8.0 Land resources

8.1 Introduction

This chapter describes the existing geology, topography, soils and land contamination of the Ensham Life of Mine Extension Project (the proposed project, hereafter referred to as 'the Project'), and considers the potential impacts to these environmental values. The main topics addressed include the characterisation of the land and soils within the Project Site, identification of environmental values related to land resources, assessment of impacts to these values and the presentation of mitigation measures to minimise potential impacts as a result of the Project.

The chapter is informed by a number of technical studies undertaken for the Project. A preliminary soils and land suitability assessment has been completed and is presented in **Appendix B-1** (Land resources).A detailed subsidence assessment undertaken for the Project is presented in **Appendix B-2** (Subsidence). The supporting studies in **Appendix B-1** (Land resources) and **Appendix B-2** (Subsidence) have been prepared based on an earlier Project definition. The Project definition presented in this chapter supersedes that definition and does not require any additional changes to the land resources and subsidence studies.

Environmental objectives and outcomes

The Project seeks to protect environmental values relating to land which are established under the Environmental Protection Regulation 2019 (EP Regulation), including soils, subsoils and landform. A subsidence assessment for the Project has confirmed the long-term stability of the proposed mine layout. Due to the bord and pillar mining method, minimal waste material is expected to be generated from the Project. Given the nature and scale of the Project, impacts to land resources are not considered to be significant, however, on a precautionary basis have been assessed as a critical matter in the environmental impact statement (EIS).

The existing Ensham Mine currently manages impacts to land in accordance with Environmental Authority (EA) conditions in Schedules G and H of EA EPML00732813. Existing management measures at Ensham Mine include maintaining factors of safety (FoS) in the mine's design (G2), establishing plans and procedures for managing rehabilitation (H3-H6) and mine waste (G4), and ensuring all potentially contaminating substances are stored and handled in accordance with Australian Standards (G5). These measures are proposed to be extended for the Project to protect land resource environmental values in the Project Site.

8.2 Legislation and policy

8.2.1 *Environmental Protection Act 1994*

The primary environmental legislative requirements for the management of soils and contaminated land in Queensland are contained within the *Environmental Protection Act 1994* (Qld) (EP Act) and subsidiary regulations.

The EP Act is administered and enforced by the Department of Environment and Science (DES). The objective of the EP Act is to protect Queensland's environment while allowing for development that improves the total

quality of life, both now and in the future, in a way that maintains ecological processes (DES, 2019b). The EP Act sets out requirements to identify and protect multiple components of the environment which subsequently controls the activities of businesses and individuals. The EP Act also includes a general duty of care for all to avoid harm to the environment.

A list of 'notifiable activities' are specified under Schedule 3 of the EP Act, which can include, but are not limited to:

- mineral processing
- aerial spraying
- landfills or waste storage
- chemical manufacturing or formulation
- chemical storage
- hazardous contaminant
- petroleum product or oil storage.

Land parcels (where notifiable activities are currently or have been historically undertaken) may be listed on the DES Environmental Management Register (EMR). Land parcels that are proven to be causing serious environmental harm are also listed on the Contaminated Land Register (CLR). Inclusion on the EMR forms a trigger for planning permits, waste disposal requirements and other contamination provisions in Queensland. Notifiable activities may result in environmental harm, and all persons involved in the activities have a general environmental duty and the duty to notify under the EP Act.

The EP Regulation establish a range of tools and measures to protect Queensland's environment while allowing for development in Queensland.

The EP Regulation defines environmentally relevant activities (ERAs) as activities with the potential to impact negatively on the environment. The current environmental authority (EA) (EPML00732813, dated 3 September 2020) authorises the carrying out of ERAs at Ensham Mine, including 'Resource Activity, Schedule 2A, 13: Mining black coal'.

The current EA (Condition G1) requires that "contaminants must not be released to land in a manner which constitutes nuisance, material or serious environmental harm." In addressing Condition G4 of the current EA, the geochemical assessment for the Project forms part of the ongoing Mining Waste Management Plan for Ensham Mine. In particular, the assessment addresses the requirement to quantify potentially acid forming (PAF) rock from mining waste present", and to "review impacts of the PAF mining waste on the rehabilitation, and identification of environmental impacts and potential environmental impacts".

8.2.2 Regional Planning Interest Act 2014

The *Regional Planning Interest Act 2014* (Qld) (RPI Act) seeks to manage the impact of resource activities on areas that contribute or are likely to contribute to Queensland's economic, social or environmental prosperity.

The RPI Act identifies and protects areas of regional interest from prescribed resource or regulated activities through the protection of:

- priority living areas (PLAs) – living areas in regional communities
- priority agricultural areas (PAAs) – high-quality agricultural areas from dislocation
- strategic cropping areas (SCAs), formerly strategic cropping land (SCL)
- strategic environmental areas (SEAs) – regionally important environmental areas.

A regional interests development approval (RIDA) is required when a resource activity is proposed in an area of regional interest.

The SCA is an area of regional interest under the RPI Act and consists of the areas shown on the SCL trigger map. SCA is defined in the RPI Act as land that is highly suitable for cropping, or likely to be highly suitable for cropping, based on a particular combination of soil, climate and landscape features. A review of the SCL trigger map identified that the Project Site encroaches SCA as shown in **Figure 7-6** in **Chapter 7** (Land use and tenure). This area is identified as the SCA assessment area.

As the Project Site is located on land mapped as a SCA, an assessment of the Project in accordance with RPI Act Statutory Guideline 01/14 (Queensland Government, 2014) was undertaken and a RIDA application will be prepared. Approval requirements regarding works within the regional interest are discussed in **Chapter 7** (Land use and tenure).

8.2.3 Soil Conservation Act 1986

The *Soil Conservation Act 1986* (Qld) (SC Act) regulates the conservation of soil resources in Queensland. The SC Act provides for the implementation of soil conservation measures by landholders to mitigate the loss of soil through erosion. Under the SC Act, soil conservation works require the preparation and approval of either a property plan or a project plan setting out the means of constructing and maintaining soil conservation measures. There will be a need for minor disturbance associated with exploration activities in the Project Site. There will be a need for minor temporary surface disturbance associated with exploration activities in Project zones 1, 2 and 3 (i.e.: drilling and 3D seismic surveys). Exploration activities for Zone 1 are covered under Environmental Authority MIN 104395712. Exploration activities in Zones 2 and 3 are covered under the current environmental authority EAML 00732813. All disturbance associated with exploration activities will be rehabilitated in accordance with the above environmental authorities.

In accordance with existing practice at Ensham Mine, gas drainage will be conducted to allow incidental mine gas to be managed to ensure a safe working environment. Gas from this gas collection system will be designed to exit the underground in Zone 2 and Zone 3 and will be flared. 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). Flaring in Zone 2 will be located outside of mapped SCA/PAA and in locations which are already disturbed from mining activities. Flaring in Zone 3, which is largely mapped as PAA/SCA, would occur on land which is also disturbed from mining activities. Establishment of flaring infrastructure would be located so as to not involve any vegetation clearing in either Zone 2 or Zone 3. A map showing the locations of the proposed flaring stacks and associated infrastructure are shown in **Figure 4-3** in **Chapter 4** (Project description).

