Section 3

Project Alternatives

WINCHESTER SOUTH PROJECT

Environmental Impact Statement

WHITEHAVEN COAL

Resource Strategies

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3 PROJECT ALTERNATIVES

This EIS presents and assesses Whitehaven WS's preferred design and staging for the Project.

As part of the development of the Project, Whitehaven WS carefully considered potential environmental, social and economic impacts as well as feedback provided by the local community, government agencies and other stakeholders (Section 1.6). Significant design constraints have been incorporated into the Project to address these considerations.

In accordance with the Terms of Reference for the Project, an analysis of feasible alternatives for the Project configuration (including conceptual, technological and locality) was undertaken by Whitehaven WS. A summary of this analysis, as well as consideration against the principles of ecologically sustainable development is provided in Sections 3.1 to 3.9.

3.1 PROJECT LOCATION

The State of Queensland has procedures for the allocation of tenements for coal, which determines where permits and mining development licences are granted.

The location for the Project is determined by the presence of coal seams that are amenable to be economically mined, and are within coal tenements held by Whitehaven WS.

The location of the Project is well placed within an existing mining precinct and in proximity to existing water, transport and energy infrastructure.

3.2 MINING OPERATIONS

The relative scale, rate and nature of a mining operation is determined by the optimum recovery of the resource and production rate that maximises value to the proponent and demonstrates ongoing viability in consideration of mine planning constraints.

Mine planning is a structured process that takes into account the range of key variables that may influence a potential mining operation and its viability. Aspects considered in the mine planning process include safety, resource recovery, risks to the operation, mining methods and rates, equipment requirements, infrastructure capacity, development timeframes and economics (i.e. capital and operating costs).

Key alternatives with respect to the proposed mining operations are provided below.

3.2.1 Extraction Method

Coal reserves are typically mined in one of two ways to maximise resource recovery within geological, environmental and tenement constraints:

- open cut methods (whereby mining is conducted from the surface downwards to progressively expose and extract the coal); or
- underground methods (whereby the coal seams are accessed by a surface opening to underground mining areas where coal is extracted).

The multiple, relatively shallow target coal seams across the Project area particularly lend themselves to recovery through open cut methods.

As such, Whitehaven WS considered underground methods to be unfeasible to access the coal reserves in the Rangal and Fort Cooper Coal Measures and therefore the Project would use open cut mining methods.

3.2.2 Open Cut Mining Method

Open cut mining operations typically employ truck and shovel or dragline methods. As part of initial pre-feasibility studies Whitehaven WS considered various types of excavation and haulage equipment currently used in open cut mines.

Whitehaven WS has chosen to use the truck and shovel method, using excavators to extract coal given:

- the versatility the equipment offers (able to excavate a variety of materials in various conditions);
- excavators are a globally accepted technology and their use is well-documented;

- space required for operation is reduced at any one time;
- can be sourced from local suppliers in the region; and
- low cost in comparison to other technologies.

The dragline method was considered unsuitable for the Project due to the geometry of the Project area (i.e. multi-seam with large interburdens and varying floor dips) and the lack of flexibility compared with the truck and shovel method.

3.2.3 Open Cut and Waste Rock Emplacement Extent

The open cut extent was initially developed during the Project initial concept stage based on the available resource definition information to determine the optimum extent of the open cut within Whitehaven WS' existing tenements.

The open cut extent was then refined to:

- avoid the Winchester Quarry; and
- avoid existing surface infrastructure (e.g. Norwich Park Branch Railway).

This refined open cut extent, which also avoided extraction within the Isaac River alluvium, was included in the Project IAS (Mine Layout Option 1) (Figure 3-1).

Based on the outcomes of the environmental studies prepared for the EIS, the open cut extent was further refined, minimising potential impacts to MSES and MNES (e.g. Ornamental Snake habitat and the *Brigalow (Acacia harpophylla dominant and co-dominant)* threatened ecological community) and potential impacts to agricultural land (Mine Layout Option 2).

The final open cut extent for the Project (Figure 2-1), has been designed to maximise economic extraction of the resource while minimising potential environmental, social and economic impacts.

In addition, the extent of the out-of-pit waste rock emplacements have been refined to minimise impacts. For example:

- the Project does not disturb any *Brigalow (Acacia harpophylla dominant and co-dominant)* threatened ecological community due to the north-eastern out-of-pit waste rock emplacement being designed to avoid the only patch that was initially within the footprint;
- impacts on habitat for the Ornamental Snake (*Denisonia maculata*) have been reduced by minimising the extent of out-of-pit waste rock emplacement; and
- the overall disturbance footprint has been reduced by optimising backfilling of the open cut.

