin Ltd. were commissioned in 2015 to undertake a risk assessment of the contamination of soils at the mine as part closure procedures. The review found lead in soil samples collected on-site which were above corresponding screening values in the Air Intake Compound, Teepee and northern mine site, Storage Yard and along road verges. The study recommended the removal of material from these areas. It was also reported that heavy metals, including arsenic, had accumulated in the upper 0.05m to 0.15m of the wetland area, which the study recommended removing. No hydrocarbons were found to have exceeded guideline values and they were therefore not considered a risk to human health. In total, 23,050m^3 of material was recommended for removal.

C.2.1.4 Closure

When the mine was closed, it was reported that a 'best practice mine closure plan' was implemented, intending to address regulatory requirements in both an environmentally and socially responsible manner[195]. The rehabilitation works done for this mine site were considered exemplary, aiming to address the environmental and social needs of the area, including continued monitoring and maintenance of the site post-closure.

Activities that affected land during the closure of the mine included the rehabilitation of the TMF, which began in 2008 with the piloting of a 9 ha demonstration cell to test the proposed closure of the main TMF. The final closure concept for the TMF deviated from the original mine closure project for a wet closure. This was deemed inappropriate in terms of residual environmental impact risk. The adoption of a dry closure concept was proposed in 2006 with restoration to agricultural grassland to enrich the existing countryside and reduce the ongoing environmental liability[196]. Restoration of the TMF began in mid-2013 and notes from the Lisheen Closure Committee Meeting confirm that the rehabilitation and restoration of the area to agricultural grassland was completed in November 2018. The entire TMF surface was reportedly rehabilitated and restored to agricultural grassland. At the end of 2015, around 38 hectares of the TMF was rock capped with approximately 29 hectares of this area fully rehabilitated and restored to pasture grassland.[197] Permeability tests were done to ensure that the waste was not dispersed. The soil used was previously stockpiled peat and it was blended with a mineralising element. That mineralising element was taken from stockpiles of glacial till sourced from the Lisheen Wind Farm Project. The general aim of this approach was to create a restoration substrate that has soil forming potential.[198]

Some seepage from the dam wall and abnormally high flow rates from finger drains at the TMF were observed by Lisheen Mine. Following a site inspection by Golder Associates, a comprehensive site investigation was carried out. While the remediation and investigation works were on-going as of March 2019, a summary report was completed in March 2019[199]. It was concluded that the volume of seepages observed would only be recharged from the permeable granular cap which store water and

[195] Based on interviews conducted for this study.

[196] The Lisheen Mine (2016), Lisheen Mine Closure, Restoration and Aftercare Management Plan, C.R.A.M.P. (2016)

[197] The Lisheen Mine – Annual Environmental Report, Jan 2015 – Dec 2015 (AER)

[198] Attachment 6 – Lisheen Mine Tailings Management Facility – progressive reclamation project (2011)

[199] Golder Associates (2019), Lisheen TMF Annual Review 2019

not the low permeability tailings. The EPA confirmed that the seepage is being actively controlled and pumped back into the TMF.

Other activities as part of the closure of the mine include:

- The removal of 155,750 m^3 of soil and subsoil as part of the clean-up work at the mine site[200]. Additional sampling was undertaken in late 2017 to check that that metal and hydrocarbon contamination was below the guideline values for industrial after-use.
- Soil sampling undertaken in 2018. The samples identified a reduction in average zinc concentrations from 28,315 mg/kg, as recorded in 2015, to 302 mg/kg. Similarly, average lead concentrations fell from 4,827 mg/kg to 70 mg/kg.
- Surface decommissioning was complete by 2018. The Teepe and the processing and backfill plants were fully decommissioned, disassembled and sold for use elsewhere. Hazardous material was removed and the area was flooded.
- Conditioning ponds, Mill, backfill plant, Tepee, water treatment plant, workshops, waste yard, ore pad and portal areas were all filled and resurfaced. The Canal, Killoran Pond, Backdoor, wetland and FAS underground fuel bay were all restored with grass and tree cover. The Drish Settlement Pond was filled in with soil and the restoration process continues.
- Carrick Hill restoration was complete. This included an area of open water with associated wetland features that provides an area of considerable nature conservation interest[201]. Carrick Hill Borrow Pit was used for sourcing construction material throughout the life of the mine and for the completion of closure. Consequently, a localised depression was formed in the Carrick Hill area, much of which is original water table.
- In mid-2017, the Irish Bioeconomy Foundation was founded on the now closed mine site. The foundation is considered to be Ireland’s national bioeconomy association and innovation cluster. It aims to establish a forum of industry, academia and policy leaders around Ireland’s emerging bioeconomy, with a mission to promote the conversion of Ireland’s natural land & sea resources to high value products for the development of a sustainable bioeconomy202.

Evidence in the literature indicates that a Biodiversity Action Plan (BAP) was developed to protect local biodiversity in 2009. The plan was implemented following the closure of the mine in 2015 and it considered the following areas the mine site including the TMF, and Carrick Hill Borrow Pit.[203]

Although the mine and its legacy is a relatively new and permanent feature in the landscape, none of the information reviewed to date has provided any indication of the extent to which the visual intrusion has affected local communities and visitors (e.g. as a result of a change in property prices or appreciation of the landscape).

Based on spatial analysis using CORINE land cover data, the following changes within the footprint of the mine can be observed based on Table C.2. 1 and Figure C.2. 1:

- The area that was classified as an industrial or commercial unit in 2000 and 2012 came to be classified as a mineral extraction site in 2018. This includes the area of 42 ha of pastureland already lost in 2000. It also includes the incorrectly classified area of coniferous woodland in 2000 and 2012 that has an approximate area of 108 ha that was classified as peatland within the baseline. The net effect from the baseline to the closure of the mine for peatland habitat is a long-term loss of 67 ha (= 108 – 42), noting that the habitat was in a degraded state in the baseline. This change would have taken place during the construction phase of the mine.

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[200] Environmental Protection Agency (2018), Site visit report, 23rd November 2018

[201] Lisheen Mine Closure Committee Meeting (2018)

[202] http://bioeconomyfoundation.com/

[203] Chapter 1 Appendices of the Lisheen Mine Biodiversity Management Plan (2016) Vedanta

- There is no additional net loss of pastureland besides the long-term loss of 42 ha observed in the operation phase of the mine, and mentioned in the preceding sub-section.

Other changes are minor and cannot be verified using CORINE data given its coarse resolution.

C.2.2 Mountains, moors and heaths

C.2.2.1 Baseline

The analysis of land cover at the mine suggests that peatlands are a major feature of the landscape in and around the footprint of the mine. The area of the mine footprint was around 483 ha of which 40% was (193 ha) was classified as peatland. The evidence collected from the literature suggests that the peatland was being degraded and stripped at a very fast pace by Bord na Móna. It is not clear whether the peatland was in good condition prior to be stripped.

C.2.2.2 Construction

The literature review and interviews did not provide information about peatlands in the construction phase of the mine.

C.2.2.3 Operation

The literature review and interviews did not provide information about peatlands in the operation phase of the mine. However spatial analysis using CORINE land cover data shows that there was 42 ha of peatland were replaced by 'industrial or commercial units', which represents a long-term loss of a natural capital asset. Peatland is an important sub-habitat, which provides significant benefits to people including sequestering carbon and providing a habitat for biodiversity. However, the peatland within the mine footprint was known to be degraded and was therefore more likely to be emitting rather than sequestering carbon. It is not clear whether the peatland was in good condition prior to be stripped.

C.2.2.4 Closure

The literature review and interviews did not provide information about peatlands in the operation phase of the mine. Spatial analysis using CORINE land cover data shows there was an area classified as an industrial or commercial unit in 2000 and 2012, which came to be classified as a mineral extraction site in 2018. This includes the area of 42 ha of pastureland already lost in 2000. It also includes the incorrectly classified area of coniferous woodland in 2000 and 2012 that has an approximate area of 108 ha that was classified as peatland within the baseline. The net effect from the baseline to the closure of the mine for peatland habitat is a long-term loss of 67 ha (= 108 – 42), noting that the habitat was in a degraded state in the baseline. This change would have taken place during the construction phase of the mine.

C.2.3 Enclosed farmland

C.2.3.1 Baseline

In the baseline, nearly 60% of the proposed site for the mine was made up of pastureland based on spatial analysis conducted for this study (Table C.2. 1).

As part of the baseline surveys for the mine, 20 farms were examined to determine their productivity and extent of field crops and grassland. The surveys also examined the type, numbers and condition of livestock on these farms. The ratio of pasture to silage to hay was 20:10:1. Grazing land was generally found to be of good quality, while swards for silage and hay were more likely to be of poor to moderate quality. Dairy farming was practised on 75% of the farms and the general standard of husbandry was high. Crop production accounted for approximately only 2% of the land examined.[204]

A veterinary survey was carried out from 1991 to 1993 to establish the general health of dairy cattle in the vicinity of the proposed mine site through the examination and analysis of blood, milk and faeces from dairy cows on farms.[205] Exposure levels were found to be in normal ranges. There were some deficiencies detected, with farms around Lisheen having the highest incidence of low and very low

[204] 1995 Minorco Environmental Baseline Report

[205] EPA Extracts from Planning Permission

Iodine status herds seen in any county in Ireland. A few other deficiencies and imbalances were detected, but none of these were linked to the presence of lead and zinc.

C.2.3.2 Construction

The literature review and interviews did not provide information regarding effects of the construction of the mine on pastureland.

