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LANDSCAPE AND VISUAL AMENITY

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20.1 Introduction

This section of the Project EIS presents the landscape and visual impact assessment (LVIA) that has been prepared to address and respond to a number of requirements identified in the ToR issued by EHP for the Project.

The Project will involve developing up to 6,625 CSG production wells over the projected 40 year life span. Development will be staged over the Project life allowing for a phased approach.

The Project tenements cover an area of approximately 8,000 km² of development and production acreage, approximately 150 km south-west of Mackay, with the area extending from the towns of Glenden in the north to Blackwater in the south. A full description of the proposed development area is detailed in the Project Description chapter (Section 4) of this EIS.

The Project's development area will be split into a number of regions for progressive development. A development scenario has been prepared by Arrow to structure and inform the EIS. The development scenario will initially involve the establishment of several development areas with approximately 600 production wells to be drilled in the first two years. Arrow will stagger the development of subsequent regions to sustain the required production rate to supply the LNG Plant. Production well installation, facility construction, operation, decommissioning and rehabilitation will occur concurrently at different locations throughout the Project life.

Whilst this LVIA has identified a number of landscape and visual constraints that may be applied to specific categories of landscape areas and visual receptors, it also acknowledges that additional and more detailed visual assessment studies may be required where the final location of visible infrastructure is proposed within proximity to high sensitive visual receptors, such as residential dwellings and homesteads within the Project area.

A cross reference to the locations where each of the requirements of the ToR has been addressed is given in Appendix B which references both the study chapters (Sections 1 through 34) and/or the Appendices (A through EE).

20.2 Methodology

The objectives of the ToR have been addressed through the application of a detailed LVIA, a process that has been developed and refined for numerous large scale industrial developments in Australia as well as internationally. This LVIA has considered the general guidelines and standard assessment techniques described in the British Landscape Institute Guidelines for Landscape and Visual Impact Assessment (the BLI Guidelines).

20.2.1 Landscape and Visual Impact Assessment

The BLI Guidelines set out a separate process for the assessment of landscape and visual impacts but notes that '*the landscape baseline, its analysis and the assessment of landscape effects, all contribute to the baseline for visual assessment studies*'.

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Landscape impacts derive from changes in the physical landscape whilst visual impacts relate to changes in the composition of available views and are assessed as the effects on people (visual receptors) who reside, travel through or work within the Project area.

20.2.2 Framework Approach

Given the extensive Project area and unknown location of key Project infrastructure, it is not possible to apply a standard LVIA technique to each potential visual receptor location within the Project area. Standard LVIA techniques address:

- Distance between visual receptor and the Project site;
- Duration of view from visual receptor location toward the Project area;
- Predicted impact of the Project on existing visual amenity;
- Nature of predicted impacts; and
- Visual receptor sensitivity.

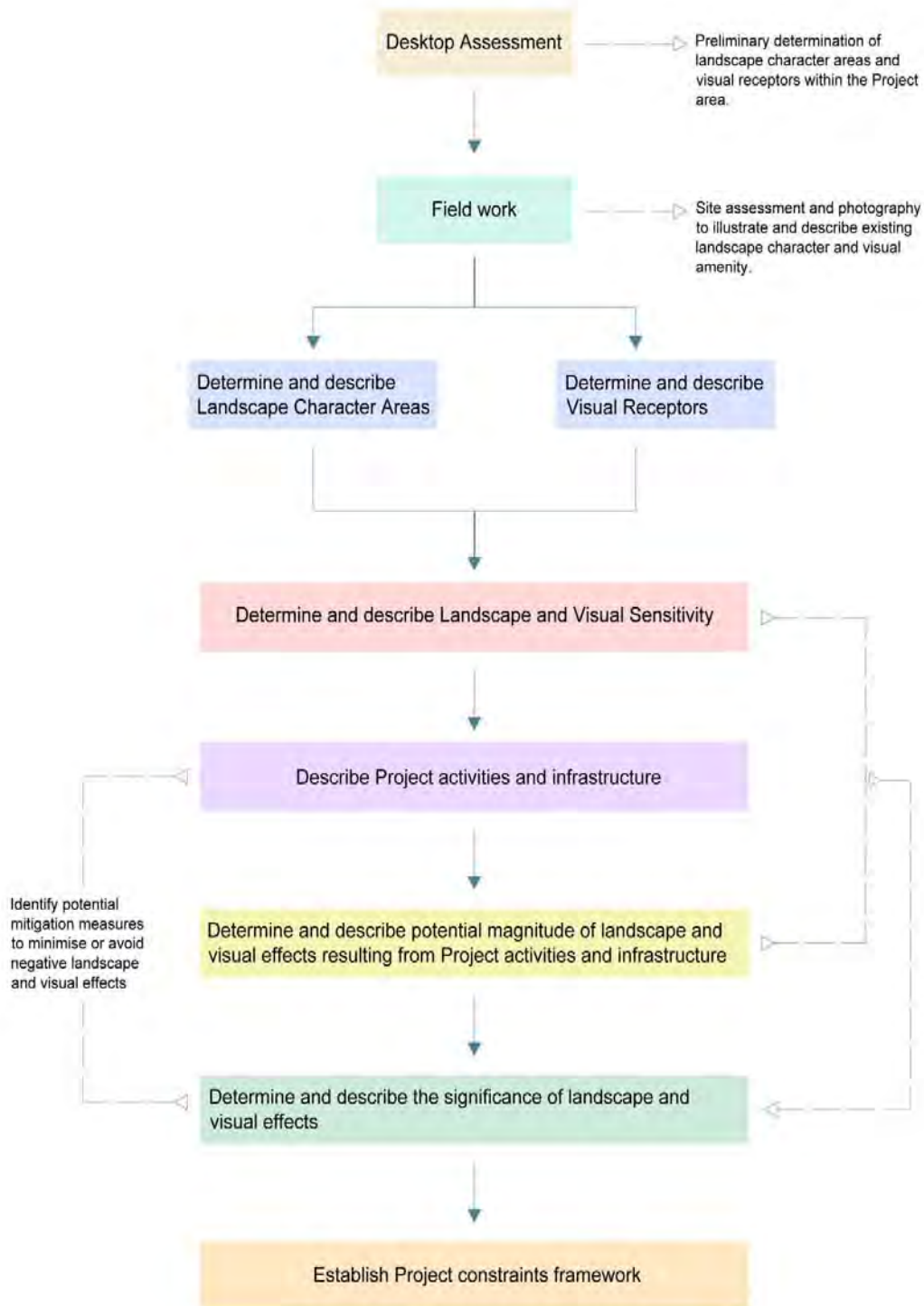
Whilst some of these techniques may be applied without being able to locate key Project infrastructure, a consideration of distance is a significant factor as it relates to overall levels of visibility and visual impact. This LVIA has assumed that visible large scale Project infrastructure will not be located within 1 km of high sensitive visual receptors in the determination of potential visual receptor sensitivity and magnitude of impacts.

In lieu of a standard LVIA, a significance based assessment has been adopted for the 'Framework Approach' impact assessment methodology used for this EIS (see Impact Assessment Method chapter (Section 6) of this EIS). The significance assessment under the framework approach methodology is based on the premise that detailed knowledge of landscape and visual characteristics and key Project processes inform decisions about whether the planned Project activities are likely to have an adverse impact on the values if the activities are conducted in prescribed ways.

The LVIA methodology adopted for this Project is presented in the following flow chart.

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LVIA Methodology flow chart



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20.2.3 Key LVIA Tasks

Key LVIA tasks included:

- Conducting a desktop study;
- Undertaking fieldwork;
- Determining the landscape character areas and their sensitivity;
- Identifying the potential visual receptors and visual sensitivity;
- Determining the overall magnitude of landscape and visual effects;
- Determining the landscape and visual effects significance; and
- Establishing a Project development constraints framework for potential landscape and visual impacts.

The key LVIA tasks are outlined below.

20.2.3.1 Desktop Study

A desktop study was carried out to identify potential landscape character areas within the Project area. This was carried out by referring to topographic maps and aerial photographs of the Project area and the surrounding landscape. Topographic maps and aerial photographs were also used to identify the locations and categories of potential visual receptors to be verified during the fieldwork component of the LVIA. The desktop study also outlined the visual character of the surrounding landscape including features such as landform, elevation, landcover and the distribution of residential dwellings and urban settlements.

20.2.3.2 Fieldwork

Site inspections were undertaken over a period of four days to record landscape characteristics within the Project area; and to determine and confirm various view categories and locations, from where the Project and associated structures could potentially be visible. The fieldwork also included preparing a photographic record from several locations within the Project area.

20.2.3.3 Determining the Landscape Character Areas and their Sensitivity

The potential effects of Project activities and associated infrastructure on the sensitivity of the landscape will primarily result from the capability of the landscape to integrate with, or to accommodate the Project. The capability of the landscape to accommodate the Project activities will result primarily from the nature and degree of perceptual factors that can influence how a person interprets and appreciates the landscape. Perceptual factors include issues of:

- Landform;
- Scale;
- Topographic features;
- Landcover; and
- Human influence or modifications.

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Landscape sensitivity assessment is based on evaluating the physical attributes identified within a number of landscape character areas (LCA), both singularly and combined. This provides a measure of the landscape's overall robustness and the extent to which the landscape could accommodate the Project activities and key constructed elements.

20.2.3.4 Identifying the Potential Visual Receptors and Visual Sensitivity

A number of visual receptor categories have been identified within the Project area, and have been classified and ranked by their potential sensitivity to the magnitude of visual change associated to various Project infrastructure elements. The visual receptor categories (ranked in order of sensitivity to visual change) include:

- Rural dwellings (homesteads);
- Public Recreational Space;
- Rural employment / farming;
- Urban development;
- Motorists;
- Business (commercial); and
- Industry / Mining areas.

20.2.3.5 Determining the Overall Magnitude of Landscape and Visual Effects

The magnitude of landscape and visual effects describes the potential nature and scale of change resulting from the proposed Project activities and the key elements associated with it. The potential magnitudes of landscape and visual effects have been assessed against individual and key Project components.

20.2.3.6 Determining the Landscape and Visual Effects Significance

The two principal criteria determining significance of landscape and visual effects are the potential magnitude of landscape or visual effect assessed against the sensitivity of the landscape area or visual receptor within the Project area. The significance of landscape and visual effects are presented in a matrix that also identifies potential landscape and visual constraints (see Section 20.12).

20.2.3.7 Establishing a Project Development Constraints Framework for Potential Landscape and Visual Impacts

Given the large number of proposed production well sites and associated infrastructure within the Project area, this visual assessment has not attempted to determine specific visual impacts associated with each regional development area; however, it does include an assessment of the key Project infrastructure in relation to potential temporary and longer term visual impacts.

This LVIA has identified landscape and visual constraints that reflect the capacity of existing environmental values to adjust to impacts arising from the key Project activities. Following a determination of visual and landscape significance, constraints have been assigned on the following basis:

- **'No Go'**: the Project activities could cause significant adverse landscape and visual impacts. Project activities will not be permitted to disturb existing environmental values.

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- **High Constraint:** key landscape and visual values will be at risk from key Project activities. Only certain types of Project activities might be permitted under stringent environmental controls.
- **Moderate Constraint:** key landscape and visual values will be at risk from key Project activities but the application of standard environmental procedures in conjunction with site-specific controls will ensure likely impacts will not exacerbate threatening processes.
- **Low Constraint:** no specific landscape or visual values have been identified and the application of standard operating procedures will ensure minimal impact as a result of the key Project activities.

20.3 Regional and Local Context

20.3.1 Location

The Project development covers an area of approximately 8,000 km² with the majority of the area extending from the town of Glenden in the north to Middlemount in the south. A smaller tenement area also extends north from Blackwater to the north of the Yarrabee mine development (Figure 20–1).

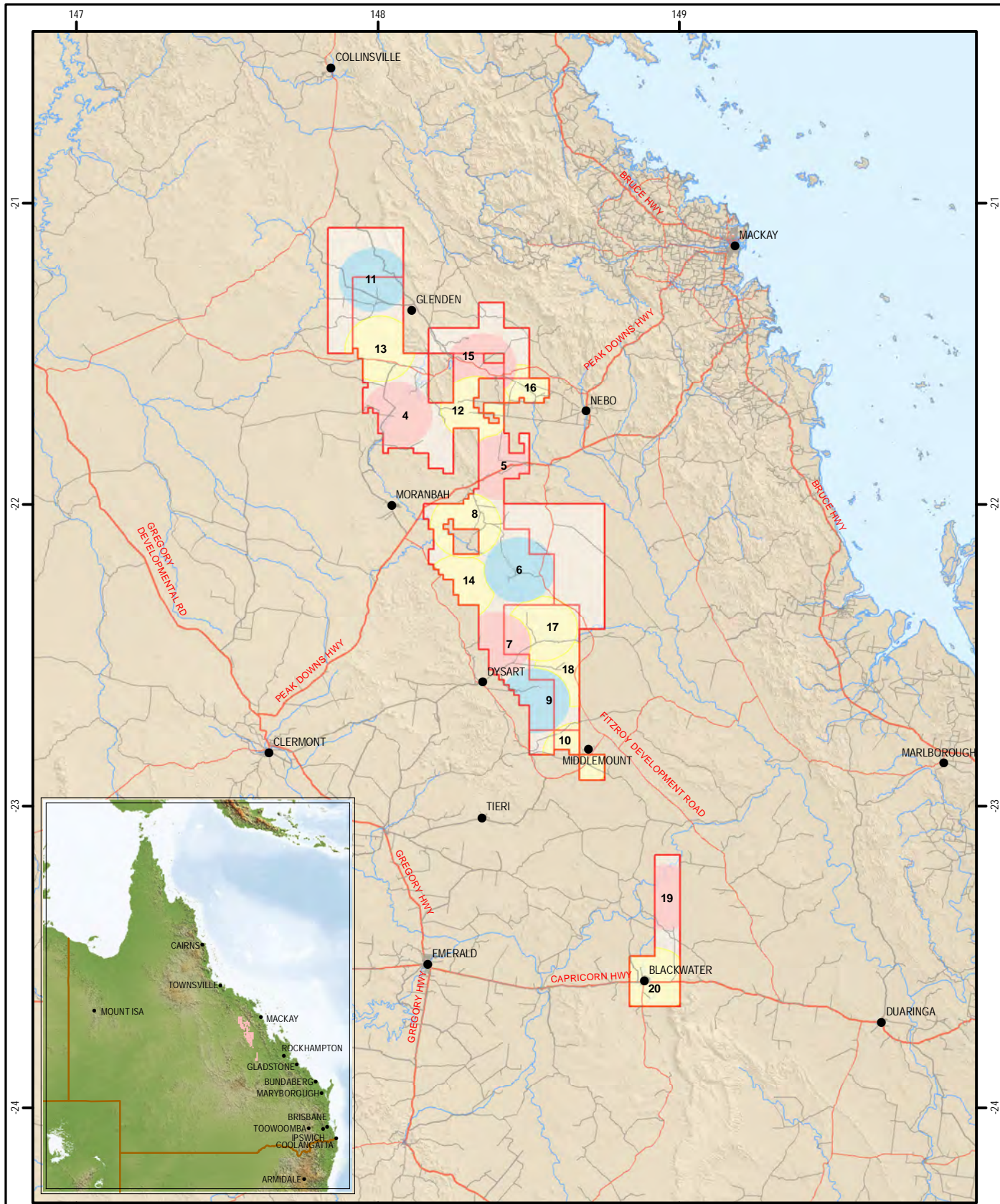
The Project area follows the Connors Range to the east and the Denham Range to the west and is located within the Isaac River and Mackenzie River sub-catchments of the Fitzroy River Catchment and the Belyando Suttor sub-catchment of the Burdekin Catchment. The Project area is illustrated in Figure 20–1. The landscape within the Project area is predominantly grazing and agricultural land, with coal mining, metals processing, oil and gas development and forestry.

The topography is gently sloping with low hills and peaks to the north of the Project area. The topography of the Project area is illustrated in Figure 20–2. The geology generally consists of fine grained sedimentary rocks, intersected by quaternary alluvium systems associated with creek and river flats, floodplains and alluvial plains.

The Project area falls within the Brigalow Belt Bioregion. This bioregion experiences a subtropical, subhumid climatic zone, with a marked wet summer and moderately dry winter. Mean annual rainfall over most of the area ranges from 500 - 700 mm, with nearly half of the annual rainfall occurring in the summer months of December through to February. Rainfall decreases from north to south and with inland distance from the coast. Cold to moderate annual mean temperatures are prevalent.

A large proportion of the Project area is visually characterised by a mosaic of remnant intact grasslands as well as cleared and degraded grazing lands with patches of regrowth vegetation (mostly Brigalow (*Acacia harpophylla*) and eucalypt regrowth). Areas of remnant woodland vegetation also occur within the Project area including forest dominated by eucalypts, Brigalow and paperbarks, as well as riparian vegetation associated with the Isaac River riparian corridor and associated grasslands. Further details on the composition and distribution of vegetation types within the Project area are included in the Terrestrial Ecology chapter (Section 17) of this EIS.

A small number of towns have been built adjacent to the Project area. These include the towns of Moranbah, Glenden, Dysart, Middlemount and Blackwater. The towns do not occur within the Project area.



