Section 4

LAND

4. Land

The purpose of this Section is to detail the existing land environment for all areas associated with the Project, including areas affected by the corridor, and any new permanent or temporary facilities constructed for the rail line. This Section covers topography, geology, soils, contamination, land use and impacts of land acquisition. The legislative process for the acquisition of land is discussed in Section 17.5.

4.1 Topography and Landform

4.1.1 Methodology

The topography and landform patterns within the study area were reviewed using relevant maps, aerial photography and existing studies. A site visit was carried out between the 8th and 26th of January 2008 to further describe significant topographical and landform features within and surrounding the study area on a regional, catchment and sub-catchment basis.

This Section describes the topographical changes along the study area and any significant topographical and landform features. Potential impacts to topography or landscape character are discussed and proposed mitigation measures are recommended, where appropriate, to avoid or minimise potential impacts.

4.1.2 Description of Environmental Values

The Project runs generally parallel and to the west of the Auburn Range and crosses over an outlier of the western fringe of the Auburn Range south of Cracow. North of Cracow the Project intercepts the edge of the Dawson River floodplain and the undulating slopes and rolling rises associated with the western foot slopes of the range.

The length of the preferred alignment can be broadly characterised into three major topographical features with various levels of earthworks potentially being required to form suitable ground levels for the proposed rail infrastructure, in particular:

- From the south between Wandoan and the outlier of the Auburn Range, the topography is gently undulating with slope angles varying between 2 and 20%. In this area extensive cut and fill sections up to 15 m deep will be required for the construction of the railway;
- The Auburn Range runs northerly, to the east of the Dawson River floodplain, and is the dominating topographic feature, with the preferred alignment traversing approximately 10 km of the range edge. The range is characterised by mixed Eucalypt woodlands on steep sandstone ridges and deeply incised gullies with cut depths of up to 18 m and fill levels proposed to range between 3 m and 15 m;
- From the Auburn Range through to Theodore the topography returns to gently undulating with much broader slopes or valleys and reduced cut and fill volumes; and
- Between Theodore and Banana, the topography in the preferred alignment is relatively flat and dominated by the edge of the Dawson River floodplain.

Elevations within the study area range from 150 m to approximately 320 m Australian Height Datum (AHD). At Wandoan, the elevation is approximately 245 m AHD and climbs to approximately 320 m AHD as the preferred alignment crosses the western fringe of the Auburn Range. The elevation

decreases to approximately 200 m AHD just north of the Auburn Range, before levelling out at 155 m AHD and continuing toward Banana at a relatively static elevation.

The study area crosses a number of identified land systems as described by Perry 1968, which are listed in Appendix G.1. A number of land resource areas and landforms within these land systems have been further described by Forster 1983 and are included (where appropriate) in Appendix G.1. For the purpose of understanding the field observations, the landform survey observation and test pit locations have also been included.

The dominant landform patterns surrounding the Project are characterised as a series of valleys in between a number of dividing hill ranges that all slope towards the Dawson River in the centre of the larger Dawson River catchment. The preferred alignment crosses numerous gullies ranging from deeply to moderately incised. Approximately 50 existing and historic creek beds have also been identified as being crossed by the preferred alignment.

4.1.3 Field Observations

During the site inspection a number of landforms were identified and described. These landform survey observation locations are identified in Map 6 – Topography and Landform in the Map Folio and Appendix G.2 provides landform survey observations.

Regional topographical and landform features are dominated by the western side of the Great Dividing Range and the Dawson River floodplain. The study area is located wholly within the catchment of the Dawson River and intercepts a number of valleys between a series of hills and ridge lines that extend from the western side of the Great Dividing Range.

At a sub catchment level the study area crosses a network of ephemeral drainage lines and stream tributaries and is dominated by low rolling hills and rises and undulating plains. The network of ephemeral drainage lines and stream tributaries direct surface runoff towards the Dawson River. The ephemeral drainage and stream tributaries are discussed in Section 6.

The following significant landform features were identified within the study area:

- From the south between Wandoan and the Auburn Range the dominant landform elements included a series of broad level hill crests of undulating and rolling rises above level to undulating plains separated by very gently to gently inclined slopes and moderately inclined slopes into open depressions forming overland flow paths;
- Through the Auburn Range fringe crossing from south to north the landform elements are dominated by a series of narrow hill crests on undulating and rolling rises and gently undulating to steep low hills separated by narrow valleys with deeply incised gullies; and
- North from the Range to Banana the dominant landform elements comprise level to gently undulating plains associated with the Dawson River floodplain and gently to moderately inclined, undulating rises and low hills.

Other significant topographical features surrounding the northern section of the study area are the tumulus hillocks in this area, which are geological features within the landform pattern. There was also a number of low lying, closed depressions supporting wetland vegetation.

It is important to note that the preferred alignment will, as far as practicable, avoid major contour features for practical reasons and will attempt to follow the natural landform where possible within engineering and financial constraints.

Photo 4-1: Typical view of the gently undulating landscape

Photo 4-2: Mixed Eucalypt woodlands on steep sandstone ridges and deeply incised gullies

Photo 4-3: Relatively flat landscape near Walshs Road looking south and north respectively

4.1.4 Potential Impacts and Mitigation Measures

The Project has the potential to impact on topographical and landform features within the multi-user corridor predominantly through changes to the physical landscape as a result of cut and fill and the construction of engineered landforms such as embankments. These impacts are likely to be significant in the gently undulating areas and where the preferred alignment passes through the Auburn Range. Potential impacts to the affected land area identified include:

- Construction of engineered landforms, including steep cut batter slopes and embankments, resulting in reduced landform amenity;
- Increased risk of landform instability;
- Disruption to visual amenity; and
- Disruption to surface hydrology/hydraulic regimes and changes to overland flow paths.

Mitigation measures to avoid or minimise these potential impacts are as follows:

Table 4-1: Construction Potential Impact and Mitigation Measures on Topography and Landform

Potential Impact	Mitigation Measure
Steep cut batter slope resulting in reduced landform amenity and landform instability	• Sites of cut are to have batters designed and constructed to incorporate surface re-contouring for the purpose of stabilising the landform.
Increased risk of landform instability and uncontrolled settlement/subsidence	• During design, minimise works associated with the disturbance of creeks, surface drainage lines and wetland areas through design of embankments, filling, vegetation clearing, bridge and culvert structures.
Disruption of the visual amenity of the landscape due to embankment placement	• Design and construct embankments and engineered landform features to incorporate the character of the surrounding landscape as practicable.
Disruption of the surface hydrological/hydraulic regimes	• During design, minimise alterations/changes to overland flow paths and the construction of embankments, filling and diversion of creeks and surface drainage lines.

Table 4-2: Operational Potential Impact and Mitigation Measures on Topography and Landform

Potential Impact	Mitigation Measure
Disruption of surface hydrology/hydraulic regime	• Periodic maintenance of surface drainage controls
Degradation of the soil profile structure and strength	• Develop and implement a rehabilitation plan that includes periodic maintenance and stabilisation of areas containing high risk dispersive and changed hydrological/hydraulic conditions

4.2 Geology and Geomorphology

4.2.1 Methodology

The geology and geomorphology within the study area were investigated through a review of aerial photographs and maps, existing studies and a two-stage site investigation.

Stage 1 of the site investigation included a terrain evaluation of the study area between Wandoan and Cracow and was reported in the draft Terrain Evaluation Report during October 2007 and as a component of the preliminary geotechnical engineering findings. The terrain evaluation was a desktop investigation to inform the concept design for the Project.

Geotechnical field investigations were completed as part of the Stage 2 works for the Project and comprised test pits and drill holes. All sites were selected in areas that had previously been subject to significant disturbance such as modified rural areas and road reserves. The objective of these investigations was to assist in validation of terrain evaluation mapping and to provide geotechnical information for the preliminary assessment of:

- Sources of construction materials;
- Areas of unsuitable foundation materials;
- Excavation conditions; and
- Cut and fill batter slopes.

4.2.2 Description of Environmental Values

Geological mapping information (DNRW, 2005) at 1:100,000 scale indicates that at the southern end of the study area, between the township of Wandoan and the southern tributary network of Bungaban Creek, the underlying geology is dominated by sedimentary rock with overlying alluvial deposits associated with the developed surface drainage lines.

Arenite deposits extend from the southern boundary of the alluvial deposits surrounding Bungaban Creek, northwards to the vicinity of the Cockatoo Creek tributary network where deposits of alluvial material and arenite-mudrock associated with surface drainage lines are indicated.