C.2.3.3 Operation

The literature review and interviews did not provide information regarding effects of the operation of the mine on pastureland. However, spatial analysis conducted as part of this study confirms that there was a gradual decrease in the extent of farmland within the footprint of the mine from the baseline to the mine operation phase (Table C.2. 1 and Figure C.2. 1). Based on CORINE land cover data, which corresponds to the operation phase of the mine, there was a decrease in the area pastureland by around 30% between 1990 and 2012. As part of this change, around 20 ha of land formerly classified as pasture in 1990 was classified as non-irrigated arable land in 2000, which the CORINE land classification defines as land for rain-fed agricultural use for annually harvested non-permanent crops, normally under a crop rotation system. This area was reclassified as pastureland in the 2012 and 2018 land cover data. An area of more than 40 ha formerly classified as pasture was classified as an industrial or commercial unit in 2000 and 2012, which aligns with the fact that the mine was operational during this time.

Farmland provides important benefits to people, notably agricultural output. The loss of agricultural output can be estimated based on the extent and condition of pastureland within the footprint of the proposed mine, as it was surveyed in the baseline. As outlined previously, it is estimated that 42 ha (104 acres) of pastureland were lost within the footprint of the mine site.

In the absence of the mine, the 42 ha of pastureland land could have been used to rear livestock animals. A simple assumption is that the use of the land would have been equally split between the rearing of cattle and sheep. For the production of cattle, Table C.2. 2 shows that half the land could have generated around 9,000 kg of output each year, worth over €15,000. For the production of lamb, Table C.2. 3 shows that the other half of the land could have generated around 22,447 kg of output each year worth over €37,000.

This amounts to an annual opportunity cost of approximately €52,149, or €938,682 over 18 years (1997 to 2015)

Table C.2. 2: Loss of agricultural output (from rearing cows) due to loss of pastureland

		Estimate	Unit
A	Area of pastureland lost	42	ha
B	Area of pastureland used for cow grazing	21 = A * 50%	ha
C	Average stocking rate	1.55	cows/ha
D	Average weight of 7-8 month old steers	285	kg/steer
E	Average weight of 7-8 month old heifer	265	kg/steer
F	Average weight of 7-8 month old calf	275 = (D + E) / 2	kg/cow
G	Kg of beef lost due to loss of pastureland	8,950 = (B * C) * F	kg
H	Average gross margin from calf rearing per ha	732.4	£/ha
I	Average depreciation from calf rearing per ha	84.1	£/ha

		Estimate	Unit
J	Value of lost output due to loss of pastureland	13,615 = B * (H – I)	£
K	Exchange rate	1.1042	€/£
L	Value of lost output due to loss of pastureland	15,034 = J * K	€

Notes: Monetary values are reported in 2018 prices. Exchange rate sourced from European Central Bank for period 01/01/2018 to 31/12/2018. Other data sourced from Agriculture and Horticulture Development Board (AHDB) and Agricultural Budgeting and Costing Book. Note that gross margins are used, as it is not possible to estimate margins that are net of production costs without further information.

Table C.2. 3: Loss of agricultural output (from rearing lamb) due to loss of pastureland

		Estimate	Unit
A	Area of pastureland lost	42	ha
B	Area of pastureland used for lamb grazing	21 = A * 50%	ha
C	Area of pastureland used for lamb grazing	52 = B * 2.471 acres/ha	acres
D	Average stocking rate[206]	8	lamb/acre
E	Number of finished lamb for each lamb reared	1.42	finished lamb/reared lamb
F	Average weight of finished lamb	38	kg/lamb (live weight)
G	Kg of lamb lost due to loss of pastureland	22,447 = (C * (D * E)) * F	kg
H	Average gross margin from lamb rearing per acre (assuming finished lamb, store lamb and wool production)	767.4	£/acre
I	Average depreciation from lamb rearing per acre (assuming finished lamb, store lamb and wool production)	121	£/acre
J	Value of lost output due to loss of pastureland	33,613 = C * (H – I)	£
K	Exchange rate	1.1042	€/£
L	Value of lost output due to loss of pastureland	37,115 = J * K	€

Notes: Monetary values are reported in 2018 prices. Exchange rate sourced from European Central Bank for period 01/01/2018 to 31/12/2018. Other data sourced from Agriculture and Horticulture Development Board (AHDB) and Agricultural Budgeting and Costing Book. Note that gross margins are used, as it is not possible to estimate margins that are net of production costs without further information.

[206] Assuming the same stocking rate as that found for Galmoy Mine

C.2.3.4 Closure

Analysis of CORINE land cover data shows that here is no additional net loss of pastureland besides the long-term loss of 42 ha observed in the operation phase of the mine. At the end of 2015 around 29 hectares of this area been fully rehabilitated and restored to pasture grassland[207], while notes from the Lisheen Closure Committee Meeting confirm that the rehabilitation and restoration of the TMF to agricultural grassland was complete in November 2018.

It was reported that from January 2015 to December 2015, 14 heifers were purchased from Kilkenny Cooperative Livestock Market Ltd. and were set to graze on rehabilitated TMF lands until ready for sale. The animals blood and tissue would be tested for various levels of toxins with preliminary findings within accepted levels.[208] These same finding were reported in the 2012 AER. From January 2012 to December 2012, Lisheen has maintained a herd of cattle on Phase 1 of the TMF rehabilitation cap. The testing of blood and tissue demonstrated no negative impact on the animals.[209]

C.2.5 Freshwater, wetlands and floodplains

This section considers the effects of Lisheen mine on freshwater, wetlands and floodplains. This broad habitat type comprises multiple sub-habitats including surface waters (standing open waters, lakes, ponds reservoirs, canals, rivers and streams), groundwaters, aquifers and wetlands.

These surface sub-habitat types do not feature within the footprint of the mine. However, there are a number of waterbodies within 3 km of the mine and the wider catchment area. This 3 km radius around the mine allows changes in the condition of surrounding habitats as a result of mining activities to be considered, but also avoids an overlap between the two mine sites which are around 7 km from each other.

As part of this study, spatial analysis was conducted to determine the extent of waterbodies within 3 km of the mine. Table C.2. 4 presents a list of surface and ground waterbodies within 3 km of the mine, as well as their total length and area respectively, and Figure C.2.3 shows a map of these waterbodies.

Table C.2. 4: Waterbodies within 3 km of Lisheen mine

Name	European code	Type	Extent	Unit
AUGHALL_BEG_010	IE_SE_16A280760	Surface water	26	km
CLONMORE STREAM (SUIR)_010	IE_SE_16C111000	Surface water	33	km
DRISH_020	IE_SE_16D020068	Surface water	8	km
DRISH_030	IE_SE_16D020070	Surface water	11	km
DRISH_040	IE_SE_16D020100	Surface water	13	km
DRISH_060	IE_SE_16D020400	Surface water	25	km
GOUL_020	IE_SE_15G020110	Surface water	10	km
GOUL_030	IE_SE_15G020200	Surface water	16	km
ROSSESTOWN_010	IE_SE_16R010040	Surface water	4	km
ROSSESTOWN_020	IE_SE_16R010150	Surface water	7	km
ROSSESTOWN_030	IE_SE_16R010300	Surface water	12	km

[207] The Lisheen Mine – Annual Environmental Report, Jan 2015 – Dec 2015 (AER)

[208] The Lisheen Mine – Annual Environmental Report, Jan 2015 – Dec 2015 (AER)

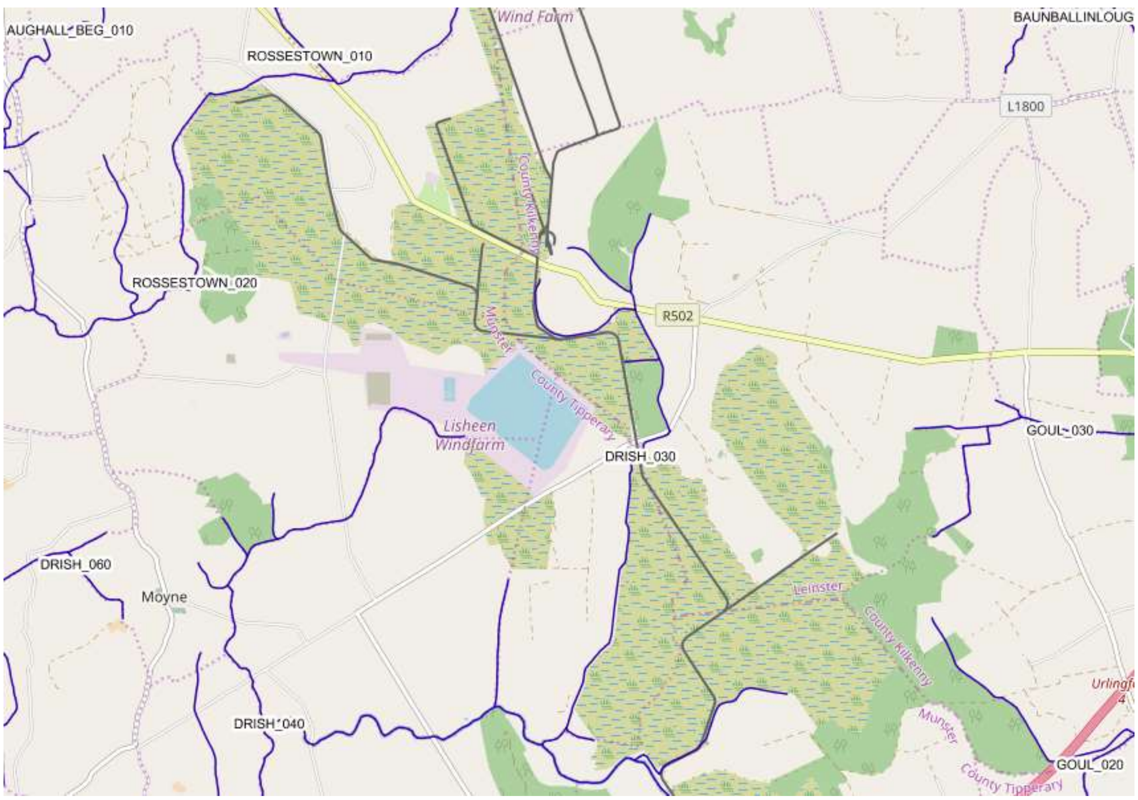
[209] The Lisheen Mine – Annual Environmental Report, Jan 2012 – Dec 2012 (AER)

Name	European code	Type	Extent	Unit
Rathdowney	IE_SE_G_114	Groundwater	520	km^2
Shanahoe	IE_SE_G_119	Groundwater	81	km^2
Templemore	IE_SE_G_131	Groundwater	930	km^2
Thurles	IE_SE_G_158	Groundwater	127	km^2

Source: Catchments.ie

The following sub-sections report findings from the literature review and interviews regarding the effects of the mine on waterbodies. In many cases, these findings may extend beyond the 3 km radius from the mine, and are a reflection of the type of effects that were monitored during the mine phases and reported in the evidence base.

