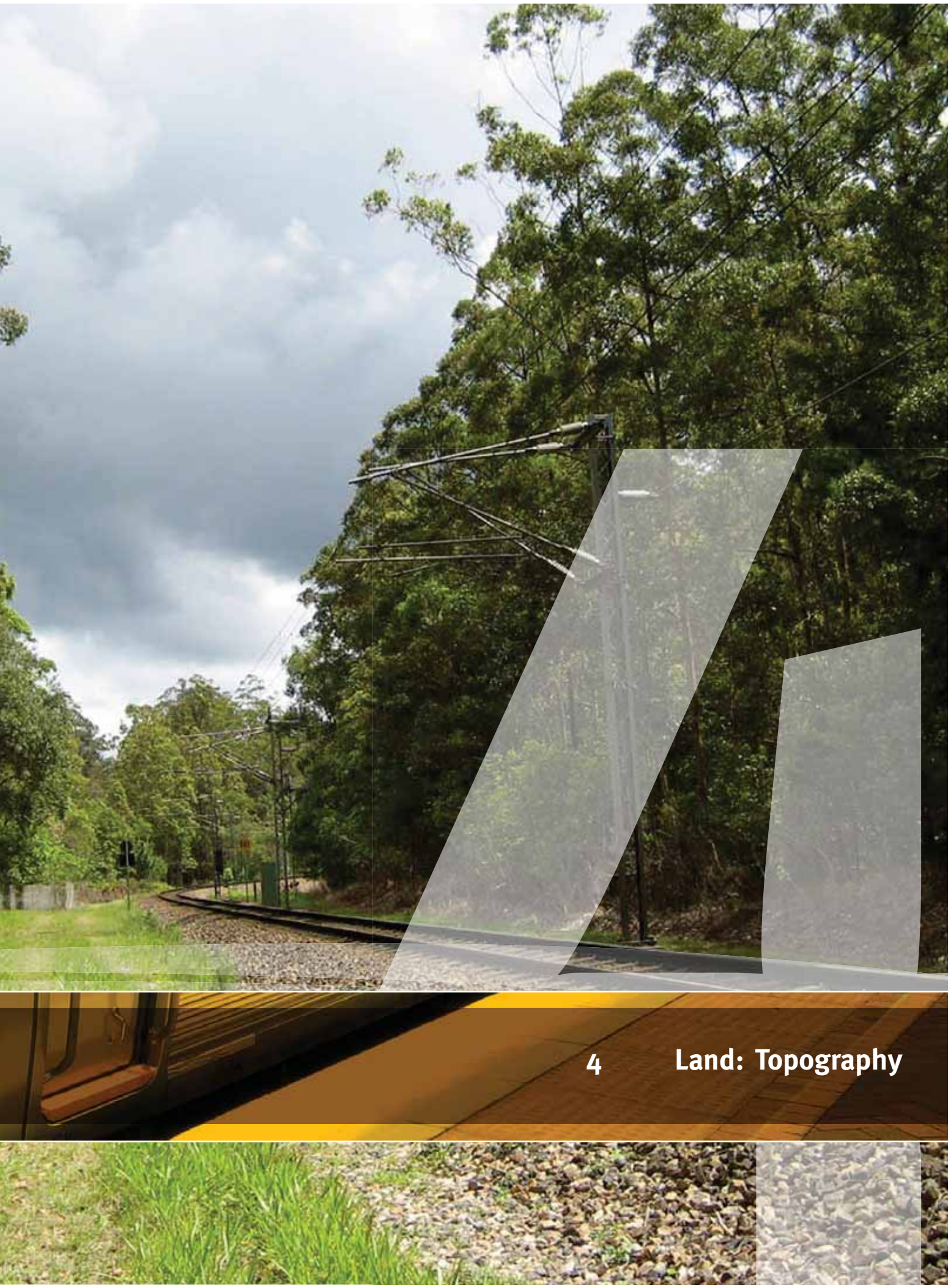


4 Land: Topography

4 Land: Topography

4.1 Introduction

The chapter aims to show the project elements in their regional and local geographical context and in relation to significant features of the landscape and any environmentally sensitive areas or areas of a high conservation value. It also aims to provide:

- a detailed topographic description, with contours at suitable increments shown with respect to Australian Height Datum (AHD)
- an assessment of the impacts of the project and their significance
- any measures taken to avoid or minimise impacts on major topographic features and mitigation measures used for the project.