Extending northwards from the Redrange Road/Nathan Road intersection to the Nathan Gorge turnoff, geological features are dominated by Ironstone deposits with areas of overlying alluvial material associated with surface drainage line and outcrops of arenite and arenite-mudrock deposits, particularly in the vicinity of the Cabbage Tree Creek tributary network, which is underlain by arenite-mudrock deposits.

Extending northwards to where the study area intercepts the Downfall Creek tributaries and the upper catchment of Cracow Creek, the underlying geology is dominated by arenite deposits. The study area then crosses a series of mafites and felsites and mixed siliciclastic/carbonate rocks adjacent to the sedimentary rocks and alluvial deposits underlying the area west of the township of Cracow.

Colluvial deposits, alluvial deposits and poorly consolidated sediments overlying sedimentary rock and the mafite and felsite intrusions have been mapped in the vicinity of Castle Creek and Lonesome Creek. North of Lonesome Creek extending to the township of Banana the dominant geological features comprise of sedimentary rocks underlying poorly consolidated sediment deposits and alluvial deposits associated with Banana Creek.

Findings from the terrain evaluation indicate that areas within floodplains intercepted by the study area, particularly in the vicinity of creek channels, are likely to be subject to regular flooding events during and following periods of prolonged rainfall. The high risk time for these events is during the annual wet season (i.e. between November and April), which has the potential to affect sub-grade strength. Furthermore the soft clays and saturated loose sands identified within the alluvial deposits are likely to be unsuitable as material beneath fill embankments and will require excavation and replacement with suitable fill material (Connell Hatch, 2007).

The dominant geological features underlying the study area are illustrated in Map 7 – Geology in the Map Folio.

4.2.3 Preliminary Geotechnical Assessment

The Stage 2 geotechnical investigations were carried out in January 2008. A number of geological units will be crossed by the Project, including:

- Quaternary Alluvial soil;
- Tertiary – Quaternary Colluvial soils;
- Tertiary-Sedimentary rock;
- Jurassic Sedimentary # 1;
- Jurassic Sedimentary # 2;
- Permian Sedimentary rock; and
- Permo-Carboniferous Igneous rock.

A summary of the descriptions of the dominant geological units identified during the Stage 2 geotechnical investigations are provided in Appendix G.3.

Findings from the geotechnical investigations suggest that the majority of material won from cuttings along the railway alignment will be suitable for reuse as general fill within the railway embankments. However, reactive clays will need to be placed within the core of fill sections. Mixing may be required to ensure conformance for embankment bulk fill where specific materials fail to comply with specification requirements.

Geotechnical investigations to date indicate that naturally occurring sources of material suitable for outer verge material, defined as the outer 1 m (horizontal thickness) of the embankment (excluding the capping layer), will be difficult to source. Material to be sourced within the study area for the outer verge will need to be either processed by blending naturally occurring materials, blending crushed and naturally occurring material or chemical stabilisation.

The capping layer material will need to be processed by crushing and screening material won from excavations or dedicated quarries. The Permo-Carboniferous Igneous units located mostly north of Cracow, intersected in cuttings along the multi-user corridor offer the greatest opportunity for the development of a source, or sources, of capping layer material.

Commercial basalt quarries exist at the northern end of the route at Kianga and Fairview, which will potentially be utilised as a source of ballast material. It is most likely that commercial quarries located at the southern end of the Project will be used for concrete aggregate.

Blasting may be required in some areas where the alignment crosses the Permo-Carboniferous Igneous geological province and Precipice Sandstone formation, which together account for approximately 20% of the preferred alignment.

While extremely expansive sub-grade conditions were not intercepted in any of the drill holes or test pit excavations, highly expansive sub-grade conditions are likely to occur in Quarternary Alluvial areas that are subject to seasonal inundation and possibly where deep weathering profiles have developed locally on mudstones of Jurassic Sedimentary #1 and Permian Sedimentary Units or within the Permo-Carboniferous Igneous rocks (Connell Hatch, 2008).

4.2.4 Potential Impacts and Mitigation Measures

The Project has the potential to impact locally on geotechnical stability as a result of cut and fill during construction and the long term stability of the landforms during operation.

Appropriate detailed geotechnical investigations will be required for the extent of the preferred alignment in order to adequately assess the geotechnical stability for construction and operation of the railway. A number of potential impacts to the affected land area were identified and included:

- Increased risk of geotechnical instability;
- Uncontrolled settlement of unsuitable, weak or low strength material; and
- Disruption of surface or subsurface hydrological or hydraulic regime.

Mitigation measures to avoid or minimise these potential impacts are detailed as follows:

Table 4-3: Construction Potential Impact and Mitigation Measures for Geology

Potential Impact	Mitigation Measure
Increased risk of geotechnical instability	• During design of embankments, filling, vegetation clearing and bridge and culvert structures avoid locating works adjacent to creeks, surface drainage lines and wetland areas; • All cut and fill should be carried out in accordance with relevant industry standards and specifications and all findings and recommendation detailed in the geotechnical investigations and reports completed during the preliminary and detailed design phases of the Project.
Uncontrolled settlement of unsuitable, weak and/or low strength material	• Further detailed geotechnical investigations will be carried out to obtain stability information for bridge foundation designs, rail embankment designs and potential settlement of structures and fill embankments; • The design process will require information on the subsurface profile relating to strength, geotechnical and chemical properties of soils and site geology and hydrogeological regime of the underlying groundwater system;

Potential Impact	Mitigation Measure
	• Design of embankments and cut and fill areas will be developed based on the recommendations of the geotechnical investigations undertaken as part of the preliminary and detailed design; • Identify areas within the preferred alignment, through further detailed geotechnical investigations that will require specific ground improvement measures to be implemented prior to and during construction; • Development of sub-grade treatment methodologies for highly expansive sub-grade material, which could include removal, reconditioning and re-compaction to a depth of the order of 600 mm in areas that are at grade or in shallow fill and flatter fill batters in areas of high fill; • Develop and implement design criteria that incorporate the recommendations of geotechnical investigations for batter slope of fill embankments and cuttings identified as having extremely low strength; • Incorporate the provision of berms in design of cuttings and fill batters for the purpose of controlling surface runoff and to enable maintenance; • For cuts in geological provinces where rock discontinuities are present, consider rock bolts, anchors, surface treatments or the adoption of suitable geotechnical stabilisation methods (for example, shotcrete or shotcrete and mesh).
Disruption of surface and subsurface hydrological and hydraulic regimes	• Schedule bulk earthworks excavation and filling activities to minimise adverse seasonal impacts (for example, minimise earthworks during the wet season – November to April); • Design and install embankment drainage structures to ensure that suitable moisture conditions are maintained within the core fill material of embankments; • Design and install embankment and cut batter drainage diversion and capture structures/measures to ensure adequate protection of batter structure and discharge of runoff to stabilised impact areas/locations.
Insufficient suitable fill material	• Detailed investigations of burrow areas will be required to obtain information relating to the suitability and availability of construction materials from offsite sources.

4.3 Soils

4.3.1 Methodology

The soil types within the study area were investigated through review of a number of existing studies, a site inspection and a soil sampling programme. Observations recorded during the site inspection and soil sampling programme were completed in accordance with McDonald *et al,* 1990. Classification of soils observed in excavated test pit profiles during site investigations were completed in accordance with the Australian Soil Classification (Isbell, 1996).

Previous studies associated with the land systems and soils within and surrounding the study area included:

- Draft Stage 2 Geotechnical Investigation Report (Connell Hatch, April 2008);
- Draft Terrain Evaluation Report (Connell Hatch, October 2007);
- Ahern CR, Shields PG, Enderlin NG and Baker DE (1994) Soil Fertility of Central and North Queensland Grazing Lands;
- Forster BA (1985) Evaluation of Agricultural Land in Taroom Shire; and
- Perry RA (compiled) (1968) Lands of the Dawson-Fitzroy Area, Queensland.

4.3.2 Description of Environmental Values

Soil types within the study area have been characterised and mapped as part of the *Lands of the Dawson-Fitzroy Area, Queensland* study (Perry (compiled) 1968). Soil types intercepted and directly adjoining the study area have been mapped in the *Digital Atlas of Australian Soils and the Soil Map Units* (Northcote *et al.*, 1960-68).