As the Project does not involve any significant surface disturbance or infrastructure, no soil conservation works are proposed.

8.2.4 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The Environmental Protection (Water and Wetland Biodiversity) Policy is administered and enforced by DES and aims to protect the quality of natural waterways or surface waters such as lakes, rivers wetlands, estuaries and the like, whilst supporting ecologically sustainable development within Queensland. The policy is progressively being developed to define the human and ecological uses of these surface waters and their respective physiochemical guidelines.

This is achieved through:

- identifying environmental values (EVs) for Queensland waters (aquatic ecosystem health, aquaculture and human consumption of aquatic foods, drinking water, agricultural uses, industrial uses, recreational uses and cultural and spiritual values)
- nominating water quality objectives (WQOs) and water quality guidelines to enhance or protect the environmental values.

EVs and WQOs are included in Schedule 1 of Environment Protection (Water and Wetland Biodiversity) Policy, which is based on the approach in the National Water Quality Management Strategy (NWQMS) (2000), Implementation Guidelines (1998) and further outlined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018).

8.2.5 National Environment Protection (Assessment of Contamination) Measure 1999

National Environment Protection Measures (NEPMs) are developed by the National Environment Protection Council to protect or manage particular factors of the environment.

The National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM) as amended 2013 provides a standardised national framework for the site contamination assessment process. The ASC NEPM also nominates health and ecological investigation and screening levels for a quantitative (Tier 1) assessment of the risk to human health and the environmental receptors under various exposure settings, depending on the intended site use.

8.3 Methodology

The following sections describe the methodology used for each identified potential impact related to land resources. References are made to the relevant EIS chapter or technical report where these impacts are further assessed elsewhere in this EIS.

8.3.1 Geochemistry

The Project mine waste assessment was based on previous geochemical assessments undertaken at Ensham Mine, incorporating 64 samples from URS (2003), 34 samples from URS (2015), and 92 samples from RGS (2019). The various assessments were completed to characterise the geochemistry of waste rock sourced from overburden, roof, floor, and interburden associated with the target Aries/Castor seams. As the Project will extend the ongoing extraction of the Aries /Castor coal seams, reference to previous geochemistry studies completed on roof, interburden, and floor rock material are considered representative for the Project.

Waste rock produced during the Project will be generated from the coal handling plant at an estimated volume of 18,000 m^3 per annum. Waste rock material will be placed into Pit C and Pit D. The estimated volume of waste material from the coal handling plant, over the life of the Project, is estimated at 225,000 $m^{3.}$ This volume represents approximately 0.6 per cent of total approved waste rock volumes (36 million m^3) currently approved for the rehabilitation of Pit C and Pit D.

Assessment of waste rock geochemistry included both static geochemical analysis (moisture content, leach testing, pH, electrical conductivity, chromium reducible sulfur, net acid producing potential [NAPP], and net acid generation [NAG]) and composite sample analysis (total metals, soluble metals, soluble chloride and sulfate, soluble ions and effective cation exchange). Results of geochemical assessments are summarised in **Section 8.4.1.2**.

8.3.2 Subsidence

The mining methodology for the Project is described in **Chapter 4** (Project description and alternatives). The Project will operate using the same bord and pillar mining method currently used on Mining Lease (ML) 7459 and ML 70365.

An assessment of the Project mining method has been undertaken to predict Project subsidence. This assessment of the stability of the Project mining operations has been undertaken in accordance with the industry accepted University of New South Wales Pillar Design Procedure to determine the design factor of safety (FoS) (Galvin, 1998). The long-term stability of the Project mining operations is assessed using the design FoS, pillar dimensions (width to height ratio) and the stability of the overburden. The assessment is based on a Project design FoS of 1.6 which complies with EA condition G2.

Compression analysis has been carried out for the maximum depth of cover above each panel pillar and bell out pillar. The maximum seam thickness has also been applied to provide the likely worst-case subsidence effects and, therefore, is a conservative scenario for the assessment of the impacts in the Project Site.

The assessment makes predictions of the Project subsidence effects by calculating and analysing:

- short and long-term pillar stability
- compression over the maximum depth of cover
- surface cracking
- sub-surface cracking.

The subsidence predictions have been verified to a high level of confidence based on visual and LiDAR survey information across the existing underground mined areas at Ensham Mine. The subsidence assessment also considers experiences from comparable bord and pillar operations in Queensland and New South Wales.

Subsidence monitoring information from the existing bord and pillar mining operations at Ensham Mine has been reviewed to allow calibration of the subsidence predictions for the Project. In addition to these survey data, published subsidence data available from comparable bord and pillar mining operations in Queensland and New South Wales has been reviewed.

The detailed mine subsidence assessment is presented in **Appendix B-2** (Subsidence).

8.3.3 Soil

8.3.3.1 Desktop soils assessment

A desktop soils assessment has been undertaken to identify existing environmental values within the Project Site. Available soils and land resources information were reviewed to develop preliminary soil mapping units (SMUs) and map their distribution across the Project Site.

A number of previous soils and land suitability assessments have been undertaken in the area. The following information sources have been reviewed as part of the desktop soils assessment for the Project:

- Burgess J.W. (2003) Land Resource Assessment of the Windeyers Hill Area Isaac-Connors and Mackenzie River Catchment, Central Queensland
- Gunn et al. (1967) Lands of Isaac Comet (1:500,000)
- Northcote et al. (1960-1968) Atlas of Australian Soils
- Hansen Consulting (2006) Terrain, Soils and Land Capability Assessment, Brisbane
- Queensland Government (1986) Emerald Land Assessment Project, Emerald

- Queensland Government (1995) Agricultural Land Evaluation Studies of the Nogoa, Comet and Dawson Rivers, Emerald.

A review of satellite imagery from Google Earth and Queensland Globe (2020) identified initial SMUs and boundaries were identified using this satellite imagery. The stability assessment of the Project coal pillars undertaken by Gordon Geotechniques (2020) (**Appendix B-2** (Subsidence)) has informed the level of surface disturbance in the Project Site.

8.3.3.2 Land suitability and agricultural land assessment

A land suitability assessment was conducted based on the RPI Act and Regional Planning Interests Regulation 2014 (RPI Regulation). The RPI Act and RPI Regulation identify and protect areas of Queensland that are of regional interest, including PLAs, SEAs, PAAs and SCA.

Agricultural Land Classes assessment interpreted land evaluation data were reviewed to indicate the location and extent of agricultural land in the Project Site that can be used for a wide range of land uses with minimal land degradation. Agricultural Land Classes assessment guidelines are described in **Appendix B-1** (Land resources).

8.3.4 Contaminated land

A desktop review of existing environmental values within the Project Site has been undertaken to assess potential sources of contamination which may be present within the Project Site. The desktop review was also undertaken to establish a preliminary understanding of the environmental setting, to assist with the conceptual understanding of any contaminated land aspects of Project.

A review of the following records was undertaken:

- regional geological and hydrogeological information available from Queensland Globe
- available historical and current aerial imagery available from QImagery
- historical certificates of title available from Citec Confirm
- discussions with landowners of select land parcels to determine the history for potential contamination
- EMR and CLR records for affected land parcels available from DES.