Chapter 5, Land: Geology and soils contains further information and discussion about the ground conditions at the site.

4.2 Methodology

4.2.1 Review of existing information

Topographical constraints were assessed on the basis of published geological information, a topographical survey and observations from the geotechnical site walkover. Interpretation of stereo pairs of aerial photographs was carried out along the preferred route for the project prior to the site visit. The photographs were taken in June 2007 for the Department of Transport and Main Roads specifically for the project. These aerial photographs were of good quality and resolution.

4.2.2 Assessment of impacts

The impact of the project on the topography of the project area has been described, and mitigation or management measures defined. Where there is a residual impact (i.e. where an impact remains after the mitigation or management strategies have been applied), the significance of the impact is assigned in accordance with the approach outlined in **Table 4.2.2.**

Table 4.2.2: Significance criteria for impacts

Significance	Criteria
High Adverse	**Impact a major problem.** The impacts of the project are likely to be important considerations due to the extensive disturbance to existing topography and environmental impact. These impacts are of concern to the project, as it is expected that there will be permanent changes to the local topography. Depending upon the relative importance attached to the issue during the decision- making process, mitigation measures and detailed design work will not remove the impacts upon the affected project infrastructure. Residual impacts would predominate. For the purpose of this report, cuttings or embankments over 20 metres are considered to have a high adverse impact on the topography.
Moderate Adverse	**Impact moderate.** The impacts on topography within the project area are likely to result in significant changes and or re-contouring of significant features of the landscape. These impacts represent issues where adverse outcomes would be experienced but mitigation measures and detailed design work can ameliorate some of the consequences upon affected infrastructure. Some residual impacts would still arise. The cumulative impacts of such issues may lead to an increase in the overall impacts upon a particular area or on a particular resource and hence may become key decision- making issues. For the purpose of this report, earthworks over 10 metres and up to 20 metres are considered to have a moderate impact on the topography.
Low Adverse	**Impact recognisable but acceptable.** These impacts are likely to be important only on a local scale and are unlikely to be of significant importance in the decision- making process. These impacts are generally of relevance for enhancing the subsequent design of the project and in the consideration of mitigation or compensation measures. For the purpose of this report, earthworks between 5 and 10 metres are considered to have a low adverse impact on the topography.
Negligible	**Minimal change.** No impacts or those which are beneath levels of perception within normal bounds or variation or within the margin of forecasting error. For instance, earthworks resulting in a cut or an embankment of 5 metres or less are considered negligible.

4.2.3 Assumptions and limitations

The assessment of topographical changes and impacts resulting from the project are based on the preliminary design issued with this EIS. This assessment has been informed by geotechnical field observations, however future stages of the project design would require detailed geotechnical surveys to confirm the ground conditions. This will inform the future design development of tunnels, cuttings, embankments and structures.

4.3 Description of environmental conditions

The Blackall Range runs parallel to the project area to the west. In the project area, high relief east-west trending ridges are the main topographic features, most noticeably between Landsborough and Mooloolah and between Mooloolah and Eudlo. **Figure 4.3** illustrates the topography of the site.

The regional topography in the area of the project can be broadly divided into two main zones:

- A region of moderate to high relief terrain, at higher elevations, exists about 5 km to 10 km to the west of the site. This region is the source of the eastward flowing drainage lines that occur in the project area.
- A region of moderate to low relief and lower elevations exists in the project area. However, the terrain becomes of higher relative relief and elevation towards the southern end of the project area, where a series of ridges and valleys extend across the route. These ridges represent the edge of the high relief region occurring to the west.

The natural ground level is typically about 35 metres AHD in the south and falls toward the north to about 15 metres AHD. Natural slopes are typically about 15% in the undulating hills in the north and increase southward where maximum natural slopes are typically between 15 and 25%.

The highest elevation within the project area is approximately 140 metres on the western border of the project area between Landsborough and Mooloolah.

As a result of the topography, the existing rail line has sharp curves and steep gradients which limit rail speeds to 50 km/hr in some areas (QR Limited metropolitan system information pack). The project area does not have any significant peaks which dominate the terrain but rather undulates with many areas of slope greater than 20%.