The CSIRO Atlas of Australian Soils for the study area provided general descriptions of the soils. Geographic Information System (GIS) analysis of the CSIRO data overlay for the study area indicated that the study area intercepts a range of soil types, including loamy to sandy duplex soils, uniform clays, sands and loams and friable earths with gradational profiles. The soil map units (Bureau of Rural Sciences after Commonwealth Scientific and Industrial Research Organisation (1991), *Digital Atlas of Australian Soils)* intercepted by the study area are illustrated in Map 8 – Soils in the Map Folio and summarised in Appendix G.4. During the site inspection a number of test pit locations were excavated and soil profiles characterised and described. Test pit excavations were undertaken within each soil map unit identified in Appendix G with the exception of Kb18.

Test pit profiles were characterised and described detailing soil colours, horizon characteristics and solum features for the depth of sampling within each test pit profile. Test pit locations are shown in Map 8 – Soils in the Map Folio and described in Appendix G.5.

A number of soil samples were also analysed for physical and chemical parameters relating to soil stability, erosivity, dispersibility, salinity, sodicity and nutrient conditions. The soil samples selected for laboratory analysis were collected from each of the soil map units indentified within the study area (except Kb18).

Within each of the soil map units, soil descriptions and profile characteristics were used to identify soil types occurring within the study area in accordance with the Australian Soil Classification (Isbell, 1996). Findings were then confirmed using the Australian Soil Classification – An Interpretive Key (Ver. 1.0 – including Upgrade 1.0) (Jaquier *et al* 2004). Seven soil orders were identified from the samples collected during the field investigations, which included:

- Tenosol;
- Kandosol;
- Chromosol;
- Dermosol;
- Vertosol;
- Sodosol; and
- Calcarosol.

Appendix G.5 summarises the soil types identified during the field investigations.

Laboratory analysis for soil physical and chemical conditions was undertaken for selected samples, which represented each of the soil orders identified. The field observations and laboratory results for each test pit were classified in accordance with the Australian Soil Classification (Isbell, 1996). Appendices G.6 to G.9 provide a summary of the laboratory results for each soil map unit analysed. Appendix G.10 shows landform survey locations and associated soil types.

Laboratory results have been reported as calculated mean values (except where stipulated in the table note). The results for each soil sample analysed are summarised in terms of dispersibility, salinity, sodicity and nutrient condition. Laboratory transcripts have been included as Appendix G.11.

Soil Stability

Soil structural stability is highly dependent on the interaction between salinity and sodicity levels within the soil profile. Non-saline/non-sodic soils tend to have a relatively stable profile structure. Structural deterioration is likely to occur with increasing severity if sodicity levels increase within slightly saline to saline soil profiles (Perverill *et al,* 1999). Structural breakdown of soils is assessed through the analysis of dispersion through the Emerson Aggregate Test.

Results of the Emerson Aggregate Tests indicated that the soils ranged from non-dispersible to moderately dispersible. Soils most likely to be vulnerable to dispersion and erosion are likely to include soils within the MM7 soil map unit, particularly Dermosols and disturbed subsurface horizons of Chromosols. Also, soils that have been identified as slightly dispersive are likely to have a high risk of accelerated erosion where landform slopes are moderately inclined to steep.

Appendix G.6 provides a summary of Emerson Aggregate Test results and dispersibility risk for each sample analysed. Appendix G.7 provides a summary of soil profile salinity conditions within each sample analysed.

Appendix G.8 provides a summary of the soil sodicity conditions within the profiles of each soil type analysed. Results indicated that soils ranged between non-sodic and marginally sodic to sodic. Strongly sodic soils were recorded within the B and C/B horizons of the Kandosol in CB3, the Chromosol in CB3 and SI4, the Dermosol in MM7 and Tenosol in Va30.

Soil Salinity

Results of the soil profile salinity conditions analysis indicated that the soils analysed within the study area ranged between non-saline and moderately saline. Two samples indicated highly saline subsurface material occurring in the B and C/B horizons. Both samples were collected from Chromosols occurring in the CB3 and SI4 soil map units. One sample indicated a profile (A and B horizons) that was extremely saline, which occurred in a Dermosol within the MM7 soil map unit. All profiles analysed indicated that saline conditions within the soil increased with depth through the profile.

Nutrient Condition

Black vertosols, or Black Earths, are one of the most fertile and highly productive soil types in Australia. Such soils are commonly found overlying alluvial and colluvial deposits, derived from basic igneous rocks, lithic sandstones and shales. Such soils are found closely associated with the Dawson River flood plain and the alluvial deposits of other streams and creeks in the study area (refer Section 6 – Water Resources).

Areas identified and mapped as Good Quality Agricultural Land (GQAL), in accordance with the *State Planning Policy 1/92: Development and the Conservation of Agricultural Land*, are an indication of high agricultural quality soil types that are also available for agricultural purposes (refer to Map 9 – Good Quality Agricultural Land in the Map Folio). The value and occurrence of this land is discussed in Section 4.5.

Although these soils were not identified during the field assessments a number of areas have been identified as having soils of significance in terms of agricultural quality. Strategies and mitigation measures for minimising these impacts are contained both in Section 4.3.3 and Section 4.5.

4.3.3 Potential Impacts and Mitigation Measures

During construction and operation of the Project there is potential for significant impact to soils resulting from disturbance and exposure of subsurface soils vulnerable to accelerated erosion, dispersivity and/or salinity due to their physical and chemical characteristics.

Soils of particular concern for management and stability will be reactive cracking clay soils, dispersive, erosion prone soils and saline soils within the proposed disturbance footprint, especially on steep slopes and/or exposed through deep cutting activities during earthworks and exposed surfaces within incised gully features.

Significant ground improvement measures are likely to be required to mitigate areas where geotechnically unsuitable materials occur in the surface and subsurface materials underlying the preferred alignment including the reactive dark cracking clays to mitigate potential impacts to proposed infrastructure and subsurface stability.

Map10 – Soil Degradation Risk Map in the Map Folio has been developed for the purpose of broadly characterising soil degradation risk areas relating to erosion, salinity and sodicity by attributing risk levels to a number of different gradients and soil types.

The Project will involve a number of activities that have the potential to impact landform and soil features and conditions within and surrounding the Project. These include all activities that create soil disturbance or change overland water flows and include:

- Placement of fill for embankment structures;
- Excavation of cuttings;

- Construction of a number of road and rail bridge structures;
- Installation of drainage structures;
- Construction of access tracks and roads;
- Service relocations and installations; and
- Construction of storage, stockpile and laydown areas and machinery.

Mitigation measures to avoid/minimise potential impacts identified for the Project are detailed as follows:

Table 4-4: Construction Potential Impacts and Mitigation Measures on Soils

Potential Impact	Mitigation Measure
Disruption of surface and subsurface hydrological and hydraulic regimes	• Scheduling of bulk earthworks and excavation and filling activities should be undertaken to ensure that these activities are minimised during adverse seasonal and climatic conditions (for example, minimise active earthworks areas during the wet season – November to April).
Increased risk of soil salinity and degradation	• Detailed investigations of areas of proposed disturbance within the multi-user corridor and properties affected by the Project to adequately assess the environmental status of soils or subsurface materials (including groundwater resources) to be disturbed during construction. These are required particularly in areas where high risk soils have been identified (i.e. highly saline and sodic soils vulnerable to structural degradation).
Loss of soil of good agricultural quality and fertile topsoil material	• Minimise impacts to land currently under cultivation and grazing pasture; • Schedule topsoil stripping and stockpiling activities to allow fertile topsoil material to be separated from bulk excavation and fill material; • Develop and implement a topsoil management plan to provide guidance to construction contractors regarding the stripping, stockpiling (including maximum storage periods and conditions) and reuse of topsoil material.
Accelerated erosion (wind and water)	• Develop and implement measures in accordance with the Soil Erosion and Sediment Control – Engineering Guidelines for Queensland Construction Sites 1996 to ensure that soil erosion does not accelerate as a result of the Project; • Scour protection for Lonesome Creek, Orange Creek and Catchment A10.

Potential Impact	Mitigation Measure
Increased risk of soil salinity and degradation	Soil handling and management measures are contained in the EMP and will be implemented prior to construction. These measures should include: • Erosion and sediment control; • Topsoil management and amelioration; • Saline soil and salinity management; and • Soil and site rehabilitation management.
Loss of soil of good agricultural quality and fertile topsoil material	• A site rehabilitation and revegetation schedule and plan will be required to be developed and implemented progressively throughout construction in order to stabilise exposed erosion prone soils and subsoils as quickly as possible; • Drainage and overland flow will need to be carefully managed and controlled so as not to impact on the stability of the rail embankments as a result of accelerated surface or subsurface erosion and/or enhanced degradation of soil structure and stability through increased salinity and sodicity.
Uncontrolled settlement of unsuitable, weak and/or low strength material	• Prepare construction areas in accordance with recommendations and findings of the preliminary and detailed geotechnical investigations. • Remove weak/low strength subsurface materials and highly reactive shrink-swell clays and apply ground improvement measures to reduce the risks associated with uncontrolled settlement of unconsolidated and/or unsuitable material under load.