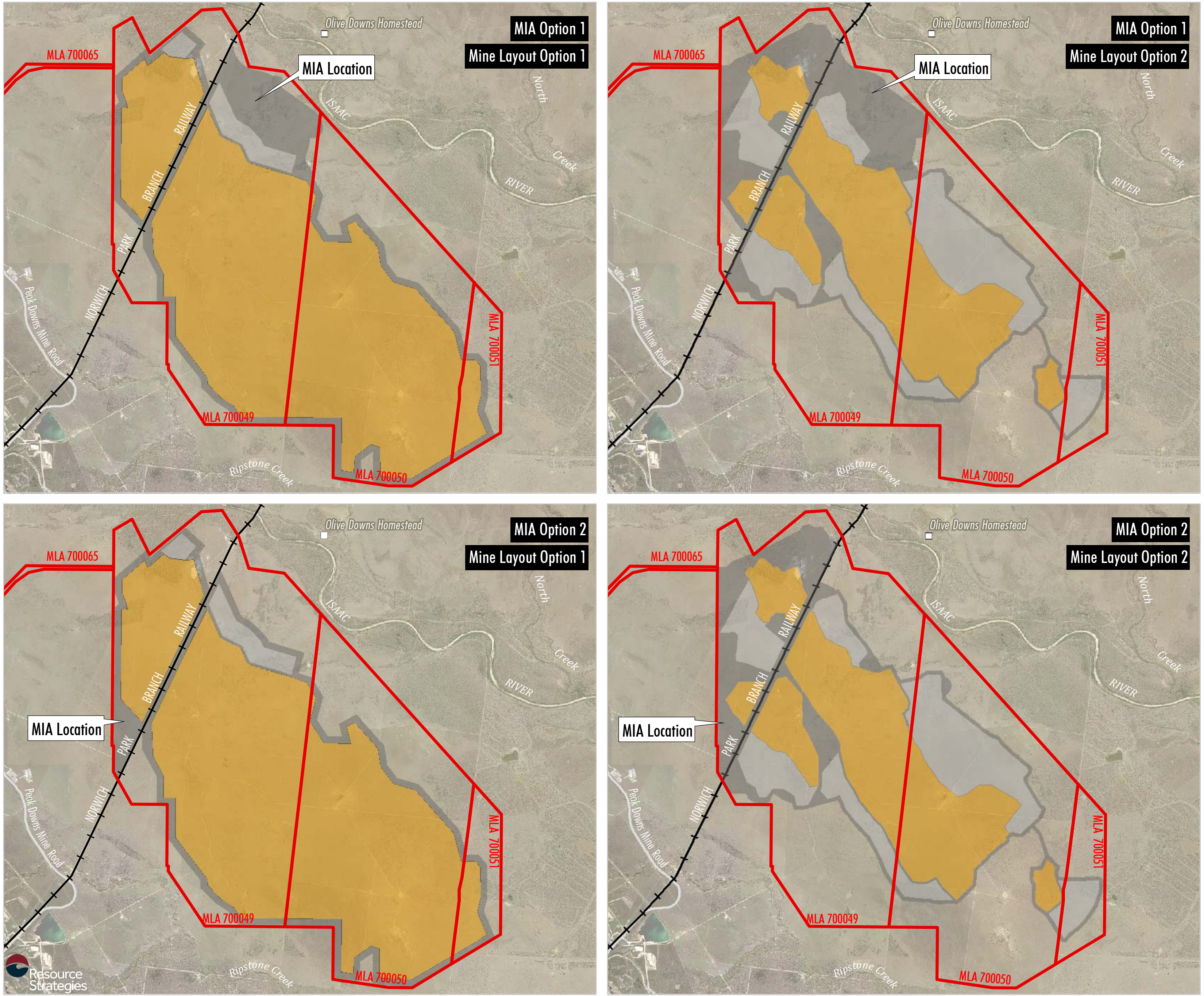
3.2.4 Mining Sequence and Extraction Rate

Whitehaven WS has considered a range of mining sequences and extraction rates for the Project. An analysis (including consideration of mining method, open cut extent and coal handling and transportation constraints) was undertaken to determine the optimum mining sequence and extraction rate for the Project in consideration of Whitehaven WS's corporate objectives.

The currently proposed mine sequence has been refined to minimise potential environmental, social and economic impacts as follows:

- Mining the Railway Pit early in the mine life so that it can be used as a Project water storage to minimise surface development area requirements.
- Progressively backfilling Railway Pit and Main Pit North, to feasibly backfill the voids to ground level to minimise the residual void area.
- Reducing impacts to Winchester Quarry by sequencing mining in consideration of the extent of already depleted reserves of hard rock.

The proposed mine sequence and extraction rate have been designed to meet Whitehaven WS's corporate objectives while minimising potential environmental, social and economic impacts. Notwithstanding, the proposed mine sequence (including the number and location of residual voids) and extraction rate are subject to change as part of the PRC Plan process, noting that residual voids would avoid the Isaac River floodplain.



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LEGEND
Mining Lease Application Boundary
Indicative Infrastructure Area
Indicative Out-of-pit Waste Rock Emplacement
Indicative Open Cut Pit Including In-pit Waste Emplacement
Railway

Source: The State of Queensland (2018 - 2020); Whitehaven (2020).
Orthophoto: Whitehaven (2019).

N
0 4
Kilometres
GDA 1994 MGA Zone 55

WHITEHAVEN COAL

WINCHESTER SOUTH PROJECT

Options Considered
- MIA and Mine Layout

Figure 3-1

3.3 MINE INFRASTRUCTURE AREA

Whitehaven WS adopted the following design constraints when considering the location of the MIA:

- Resource sterilisation – the MIA should be located to not sterilise coal resources that could be economically mined.
- Safety – the MIA should be located at least 500 m from the crest of the open cut extent to provide an appropriate distance from blasting activities.
- Flood immunity – the MIA should be located outside the 1:100 AEP flood extent, wherever practicable.
- Access to rail infrastructure – the MIA should be located near to Norwich Park Branch Railway to minimise rail spur length and associated surface development area.
- Accessibility – the MIA should be located proximal to existing access roads to allow for efficient and practical access.
- Haul distance – the MIA should be located proximal to the open cut extent to reduce the haul distance for ROM coal, and thereby reduce potential noise and air quality impacts, and greenhouse gas emissions.
- Minimise surface development – the MIA should be designed to minimise its surface development area.
- Minimise vegetation clearance – the MIA should be located to minimise the clearance of vegetation as far as practicable.
- Minimise bulk earthworks – the MIA should be located on relatively flat ground to reduce the earthworks required to level the ground to construct infrastructure.

Whitehaven WS considered the two options with respect to the location of the MIA which met the design constraints listed above:

- Option 1 – northern part of the Project.
- Option 2 – south-west corner of the Project.

These options are shown on Figure 3-1.

Whitehaven WS selected Option 1 for the proposed MIA location based on the following:

- The Option 1 access road entrance on Eagle Downs Mine Access Road was preferred from a road safety perspective, i.e. would avoid a new intersection on Peak Downs Mine Road in the vicinity of the rail level crossing (Plate 3-1 and Figure 3-2).
- The Option 2 access road and water supply pipeline may need to be relocated as they would connect to parts of the Peak Downs Mine Access Road and Eungella Pipeline Southern Extension which are approved to be realigned by BMA for the Peak Downs Mine (Figure 3-2).
- The Option 1 MIA would be located closer to the Winchester Quarry which would be utilised during construction for construction material (Figure 3-1).
- When combined with the access road Option 1, results in a significant reduction in the distance between the Project and the township of Moranbah. This is a relevant factor to employee safety and amenity (Figure 3-1).

