

4.0 Project description and alternatives

4.1 Introduction

This chapter presents information on the Ensham Life of Mine Extension Project (the proposed project, hereafter referred to as 'the Project') including an overview of the mining activities proposed for the Project, and, a brief overview of the existing Ensham Mine operations.

4.2 Project overview

Ensham Mine is an existing open-cut and underground bord and pillar coal mine located approximately 35 kilometres (km) east of Emerald in Queensland. The existing bord and pillar operations are authorised to continue until 2028 within Mining Lease (ML) 7459 and ML 70365, extracting a portion of the various combined Aries/Castor seam plies.

The proponents for the Project propose to increase the life of the existing underground operations by extending the underground bord and pillar mine into an area identified as the Project Site which includes zones 1, 2 and 3 (**Figure 4-1**).

The Project has a surface area of approximately 2,737 hectares (ha) being:

- Zone 1: a new mining lease (MLA 700061 lodged 25 March 2020) contained within the existing MDL 217 (approximately 2,134 ha)
- Zone 2: an area within the approved mining leases ML 70326, ML 70365 and ML 7459 (approximately 394 ha)
- Zone 3: an area within the approved mining leases ML 7459 and ML 70366 (approximately 209 ha).

Note: zones 1, 2 and 3 comprise the Project Site.

4.2.1 Project objectives

Approval of the Project will allow Ensham Mine to:

- continue to produce at current planned coal production rate of approximately 4.5 million tonnes per annum (Mtpa) retaining the current Environmental Authority (EA) limit (condition A5) which authorises the mining of 12 million tonnes of run of mine (ROM) coal per annum.
- extend the life of mine (LOM) by up to nine years with sufficient coal reserves to approximately 2037.
- progress the underground operation to the west of the existing approved underground operations with no additional surface infrastructure proposed as part of the new mine lease (Zone 1). The Project would continue to utilise existing operational mine equipment and infrastructure located on the existing and approved mining leases.
- continue to provide long-term employment within the Central Highlands region. The Project is proposed to commence in 2021 in Zone 2 using existing underground mining equipment and mining methodologies.

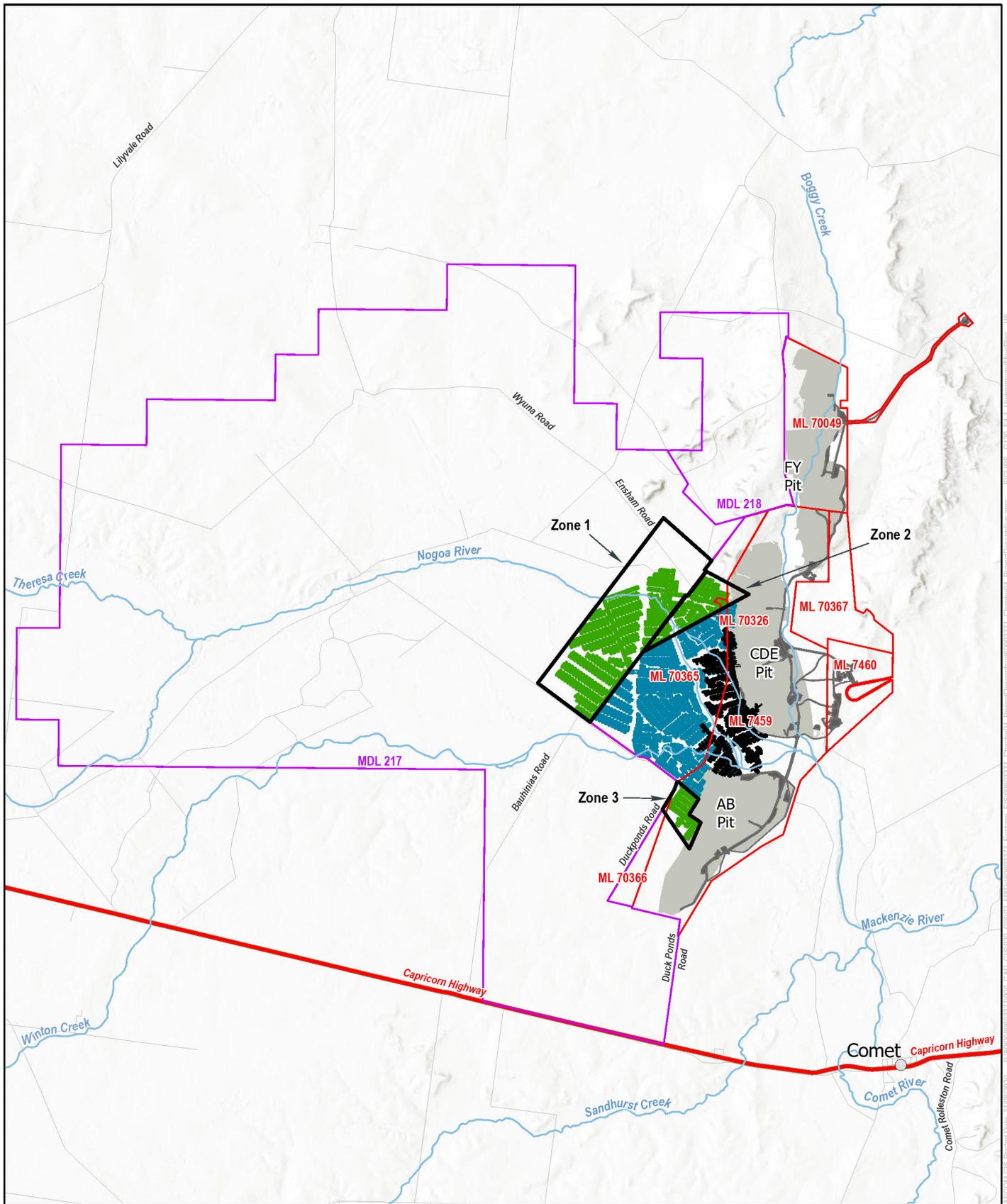


Figure 4-1
Underground mine plan (Approved and the Project)