This information was used to form an understanding of areas of potential contamination in the vicinity of the Project. Existing operations and infrastructure associated with Ensham Mine's current operations have not been assessed as these already operate under Ensham Mine's existing EA.

8.4 Description of environmental values

8.4.1 Geology and geochemistry

8.4.1.1 Regional and Project geology

The Project Site is located in the central part of the Bowen Basin which is a sedimentary basin comprising Permian and Triassic age geology. The Bowen Basin is the largest productive coal basin in the country. In the Project Site, the coal deposits are the Aries and Castor Seams which are part of the Permian Rangal Coal Measures. The surface geology of the Project Site is dominated by the Nogoa River alluvium to the south and the Tertiary sediment to the south and north.

The stratigraphic sequence across the Project Site comprises unconsolidated Quaternary aged sediments unconformably overlying consolidated Permian and Triassic aged sequences. The Permian and Triassic strata

form regular layered fluvio-deltaic sedimentary sequences, while the Quaternary sediments are more complex and irregular.

Coal seams in the Bowen Basin exhibit great variations in rank and quality, from low to high-volatile bituminous coking coal in the east, to low-ash thermal coals in the south and west. The coal seams of economic importance are separated by four regressive depositional phases, which are generally filled with non-coal bearing marine sediments (Hutton, 2009).

The coal seams in the Project Site are classified as the relatively young Group IV coals, which includes the diverse, but widely distributed Rangal Coal Measures. Deposited under fluviatile, lacustrine, and paludal conditions, the Rangal Coal Measures are characteristically non-marine and low in sulfur in comparison to the predominately marine-influenced Group III coals.

The seams to be mined by the Project include the Aries and Castor seams, while the Pollux, Orion, Libra, and Virgo seams are relatively thin and considered uneconomic. The Project will extend existing underground mine workings in both a northern and western direction, to access economic deposits of the Aries and Castor seams.

8.4.1.2 Previous geochemical studies

URS (2006) completed a geochemical assessment of overburden materials from Ensham Mine's existing underground mining operations. The study comprised a total of 64 samples, of which 49 were overburden samples (sandstone, siltstone, and mudstone) and 17 were coal reject samples[1] (five coal samples from the Aries seam, and 12 roof and floor samples).

Overall, the study indicated that the overburden and waste rock materials were alkaline, of low to moderate salinity, had a relatively high cation exchange capacity and were moderately to highly sodic. Most of the materials (88 per cent) had a total sulfur content of less than or equal to 0.1 per cent sulfur and were considered to be non-acid forming (NAF). In addition, there was sufficient acid neutralising capacity to buffer any dissolved acidity produced.

URS (2015) completed a second geochemical assessment of overburden and potential waste rock materials from the roof, interburden, and floor of the Aries and Castor seams that involved testing of 34 samples, consisting of 19 overburden samples and 15 potential waste rock samples from the Ensham Mine site. This assessment found that overburden and potential waste rock samples contained low sulfide-sulfur (S) concentrations of less than 0.05 per cent S with up to two orders of magnitude more acid buffering capacity compared to the rocks with potential acid generating capacity. Overall, 97 per cent (33) of the samples were classified as NAF or acid consuming (AC). The assessment concluded that all mine waste (including overburden and potential waste rock) samples have minimal risk of acid generation and a very high factor of safety in terms of its potential to prevent/minimise the generation of acid.

Total metal and metalloid concentrations from overburden and waste rock were not found to be enriched compared with mean upper continental crust abundances. Where detected, metal concentrations in overburden and waste rock were below the ASC NEPM Health Investigation Level (HIL) guideline values for parklands and recreational open space, considered applicable based on final land-use.

Assessment of drainage water quality was undertaken via leach testing on the overburden and waste rock with a 1:5 deionised water method and kinetic leach testing method (over approximately 4 weeks) (URS (2015)). The results found 88 per cent of total sulfur concentrations were less than 0.1 per cent, with an average of 0.07 per cent sulfur. Average net acid production potential (NAPP) was approximately 42 kg H_2SO_4/t with the

[1] The URS (2016) report was completed prior to the current coal handling plant trial. The operating coal handling plant does not use a process that generates coal rejects other than waste rock.

results indicating all analysed overburden samples being NAF. Analysed $pH_{1:5}$ for overburden and waste rock ranged from 6.8 to 9.6 with 89 per cent being above pH 8.5 and 59 per cent being above pH 9.0.

Electrical conductivity ($EC_{1:5}$) from waste rock ranged from 224 µS/cm to 1,040 µS/cm and were within the Australian livestock drinking water guidelines (ANZECC and ARMCANZ, 2000) and within the Ensham Mine EA Condition C4 (12,500 µS/cm).

Leachable dissolved metal and metalloid concentrations from overburden and waste rock samples, with the exception of one sample (from 22 samples analysed) for molybdenum, were below the Australian livestock drinking water guidelines (ANZECC and ARMCANZ, 2000). Soluble arsenic concentrations were detected in eight of 22 samples between 0.1 mg/L and 0.2 mg/L, slightly above the limit of reporting of 0.1 mg/L. Detected soluble arsenic concentrations were below the Australian livestock drinking water guidelines (ANZECC and ARMCANZ, 2000), but above the EA C5 condition (0.013 mg/L As)[2].

Leachable sulfate in overburden and waste rock ranged between 10 mg/L and 60 mg/L, which was below the Australian livestock drinking water guidelines (ANZECC and ARMCANZ, 2000) and compliant with the EA W5 condition.

URS (2015) concluded that runoff and seepage water derived from overburden and waste rock materials are not considered likely to:

- Generate acid
- Generate readily mobilised metals
- Generate sulfate.

RGS (2019) conducted characterisation studies of 92 fresh samples of Quaternary, Tertiary, and Permian siltstone and sandstone overburden samples from two drill holes, and six bulk samples of overburden from in-pit spoil dumps. Overall, the study found that salinity was generally elevated in Quaternary sediments, but lower in Tertiary and Permian materials.

Half of the coal total sulfur assay results were less than 0.5 per cent sulfur, and 90 per cent were less than 1 per cent sulfur, indicating a relatively low total sulfur content for these samples. Within the 92 samples that were analysed, one coal sample underwent acid base accounting and this sample classified the material as non-acid forming (NAF) to uncertain.

The RGS study included a review of local groundwater quality utilising monitoring data over the 11-year time period 2006 to 2017. The study found that local groundwater conditions were neutral, saline and dominated by sodium chloride (NaCl) with no evidence of acid in groundwater. Shallow groundwater in Quaternary alluvium contained higher electrical conductivity (up to 30,000 µS/cm) and dissolved sodium (up to 7,500 mg/L) compared to Permian aged overburden rock units with lower electrical conductivity (12,000 µS/cm) and dissolved sodium (2,000 mg/L).

Overall, the RGS study found that runoff and seepage water generated from waste rock areas was pH neutral with low concentrations of dissolved metals and metalloids and salinity that are within current EA limits.