0 10 20 40 60 km
 1:2,000,000
 Projection: Geographic (GDA94)

Bowen Gas Project Tenements	Field Compression Facility Development Area
Development Area ID	Central Gas Processing Facility Development Area
	Integrated Processing Facility Development Area

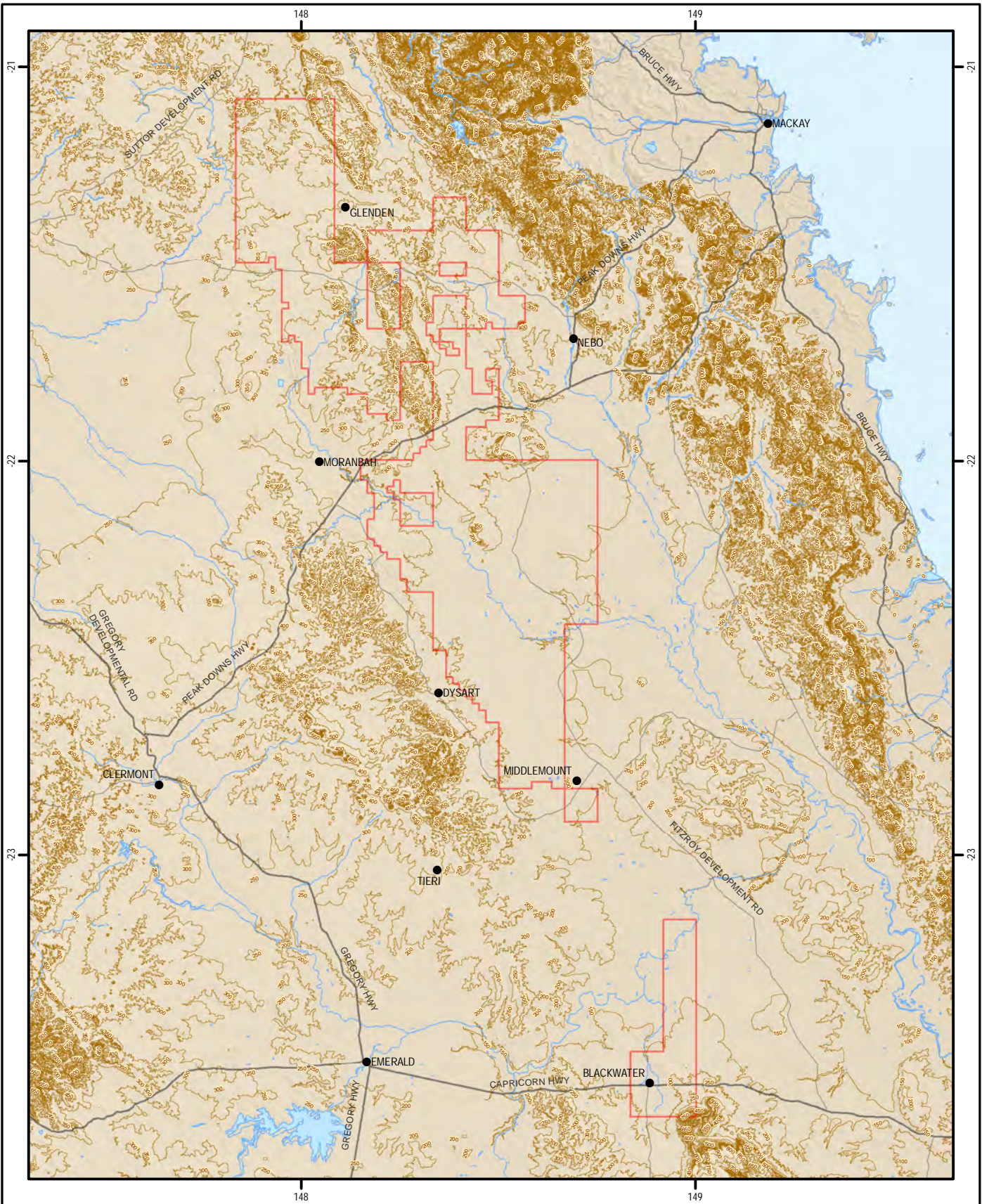
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LOCATION PLAN



0 10 20 40 km
 1:1,500,000
 Projection: Geographic (GDA94)

Bowen Gas Project Tenements

Contour (50m Interval)

Watercourse

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TOPOGRAPHY

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20.3.2 The Post European Settlement Landscape

The landscape surrounding the Project area was first explored in the mid-19th century and identified by early explorers as favourable areas to establish pastoral lands, with grazing accounting for the principal rural land use within the local area surrounding the Project.

The pre European landscape within and surrounding the Project area included tracts of natural grassland with scattered tree and shrub cover, as well as 'treeless' downs; however, the extent of natural grassland has been significantly impacted and reduced in the area post European settlement with areas of fertile soil cultivated for cropping, with other areas of grassland intensively grazed for beef production.

The post European settlement landscape has also experienced significant land clearing from around the 1950s onwards, which has altered the mosaic of native vegetation communities and significantly reduced the broader extent of brigalow acacia forests and open grassy eucalypt woodland that would have been widespread in the pre European settlement landscape.

The extensive utilisation of land for pastoral grazing and agricultural cropping has resulted in a number of direct and indirect changes to the character of the landscape, including:

- Reduction of natural vegetation density and diversity (clearance of native vegetation and ongoing improvement of less productive pasture);
- Introduction of exotic noxious weed species; and
- Erosion (sheet, gully and stream bank).

Plate 20-1 Agricultural and Mining Landuse Images (Source GBD, 2012)



In addition to significant landscape change that has occurred through the adoption of European agricultural practices, exploration in the mid-19th century also identified coal deposits within the Bowen Basin, including those within and surrounding the Project area. Changes to the landscape have also resulted from a number of existing and historic mining projects, including open cut, underground and CSG projects within, and beyond, the Project area. As well as large scale industrial infrastructure associated with existing coal mine projects, the landscape has also accommodated an expansion of early settlements and the establishment of purpose built urban development to house mine workers including associated networks of road and utility corridors.

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Existing and operational open cut coal mines within and surrounding the Project area includes the following:

- Burton mine (Peabody Energy);
- Coppabella mine (Macarthur Coal);
- Eastern Creek mine (X-Strata);
- German Creek mine (Anglo Coal);
- Glenden mine (X-Strata);
- Goonyella Riverside mine (BHP Billiton / Mitsubishi Corporation);
- Hail Creek mine (Rio Tinto);
- Jellinbah East mine (Terramin);
- Millennium mine (Peabody Energy);
- Newlands mine (X-Strata);
- Norwich Park mine (BHP Billiton / Mitsubishi Corporation);
- Peak Downs mine (BHP Billiton / Mitsubishi Corporation);
- Saraji mine (BHP Billiton / Mitsubishi Corporation);
- South Walker Creek mine (BHP Billiton / Mitsubishi Corporation);
- Suttor Creek mine (X-Strata); and
- Yarrabee mine (Yancoal).

20.3.3 Population Centres

Urban population centres adjacent to the Project area include:

- Dysart, established 1973, population 3,003 (ABS Census, 2011);
- Glenden, established 1982, population 1,308 (ABS Census, 2011);
- Moranbah, established 1971, population 8,965 (ABS Census, 2011);
- Middlemount, established early 1980's, population 1,914 (ABS Census, 2011); and
- Nebo, region settled in early 1860's, population 841 (ABS Census, 2011).

All population data sourced from: ABS, 2011 (Community Profiles).

The majority of towns surrounding the Project area, have been established, and continue to expand, in support of the local coal mining industry. Most towns include a mix of permanent and temporary accommodation structures as well as a range of local amenities and facilities. These are illustrated in the Plates 20–2 to 20–5 below.

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Plate 20-2 Dysart Aerial View, 2010



Plate 20-3 Blackwater Aerial View, 2006



Plate 20-4 Glenden Aerial View, 2010



Plate 20-5 Middlemount Aerial View, 2010



Source: Google Earth Pro 2012

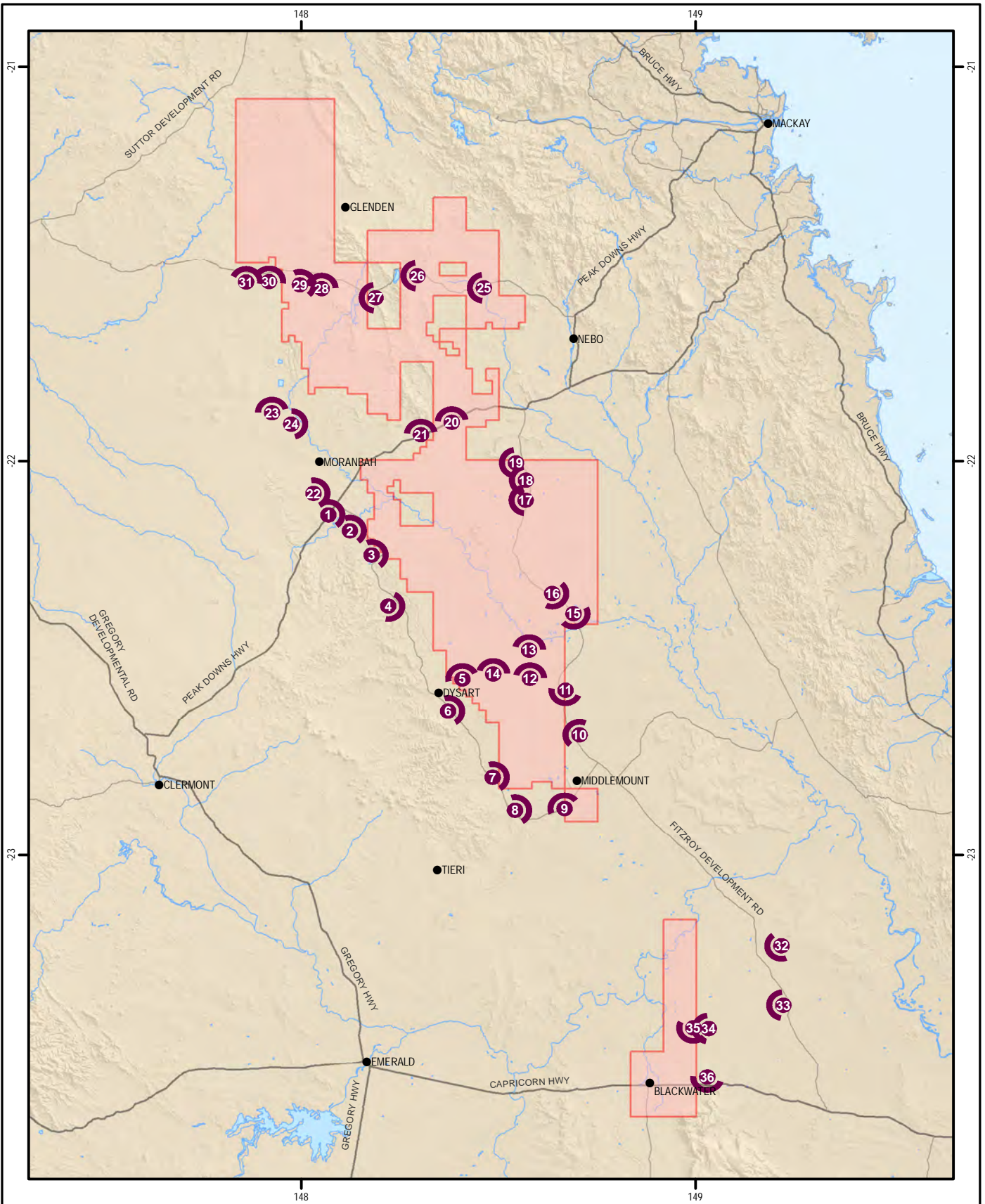
20.4 Panorama Photographs

A series of digital photographs were taken during the course of the fieldwork to illustrate a range of views across the landscape within the Project area.

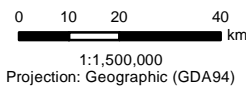
The photographs were taken with a digital Nikon D700 SLR camera with a 50 mm prime lens. Individual photographs were digitally stitched together to form a segmented panoramic image to provide a visual illustration of the existing view from each photo location.

Coordinate locations for each panorama photograph were recorded with a hand held GPS unit to an accuracy of around plus or minus four meters. Additional information including the bearing or direction of each photograph, time of day and prevailing weather conditions was also recorded.

The panoramic photographs presented in this LVIA have been annotated to identify key features or structures located within the existing view. The panorama photograph locations are illustrated in Figure 20-3, and the panoramic photographs illustrated in Figure 20-4 to Figure 20-12.



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■ Bowen Gas Project Tenements

● Photo Location

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PHOTO LOCATIONS

Photo Location P1
 Dysart Road
 View north to south east
 E:614510 N:7553126



— Distant views toward forested ridgelines

Cleared pastoral land with scattered tree re-growth. Denser stands of vegetation along creek line mid distance views.

Photo Location P2
 Dysart Road
 View north to east
 E:618494 N:7549962



— Pastoral land

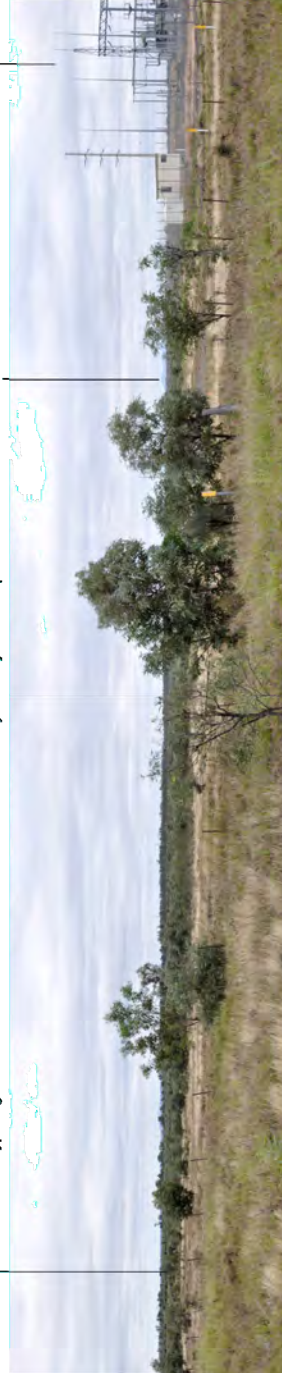
— Gently undulating landform and dense tree cover truncate vistas and views both within and beyond Project development area

— Creek crossing

— Dysart Road

— Dense tree cover following creek line

Photo Location P3
 Dysart Road
 View east
 E:624073 N:7541345



— Local substation

— Glimpsed views toward distant forested hills

— Gently undulating landform and dense tree cover truncate vistas and views both within and beyond Project development area

— Pastoral land with acacia/eucalypt re-growth

Photo Location P4
 Dysart Road
 View south east to south
 E:628314 N:7526518



— Dense vegetation screening views toward open cut mines and Project development area

— Railway line

— Vistas along road corridors provide the majority of views beyond the Project area

— Dysart Road

Source: Greenbean Design

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Photo Location P5
Golden Mile Road (east Dysart)
View north
 E:642681 N:7505346

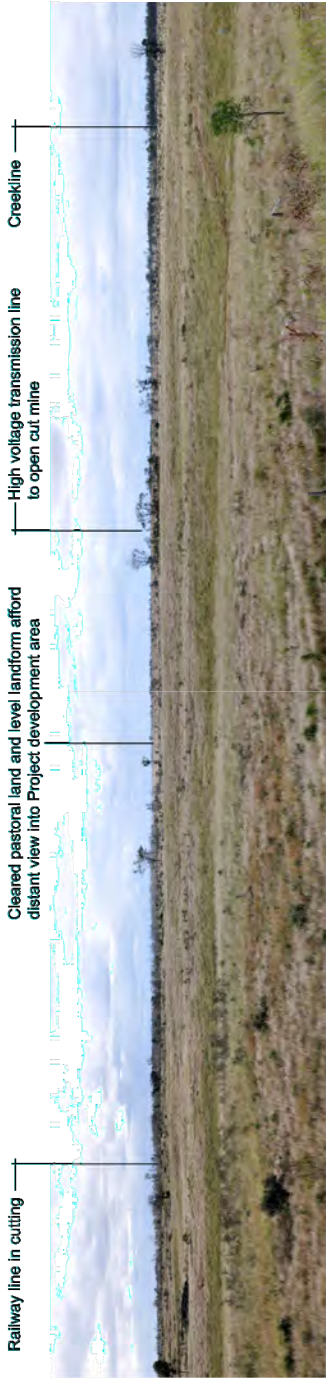


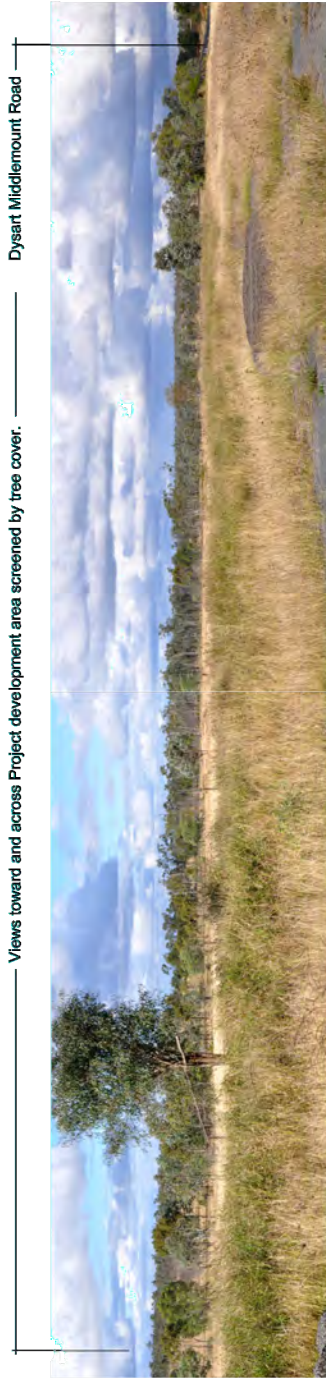
Photo Location P6
Dysart Road
View north to south east
 E:639901 N:7499037