Table 4-5: Operational Potential Impact and Mitigation Measures on Soils

Potential Impact	Mitigation Measure
Accelerated erosion (wind and water)	• Periodic maintenance of erosion prone, dispersive soils will be required in order to maintain stable surface soils, prevent accelerated erosion, remediate disturbed soils and protect vulnerable soils and sensitive areas within the receiving environment
Increased sedimentation	• Periodic maintenance of surface drainage controls

4.4 Land Contamination

4.4.1 Methodology

A desktop review was undertaken of the study area for land which shows evidence of being contaminated or shows a risk of potentially being contaminated through high risk land use indicators identified as Notifiable Activities in Schedule 2 of the *Environmental Protection Act 1994* (EP Act).

Aerial photographs and cadastral information was overlain with the study area footprint to provide a focus area. All Lots identified as being situated wholly or partially within the study area were subjected to the following assessment:

- Review of the Department of Defence (Defence) Unexploded Ordinance (UXO) mapping;
- Review of the Environmental Protection Agency's (EPA) Environmental Management Register (EMR) and Contaminated Land Register (CLR);
- Preliminary visual review of aerial photography to identify any additional Lots that may not have been listed on the EMR/CLR databases but show potential visual indicators such as:
  - Signs of past or present stockpiling activities;
  - Known notifiable activities, as provided in Schedule 3 of the EP Act;
  - Unspecified industrial activities; and
  - Land bearing visible scars from previous possible storage and/or contaminating activities.

4.4.2 Description of Environmental Values

Unexploded Ordinance Mapping

A review of Defence UXO mapping shows that no UXO affected sites are situated within the study area. As such, there is considered to be no risk to the Project from UXO.

Environmental Management Register

The EP Act identifies Lots based on the risk of contamination to exist. The EMR lists Lots which have been used for a notifiable activity (Schedule 3 of the EP Act) and/or land that has been identified to contain a degree of contamination through a preliminary site investigation as detailed in Appendix 5 of the Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland (EPA, 1998) (the Draft Guideline). As such, land listed on the EMR has the potential to be contaminated because of a previous or current land use. However, in general terms these sites have a low probability of causing a risk to human health or the environment under the current land use.

One hundred and forty five (145) Lots were searched for entities in the EMP and CLR. Of these, eight were recorded on the EMR. Results of the database search are summarised in Table 4-6 below and locations are illustrated geographically in Map 11 – EMR Listed Properties in the Map Folio.

Table 4-6: Properties Listed on the Environmental Management Register

Lot	Plan	Address	Area (ha)	Notifiable Activity*
2	FT211	Wandoan, 4419	1.7	Hazardous Contaminant
242	SP116402	Wandoan, 4419	7.5	Petroleum Product or Oil Storage
48	FT815	1500 Nathan Rd, Bungaban, 4419	590.5	Livestock Dip or Spray Race
8	FT218	8046 Jackson-Wandoan Rd, Wandoan, 4419	251.9	Livestock Dip or Spray Race
4	DW195	14705 Leichhardt Hwy, Castle Creek, 4719	775.4	Livestock Dip or Spray Race

Lot	Plan	Address	Area (ha)	Notifiable Activity*
4846	PH1055	Eidsvold Theodore Rd, Cracow, 4719	3,720.0	Mine Wastes
23	DW516	1174 Nathan Gorge Rd, Cracow, 4719	9,600.0	Livestock Dip or Spray Race
1	FT861	5853 Nathan Rd, Cockatoo, 4420	3,991.2	Livestock Dip or Spray Race

* Notifiable Activity as listed in Schedule 2 of the EP Act

The notifiable activities listed in above pursuant to Section 374 of the EP Act and include:

- *Livestock dip or spray race operations* – operating a livestock dip or spray race facility;
- *Petroleum product or oil storage* – storing petroleum products or oil:
  - In underground tanks with more than 200 L capacity; or
  - In above ground tanks for:
    - petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code – more than 2,500 L capacity; or
    - petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code – more than 5,000 L capacity; or
    - Petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS 1940, 'The storage and handling of flammable and combustible liquids' – more than 25,000 L capacity.
- *Hazardous contaminants and/or mine wastes:*
  - Storing hazardous mine or exploration wastes, including, for example, tailings dams, overburden or waste rock dumps containing hazardous contaminants; or
  - Exploring for, or mining or processing, minerals in a way that exposes faces, or releases groundwater, containing hazardous contaminants

It should be noted that it is possible for properties not listed on the EMR to have been contaminated through a non-notifiable activity. Land contamination of this nature is likely to result from unscheduled, accidental spillages or leakages of potentially hazardous substances. The possibility remains for such sites, unidentifiable by desktop assessment, to be present within the study area.

Contaminated Land Register

Land is recorded on the CLR when the extent of contamination, following detailed site investigation, is deemed by the EPA to require remediation or management. The search found that none of the identified potentially contaminated sites are listed on the CLR.

Additional Visual Observation

No additional Lots were identified during the preliminary aerial photography review as showing evidence of land uses that could be deemed Notifiable Activities. However, due to the significant variations in aerial photograph resolution along the Project corridor, minor structures and other assets on individual Lots were not always discernable.

4.4.3 Potential Impacts and Mitigation Measures

The location of the EMR listed properties are shown in Map 11 – EMR Listed Properties in the Map Folio. Almost half of the Lots identified on the EMR will not affect the Project since the preferred alignment will avoid them. The 5 lots through which the preferred alignment passes are very large and are primarily identified due to the presence of livestock dip or spray race facilities. Contamination caused as a result of these types of agricultural activities is typically confined to relatively small areas within larger lots.

The extent of contamination, if any, through past or present land use within these Lots must be further investigated once the rail alignment is finalised by:

- Development of a site history; and
- An inspection of the site to establish where the contamination was localised.

A preliminary site investigation will be necessary prior to disturbance of EMR listed land, conducted in accordance with Appendix 5 of the Draft Guidelines, in order to validate the potential risk of contamination. If site investigation reveals contamination to be present, remediation or an alternative suitable management approach may be required prior to change in land use. Provided that some flexibility exists within the design of the alignment it may also be possible to selectively avoid any contamination hotspots should they be identified.

Under conditions where contaminated land recorded on the EMR is to be excavated and disposed of off-site, a disposal permit is to be obtained from the EPA prior to the commencement of works, under Section 424 of the EP Act. Disposal permits are issued for a given volume of soil and dictate the site of disposal and any handling requirements.

If future alterations to the preferred alignment are made, resulting in disturbance to additional EMR listed sites, a preliminary contaminated site investigation should be undertaken prior to land disturbance unless previously conducted.

Similarly, where alterations to the preferred alignment result in disturbance of land subject to a previously submitted EPA approved Site Management Plan (SMP), the document should be followed or amended as required to include the relevant construction activities being undertaken.

A SMP/Remedial Action Plan (RAP) should be developed prior to commencement of construction on an EMR listed site and be incorporated into the Construction Environmental Management Plan (EMP(C)).

The following table serves as a schedule of further investigations and actions required if the final alignment will pass through sites that show evidence of contamination. A non-exhaustive list of common chemical contaminants associated with the specific notifiable activities identified within the multi-user corridor is also included. The risks associated with each of the contaminants addressed in this Section have been identified and discussed in Section 15.

Table 4-7: Pre-Construction Potential Impact and Mitigation Measures for Contaminated Land

Notifiable Activity	Potential Impacts	Mitigation Measure
Livestock Dip and/or Spray Race	• Arsenic; • Organochlorines and Organophosphates; • Carbamates; and • Synthetic pyrethoids.	• Undertake a preliminary site investigation; • Obtain a disposal permit where soil is to be removed from site; • Develop a Site Management Plan/Remedial Action Plan prior to construction and incorporate it into the EMP(C).
Petroleum Product or Oil Storage	• Hydrocarbons	• Undertake a preliminary site investigation; • Obtain a disposal permit where soil to be removed from site; • Develop a SMP/RAP prior to construction and incorporate it into the EMP(C).
Hazardous Contaminants and/or Mine Wastes	• Arsenic; • Mercury; • Cyanides; • Aluminium; • Copper; • Chromium; • Cobalt; • Lead; • Manganese; • Nickel; • Selenium; • Zinc; and • Radio-nuclides.	• Undertake a preliminary site investigation; • Obtain a disposal permit where soil to be removed from site; • Develop a Site Management Plan/Remedial Action Plan prior to construction and incorporate it into the EMP(C).