Legend

- | | | | |
|--|-------------------------------|---|----------------------|
|  | Project Area |  | Mined out |
|  | Mining leases |  | Approved to be mined |
|  | Mineral development licence |  | The Project |
|  | Pit | | |
|  | Mine infrastructure footprint | | |

ENSHAM LIFE OF MINE EXTENSION PROJECT

Projection: GDA 1994 MGA Zone 55 Scale: 1:215,000
 Source: State of Queensland, 2019. ESRI Online data, 2020.
 Indemitsu RFI, 2020

4.2.2 Expected capital expenditure

Capital expenditures relevant to the Project include one-off sustaining costs (i.e. infrastructure costs associated with the expansion of the Ensham Mine directly attributable to the Project) and ongoing sustaining costs such as the rebuild and replacement of major mining equipment and other capital expenditures.

The capital costs associated with the Project (in 2020 dollars) are estimated at \$314.9 million, and comprise:

- \$72.4 million incurred within Central Queensland
- \$107.1 million incurred within the rest of Queensland
- \$66.1 million incurred within the rest of Australia
- \$69.3 million incurred overseas.

Of the \$314.9 million, \$10.9 million are one-off sustaining costs, and \$304 million are ongoing sustaining costs. Further details regarding the economics of the Project are presented in **Chapter 22** (Economics) and **Appendix J Economic Assessment**.

4.3 Site description

4.3.1 Location

The Project is located at the existing Ensham Mine, in the western part of the central Bowen Basin, approximately 200 km west of Rockhampton, and 35 km east of Emerald along the Nogoa River in Central Queensland. The Project covers approximately 2,737 ha of land. The location of the mine from a regional context is shown in **Chapter 1** (Introduction).

Being located in the central Bowen Basin, the Project is situated in an existing mining precinct with a number of other coal mines operating in the area. The Project is located within the Central Highlands Regional Council (CHRC) local government area.

Land use in Zone 1 of the Project includes dry land cropping, cattle grazing and irrigated cropping. The Nogoa River and some minor tributaries traverse through the Project, with the Nogoa River fed by the ephemeral Terresa Creek and releases from the upstream Fairbairn Dam, providing a year-round water supply to downstream users.

Zones 2 and 3 of the Project Site are located in areas within the existing Ensham Mine mining leases as shown in Figure 4-1. The southern portion of Zone 2 includes an area mapped as Strategic Cropping Area (SCA) and Priority Agricultural Area (PAA) while the northern portion is largely disturbed with large areas of cleared land and includes seismic lines and tracks. It contains areas of rehabilitated spoil as well as unrehabilitated spoil and pre-strip areas from open-cut mining. Zone 3 is disturbed land with borrow pits, dragline spoil, levees, topsoil stockpiles, pre-strip areas, tracks, and seismic lines associated with the existing open-cut operations at Ensham Mine. Zone 3 is largely cleared with sparse stands of vegetation across the area. The majority of Zone 3 is mapped as SCA and PAA. Both Zone 2 and Zone 3 are used for grazing.

All activities directly associated with the Project will be carried out within the Project Site. There will be no off-lease activities relevant to the Project.

4.3.2 Tenements and ownership

The Project comprises nine registered land parcels which are a mix of freehold, reserve and lands lease properties. Part of the Project is also subject to a secondary interest, being a strata easement for the purposes of a stock route.



The partners of Ensham Resources Joint Venture (Ensham JV) holds various resource tenements within Ensham Mine. The tenements include seven MLs and two MDLs. The existing bord and pillar operation is currently located on ML 7459 and ML 70365.

Tenure arrangements within the Project Site are detailed in **Chapter 7** (Land use and tenure).

4.4 Existing Ensham Mine operations

The existing mining operations at Ensham Mine consist of open-cut and underground operations, and rehabilitation of the open-cut mining areas. The open-cut operation is scheduled to continue to approximately 2024, followed by further rehabilitation of the open-cut mine. Current underground operations are approved to continue until 2028.

The existing underground workings are accessed through three portals located in Pits C and D. These portals are used for ventilating the mine, for personnel and materials access, and conveying ROM coal from the underground workings to the coal stockpile.

Coal is then transported by road trains on a private road to the coal handling plant (CHP) where it is crushed and sized to produce Product Coal. Product coal is transported via rail to Gladstone for electricity generation at the Gladstone Power Station and to the Gladstone Coal Terminal for export overseas.

Methane gas is currently drained from the target coal seam through in-seam drainage holes that are connected to an underground piping system which transports the gas to the surface via a borehole where the gas is flared. As is a common practice in the Bowen Basin, underground in-seam gas drainage is a means of draining in-situ gas in advance of mining to maintain a safe working environment. Flaring of the drained gas is required to reduce greenhouse gas emissions as required by the Clean Energy regulator and s318CO (2) of the Minerals Resource Act 1989. Gas from the existing underground mining operation is currently being flared in locations to the west of C and D pits as shown in **Figure 4-2**.