Photo Location P7
Dysart Road
View east
 E:6544284 N:7474600



Photo Location P8
Dysart Road
View south east to south
 E:656931 N:7468092



Source: Greenbean Design

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PHOTO SHEET 2

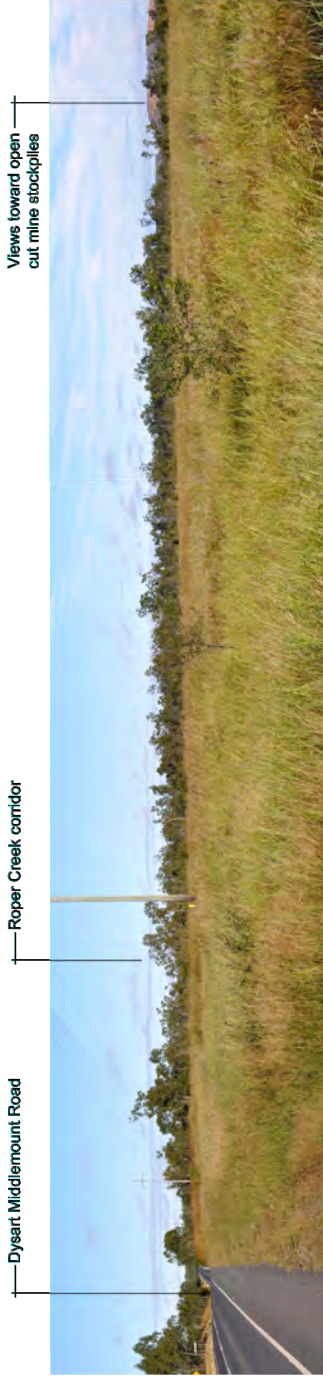


Photo Location P9
Dyeart Middlemount Road
View west to north west
E:671862 N:7469450



Photo Location P10
Fitzroy Developmental Road
View north to north west
E:673528 N:7489052

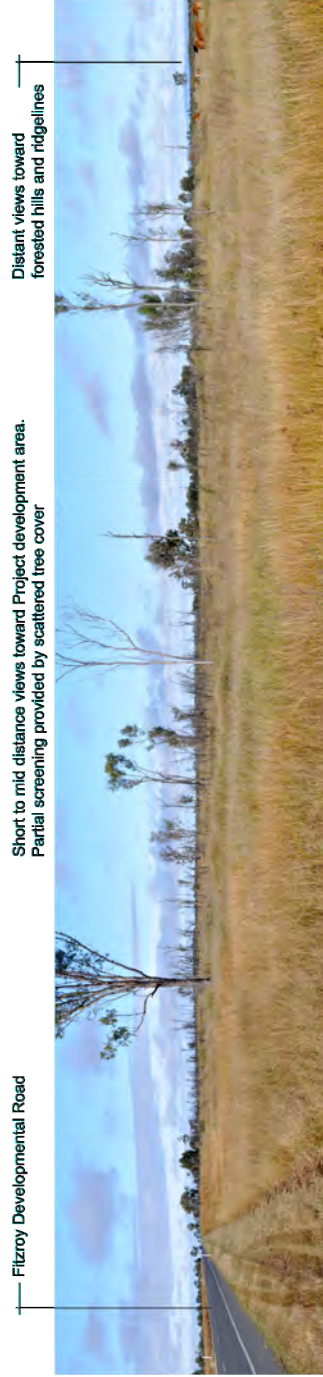


Photo Location P11
Fitzroy Developmental Road
View south to west
E:670014 N:7502668

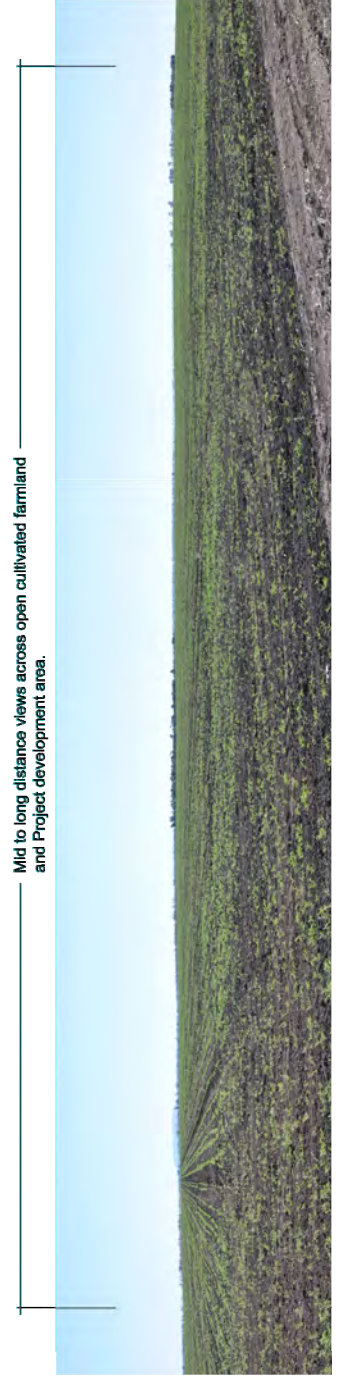


Photo Location P12
Golden Mile Road
View north west to north east
E:663326 N:7505872

Source: Greenbean Design

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Photo Location P13
 Dysart Connection Road
 View north to north east
 E:650563 N:7510775



Photo Location P14
 Golden Mile Road
 View north
 E:648100 N:7508261

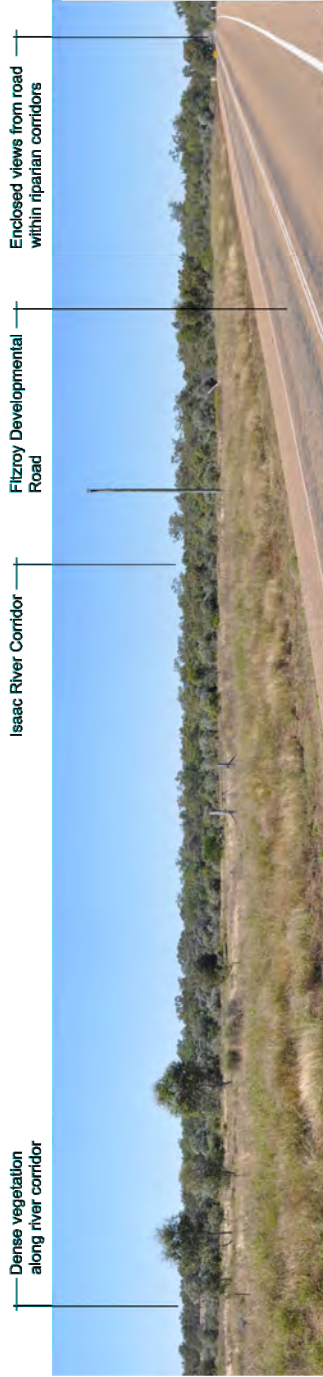


Photo Location P15
 Fitzroy Developmental Road
 View south to south east
 E:674319 N:7520462

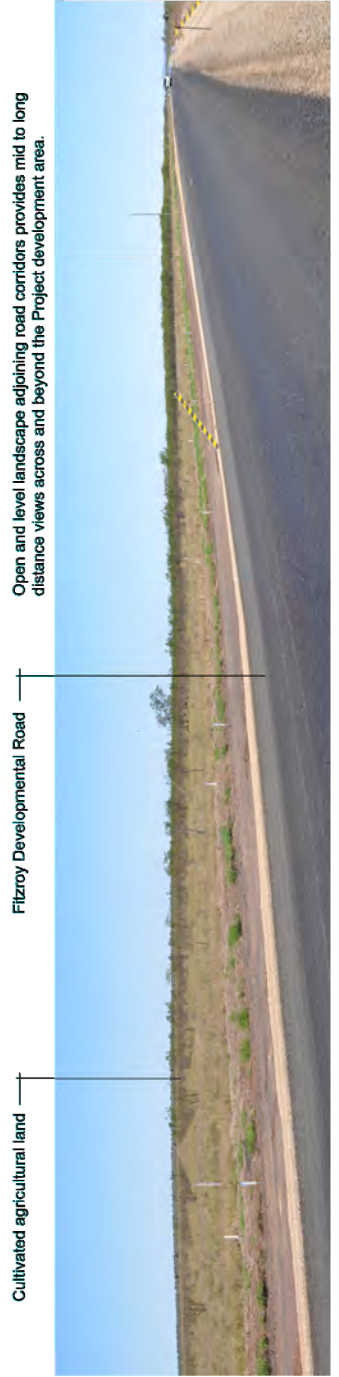


Photo Location P16
 Fitzroy Developmental Road
 View south to south east
 E:673705 N:7521971

Source: Greenbean Design

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Short distance views toward Project development area across open and cleared pastoral land

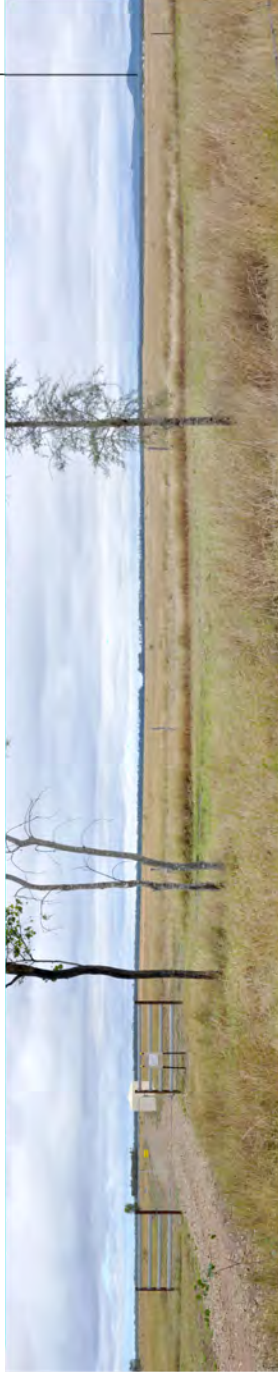


Photo Location P17
Fitzroy Developmental Road
View west to north west
E:662629 N:7555988

Distant views toward timbered hills and ridgelines partially screened by scattered tree cover across pastoral land



Photo Location P18
Fitzroy Developmental Road
View south to south west
E:662717 N:7556499

Distant views toward forested hills and peaks



Photo Location P19
Fitzroy Developmental Road
View south to south east
E:660879 N:7565000

Railway line in cutting

Peak Downs Highway

Distant vista toward forested hills

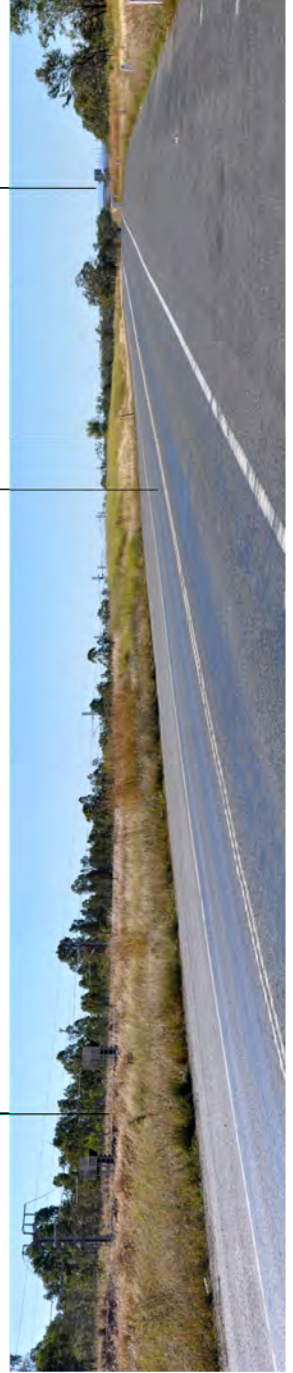


Photo Location P20
Peak Downs Highway
View north to north east
E:673705 N:7521971

Source: Greenbean Design

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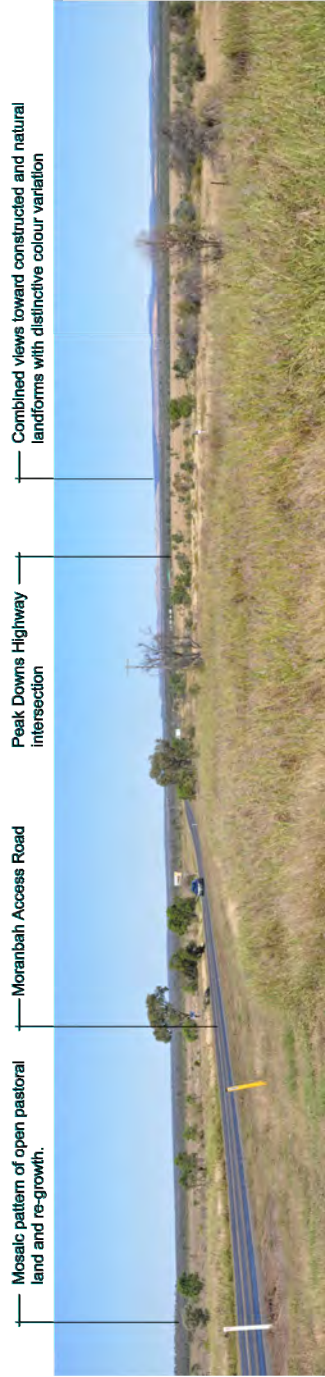


Simple ridgeline landform with forested landcover

Railway line in cutting

Peak Downs Highway

Photo Location P21
Peak Downs Highway
View west to north west
E:634836 N:7573390



Mosaic pattern of open pastoral land and re-growth.

Moranbah Access Road

Peak Downs Highway intersection

Combined views toward constructed and natural landforms with distinctive colour variation

Photo Location P22
Moranbah Access Road
View south to south east
E:612307 N:7557381

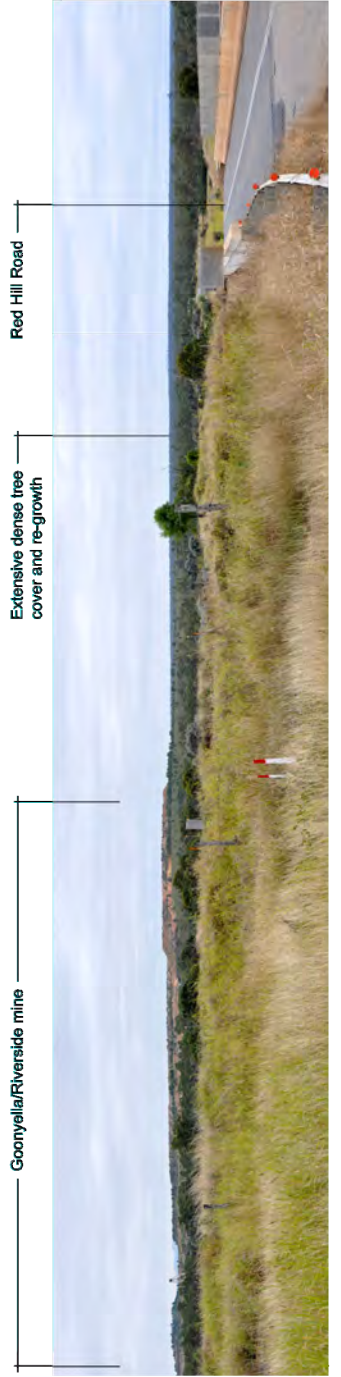


Mosaic pattern of open pastoral land and re-growth.

Goonyella/Riverside mine

Goonyella Road

Photo Location P23
Goonyella Road
View north to north west
E:597610 N:7584490



Goonyella/Riverside mine

Extensive dense tree cover and re-growth

Red Hill Road

Photo Location P24
Red Hill Road
View north to east
E:598930 N:7583319

Source: Greenbean Design

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Photo Location P25
Suttor Developmental Road
 View west to north west
 E:653144 N:7616283



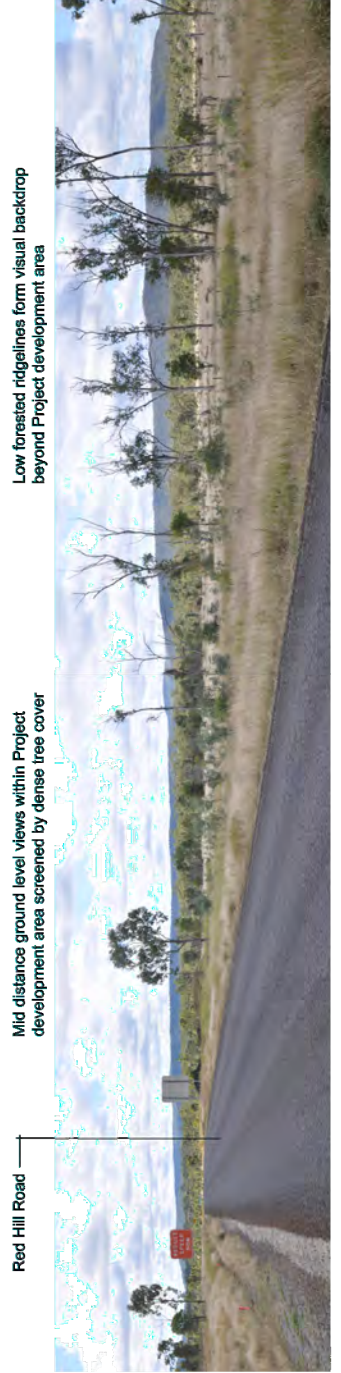
Photo Location P26
Suttor Developmental Road
 View west
 E:630364 N:7620295



Photo Location P27
Ellensfield Road
 View west to north west
 E:621744 N:7612107



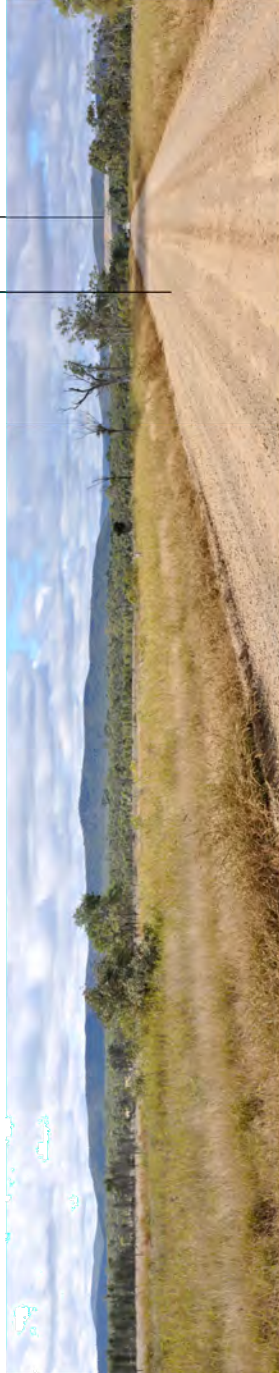
Photo Location P28
Red Hill Road
 View north to east
 E:617211 N:7615321