Construction of the railway along the preferred alignment will involve a range of works typical of a railway development project. Likely construction activities are expected to include excavation work, cut and fill work, localised dewatering and establishment of embankments.

If at any stage during earthworks potentially contaminated soils are encountered, work should cease temporarily and a preliminary contaminated site investigation shall be undertaken. Contamination may be identified on a visual or olfactory basis. A preliminary investigation should conform to Appendix 5 of the Draft Guidelines and will include:

- Development of a site history;
- An inspection of the site;
- A basic sampling program to determine if contamination is present; and
- A report documenting findings.

As well as the potential to encounter existing land contamination during the construction phase, the project works will also include a number of activities that have the potential to cause contamination impact on the land and water resources within and surrounding the Project. These relate to all activities that create contamination and potentially include the following:

- Spills and air emissions from machinery;
- Soils imported on the tread of off-site vehicles;
- Leakage and exposure of hazardous materials;
- Misuse of construction materials;
- Spillages of hazardous materials and dangerous goods; and
- Imported contamination and potential ASS in bodies of fill material.

Mitigation measures to avoid/minimise potential impacts identified for the Project are detailed as follows:

Table 4-8: Construction Potential Impact and Mitigation Measures for Contaminated Land

Potential Impact	Mitigation Measure
Machinery: Leakages of: • Fuel; • Oil; • Coolant. Imported soils on tyres/tread; and Air emissions.	• Daily inspection of on-site machinery; • Undertake maintenance of site machinery and vehicles as soon as practicable after the requirement is identified; • Inspection for and repair of all leaks prior to allowing any external vehicles or machinery on-site; • Incorporate proposed mitigation measures into an EMP(C).
Hazardous Materials: • Exposure of hazardous materials to local ecosystems; • Contact with environmentally sensitive receptors; • Leakages from storage containers; • Misinterpretation of directions of use; and • Excessive volume of hazardous material used.	• Record in a manifest the nature, quantity and location of all hazardous materials on site; • Include Material Safety Data Sheets (MSDS) for all hazardous materials with the manifest; • Maintain hazardous materials manifest on site and update regularly; • Store hazardous materials in clearly designated areas, as far as practicable from residences, water courses and other vulnerable receptors; • Storage areas to consist of a compacted base and bunding to contain spillages, as per AS 1940 and 3780; • Storage areas to be roofed to prevent contamination and infiltration of stormwater; • The Construction Contractor shall nominate a Site Safety Officer and provide an Emergency Response Plan, along with prescribed placarding, HAZCHEM cards and fire

Potential Impact	Mitigation Measure
	extinguishers; • Where on-site storage exceeds minor storage limits a permit shall be obtained from the appropriate authority for bulk storage of chemicals, oils and/or petroleum products; and • Residual stocks of hazardous materials should be removed from the construction site and returned to an appropriate storage area or disposed of at an appropriate waste facility at the end of construction.
Spillages: Accidental spillage of: • Hazardous materials; and • Dangerous goods.	• Any spills of dangerous goods shall be rendered harmless through: – Investigation; – Collection; and – Disposal at a suitable disposal facility, as arranged by the Construction Contractor. • The EMP(C) will acknowledge all identified sensitive receptors within the construction site and include a suitable Emergency Spill Containment Plan.
Construction Material: Contamination and ASS potential of: • Fill material imported from an external site under the same management; and • Fill material imported from an independent site.	• All fill material imported from offsite is to be procured from a licensed quarrying facility and accompanied by relevant documentation to verify it is contaminant and ASS free; • All on site fill material is to be cleared for contamination prior to disturbance and stockpiled in separate, bunded and lined treatment areas where it is to be analysed for contaminants and ASS prior to being reused on site; and • All documentation related to fill shall be retained on file by the Construction Contractor.

Land contamination issues arising during the operation phase of the Project are likely to include, but are not limited to:

- Spillage or leakage of goods/cargo in transit i.e. petroleum products, liquefied gases, flammable and toxic chemicals or other hazardous wastes;
- Production and deposition of fine iron dust from heavy braking;
- Soil and surface water contamination from herbicides applied as a weed control measure; and
- General waste and debris generated from rail operation.

Such impacts may generate newly contaminated land or exacerbate existing contamination without the implementation of suitable mitigation measures.

Any long term mitigation measures for contaminated land issues arising during the operational phase of the railway should be detailed in the SMP and/or RAP. Such measures will be an expansion of the management approaches adopted for hazardous materials and spillages during the construction phase.

Table 4-9: Operational Potential Impact and Mitigation Measures for Contaminated Land

Potential Impact	Mitigation Measure
Hazardous Materials: • Production and deposition of fine iron dust from heavy braking; • Soil and surface water contamination from herbicides applied as a weed control measure; and • General waste and debris generated from rail operation.	• Record in a manifest the nature, quantity and location of all hazardous materials within the multi-user corridor; • Record in a manifest the nature, quantity and location of all hazardous materials to be transported by rail; • Include MSDS for all hazardous materials within a manifest; • Maintain hazardous materials manifest in a readily accessible location and update regularly; • Store hazardous materials in clearly designated areas, as far as practicable from residences, water courses and other vulnerable receptors; • Storage areas to consist of a compacted base and bunding to contain spillages, as per AS 1940 and 3780; • Storage areas to be roofed to prevent contamination and infiltration of stormwater; • The rail operator shall nominate a Rail Safety Officer and provide an Emergency Response Plan, along with prescribed placarding, HAZCHEM cards and fire extinguishers; • Where on site storage exceeds minor storage limits a permit shall be obtained from the appropriate authority for bulk storage of chemicals, oils and/or petroleum products.

Potential Impact	Mitigation Measure
Spillages or leakage of goods/cargo in transit i.e. petroleum products, liquefied gases, flammable and toxic chemicals or other hazardous wastes	• Any spills of dangerous goods shall be rendered harmless through investigation, collection and disposal at a suitable disposal facility, as arranged by the Rail Safety Officer; • The SMP and/or RAP will acknowledge all identified sensitive receptors within the multi-user corridor and include a suitable Emergency Spill Containment Plan; • Copies of Emergency Spill Containment Plan to be available on board each train, as well as in each traffic controller hut; • All train operators and rail staff working within the multi-user corridor to be familiar with the Emergency Spill Containment Plan; • Emergency spill kits to be provided at each traffic controller hut within the multi-user corridor.

4.5 Land Use and Infrastructure

4.5.1 Methodology

The existing values relating to various land use and infrastructure elements of the study area such as dominant land use, sensitive receptors, land tenure, Native Title, infrastructure, road reserves, stock routes, and mining and petroleum leases and permits, were obtained through various forms of investigation, including:

- Community profiles;
- Desktop analysis of aerial photographs, topographical data, planning scheme and trunk infrastructure maps;
- Use of the DNRW Digital Cadastral Database (DCDB);
- Search of current Mining Leases, Coal Resources Areas, GQAL, Reserves, Stock Routes;
- A search of the National Native Title Tribunal database;
- Meetings with the various members of the study team, and officers from DNRW; and
- Field verification in January 2008.

Investigation of statutory planning instruments was undertaken at three scales; state-wide, regional and local. The activities undertaken for each scale were:

- State Planning Policies – Analysis of all relevant State Planning Policies was undertaken in order to determine the specific requirements set out by each. The requirements of relevance for the Project were subsequently identified and documented;

- Regional Planning – Identification of the regional planning intent for the study area consisted of the analysis of the Central Queensland Regional Growth Management Framework (RGMF). This RGMF was analysed to determine the future regional growth intent and compared with the predicted Project outcomes. This provided an understanding of the Project's compatibility with regional planning intent; and
- Local Government Planning Schemes – The local government planning schemes for the Taroom and Banana Shires (in lieu of the planning schemes for the new regional councils) were analysed. The future development intents were determined through an analysis of the respective planning scheme Desired Environmental Outcomes (DEO's). The predicted outcomes for the Project were compared with the planning scheme intents to determine the compatibility of the Project. Zoning plans for both shires were also used to develop an appreciation of the land use context. Development approvals and proposals for the study area were obtained through online development application searches and discussions with local government officers.

4.5.2 Description of Existing Planning Framework

State Planning Policies

State Planning Policies (SPPs) are a means for the Queensland Government to express its interests in development related issues that can be implemented through local government planning schemes and development assessment processes. Many provisions of the SPPs relate to requirements on behalf of certain local governments, however some also contain direct requirements for certain developments. A discussion of the six SPPs is provided below, including their intent and their relevance to the Project.