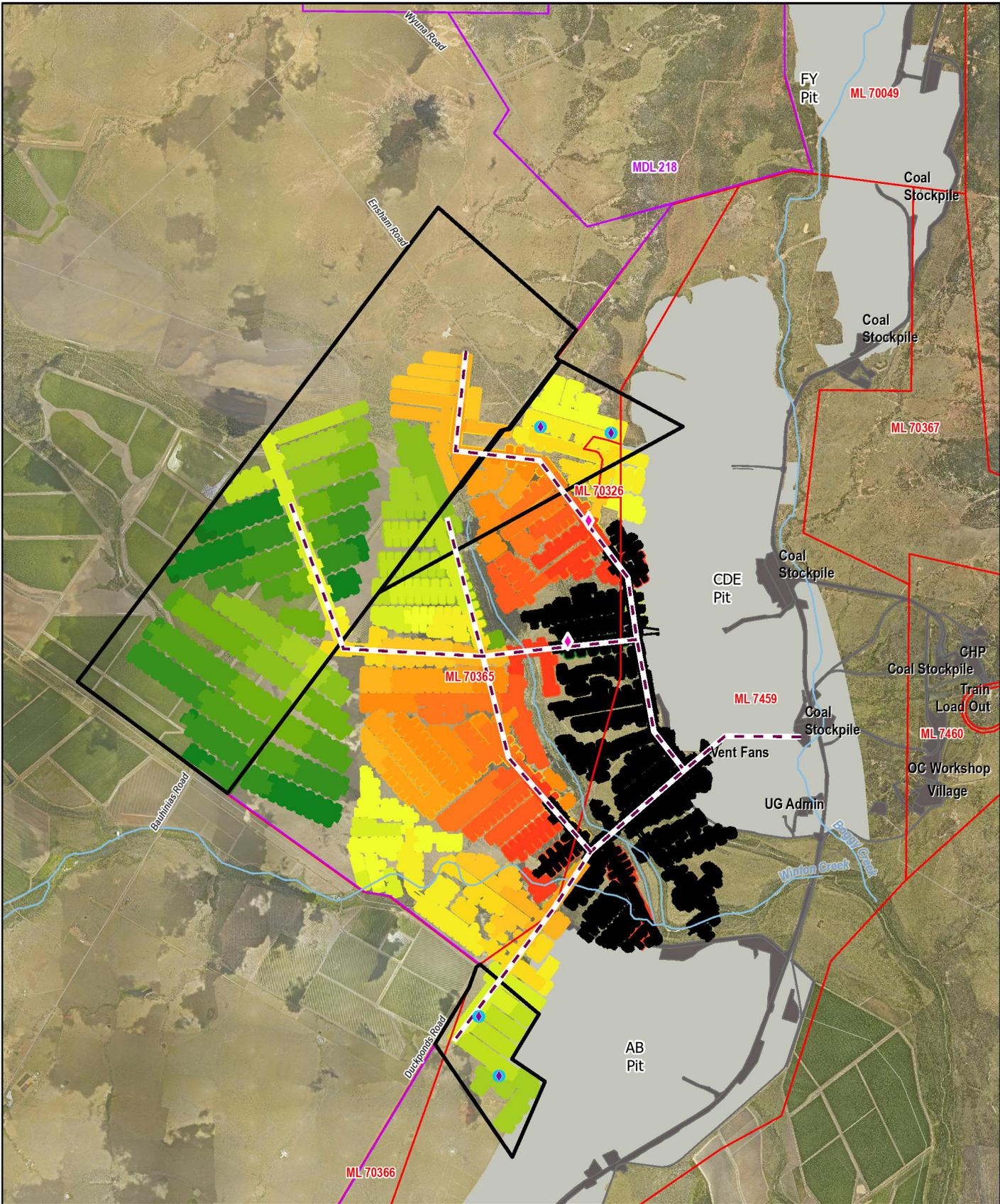
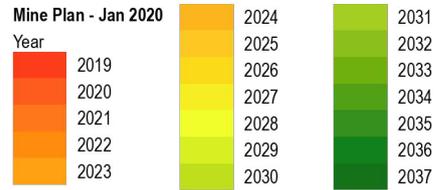


Figure 4-2
Mining Infrastructure

Legend

- Project Area
- Coal conveyor transport system
- Flaring infrastructure
- Existing flaring infrastructure
- Exclusion zone
- Mineral development licence
- Mining leases
- Mine infrastructure footprint
- Pit
- Mined out areas



ENSHAM LIFE OF MINE EXTENSION PROJECT

AECOM GIS Printed Date: 25/02/2021. \\Secure\Projects\606\6060337\1040_CAD_GIS\2020_GIS\2020_ADO\6060337_Ensham_ESI\6060337_Chapter04_ProjectDescription.aprx. FIGURE 4-2_MiningInfrastructure_V2

4.5 Project construction

As the Project is a continuation of the existing underground mine, using existing surface infrastructure located on the existing approved MLs (which includes Zone 2 and Zone 3), no additional infrastructure activities other than installation of four flares as detailed in **Section 4.6.4.2** if required.

As there will be no material surface construction activities or construction traffic, the Project will not require any upgrades to the existing road infrastructure. The traffic assessment for the Project is discussed further in **Chapter 23** (Transport).