Source: Greenbean Design

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Photo Location P29
Sutor Developmental Road
View north east to east
E:616913 N:7615922



Open cut stockpiles

Sutor Developmental Road

Mid distance views toward forested slopes and ridgelines

Photo Location P30
Sutor Developmental Road
View west
E:613368 N:7617545



Pasture with scattered tree cover

Distant views toward forested slopes and ridgelines

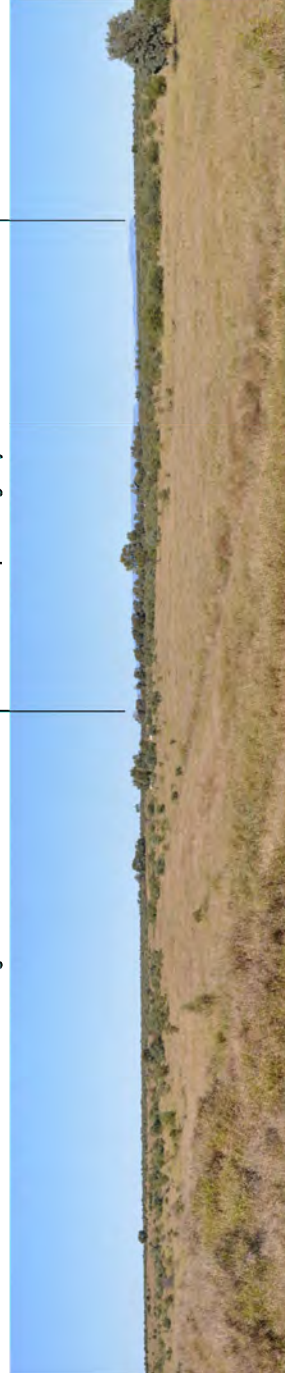
Photo Location P31
Sutor Developmental Road
View west to north west
E:610486 N:7618376



Sutor Developmental Road

Mid distance views toward forested hills and ridgelines through scattered tree cover

Photo Location P32
Fitzroy Developmental Road
View west to south west
E:725119 N:7419493



Open and distant views across cleared pastoral land with scattered tree and shrub re-growth

Distant views toward timbered slopes and ridgelines south of Capricorn Highway

Source: Greenbean Design

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Photo Location P33
Locarno Road
View west to south west
E:721364 N:7405097

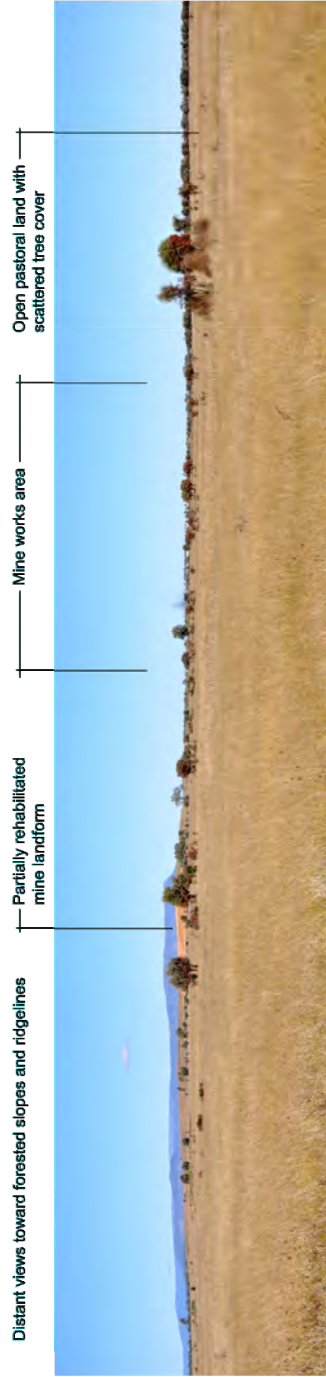


Photo Location P34
Bluff Jellinbah Road
View west
E:703587 N:7405440



Photo Location P35
Bluff Jellinbah Road
View west to north west
E:701202 N:7405984

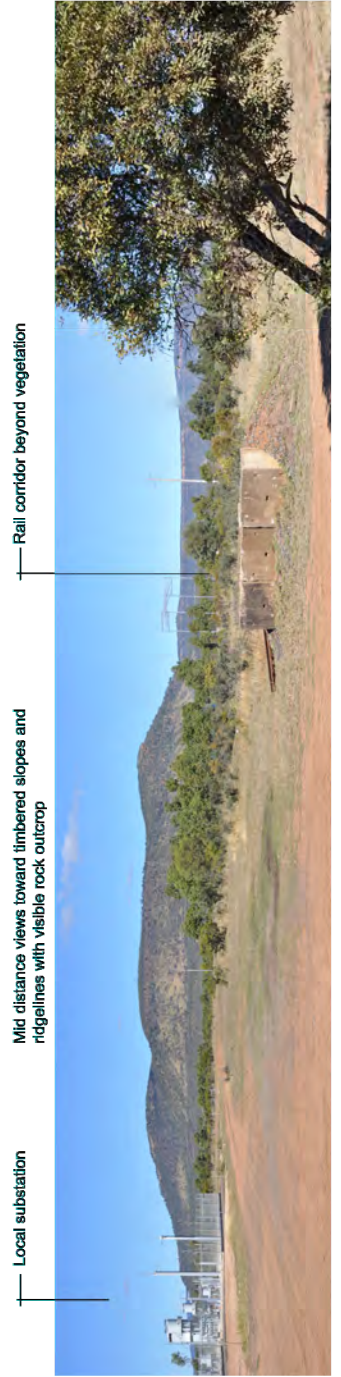


Photo Location P36
Capricorn Highway
View south
E:701202 N:7405985

Source: Greenbean Design

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Section 20 Landscape and Visual Amenity

20.5 Landscape Character Areas and Sensitivity

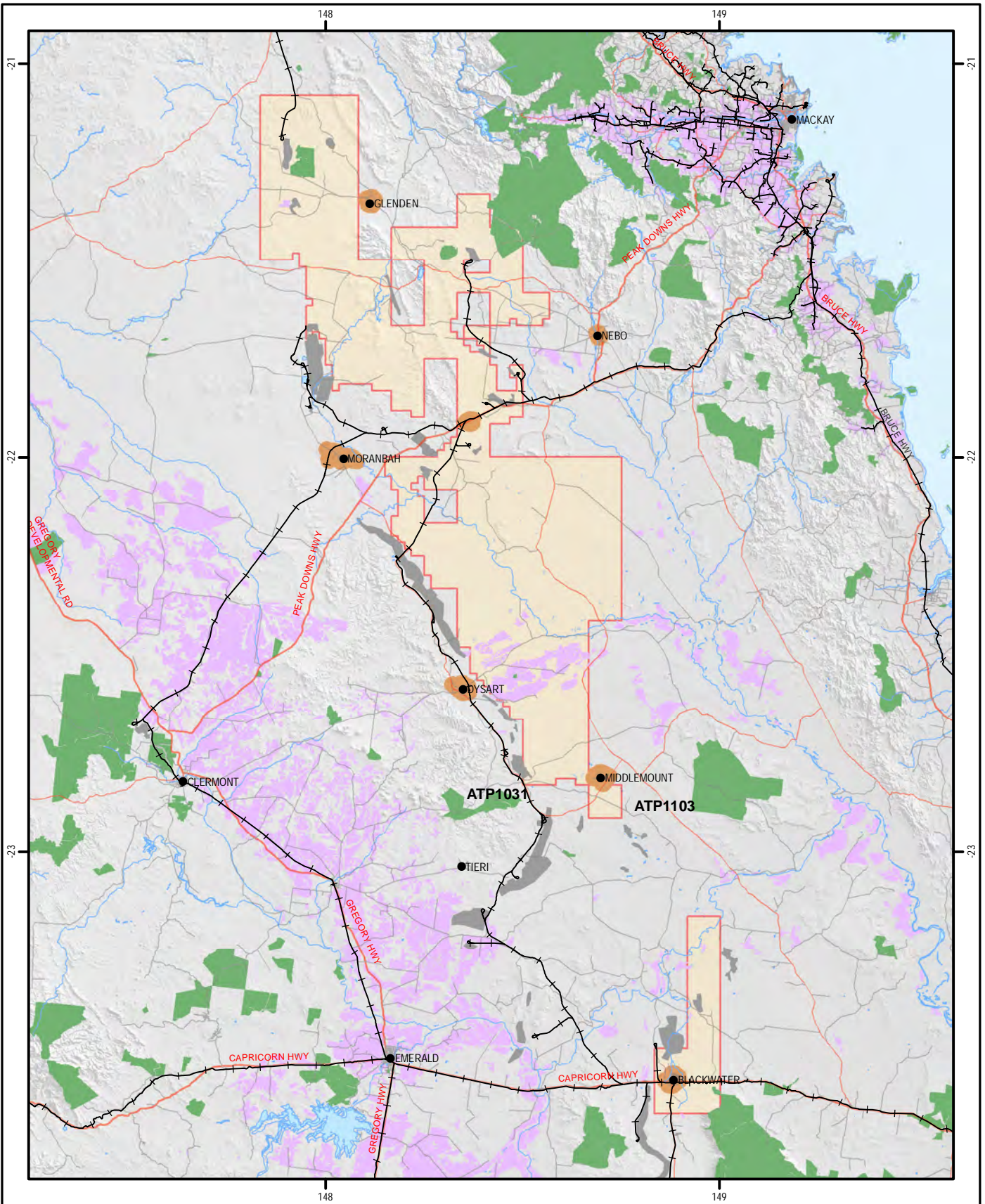
20.5.1 Landscape Character Areas

This LVIA has identified six typical LCA that occur within the Project area. The six LCA represent landscape areas that are relatively consistent and recognisable in terms of their key elements and physical attributes; that may include a combination of topography / landform, vegetation / landcover, land use and built structures (including settlements and road corridors).

The LCA are not defined or considered to be discrete areas, and characteristics within one LCA may well occur within adjoining or surrounding LCA. The LCA have not been assessed, described or illustrated as singular 'landscape units'. For the purpose of this LVIA the LCA have been identified as:

- LCA 1 – Mining tenements;
- LCA 2 – Urban areas;
- LCA 3 – Road and rail corridors;
- LCA 4 – Agricultural areas (pastoral grazing and cropping);
- LCA 5 – Drainage; and
- LCA 6 – Forested areas (hills and plains).

The general location and extent of the LCA within the Project area are illustrated in Figure 20–13, and typical photographic images for each LCA area are illustrated in Figure 20–14 to Figure 20–19.



0 10 20 40 km
 1:1,500,000
 Projection: Geographic (GDA94)

- Bowen Gas Project Tenements
- Existing Mining Areas
- Urban Areas
- National Park, Slate Forest, Forestry Reserve
- Cultivated Agricultural Areas
- Grazing Areas (within tenements only)
- Major Road
- Other Road
- Watercourse
- Railway

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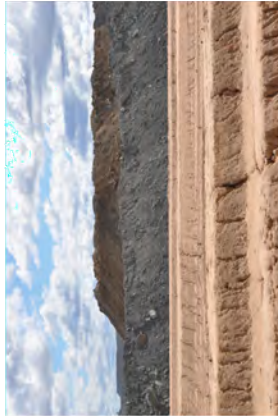
BOWEN GAS PROJECT EIS

LANDSCAPE CHARACTER AREAS

Landscape Character Area 1

Mining tenements

Typical images associated with mining tenements and associated large scale infrastructure.



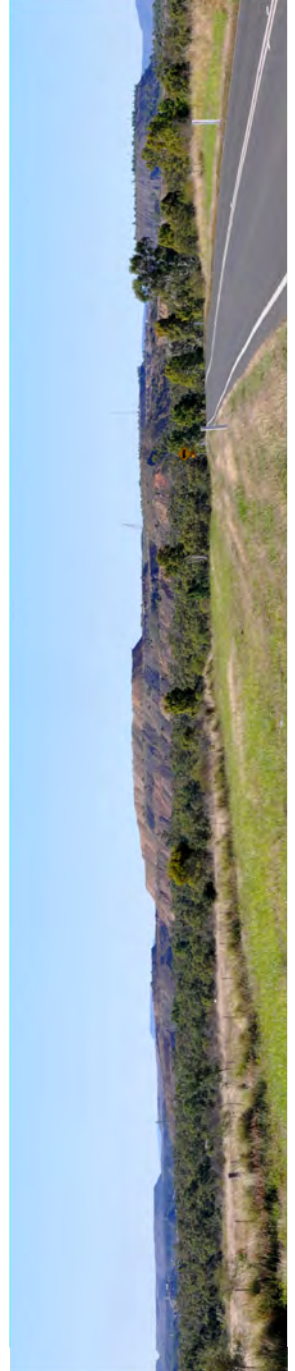
Topsoil and overburden stockpiles occur throughout this landscape character area often forming visual barriers to open cut mine operations beyond.



Mine tenements incorporate a range of infrastructure elements including roads and bridges, substations and railway line connections to distant port facilities.



Large open cut mines (such as the Goonyella Riverside mine) dominate views within local landscape viewsheds, but are also visible, and contrast with, natural landforms in mid to long distance views.



Source: Greenbean Design

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LANDSCAPE CHARACTER AREA 1



LANDSCAPE AND VISUAL ASSESSMENT

Figure: 20-14



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Landscape Character Area 2

Urban areas and surrounds

Typical images within urban and surrounding areas



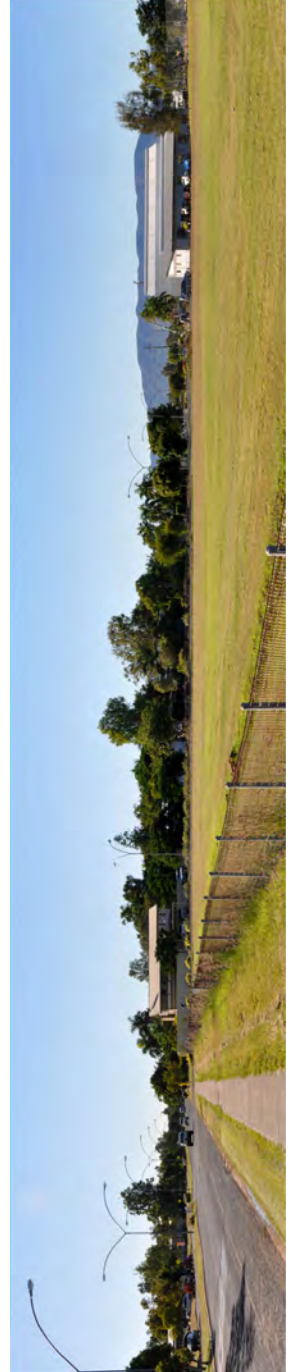
Urban areas that surround the Project development area were largely constructed by mining companies from the 1970's onwards. Urban areas continue to expand to support existing and proposed open cut mine operations



Urban areas contain a range of facilities, including schools, shops, motels and sporting areas. Urban areas are also supported by local airports as well as a network of local roads connecting to regional highways.



Urban areas are dynamic and undergoing change to accommodate an increase in population for future planned coal mine and gas projects. These changes incorporate a range of temporary residential structures which contrast with elements of longer term structures.



Source: Greenbean Design

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LANDSCAPE CHARACTER AREA 2



LANDSCAPE AND VISUAL ASSESSMENT

Figure: 20-15



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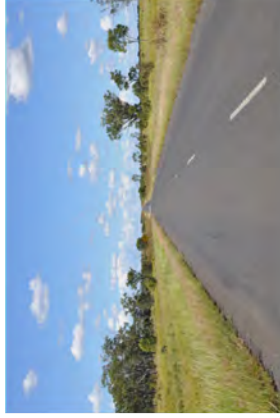
Date: 18-10-2012

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Landscape Character Area 3 Road and rail corridors

Typical images along road and rail corridors within the Project development area



Road corridors follow a hierarchy from highway to regional and local connecting roads. Sealed, unsealed and gravel roads traverse the Project development area and provide an opportunity for short, mid and distant views across adjoining landscape. Freight rail corridors carry coal from mine sites to coal terminal facilities often following road corridors.

Other constructed elements that occur within the vicinity of road corridors include a range of electrical infrastructure, local substations and high voltage transmission lines.

Source: Greenbean Design

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LANDSCAPE CHARACTER
AREA 3



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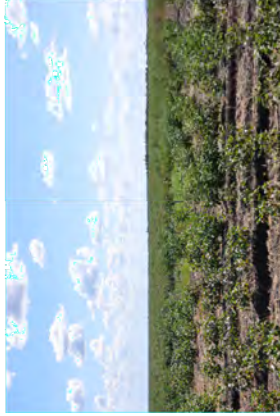
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Landscape Character Area 4

Agriculture

Typical images across cultivated and pastoral agricultural land within the Project development area



Agricultural areas within the Project development area are largely defined by cultivated crop and beef production. The more significant proportion of land is occupied by pastoral grassland which extends from the north to south extents of the Project development area. Areas of cultivation are more commonly associated with fertile soils extending from river corridors across associated flood plain.

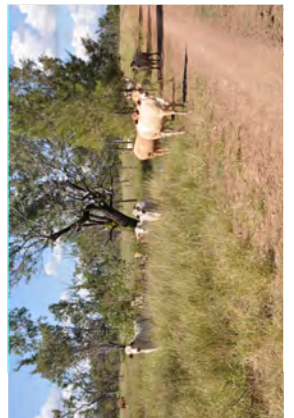


Areas of cultivated farmland have been extensively cleared of tree cover and in some instances offer mid to long distance vistas across and beyond the Project development area.