Figure C.2.3: Surface waterbodies at Lisheen



Source: Catchments.ie

C.2.5.1 Baseline

The area in which the Lisheen mine and TMF are located is drained by the Drish and Rossestown rivers, and their tributaries. The western part of the site drains to the Rossestown River, which flows in a south-westerly direction and joins the River Suir at approximately 8.2 km to the south west. The central and eastern parts of the site drain to the Cooleeney watercourse and the Derryfadda Stream respectively, both of which flow southwards and join the Drish River at approximately 3 km to the south of the mine. The Drish and Rossestown Rivers are the receiving watercourses for discharges from the mine and TMF.

Water quantity

Prior to the construction of the mine, the River Suir and its tributaries were not utilised as a raw water source for drinking water production. However, the 1995 EIS[210] noted a proposed major abstraction from the Clodaigh River to the River Suir at Holycross, located at approximately 17 km downstream of the site. The proposed abstraction was to be utilised as a potential source for the Thurles Regional Water Scheme.

Downstream of the mine site, abstraction pipes were recorded in the Drish River at Ballyduff approximately 6km from the mine site leading to the Centenary Co-Operative Creamery Society Ltd, as well as from the River Suir, downstream of Thurles, supplying the Comhlucht Suicre premises. Additionally, the Drish, Rossestown and Suir Rivers were being extensively utilised through surface water abstractions to support the watering of livestock.

A baseline survey of private wells was undertaken as part of the 1995 EIA. Some 176 private wells were identified within 5 km of the mine. Most of these wells were used to supply individual households with a few major abstractions associated with group schemes and agri-business.

The 1995 EIS highlighted the Moyne Group Scheme as the primary groundwater user with the Lisheen area. The Group Scheme abstracted approximately 450 m^3/day from a series of five supply wells centred around Lisheen. A local cheese factory at Cooleeney Farm, approximately 1.5 km to the south of the mine site, was also supplied by groundwater during this phase. The groundwater sampled at this site was characterised as having particularly high potassium, iron, manganese and ammonia levels, all above Drinking Water Standards.

Water quality

Table C.2. 5 presents the historical water quality of surface waters within 3 km of the mine based on their WFD status derived from the Irish EPA's biological Q values. Water quality data was available for five of the 11 surface waters within 3 km of the mine for 1992 and 1996, which correspond to the baseline.

Within the Drish River, one waterbody had high status in 1992, which dropped to moderate status in 1996. Two other waterbodies had good status in 1992, which was maintained through to 1996. The baseline water quality of the Drish River is described in the 1995 EIS as very hard water with low suspended solids at the time of sampling, iron concentrations in exceedance of the Drinking Water Standard[211], nitrite at the limit for Salmonid Waters[212] moderately elevated nitrate concentrations and extremely low heavy metal concentrations. Nutrients were noted to be elevated leading to dense macrophyte cover where flow conditions and water depth were suitable, which in turn lead to lowered dissolved oxygen concentrations.

Within the Rossestown River one waterbody had poor status in 1992 and 1996 whereas another waterbody with moderate status in 1992 improved to good status in 1996. The baseline water quality of the Rossestown River is described in the 1995 EIS as being affected by treated sewage effluent outfall upstream of the mine site, with extremely high ammonia concentrations, elevated biological oxygen demand levels, elevated iron, manganese, nitrate and phosphate concentrations and low heavy metal concentrations, with the exception of barium.

The baseline water quality of the River Suir upstream of the Drish and Rossestown confluences, exhibited locally elevated concentrations of suspended solids, ammonia and nitrite concentrations in exceedance of the Salmonid Regulations and low heavy metal concentrations, with the exception of aluminium, barium and iron. However, apart from the high ammonia concentrations, the baseline

[210] Minorco (1995) Environmental Baseline Reports: Lisheen Zinc/ Lead Project.

[211] Drinking Water Standard - S.I. No. 81 of 1988 - European Communities (Quality of Water Intended For Human Consumption) Regulations, 1988

[212] Salmonid Regulations - S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988

water quality of the River Suir was considered to be relatively good for a major river which drains rich agricultural land and passes through a number of large towns.

Table C.2. 6 presents the historical water quality of groundwaters within 3 km of the mine based on their WFD status derived from the Irish EPA's biological Q values. Water quality data was not available for the four groundwaters within 3 km in the baseline. The 1995 EIA identified groundwater in the Lisheen area as being largely contaminated by a combination of septic tank effluent and agricultural activities. Nearly 80% of wells sampled for the baseline study recorded some level of contamination from chloride, sodium and potassium. However, levels of heavy metals, such as arsenic, cadmium, copper, lead, mercury and zinc were noted to be within Drinking Water Standards within the unpolluted wells sampled.

Table C.2. 5: Historical surface water quality within 3 km of Lisheen mine

Name	European code	Total length (km)	WFD status (based on EPA biological Q value)									At risk status (2010-2015)
			Baseline		Construc-tion	Operation					Closure	
			1992	1996	1999	2002	2005	2008	2011	2014	2017	
AUGHALL_BEG_010	IE_SE_16A280760	26	-	-	-	-	-	-	-	-	-	
CLONMORE STREAM (SUIR)_010	IE_SE_16C111000	33	-	-	Poor	Good	Moderate	Poor	Good	Moderate	Moderate	
DRISH_020	IE_SE_16D020068	8	-	-	-	-	-	-	-	-	-	
DRISH_030	IE_SE_16D020070	11	High	Moderate	Bad*	Poor*	Poor*	Poor*	Poor	Poor	Poor	At risk - agricultural pressures
DRISH_040	IE_SE_16D020100	13	Good	Good	Moderate	Poor	Poor	Poor	Poor	Poor	Poor	At risk - agricultural pressures
DRISH_060	IE_SE_16D020400	25	Good	Good	Good	Good	Moderate	Poor	Good	Good	Good	At risk - agricultural pressures
GOUL_020	IE_SE_15G020110	10	-	-	-	-	-	-	-	-	-	
GOUL_030	IE_SE_15G020200	16	-	-	-	-	-	-	-	-	-	
ROSSESTOWN_010	IE_SE_16R010040	4	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	At risk – extractive industries
ROSSESTOWN_020	IE_SE_16R010150	7	-	-	-	-	-	Poor	Poor	Poor	Poor	At risk – extractive industries
ROSSESTOWN_030	IE_SE_16R010300	12	Moderate	Good	Good	Good	Good	Poor	Moderate	Poor	Poor	

Notes: *Toxic elements detected in waterbodies. Data sourced from Catchment.ie.

Table C.2. 6: Historical groundwater quality within 3 km of Lisheen mine

Name	European code	Total area (km2)	WFD status (based on EPA biological Q value)	
			Operation	
			2007-2012	2010-2015
Rathdowney	IE_SE_G_114	520	Good	Good
Shanahoe	IE_SE_G_119	81	Good	Good
Templemore	IE_SE_G_131	930	Good	Good
Thurles	IE_SE_G_158	127	Good	Good

Notes: Data sourced from Catchment.ie.

Fisheries

The fish stocks in selected areas of the River Drish upstream of Boolabeha Bridge were surveyed in September 1993. Four survey sites were selected, one upstream and three downstream of the bridge north-west of Castletown. Two of these sites, Drish 1 and Drish 2, had been surveyed previously (1991). Trout and pike were the principal angling species present. No juvenile salmon were encountered and the numbers of other fish species were greatly reduced, compared to 1991. It was not clear whether this reflected a general decline or was a result of the timing of the survey. The trout and pike in the Drish were found to be fast growing and similar to those in comparable rivers in the Irish midlands. Almost all of the fish encountered were in excellent condition. This river supports a self-sustaining stock of brown trout of considerable angling significance.

No fish kills were recorded by the Southern Regional Testing Board on the Drish, Rossestown, Bregagh, Clover or Black Rivers during the period 1994/1995. The mean redd count for trout in the River Drish ranged from 5.5 per km to 9.5 per km.[213] The Rossestown had a value of 4.1 per km and in the Black River the equivalent count was 6.9 per km. No trout redds were detected in the unnamed small tributary of the Drish, close to Killoran. The mean redd count for salmon in the River Drish ranged from 0.6 per km to 4.2 per km. No salmon redds were located in either the Rossestown or in the unnamed tributary of the Drish. The Black River had a mean redd count of 0.8 per km.