4.6 Project operations

4.6.1 Conceptual mine design, schedules and ROM production

The mining sequence for the Project is based on the extension of the current planned mine workings. **Figure 4-2** shows the existing approved mined underground areas (under EA EPML00732813), the mining schedule from 2021 to 2037, and, the underground conveyor system required to support the existing approved mining areas and the Project, while **Figure 4-3** shows the planned coal production from 2021 to 2037.

4.6.2 Exploration Activities

There will be a need for minor temporary disturbance associated with exploration activities in zones 1, 2 and 3 (ie: drilling and 3D seismic). The environmental harm associated with these activities for Zone 1 have been assessed and authorised under Environmental Authority MIN 104395712. These activities in Zones 2 and 3 have been assessed and authorised under the current environmental authority EAML 00732813. All disturbance associated with these activities will be rehabilitated in accordance with the above-mentioned environmental authorities.

As shown in **Figure 4-2**, Zone 2 would be the first underground area to be accessed from ML 70365 in approximately 2021, before mining continues into the area north of the Nogoia River in Zone 1. South of the Nogoia River in Zone 1, mining would extend in a south-west direction from approximately 2027. Mining in Zone 3 would continue from ML 70365 beyond approximately 2028.

Mine design has been completed with a factor of safety of 1.6 for bord and pillar workings beneath the Nogoia flood plain inclusive of the Nogoia River as discussed in **Chapter 8** (Land resources). Underground mining for the Project will occur at a depth of approximately 120 to 210 metres (m) below the surface.



Figure 4-3 Ensham Mine ROM coal production

4.6.3 Mining and processing equipment and infrastructure

A mining infrastructure study has been conducted as part of the Prefeasibility Assessment (Idemitsu, 2020) and the findings of that study are discussed in the following sections.

4.6.3.1 Underground equipment

The Project will continue to use continuous underground miners (or similar) which will provide sufficient capability to mine the Project. Other existing equipment that will likely continue to be used includes shuttle cars, mobile bolters and feeder breakers and ancillary underground equipment.

4.6.3.2 Coal clearance system

Extracted coal is currently transported from the underground production panels to the ROM storage area by a system of underground conveyors. The existing underground coal clearance system has sufficient capacity for the Project and will be extended in the underground workings as the mining operations move into zones 1, 2 and 3.

4.6.3.3 ROM storage area

The ROM stockpile area is expected to remain approximately the same size during the Project. Existing or similar loaders and road trains will continue to be utilised to manage the ROM stockpiles.

4.6.3.4 Coal handling plant

The existing CHP comprises a truck dump station, crushing and screening plant, product conveyors, stackers, reclaim system and loadout system.

After crushing, the product coal will continue to be stockpiled and loaded onto trains via the existing train loadout facility.

A minor upgrade of the CHP, within the footprint of the current CHP disturbed area, is currently being trialed. The trial includes a small dry processing module which complies with existing EA conditions. This module would be integrated into the existing footprint of the CHP to assist with the dry removal of rock from the coal. The introduction of technology to remove rock from the coal is consistent with the previously approved coal handling and preparation plant (CHPP) function with a significantly lower environmental impact. (i.e. no tailings facility and associated additional water use). Removed rock would continue to be dry disposed of in the existing open-cut pits as authorised under the current EA.

4.6.4 Associated infrastructure

4.6.4.1 Ventilation

Existing underground ventilation systems will be extended into the Project as zones 1, 2 and 3 are developed with current practices and procedures utilised.

4.6.4.2 Gas drainage and management

In accordance with existing practice at Ensham Mine, gas drainage will be required for the Project to allow seam gas pre-drainage to ensure a safe working environment in the underground workings. Coal seam drainage gas will be vented in Zone 2 and Zone 3 via flaring infrastructure. A total of four flares will operate continuously on existing mining leases: two flares will be located in Zone 2 (ML 70326, ML 70365 and ML 7459) and two flares in Zone 3 (ML 7459 and ML 70366). Further information regarding the greenhouse gas assessment is presented in Chapter 16 (Greenhouse gas).

Installation and use of gas flares is a safety mitigation, represents a lower environmental impact than free venting, is required under Mineral Resources Act 1989 legislation, and would be established in locations already approved for disturbance identified in Zones 2 and 3 shown in **Figure 4-2**.

The setup of the flares will be risk based and include an exclusion zone which will be fenced to prohibit wildlife and people from unauthorised entry. This exclusion area would likely be approximately 80 m by 20 m on disturbed land which would not require vegetation clearing (other than maintenance of grass levels to minimise fire risk). These locations would utilize existing tracks on existing mining leases for construction purposes and ongoing general access. Flaring stacks would be approximately 8 m tall with the flare height being up to 3 m above the stack.

4.6.4.3 Compressed air

Surface compressors are currently located within the Red Hill infrastructure complex located in Pit C above the portals. The existing compressed air system will be adequate to support the Project.

4.6.4.4 Electricity supply

66 kilovolt (kV) power is currently provided to Ensham Mine from the Ergon Lilyvale substation via an existing 27km overhead transmission line. The underground mine is supplied via an existing 66/11 kV 10 megavolt amp transformer located at Red Hill.

Demand modelling conducted for the Project indicates there is sufficient capacity to supply power for the Project and no new surface electrical infrastructure will be required.

Should additional underground power be required for the Project then a borehole will be utilised, The location of the borehole would be in the northern section of ML 70365 on non-strategic cropping land and above 0.1%AEP flood line.

4.6.4.5 Communications

The current underground communications system is located along conveyors, mining operations and substations to provide communications between underground and surface personnel.