Pastoral landscapes exhibit a restricted range of a visual characteristics which are largely consistent in pattern throughout the Project development area and determined by a simple landcover and landform combination.

Constructed elements within agricultural areas tend to be small to moderate scale and typically concentrated around farm homesteads. There is a low level of activity within these areas which increases in periods of crop preparation and harvesting.



Source: Greenbean Design

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LANDSCAPE CHARACTER AREA 4



LANDSCAPE AND VISUAL ASSESSMENT

Figure: 20-17



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Date: 18-10-2012

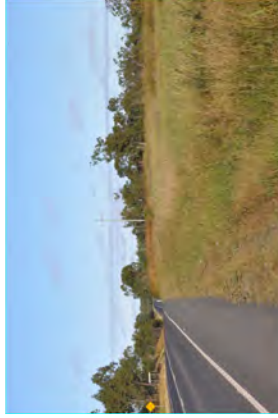
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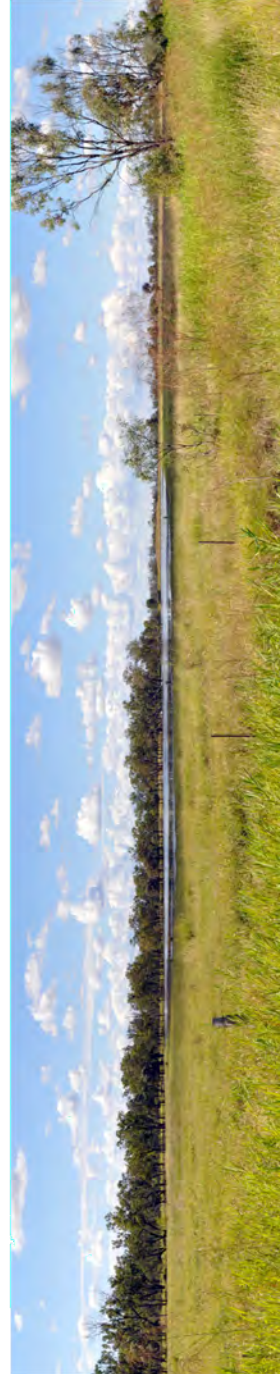
Landscape Character Area 5

Drainage

Typical images toward constructed and natural drainage systems within the Project development area

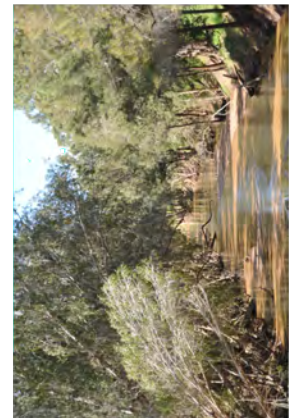
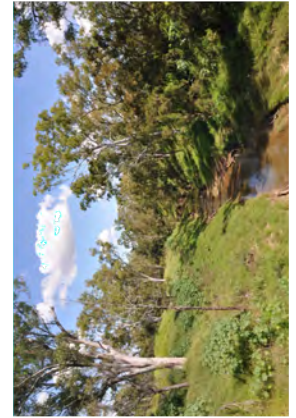


Elements of major constructed drainage systems are found within urban areas and large scale industrial development such as mine sites.



Many smaller creek lines are ephemeral but prone to rapid flooding along with wider riparian areas within the Project development area following periods of heavy and prolonged rainfall.

More significant riparian corridors, such as the Isaac River, contain dense stands of tree and shrub vegetation which truncate mid to long distance views across the Project development area and broader landscape region.



Source: Greenbean Design

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LANDSCAPE CHARACTER AREA 5



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Landscape Character Area 6

Forested areas (hills and plains)

Typical images toward forested areas and tree cover within the Project development area



More extensive portions of forests within the Project development area are visible across low undulating hills and peaks within, and beyond, the northern portion of the Project development area (around Glenden). Forest cover is also visible across steep sided hills beyond the south portion of the Project development area (beyond Blackwater).

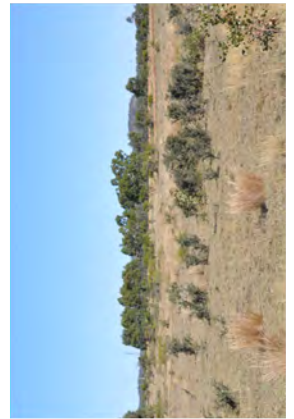
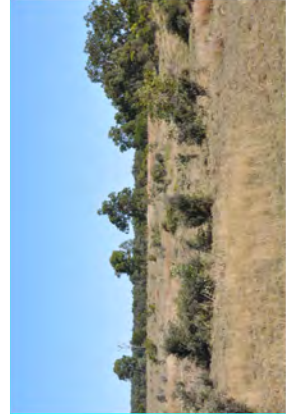


Discrete areas of dense tree cover occur throughout the Project development area and generally associated with landform and landscape features that present difficulties and obstacles for land clearing.



Forests on low undulating hills provide a visible dark toned backdrop to mid and long distance views from locations within the Project development area and contrast with broader areas of light pastoral land cover.

Tree cover across broader pasture is fragmented and limited by grazing; however, areas of re growth are evident where cattle have been removed.



Source: Greenbean Design

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LANDSCAPE CHARACTER AREA 6



LANDSCAPE AND VISUAL ASSESSMENT

Figure: 20-19



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Section 20 Landscape and Visual Amenity

20.5.2 Landscape Sensitivity

The British Landscape Institute describes landscape sensitivity as ‘the degree to which a particular LCA can accommodate change arising from a particular development, without detrimental effects on its character’.

The assessment of landscape sensitivity is based on evaluating the physical attributes identified within each LCA, both singularly and as a combination that gives rise to the landscape’s overall robustness and the extent to which it could accommodate the Project. The criteria used to determine landscape sensitivity are outlined in Table 20–1 and based on current good practice employed in the assessment of large scale industrial developments. Landscape sensitivity is a relative term, and the intrinsic landscape values of the surrounding landscape may be considered of a higher or lower sensitivity than other areas in the Bowen Basin region.

Whilst the assessment of landscape sensitivity is largely based on a systematic description and analysis of landscape characteristics, this LVIA acknowledges that individuals and other members of the local community within the Project area will place higher values on the local landscape. These values may transcend preferences (likes and dislikes) and include personal, cultural as well as other parameters.

Table 20-1 Criteria for the Assessment of Landscape Sensitivity

Characteristic	Aspects indicating lower sensitivity to the Project development	Aspects indicating higher sensitivity to the Project development
Landform and scale: patterns, complexity and consistency	<ul style="list-style-type: none"> • Large scale landform • Simple • Featureless • Absence of strong topographical variety 	<ul style="list-style-type: none"> • Small scale landform • Distinctive and complex • Human scale indicators • Presence of strong topographical variety
Landcover: patterns, complexity and consistency	<ul style="list-style-type: none"> • Simple • Predictable • Smooth, regular and uniform 	<ul style="list-style-type: none"> • Complex • Unpredictable • Rugged and irregular
Settlement and human influence	<ul style="list-style-type: none"> • Concentrated settlement pattern • Presence of contemporary structures (e.g. utility, infrastructure or industrial elements) 	<ul style="list-style-type: none"> • Dispersed settlement pattern • Absence of modern development, presence of small scale, historic or vernacular settlement
Rarity	<ul style="list-style-type: none"> • Common or widely distributed example of landscape character area within a regional context 	<ul style="list-style-type: none"> • Unique or limited example of landscape character area within a regional context
Intervisibility with adjacent landscapes	<ul style="list-style-type: none"> • Limited views into or out of landscape • Neighbouring landscapes of low sensitivity • Weak connections, self-contained area and views • Simple large scale backdrops 	<ul style="list-style-type: none"> • Prospects into and out from high ground or open landscape • Neighbouring landscapes of high sensitivity • Contributes to wider landscape • Complex or distinctive backdrops

Section 20 Landscape and Visual Amenity

The criteria set out in Table 20–1 have been used to evaluate each of the LCA's using sensitivity grades of higher, medium or lower. The sensitivity grades are illustrated in Tables 20–4 to 20–9 using shading against each of the criteria set out in Table 20–1.

The sensitivity of overall grades of higher, medium or lower landscape sensitivity were determined using the definitions in Table 20–2.

Table 20-2 Landscape Sensitivity Ratings

Rating	Description
High (Rating of 21 to 25)	Key characteristics of the LCA may be adversely impacted by the Project, and may result in major alterations to perceived characteristics of the landscape. The degree to which the landscape may accommodate the Project development will potentially result in a number of perceived uncharacteristic and significant changes.
Medium (Rating of 11 to 20)	Some characteristics of the LCA may be altered by the Project, although the landscape may have the capability to absorb some change. The degree to which the landscape may accommodate the Project will potentially result in the introduction of prominent elements but may be accommodated to some degree.
Low (Rating 10 or less)	The characteristics of the LCA are generally robust, and will be less affected by the Project. The degree to which the landscape may accommodate the Project will not significantly alter existing landscape character.

20.5.3 Visual Absorption Capability

Visual absorption capability (VAC) is a classification system used to describe the relative ability of the landscape to accept modifications and alterations without the loss of landscape character or deterioration of visual amenity.

VAC relates to physical characteristics of the landscape that are often inherent and often quite static in the long term; however, in mining landscapes the degree and extent of VAC is variable and susceptible to change.

Undulating areas with a combination of open views interrupted by groups of trees and small forested areas would have a high capacity to visually absorb key components of the Project without significantly changing visual amenity.

On the other hand, areas of cleared vegetation on level ground with limited screening, or areas spanning across prominent ridgelines without significant vegetation, would have a lower capacity to visually absorb specific Project elements without changing the visual character and potentially reducing visual amenity.

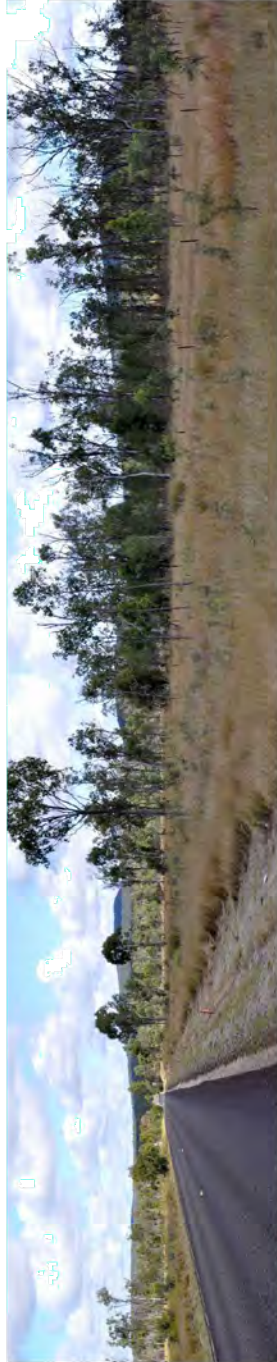
Given the extent and combination of existing natural and cultural character along the Project alignment, the capability of the landscape to absorb the key components of the Project is primarily dependent upon vegetation cover and landform. For the purpose of this LVIA, the VAC ratings have been determined using the definitions in Table 20–3.

Section 20 Landscape and Visual Amenity

Table 20-3 Visual Absorption Capability Ratings

Rating	Description
High	Project activities and infrastructure would be extensively screened by surrounding vegetation and undulating landform.
Medium	Project activities and infrastructure would be visible but existing vegetation and surrounding landform would provide some screening or background to reduce visual contrast.
Low	Project activities and infrastructure would be highly visible either due to lack of screening by existing vegetation or surrounding landform (e.g. open flat farmland cleared of vegetation, or steep hillside crossing ridgeline).

Photographic examples of the existing landscape VAC within the Project area are illustrated in Figure 20-20.



View west from Red Hill Road

Visual Absorption Capability

High

Visual Absorption Capability

Project activities and infrastructure would be extensively screened by surrounding vegetation and landform.



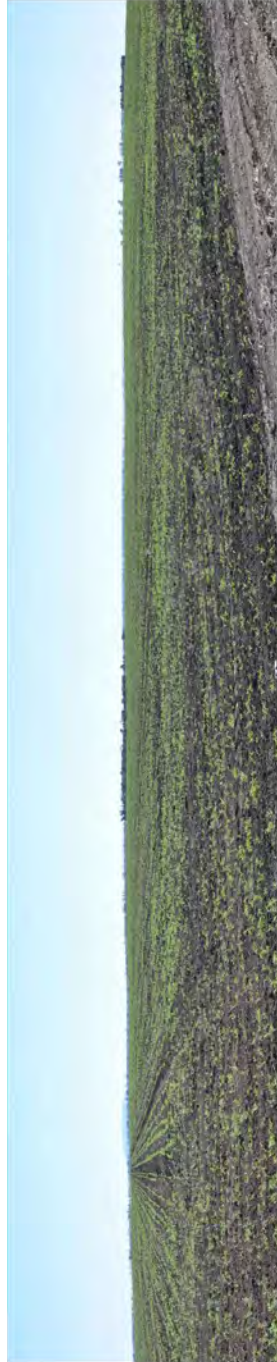
View south to south west from Bluff Jellinbah Road

Visual Absorption Capability

Moderate

Visual Absorption Capability

Project activities and infrastructure would be visible but existing vegetation and surrounding landform would provide some screening or background to reduce visual contrast.



View west from Golden Mile Road

Visual Absorption Capability

Low Visual Absorption Capability

Project activities and infrastructure would be highly visible either due to lack of screening by existing vegetation or surrounding landform.

Source: Greenbean Design

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VISUAL ABSORPTION CAPACITY



LANDSCAPE AND VISUAL ASSESSMENT

Figure: 20-20



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Section 20 Landscape and Visual Amenity

LCA 1 Mining Tenements

Plate 20-6 Typical View toward Existing Mining Tenement (Source GBD, 2012)



Table 20-4 LCA 1, Landscape Sensitivity

	Lower Sensitivity		Medium	Higher Sensitivity	
	Low	Low to Med		Med to High	High
Sensitivity Rating	1	2	3	4	5
Landform and scale: patterns, complexity and consistency					
	A variety of landform types extend across active mining areas. The majority of visible landforms consist of moderate to steep sided slopes of overburden stockpiles; with the top of stockpiles relatively level (although differing stockpile height provides some variation to skyline views). Areas within mine tenements beyond active mine workings present gentler sloping landforms. Mining activities tend to result in visible large scale landscape features including the placement of overburden as well as construction of large scale infrastructure items (coal handling plants, workshops etc...) as well as mine machinery (trucks, excavators etc...) Overburden stockpiles can form recognisable and repeating linear features throughout portions of the Project area. A working mine site is visually limited in natural features; however, mining operations can result in some level of artificial complexity in landscape pattern.				
Landcover: patterns, complexity and consistency					
	Landcover within mining tenements extends across active open cut mine working and adjoining areas of pastoral grassland and vegetated areas. The resultant pattern of landuse beyond active mine working presents a simple backdrop to open cut mining developments with a low level of landscape complexity. Landcover within active mine working areas is largely defined by overburden stockpiles which support sparse areas of vegetation. The formed stockpiles present a relatively smooth, geometrically regular and predictable landcover within the context of mined landscapes..				
Settlement and human influence					
	There are limited examples of settlement within operating mine sites. Beyond active mine site areas rural homestead are dispersed with some evidence of contemporary structures including utility infrastructure and agricultural industrial elements. Human modifications to the landscape are evident and dominate the landscape within mining areas.				
Rarity					
	The main elements within this LCA are represented within the Project area as well as the surrounding landscape.				

Section 20 Landscape and Visual Amenity

	Lower Sensitivity			Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Sensitivity Rating	1	2	3	4	5
Intervisibility	Views into significant portions of this LCA are limited and restricted by surrounding landform and vegetation which contains and restricts opportunities for long distant views.				
Sensitivity Rating VAC Rating	Low (Score 9 out of 25) High				

LCA 2 Urban Areas

Plate 20-7 Typical View within Blackwater Urban Area (Source GBD, 2012)



Table 20-5 LCA 2, Landscape Sensitivity

	Lower Sensitivity			Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Sensitivity Rating	1	2	3	4	5
Landform and scale: patterns, complexity and consistency					
	Landform within and surrounding urban areas is generally level to gently undulating, or has been modified to accommodate built development. Landform varies between small to moderate scale and is relatively simple in structure.				
Landcover: patterns, complexity and consistency					
	Landcover through this LCA is simple and regular being largely determined by human occupation and cultural adaptation.				
Settlement and human influence					
	Settlement is concentrated with evidence of contemporary structures including utility infrastructure and industrial elements.				
Rarity					
	The main elements within this LCA are represented within the Project area as well as the surrounding landscape.				
Intervisibility					
	Views into some portions of this LCA limited and restricted by surrounding landscape and vegetation patterns which contain opportunities for long distant views.				