The proposed MIA location (Option 1) meets the adopted design constraints and minimises potential environmental, social and economic impacts.

3.4 PRODUCT COAL TRANSPORT AND PORT OPERATIONS

The pre-feasibility study for the Project indicated that given the size of the Project, there was no viable alternative to transport product coal for export other than by rail.

The existing railway network provides access to the Bowen and Mackay coal ports, approximately 250 km north and approximately 150 km north-east, respectively, and the Gladstone coal ports, approximately 350 km south-east, through the Newlands, Goonyella and Blackwater rail networks, respectively. These ports were considered by Whitehaven WS with respect to availability of capacity and total logistic costs.

Whitehaven WS's preference is to export product coal to market from DBCT due to economic considerations. However, Whitehaven WS expect product coal may be shipped out of other ports during the life of the Project, subject to port capacity.

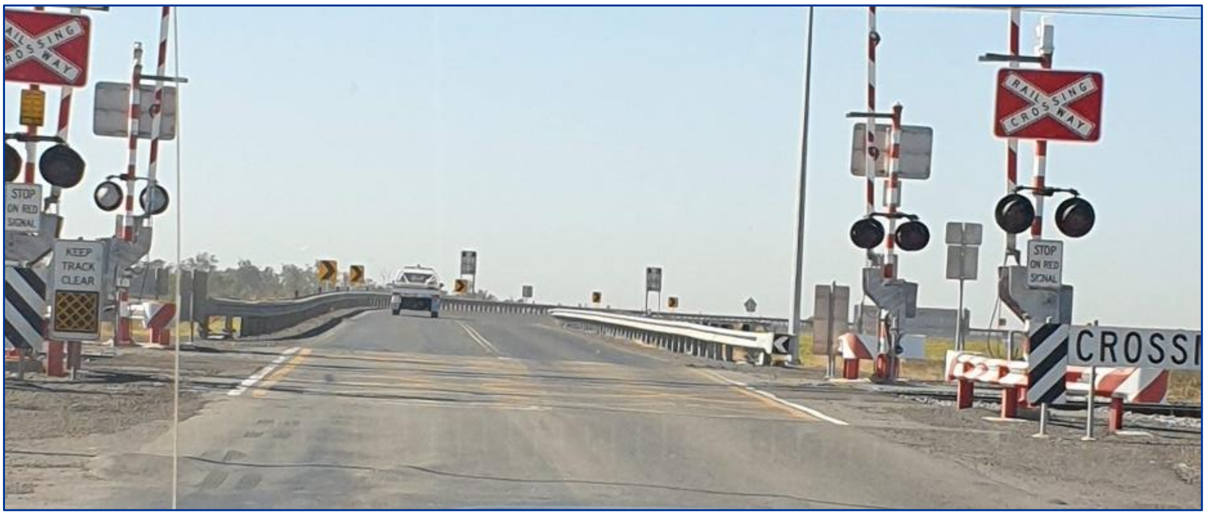


Plate 3-1 – Existing Rail Crossing at Peak Downs Mine Road

3.5 WORKFORCE ACCOMMODATION

Workforce accommodation options for the Project include self-accommodation (i.e. home ownership), rental accommodation and utilisation of existing accommodation villages in Moranbah, Dysart or Coppabella.

Whitehaven WS initially considered construction of an on-site temporary accommodation camp for use during the construction phase of the Project. This option was, however, discarded based on the outcomes of stakeholder engagement.

Engagement with the operators of existing accommodation villages in Moranbah, Dysart and Coppabella indicates that there is the ability to accommodate both the Project construction and operational workforce at these locations.

In addition, the Project workforce would also be able to utilise existing housing in the surrounding area (e.g. Moranbah).

Engagement with the Isaac Regional Council found that housing availability is a key issue in the local community (Appendix C). In response to this key concern, Whitehaven WS has made significant commitments in regard to housing (Section 4.4.5).