State Planning Policy 1/92 – Development and the Conservation of Good Quality Agricultural Land

Defined Good Quality Agricultural Land is a valuable and vital resource which ensures the productivity of agricultural industries into the future. State Planning Policy 1/92 is in place to ensure that development does not continue to destroy the viability of fertile lands throughout Queensland. This SPP requires local governments to identify and protect GQAL through their planning schemes, however this policy also contains two overarching principles that apply to all development in Queensland:

- Principle 1 – GQAL has a special importance and should not be built on unless there is an overriding need for the development in terms of public benefit and no other site is suitable for the particular purpose; and
- Principle 2 – The alienation of some productive agricultural land will inevitably occur as a consequence of development, but the Government will not support such alienation when equally viable alternatives exist, particularly where developments that do not have very specific locational requirements are involved.

The Project meets the definition of Principal 1 on the basis of the Project's community benefit. This position is supported by the State through the declaration of the Project as a 'significant project'.

State Planning Policy 1/02 – Development in the Vicinity of Certain Airports and Aviation Facilities

This SPP is designed to minimise the impacts of development upon the operation of certain airports and aviation facilities. No airports or aviation facilities identified in the SPP are located close to the Project. Consequently, this SPP does not apply to the Project.

State Planning Policy 2/02 – Planning and Managing Development Involving Acid Sulfate Soils

This SPP is intended to represent the State's interests concerning development involving acid sulfate soils in low-lying coastal areas. The shires of Taroom and Banana are not included in the list of local government areas to which the SPP applies. Therefore, this SPP is not applicable to the Project.

State Planning Policy 1/03 – Mitigating the Adverse Impacts of Flood, Bushfire and Landslide

SPP 1/03 is designed to ensure that the natural hazards of flood, bushfire and landslide are adequately considered when making development decisions. Annex 1 of this SPP identifies Community Infrastructure (including railway lines, stations and associated facilities) as being subject to the provisions of the SPP. The preferred alignment passes through areas of low and medium bushfire hazard, these areas, derived from the Taroom and Banana Shires, are illustrated in Map 5 – Bushfire Risk in the Map Folio.

Outcomes 1, 2 and 3 of the SPP are applicable to the Project. These are:

- Outcome 1 – Within natural hazard management areas, development to which this SPP applies is compatible with the nature of the natural hazard, except where:
  - the development proposal is a development commitment; or
  - there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal.
- Outcome 2 – Development that is not compatible with the nature of the natural hazard but is otherwise consistent with Outcome 1:
  - minimises as far as practicable the adverse impacts from natural hazards; and
  - does not result in an unacceptable risk to people or property.
- Outcome 3 – Wherever practicable, community infrastructure to which this SPP applies is located and designed to function effectively during and immediately after natural hazard events commensurate with a specified level of risk.

As with SPP 1/92, it is important to consider the Project in light of the overriding need for the development to occur in the public interest. Further, a number of alignment options for the Project were identified and compared through a multi-criteria analysis process before a decision was made with respect to the preferred alignment. It should be noted that any railway connection between Wandoan and Banana will traverse low and medium bushfire risk areas.

The Project will be designed such that the adverse impacts from natural hazards are minimised, and such that functionality is maintained during and immediately following natural hazard events.

State Planning Policy 1/07 – Housing and Residential Development

This policy applies to Local Government Areas (LGA's) that have a population of 10,000 or more including at least one urbanised area, and is experiencing notable growth in residential approvals. The SPP outlines processes for these local governments to follow in order to modify (if necessary) their planning schemes to remove barriers to, and provide opportunities for, a range of housing options that respond to the housing needs of the community. The local governments to which this SPP applies do not include Taroom or Banana Shires. Therefore, this SPP is not relevant to the Project.

State Planning Policy 2/07 – Protection of Extractive Resources

This SPP is intended to protect extractive resources of State or regional significance from developments that may prevent or severely constrain current or future extraction when the need for the resource arises. The Key Resource Areas (KRA's) to which this SPP applies do not include any areas within Taroom or Banana Shires. Therefore, this SPP does not apply to the Project.

Regional Planning Framework

One level down from the state-wide scale, planning in Queensland is undertaken within regions which are comprised of numerous of Local Government Areas. Each of these regions is required to develop a regional planning framework to guide development and growth. The Project is situated within two regions – Maranoa and District and Central Queensland. The Central Queensland region has developed the Central Queensland Regional Growth Management Framework (CQRGMF). However, currently Maranoa and District is in the process of developing a regional plan. The CQRGMF can be used to assess the compatibility of the Project with regional planning intent for the study area.

The CQRGMF outlines a policy framework which provides direction and intent for the future development of the region. The CQRGMF was prepared in 2002 in accordance with the *Integrated Planning Act 1997* (IP Act), and is endorsed by State Cabinet. Consequently, the plan has statutory recognition within Queensland's planning framework. The aim of the framework is to promote development and capitalise on Queensland's economic growth whilst preserving and enhancing the social and ecological environments.

The CQRGMF is built around guiding principles in the following areas:

- Resource use;
- Conservation and management;
- Economic development;
- Infrastructure;
- Social and cultural development;
- Education, Training and Research; and
- Planning and governance.

A range of strategies are contained in the CQRGMF relating to each of the guiding principles listed above. The following strategies are of particular relevance for the Project:

- Support the use of land resources within the limits of their capabilities;
- Identify opportunities and address impediments to mining development, light metal manufacturing, minerals and chemical processing and the petro-chemical industry;
- Plan and develop a strategic transport network that meets current and projected community and industry needs and uses best practise approaches and technology; and
- Maintain and improve (as required) the regions rail network to ensure the safe, efficient movement of people and products.

The regional drivers identified in the CQRGMF are based on economic, social and environmental growth. The region possesses a number of competitive advantages, and as identified in the CQRGMF (2001:33), there is a need to clearly recognise, articulate and capitalise upon these competitive advantages for the benefit of the region.

The Project provides an opportunity to benefit from the strong economic growth currently occurring in Queensland. The Project will address the existing capacity constraints of the coal rail network, which are presently limiting potential growth, and will provide a crucial transport link which will allow for increased resource extraction and export capacity to assist is satisfying current and future demand. The Project has been identified as an important piece of missing infrastructure by the Queensland Government and QR, providing access to an estimated four billion tonnes of thermal coal. As such, the Project is likely to advance the regional development intent outlined in the CQRGMF.

Local Government Planning Schemes

During Queensland's recent Council amalgamations the Taroom and Banana Shire Councils were both changed. The Banana Shire was expanded to include part of the old Taroom Shire. The remaining area of Taroom Shire was amalgamated into the Dalby Regional Council. Until such time that a new Planning Scheme is developed for the new Banana Shire and Dalby Regional Councils the existing Taroom and Banana Shire planning schemes will set out the development intent for the areas within the respective areas. As such, it is necessary to discuss the planning intent for the preceding local governments, with the knowledge that this planning intent will remain valid for some time into the future.

Development intent for Taroom and Banana Shires is primarily displayed through the zoning plans within each planning scheme. The zoning plans for both local governments indicate that the preferred alignment will pass exclusively through the rural zones in Taroom and Banana Shires. Based on descriptions within both planning schemes, the rural zone is intended as an area of primary production. Where development is to take place in the rural zone, it should not prejudice rural activities. As a result, development must ensure the quality of the natural environment is maintained and GQAL is protected from alienation, fragmentation and encroachment of incompatible uses. The rural amenity is to be preserved through the protection and enhancement of the rural scale, intensity, form and character, and sites of conservation importance. Adverse impacts on local road networks must be avoided, and the Project itself must also be located and designed to minimise the need for natural hazard mitigation. In addition, any development must also have appropriate water supply, stormwater disposal, sustainable effluent, waste disposal and power.

Due to the extensive and linear nature of the Project, impacts could arise which are likely to affect the achievement of some of the specific development intent applicable to the directly affected properties in the rural zones for both shires. These impacts may include:

- The disturbance of GQAL;
- Impacts on established residences on rural properties;
- Impacts on areas of cultural significance;
- Impacts on local road networks;
- Impacts on bushfire risk; and
- Impacts on property management.

These impacts are discussed within the EIS, and measures to minimise these impacts are identified, forming commitments within the EMP.