The 1995 EIA identified the Suir, Drish and Rossestown Rivers as being associated with the productivity of game-fish including the spawning of salmon and brown trout. The Central Fisheries Board identified the Suir and Drish rivers as important for tourism generated through angling. Fishing rights were controlled by three angling associations - the Thurles, Holycross and Ballycamas Anglers Association, the Loughmore Anglers Association and the Templemore Anglers Association.

C.2.5.2 Construction

Effects on waterbodies may have occurred during the construction of Lisheen mine. For example, mine dewatering during construction could impact stream flows in local watercourses, and in turn surface water fed supplies. The literature review and interviews did not identify evidence to determine any effects. However, data from the EPA is available for waterbodies within 3 km of the mine in Table C.2. 5. Data covered six of the 11 surface waters within 3 km of the mine. Compared to the baseline, two waterbodies with the Drish River saw a drop in their WFD status from the baseline to the construction phase. One of these waterbodies[214] saw its status drop from moderate to bad during construction, when toxic elements were found during sampling, although it should be noted that it had previously declined from High to Moderate between 1992 and 1996. However, information relating to the operation phase of the mine confirmed that this decline in status was likely linked to the Lisheen mine. Within the Rossestown River, water quality was maintained from the baseline to the construction phase.

[213] The number of spawning redds in any stretch of river is recognised to vary considerably from year to year. In addition, the efficiency of a survey depends on the water clarity, depth and the accessibility of the bank. Also, in spate rivers gravel beds may become mobile during very high floods and mask the presence of spawning redds. In the rivers and streams investigated in this survey the gravels are relatively stable and spawning redds were evident, not only during the period of the investigation but even in late April. Therefore, such surveys generally underestimate the number of spawning redds.

[214] Dirsh_030

C.2.5.3 Operation

Water quantity

The 1995 EIA predicted that mine dewatering would have an impact on stream flows in local watercourses, during the construction and operation phase of the mine life cycle. The main watercourses in the vicinity of the Lisheen Mine, the Suir, Drish and Rossestown Rivers, were not used as sources of drinking water for human consumption. While it is unclear if the proposed major abstraction at Holycross, at 17 km from the mine site, was in operation during this period, this lies outside the estimated cone of depression/ zone of influence associated with mine dewatering.

Although the main channel of the Drish River was outside the 1m drawdown area, it was predicted that the area of drawdown would extend into 12% of the Drish catchment. The Rossestown River flows over the mine area and over the cone of depression caused by mine dewatering.

To compensate for bedflow losses caused by the mine dewatering scheme, treated mine-water was discharged at four emission points to both the Drish River and the Rossestown River. Based upon a study into bedlosses of the Rossestown River undertaken in October 2001, a minimum flow of 3.5Ml/d was required to maintain the flow of the river whilst mine dewatering was taking place.

Flow within the local river systems remained augmented after the cessation of dewatering in December 2015 and until full groundwater level recovery. Flow within the Rossestown was monitored during this period and it was recommended by the 2016 Closure, Restoration, Aftercare Management Plan (CRAMP) that a minimum flowrate of $0.04m^3/s$ is maintained. Three of the surface water discharges have since been decommissioned. Only one of them, which discharges to the Drish River via Cloheen Pond, remains.

Lisheen Mine actively dewatered the surrounding aquifer system to allow safe underground mineral extraction. The dewatering recessed water levels for a maximum area of approximately 90 - $95km^2$.

There were a number of wells impacted by mine dewatering[215]. The wells were used for farm and house purposes, and there were approximately 70 wells impacted by mine operations. The mine sent letters to landowners promising that they would make "alternative supplies of water available" due to the impact of their supply. The solutions were expected to include a deeper well, a higher lift pump, or connection to a local group scheme. This impact was only expected to exist during the operation of the mine, with water levels expected to be restored after the mining operation ended.

Lisheen Mines conducted a 6-monthly inventory of district-wide groundwater wells. Within the majority of periphery boreholes, the rate of drawdown was less than 1m and within the magnitude of normal season variations. The largest drawdown response was observed in wells located 1-2km to the south of Derryville, ranging from 16 – 22m, and in wells located approximately 1km to the north of Lisheen, whereby drawdown ranged between 12 – 18m.

Mine dewatering augmented natural groundwater flow conditions, which can impact down-gradient groundwater-reliant receptors including the local river system and private water supplies. Lisheen Mine was said to have largely mitigated this impact through investment in a new group water scheme in 2000 for residents of the Kylmakill and Barnalisheen townlands. The Moyne Group Scheme was upgraded by the Lisheen mine in 2000 and eight water supplies were replaced since the beginning of mine dewatering. In 2003, the scheme was supplying water to 260 households, 105 farms and 4 businesses[216]. The Lisheen mine also contributed to North Tipperary County Council for the extension of Templemore water supply scheme to Templetuohy, meaning that a greater catchment was served by remedial schemes than the one actually affected by the mine dewatering.

Final dewatering pumps were switched off on 31st December 2015 with groundwater levels considered to have fully recovered by late winter 2017, a recovery time of just over 2 years.

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[215] 1996 Minorco Add Information Attachments

[216] O'Neill Groundwater (2004), Anglo American Lisheen Mining Limited - EIS

Water quality

According to the 2013/14 sustainability report for the mine, 99% of water used in the mine was reclaimed from the TMF. The total quantity of effluent discharge was around 28.2 cubic meters, which was compliant with the legalised limits.[217] The amount of water discharged into the rivers during the year 2014-15 was approximately 28.3 million cubic metres, which, in the summer months, was more than 5% of the annual average volume of the water bodies. There were some positive impacts of discharging a large volume of highly oxygenated water into the receiving environment. However, there were also some issues with the water quality, such as sedimentation localised to the discharge locations.[218]

The biological Q values for watercourses near the mine decreased during operation. Operators argued that as the mine was in a peaty area, ammonia levels were naturally higher; particularly given that there was industrial peat extraction upstream, as well as discharge from farms. However, the EPA argued that it was difficult to determine the source, and that mitigation measures were required regardless of responsibility.

During the operation phase, Lisheen management met with an Environmental Monitoring Committee (EMC) on a quarterly basis. This EMC was made up of representatives from the EPA, Tipperary North Riding County Council, Southern Regional Fisheries Board and the Exploration and Mining Division of the Department of Communications, Climate Action and Environment. It was through this forum that elevated levels of metal concentrates in stream sediments were first identified in 2005[219]. These increases occurred despite the discharge water from Lisheen being in full compliance with the IPC licence conditions.

Table C.2. 5 presents the historical water quality of surface waters within 3 km of the mine based on their historical WFD status derived from the Irish EPA's biological Q values. Water quality data was available for six of the 11 surface waters within 3 km of the mine for most of operation phase, with data from 2002 to 2014. Within the Clonmore Stream, there were fluctuations in WFD status from within the operation phase, compared to the construction phase. The reason for these fluctuations is not clear. Within the Drish River, all waterbodies within 3 km of the mine were found to be at risk of agricultural pressures between 2010 and 2015. The waterbody which dropped to bad status during construction due to toxic elements from the mine (DRISH_030) continued to have poor status until after the closure of the mine. Between 2010 and 2015 the waterbodies had risks associated with agricultural pressures. Another waterbody within the Drish River (DRISH_040) also saw a sustained drop to poor status during the operation stage of the mine. The waterbody DRISH_060 saw a temporary drop in its status within the production phase between 2005 and 2008, and recovered to good status until the closure of the mine.

Within the Rossestown River, two waterbodies were found to be at risk of extractive industries between 2010 and 2015. However, the poor status of one of these waterbodies (ROSSESTOWN_010) was in place prior to the construction of the mine so it is not possible to determine the additional negative effect that mine activities would have had on that waterbody. Data is not available for the other waterbody (ROSSESTOWN_020) prior to the construction of mine to determine whether it had a higher level of water quality prior to the construction phase of the mine. Again, for this waterbody, it is not possible to determine the additional effect that mine activities would have had on the waterbody. A third waterbody (ROSSESTOWN_030) saw a drop in its level of water quality in 2009, which was largely sustained until the closure of the mine. It is not clear though whether the change in status of this particular waterbody was attributable to mine activities.

Following identification of the decline in water quality within the Dirsh and Rossestown Rivers, a survey of sampling and monitoring was undertaken in 2006, which identified concentrations of arsenic, cadmium, copper, lead, mercury and zinc within the stream sediments immediately

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[217] 2013-14 SD report

[218] 2014-15 SD report

[219] The Lisheen Mine/ Anglo American (2007), The Lisheen Mine Sustainability Report

downstream of the mine discharge points in exceedance of EPA-agreed environmental limits. With the exception of zinc, concentrations decreased downstream of the mine outfalls towards the confluence with the River Suir. Sampling of the River Suir showed that the contaminated sediments did not appear to have reached the main channel of the Suir.

As part of the survey undertaken in 2006, water samples were collected downstream of the Drish and Rossestown discharge points. These samples were elevated in, and exceeded the quality standards, for ammonium, zinc, nitrite and biological oxygen demand (BOD). Except for zinc, these determinants were also found to be elevated in the background waters upstream of the discharge point, suggesting that soil type and farming practice were contributing to these exceedances. [220] The EPA issued a precautionary restriction order on livestock entering the rivers for drinking and the Southern Regional Fisheries Board also restricted angling in certain sections of the river.

Following this survey, Lisheen Mine conducted clean-up operations on both rivers during 2007 and 2008, removing any sediments containing elevated metal concentrations. In 2010, Lisheen Mine received permission from the EPA to install abatement at the emission points as to provide further mitigation. River sediments were routinely monitored since the issue was first raised.

Early groundwater samples around the TMF showed variably elevated concentrations of sulphate, a key indicator for containment performance, and certain trace metals. Monitoring results indicated exceedances that were limited to groundwaters locally surrounding and underlying the TMF footprint.