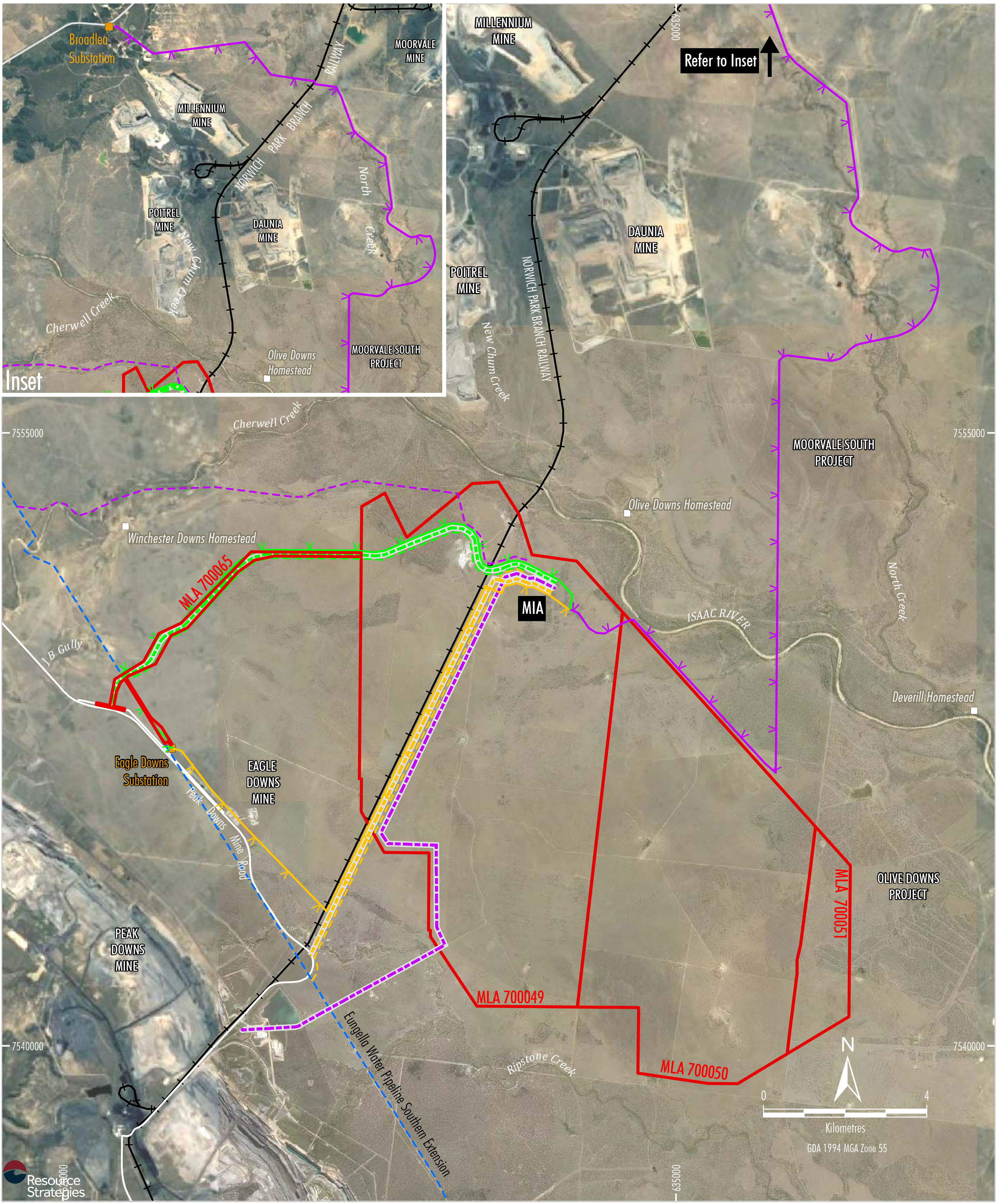
The use of existing accommodation villages would minimise potential environmental, social and economic impacts of the Project.

3.6 INFRASTRUCTURE CORRIDOR ALIGNMENT

During the pre-feasibility study a number of alternative infrastructure corridors were investigated. The options are shown on Figure 3-2. The corridor was selected to minimise potential environmental, social and economic impacts through the following constraints:

- minimise impacts to surrounding tenement holders, through the location of the corridors along tenement boundaries and geological features where practicable;
- minimise surface development related impacts by co-locating the access road, water supply pipeline and ETL in a consolidated infrastructure corridor;
- minimise the length of the infrastructure corridor;
- minimise potential interaction with mining operations;
- minimise impact to existing stock routes; and
- avoid dwellings and existing/planned infrastructure.

Further details on the alignment options for the ETL, water supply pipeline and mine access road are provided in the sections below.



LEGEND
- Mining Lease Application Boundary
- Eungella Water Pipeline Southern Extension
- Railway
- Substation

Infrastructure Corridor Options

Option 1	Option 2	Option 3
ETL	ETL	ETL
Mine Access Road	Mine Access Road	Mine Access Road
Raw Water Supply Pipeline	Raw Water Supply Pipeline	Raw Water Supply Pipeline

Source: The State of Queensland (2018 - 2019); Whitehaven (2020). Orthophoto: Google (2019); Whitehaven (2019).

WHITEHAVEN COAL

WINCHESTER SOUTH PROJECT

Options Considered - Infrastructure Corridors

Figure 3-2

3.6.1 Electricity Transmission Line

Whitehaven WS considered the following options with respect to the alignment of the ETL for the Project (Figure 3-2):

- Option 1 – connecting to the Eagle Downs Substation from the north.
- Option 2 – connecting to the Eagle Downs Substation from the south.
- Option 3 – connecting to the Broadlea Substation.

Option 1 (i.e. Eagle Downs Substation northern connection) was selected for the Project as it would (in addition to the points above):

- be the shortest alignment, minimising capital costs and surface disturbance requirements;
- avoid the Eagle Downs Mine subsidence zone (alignment follows a faulted zone, with minimal subsidence predicted to occur); and
- provide potential for co-location of the ETL, mine access road and water pipeline.

Option 2 remains a viable alternative.

3.6.2 Water Supply Pipeline

A significant proportion of mine site water requirements would be sourced from water collected on the site, including rainfall runoff and groundwater inflows to the open cut pits which will be stored in the mine-affected water storages for recycling and reuse (Appendix B).

Whitehaven WS would preferentially source water from rainfall runoff and groundwater inflows, and would supplement the water supply with either an external water supplier (e.g. Sunwater) via a water supply pipeline or via water sharing with surrounding mining operations. Therefore, minimising potential impacts to water resource availability from the Isaac River or regional water availability due to the Project.

Whitehaven WS considered and engaged with neighbouring mining operations regarding utilising existing or proposed water infrastructure to supplement the Project's raw water supply requirements.

Whitehaven WS has chosen to develop a stand-alone water supply pipeline for the Project as it reduces reliance on nearby water sources and provides certainty in water supply for continued operations.

Whitehaven WS considered the following options with respect to the alignment of the water supply pipeline for the Project (Figure 3-2):

- Option 1 – connecting to the Eungella pipeline network to the west.
- Option 2 – connecting to the Eungella pipeline network to the south.
- Option 3 – sharing the pipeline alignment proposed by the Olive Downs Project (not currently constructed) to the north-west.

Option 1 (i.e. western connection to the Eungella pipeline network) was selected for the Project as it would:

- limit potential interaction with the Project open cut and out-of-pit waste rock emplacement areas;
- limit the number of easements or leases by co-locating the alignment with the ETL and access road;
- provide timing certainty (Whitehaven WS could begin construction of the water supply pipeline after receiving approval for the Project) without being encumbered with another Project; and
- reduce cumulative surface disturbance (combined corridor with the ETL and access road).

Option 2 remains a viable alternative.