The existing underground fibre optic communication network is adequately servicing the current mining operations and will be extended underground for the Project.

4.6.4.6 Raw water supply

The current water supply system at Ensham Mine, including surface potable water infrastructure, will be utilised for the Project. Additional piping and booster pumps will be installed underground to supply the required water pressure for the Project.

No changes in water licencing arrangements or the existing water supply surface infrastructure are expected for the Project.

4.6.4.7 Mine dewatering

Mine affected water is currently pumped from the underground to surface infrastructure using a dedicated dewatering system. This dewatering system would be extended underground for the Project.

No changes to the surface mine water infrastructure will be required.

4.6.4.8 Flood protection

Flood protection will continue to be provided to the open cut pits and underground portals in proximity to the floodplain by the existing Regulated Structures (the levees). These levees are certified on an annual basis by a suitably qualified RPEQ engineer to a 0.1% AEP + 0.5m flood height.

No changes to these levees will be required.

4.6.4.9 Surface buildings

The existing surface buildings have sufficient capacity for the Project. No new surface buildings will be required to be constructed for the Project.



4.6.5 Transport infrastructure

4.6.5.1 Road transport and traffic

The Project will not increase traffic volumes from current approved levels and will have no discernible impact on the operation of the relevant sections of both the state-controlled (Capricorn Highway) and CHRC controlled (Duckponds Road) networks. A detailed assessment of the Capricorn Highway/Duckponds Road intersection identified that the current configuration would be more than adequate to cater for Project traffic volumes.

As such, the existing access facilities for Ensham Mine currently provided via the gated access on Duckponds Road will be suitable to cater for the Project.

No changes to the road infrastructure will be required.

4.6.5.2 Rail transport and port operations

Product coal from Ensham Mine is railed on the Rockhampton to Longreach Queensland Rail network system for delivery to both the Gladstone Coal Terminal and the Gladstone Power Station.

No changes to the rail transport or port operations will be required.

4.6.6 Workforce

4.6.6.1 Operational workforce

The Ensham Mine currently employs approximately 687 full-time equivalent (FTE) personnel, who are a mixture of local Emerald and surrounding community-based persons, and, drive in/drive out and fly in/fly out persons. This workforce will be maintained up to approximately 2024 when the current open-cut operations are scheduled to be completed (See **Figure 4-4**). From that time, the workforce will be approximately 603 FTE personnel until around 2037, inclusive of the Project. A further reduction in the mine workforce will occur in approximately 2037 with the remaining workforce undertaking decommissioning and rehabilitation activities.

A summary of the expected workforce requirements is shown in **Figure 4-4**.

Secondary employment opportunities currently supported through the ancillary services to the Ensham Mine include extended requirements for workforce accommodation and a large range of mine support services such as, fabrication, maintenance and rehabilitation related services.

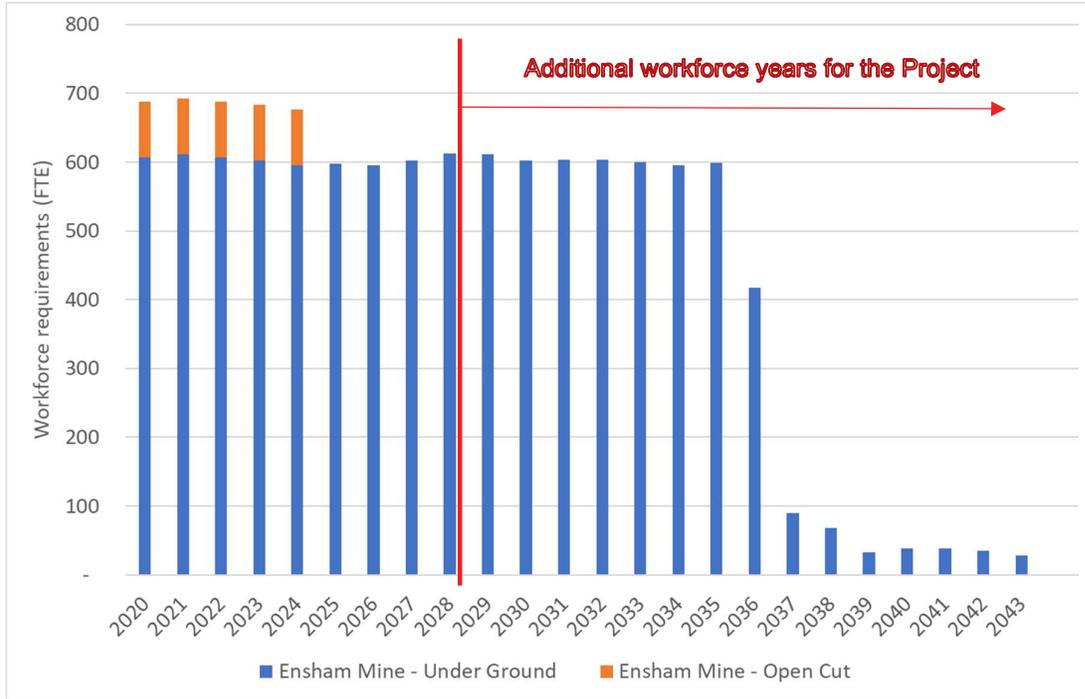


Figure 4-4 Expected workforce requirements

4.6.6.2 Hours of operation

Production personnel currently work 12 hour rotating shifts (day/night) on a 7/7 roster, whereas staff principally work 10-hour day shifts on a 5/2 roster.