Section 20 Landscape and Visual Amenity

	Lower Sensitivity			Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Sensitivity Rating	1	2	3	4	5
Sensitivity Rating VAC Rating	Medium (Score 11 out of 25) High				

LCA 3 Road and Rail Corridor

Plate 20-8 Typical View along Suttor Developmental Road Corridor (Source GBD, 2012)



Table 20-6 LCA 3, Landscape Sensitivity

	Lower Sensitivity			Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Sensitivity Rating	1	2	3	4	5
Landform and scale: patterns, complexity and consistency					
	Landform varies between moderate to large scale and is relatively simple in structure. Topography is generally level to gently sloping land through the Project area.				
Landcover: patterns, complexity and consistency					
	Landcover adjoining this LCA is simple and regular being largely determined by pastoral livestock production, cultivated areas and mining developments.				
Settlement and human influence					
	Settlement is dispersed with some evidence of contemporary structures including utility infrastructure and agricultural industrial elements.				
Rarity					
	The main elements within this LCA are well represented within the Project area as well as the broader regional area.				
Intervisibility					
	Views into some portions of this LCA are limited and restricted by surrounding landform although some portions of elevated roads present opportunities for long distant views.				
Sensitivity Rating VAC Rating	Low (Score 10 out of 25) Varies (generally medium to high)				

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LCA 4 Agricultural Areas (Pastoral Grazing and Cropping)

Plate 20-9 Cultivated Agricultural Land along Golden Mile Road (Source GBD, 2012)



Table 20-7 LCA 4, Landscape Sensitivity

	Lower Sensitivity			Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Sensitivity Rating	1	2	3	4	5
Landform and scale: patterns, complexity and consistency					
	Pastoral landform varies between large to moderate scale and is relatively simple in structure, with topography generally level to gently undulating land through pastoral areas. Cropped areas also exhibit large to moderate scale tending to occur over level to gently sloping land.				
Landcover: patterns, complexity and consistency					
	Landcover through pastoral grassland is simple and regular being largely determined by livestock production. Pastoral areas also extend through lightly wooded and denser area of tree cover where landcover pattern becomes more varied and complex.				
Settlement and human influence					
	Settlement through both the pastoral and cropped agricultural landscape is largely dispersed with some evidence of contemporary structures including utility infrastructure and agricultural industrial elements.				
Rarity					
	The main elements within this LCA are common and well represented within the Project area with the management of pastoral grassland landscape as the dominant 'rural' activity, with crop production restricted to higher fertile soils within proximity to riparian corridors.				
Intervisibility					
	Views into and from some portions of pastoral landscapes are limited and restricted by surrounding landform and tree cover which constrains opportunities for long or middle distant views. Views into and from area of cropping, where beyond the influence of riparian vegetation, may extend to distant views and skyline features (hills and peaks) beyond the Project area.				
Sensitivity Rating	Medium (Score 13 out of 25)				
VAC Rating	Varies (pastoral medium to high) (cropping low to medium)				

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LCA 5 Drainage

Plate 20-10 Drainage (Source GBD, 2012)



Table 20-8 LCA 5, Landscape Sensitivity

	Lower Sensitivity			Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Sensitivity Rating	1	2	3	4	5
Landform and scale: patterns, complexity and consistency					
	Landform varies between moderate to small scale and is relatively simple in structure. Topography is generally level to gently sloping land through drainage areas (rivers and creek lines).				
Landcover: patterns, complexity and consistency					
	Landcover through this LCA is simple and regular being largely determined by pastoral grasslands and remnant tree cover.				
Settlement and human influence					
	Settlement is dispersed with some evidence of contemporary structures including utility infrastructure and agricultural industrial elements.				
Rarity					
	The main elements within this LCA are common and well represented within the broader landscape.				
Intervisibility					
	Views into some portions of this LCA are limited and restricted by surrounding landform and tree cover which contains opportunities for long distant views.				
Sensitivity Rating VAC Rating	Medium (Score 13 out of 25) Varies (generally medium to high)				

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LCA 6 Forested Areas

Plate 20-11 View toward Forested Hills and Ridgelines (Source GBD, 2012)



Table 20-9 LCA 6, Landscape Sensitivity

	Lower Sensitivity		Medium	Higher Sensitivity	
	Low	Low to Med		Med to High	High
Sensitivity Rating	1	2	3	4	5
Landform and scale: patterns, complexity and consistency					
	Landform varies between moderate to large scale and is relatively simple in structure. Simple ridgelines limit the extent of topographical variation across the LCA with low hills and peaks extending beyond the Projects development area.				
Landcover: patterns, complexity and consistency					
	Landcover through this LCA is simple and regular being largely determined by forested areas.				
Settlement and human influence					
	Settlement is dispersed with some evidence of contemporary structures including utility infrastructure and agricultural industrial elements.				
Rarity					
	Forested and remnant woodland areas are visible across hills and peaks as well as riparian corridors within the Project area and extend across significant portions of the surrounding landscape that are visible from elevated locations within the Project area.				
Intervisibility					
	Views into some portions of this LCA limited and restricted by surrounding landform and vegetation which contains opportunities for long distant views.				
Sensitivity Rating VAC Rating	Medium (Score 15 out of 25) Medium to high				

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Table 20-10 Landscape Sensitivity Summary

Landscape Character Area	Sensitivity Rating	Notes
LCA 1 Mining tenements	Low	Large operational open cut mine developments are located throughout the Bowen Basin, and within the Project area. Mines have a significant impact on the visual amenity of the surrounding landscape. Existing mines are dynamic and have the potential to expand across the Project area. There are also a number of proposed mines within the Project area. Coal mines are likely to continue to influence and be a dominant landscape and visual feature within the Bowen Basin for the lifespan of the Project.
LCA2 Urban Areas	Low	The growth of urban settlement areas (constructed over the last 45 years or so), are recent development types within the Project area. The majority of towns have been established by mining companies to accommodate and provide amenities for employees engaged in mine and related industrial occupations. Urban areas are largely functional in design and layout and on the whole do not directly relate or respond to the surrounding natural landscape. Urban areas are dynamic and continuing to expand (rapidly in some areas) in response to ongoing and proposed mine projects
LCA3 Road and rail corridors	Low	There are a relatively small number of regional and local road connections throughout the Project area, with the majority linking urban development with surrounding employment areas and mine sites. A number of unsealed and gravel roads extend within the Project area forming a network of linkages to rural homesteads and pastoral agricultural areas.
LCA 4 Agricultural areas (Pastoral grazing and cropping)	Medium	Areas of pastoral grassland form the dominant visual backdrop against the Project area, extending across open as well as vegetated woodland landscapes. Pastoral grassland is more likely to be considered 'naturalistic' in appearance than cropped agricultural areas. Whilst cropped agricultural areas are more limited in extent there is a greater degree of human interaction through cultivation, sowing / planting, spraying and harvesting.
LCA 5 Drainage	Medium	A number of rivers and creeks extend across the Project area and are often associated with dense vegetation corridors that truncate views across the landscape.
LCA 6 Forested areas	Medium	Areas of forest occur throughout the Project area, but more extensively in areas of rising hills and rock outcropping in northern portions of the Project area (extending north to north west from Coppabella to Glenden). Large tracts of forested and timbered areas (associated with National Parks and State Forests) also occur beyond the Project area. Some tree cover within the Project area has been cleared from pastoral grazing and cropped agricultural land.

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20.6 Major Views, Visual Receptors and Sensitivity

20.6.1 Major Views and Vistas

Large tracts of the landscape within the Project area (including land within mine and pastoral leases), as well as extensive areas of rural and agricultural / mining land adjoining the Project area, are either privately owned or have restricted or prohibited public access. As such there is limited opportunity for major views to occur from ridgelines or potential lookout locations within the Project area. Distant views from elevated landforms beyond the Project area, including visually sensitive locations such as National Parks and reserves are unlikely to be significantly impacted by the Project activities.

The Project development viewshed (the extent of landscape from which Project activities and infrastructure may be visible) as well as views toward proposed infrastructure within the Project area, will be largely contained within the Project area, and by virtue of distance, are unlikely to be readily discernible from areas beyond the immediate Project tenement. The majority of available public vistas toward the Project area extend from road corridors within the Project area. Views from moving vehicles are transitory and dynamic in nature with the relationship between view and viewer constantly changing.

20.6.2 Visual Receptors and Sensitivity

Despite the extent of the Project area there are a relatively small number of visual receptor categories. Those identified for the purpose of this LVIA include:

- Residential receptors (homesteads and urban areas);
- Pedestrians (recreational);
- Public Recreational Space;
- Rural employment / farming;
- Urban development;
- Motorists;
- Business (commercial); and
- Industry / mining areas.

20.6.2.1 Residential Receptors (Homesteads)

Figure 20–21 illustrates rural and farming homesteads located throughout the Project area, as identified during a desktop study. Ground truthing will be undertaken at the planning and detailed design stage to confirm the precise number and location of these homesteads. Visual receptors at homestead locations may be subject to long term views toward Project activities and infrastructure subject to visibility. Residential receptors are considered to have a higher degree of visual sensitivity than other categories of visual receptors.

20.6.2.2 Pedestrians (Recreational)

Recreational pedestrian activities (including bushwalking / bird watching etc.) occur within the broader region of the Bowen Basin; however, there are limited opportunities for recreational pedestrian activities within the Project area due to restricted access. The majority of landscape areas dedicated for outdoor recreational activities (including National Parks and State Forests) are located beyond the

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Project area. Landforms and vegetation cover within these areas will tend to restrict view toward the Project area.

20.6.2.3 Public Recreational Space (Sport and Park Facilities)

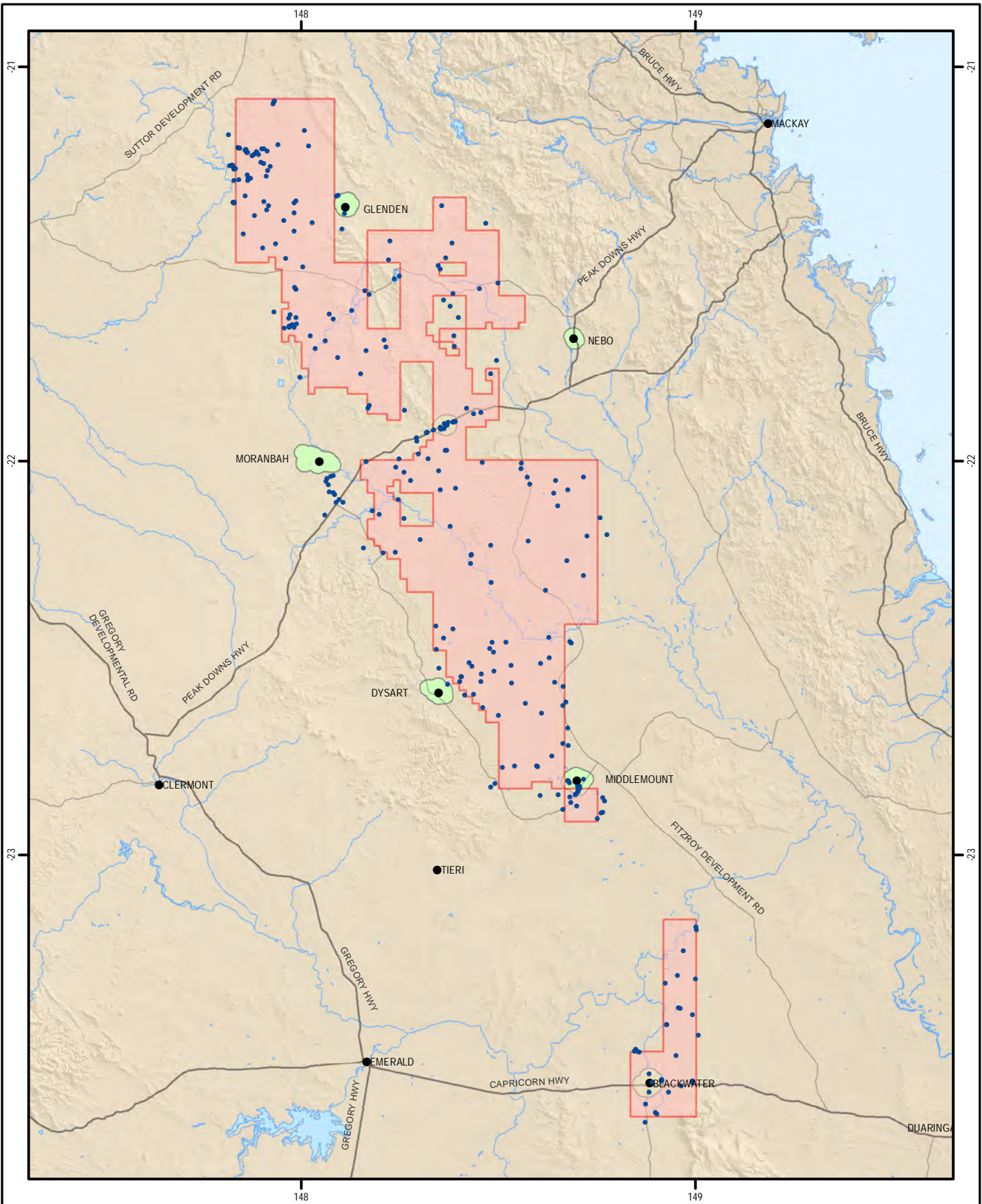
Public recreational space occurs within urban development areas surrounding the Project area and includes ovals and parks. Visual receptors within these areas are unlikely to be impacted by Project activities or associated infrastructure.

20.6.2.4 Rural Employment / Farming

Views toward Project activities and infrastructure will occur from rural and farming areas, with potentially short distance views where elements of the Project are located within intensively cropped or cultivated agricultural areas. Whilst the majority of Project infrastructure elements will be located within rural areas there are a very low number of visual receptors associated with these areas.

20.6.2.5 Urban Development

Urban development areas are generally located beyond the Project area and no Project activities are intended to occur within them. Visual receptors located within areas of urban development are unlikely to be impacted by the Project and will tend to have a low visual sensitivity to Project activities, and more so where people within urban areas are employed in existing mining, industrial or associated activities.



0 10 20 40 km
 1:1,500,000
 Projection: Geographic (GDA94)

- Bowen Gas Project Tenements
- Sensitive Receptor Point Location
- Sensitive Receptor Urban Area

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SENSITIVE RECEPTORS

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20.6.2.6 Motorists

Views toward the Project area will extend from a number of roads including highways (H), regional (R) and local (L) connecting roads. Whilst a number of roads pass through or within proximity to the Project area, views toward Project activities or infrastructure will be largely short term and indirect (see Table 20–11).

Table 20-11 Roads and Motorist Receptors

Road	Average Annual Daily Traffic
Peak Downs Highway (H) (Fitzroy Developmental Road to Coppabella) (Coppabella to Moranbah)	3,938 3,235
Capricorn Highway (H) (Dingo to Blackwater)	3,325
Suttor Developmental Road (R) (Nebo to Elphinstone) (Elphinstone to Red Hill Road)	1,279 470
Collinsville to Elphinstone Road (R) (Elphinstone to Glenden)	604
Newlands Access Road (R) (Glenden to Newlands Mine)	1,309
Fitzroy Developmental Road (R) (Mount Flora to Middlemount) (Middlemount to Junee Road) (Junee Road to Dingo)	1,135 938 974
Moranbah to Dysart Road (R) (Moranbah to Dysart)	2,525
Dysart to Middlemount Road (R) (Dysart to German Creek) (German Creek to Middlemount)	1,208 2,932
Golden Mile Road (L)	No data
Rolphe Creek Road (L)	No data
Daunia Road / Annadale Road (L)	No data
Iffley Road (L)	No data

*Average Annual Daily Traffic data sourced from the Arrow Bowen Gas Project Road Impact Assessment (July 2012, URS Australia Pty Ltd)

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The following images illustrate a range of road categories and the extent of available views along road corridors.

Plate 20-12 Peak Downs Highway
(Source GBD, 2012)



Plate 20-13 Capricorn Highway
(Source GBD, 2012)



Plate 20-14 Suttor Developmental Road (sealed)
(Source GBD, 2012)



Plate 20-15 Suttor Developmental Road (gravel)
(Source GBD, 2012)



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Plate 20-16 Collinsville to Elphinstone Road (sealed) (Source GBD, 2012)



Plate 20-17 Fitzroy Developmental Road (sealed) (Source GBD, 2012)



Plate 20-18 Fitzroy Developmental Road (sealed) (Source GBD, 2012)



Plate 20-19 Fitzroy Developmental Road (sealed) (Source GBD, 2012)



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Plate 20-20 Dysart Middlemount Road (sealed)
(Source GBD, 2012)



Plate 20-21 Golden Mile Road (sealed)
(Source GBD, 2012)



20.6.2.7 Business (Commercial)

Commercial business areas are largely located within urban areas and visual receptors within these areas are unlikely to be significantly impacted by the Project development.

20.6.2.8 Industry / Mining Areas

Visual receptors within mining or associated industrial areas will tend to have a low sensitivity to elements of the Project and will be exposed to similar types as well as larger scale infrastructure elements within mining or industrial areas.

20.6.2.9 Visual Sensitivity

The Guidelines determine that the sensitivity of visual receptors and views will be dependent on:

- Location and context of the viewpoint;
- Expectations and occupation or activity of the receptor; and
- Importance of the view which may be determined with respect to visitation and popularity.

For the purpose of this LVIA, levels of receptor sensitivity have been determined within a range of low to high sensitivity and are outlined in Table 20–12.

Table 20-12 View Location Sensitivity

View Category	Sensitivity
Residential Properties (homesteads)	High Sensitivity
Pedestrians (recreational)	Medium to High Sensitivity
Public Recreational Space	Medium Sensitivity
Rural employment / farming	Low to Medium Sensitivity

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View Category	Sensitivity
Urban development	Low Sensitivity
Motorists	Low Sensitivity
Business (commercial)	Low Sensitivity
Industry / Mining	Low Sensitivity

20.7 Project Description

The Project area will be split into a number of regions for progressive development. The development area is illustrated in Figure 20–1, which will be split into numerous localised gas fields. Each gas field will include infrastructure associated with:

- Wells;
- Field Water and Gas Gathering Systems;
- Processing Facility - which may be a:
 - Central gas processing facility (CGPF);
 - Integrated processing facility (IPF); or
 - Field compression facility (FCF).
- Power generation and distribution facilities; and
- Monitoring and telecommunication facilities.

It is important to note that the Project infrastructure has not yet been located or subject to detail design and the general layout of facilities is not yet complete. This is due to a number of factors which include the:

- Ongoing identification of viable gas reserves through exploratory drilling and pilot well programs, and the period of time over which this is scheduled to occur;
- Need to refine petroleum development plans as new reservoir data from appraisal wells is collected and assessed; and
- Ongoing design and site selection for production wells and associated infrastructure across the Project area, and the ability for this infrastructure to integrate with existing land uses and environmental constraints.

20.7.1 Wells and Field Gathering Systems

Developing each region will comprise drilling production wells, installing surface wellhead facilities and installing gas gathering and associated water gathering facilities.