3.6.3 Mine Access Road

Whitehaven WS considered the following options with respect to the alignment of the mine access road for the Project (Figure 3-2):

- Option 1 – Development of an access road via Eagle Downs Mine Access Road to the west.
- Option 2 – Development of an access road adjacent to the Norwich Park Branch Railway.
- Option 3 – Extension of the existing Winchester Access Road.

TTPP (2021) assessed two main access routes for the Project, with vehicular access for the Project via the Mine Access Road from Eagle Downs Mine Road or access for the Project via Winchester Access Road.

Option 1 (i.e. access road via Eagle Downs Mine Access Road) was selected for the Project as it would (in addition to the points above):

- be preferred to Option 2 from a road safety perspective (i.e. would avoid a new intersection on Peak Downs Mine Road in the vicinity of the rail level crossing – Plate 3-1);
- not need to be relocated in the future (other options may need to be relocated as they would connect to parts of the Peak Downs Mine Access Road that may be realigned for the Peak Downs Mine);
- result in a significant reduction in the distance between the Project and the township of Moranbah. This is a relevant factor to employee safety and amenity;
- minimise potential subsidence impacts to the access road from Eagle Downs Coal Mine (the alignment follows a faulted zone, with minimal subsidence predicted to occur); and
- allow continued operation of the Winchester Quarry.

Options 2 and 3 also remain viable alternatives.

3.7 FINAL LANDFORM AND LAND OUTCOMES

3.7.1 Final Landform Design

A number of options were considered by Whitehaven WS with respect to the number and location of residual voids retained in the Project final landform. Options that were considered regarding rehabilitation of the Project include:

- Option 1 – partial backfill of Main Pit South, North-West Pit, West Pit and South Pit, with no residual voids in Railway Pit and Main Pit North. Four residual voids remain.
- Option 2 – retaining six residual voids in the final landform (i.e. no significant backfilling).
- Option 3 – complete backfill of all open pits so no residual voids remain in the final landform.

In all scenarios, the final landform for the Project would be safe, geotechnically stable and non-polluting.

Whitehaven WS estimates that the economic cost to backfill all six open pits (i.e. Option 3) would be in the order of $1.8 billion. In practice, the cost would likely be higher given the additional costs associated with sourcing and applying topsoil, seed and fertilisers to revegetate the landforms. This significant cost would render the Project commercially unfeasible (Sections 3.8 and 8).

Option 2 (retaining six residual voids) is the most cost effective. However, Whitehaven WS is committed to reducing the number and size of residual voids and therefore discounted this option. In addition, the Railway Pit was given priority for complete backfill, as is the closest pit to the Isaac River floodplain.

In consideration of this, the Project's mine sequence has been optimised to identify a feasible mine plan that minimises the number and extent of residual voids (Option 1), and avoids the creation of residual voids within the Isaac River floodplain.

In addition to the number and location of voids, Whitehaven WS has also considered the potential implications of partially backfilling residual voids, for example to physically cover the lower exposed coal seams.

The outcome of Option 1 is that the predicted equilibrated water levels within the residual voids are between approximately 20 m and 60 m below the pre-mining groundwater levels, and therefore act as sinks to groundwater flow. As the residual voids would act as sinks, evaporation from the equilibrated water body would, over time, concentrate the salts present in the water. However, as they act as sinks, the saline residual void water body would not pose a risk to the surrounding groundwater regime or receiving environment.

Partially backfilling the residual voids to cover the exposed coal seams (which have a high salt content of approximately 13,230 µS/cm [Appendix B]) would not avoid the water body from becoming saline.

Water that accumulates in the partially backfilled residual voids would still have elevated salinity due to the effects of evaporation (i.e. concentration effects) and the potential to draw water from coal seams through the porous backfill material. However, the partially backfilled residual void would result in the saline residual void water body having an increased equilibrated water level. The increased water level risks the saline residual void water body acting as a source to the surrounding groundwater as opposed to a sink.

The residual voids have therefore been designed to act as groundwater sinks in perpetuity, preventing the migration of saline water into adjacent aquifers. Further detail on the modelled final landform in relation to residual void water quality is provided in Sections 4.1.3, 4.2.3, 6.1.2 and 6.2.5.

The optimal mine plan adopted for the Project would result in no residual voids within Railway Pit and Main Pit North and partial backfilling of Main Pit South, North-West Pit, West Pit and South Pit. This option includes significant operational cost to the Project that would not otherwise be incurred for Option 2.

The four residual voids included in Option 1 would result in a reduction in the land available for grazing in the long-term. Deloitte Access Economics (2021) concluded that the foregone benefits associated with reduced income opportunities from grazing post-mining would be immaterial (Appendix K).

The four residual voids would also be safe, stable and non-polluting.

Further detail on the rehabilitation strategy for the Project is provided in Section 6.

3.7.2 Final Land Use

The post-mining land use (PMLU) for the Project has been developed in consideration of the requirements of the *Mined Land Rehabilitation Policy* (Department of Environment and Heritage Protection [DEHP], DNRM and Queensland Treasury, 2017), having regard to the surrounding landscape and existing land uses, community views and the objectives of the relevant local and regional planning strategies (Section 6.3).

Whitehaven WS has considered a number of potential PMLUs. Grazing was adopted as the main PMLU as:

- It is consistent with the existing (pre-mining) land use within the Project area and surrounding landscape, the social, economic and environmental objectives of relevant regional plans and local planning strategies, and community views (Section 6.3.1).
- Low-intensity grazing as a land use would be unlikely to result in increased potential for harm to the surrounding environment (Section 6.3.1).
- Grazing is consistent with approved land use outcomes for the mining operations/projects surrounding the Project.

The four residual voids would not be available for grazing post-mining and would be non-use management areas (NUMAs) for the reasons provided in Section 6. Deloitte Access Economics (2021) concluded that the foregone benefits associated with grazing the NUMAs would be immaterial (Appendix K).

3.8 NOT CARRYING OUT THE PROJECT

Consideration of the potential consequence of not proceeding with the development of the Project is provided in Section 8.

In summary, if the Project were not to be carried out, approximately 500 direct operational employment opportunities and associated flow-on effects would be foregone, which would generate in the order of 1,894 full time equivalents (FTE) on average in Queensland (Appendix K).