[2] It is noted that discharge from the voids (for compliance with Condition W5) would only occur as a result of high rainfall ingress to the voids, which would result in diluation.

8.4.2 Soils

8.4.2.1 Soils and land suitability

The desktop soils and suitability assessment found seven soil types, classified by the Australian Soil Classification (Isbell, 2002):

- 1 – Leptic Rudosol
- 2.3 – Acid Brown Clastic- Leptic Rudosol
- 3.2 – Acidic Mesotrophic Red Kandosol
- 5.1 – Sodic Pedaric Brown Dermosol
- 5.2 – Sodic Pedaric Brown Dermosol
- 5.3 – Sodic Pedaric Brown Dermosol
- 6.2 – Endohypersodic, Epipedal Black, Grey or Brown Vertosol.

The Project Site includes areas of gently undulating plains with clay loam to gravel clays, brown-yellow clays, reddish brown to dark brown clays on undulating plains, hill slopes with sandy loams to sandy and light clay soils to shallow rocky soils on escarpment slopes.

The Project is located in an area dominated by Vertosols and Dermosols often associated with gently undulating plans typical of the region. The majority of the Project Site south of the Nogoa River is mapped as Endohydpersodic, Epipedal Black, Grey or Brown Vertosols. Rudosols and Kandosols are present north of the Nogoa River where the terrain is more undulating.

The distribution of soil types across the Project Site is illustrated in **Figure 8-1**. Detailed descriptions of the main soils types identified in the desktop study for the Project are provided in **Appendix B-1** (Land resources).

8.4.2.2 Agricultural land audit

The land suitability and agricultural land assessment in Hansen Report (2006) found the primary agricultural land class associated with soils in the area was Class C (pasture land). Class B (limited crop land) and Class D (non-agricultural land). A topsoil stripping depth assessment found the topsoil suitable for rainfed (dryland) cropping, grazing of natural and improved pastures, irrigated agricultural and agricultural land class. Overall suitability ratings of each soil type are outlined in **Appendix B-1** (Land resources).

8.4.2.3 Strategic cropping area

The Project Site is located in areas of regional interest mapped as SCA and PAA.

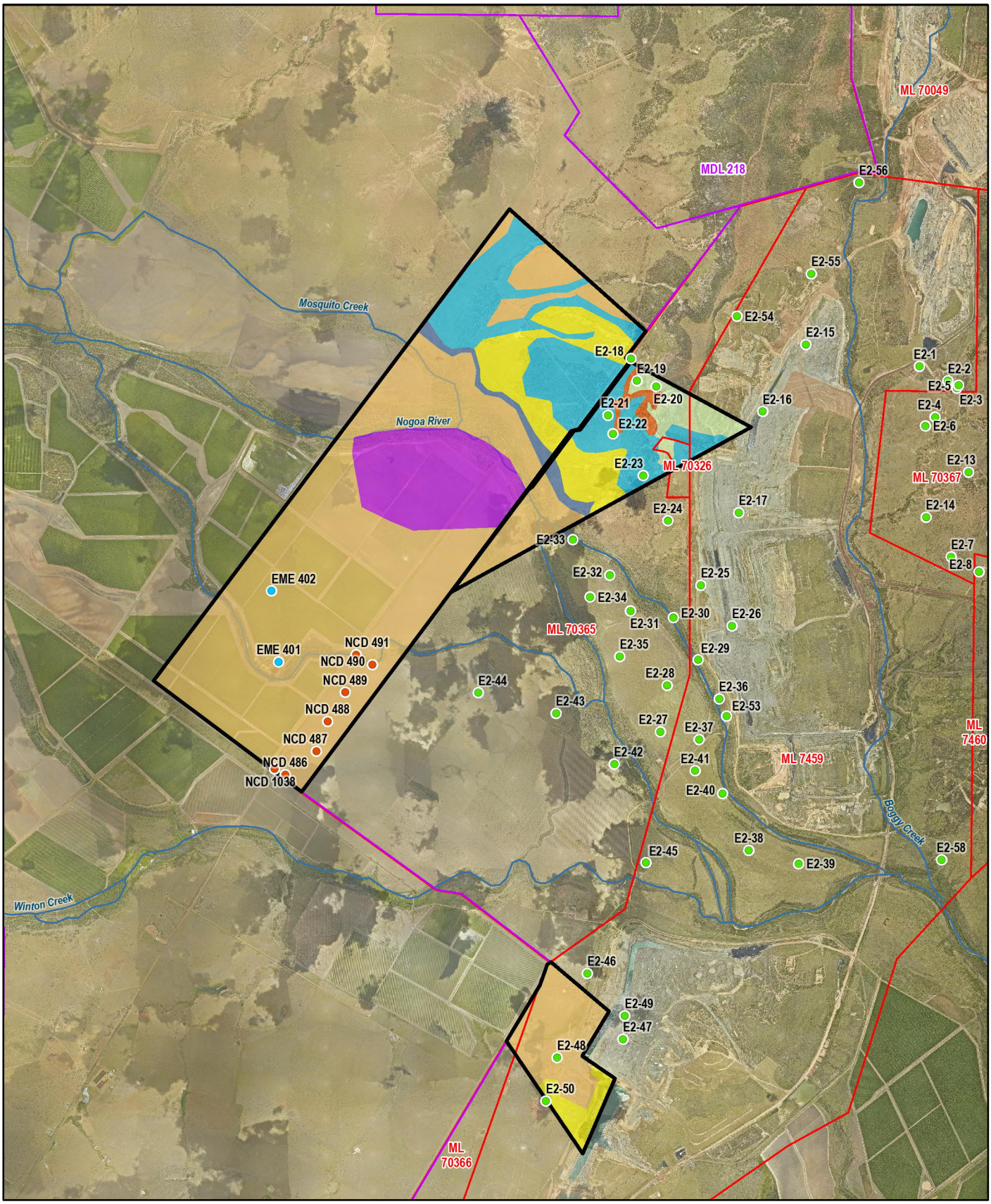


Figure 8-1
Soil mapping units

Ensham RESOURCES

0 1 2 km

ENSHAM LIFE OF MINE EXTENSION PROJECT

Legend

- Project Area
- Mineral development licence
- Mining leases
- Soil survey site (Hansen Consulting, 2006)
- Soil survey site (Queensland Government, 1995)
- Soil survey site (Queensland Government, 1986)

Soil mapping units

- 1 - Leptic Rudosol
- 2.3 - Acidic Brown Clastic-Leptic Rudosol
- 3.2 - Acidic Mesotrophic Red Kandosol
- 5.1 - Sodic Pedaric Brown Dermosol
- 5.2 - Sodic Pedaric Brown Dermosol
- 5.3 - Sodic Pedaric Brown Dermosol
- 6.2 - Endohypersodic, Epipedal Black, Grey or Brown Vertosol

Projection: GDA 1994 MGA Zone 55 Scale: 1:75,000
Source: State of Queensland, 2019. AECOM, 2020. Indemitsu RFI 2019 Imagery. Indemitsu, 2019

8.4.3 Contamination

A review of current and historical ownership of land parcels within the Project Site was undertaken to assess whether ownership records may indicate the potential for contaminating activities or land uses to have been present. A summary of current tenure is included in **Table 8-1**.