Groundwater quality was monitored at an extensive network of monitoring boreholes and private wells around the mine site and TMF, throughout the active life cycle of the mine. Three main trends in groundwater quality were identified during these phases. Prior to early 2002, where dewatering had not reached the elevation of the ore horizons, pyrite oxidation occurred at minor rates and therefore had limited influence on abstracted waters. Between 2002 to early 2005, where groundwater levels were lowered to the ore horizon over an increasing mine area, the transport of mineral acidity from pyrite oxidation increased. Post-2005, after which groundwater levels were lowered to the ore horizon across the majority of the Lisheen area, the rate of transport for mineral acidity had stabilised. The available AERs (2008-2015) reported numerous concentrations of ammonia, nickel, sulphate and zinc at these locations to be in exceedance of surface water quality standards.[221] However, a summary of the annual emission volumes for key parameters for between 2000 and 2015 shows that the significant majority of surface water samples were compliant with the relevant IPC licence limits (the worst year being 2009 with 91.3% of samples recorded as compliant).

Table C.2. 6 presents the historical water quality of groundwaters within 3 km of the mine based on their historical WFD status derived from the Irish EPA's biological Q values. All waterbodies were found to have good status from 2007-2012 and 2010-2015 which correspond to the operation phase of the mine. In the absence of baseline data about the status of these waterbodies, it is not clear whether the mine had an impact of groundwater quality within 3 km of its footprint.

Fisheries

A survey of fish populations was undertaken in June 2006 as part of continued monitoring of surface water features in the Lisheen Mine area. The survey concluded that the overall fishery potential of the Drish and Rossestown Rivers was limited based upon low population densities for brown trout and salmon. Notably low fish populations were recorded around the discharge points. Due to pike predation and poor nesting habitats at these locations, it is inconclusive whether this is as a result of the mine discharge.

Fish populations recorded near points of mining discharge were notably low. Samples taken from fish tissue suggested that mining discharged was introducing elevated levels of arsenic, cadmium, chromium, copper, lead and mercury which were being bioaccumulated within fish populations. Concentration levels decreased the further downstream the fish was tested. It is noted that the

[220] 2005 SD report

[221] Lisheen Mine, Annual Environmental Reports (2000 to 2015)

amounts in various tissues were below the recommended limits. High levels of arsenic were recorded in the muscle tissue of brown trout which was above the background levels recorded for sites further downstream prior to mining activity. The elevated cadmium and mercury concentrations in the muscle tissue were also notably high although only a single fish in each case exceeded the limits at both sites. Concentrations of arsenic were above the limit at all sampling points.

According to the 2007 sustainability report for the mine, an ecotoxicity report concluded that there was negligible impact of suspended solids in water discharge on fish, livestock and humans, however there was some impact on river invertebrates.[222]

Following the identification of the accumulation of heavy metals in the stream sediments of the Drish and Rossestown Rivers, the Southern Regional Fisheries Board restricted angling in certain sections of the river[223]. An ecotoxicity report completed by Golder Associates in 2006 concluded that there was a negligible impact on fish, livestock and humans, but that there was some impact on river invertebrates[224]. Following receipt of this report, the Southern Regional Fisheries Board lifted its restriction notice.

According to the interviews conducted as part of this study, the Fisheries Board called an emergency when it became apparent that there was an impact to macroinvertebrate and gammarid populations. Electrofishing surveys were carried out to count population and continued until the issue was identified. The stream sediment was removed at both mines, and the discharge was adjusted to remove sediment before the outfall at Lisheen. The EPA and ecologists assessed the results of this work and noted that the situation generally improved thereafter. The operator and EPA increased the number of fish counts thereafter.

Within the Drish River, the 2006 survey identified significantly elevated concentrations of most heavy metals within sediments immediately down-stream of the mine emission points. Sediment concentrations for arsenic, cadmium, copper, lead, mercury and zinc were observed to exceed agreed environmental limits at emission points. It is noted that, with the exception of zinc, concentrations decreased downstream of the mine outfalls towards the confluence with the River Suir. Concentrations of arsenic were above the limit at all sampling points.

Heavy metal analysis indicated increased concentrations in shrimp tissue samples downstream of the outfall with notable increases in lead (23-fold increase) and zinc (>3-fold increase). It was concluded that shrimp were bioaccumulating heavy metals contained in the sediment from the Drish emission point. To remediate this issue, a plan was developed and implemented with Inland Fisheries Ireland. The affected river stretches were dredged and upgraded in summer 2016.

Similar to the Drish, the 2006 survey recorded significantly elevated concentrations of most heavy metals within sediment of the Rossestown River downstream of the mine emission points. With the exception of copper, all tested metals exceeded the agreed environmental limits at the mine emissions points with arsenic exceeding at all sampling locations. With the exception of zinc, concentrations decreased downstream of the mine outfalls towards the confluence with the River Suir. Heavy metal analysis recorded increased concentrations in shrimp tissue samples downstream of the outfall with notable increases in lead and zinc. Similar to the Drish, it was concluded that shrimp were bioaccumulating heavy metals contained in the sediment from the Rossestown emission point.

Works were subsequently carried out to remove sediment from the affected section of the rivers, and deposit it into the Tailings Management Facility. Cleaning work in the Rossestown River was completed during 2007, followed by the Drish River in the summer of 2008. Sampling following the remediation works demonstrated that both rivers were below guidance values for heavy metals.

[222] 2007 Sustainability Report

[223] The Lisheen Mine/ Anglo American, (2007) Lisheen Mine Sustainability Report – Our Impact

[224] Golder Associates (2006), Report on screening level risk assessment of metals in the Drish and Rossestown Rivers

However, in September 2008, the entire lengths of the Drish and Rossestown Rivers were re-sampled, and a number of locations on both rivers again recorded exceedances above guidance value. This continued into 2009, although an improvement was noted in the Rossestown River as a result of separate flooding-related works that were carried out. Additional abatement measures were planned to capture sediment, and the issue was reportedly resolved by 2013[225]

C.2.5.4 Closure

Water quantity

Following the cessation of mine dewatering in December 2015, groundwater levels were considered to have fully recovered by late winter 2017, a recovery time of just over two years. The impact of mine dewatering on groundwater levels and flows was predicted to cease following the cessation of pumping and the recovery of groundwater levels in the mine.

The 2016 CRAMP sets out the proposed monitoring scheme for surface water and groundwater in the Lisheen Mine area. Groundwater has been monitored from six regional wells surrounding the mine site area at a biannual frequency for up to three years into aftercare, falling to annually and further reduced frequency as aftercare has progressed. Two compliance wells, CW1 and CW2, were installed south-westerly of the Main Zone and south-westerly of the TMF. They are sampled on a similar frequency to the regional wells. The Moyne Group Water Scheme committee took over the management of the scheme and the running costs in February 2018[226].

Between January 2016 and November 2018, down-gradient monitoring wells recorded falling concentrations for the majority of tested determinants. As of November 2018, concentrations of sulphate, lead, arsenic, zinc, ammonia and nitrate were below compliance limits at the down-gradient compliance point CW02. It is noted that nickel concentrations have infrequently recorded at or above the compliance limit of 0.02 mg/l.[227].

Water quality

The operators at Lisheen installed lagoons and wetlands at discharge points to trap excess nutrients; which later had to be removed during the decommissioning period. As with Galmoy Mine, a large wetland was installed (several hectares) at Lisheen post-closure, and is reportedly growing well. This takes run-off from the tailing facility, making it less likely that nutrients can escape. Other operators elsewhere have developed plans to install wetlands as a result.[228]

As part of mine closure plans, the affected river stretches were dredged and upgraded in the summer of 2016. Aftercare monitoring undertaken between 2016 and 2018 indicated that sulphate and ammonia concentrations at the remaining outfall to the Drish River, SW1, were below compliance limits set in the IPC licence. Nickel and zinc concentrations remain above the IPC limit, although a downward trend was observed throughout 2018.

As of November 2018, three of the four mine surface water discharges had been decommissioned. Only emission point SW1 to the Drish River remains and shall be retained in perpetuity. Meeting notes from the Lisheen Mine Closure Committee Meeting indicate that concentrations of zinc and nickel here were consistently above the IPC licence limits. Whilst elevated concentrations are in breach of the IPC licence, monitoring in the Drish River immediately downstream of the SW1 emission point show metal concentrations are below the IPCL limit and therefore that the emission is “not causing any negative impact to the Drish River”[229].

[225] Lisheen Mine Sustainability Report, 2013-14

[226] Golder Associates (2019), The Lisheen Mine Annual Environmental Report Final

[227] Vedanta (2018), Lisheen Mine Closure Program – Mine Closure Committee Meeting, November 2018

[228] Interview with Pól O’Seasnáin (EPA) on 27 June 2019

[229] Golder Associates Ireland Ltd (2019), The Lisheen Mine 2018 AER Final

Water chemistry mixing models, undertaken as part of continued monitoring requirements and reported at the Mine Closure Committee Meeting in November 2018, predicted that TMF site discharges will comply with relevant environmental limits within 7 years of covering (i.e. by 2025). The exception to this is zinc, which will be investigated as part of continued monitoring. To minimise any risk to surface water quality, all sludge material which has previously accumulated within the outfall channels and treatment ponds associated with the site emission points was transferred to the TMF for restoration.