The project traverses conservation areas (including two national parks) and areas of remnant vegetation. Areas of high environmental significance are shown on **Figure 4.3** and include: Dularcha National Park, Eudlo Creek National Park and the Mooloolah – Eudlo ridgeline. In the southern portion of the project area, there are several areas of valuable habitat, including: Dularcha National Park, Eudlo Creek National Park and two Bioregional Wildlife Corridors (in the areas around Rose Road and The Pinch Lane). These features are further discussed in **Chapters 11, 12, 13 and 21.**

4.3.1 Towns

Landsborough

The topography is generally flat from Landsborough to south of Rose Road, before rising to an east-west tending ridge line, where the existing rail line passes under Rose Road in a tunnel.

Mooloolah

The area close to Mooloolah is undulating, with an east-west ending ridge to the south, a relatively level area around the township itself and rising to another east-west ridge north of Mooloolah, where the existing rail passes through a tunnel below Pinch Lane. The central plain area is crossed by a number of natural drainage lines.

Eudlo

Around Eudlo, the topography is dominated by the level alluvial plains associated with Eudlo Creek, before rising to the north towards a west to east tending ridge.

Palmwoods to Woombye

The town of Palmwoods is located on a slope that trends down towards the duck ponds in Kolora Park. The existing rail infrastructure is a significant element in the town and also limits the movement of high vehicles from east to west.

This area comprises a generally level and low lying area adjacent to Paynter Creek.

Nambour

The section from Woombye to Nambour is undulating, with low lying areas to the west of the existing railway.

4.3.2 Catchments

Creeks and rivers

The project area spreads over four major catchments: Mooloolah River, Eudlo Creek, Paynter Creek and Petrie Creek.

The following named watercourses (also shown on **Figure 4.3**) pass through the project area (listed south to north):

- Mellum Creek (Pumicestone Passage Catchment)
- Addlington Creek (flows into Ewen Maddock Dam – and is a tributary of Mooloolah River)
- South Mooloolah River (a tributary of Mooloolah River)
- Mooloolah River
- Acrobat Creek (a tributary of Eudlo Creek)
- Eudlo Creek (a tributary of the Maroochy River)
- Paynter Creek (a tributary of the Maroochy River)
- Petrie Creek (a tributary of the Maroochy River)

Many of these waterways are significant from an ecological, recreational and visual perspective. Pumicestone Passage, which Mellum Creek flows into, is one of four passage-type estuaries in Queensland. Its mangrove fringed wetland contains extensive seagrass meadows and is a valuable nursery area for commercial and recreational fisheries. Of international significance, the Pumicestone Passage is listed under the Ramsar Convention as an important feeding and roosting site for migratory birds.

4.4 Information provided by the community

Throughout the project, there has been on-going community consultation. Activities and information releases are discussed in **Chapter 1, Section 1.9**. Issues raised to date and considered in both the route identification process and the assessment of the impact of the projects is discussed in **Table 4.4**.

Table 4.4: Community feedback, related to topography

Issues raised	Response	Section
Concerns about the extent of cuttings adjacent to the proposed tunnels at Rose Road (in Dularcha National Park) and The Pinch Lane (a bioregional wildlife corridor).	Tunnels have been lengthened to reduce the extent of cut in these areas.	Refer drawings **C001 to C028**
Concerns about crossing extensive areas of floodplain, particularly in the Eudlo area.	These concerns were addressed during the selection of the preferred route for the proposed rail corridor and the selection of bridge structures for crossings of the area south of Eudlo station.	Refer **Drawings C001 to C028**
Flat land is preferable compared to large excavations and tunnelling through mountains and ridges, from both a visual aspect and a monetary one as well.	Topography was a significant driver in the selection of the preferred route. However, the terrain of the project area means that, in some places, tunnelling and sections of bridge or structure are unavoidable.	Refer **Drawings C001 to C028**, and The Route identification report executive summary, included as **Appendix D**