Table 8-1 Current tenure of land parcels within the Project Site

Lot on plan description	Current land owner	Tenure type
Lot 6 TT309	Central Highlands Regional Council (CHRC) (Reserve)	Reserve Lands Lease
Lot 7 TT309	CHRC (Reserve)	Reserve Lands Lease Easement
Lot 8 TT345	Cowal Agriculture Holdings Pty Ltd	Freehold
Lot 2 CP911010	Privately Owned	Freehold
Lot A AP7202	CHRC (Reserve)	Reserve Easement
Lot 32 RP908643	Idemitsu Australia Resources Pty Ltd, Bligh Coal Limited and Bowen Investment (Australia) Pty Ltd	Freehold
Lot 30 CP864574	Idemitsu Australia Resources Pty Ltd, Bligh Coal Limited and Bowen Investment (Australia) Pty Ltd	Freehold
Lot 31 CP864573	Idemitsu Australia Resources Pty Ltd, Bligh Coal Limited and Bowen Investment (Australia) Pty Ltd	Freehold

The three existing land parcels currently subject to existing mining are owned as tenants in common by Idemitsu Australia Resources Pty Ltd and Bowen Investment (Australia) Pty Ltd. Lot 32 RP908643 is also under part ownership by Bligh Coal Limited. All three land parcels are freehold.

Of the land to be leased as part of the Project, current land title searches indicate that one land parcel and one easement to the north of the Nogoa River are freehold tenure. Land parcels to the south are owned by Cowal Agriculture Holdings Pty Ltd, a cropping conglomerate based in the Central Highlands region, with a small strip of land to the east leased from the CHRC to a private interest.

A search of historical title was undertaken for Lot 2 CP911010, which confirmed Deed of Grant (40070087) under indefeasible title was issued in 2015. DNRME surveyed the land on 28 July 1997, however the nature of land use at the time of survey (i.e. unallocated state land) was not confirmed.

A search of historical title was also undertaken for Lot 8 TT345, which confirmed that Cowal Agriculture Holdings Pty Ltd was nominated as the registered trustee in October 2013. Prior to this, registered trustees include Primeag Australia Limited (10 January 2008 to 25 October 2013) and Brayland Farming Pty Ltd (30 November 2004 to 10 January 2008). Deed of Grant (30595202) was issued 14 May 1990.

Historical tenure of other land parcels within the Project Site was not able to be searched given current ownership status as 'Reserve'. Land parcels already owned by the Ensham JV partners were not assessed further as historical tenure has been established in support of the existing EA.

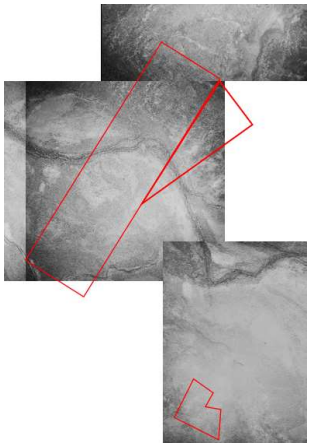
8.4.3.1 Historical aerial imagery

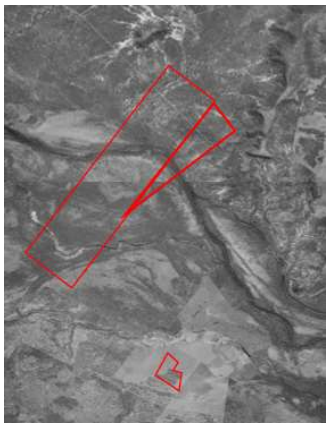
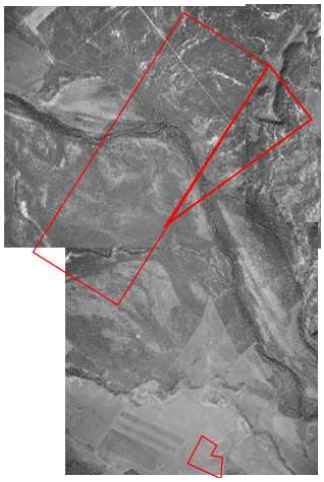
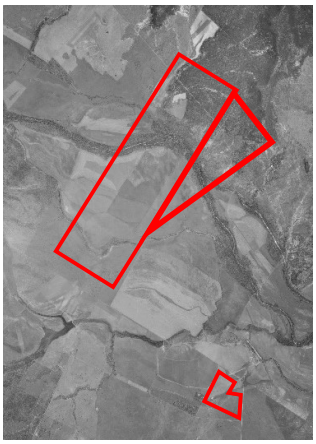
A review of historical aerial imagery was undertaken to identify the visual presence of past activities or land uses which may have the potential to cause land contamination. Aerial images sourced from DRNME include:

- 2002 – Capella 8551 Run 8 094-113, Frame 098; and 8551 Run 9 114-133, Frame 129
- 1994 – Emerald-Comet Area Water Resources Run 3 148-171, Frame 150; and Run 4 122-147, Frames 141-143; and Run 4 122-147, Frame 144
- 1984 – Denison Trough Project Run 2N 1839-1851, Frame 1848
- 1973 – Capella Run 10 Q2688, Frame 60; Q2688, Frame 63; and Run 11 Q2494, Frame 34
- 1966 – Cooroorah Run 3 Q1695, Frame 74; and Run 4 Q1695, Frame 66
- 1952 – Gordonstone Run OET, Frame 115; Run 2 Q351, Frame 142; and Run 3 Q351, Frame 121; and Run 3 Q351, Frame 123.

Historical imagery, along with an indicative outline of the Project Site, is presented in **Table 8-2**.

Table 8-2 Historical aerial imagery of the Project Site

Year	Land use description	Image
1952	**North and south: the Project Site has not been developed. Minor areas of clearing are visible, it is not known whether these are anthropogenic or naturally occurring.**	

Year	Land use description	Image
1966	**North: an easement has been cleared running north-west to south-east in the northern portion of the Project Site.** **South: no discernible change.**	
1973	North: further development of easements in the northern portion of the Project Site. South: no discernible change to the south of the Nogoa River. The area to the south has been cleared. Cropping in the general area has increased.	
1984	North: an area has been cleared north of the Nogoa River but south of the easement, with a possible areas of land disturbance in the northern third of the cleared area. South: the area south of Nogoa River has been cleared and subdivided for agriculture. Windrows and uniform, paddocked vegetation indicate a likely cropping land use. The area in the south has been partially revegetated.	

Year	Land use description	Image
1994	North: a second area of clearing and land disturbance is visible just north of the Nogoa River. The nature of the disturbance cannot be discerned. The initial area of clearing still remains to the south of the easement. South: land to the south of the Nogoa River system is generally under an intensive agricultural use (cropping). The area is divided into working paddocks with evidence of tillage. A dam has been constructed to the west of the Project Site.	
2002	North: previously identified areas of disturbance are now grassed and do not appear to be actively disturbed. The area is sparsely vegetated with riparian vegetation along drainage lines, indicating that some broadscale clearing had previously occurred. Mining activities are present in the existing Ensham Mine footprint. South: no discernible change to the south of the Nogoa River. The area to the south is now adjacent to intensive cropping land.	