In addition, were the Project not to proceed, substantial royalties (in the order of $563 million in net present value terms [NPV]) would not be generated (Appendix K).

3.9 ECOLOGICALLY SUSTAINABLE DEVELOPMENT AND HUMAN RIGHTS CONSIDERATIONS

3.9.1 Background

The concept of sustainable development came to prominence at the World Commission on Environment and Development (1987), in the report titled *Our Common Future*, which defined sustainable development as:

> *Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

In recognition of the importance of sustainable development, the Commonwealth Government developed a *National Strategy for Ecologically Sustainable Development* (NSESD) (Commonwealth of Australia, 1992) that defines ecologically sustainable development as:

> *…using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.*

The NSESD was developed with the following core objectives:

- to enhance individual and community wellbeing and welfare by following a path of economic development that safeguards the welfare of future generations;
- to provide for equity within and between generations; and
- to protect biological diversity and maintain essential processes and life support systems.

In addition, the NSESD contains the following goal:

> *Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.*

In accordance with the core objectives and a view to achieving this goal, the NSESD presents private enterprise in Australia with the following role:

> *Private enterprise in Australia has a critical role to play in supporting the concept of ESD* [ecologically sustainable development] *while taking decisions and actions which are aimed at helping to achieve the goal of this Strategy.*

The Project would require approval under both the SDPWO Act and the EPBC Act (Section 1.7). In deciding whether or not to approve the Project, the Commonwealth Minister must take into account the principles of ecologically sustainable development pursuant to section 136(2) of the EPBC Act.

The relevant definition of the principles of ecologically sustainable development is provided in section 3A of the EPBC Act:

> *The following principles are **principles of ecologically sustainable development**:*
>
> *(a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;*
>
> *(b) if 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;*
>
> *(c) the principles of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;*
>
> *(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;*
>
> *(e) improved valuation, pricing and incentive mechanisms should be promoted.*

The Project also requires approval under the EP Act. Consistent with the NSESD, section 3 of the EP Act defines ecologically sustainable development as:

> *…development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (**ecologically sustainable development**).*

Further, section 58 of the EP Act provides for the chief executive to consider the following principles in preparing an EIS Assessment Report:

- the precautionary principle;
- inter-generational equity; and
- conservation of biological diversity and ecological integrity.

Section 58(1) of the Human Rights Act provides that it is unlawful for a public entity to act or make a decision in a way that is not compatible with human rights, or to fail to give proper consideration to a human right relevant to the decision. In deciding whether to approve the Project, the relevant decision-makers must give proper consideration to any human right relevant to the decision. This is considered further in Section 1.7.

Decision-makers should have regard to the human rights implications that may arise as a result of the impacts of the Project and the mitigation measures that are set out in this EIS, including for example the principles of social equity and ecologically sustainable development and the Project's greenhouse gas emissions.

3.9.2 Consideration of Ecologically Sustainable Development for the Project

As part of the development of the Project, Whitehaven WS carefully considered potential environmental, social and economic impacts as well as feedback provided by the local community, government agencies and other stakeholders.

The design, planning and assessment of the Project has been carried out applying the principles of ecologically sustainable development and in a manner which is not incompatible with human rights, through:

- incorporation of risk assessment and analysis at various stages in the Project design, environmental assessment and decision-making;
- adoption of high standards for environmental and occupational health and safety performance;
- consultation with regulatory and community stakeholders;
- assessment of potential greenhouse gas emissions associated with the Project; and
- optimisation of the economic benefits arising from the development of the Project.

Assessment of potential medium and long-term impacts of the Project was carried out during the preparation of this EIS on aspects of surface water and groundwater, agriculture, transport movements, air quality emissions (including greenhouse gas emissions), noise emissions, aquatic and terrestrial ecology, heritage and socio-economics.

In addition, it can be demonstrated that the Project can be operated in accordance with ecologically sustainable development principles through the application of mitigation measures, compensatory measures and offset measures that have been developed based on conservative impact assumptions for the Project.

The following sub-sections describe the consideration and application of the principles of ecologically sustainable development to the Project.

Precautionary Principle

Environmental assessment involves evaluating the likely environmental outcomes of a development. The precautionary principle reinforces the need to take risk and uncertainty into account, especially in relation to threats of irreversible environmental damage.

A PRA (Appendix N) was conducted to identify Project-related risks and develop appropriate mitigation measures and strategies.

The PRA addressed the key potential environmental impacts associated with the Project, including long-term effects. In addition, potential long-term risks are considered by the specialist studies conducted in support of this EIS (Section 1.1).

In the Groundwater, Surface Water and Flooding and Economic Assessments (Appendices A, B and K), risk and uncertainty have also been taken into account through sensitivity and/or uncertainty analysis. Other specialist studies have accounted for uncertainty by adopting conservative Project assumptions and/or prediction methodologies, such as the Noise and Vibration Assessment, Air Quality and Greenhouse Gas Assessment, Road Transport Assessment and Geochemistry Assessment (Appendices G, H, I and M).

Findings of these specialist assessments are presented in Sections 4 and 5 and relevant appendices. Measures designed to mitigate potential environmental impacts arising from the Project are also described in Sections 4 and 5, and summarised in Section 7.

The specialist assessments and PRA have evaluated the potential for harm to the environment associated with the development of the Project. A range of mitigation measures have been adopted as components of the Project design to minimise the potential for serious and/or irreversible damage to the environment, including the development of environmental management and monitoring programs, compensatory measures and ecological offsets based on conservative assumptions (Sections 4 and 5). Where residual risks are identified, contingency controls have been considered (Section 4 and Attachment 5).

In addition, for key Project environmental assessment studies (i.e. Groundwater Assessment [Appendix A] and Surface Water and Flooding Assessment [Appendix B]), peer reviews by recognised experts have been undertaken (Attachment 3).

Social Equity

Social equity is defined by inter-generational and intra-generational equity. Inter-generational equity is the concept that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations, while intra-generational equity is applied within the same generation.