The main residual impacts for Lisheen are related to the Tailings Management Facility (TMF). According to interviews conducted as part of this study, there have been residual issues with seepage into an area adjacent to the Lisheen TMF. The issue was picked up by the ongoing monitoring in place as part of the closure and as the TMF remains under an active Integrated Pollution Control (IPC) licence. There is a small level of seepage, which is being actively controlled with seepage water being pumped back into the TMF. The design of the TMF is such that the water running off would be relatively clean (from rainwater) having collected in a cap of approximately 1m thick, with contaminants settling at a deeper level below the cap. In this case, contaminated water seemed to have seeped out from leaks in the lining of the TMF. It took 4-5 months to investigate the cause and the remediation works that would be required to address it and these works are now underway as of the second half of 2019.The major contamination concerns are tailings water containing sulphates and elevated zinc levels. There were also initial concerns about the TMF stability resulting in increased monitoring and emergency plans being activated. However geotechnical monitoring of the TMF indicated that the dam was stable. There has been active engagement and supervision by the authorities of the EPA, TCC and EMD throughout in managing the issue and the TMF remains under an active IPC licence.

Fisheries

According to Inland Fisheries Ireland, the mine operators allocated funds for the rehabilitation of the River Drish in conjunction with North Tipperary County Council[230]. The project involves installing deflectors and other fishery structures. The mine operators undertook some dredging and upgrading works were undertaken along the river in the summer of 2016 as part of the remediation actions required to meet planning conditions. This was noted to be complete in November 2018[231].

C.2.7 Air quality

C.2.7.1 Baseline

Prior to the commencement of mining activities, dust deposition in the area of the then proposed mine was low and typical of other similar rural locations in Ireland. Monitoring of air lead concentrations before construction began indicated that the ambient levels at the nearby villages of Moyne and Templetouhy were well below the EC Directive limit value for lead. For cadmium and thallium the levels were near to or below the analytical detection limit.

C.2.7.2 Construction

Dust deposits that formed on vegetation and vehicles in the area due to emissions from the mine's return air shafts were reportedly a major concern to the local population.[232] However, as with the baseline, the literature review and interviews did not provide further data on air quality levels in the baseline.

[230] Inland Fisheries Ireland website accessed August 2019.

[231] The Lisheen Mine Closure Committee Meeting, Preparation for the Mine Closure Certificate, 6th November 2018

[232] 2005 SD report

C.2.7.3 Operation

Environmental management systems and IPC Licence requirements ensure that Lisheen mine operators undertake rigorous air quality monitoring of particulates (dusts), hydrogen sulphide, sulphur dioxide, nitrogen dioxide, carbon dioxide, lead, zinc, arsenic and cadmium. In 2004 and 2005 the mine was 100% compliant with IPC licence limits. In 2006, 99.67% air quality compliance with Licence Conditions was achieved. [233] Information regarding compliance, or otherwise, in other years of the mine's operation is limited.[234]

Generally, there were regular emissions monitoring of the exhaust vents and the load out. This work was conducted throughout the operation of the mine.[235] Further air quality monitoring was undertaken in 2012, at the time that an Environmental Impact Study was being undertaken for the proposed development of a new water impoundment facility. At this time, air quality around Lisheen mine was reported as 'good' with average concentrations below background/detection limits or relevant IPC/IPPCL licence limits. Isolated elevated metal concentrations (zinc/arsenic) above CAFÉ/IPPC limits were however observed in the ambient air within the main plant site. Although monitoring data showed that air quality on the site has fluctuated over time, no limits had been exceeded.[236] PM_{10} levels have not exceeded the 40ug/m^3 threshold, with an average recording of 12.4 ug/m^3 from 2010-2013.

C.2.7.4 Closure

Though changes in air quality may have been a consequence of the closure of Lisheen mine, the literature review and interviews did not identify evidence to determine this.

C.2.8 Minerals

Minerals extraction is only expected to occur during the operation of the mine, therefore this sub-section below only relates to this phase of the mine.

22.4 million tonnes of ore was mined at Lisheen over its life, or approximately 1.4 million tonnes per year[237]. This resulted in the production of around 300,000 tonnes of zinc and lead concentrate each year, although this varied depending on the stage of Lisheen's lifecycle. This corresponds with other evidence, which suggests that approximately 6,300 tonnes of ore grade material was transported from the mine to the surface daily via a conveyor system.

C.2.9 Energy

Lisheen was one of the largest users of electricity in Ireland. Based on analysis of its AERs, Lisheen consumed an average of 123,000 megawatt hours (MWh) of electricity and 1.31 million litres of fuel per year. This resulted in approximately 76,737 tonnes of CO_2 emitted each year, or 1.23 million tonnes over its lifetime. This resulted in a shadow cost (of carbon) of €24.56 million[238].

In 2009, a wind farm was constructed and commissioned on the mine site. It was intended to generate 36 megawatts of power by means of 18 turbines and became operational as of August 2009. According to the interviews conducted for this study, the wind farm was leased out to a wind power company, which was also able to make use of the over-ground land. The interviewees reported that the construction of the wind farm did not include enough consultation with the community before

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[233] 2007 SD report

[234] 2005 Anglo American Sustainability Report

[235] The Lisheen Mine – Annual Environmental Report, Jan 2014 – Dec 2014 (AER)

[236] Chapter 8 Air Quality – EIS (2013) Golder Associates

[237] Irish Times, 2015. 'Lisheen Mine makes its final shipment'. Available at: https://www.irishtimes.com/business/energy-and-resources/lisheen-mine-in-tipperary-makes-final-shipment-1.2509609

[238] Shadow Price of Carbon of €20 from *Public Spending Code: Central Technical References and Economic Appraisal Parameters*. Department of Public Expenditure and Reform, 2019.

submitting the planning application for the wind farm. A local community action group was formed to call for the consideration of their concerns regarding property prices, health and flickering (perceived or otherwise) created by wind turbines.

The interviewees also reported that other members of the community later allowed the construction of wind turbines on their own land after the Lisheen wind turbines were built. 12 wind-turbines were constructed, bringing the total number of 30, with installed capacity of 60 MW. The mine used some of the power generated by the wind farm when the mine was still operational. The wind farm also supplied wind power to the whole town of Thurles.[239]

The wind farm is currently maintained and operated by Brookfield Renewable and is intended to continue operation into the future.[240] Based on an average load factor of 50%, it continues to generate enough electricity to meet the full energy consumption of 14,200 homes[241] and displace 120,900 tonnes of fossil fuels each year[242].

B.6 Economic effects

Lisheen Mine operated between 1999 and 2015. It had a construction phase of approximately two years prior to production. Over its lifetime, the mine had significant impact on the mining industry, its local communities and the wider Irish economy. The economic impact of Lisheen Mine has been assessed according to several economic indicators, and the summary of key indicators is presented below:

[239] Based on interviews conducted for this study.

[240] The Lisheen Mine (2016), Lisheen Mine Closure, Restoration and Aftercare Management Plan, C.R.A.M.P. (2016)

[241] Based on the full energy consumption of households. In reality, as only a portion of households' total energy consumption relates to electricity, the turbines were capable of supply electricity to more households.

[242] Based on a net displacement factor of 0.46 (SEAI, 2012)

Table C.3.1: Summary of Key Economic Indicators for Lisheen Mine in 2018 € Values

Economic Indicator	2018 € Value
Sales and Turnover	
Value of Sales (Turnover)	€2,760,000,000
Approximate share of total Irish zinc and lead production	35%
Total Lifetime Expenditure*	**€5,826,936,980**
Direct Expenditure*	€2,290,022,000
Indirect Expenditure*	€1,969,278,020
Induced Expenditure*	€1,567,636,960
Average Total Jobs Supported	**843**
Average Direct Employment	*350*
Average Indirect Employment	*322*
Average Induced Employment	*171*
Contribution to Public Finances	**€234,000,000**
Royalties and Dead Rent	€65,300,000
Corporation Tax	€55,300,000
PRSI	€36,000,000
PAYE	€77,400,000
Local Authority rates	€16,500,000
Development Contributions	€6,580,000
Gross Value-Added to the Irish Economy	**€1,276,070,000**

*Note: expenditure impacts are calculated for construction and operations phases only

The analysis undertaken for the economic impact assessment was compiled using a range of data sources. Direct impacts were estimated primarily from data contained in annual financial returns of Lisheen Milling Ltd (LML). It is important to note that while LML undertook the processing of ore, Lisheen Mining Partnership (LMP) oversaw the mining of ore; annual financial returns for which are mostly not publicly available. As a result, data from LML was combined with data from other sources and modelled in order to estimate the full impacts of the overall mine operation. In particular, a set of combined returns from 2015 has been used to verify the relationship between the 'purchase of ore' by LML and the corresponding 'turnover' at LMP, thereby allowing for expenditure and gross value-added to be estimated for the entire mining operation using LML's accounts. Total employment levels and wage data were sourced from LML's accounts, the Mine's Annual Sustainability Reports, and other public sources.

In order to determine the wider economic impact, the annual financial accounts were used in conjunction with the economic multiplier analysis for the Irish mining industry, compiled by Indecon Consultants for DCCAE in 2013.

In order to determine the lifetime impact of the mine, and to provide a basis for comparison, all figures (unless stated otherwise) have been adjusted to 2018 values using the Consumer Price Index.

C.3.1 Sales and Exports

Value of Sales

The value of sales is measured by the annual turnover of Lisheen Milling Ltd. Using company data (Annual Returns to the Companies Registration Office), the total and annual average turnover for Lisheen mine is shown below.