8.4.3.2 EMR/CLR records

A search of the EMR/CLR was undertaken on land parcels within the Project Site to confirm whether any land parcels have been listed for known notifiable activities under the EP Act. The EMR/CLR records are summarised in **Table 8-3**.

Table 8-3 Current EMR/CLR listings within the Project Site

Lot on plan description	EMR/CLR listing?	Recorded notifiable activity and definition as per EP Act 1994
Lot 6 TT309	No	None
Lot 7 TT309	No	None
Lot 8 TT345	No	None

Lot on plan description	EMR/CLR listing?	Recorded notifiable activity and definition as per EP Act 1994
Lot 2 CP911010	Yes	*Waste storage, treatment or disposal* - storing, treating, reprocessing or disposing of regulated waste (other than at the place it is generated), including operating a nightsoil disposal site or sewage treatment plant where the site or plant has a design capacity that is more than the equivalent of 50,000 persons having sludge drying beds or on-site disposal facilities.
Lot A AP7202	Not searched*	Not searched*
Lot 32 RP908643	Yes	• *Petroleum product or oil storage* - storing petroleum products or oil: (a) in underground tanks with more than 200L capacity; or (b) in above ground tanks with - (i) for petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code - more than 2, 500L capacity; or (ii) for petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code - more than 5, 000L capacity; or (iii) for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia - more than 25, 000L capacity. *Mine Wastes* – (a) storing hazardous mine or exploration wastes, including, for example, tailings dams, overburden or waste rock dumps containing hazardous contaminants; or (b) exploring for, or mining or processing, minerals in a way that exposes faces, or releases groundwater, containing hazardous contaminants.
Lot 30 CP864574	Yes	None
Lot 31 CP864573	Yes	*Landfill* - disposing of waste (excluding inert construction and demolition waste). *Mine Wastes* – (a) storing hazardous mine or exploration wastes, including, for example, tailings dams, overburden or waste rock dumps containing hazardous contaminants; or (b) exploring for, or mining or processing, minerals in a way that exposes faces, or releases groundwater, containing hazardous contaminants.

*Lot A AP7202 was unable to be searched as road reserves and easements are not included on the EMR/CLR database.

The nature and location of waste disposal at Lot 2 CP911010, Lot 32 RP908643 and Lot 31 CP864573 is not specified on the EMR records. Similarly, further detail regarding fuel storage on Lot 32 RP908643 has not been provided on the EMR listings.

8.4.3.3 Anecdotal evidence

Additional information was sought regarding historical activities which may have had the potential to generate contamination.

Project Site

Anecdotal evidence suggests that the only potential contamination on the land related to tyres placed in a gully near Wyuna Road to manage ongoing erosion. These areas of disturbance were identified as a current dam and an area which had been cleared for fodder cropping.

Open-cut mining activities associated with Lot 30 CP864574, Lot 32 RP908643 and Lot 31 CP864573 are managed in accordance with the current EA and management procedures set out under Ensham Mine's Integrated Management System. Only portions of these land parcels fall within the Project Site (zones 2 and 3).

Petroleum storage on Lot 32 RP908643 is within the Project Site and is undergoing redevelopment as part of active mine activities, with upgraded facilities designed in accordance with Australian Standard AS1940, 'The storage and handling of flammable and combustible liquids' (AS1940) scheduled to be operational in 2020. Currently, diesel is stored in two above ground tanks for refuelling of light vehicles. Spills are captured by hardstand and are passed through a triple interceptor to a sump. Wastes are disposed of by a contractor as required. This facility is currently being decommissioned and new self-contained, above ground storage facilities will be commissioned in 2020 in areas outside the Project Site.

Post mined underground decommissioning will include underground infrastructure removal and validation of soils. Diesel fuels and engine oils (stored in dedicated flammable goods containers) are the only petroleum products stored by the Mine within the Project Site, and both are considered Class C3 under AS1940. There are no records of significant spills or product losses associated with hydrocarbon storage at this land parcel.

Outside Project Site

The history of cropping in the vicinity of the Project Site, including to the north and south of the Nogoa River may indicate long term application of pesticides to support productivity. Given the nature of cropping within the area is typically for the consumable crops such as grains, the application of pesticides is likely to be at concentrations not warranting widespread investigation. It is noted that there is the potential for runoff of pesticides to surface water receptors which over time may result in accumulation in sediments along riparian channels.

Aside from mining activities, other sources of potential contamination identified with these land parcels outside the Project Site may include waste management, refuelling activities, and, equipment/plant maintenance (including abrasive blasting). These activities occur on land parcels outside of the Project Site.

Portions of land parcels (Lot 31 CP864573, ASP277626 32 RP908643, 33 RP864576 and 30 RP864574) that fall within the Project Site intersect active mining pits. Active portions of Ensham Mine will be subject to the Notifiable Activity of 'Mine Waste' based on the presence of overburden stockpiles, waste waters and product coal. The origin of the listing for the Notifiable Activity of 'Landfill' of Lot 31 CP864573 relates to the disposal of used tyres (a regulated waste) in seven pits across this land parcel in locations outside the Project Site. No other wastes are disposed in this manner at Ensham Mine and this activity is in accordance with current EA conditions and management procedures set out under Ensham Mine's Integrated Management System.

8.4.3.4 Areas of potential contamination

Based on the information regarding the potential for land contamination within the Project Site, the following areas of potential concern have been identified.

Lot 2 CP911010 – EMR listing for waste storage, treatment or disposal

Existing operations are within Lot 2 CP911010 and may account for the land parcel holding a listing on the EMR for 'waste storage, treatment or disposal'. The exact nature of the contaminating activity at this location could not be ascertained from the EMR/CLR or from anecdotal evidence. This land is associated with the Chelbrook homestead and the Project Site covers a portion of the land parcel.

Lot 32 RP908643 – EMR listing for mine waste and petroleum product or oil storage

Operational mine activities on this land parcel have necessitated an EMR listing. Existing activities are managed under the existing EA and are not subject to change or modification by the Project. Similarly, above ground hydrocarbon sources on this land parcel (and currently within the Project Site) are considered a low risk of significant contamination generation which may be subject to groundwater drawdown. As such, these will not be considered further in this assessment.

Lot 31 CP864573 – EMR listing for landfill and mine waste

Operational mine activities on this land parcel have necessitated an EMR listing. Existing activities are managed under the existing EA and are not subject to change or modification by the Project. As such, these will not be considered further in this assessment. It is noted that inert waste disposal (tyres) is a managed and monitored disposal process and is unlikely to generate groundwater contamination which may be subject to groundwater drawdown.

It has been assumed the storage of pesticides, fuels and other chemicals used as part of agricultural practice has been in accordance with standard hazardous materials storage procedures.

Uncontrolled filling and/or farm dumps

The potential for farm dumps has been identified across the Project Site, particularly north of the Nogoa River. Farm dumps may consist of small volumes (typically less than 20 cubic metres) of locally sourced wastes such as building materials, empty feed or chemical drums or household items, often deposited into gullies, sinkholes or excavated trenches.