No changes to the existing roster arrangements and workforce residential locations, other than the extension of production activities to 2037, are expected for the Project.

4.6.6.3 Workforce accommodation

The current workforce is a mixture of local Emerald and surrounding community-based persons, and drive in/drive out and fly in/fly out personnel. The Social Impact Assessment identifies that approximately 78 per cent of Ensham Mine personnel are either Emerald based or drive in/drive out based. In addition to the local workforce that reside in local community housing, Ensham Mine maintains a 600 person workers camp.

As the Project does not involve any construction activity, there would be no construction workforce required. It is expected that current operational workforce arrangements will continue for the Project and no new accommodation facilities would therefore be required.



4.6.7 Waste materials

The Project will continue to generate mining and non-mining waste materials during the operational phase, as well as waste water and air emissions.

Waste generated as part of the Project will be managed using the existing waste management systems utilised by the current mine operations.

No changes to the waste management systems onsite will be required.

4.6.7.1 Waste rock

Waste rock produced by the Project will be generated from the coal handling plant at approximately 18,000 m³ per annum. The Project will place the waste overburden rock into Pit C and Pit D. The estimated volume of waste rock from the proposed Project over the life of the mine is 225,000 m³ in total which is approximately 0.6 per cent of total approved waste rock volumes (36 million m³) currently approved for the rehabilitation of Pit C and Pit D. At less than 1 per cent of total approved rock volume for Pit C and Pit D, it is not envisaged that this addition would impact the approved final landform outcomes including final void water heights shown in Appendix 3 of the EA.

Characterization of this waste rock including AMD potential and metalloid mobility is discussed in more detail in **Chapter 8 Land Resources**.

A detailed mine waste assessment is included in **Chapter 8** (Land resources) and **Chapter 18** (Waste management).

4.6.7.2 Non-mine waste

Ensham Mine's existing operations produce general solid and liquid wastes that are typical of mine site operations. These sources include:

- regulated waste including hydrocarbon waste such as waste oil, oily water, oily sludge, grease, oil rags, oil filters, as well as coolant, drums, detergents, solvents, batteries, tyres, paints and resins
- general waste including food waste, packaging and food containers
- recyclable waste including paper, cardboard, plastics, glass and aluminium cans
- wood waste including timber, pallets, and off-cuts
- tyres including light vehicle tyres and mine truck tyres
- scrap metal from mine infrastructure areas including drums, conveyor rollers, air filters and miscellaneous metal from maintenance activities.

Waste types, annual generation rates and applied management strategies for the mine site are not expected to materially change from current operations for the Project as coal production rates will remain relatively constant.

General waste is currently transported and disposed of by an authorised waste management contractor at a licenced landfill. Recyclable materials are taken to an authorised recycling centre for initial processing, involving segregation, crushing and baling for transport to various companies for recycling. Regulated wastes are transported by a licenced waste contractor to an authorised resources recovery facility for recycling, reprocessing, treatment and disposal.

Sewage is treated at existing onsite sewage treatment plants with effluent used for the irrigation of rehabilitated areas and plantation trees as authorised under the Ensham Mine EA. The current system capacity will be adequate and no upgrade will be required for the Project.

The waste inventory, characteristics of non-mining wastes and their management are discussed in detail in **Chapter 18** (Waste management).

4.6.7.3 Waste water

Waste mine water will continue to be managed using the existing water management system for the Project.

Waste water discharges associated with the Project are discussed in **Chapter 10** (Surface water resources).

4.6.7.4 Air emissions

Surface activities at the existing Ensham Mine with the potential to impact air quality include vehicle movements on unsealed roads, coal handling, and crushing operations.

The main sources of direct and indirect greenhouse gas emissions from the Project are:

- fugitive emissions of CH₄ (methane) and CO₂ (carbon dioxide) due to underground air ventilation processes
- direct CO₂ from gas flaring of coal seam methane pre-drainage
- direct CO₂ emissions from fuel combusted by mining equipment/vehicles
- fugitive emissions from post-mining activities from coal stockpiles, and during conveying of coal from the underground to the CHP
- indirect CO₂ emissions from off-site electricity generation.

Overall the air quality impacts associated with the Project are not expected to exceed the current EA requirements and will reduce over the life of the Project as open-cut operations cease. Management of greenhouse gas emissions from the underground mine will be achieved through flaring in Zone 2 and Zone 3.

Air emissions associated with the Project are discussed in **Chapter 15** (Air quality) and **Chapter 16** (Greenhouse gas).

4.7 Feasible alternatives

A range of alternative options have been considered in the development of the Project. Alternatives were considered in terms of location, mine plan and infrastructure configuration, and mining methods. This section discusses the range of alternatives considered and provides justification for the Project.

4.7.1 Strategic alternatives

A prefeasibility assessment (PFA) (Idemitsu, 2020) was undertaken which considered a number of strategic alternatives as discussed in summary below.

A ‘do nothing’ scenario was considered as an alternative option to the Project. This option showed that employment for the workforce (approximately 603 FTEs) and the community and economic benefits to the regional, state and national economies reduce over the years leading up to the existing mine closure in 2028. State royalties, of approximately \$256 million, and Commonwealth tax revenue derived from the additional coal resource in the Project would be foregone and the contribution to Queensland’s economy and COVID-19 recovery would not be realised.

This was not seen as a preferred outcome given the social and economic harm that closure of the mine would cause, and as such, this scenario was not advanced.