The principles of social equity are addressed through:

- assessment and mitigation as described in the SIA of the social and economic impacts of the Project (Sections 4.4 and 4.11 and Appendices C and K), including the distribution of impacts between stakeholders and consideration of the potential economic costs of greenhouse gas emissions (Appendix K);
- management measures to be implemented in relation to the potential impacts of the Project on water resources, social values, biodiversity, noise, air quality, greenhouse gas emissions, transport, Aboriginal cultural heritage, land, economics and hazards and risks (Sections 4 and 5);
- implementation of environmental management and monitoring programs (Sections 4 and 7) to minimise potential environmental impacts (which include environmental management and monitoring programs covering the Project life);
- implementation of measures during the life of the Project to offset potential localised impacts that have been identified for the development (Sections 4.5 and 5.7 and Attachment 5); and
- implementation of significant financial and community commitments, including construction of new houses in Moranbah, to ensure the Project does not adversely affect the affordability and availability of housing and accommodation in local communities, as reduced availability, affordability and accessibility of housing and accommodation was a key concern identified during consultation with stakeholders (Section 4.4 and Appendix C).

The Project would benefit current and future generations through employment. It would also provide significant stimulus to local and regional economies and provide Queensland export earnings and royalties, thus contributing to future generations through social welfare, amenity and infrastructure.

The Project incorporates a range of mitigation measures to minimise potential impacts on the environment, the costs of these measures would be met by Whitehaven WS and have been included in the Economic Assessment (Appendix K). The potential benefits to current and future generations have, therefore, been calculated in the context of the mitigated Project.

Conservation of Biological Diversity and Ecological Integrity

Biological diversity or 'biodiversity' is considered to be the number, relative abundance, and genetic diversity of organisms from all habitats (including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are a part) and includes diversity within species and between species, as well as diversity of ecosystems (Lindenmayer and Burgman, 2005).

For the purposes of this EIS, ecological integrity has been considered in terms of ecological health and ecological values.

The Project area is located within a largely agricultural landscape, with grazing generally being the primary land use. As such, the majority of vegetation (approximately 90%) within the Project area has been historically cleared in favour of livestock grazing and agriculture and exists in a non-remnant state (Appendix D). Habitat connectivity is generally low due to high fragmentation and disturbance of native vegetation (Appendix D).

Surveys conducted for the Project have identified threatened ecological communities and habitat suitable for threatened flora and fauna species (Sections 4.5 and 5).

The environmental assessment in Section 4.5 describes the potential impacts of the Project on local and regional ecology in the context of MSES (Matters of State Environmental Significance) and associated Project mitigation and offset measures. While the environmental assessment in Section 5 describes the potential impacts of the Project on ecological MNES (Matters of National Environmental Significance) and associated Project mitigation and offset measures.

In accordance with ecologically sustainable principles, the Project addresses the conservation of biodiversity and ecological integrity by proposing an environmental management framework designed to conserve ecological values, where practicable, after consideration of potential Project impacts as described in the sub-sections below.

Greenhouse Gas Emissions, Biological Diversity and Ecological Integrity

Many natural ecosystems are considered to be vulnerable to climate change. Patterns of temperature and precipitation are key factors affecting the distribution and abundance of species (Preston and Jones, 2006). Projected changes in climate would have diverse ecological implications. Habitat for some species would expand, contract and/or shift with the changing climate, resulting in habitat losses or gains, which could prove challenging, particularly for species that are threatened.

Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases is listed as a key threatening process under the EPBC Act.

It is acknowledged that (subject to the efficacy of national and international greenhouse gas abatement measures) all sources of greenhouse gas emissions, irrespective of their scale, would contribute in some way towards the potential global, national, state and regional effects of climate change.

The Project's contribution to global climate change would be proportional to its contribution to global greenhouse gas emissions. Consistent with the approach adopted for the *Greenhouse Gas Protocol* (World Business Council for Sustainable Development [WBCSD] and World Resources Institute [WRI], 2015), the Project's Scope 1 emissions would be attributed to Whitehaven WS, whereas the Project's Scope 2 emissions and Scope 3 emissions are the Scope 1 emissions of another party (e.g. the Project's Scope 2 emissions associated with purchased electricity would be the Scope 1 emissions of the power generator).

At the 21st meeting of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2015, the *Paris Agreement* was adopted by the COP. The goal of the *Paris Agreement* is to limit global temperature increases to well below 2°C above pre-industrial levels (Article 2[1][a]).

This is to be achieved by nationally determined contributions (NDCs) (Article 3), with parties aiming to reach peak global emissions as soon as possible, so as to achieve a "*balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century*" (Article 4[1]).

The *Paris Agreement* does not specify the ways in which global emission reductions are to be achieved. It requires parties to prepare, communicate and maintain NDCs and to pursue domestic measures to achieve the objectives of the NDCs (Article 4[2]). The NDCs are to be communicated every five years, with each successive NDC to represent a progression beyond the previous NDC (Article 4[3], [9]).

To date, 188 parties have ratified the *Paris Agreement* and 186 parties have submitted their first NDCs. Parties' second or updated NDCs are due to be submitted by 2020, currently two parties have submitted their second NDCs.

Australia's first NDC submitted to the UNFCCC in August 2015 sets an economy-wide greenhouse gas emission reduction target of 26 to 28% on 2005 levels by 2030 (Commonwealth of Australia, 2015).

A range of policies including the Emissions Reduction Fund, the Safeguard Mechanism, the Renewable Energy Target and the National Energy Productivity Plan have been implemented by the Commonwealth Government to help Australia meet the target in its NDC.

In addition, the Queensland Government has released the *Queensland Climate Transitional Strategy* (DEHP, 2017a), which outlines how Queensland will achieve its target of net-zero emissions by 2050. The Queensland Government also released its climate adaptation strategy (DEHP, 2017b) which provides a framework for ensuring an innovative and resilient Queensland that manages the risks and harnesses the opportunities of a changing climate.

The *Queensland Climate Adaptation Strategy* (DEHP, 2017b) introduces a "Sectors and System Pathway" to address the specific adaptation needs of Queensland's major economic sectors, in regards to climate change. It is noted that the Industry and Resources Sector Adaptation Plan for manufacturing, mining, energy and supporting services has not been developed at the time of writing.