Table C.3.2: Value of Sales - Estimated Turnover in 2018 € Values

	Lisheen (1999-2015)
	€
Total Turnover	2,760,000,000
Average Annual Turnover	*172,500,000*

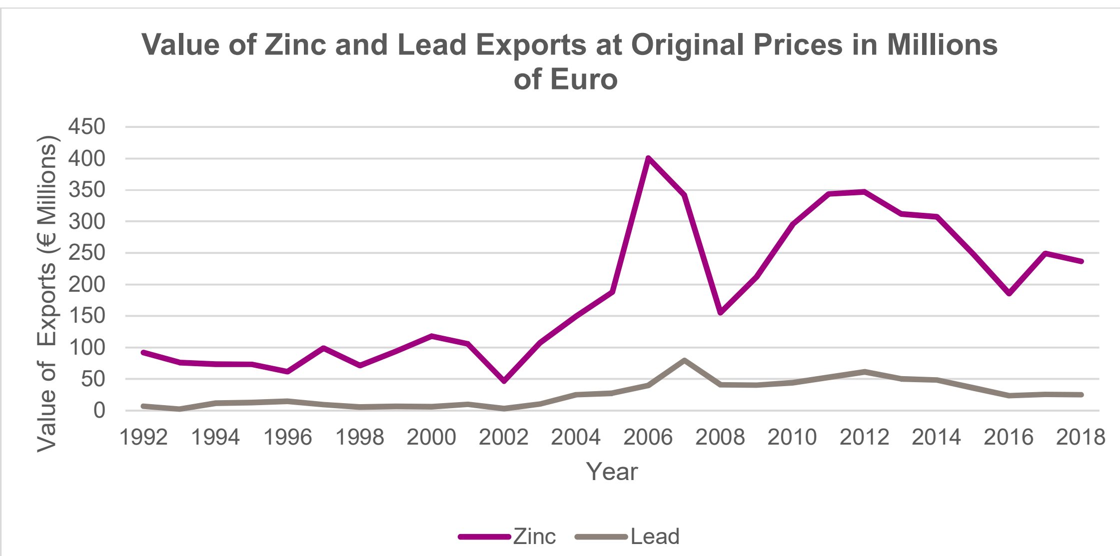
Source: AECOM Analysis of Annual Accounts

Lisheen mine had a lifetime turnover total was of €2.76 billion and an average annual turnover of €172 million. However, annual turnover had significant variation due to volatile zinc and lead prices. External price changes had a two-fold effect on the value of sales turnover: not only did it affect the value of the metal produced by the mine, but the mines generally altered their production levels and held ore in reserve based on whether prices were high or low.

Value of Exports

The total value of Irish lead and zinc exports is shown below. While company data does not show the exact percentage of turnover that relates to exports, as there are no smelters in Ireland, it can be assumed that all of Lisheen's zinc and lead concentrate was sold abroad.

Figure C.3.1: Value of Irish Zinc and lead Exports (€ Millions) at Original Prices



Source: United Nations Comtrade Database – International Trade Statistics Database

However, the value of these exports is especially volatile from 2005 onwards due to producers' exposure to fluctuating metal prices and euro-dollar exchange rates. Mining firms react to these rapid changes in price by altering their production levels; making it difficult to get an accurate picture of their individual shares of Irish exports (see above). At the height of production (between 2006 and 2007), Lisheen accounted for around 35% of Irish zinc and lead production, and approximately 30-40% of the value of Irish zinc and lead exports.

Figure C.3.2: Lead and Zinc Prices, 2000-2015

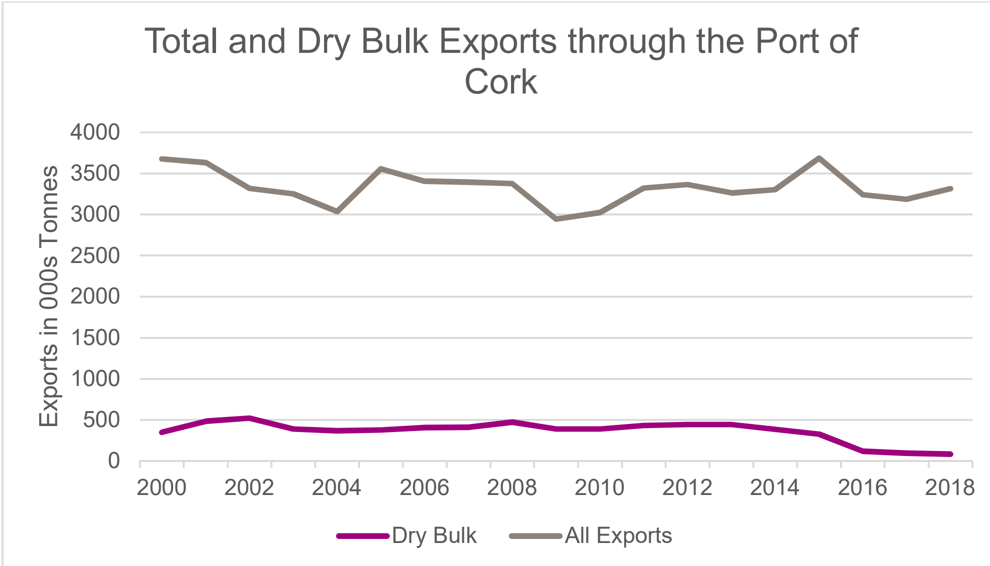
Source: World Bank Commodity Price Data

Port Statistics

The Central Statistics Office port statistics provide an insight into the magnitude of processed ore (concentrate) exports, and the impact of the Lisheen mine on port towns. Zinc and lead concentrate are classified as ‘Dry Bulk’, and dry bulk exports for Cork ports are shown below.

Lisheen exported its concentrate primarily through the Port of Cork, and maintained a specialised storage and shipping facility at Tivoli Docks for this purpose. Between 300,000 and 500,000 tonnes of dry bulk cargo was exported annually from the Port of Cork between 2000 and 2015, and as with New Ross in the case of Galmoy, these volumes decline significantly after the closure of Lisheen mine in 2015. However, dry bulk exports represented just 10%of total Cork exports, meaning that the effects of Lisheen’s closure were largely absorbed by increased trade in other sectors and the diversity of trade through the port.

Figure C.3.3: Dry Bulk Exports (000s Tonnes) through the Port of Cork, 2000-2018



Source: CSO Maritime Statistics

C.3.2 Mine Direct Expenditure

A mine's impact on the wider Irish economy largely depends on its spending. Spending for and Lisheen mine was assessed over their lifetimes, and direct expenditure is split into four main categories:

- **Capital and Development:** Spending on capital goods, such as buildings, vehicles and equipment
- **Non-Labour Inputs:** Spending on non-labour and non-capital inputs to the production process, including raw materials, supplies, services and general operating expenses. This figure is also used to calculate Gross-Valued Added (GVA).
- **Wages and Salaries:** All wages paid directly to employees. This also includes redundancy payments as part of the mines' closures.

All figures come from the annual returns of Lisheen Milling Ltd. It is important to note that there were significant gaps in the data available for Lisheen, as only the annual returns of Lisheen Milling Ltd. (and not Lisheen Mining Partnership) are publicly available for most years. One set of combined returns from 2015 has been used to estimate combined expenditure and employment levels for the Mine.

It is also important to note that as this is an assessment of the economic impact of expenditure, only physical expenditure has been considered in this analysis. This means that certain flows that may otherwise factor into determining whether a business makes a profit or loss, such as disposals of assets, have been excluded.

Expenditure was further categorised according to whether it occurred during the construction, operations or closure/aftercare phases of the mine and the results are presented in the tables below. All expenditure has been converted to Euro using contemporaneous exchange rates (as Lisheen Milling Ltd. filed its annual accounts in US dollars) and adjusted to 2018 Prices.

Construction on Lisheen Mine began in 1997 and commercial operations commenced in 1999. €347 million was spent on construction of the mine, with €1.94 billion of direct expenditure during the operations phase. This gives total direct spending by Lisheen Mine of €2.29 billion over its operational lifetime. In addition, an additional €65 million was spent on closure and aftercare, including worker's redundancy payments and site remediation works. It is not known how much was spent on pensions in this period.

Table C.3.3: Estimated Total Expenditure at Lisheen Mine in 2018 € Values

	Construction (1995-1997)	Operations (1997-2009)	Closure and aftercare (2009- ongoing)	Total
Type of Expenditure	**€**	**€**	**€**	**€**
Capital and Development	347,400,000	106,950,000	-	454,350,000
Non-labour Inputs	-	1,483,930,000	-	1,483,930,000
Wages and Salaries	-	351,742,000	43,582,000	395,324,000
Site remediation	-	-	22,231,000	22,231,000
Total Direct Expenditure	**347,400,000**	**1,942,622,000**	**65,813,000**	**2,355,835,000**

Source: AECOM Analysis of Annual Accounts

C.3.3 Mine Direct Employment

Employment levels are key to understanding a mine's economic impact on both the Irish economy and local community.

As Lisheen Mine continued to mine and mill ore for the entire period for which it operated, employment levels at Lisheen were more stable than Galmoy, with a range of 300-400 and an average of 350 over its operational life.

Table C.3.4: Snapshot of Direct Employment at Lisheen Mine

	2005	2010	2015
Total	339	370	330

Source: AECOM Analysis of Lisheen Milling Ltd. and Lisheen Mine Partnership Annual Accounts, Newspaper Articles

2011 POWSCAR Data from the electoral division in which Lisheen is located indicate that 36% of workers lived within 10km of the Mine and 77% lived within 30km.

Up to 700 workers were employed during the construction phase of the mine[243], but as with Galmoy, there are no records of whether these were full-time workers.

C.3.4 Contribution to Public Finances

Lisheen mine contributed financially to the respective local authorities and to the Exchequer in a number of ways: Royalties for the minerals extracted; licence/lease fees ('Dead Rent') associated with the mining lease, paid regardless of whether minerals are extracted; taxation (corporate tax, pay related social insurance); and local authority contributions and rates.