Additional scenarios considered are discussed further in Table 4.1 and summarised below:

- Development of a greenfields mine separate to the existing Ensham Mine and current infrastructure, and

- Development of a brownfields mine expansion utilising existing Ensham Mine and current infrastructure.

Development of a greenfields underground mine was considered to involve significant:

- disturbance of additional surface areas external to and west of the existing mining leases, including potentially strategic cropping areas, and
- investment of capital to replicate existing onsite coal handling and raiiling infrastructure.

Both of the above points would represent significant investment hurdles and would likely make this scenario unviable leading to the same outcome as the ‘do nothing’ scenario.

Based on the above, development of a brownfields mine expansion was considered the best scenario due to:

- proximity to Ensham Mine’s existing operations which include all the supporting mine infrastructure required to operate the Project which delivers a lower capital investment requirement and no impacts on surface agricultural activities and strategic cropping areas
- existing access to the Capricornia Coal Chain, which comprises the Blackwater and Moura Rail corridors, both coal terminals at the Port of Gladstone (RG Tanna Coal Terminal and Wiggins Island Coal Export Terminal) and rail haulage operators (Aurizon and Pacific National)
- availability of the coal resource and it’s technical and economic feasibility.

Coal resources within the existing tenements were considered limited based on consideration of the following criteria:

- availability of a full seam, mined on an in situ basis
- line of oxidation (LOX) lines, beyond which, weather or oxidised coal was not targeted
- a minimum underground working section thickness of 1.5 m below 60 m depth of cover within a 100 m buffer to the existing open-cut
- tenement boundaries.

Full details of the social and economic considerations and outcomes for the Project are contained in **Appendix I-1 (Social impact assessment)** and **Appendix J-1 (Economics)** respectively.

Table 4-1 Project alternatives

| Case # | Description | Average production (Mtpa) | Project life |
|-----------------------|--|---------------------------|--------------|
| Base Case | Thick and thin seam in ML’s only, includes Zone 2 and Zone 3. Maintain current operation (5-production units), excluding CHPP. | 4.3 | 10 years |
| Long Term Plan | Base Case including thick seam in Zone 1. Maintain current operation (5-production units), excluding CHPP. | 4.3 | 13 years |
| MDL Case 1 | Base Case - including the Zone 1 thick & thin seam, excluding CHPP. Maintain current operation (5-production units) with no coal washing. | 4.1 | 17 years |
| MDL Case 2 | Base Case – including the Zone 1 thick & thin seam and including CHPP. Maintain current operation (5-production units) and commence with coal washing when required in 2027. | 3.8 | 17 years |
| MDL Case 3 | MDL Case 1 – without dilution. | 4.0 | 17 years |

The Base Case is limited to mining within existing approved MLs only, with no mining proposed in MDL 217. MDL Cases 1 to 3 consider thin seam mining in Zone 1 only, and a coal handling and preparation plant is considered in MDL Case 2 only.

MDL Case 1 was considered the preferred option. The selected option has been evaluated and proven to be technically and financially feasible (Idemitsu, 2020).

4.7.2 Mine plan options analysis

With the brownfields scenario identified, the PFA undertook an analysis of potential mine plans to select a preferred mine plan and preferred mining methodology. Having considered the social and economic aspects in the mine scenario phase (above) the mine plan and methodology for the project were considered based on technical and financial feasibility (Idemitsu, 2020).

Six underground mine development cases were evaluated in the PFA. All options sought to extend the Ensham LOM to ensure employment for the existing workforce is maintained up to and beyond 2028. The identification of options and alternatives was primarily based on:

- seam thickness and structure (fault locations)
- access for personnel and materials
- conveyor access to the surface
- ventilation requirements.

The mine plan is based on the current design principles currently used at the existing Ensham Mine.

4.7.2.1 Mining methods

The existing underground mine extracts a portion of the various combined Aries/Castor seam plies using the place change bord and pillar mining method. Bord and pillar mining was adopted due to the intensity of faulting (typical of the Rangal Coal Measures) and the presence of the Nogoia River and its floodplain (Idemitsu, 2020). All of the alternative options considered would adopt the same bord and pillar mining method.

4.7.3 Ecologically sustainable development

The Project's compatibility was reviewed against the objectives and principles defined in the *National Strategy for Ecologically Sustainable Development* (Ecologically Sustainable Development Steering Committee, 1992) (Table 4-2).

The goals of ecologically sustainable development are to develop and improve the quality of life, both now and in the future, in a manner that maintains the integrity of ecological processes on which life depends.