8.5 Potential impacts

8.5.1 Geochemical

The Project will involve a continuation of mining in the Aries/Castor coal seams using the existing bord and pillar form of underground mining.

Geochemistry data from historical studies summarised in Section 8.4.1 has identified waste rock from the mine as being NAF with a limited acid generation potential and a very high factor of safety associated with buffering capacity within the rock. Waste rock material has not been identified as having an acid generating risk in excess of inherent buffering capacity.

Waste rock has been identified as having low to moderate salinity, moderate to high pH and a high cation exchange capacity, suggesting material is likely to be dispersive and not suitable as a final cover. Total metal concentrations were not found to be enriched within overburden and waste rock when compared with mean upper mantle

Assessment of potential drainage water quality via leachate testing with 1:5 deionised were identified as NAF with 88 per cent of total sulfur concentrations being less than 0.1 S and an average NAPP of 42 kg H_2SO_4/t. Potential drainage water was found to be alkaline and of low salinity. Electrical conductivity did not exceed the Australian livestock drinking water guidelines (ANZECC and ARMCANZ, 2000) or EA Condition W4 (10,000µS/cm).

Leachable dissolved metal concentrations in overburden and waste rock samples bar one molybdenum sample (from 22) were below the Australian livestock drinking water guidelines (ANZECC and ARMCANZ, 2000). Soluble arsenic concentrations were detected in eight of 22 overburden and waste slightly above the limit of reporting of 0.1 mg/L.

Overall, geochemical studies have found that overburden and waste rock are not acid generating, have a high degree of buffering capacity, are not enriched in metals, are not likely to generate high levels of salinity or metals in runoff above applicable guidelines and existing EA conditions.

8.5.1.1 Waste management and rehabilitation of waste rock in mined voids

Waste rock produced by the Project will be generated from the coal handling plant at around 18,000 m^3 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 m^3 in total which is approximately 0.6 per cent of total approved waste rock volumes (36 million m^3) 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 in Appendix 3 of the EA.

The Project underground workings will be dewatered during mining. The quality of the water pumped from the existing underground mine is associated with groundwater that is known to be saline. Groundwater in the coal seams is saline (refer to **Chapter 12** (Groundwater)), there has not been any observation or measurement of acidity in the groundwater or in water that is pumped from the underground workings to the surface water management network. No changes are anticipated to the quality of the water being pumped from underground workings although the volume of water may increase.

Post closure, flooding of the underground workings by natural groundwater rebound or using surface water storages to increase the rate of void flooding at mine closure will replace the currently oxidising conditions in the water present in the underground workings with an anoxic/reducing environment. The Underground Water Impact Report (SLR, 2020) found the final water quality in the flooded underground workings is likely to be the same as the groundwater around the coal seams.

More detailed information on the potential impacts to groundwater are presented in **Chapter 12** (Groundwater).

8.5.2 Subsidence

The detailed mine subsidence assessment undertaken for the Project (**Appendix B-2** (Subsidence)) reviewed the bord and pillar design to understand the potential maximum subsidence expected across the Project Site. This assessment, using a design FoS of 1.6, has confirmed the long-term stability of the proposed mine layout.

8.5.2.1 Subsidence predictions

Due to the nature of the bord and pillar mining method with large barrier pillars between panels, the mine design, and depth of cover, subsidence (if it occurs) is predicted to be typically less than 40 millimetres (mm)

in the Project Site. This is a result of elastic compression of the pillars, based on the additional load on the pillars after the coal is extracted. As the assessment predicts low levels of subsidence and associated strains and tilts, no surface cracking is anticipated within the Project Site (nor has it been recognised at the current underground workings which employs the same mining method). Similarly, significant depressions in the surface topography, where ponding of the surface drainage may occur, are unlikely to occur due to the low levels of subsidence predicted (refer to memo from Gordon Geotechniques (2021)). This is consistent with experience at the existing Ensham Mine operations where no surface cracking or ponding has been observed above the mined out areas.

In relation to bord and pillar mining, guidance published by Department of Agriculture, Water and the Environment (DAWE) states (IESC, 2015):

"Where the pillars have been designed to be stable, the vertical subsidence is typically less than 20 mm. Natural or seasonal variations in the surface levels, due to the wetting and drying of soils, are approximately 20 mm; hence, vertical subsidence of less than 20 mm can be considered to be no more than the variations that occur from natural processes and should have negligible impact on surface infrastructure."

IESC (2015) detailed in their report, that in some environments, up to 50 mm of vertical movement may occur due to seasonal moisture variation.

This is consistent with Ensham's approach of developing stable pillars that result in negligible subsidence. Whilst the Commonwealth guidance discusses seasonal variation of 20 mm having a negligible effect on surface infrastructure, the guidance also states that seasonal variation can be as high as 50 mm due to changes in moisture content.

Ensham produced survey data in March 2016 and February 2017 to assess potential surface effects above existing mined out areas at Ensham. This data for the existing underground operations at Ensham Mine shows that any ground movement is within the 50 mm accuracy of the surveys. Surface effects observed in the Ensham survey data may indicate natural ground movements, as well as potential subsidence effects.

8.5.2.2 Subsidence impact assessment

Based on the results of the subsidence analysis, the assessment of environmental values within the Project Site has concluded that impacts as a result of the Project are unlikely.

Two homesteads are located within the Project Site (Braylands Homestead and Chelbrook Homestead) on freehold land. As all works are below the surface of the ground, and subsidence is not predicted to be material within the confines of seasonal variation in surface levels, impacts to homesteads will be negligible.

There is no public infrastructure within the Project Site. Therefore, there will be no subsidence-related impacts to public infrastructure within the Project Site.

8.5.3 Soil

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). Flaring in Zone 2 will be located outside of mapped SCA/PAA and in locations which are already disturbed from mining activities. Flaring in Zone 3, which is largely mapped as PAA/SCA, would occur on land which is also highly disturbed from mining activities. Establishment of flaring infrastructure would be located so as to not involve any vegetation clearing in either Zone 2 or Zone 3.

Subsidence as a result of the Project is predicted to be within the expected levels of natural ground swell variation, so it is unlikely that the formation of significant depressions in the surface topography of the Project

Site will occur. This has been confirmed through a review of LiDAR survey data and visual inspections above mined out underground workings at Ensham.

Therefore, it is unlikely that SCA or PAA will be impacted by the Project mining activities.

8.5.4 Contaminated land

8.5.4.1 Disturbance of potentially contaminated soil

The potential for land contamination has been identified across the Project Site. In areas of known contamination (such as pesticide storage), unknown or undefined activities (such as waste storage described in the EMR listing of Lot 2 CP911010) or other historical potentially contaminating activities (such as informal farm dumps). Contaminant releases are managed under EA - Schedule C. The Project does not require significant disturbance to shallow soils or to surface works and is unlikely to materially influence or disturb activities across the existing Ensham Mine.

In the case that any Notifiable Activities are positively identified during studies, it should be noted that according to the EP Act, landowners, or occupiers have a requirement to DES for notification of these activities for inclusion on the EMR.