As coal from the Project is expected to be used overseas, emissions associated with the end use of Project coal would be accounted for and managed as Scope 1 greenhouse gas emissions under the NDCs of these countries, in accordance with the international legal framework under the UNFCCC, including the *Paris Agreement*.

A greenhouse gas assessment was undertaken by Katestone for the Project (Appendix H) and provides an estimation of the potential greenhouse gas emissions associated with the Project, with a summary provided in Section 4.8.

Measures to reduce the Project's direct (Scope 1) greenhouse gas emissions are described in Section 4.8.5. However, approximately 97% of the estimated total Scope 1, 2 and 3 emissions are associated with the end use of the Project product coal by customer organisations (i.e. primarily for steelmaking).

Valuation of potential impacts of greenhouse gas emissions has been incorporated in the Economic Assessment (Appendix K) for the Project.

The potential implications of climate change on water resources are addressed in Appendices A and B.

Measures to Maintain or Improve the Biodiversity Values of the Surrounding Region

A range of measures would be implemented for the Project to maintain or improve biodiversity values of the region in the medium to long-term. As summarised below and detailed in Sections 4.5 and 5, these measures include impact avoidance, minimisation, mitigation and offsets (for residual impacts).

Project elements have been located and designed to avoid or minimise potential biodiversity impacts where possible based on the outcomes of baseline survey work. Key measures to avoid or minimise impacts to vegetation and habitat disturbance and fauna species include:

- Design of the Project to avoid the *Brigalow (Acacia harpophylla dominant and co-dominant)* threatened ecological community located adjacent to the Main Pit South out-of-pit waste rock emplacement.
- Design of the Main Pit South western out-of-pit waste rock emplacement to avoid disturbance of Ornamental Snake habitat.
- Avoiding creek crossings/waterways for the infrastructure corridor.
- Avoiding palustrine wetlands on the boundary of MLA 700049/MLA 700050 and establishing a 50 m buffer on two of the wetlands.
- Co-locating the mine access road, ETL and water pipeline within a single infrastructure corridor.

Sections 4, 5 and 7 summarise a number of Project measures that would assist in maintaining the biodiversity of the region, including measures such as clearance protocols, weed management and rehabilitation of disturbed areas.

Residual impacts of the Project to biodiversity are also provided for by a biodiversity offset that would comply with the EO Act and the EPBC Act. All residual impacts have been conservatively assessed and an offset management strategy is proposed as part of the Project to maintain or improve biodiversity values of the region in the medium to long-term (Attachment 5).

Valuation

One of the common broad underlying goals or concepts of sustainability is economic efficiency, including improved valuation of the environment. Resources should be carefully managed to maximise the welfare of society, both now and for future generations.

In the past, some natural resources have been misconstrued as being free or underpriced, leading to their wasteful use and consequent degradation. Consideration of economic efficiency, with improved valuation of the environment, aims to overcome the underpricing of natural resources and has the effect of integrating economic and environmental considerations in decision-making, as required by ecological sustainable development.

While environmental costs have been considered to be external to project development costs historically, improved valuation and pricing methods attempt to internalise environmental costs and include them within project costing.

The Economic Assessment (Appendix K) undertakes an analysis of the Project and incorporates environmental values via direct valuation where practicable (e.g. greenhouse gas emissions of the Project). Furthermore, wherever possible, direct environmental effects of the Project would be internalised through the adoption and funding of mitigation measures by Whitehaven WS to mitigate and offset potential environmental impacts (e.g. biodiversity offset costs).

The Economic Assessment (Appendix K) has been prepared in accordance with the *Economic Impact Assessment Guideline* (Department of State Development [DSD], 2017) and the *Project Assessment Framework – Cost-benefit analysis* (Queensland Treasury, 2015).

Greenhouse gases directly generated by the Project (i.e. Scope 1 emissions) on average are estimated to be approximately 506 kilotonnes carbon dioxide equivalent (kt CO_2-e) per year (Appendix H). Indirect emissions associated with the on-site use of electricity (i.e. Scope 2 emissions) are estimated on average to be 50 kt CO_2-e per year (Appendix H).

The Economic Assessment in Appendix K indicates a net benefit of $576 million in NPV terms to the Queensland community would be forgone if the Project is not implemented (i.e. net of the value of externalities including Scope 1 and 2 greenhouse gas emissions).

The demand for coal used in the manufacturing of steel (metallurgical coal) is expected to remain steady in the long-term as there are currently limited practicable substitutes available. International measures to 'decarbonise' global economies may alter the future demand for and/or supply of thermal coal.

Expected global trends are factored into coal price forecasts considered in the Economic Assessment (Appendix K). The Economic Assessment also includes sensitivity analysis for variations in export coal prices and the social cost per tonne of carbon emissions. The sensitivity analysis shows that the Project would still generate a substantial net benefit to the Queensland community under the scenarios considered (Appendix K).

The value of externalities from indirect (Scope 3) greenhouse gas emissions are not considered in the net benefit calculation of the Project's impacts on the Queensland community. This is consistent with economic assessment convention, where the potential negative and positive economic impacts of an activity are considered together, in the country where the activity takes place (e.g. economic positives and externalities of Japanese steel manufacturing or power generation in a customer facility, including the Scope 1 greenhouse gas emissions of that facility). This approach is consistent with the *Greenhouse Gas Protocol* and the *Paris Agreement* which seek to avoid double counting of emissions (WBCSD and WRI, 2015).

Notwithstanding, Scope 3 greenhouse gas emissions that may be emitted by other parties, such as from the use of the product coal produced by the Project, are considered in this EIS. On average, over the life of the Project, the indirect (i.e. Scope 3) emissions from these activities are estimated to be approximately 19 million tonnes of carbon dioxide equivalent (Mt CO_2-e) per year (Appendix H).

These greenhouse gas emissions would be accounted for by customer country international greenhouse gas abatement obligations (e.g. under the *Paris Agreement*).