4.5.3 Description of Environmental Values

Land Tenure

The preferred alignment directly affects 84 parcels of land (Lot Plans), of these there are 7 government owned parcels and 77 privately owned parcels with 56 separate private landowners. These properties are predominantly of a low intensity rural nature.

As indicated above, the preferred alignment passes through predominantly large rural holdings. Most of the proposed multi-user alignment is located on land held in freehold title or lands lease, with freehold tenure being more prominent around the township of Banana and across the broad river plain north of Camboon and Theodore, and around and north of Wandoan, and with leasehold tenure being more prominent halfway along the corridor, in the areas surrounding Spring Creek and Cracow. The proposed alignment also crosses a number of road reserves as described further at section 10.4. The study area has been chosen to avoid significant forms of tenure (such as National Parks), as shown in Map 12 – Land Tenure in the Map Folio. Some small parcels of Reserve Land and State Land around the township of Wandoan fall within the study area but are mostly avoided by the preferred alignment.

Native Title

There are currently three native title claims over the study area. These claims are held by the Wulli Wulli, Gangulu, and Iman #2 People respectively (see Map 13 – Aboriginal Cultural Heritage Native Title and Artefacts in the Map Folio). Negotiations with the registered Native Title Claimants and the Project's management of Native Title are discussed further in Section 11.

Dominant Land Uses

The dominant land uses within the Dawson Valley are:

- Cattle breeding and fattening, wheat, sorghum and timber around Wandoan;
- Cattle breeding and fattening, wheat, sorghum and timber around Taroom;
- Gold mining at Cracow;
- Cotton, sorghum and mung beans around Theodore;
- Cattle breeding and fattening around Banana; and
- Coal mining, cattle breeding and fattening, cotton, wheat, sorghum, sunflower and grain around Moura and Biloela.

Dawson Valley plays an important role within Queensland, with the majority of land in the region used for some type of agricultural production, mostly relating to cattle breeding and fattening. It is estimated that beef production in the region generates approximately $135 million annually. Dryland cropping (including grain sorghum and wheat) and irrigated cropping (most notably cotton) are also prevalent within the Dawson Valley, and these practices are mainly concentrated in the more fertile black soils. There are extensive coal reserves throughout the study area, with thermal coals located around Taroom and Wandoan, and thermal and coking coals near Theodore and Moura estimated to be in excess of six billion tonnes. While most of these coal deposits are undeveloped, coal is mined

at Moura and near Biloela. In addition, gold is mined at Cracow. Dominant land uses in the study area are shown in Map 14 – Land Use in the Map Folio.

It is important to note that the preferred alignment avoids the major townships throughout the study area. Outside the town the land uses are almost exclusively rural/agricultural in nature, and the properties are relatively large in area. Photo 4-4 contains four images depicting the typical landscape within the study area.

Photo 4-4: Typical landscape within the study area. Clockwise (from the top left) – a residence on a property south-west of Cracow; cattle grazing on a property north-east of Wandoan; crop production south-east of Theodore; and rural land south of Banana

Residential and Recreational Areas

The townships and communities within the study area have historically grown on the back of the early agricultural industries in the area. Increasingly at present, some communities are also being influenced by the mining industry and have experienced significant local demand for housing and local services.

Wandoan is the largest community within close proximity of the Project and is located within Dalby Regional Council (formerly Taroom Shire), south of Taroom, along the Leichhardt Highway and at the southern end of the study area. The town is essentially a service centre, providing support for the surrounding cattle, wheat, sorghum and timber industries. Wandoan is a major cattle trucking centre, and is a convenient stop for travel between Miles and Taroom. A variety of social infrastructure, services, clubs and associations are based in Wandoan for the community within and around the township.

The preferred alignment is located close to a number of industrial land uses fringing Wandoan. In addition, the Wandoan Outpatients Clinic and the Wandoan State School are within 500 m and 1 km of the alignment respectively on the other side of the Leichardt Highway.

Situated between the townships of the study area, there are also many small communities associated with the rural areas throughout the Dawson Valley.

These communities generally have limited reticulated services or social infrastructure, however they form an important part of the social fabric of the area. Only a relatively small number of individual residential dwellings exist within 1 km of the preferred alignment. Of these; one residential dwelling is located within 100 m of the preferred alignment, 9 within 500 m and 30 within 1 km.

There are no designated recreation areas intersected by the preferred alignment.

Further information on the towns within the study area is provided in Sections 13 and 14.

Existing Infrastructure

Various forms of infrastructure are located within the Dawson Valley. Primarily, this infrastructure is centred around the major townships of Biloela, Theodore, Cracow and Wandoan.

These townships (those nearest the study area) all have reticulated water supply that is provided and maintained by the relevant local Council. In areas outside of these towns, un-reticulated water supplies (such as bores, dams and rain tanks) represent the predominant forms of water supply.

Other utilities within the region include electricity and gas infrastructure, as shown in Map 15 – Utilities Electricity/Gas in the Map Folio. The primary power provider within the Dawson Valley region is Ergon Energy. The Ergon Energy network includes small-scale overhead powerlines in proximity to Cockatoo, Spring Creek, Cracow, and generally from Theodore north to Banana. These powerlines are relatively minor in nature and construction of the Project will need to ensure that appropriate relocation efforts are undertaken along the alignment as construction progresses. Discussions with Ergon Energy have indicated that there is one area of interest with the study area where a larger scale overhead power line asset crosses the preferred alignment, and represents a more significant constraint for the Project. This easement travels in an east-west direction north of Theodore. The construction and operation of the Project must avoid impacts to this transmission line, and ongoing liaison with Ergon Energy about this issue is required.

Gas supply infrastructure within the Dawson Valley is restricted to an area north-east of Wandoan and to the east of the study area. This gas pipeline is associated with the Santos Scotia gas field and the Origin Energy Peat gas field, both east of Wandoan. The Project is unlikely to impact on this gas infrastructure.

Stock Routes

Stock routes are pathways for travelling stock on roads, reserves, unallocated state land and pastoral leases. In Queensland, a stock route may be a route ordinarily used for moving stock on foot or a road that is declared in the *Land Protection Regulation 2003* to be a stock route. Most stock routes are on public roads that may also carry traffic and public utilities.

As shown in Map 16 – Stock Routes in the Map Folio, stock routes are located within the study area in a number of locations. These stock routes are generally associated with the following roads:

- Leichhardt Highway north-west of Wandoan;
- Bungaban Twelve Mile Road north of Wandoan;

- Nathan Road/Redrange Road west of Cockatoo;
- Cracow Road near Spring Creek;
- Defence Road east of Theodore; and
- Leichhardt Highway between Lonesome Creek and Banana.

Discussions with the Stock Route Management Group within the DNRW have indicated that there is no formal approvals process (required under legislation) relating to the areas where stock routes are traversed by the preferred alignment. The DNRW Stock Route Management Group will provide feedback on the areas where the preferred alignment crosses stock routes, and will also involve the relevant local governments in this process, given that they maintain these stock routes.

In all areas where the alignment crosses stock routes, it is understood that a grade separated crossing will be provided to ensure that the movement of stock through these areas can still take place. Standard underpass requirements have been discussed with the Stock Route Management Group. In locations along the preferred alignment where implementing a standard underpass may be problematic, alternative solutions (such as slight realignment or adjustment of the stock route) will be explored with the stakeholders from State and local governments.

Mining and Petroleum Leases and Permits

The study area is situated within the boundaries of a number of mining and petroleum exploration and resource areas (see Map 17 – Mining Areas Exploration Permits in the Map Folio). As the exploration and resource areas are distributed liberally throughout the study area, it is important to ensure that the Project minimises conflicts with official coal resource areas and areas subject to mining leases. Importantly, the study area avoids all official coal resources, and only fringes the Cracow mining lease.

From Wandoan, the preferred alignment travels north through a small part of the Coal Measured-Indicated Resource Area surrounding the proposed Wandoan Coal Mine, and through a coal Exploration Permit, avoiding an official coal resource to the east (traversing part of its Coal Measured-Indicated Resource Area). The preferred alignment then travels through areas subject to petroleum Exploration Permits and Petroleum Leases. The petroleum Exploration Permit extends up to Spring Creek, where mineral Exploration Permits and coal Exploration Permits are also traversed by the preferred alignment.

The coal Exploration Permit ceases just south of Cracow, where the preferred alignment passes to the west of the township, slightly traversing a mining lease associated with the Cracow Gold Mine. The preferred alignment then continues north through mineral Exploration Permits north of Cracow and around Lonesome Creek before reaching Banana.