8.5.4.2 Drawdown of potentially contaminated groundwater

Groundwater modelling prepared as part of this EIS has not identified any significant drawdown impacts to shallow aquifers or connectivity between aquifer systems. Groundwater drawdown of perched waters or leachate during mine operation is not considered a risk to the Project.

Groundwater modelling which reviewed long term effects of the mine following completion of mining indicates that groundwater in target coal seams show a lower water level in the area that underground mining was occurring. Modelled water levels are around 10 m lower than in the surrounds, which indicates a permanent reduction in long-term water levels, confirming that final voids associated with the open-cut mine and final closure landforms will continue to act as a groundwater ‘sink’.

8.5.4.3 Generation of additional areas of contamination

The Project is located underground and will make use of existing infrastructure on the approved MLs at Ensham Mine. Therefore, it is unlikely that activities within the Project Site have the potential to generate additional areas of surface contamination. Potential sources of contamination or activities which may have the potential to generate contamination within the Project Site include minor spills of fuels, greases and lubricating oils which may cause localised contamination during ad hoc refuelling and maintenance activities.

8.6 Mitigation measures

8.6.1 Geochemical

Geochemical studies completed for the Project have found impacts from waste rock are expected to have limited potential for acid, salinity or metals and metalloid generation in solids or runoff from approved waste rock areas in Pit C and Pit D. Runoff or seepage within the open-cut voids of Pit C and Pit D is expected to be within existing EA limits.

Waste rock generated from the CHP will be buried within the approved rehabilitation areas of Pit C and Pit D in accordance with the residual void plan. Monitoring of groundwater adjacent to the rehabilitated pits will be conducted as per the approved EA Conditions.

8.6.2 Subsidence

Consistent with current practice at Ensham Mine LiDAR data will continue to be collected across the existing workings and the Project footprint on an annual basis to monitor for subsidence.

Where surface levels assessed by LiDAR may indicate a difference as a result of mine activities, an investigation will be undertaken by Ensham. The investigation will include a visual inspection of these areas and, where warranted, an investigation report will be prepared. The report will be submitted to the Administering Authority as well as the land owner/land occupier.

The potential impacts on subsidence on other environmental values are discussed in the relevant chapters of this EIS.

8.6.3 Soil

Given there will be no material surface soil disturbance as a result of the Project, no mitigation measures are proposed.

8.6.4 Contaminated land

8.6.4.1 Disturbance of potentially contaminated soil

As the Project is an extension of the existing underground mine and activities will use existing surface infrastructure, the Project is unlikely to disturb any potentially contaminated land. Should any potential surface contamination be uncovered, it will be managed in accordance with existing EA conditions and practices at Ensham Mine. The handling and storage of potentially contaminating substances will be managed in accordance with the existing management plans:

- SOP.09.01.04 Using Hazardous Substances
- SOP.09.06.06 Servicing and Refuelling Equipment
- EIMP.05.00.02 Hydrocarbons.

8.6.4.2 Interception of potentially contaminated groundwater

Potential interception of any contaminated groundwater associated with waste storage on Lot 2 CP911010 (if present) from shallow aquifers is not considered a risk based on the Groundwater impact assessment (**Appendix F-1**).

8.6.4.3 Generation of additional areas of contamination

The continuation of standard operating procedures, work method statements and processes in line with the Ensham Mine Integrated Management System will provide guidance on managing activities that have the potential to generate land contamination. Further detail on the waste management process is presented in **Chapter 18** (Waste management).

8.7 Summary and conclusions

8.7.1 Geochemical

Geochemical assessment has indicated waste rock from the Aries /Castor coal seams is NAF and will generally produce non-acidic, alkaline, low salinity drainage. Metals and metalloid concentrations in waste rock are not anticipated to generate dissolved metals and metalloids in water runoff or final mine pits that will exceed EA

conditions. Groundwater modelling indicates final voids associated with the open-cut mine and final closure landforms will continue to act as a groundwater 'sink', in compliance with the existing EA Condition C56.

Waste rock generation from the coal handling plant will be approximately 225,000 m3 and represents 0.6 per cent of total waste rock volumes contained in Pit C and Pit D under the approved final landform conditions of Appendix 3 in the existing EA. Any waste rock produced at the CHP will be stored within the existing open-cut voids of Pit C and Pit D in accordance with Appendix 3 of the EA.

8.7.2 Subsidence

Compression analysis has been carried out for the maximum depth of cover above each panel pillar and bell out pillar. The maximum seam thickness has also been applied to provide the likely worst-case subsidence effects and therefore is a conservative scenario for the assessment of the impacts in the Project Site.

Based on this analysis, the predicted subsidence above the panel pillars following secondary coal recovery in the Project Site is typically less than 40 mm. This reduces to typically less than 20 mm above the bell out pillars where there is less load.

The nature of the mining method generating only elastic compression of the strata indicates that sub-surface cracking above the Project Site is not expected. Due to the predicted low levels of subsidence and associated strains and tilts, no surface cracking is predicted above the Project Site. The expected low levels of subsidence are unlikely to result in the formation of significant depressions in the surface topography where ponding of the surface drainage may occur.

Geotechnical assessment of the proposed bord and pillar mining method predicts subsidence to be typically less than 40 millimetres (mm) in the Project Site under normal conditions. This is less than an average anticipated 50 mm land surface elevation variation associated with seasonal temperature and ground moisture content variations. LiDAR data will be collected across the Project site on an annual basis to determine if there are any unexpected trends in surface levels that could potentially indicate subsidence issues.

Geotechnical assessment of potential subsidence and stability under extreme flood events is discussed in Chapter 11 (Flooding). No impacts were identified under the Nogoa River floodplain for a 0.1 per cent AEP (1 in 1,000 year) event with existing 1.6 factor of safety. To maintain the proposed 1.6 factor of safety under the Nogoa River channel during extreme flood conditions mining height will be reduced to 3.87 m as is standard practice in other areas of the Ensham bord and pillar mine (Refer to "Increase in Pillar Load During a Flood Event" memo (Gordon Geotechniques, 2021).

8.7.3 Soil

The desktop soils and land suitability assessment for the Project has identified seven SMUs in the Project Site. The Project Site includes areas of gently undulating plains with clay loam to gravel clays, brown-yellow clays, reddish brown to dark brown clays on undulating plains, hill slopes with sandy loams to sandy and light clay soils to shallow rocky soils on escarpment slopes.

The Project Site is located in areas of regional interest mapped as SCA and PAA. It is indicated that the expected low levels of subsidence are unlikely to result in the formation of significant depressions in the surface topography but LiDAR survey data will be checked annually to confirm this. Therefore, it is unlikely that areas mapped as SCA and PAA will be impacted by the Project.

8.7.4 Contaminated land

There is the potential for land contamination to be present within the Project Site. Contamination may be associated with known contaminating activities such as waste storage described in the EMR listing of Lot 2

CP911010, potential pesticide storage or potential contamination associated with activities listed in the Waste Management Plan. Contamination controls will continue to be managed under the Project operational procedures and processes and in accordance with EA and conditions pertinent to contamination as outlined in the EP Act.

In the event that contaminated land is identified within the Project Site, it will be managed in accordance with the ASC NEPM and Part 8 of the EP Act.