20.7.1.1 Production Wells

A number of well types are under review and it is possible that a variety of well types will eventually be installed. The base case development scenario will employ surface-in-seam chevron wells in a dual lateral configuration which will be used on a nominal 800 m grid pattern with an indicative density of 1 well per 65 – 130 ha.

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Prior to drilling a well, a temporary drilling site will be prepared. In some cases preparation can involve construction of temporary pits to hold the fluids used for drilling. In some locations, vegetation trimming may be required. To ensure safe operation of the drilling rig and associated equipment, drilling sites are prepared in consideration of the topography, access points, number of well heads and other site specific criteria, this results in minor variations to the size and shape of drill pads.

Plate 20-22 Production Well Drilling
(Source GBD, 2012)



Plate 20-23 Production Well Drilling
(Source GBD, 2012)



Once the well is installed, the footprint is reduced to approximately 10 by 10 m. This is sufficient to house the wellhead and associated equipment. The larger drilling site footprint is then rehabilitated, and the larger footprint is utilised again during operational workover activities when required.

During the well production phase, gas from the well will flow up the annulus (between the liner and the tubing) before exiting the wellhead and entering the metering and control skid. The metering and control skid will comprise gas and water metering, a gas control valve (throttling and pressure management), a control and communications unit, and power to the well. Where downhole well separation proves to be insufficient, surface separators are installed to separate the water from the gas.

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Plate 20-24 Production Well Head
(Source GBD, 2012)



Plate 20-25 Production Well Head
(Source GBD, 2012)



Plate 20-26 Overhead Power Line to Well Head (Source Arrow)



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Plate 20-27 Production Well Head (Source Arrow)



20.7.1.2 Gathering Systems

Each well also requires constructing water and gas gathering lines to link the well back to a processing facility. Access tracks and connecting the well to the electricity grid will be required (where appropriate). Gas gathering lines will include low point drains to manage any water not separated from the gas at the wellhead, which may accumulate in low points of the system. Similarly, water gathering lines will include high point vents to allow the removal of trapped gas. Gathering lines will typically be buried at a minimum depth of 0.75 m.

20.7.2 Processing Facilities

Three types of processing facilities are currently envisaged with selection dependent on location, and timing of development. These types are described below.

20.7.2.1 Central Gas Processing Facility (CGPF)

CGPFs are high pressure compression facilities where gas is dehydrated to sales specification and compressed to allow export to the Arrow Bowen Pipeline via a pipeline lateral. CGPFs will also include a water transfer station and transfer dam to facilitate transfer of water to an IPF. CGPFs are expected to have multiple compression trains that will consist of:

- Drive engines and/or motors;
- Compressors;
- Cooling fans;
- Separators and gas dehydration;
- Control and safety systems;
- Electrical panels;
- Station pipework;

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- Pig launcher / receiver;
- Supervisory control and data acquisition (SCADA);
- Control room; and
- Ancillary systems.

CGPFs may be co-located with integrated power generation facilities, which will provide power to the facility. Alternatively CGPF power could be supplied from an IPF via overhead powerlines (see below). However, power supply from the electricity transmission network is also being considered, hence the potential construction of transmission and/or distribution lines over significant distances.

Plate 20-28 CGPF
(Source Arrow, 2012)



Plate 20-29 Pig Station Launcher
(Source Arrow, 2012)



20.7.2.2 Integrated Processing Facility (IPF)

IPFs will contain the same gas compression and processing equipment as the CGPFs, but will also contain a water treatment facility to treat associated water. The term “integrated” is used as the facility contains both gas and water processing facilities.

At the water treatment facility, produced water will be collected in feed dams, treated, and then stored onsite for distribution to the end user, which may include irrigation; mine wash water, water utility company water, power station cooling water, town water supply or reinjection.

The size of each dam will be dictated by the quantity of water that will flow through the dam during its life and the need for the pond to attenuate, buffer or store flows.

Plate 20-30 Typical Dam (Source Arrow)



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All dams will have metering on inlets and outlets with telemetry controls on pump rates and levels.

IPFs may be co-located with integrated power generation facilities that will provide power to the facility. However, power supply from the electricity transmission network is also being considered, hence the potential construction of transmission and/or distribution lines over significant distances.

20.7.2.3 Field Compression Facility (FCF)

Where there is insufficient pressure within low pressure flow lines or trunklines to move gas from the wells directly to a CGPF or IPF, an FCF will be installed to boost the gas pressure to enable the transportation of the gas over longer distances.

Gas will be received at a FCF from the low pressure gathering lines, compressed to medium pressure and discharged to medium pressure infield pipelines which will transport the gas to a CGPF or IPF.

A FCF may contain one compression train or multiple compression trains depending on the quantity of gas being delivered from wells in the area.

FCFs consist of compression trains and are typically made up of:

- Drive engines and/or motors;
- Compressors;
- Cooling fans;
- Separators;
- Control and Safety systems;
- Electrical panels;
- Pipe work;
- Pig launcher;
- SCADA; and
- Flare and/or vent.

FCFs will most likely be of skid based modular construction to minimise onsite construction and periods of disturbance. Flaring may take place at FCFs and utilise an 80 m high stack within a designated compound area. Whilst flaring is a relatively visual operation, the overall potential impact will be determined by local topography and tree cover between visual receptor locations and the flare, as well as other determining criteria such as distance, time of day and duration of flaring.

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Plate 20-31 Typical Node Station
(Source Arrow Energy, 2012)



Plate 20-32 Typical Field Compressor Facility
(Source Arrow Energy, 2012)



Plate 20-33 Typical Flare Detail
(Source GBD, 2012)



Plate 20-34 Typical Field Compressor Detail
(Source GBD, 2012)



20.7.3 Power Generation and Distribution

A number of key Project infrastructure elements will require an electrical supply to power various operations, including:

- Wellhead facilities (gas and water extraction and SCADA)
- FCFs (gas compression and water transfer stations (WTSs));
- CGPFs (gas compression and WTSs); and
- IPFs (gas compression and WTSs).

The power supply options being investigated for the supply of electrical energy to the Project include:

- Infield integrated power generation at compression facilities;
- Infield local electrical generation at wellheads;
- Infield local distribution to individual wells from generation or main grid options; and
- Grid connection.

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Whilst the final detail design and layout of Project infrastructure will determine the location and type of power generation and supply, the base case adopted for the Project is a combination of infield integrated electrical power generation with either above or below ground electrical reticulation between generation facilities and Project infrastructure.

20.7.3.1 Integrated Infield Electrical Power Generation

Use of integrated power generation to provide electrical power is a potential method to supply power to each IPF or CGPF and, where possible, to a wider area grid to power other facilities. In this scenario, CSG would be used as a fuel source for power generation. In this option, the proposed power generation equipment would use high efficiency low emission reciprocating gas engines or other high efficiency technology options.

Individual local gas powered electrical generators may be used to provide electrical power to the wellheads. In each case the generator will supply electrical power to drive the water pump and control systems. The technology selected for this application will be a high efficiency gas engine or microturbine with low emission.

Plate 20-35 Gas Fired Power Plant, Generators and Local Substation (Source GBD, 2012)



20.7.3.2 Grid Connection

Whilst the base case option for power supply will be integrated power generation through local gas fired power plants, investigations are being carried out for electrical supply from existing 66 kilovolts (kV) and 132 kV transmission line infrastructure. Arrow will work with the network service providers to establish, subject to availability and location, suitable 66 kV or 132 kV connections at new zone or local substations on Arrow's petroleum leases in the vicinity of the major facilities to be developed.

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Plate 20-36 132kV Double Circuit Transmission Line (Source GBD, 2012)



Plate 20-37 Local Substation (Source GBD, 2012)



20.7.4 SCADA and Telecommunications

For telecommunications, it is envisaged that the following systems will be deployed in the field:

- Well site telemetry systems;
- Closed circuit television for security and site monitoring (e.g. water dam levels); and
- Intruder detection systems – either perimeter (fence-line) mounted or sub-surface “listening” devices.

20.7.5 Construction, Operation and Maintenance Camps

Camps will be established to accommodate the construction workforces associated with constructing the production wells, gathering infrastructure and processing facilities. Arrow proposes that these camps be located adjacent to IPF construction sites to minimise the extent of commuting. All IPFs are expected to have an associated construction camp.

The construction camps will be purpose-built. Initially, each campsite will be developed over four weeks to accommodate approximately 100 to 300 workers. Following the peak construction period within the development area, camps will be maintained to accommodate the production well drillers and gathering line workforce, and camp sizes will be reduced for the rest of the Project life to accommodate approximately 70 workers who will be focussed on field development works (pipelines and drilling). It is anticipated that camps will accommodate an average of some 187 workers over the life of the Project.

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Plate 20-27 Typical Camp Site - Operation and Maintenance (Source GBD, 2012)



20.8 Magnitude of Landscape and Visual Effects

The key Project development activities and components that have been assessed against the potential magnitude of landscape and visual effect criteria include:

- Production wells;
- Gas and water gathering pipelines;
- FCF;
- CGPFs;
- IPFs;
- SCADA infrastructure;
- Power generation; and
- Camps and associated facilities.

The magnitude of landscape effects describes the potential nature and scale of change to the pre-development landscape from the proposed Project activities and components associated with it. The criteria that have been applied to determine landscape magnitude are described in Table 20–13.

Table 20-13 Landscape and Visual Magnitude Criteria

Magnitude Rating	Description
High (H)	<p>Landscape Total loss of major change to pre-development landscape or introduction of elements which are uncharacteristic to the existing landscape features.</p> <p>Visual The Project would be a significant and dominant feature within the surrounding landscape and at complete variance with the landform, scale and pattern of the landscape.</p>

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Magnitude Rating	Description
Medium (M)	<p>Landscape Partial loss or alteration to pre-development landscape or introduction of elements that may be prominent but not necessarily uncharacteristic with the existing landscape features.</p> <p>Visual The Project would be a recognisable feature, but not dominate views within the surrounding landscape.</p>
Low (L)	<p>Landscape Minor loss or alteration to pre-development landscape or introduction of elements that may not be necessarily uncharacteristic with the existing landscape features.</p> <p>Visual The Project would form a visible element within the surrounding landscape but is unlikely to constitute a marked effect on existing views.</p>
Negligible (N)	<p>Landscape Very minor loss or alteration to pre-development landscape or introduction of elements which are not uncharacteristic with the existing landscape features (resulting in a no change situation).</p> <p>Visual The Project would result in no discernible deterioration in the existing view.</p>

The magnitude of visual effects describes the potential change to existing visual amenity within the Project area from the proposed Project activities and associated components. The criteria that have been applied to determine visual magnitude are described in Table 20–14.

Table 20-14 Landscape and Visual Magnitude

Project Activity	Landscape Magnitude Rating	Visual Magnitude Rating
Production wells	Low	Low
Gas and water gathering pipelines (post installation)	Low	Low
FCFs	Low	Low
CGPFs	Medium	Medium
IPFs	Medium	Medium
SCADA infrastructure	Low	Low
Camp site and associated facilities	Low	Low

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20.9 Significance of Landscape and Visual Effects

The two principal criteria for determining significance are the sensitivity of the landscape and visual receptor and magnitude of effects resulting from the Project activities (see Table 20–15). The significance of landscape and visual effects has been determined using informed and well-reasoned professional judgement.

Table 20-15 Landscape and Visual Significance

		Sensitivity		
		High	Medium	Low
Magnitude	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Low
	Negligible	Negligible	Negligible	Negligible

High significance

The Project would have the capacity to cause a significant deterioration in the existing view. The Project's visual effects may not be minimised by mitigation measures and cumulative impacts may result in an increased level of impact.

Medium significance

The Project would be out of scale and discordant with the landform, scale and pattern of the landscape and have the capacity to cause a noticeable deterioration in the existing view. The Project's visual effects may be partially mitigated through appropriate measures.

Low significance

The Project would complement the scale, landform and pattern of the surrounding landscape and would not create a noticeable deterioration in the existing view. The Project's visual effects would be positively mitigated through appropriate measures.

Negligible significance

The Project would result in no discernible deterioration in the existing view.

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20.10 Landscape and Visual Constraints

This LVIA has identified landscape and visual constraints that reflect the capacity of existing environmental values to adjust to impacts arising from the key Project activities. Following a determination of visual and landscape significance, constraints will be assigned as per Table 20–16.

Table 20-16 Constraints Criteria

Magnitude rating	Description
'No Go' (N)	The Project activities could cause significant adverse landscape and visual impacts. Project activities will not be permitted to disturb existing environmental values.
High Constraint (H)	Key landscape and visual values will be at risk from key Project activities. Only certain types of Project activities might be permitted under stringent environmental controls.
Moderate Constraint (M)	Key landscape and visual values will be at risk from key Project activities but the application of standard environmental procedures in conjunction with site-specific controls will ensure likely impacts will not exacerbate threatening processes.
Low Constraint (L)	No specific landscape or visual values have been identified and the application of standard operating procedures will ensure minimal impact as a result of the key Project activities.

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20.11 Landscape and Visual Significance and Constraints Matrix

The landscape and visual significance and constraints matrix is outlined in Table 20–17 and Table 20–18.

Table 20-17 Landscape Significance and Constraints

Key Project Activities	Production Wells									Gas & Water Gathering Pipelines									FCFs									CGPFs								
	Landscape Significance				Landscape Constraints					Landscape Significance				Landscape Constraints					Landscape Significance				Landscape Constraints													
	H	M	L	N	N	H	M	L	H	M	L	N	N	H	M	L	H	M	L	N	N	H	M	L	H	M	L	N	N	H	M	L				
LCA 1				N				L				N				L				N				L				N				L				
LCA 2			L					L				N				L			L					L			L					L				
LCA 3			L					L				N				L			L					L			L					L				
LCA 4			L					L				N				L		M						M		M						M				
LCA 5			L					L				N				L		M						M		M						M				
LCA 6			L					L				N				L		M						M		M						M				



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Key Project Activities	IPFs								SCADA								Camp Sites & Facilities							
	Landscape Significance				Landscape Constraints				Landscape Significance				Landscape Constraints				Landscape Significance				Landscape Constraints			
	H	M	L	N	N	H	M	L	H	M	L	N	N	H	M	L	H	M	L	N	N	H	M	L
LCA 1				N				L				N				L				N				L
LCA 2			L					L				N				L			L					L
LCA 3			L					L				N				L			L					L
LCA 4		M					M					N				L		M					M	
LCA 5		M					M					N				L		M					M	
LCA 6		M					M					N				L		M					M	



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Table 20-18 Visual Significance and Constraints

Key Project Activities	Production Wells									Gas & Water Gathering Pipelines									FCFs									CGPFs								
	Visual Significance				Visual Constraints					Landscape Significance				Landscape Constraints					Landscape Significance				Landscape Constraints					Landscape Significance				Landscape Constraints				
	H	M	L	N	N	H	M	L	H	M	L	N	N	H	M	L	H	M	L	N	N	H	M	L	H	M	L	N	N	H	M	L				
Residents (homesteads)			L					L				N				L		M						M		M						M				
Residents (urban)			L					L				N				L		M						M		M						M				
Pedestrians			L					L				N				L		M						M		M						M				
Public recreation			L					L				N				L		M						M		M						M				
Rural farming				N				L				N				L			L					L			L					L				
Motorists				N				L				N				L			L					L			L					L				
Business (commercial)				N				L				N				L				N				L				N				L				
Industrial				N				L				N				L				N				L				N				L				

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Key Project Activities	IPFs									SCADA									Camp Sites & Facilities					
	Visual Significance				Visual Constraints					Landscape Significance				Landscape Constraints					Landscape Significance				Landscape Constraints	
	H	M	L	N	N	H	M	L	H	M	L	N	N	H	M	L	H	M	L	N	N	H	M	L
Residents (homesteads)		M					M				L					L		M					M	
Residents (urban)		M					M				L					L		M					M	
Pedestrians		M					M				L					L		M					M	
Public recreation			L					L			L					L			L					L
Rural farming			L					L			L					L			L					L
Motorists			L					L				N				L			L					L
Business (commercial)				N				L				N				L				N				L
Industrial				N				L				N				L				N				L



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20.12 Aerial Visual Impacts

Views toward the Project area will be available from aircraft following flight paths over and surrounding the Project area, including flights that service existing regional mining centres and towns such as Moranbah.

The overall visibility of Project activities and infrastructure from the air will largely be determined by the contrast in colour between Project infrastructure and the surrounding landscape. Plates 20–28 and 20–29 illustrate aerial views toward the industrial Wallumbilla gas hub and production wells within the Fairview gas field. These images illustrate that aerial views toward gas infrastructure become more noticeable with dark toned forested background; however, decreases across lighter toned pastoral landscapes. Views from aircraft will be transitory and short term in nature and are unlikely to result in any significant visual impacts.

Plate 20-28
Wallumbilla Gas Hub Aerial View (2006),
Approximately 1,000 m AGL (Source Google Earth
Pro, 2012)



Plate 20-29
Fairview Gas Development Aerial View (2006),
Approximately 10,000 m AGL (Source Google Earth
Pro, 2012)



20.13 Night Lighting

Night time lighting is likely to be concentrated within the main development infrastructure areas and access roads. Headlights and flashing lights will be associated with vehicular movements around the development area primarily during the construction period and less so during operation.

The potential night time lighting impacts may include issues of direct light spill from floodlights or other lighting elements toward surrounding rural residential dwellings and roads; however many of the rural residential dwellings surrounding the study area are unlikely to have a direct line of sight toward the

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key infrastructure elements and there is unlikely to be any significant visual impact created by direct lighting impacts.

There is a potential impact of lighting on native fauna. These impacts and mitigations are discussed in the Terrestrial Ecology chapter (Section 17) of this EIS.

20.14 Cumulative Impacts

A cumulative impact may result from Project activities and associated infrastructure being constructed in conjunction with other existing or proposed development. Separate CSG developments could occur within the wider viewshed or be located within a regional context where visibility is dependent on a journey between each Project site or an individual Project viewshed.