Table 4-2 Integration of ESD principles into the Project development

| Guiding principles of ESD | Integration into Project development |
|--|--|
| Core objectives | |
| <p><i>To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations</i></p> | <p>The Project will provide significant social and economic benefits to the broader community in terms of economic stimulus from export revenues and royalties, increased employment opportunities and opportunities for suppliers as detailed in Chapter 22 (Economics). Outcomes for the “do nothing” and “greenfields development” scenarios would not assist in the enhancement of individual and community well-being and welfare through economic development that safeguards the welfare of future generations.</p> |
| <p><i>To provide for equity within and between generations (the Intergenerational Equity Principle)</i></p> | <p>Through appropriate management strategies and monitoring of the impacts, the Project will not significantly reduce, or fail to maintain the health, diversity and productivity of the Queensland environment or affect future generations.</p> <p>Disturbed land associated with the Project will be progressively rehabilitated as detailed in Chapter 9 (Rehabilitation and closure).</p> <p>The brownfields nature of the Project provides opportunities for the Project to minimise impacts. This will include making use of existing infrastructure within previously disturbed areas at Ensham Mine, thereby avoiding the requirement for clearing of vegetation.</p> <p>Water management practices currently employed at Ensham Mine will ensure that the downstream water quality is not adversely affected by the Project. Measures to protect water quality are detailed in Chapter 10 (Surface water resources).</p> <p>Project emissions will be minimised or mitigated to have no significant long term adverse effect on the surrounding environment.</p> |
| <p><i>To protect biological diversity and maintain essential ecological processes and life-support systems</i></p> | <p>The terrestrial and aquatic ecology values in the vicinity of the Project are described in Chapter 13 (Terrestrial ecology) and Chapter 14 (Aquatic ecology) respectively. These chapters also provide an assessment of the impacts along with mitigation measures throughout the life of the Project.</p> <p>As very limited surface disturbance is expected as a result of the Project, including surface subsidence, potential impacts to terrestrial and aquatic ecosystems from the Project are very limited.</p> |

| Guiding principles of ESD | Integration into Project development |
|--|--|
| <p>Guiding ESD principles</p> <p><i>Decision-making processes should effectively integrate both long and short term economic, environmental, social and equity considerations</i></p> | <p>The Project will provide immediate and long-term benefits to the economic and social fabric of Queensland and in particular the Central Highlands region. The Project will contribute to the national, state and local economies as detailed in Chapter 22 (Economics).</p> |
| <p><i>Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation (the Precautionary Principle)</i></p> | <p>Ensham JV has undertaken an assessment of the risk of serious or irreversible environmental damage consistent with the Precautionary Principle and used the findings to determine appropriate environmental control strategies. The assessment identified that there are no serious or irreversible environmental damage for the Project. Full details of the risk assessment are detailed in this environmental impact statement (EIS) (Chapter 26 (Commitments)). The Project has the technical and financial support and resources to establish and maintain these environmental protection controls.</p> |
| <p><i>The global dimension of environmental impacts of actions and policies should be recognised and considered</i></p> | <p>Ensham JV is aware of their corporate responsibilities in relation to the Project. The Ensham JV participates in the Australian Greenhouse Challenge program, a federal government initiative to encourage reductions in greenhouse gas emissions.</p> <p>The Project will generate greenhouse gas emissions from site operations, product transport and product use. As outlined in Chapter 16 (Greenhouse gas), Ensham JV has recognised and considered these aspects and proposes a range of mitigation measures for site level emissions.</p> |
| <p><i>The need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised</i></p> | <p>The Project will add value to international, Australian and Queensland economies. There will be indirect flow on effects to other areas of the Queensland economy as a result of the Project. Ensham Mine will continue to make use of local suppliers and contractors during the Project as detailed in Chapter 21 (Social).</p> |
| <p><i>The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised</i></p> | <p>Ensham Mine currently performs consistently in the top ten board and pillar operations globally. The Project will continue Australia's international competitiveness. Ensham JV has used the Project's proximity to the existing Ensham Mine to minimise environmental impacts and will be subject to an EA and contemporary management plans ensuring that all environmental impacts are managed appropriately.</p> |
| <p><i>Cost-effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentives mechanisms</i></p> | <p>The Project is consistent with the relevant local, State and Commonwealth government policies.</p> |

Guiding principles of ESD
Integration into Project development

Decisions and actions should provide for broad community involvement on issues which affect them

Ensham JV has undertaken community consultation prior to preparing the EIS, which is detailed in **Chapter 2** (Consultation process) and **Chapter 21** (Social) and will continue the progress through the Project's life. Ensham JV will continue to work with and maintain open communication with the community and stakeholders on all aspects of Ensham Mine. Ensham JV will continue to have meetings with local councils and continue briefings with community groups and stakeholders.

Specific ESD objectives for the mining sector

To ensure mine sites are rehabilitated to sound environmental and safety standards and to a level at least consistent with the condition of surrounding land

Ensham JV has prepared a Rehabilitation Management Plan for the Project (see **Chapter 9** (Rehabilitation and closure)) in which the land disturbed by the Project is to be progressively rehabilitated to a safe and stable landform that does not cause environmental harm and is able to sustain an approved post-mining land use.

To provide appropriate community returns for using mineral resources and achieve better environmental protection and management in the mining sector

This Project will produce coal for domestic and international consumption. Increased demand for coal products in south-east Asia and other international markets has created a window of opportunity for the extension of Ensham Mine. For the foreseeable future, coal exports from the Project will provide significant revenues to Commonwealth, State and local Governments.

The Project will be developed to minimise resource waste and sterilisation. The mine sequencing will be designed to maximise resource extraction.

Ensham JV has undertaken a comprehensive EIS process to identify the opportunities to improve environmental protection and management for the Project. This EIS documents the detailed assessments that have been undertaken. In addition, the summary of commitments (**Chapter 26** (Commitments)) outlines the proposed environmental management strategies for the Project. The Project has the technical and financial support to establish and maintain these environmental management controls.

To improve community consultation and information, improve performance in occupational health and safety and achieve social equity objectives

Ensham JV has undertaken community consultation prior to preparing the EIS. The details of which, are presented in **Chapter 2** (Consultation process) and have been incorporated into the assessment of social impacts as defined in **Chapter 21** (Social). Ensham JV has undertaken a review of the risks to occupational health and safety posed by the Project and proposes appropriate management measures as detailed in **Chapter 19** (Hazards and safety).