Royalties and Dead Rent

Royalties are the state's primary direct source of mining income. Royalties are paid to the state as a percentage of annual revenue, with the percentage rates negotiated at the beginning of a mining licence/lease, on a case by case basis.

In the case of Lisheen the minerals were primarily State-owned and a higher royalty rate was received by the State as a result. Once the negotiations were finalised with the two companies, they were adjusted to take into account these factors and provide a reasonable comparable basis for the two

[243] The Irish Times, 1997. 'Go-ahead for development of Lisheen Mine Project'. https://www.irishtimes.com/business/go-ahead-for-development-of-lisheen-mine-project-1.78960

companies. The royalty rates which were applied are detailed below. Lisheen contributed €64.3m in royalties over its lifetime.

Table C.3.5: Royalties Rates at Lisheen Mine

Royalties Rates
1.75% until 317 December 2000; 1.5% from 1 January 2001 to 31 December 2007; 3.5% thereafter.

Source: DCCAE, 'Fiscal Framework'

Taxation

In addition to royalties (which are charged on mining revenue), mining companies are also liable to pay corporation tax on profits. Different enterprises are taxed at different rates.

Lisheen spilt their zinc and lead production into two parts: mining (extracting the ore from the ground) and milling (processing the raw ore into ore concentrate). Corporation tax for the mining industry is paid at 25% of profits. As Lisheen Mine had spilt their production into mining and manufacturing / processing they paid two rates, 25%for mining and 12.5% for milling. However, this is currently under examination by the Revenue Commissioners. Overall, Lisheen paid €55.3m in corporation tax; although it is possible that more was paid by parent companies or other group companies.

Approximately €36 million was paid in employer's PRSI, as well as about €77.4 million by workers in PAYE.

Commercial Rates

Mine operators also pay commercial rates to the relevant local authority, which was North Tipperary County Council for Lisheen. Rates are paid to reflect the costs of doing business on a local level, such as providing appropriate infrastructure. During its lifetime, Lisheen paid €16.5m in local authority rates.

Developments are also generally required to pay development contributions after being granted planning permission. Lisheen paid €6.58 million to North Tipperary County Council for improvements to local infrastructure during construction.

C.3.5 Wider Economic Impacts

Gross Value-Added

Gross Value-Added (GVA) is defined as "output minus intermediate consumption"[244]; where intermediate consumption refers to goods that are consumed / used during the production process. In the mining industry, various inputs are used up in extracting the ore and creating a finished product that can then be sold. Electricity, fuel or tools are all examples of items that might be consumed during the production process for lead and zinc ore, and must be taken into account when estimating the value-added amount. As GVA measures the *additional* value created by a firm or industry, it is a good indicator of the size of Lisheen mine in relation to the wider Irish economy.

At the firm level, GVA can be approximated with companies' annual accounts using the following formula, which was applied to both mines:

Turnover – Cost of Sales + Depreciation + Employee Costs + Amortisation[245]

[244] Eurostat: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Gross_value_added

[245] https://sp-bpr-en-prod-cdnep.azureedge.net/published/2018/2/23/A-Guide-to-Gross-Value-Added--GVA--in-Scotland/SB%2018-15.pdf

The table below shows that Lisheen mine contributed nearly €1.28 billion to the Irish economy over its lifetime. This compares to GVA of €11.97 billion for the mining and quarry sector between 1999 and 2015, indicating that Lisheen was responsible for 11% of gross value-added for the sector.

Table C.3.6: Estimated Gross Value-Added Contribution of Lisheen Mine in 2018 € Values

	Total
	€
Total Turnover	2,760,000,000
(Less Intermediate Consumption)	*(1,483,930,000)*
Gross-Valued Added	**1,276,070,000**

Source: AECOM Analysis of Annual Accounts

It's important to note that the mining and quarrying sector includes Tara Mines, as well as 350 large commercial quarries[246] producing limestone, gypsum and dolomite (among other minerals). This means that although the mines produced and exported significant amounts of lead and zinc in a national and international context (as described in Section C.3.1), they accounted for a smaller proportion of GVA for the broader mining and quarrying sector in Ireland.

Expenditure Impacts

Every €1 directly spent by a business will have an impact in the economy beyond just that of itself. If a company spends money on purchasing supplies or hiring workers, those suppliers and employees will increase their own spending in response. This is known as the multiplier effect, and these expenditure effects can be broken down into three components:

- **Direct Expenditure:** Relates to the expenditure that can be specifically attributed to the mine, or the initial amount spent by Lisheen.
- **Indirect Expenditure:** Indirect impacts which arise as a consequence of changes in the level and value of sales for suppliers of goods and services to the mining industry. Type I multipliers measure the combined direct and indirect impacts of expenditure.
- **Induced Expenditure:** Relates to increases in spending by households as a result of increased earned income. As production increases in a firm and its linked industries, the resulting employment and wages earned can cause an increase in consumer spending in the wider economy. Type II multipliers measure the combined direct, indirect and induced impacts of expenditure.

Type I and Type II multipliers for the mining industry can be calculated using input-output tables from the Central Statistics Office (CSO), and have been estimated by *Indecon* at 1.91 and 2.59 respectively.[247] A Type II multiplier of 2.59 means that each additional €1 spent by the mining industry will cause an additional €2.59 in direct, indirect and induced spending.

These multipliers are high relative to other sectors for two reasons. Firstly, labour is a large component of mining companies' expenditure, and nearly 25% of national spend on inputs to the mining and quarrying in sector relates to wages and salaries. Secondly, the mining and quarrying sector spends significant amounts on Irish-produced inputs, with the largest suppliers to the industry

[246] https://www.irishconcrete.ie/backbone-sustainable-construction/quarries-and-aggregates/

[247] Indecon, 2013. *'Assessment of Economic Contribution of Mineral Exploration and Mining in Ireland.'*

including electricity and gas supply, land transport services, wholesale trade, and construction / construction works[248].

It is also important to consider the effect that the construction phase had on the wider Irish economy. Multipliers for the construction industry have been calculated by AECOM[249] in order to analyse the impacts of construction expenditure, and the Type I and Type II multipliers are 1.58 and 2.29 respectively. These multipliers have been applied to the construction and operations phase at Lisheen, to calculate the direct, indirect and induced expenditure impacts of the mines. Construction is a labour-intensive industry and is also linked to other labour-intensive industries, such as real estate, security and financial services, meaning that expenditure during the construction phase, although short-term, had significant induced effects. These are shown in the tables below.

The table below shows the expenditure impacts of Lisheen Mine. Lisheen had direct expenditures during the construction and operations phase of €347 million and €1.94 billion respectively. The total lifetime expenditure impact was approximately €5.8 billion, made up of direct, indirect and induced expenditure.

Table C.3.7: Estimated Direct, Indirect and Induced Expenditure Impacts at Lisheen Mine in 2018 € Values

Job Function	Construction (1997-1999)	Operations (1999-	Total Lifetime Expenditure
	€	€	€
Total Direct Expenditure	**€347,400,000**	**€1,942,622,000**	**€2,290,022,000**
Type I Multiplier	*1.58*	*1.91*	
Total Indirect Expenditure	**€201,492,000**	**€1,767,786,020**	**€1,969,278,020**
Type II Multiplier	*2.29*	*2.59*	
Total Induced Expenditure	**€246,654,000**	**€1,320,982,960**	**€1,567,636,960**
Combined Direct, Indirect and Induced Expenditure Impacts	**€795,546,000**	**€5,031,390,980**	**€5,826,936,980**

Source: AECOM Analysis of Annual Accounts

Employment Impacts

An increase in the number employed by the mining industry can have a knock-on effect in other industries and businesses. As with expenditure, indirect employment results from the employment generated by companies in the mines' supply chains, while induced employment is generated by increased consumer spending; usually as a result of an increase in wages and salaries in the community.

Using average annual employment figures from Section C.3.3 and employment multipliers calculated by *Indecon*[250], the direct, indirect and induced employment impacts of Lisheen mine are shown in the table below.

[248] Base on AECOM Analysis of 2011 Central Statistics Office Input-Output tables.

[249] Construction multipliers have been calculated from input-output tables supplied by the CSO

[250] Indecon, 2013. *'Assessment of Economic Contribution of Mineral Exploration and Mining in Ireland.'*

Table C.3.8: Estimated Average Direct, Indirect and Induced Employment Impacts at Lisheen Mine

Job Function	Lisheen Average Employment
Direct Employment by Mines	350
Sectoral Type I Multiplier	*1.92*
Indirect Employment Impact	322
Sectoral Type II Multiplier	*2.41*
Induced Employment Impact	171
Combined Direct, Indirect and Induced Average Employment	**843**

Source: AECOM Analysis of Annual Accounts

Through direct, indirect, and induced employment effects, Lisheen supported an average of 843 jobs in the wider Irish economy.

While it is not possible to quantify the extent, it is likely that many of these indirect jobs were created in the local region. While certain specialist supplies may not have been available locally, local services are likely to have been used in the day-to-day operation of the mine, and a significant proportion of indirect employment would relate to local workers. Similarly, jobs resulting from higher levels of consumer spending are likely to have been created locally as workers spend their wages in businesses in the local community.

Contributions to the Local Community

As part of their corporate social responsibility to the local community, Lisheen maintained a sponsorship programme.

The 2005 Mine Sustainability details a sponsorship committee with an annual budget of €16,500 for community organisations and projects, including local schools, sports clubs and civic organisations. The mining company also spent approximately €1.5 million on local capital projects, such as €650,000 for the redevelopment of community halls in Moyne and Templetuohy, €300,000 for a local GAA club, and €200,000 for the construction of a running track at Moyne Athletic Club.

Appendix D
Documents Reviewed

10. Appendix D. List of documents reviewed

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