A number of stakeholders have been consulted over potential mining and petroleum leases. Phil Ferenczi of DME Central Region was contacted in January 2008 regarding mining and resource related issues and Don Runge of Cracow Gold Mine, regarding a number of issues including potential impact of the mining activities on the multi-user corridor (unlikely), opportunity of shipping materials and providing building materials for the Project. The Project engineering team will continue to work with key stakeholders to ensure that any potential conflicts between existing mining and petroleum interests and the Project are resolved before detailed design.

4.5.4 Potential Impacts and Mitigation Measures

Land Acquisition

Information on necessary acquisition of land for the Project, and the likely resultant impacts was obtained through desktop assessment of aerial photography, survey plans and discussions with the Community Engagement team. A number of potential impacts to affected properties were identified and included:

- Physical fragmentation of properties;
- Potential loss of property viability;
- Loss of access;
- Loss of community cohesion through isolation; and
- Loss of land value due to close proximity to the project alignment.

Mitigation measures to avoid or minimise potential impacts identified for the Project are detailed as follows:

Table 4-10: Construction Potential Impacts and Mitigation Measures of Land Acquisition

Potential Impact	Mitigation Measure
Acquisition of part or all of a property may lead to physical fragmentation of the property.	• Undertake regular community engagement to inform the community how they will be affected and how they will be protected; • Ensure that appropriate design measures are put in place to minimise the impact of physical fragmentation.
Acquisition of part or all of a property may lead to a potential loss of property viability.	• Ensure that all appropriate property resumptions are undertaken with an emphasis on maintaining property viability; • Due consideration of remediation for those sites and properties that may significantly lose functionality.
Partial acquisition and property fragmentation may lead to residential isolation due to a loss of access to the main road.	• Ensure that local access roads are maintained and replaced where necessary; • Minimise potential disturbances through the use of community consultation and appropriate 'advertising'.
Community cohesion may be affected as those affected by land acquisitions may feel isolated and lacking community aspiration as they are physically cut off from the rest of the community.	• Ensure the key stakeholders, including land owners, government agencies, community groups and the socially disadvantaged are consulted at all stages of the construction to ensure that their interests are catered for.

Potential Impact	Mitigation Measure
Loss of land value due to proximity of a property to the final alignment.	• Current State Government policy allows for compensation for directly affected landowners (i.e. land required for the road corridor) through either hardship or acquisition processes. Notably there is no current provision for the payment of monetary compensation to indirectly affected landowners. However, other mitigation measures aimed at maintaining residential amenity (see above) may assist in reducing the severity of any negative impacts on property values.

Good Quality Agricultural Land

Potential impacts of the Project upon Good Quality Agricultural Land (GQAL) were identified through analysis of soils, Council GQAL maps and consideration of the *State Planning Policy 1/92: Development and the Conservation of Agricultural Land* (SPP).

This SPP requires development approvals to take into account the location and extent of GQAL. The Identification of Good Quality Agricultural Land planning guideline (DPI and DHLGP, 1993) identifies the following four classes of agricultural land to assist in identifying GQAL:

Table 4-11: Good Quality Agricultural Land Classes

Class A Crop land	Land that is suitable for current and potential crops with limitations to production which range from none to moderate levels.
Class B Limited crop land	Land that is marginal for current and potential crops due to severe limitations; and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping.
Class C Pasture land	Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment.
Class D Non-agricultural land	Land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and/or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop or poor drainage.

Class A is always classified as GQAL. In some local governments areas Class B and Class C will be classified as good quality agricultural land depending on the scarcity of Class A land and use of the land for pastoral industries.

The largest sections of best quality agricultural land within the study area occur:

- In the northern section of the study area from Banana south to Lonesome Creek;
- An area to the east of Spring Creek; and
- The southern portion of the study area from Bungaban/Twelve Mile Road south to Wandoan (refer to Map 9 – Good Quality Agricultural Land in the Map Folio).

The SPP has been considered in the selection of the study area and specifically the alignment has avoided significant areas of GQAL which are located to the west of the selected study area passing near Theodore (Alternatives to the Project – Section 1.6). However, a loss of GQAL and productive land will occur as a result of the Project and may lead to a loss of agricultural productivity in some areas.

The following potential impacts were identified during the study:

- Loss of high yield agriculture;
- Fragmentation of GQAL; and
- Loss of income through loss of GQAL.

Mitigation measures to avoid or minimise potential impacts identified for the Project are detailed as follows and include mitigation measures derived from the analysis of the SPP.

Table 4-12: Construction Potential Impact and Mitigation Measures on GQAL

Potential Impact	Mitigation Measure
Banana • Loss of approximately 338 ha Class A • Loss of approximately 147 ha Class B • Loss of approximately 104 ha Class C Taroom • Loss of approximately 329 ha Class A • Loss of approximately 41 ha Class C	• GQAL loss has been reduced through route selection • Where possible minimise the footprint of the final fenced alignment.
Loss of high yield agriculture (such as "A" Class crop land) through development periphery works associated with construction.	• Ensure that appropriate desktop and field studies are undertaken to prevent development on "A" Class GQAL where possible; • Ensure that in areas where GQAL is unavoidable that every possible effort is made to avoid A and B Class GQAL.
Fragmentation of the GQAL through the development of the Project.	• Ensure that all possible alternatives have been explored before committing to fragment the GQAL with the Project.
Loss of income through the loss and fragmentation of the GQAL.	• Ensure where possible that the impacted GQAL is of a low value and will not impact on the economic viability of the property; • Compensation to property owners to offset loss and fragmentation of GQAL where appropriate.

Existing Infrastructure

Identification of any infrastructure affected by the Project was obtained through analysis of trunk infrastructure maps. Potential relocation of infrastructure elements was identified through discussions with the study team and analysis of survey plans. The following potential impacts were identified during the study:

- Potential loss of service during construction relocations; and
- Potential disruption of essential services through accidental interruption of infrastructure.

Mitigation measures to avoid or minimise potential impacts identified for the Project are detailed as follows:

Table 4-13: Construction Potential Impact and Mitigation Measures on Existing Infrastructure

Potential Impact	Mitigation Measure
Potential loss of service from interruptions of essential infrastructure during construction relocations.	• Develop as part of the construction environmental management plan to minimise the interruption of services based on the location of the infrastructure and the time it will take to move the services; • Undertake community consultation to determine which services are the most essential and plan to minimise the interruptions of these services; • Undertake community consultation and appropriate advertising to effectively communicate to the community when the services will be interrupted due to infrastructure relocation.
Potential disruption of essential services through accidental interruption of infrastructure.	• Liaise/consult with the infrastructure providers to developing mapping of all known infrastructure; • Develop an emergency response plan in association with the infrastructure provider and local emergency response providers to minimise the amount of disruption that may be caused by the accidental interruption of the infrastructure; • Undertake community consultation and appropriate advertising to inform the local community of the procedures in place for informing the construction team of an interruption and the procedures that the construction team will undertake to efficiently reinstate the services.

Stock Routes

The EIS has identified a number of stock routes which may be affected by the preferred alignment, the following mitigation measures are proposed to manage these potential impacts:

Table 4-14: Construction Potential Impact and Mitigation Measures for Stock Routes

Potential Impact	Mitigation Measure
Impact to existing stock routes	• Grade separated crossing will be provided to ensure that the movement of stock through these areas can still take place, or • In locations along the alignment where implementing a standard underpass may be problematic, alternative solutions (such as slight realignment or adjustment of the stock route) will be explored with the stakeholders from State and local governments.

Mining and Petroleum Leases and Permits

Impacts upon past, present and future mining and petroleum leases and permits were identified from discussions with DNRW officers. Where the Project traverses an area subject to such a lease or permit, mitigation measures were identified to minimise any potential conflict, if relevant.

Table 4-15: Construction Potential Impact and Mitigation Measures on Mining and Petroleum Leases

Potential Impact	Mitigation Measure
Impacts to coal resource areas and mining leases, affecting the ability of the coal resource to be extracted, or for the mining activities to occur.	• The study area has been selected to avoid coal resource areas and areas subject to mining leases, thereby removing the risk of impacts to these areas and extractive industry in these locations.
Impacts upon land subject to mining and petroleum exploration/resource areas, including restricting the ability of future exploration in these areas.	• Mining and petroleum exploration/resource areas include extensive tracts of land throughout the Dawson Valley region. As such, any alignment option of the Project would implicate land that is subject to both mining and petroleum exploration or resource areas. Impacts from the Project upon these areas are considered to be negligible, as the Project is a comparatively thin corridor throughout vast areas subject to these permits. In addition, the nature of the Project is such that it may help to facilitate any future extraction of resources in these areas.