'Direct' cumulative visual impacts can occur where two or more developments have been constructed within the same locality, and could be viewed from the same view location simultaneously.

'Indirect' cumulative visual impacts can occur where two or more developments have been constructed within the same locality, and can be viewed from the same view location but not within the same field of view.

A 'sequential' cumulative visual impact can arise as a result of multiple Projects being observed at different locations during the course of a journey (e.g. from a vehicle travelling along a highway or from a network of local roads), which could form an impression of greater magnitude within the construct of short term memory.

Relevant projects included in the cumulative impact assessment included:

- Projects within the sphere of influence of the Project, which are listed on the DEEDI website that are undergoing assessment under *The State Development and Public Works Organisation Act 1971* for which an Initial Advice Statement (IAS) or an EIS are available; and
- Projects within the sphere of influence of the Project, which are listed on the website of EHP that are undergoing assessment under the *Environmental Protection Act 1994* for which an IAS or an EIS are available.

Developments that satisfied the above criteria and could reasonably and practically be assessed for impacts were included in this cumulative impact assessment.

The projects included in the cumulative impact assessment for the study area are listed in Table 20–19. The developments listed below range from coal resource projects, other energy resource projects, energy infrastructure projects, transport infrastructure projects and water infrastructure projects.

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Table 20-19 Other Projects Relevant to the Project Area

Project and Proponent	Description	Location	Project Status	Relationship to Arrow Bowen Gas Project
Caval Ridge Mine – BMA	<ul style="list-style-type: none"> • New open-cut mine to produce 5.5 mtpa of coking coal for export; • Construction period: 2012 – 2014; • Workforce: 1,200 (construction) and 500 (operational); and • Estimated capital cost \$4 billion. 	6 km south-west of Moranbah.	Project approved. EIS and Coordinator-General's Report available. Coordinator-General's Report on project change being prepared.	Located ~20 km west of the development area boundary of ATP 1103 (Mavis Downs development region). Construction period may overlap.
Red Hill Mine Project - BMA	<ul style="list-style-type: none"> • New underground mine to produce 14 mtpa of coking coal for export; and • Workforce: 3,000 (construction) and 1,500 (operational). 	30 km north of Moranbah.	Project listed as withdrawn on the EHP website.	Located within ATPA 742 (Suttor Creek development region).
Daunia Mine – BMA	<ul style="list-style-type: none"> • New open-cut coal mine to produce 4.5 mtpa of coal; • Workforce: 1,000 (construction) and 450 (operational); • Construction period: 2011 – 2013; and • Estimated capital cost \$1.6 billion. 	30 km south-east of Moranbah.	Project approved. EIS and CG's Report available.	Located within ATP 1103 (just west of Mavis Downs development region). Construction schedules will not overlap.
Byerwen Coal – Joint venture between QCoal and JFE Steel	<ul style="list-style-type: none"> • New integrated open-cut and underground coal mine with a yield of up to 10 mtpa; • Construction phase: 2012 – 2013; • Workforce: 350-500 (construction) and 1000 (operational); and • Estimated capital cost \$1.5 billion. 	20 km west of Glenden	IAS available EIS in progress	Located within ATP 742 (Suttor Creek development area). The construction schedule will not overlap.

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Project and Proponent	Description	Location	Project Status	Relationship to Arrow Bowen Gas Project
Connors River Dam and Pipeline - SunWater	<ul style="list-style-type: none"> A 373,622 megalitre water supply dam. Includes a 133 km pipeline to Moranbah to service coal mines and associated communities; Workforce: 620 (construction) and 6 (operations); and Estimated capital of \$1.17 billion. 	<p>Dam: on Connors River near Mount Bridgett, 110 km east of Moranbah</p> <p>Pipeline: will run from the dam to Moranbah.</p>	<p>Project approved. EIS, SEIS and CG's Report available. The Queensland Government has recently announced that this dam will not proceed.</p>	<p>Dam is located ~35 km east of the development area boundary of ATP 759 (Mavis Downs development region) with the pipeline passing through the development areas of ATP 759 and ATP 1103 (Mavis Downs development region) to Moranbah.</p>
Ellensfield Coal Mine Project – Vale Australia	<ul style="list-style-type: none"> Development of an underground coal mine producing an average of 2.5 mtpa of coking and thermal coal for export; Construction period: 2012 – 2015; and Workforce: 250-300 (construction) and 220-240 (operations). 	~35 km north-east of Moranbah.	EIS recently updated and not available at the time of assessment.	<p>Located on the southern boundary of ATPA 749 (Kemmis Creek development region). Construction periods may overlap.</p>
Foxleigh Plains Project – Anglo Coal	<ul style="list-style-type: none"> Expansion existing Foxleigh open-cut mine to the north of the current operations producing up to 4 mtpa of run of mine; Open-cut mining will commence by the end of 2013; and Workforce: additional 90 employees, to existing operations, is required during project operations due to increase in production rate. 	~6 km south of Middlemount	IAS available EIS in progress	<p>Located with southern portion of ATP 1031 (German Creek development region). The construction schedule will not overlap.</p>
Minyango Project – Blackwater Coal	<ul style="list-style-type: none"> Development of a greenfield underground coal mine with a production rate of up to 7.5 mtpa of product coal for export; Construction phase is not known; and Estimated capital of \$750 million. 	Immediately south of Blackwater.	IAS available. EIS in progress.	Located within ATP 1025.

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Project and Proponent	Description	Location	Project Status	Relationship to Arrow Bowen Gas Project
Washpool Coal Mine Project – Washpool Coal subsidiary of Aquila Resources Limited	<ul style="list-style-type: none"> • Development of a greenfield open-cut coal mine producing up to 2.6 mtpa of product hard coking coal; • Construction period: 2012 – 2013; • Workforce: 307 (construction) and 378 (operation); and • Estimated capital of \$396 million. 	~24 km north-west of Blackwater.	EIS available.	Located ~18 km west of the development area boundary of ATP 1025. The construction schedule will not overlap.
Eagle Downs Coal Project – Bowen Central Coal Joint Venture (Bowen Central Coal and Aquila Coal)	<ul style="list-style-type: none"> • Development of a greenfield underground coal mine producing up to 8 mtpa of coking and thermal coal for export; • Construction period: 2012-2014; • Workforce: 360 (construction) and 570 (operations); and • Estimated capital of \$1.26 billion. 	~20 km south-east of Moranbah	EIS approved. EIS available.	Located ~2 km west of the development area boundary of ATP 1103 (west of Mavis Downs development region). The construction schedule will overlap.
Grosvenor Coal Project – Anglo Coal	<ul style="list-style-type: none"> • Development of a greenfield underground coal mine to produce 5 mtpa of product coal; • Construction period: 2012 – 2014; • Workforce: 480 (construction) and 480 (operations); and • Estimated capital \$1.115 billion. 	Immediately north of Moranbah.	EIS is complete. EIS available.	Located ~12 km north-north-west of the development area boundary of ATP 1103. The construction schedule will not overlap.
Middlemount Coal Project (Stage 2) – Middlemount Coal	<ul style="list-style-type: none"> • Stage 2 is an expansion of the current open cut mine to produce up to 5.4 mtpa of ROM coal; • Stage 2 forms the basis of the project as Stage 1 is approved for production of 1.8 mtpa of ROM coal; • Construction period: 2011 – 2014; and • Workforce: 450 (construction) and 500 (operations). 	~6 km south-west of Middlemount	EIS is complete. EIS available.	Located ~3 km west of the development area southern boundary of ATP 1031. The construction schedule will not overlap.

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Project and Proponent	Description	Location	Project Status	Relationship to Arrow Bowen Gas Project
Eaglefield Expansion Project - Peabody	<ul style="list-style-type: none"> Open-cut expansion and associated infrastructure upgrades to increase production from 5 mtpa to 10.2 mtpa ROM coal; Construction period: 2012 – 2013; and Workforce: 700 (construction) and 440 (operations). 	~36 km north of Moranbah and 32 km south-west of Glenden	EIS is complete. EIS available.	Located on the south-western boundary of ATPA 742 (Suttor Creek development region). The construction schedule will not overlap.
Codrilla Coal Mine Project – Macarthur Coal	<ul style="list-style-type: none"> Development of an open-cut coal mine producing an average of 4 mtpa of ROM coal; Construction phase: 2012 – 2013; and Workforce: 170 (construction) and 240 (operations). 	~45 km south-south-west of Nebo.	EIS is complete. IAS and SEIS available.	Located with the development boundary of ATP 759 (Mavis Downs development region).
Saraji East Coal Mine - BMA	<ul style="list-style-type: none"> Development of a greenfield underground coal mine to produce up to 14 mtpa of product coal for export; and Workforce: 2,500 (construction) and 1,400 (operations). 	~30 km north of Dysart	Project listed as withdrawn on the EHP website	Located within the development boundary of ATP 1103.
Arrow Bowen Pipeline – Arrow	<ul style="list-style-type: none"> Construction of an approximate 580 km of pipelines which will convey CSG for subsequent export as LNG and associated above ground infrastructure; Construction to commence in 2016 with first gas to Gladstone in 2017; Workforce: 693 (construction), 10 (commissioning and decommissioning) and 15 (operations); and Capital expenditure \$1.2 billion. 	Pipeline would commence at Red Hill, ~90 km north of Moranbah and terminate at Gladstone	EIS is complete. EIS available.	Pipeline commences in the northern part of ATPA 742 and runs south-east through the development areas and on to Gladstone. The construction schedule will overlap.

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Project and Proponent	Description	Location	Project Status	Relationship to Arrow Bowen Gas Project
Northern Bowen Basin Transmission Network Reinforcement Project – Powerlink Queensland	<ul style="list-style-type: none"> Construction of 2 new substations (1 at Moorvale and 1 at Peak Downs); Construction of 3 transmission lines; between Nebo and Moorvale; between Moorvale and Broadlea; and Moorvale and Peak Downs; Transmission line between Nebo, Moorvale and Boradlea is proposed to be constructed by late 2014; and Workforce: 50 (construction). 	Substations in the Moorvale area (~26 km east of Moranbah) and Peak Downs (~21 km south east of Moranbah) area. Transmission lines running from; Nebo to Moorvale; Moorvale to Boradlea (~18km east of Moranbah); and Moorvale to Peak Downs.	EIS is complete.	Transmission line to cut through ATP 1103 from Nebo to Broadlea. Not expected to have overlapping construction schedules
Goonyella to Abbot Point Rail Project – BHP Billiton Group	<ul style="list-style-type: none"> Construction of a dedicated rail line, approximately 260 km in length, to transport up to 60 MTPA of coal; 60m wide rail corridor; Balloon loops at Goonyella Riverside Mine and Port of Abbot Point; Construction is scheduled to commence by no later than 2015; and Workforce: 2000 (construction) and 500 (operations). 	The line would run from the Goonyella Riverside Mine in the Bowen Basin (~24 km north-west on Moranbah), to the Port of Abbot Point.	EIS in progress. IAS available.	Rail line commencing on the boundary of ATP 1103 and travels north along boundary of ATPA 742 to Collinsville. The construction schedule will overlap.
Moranbah South Project – Anglo American Metallurgical Coal	<ul style="list-style-type: none"> Construction and operation of a greenfield underground coal mine; 14 Mtpa of high quality coking coal for the export market; Mine life in excess of 30 years; Construction will commence in 2014; and First longwall coal production will commence in 2017. 	Directly to the south of Moranbah, ~150 km south-west of Mackay	IAS available	Project site is just west of ATP 1103 (near Moranbah) The construction schedule may overlap.

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20.15 Mitigation

The purpose of mitigation is to avoid, reduce, or where possible remedy or offset any significant negative impact arising from the Project activities. Potential visual impacts will be minimised by objectives to:

- Minimise the extent to which Project activities will be visible from various view locations; and
- Minimise the visual contrast between the main infrastructure elements associated with the Project and the surrounding landscape in which they will be seen.

The objectives will be addressed through a number of mitigation measures and include:

- Retention of existing vegetation where possible [B118];
- Re-establishment of vegetation cover on disturbed areas [B097];
- If possible, promote and manage natural regeneration of native plants within the Project area [B098];
- Where practical, colour selection and finishes for key infrastructure elements will be considered as part of the design process within the Project area [B100]; and
- Lighting design.

20.15.1 Retention of Existing Vegetation

The large majority of remnant and re growth vegetation within the Project area and those beyond the primary construction areas will be retained. Scattered tree cover and areas of denser woodland within the Project area will provide ongoing screening for a number of surrounding view locations resulting in a reduction or complete mitigation of visual impact.

20.15.2 Re-establishment of Vegetation Cover on Disturbed Areas

The re-establishment of vegetation cover across disturbed areas where not conflicting with longer term operational infrastructure will help to increase the visual absorption capability of the landscape within the Project area and reduce the overall visibility of Project infrastructure.

20.15.3 Colour Selection and Finishes

The visibility of Project infrastructure will be largely dependent on the level of visual contrast between the infrastructure and the surrounding landscape against which they may be visible. Although relatively long distances may exist between potential view locations and infrastructure within the Project area, the colour contrast and reflectivity of materials and finishes will be taken into account when selecting construction materials with the aim of minimising any potential visual impacts [B027].

20.15.4 Night Lighting Impacts and Mitigation Measures

Night time lighting is likely to be concentrated within the main Project development infrastructure areas and access roads. Headlights and flashing lights will be associated with vehicular movements within

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the development regions but this will occur primarily during the construction period and less so during operation.

The potential night time lighting impacts may include issues of direct light spill from floodlights or other lighting elements toward surrounding rural residential dwellings and roads; however, it is likely that the majority of rural residential dwellings within the Project area are unlikely to have a short distance and direct line of sight toward the key infrastructure elements and there is unlikely to be any significant visual impact created by direct lighting impacts.

Notwithstanding the potential minimal impact associated with direct lighting, there are mitigation measures that may assist in minimising potential light spill, which are outlined in the EM Plan (Appendix Z) and include:

- Shielding lights with hoods and louvers where practicable. Design lighting in accordance with AS 4282-1997 *Control of the Obtrusive Effects of Outdoor Lighting* [B102]; and
- Orientating infrastructure within the Project area to minimise potential light spill [B101].

Flaring may take place at FCFs and utilise an 80 m high stack within a designated compound area. Whilst flaring is a relatively visual operation, the overall potential impact will be determined by local topography and tree cover between visual receptor locations and the flare, as well as other determining criteria such as distance, time of day and duration of flaring. Flaring is unlikely to result in significant visual impacts in the broader context of the Project area.

20.16 Conclusion

Whilst the 'framework assessment' has determined that the majority of Project infrastructure would be subject to low to moderate landscape and visual constraints, this LVIA has assumed that Project infrastructure elements with a medium to high magnitude of landscape or visual effect will be located a minimum 1 km from high sensitive visual receptor locations, including homesteads and other residential dwellings.

Whilst some Project infrastructure will be visible from distances beyond one kilometre, the overall level of Project infrastructure visibility (and resultant impact) is reduced as a person's view cone increases with distance.

This LVIA has determined the overall landscape and visual significance of the Project area to be low, although some characteristics of the landscape within the Project area will be altered in a localised context by some Project activities and the construction and operation of Project infrastructure.

A large proportion of the landscape within the Project area will have a reasonably high capability to accommodate and visually absorb the majority of changes associated with the Project, including areas that are visually influenced by existing coal mine operations as well as areas with dense and scattered woodland and/or gently undulating landforms.

Additional detailed landscape and visual assessment studies may be required to inform Project infrastructure siting, as well as site specific mitigation measures, where medium to high magnitude landscape and visual effects have the potential to impact high sensitive visual receptor locations, including residential dwellings and homesteads.

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The capability of the landscape to accommodate change is largely derived from the large and open landscape character identified across much of the Project area, together with the extent and location of existing activities that have significantly altered the post European settlement landscape (including agricultural and mining related development). The landscape within the Project area is visually dynamic and subject to ongoing modification through prospective mine development and expansion of existing urban infrastructure to accommodate a growing local and regional workforce.

This LVIA has determined that the Project would have a potential low visual impact on a large number of people residing in rural areas within and surrounding the Project area as well as people living in consolidated urban development or travelling along highways and local roads within the immediate Project area.

The existing character of the landscape within and surrounding the study area has been altered over time through agricultural improvements, cattle grazing, light industrial and existing mining operations. The typical characteristics of the landscape are considered to be generally robust, with an overall low to moderate sensitivity toward the change likely to occur with the construction and operation of the Project.

There are limited and restricted opportunities to obtain extensive views or panoramas across the Project area due to tracts of woodland vegetation surrounding the study area combined with the screening influence of low undulating topography over portions of the study area.

The character of the landscape within and surrounding the study area is reflected over wider areas at both local and regional levels and is understood not to have significant regional, state, national or international value.

There is a generally low level of human occupation within the landscape surrounding the greater extent of the Project area, with the majority of urban development and rural localities likely to be located at medium to long distances from the main infrastructure elements associated with the Project.

Tree cover that surrounds many residential dwellings / homestead within the Project area is likely to provide partial (and often complete) screening toward the potential location of Project infrastructure element. The screening potential of woodland and scattered tree cover is also enhanced by low undulating topography in portions of the Project area.

Subject to the preparation of detailed layout and design works, the Project may require removal of existing tree cover to accommodate some infrastructure; however, wherever possible and subject to operational and engineering requirements, existing tree cover will be retained (and supplemented as necessary) to provide screening mitigation within the Project area.

The majority of Project infrastructure will be small to medium scale and is unlikely to obscure or obstruct sunlight due to the construction of buildings or alterations to the landform.

Visual impacts will be mitigated to minimise the potential for visual contrast between built elements and existing backdrops as well as the potential for reflectivity or glint toward surrounding areas.

Night time lighting requirements for the majority of Project infrastructure are unlikely to have a direct impact on the majority of surrounding visual receptor locations including individual residential dwellings and areas of urban development subject to viewing distance and the presence of existing vegetation with screening potential.