Figure 4.3: Topography and Areas of Environmental Significance

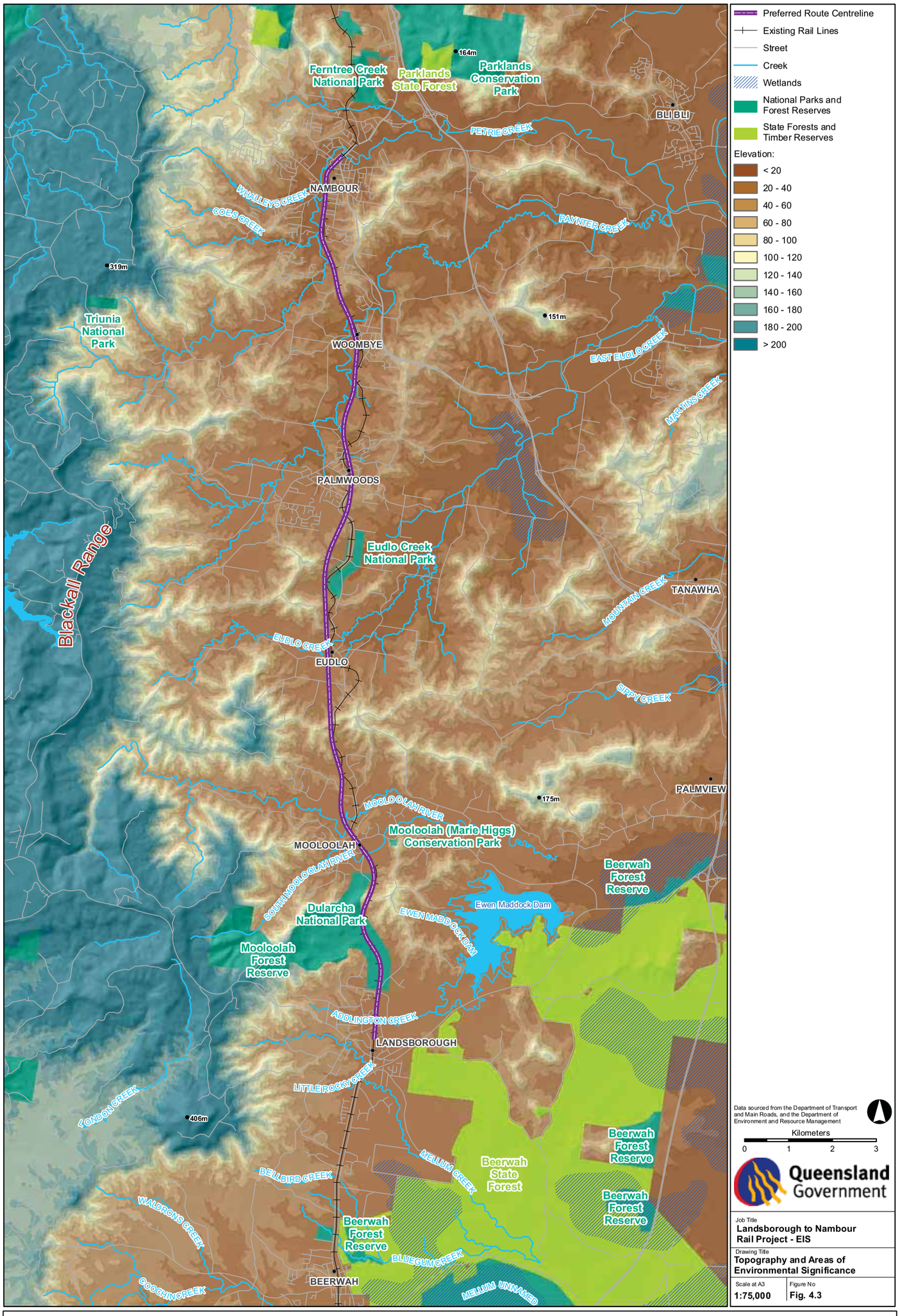
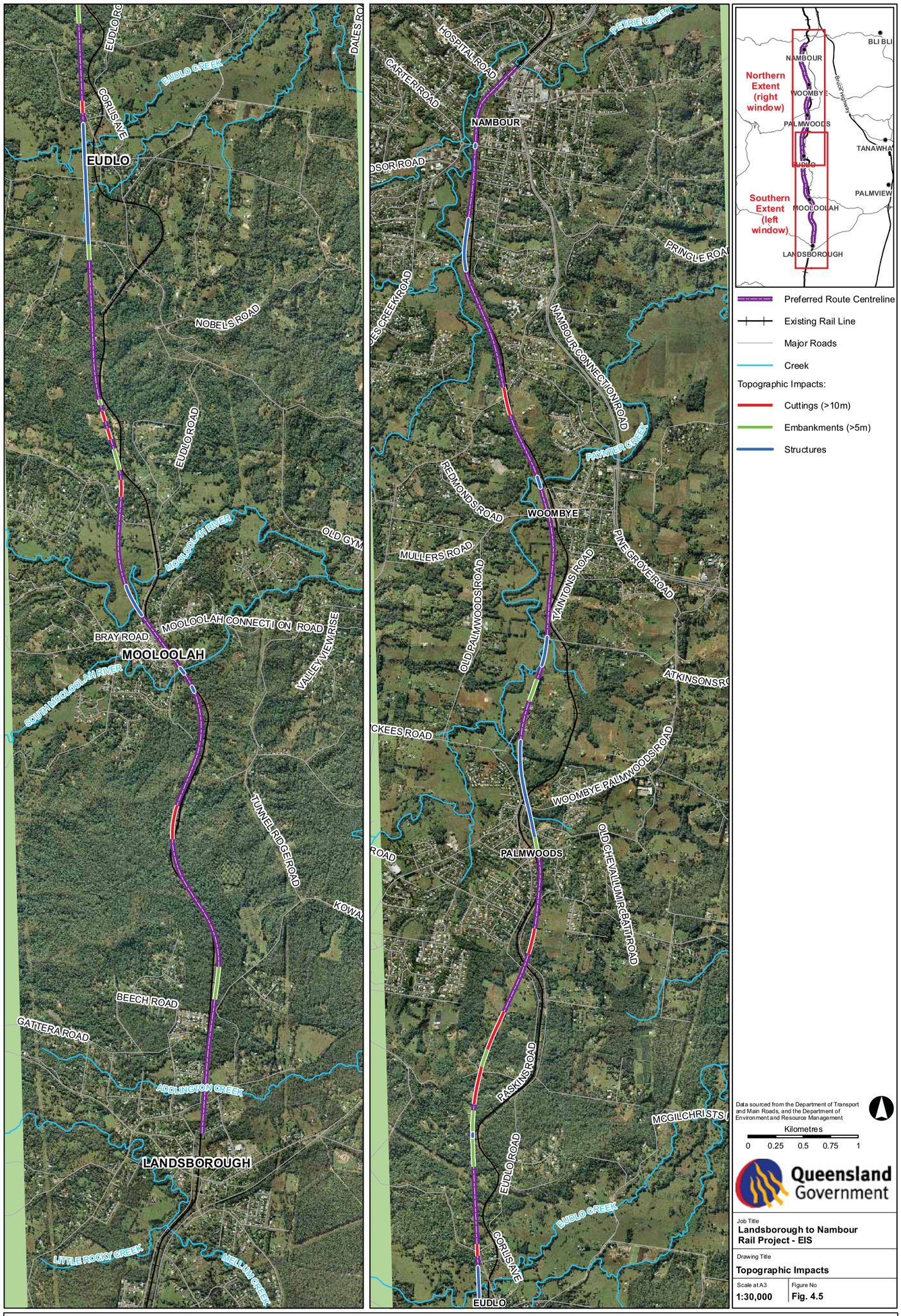


Figure 4.5: Topographic Impacts



4.5 Assessment of potential impacts and mitigation measures

The preferred route for the project has been developed to avoid areas of steep slopes and high ground wherever possible. There are several ridgelines traversing the project area from east-west, which are unavoidable. At these ridge crossing points, the route has been identified to allow for the optimal crossing location, which is generally in close proximity to the existing rail tunnels at Rose Road and The Pinch Lane. Allowance for construction of new tunnels, whilst keeping the existing tunnels and track operational, has also dictated the project design in these locations. New tunnels cannot be constructed in close proximity to existing operational tunnels. Therefore this was a significant constraint to the sitting of the preferred route in two locations.

In the route identification process, consideration was given to the cut to fill balance and to the balance of earthworks on adjacent sections, so that material does not need to be hauled for long distances along the alignment, or on local roads. Areas of significant cut and fill are shown in **Figure 4.5**.

4.5.1 Cuttings

There are nine major cuttings occurring along the proposed rail corridor (i.e. cuttings greater than 10m high along the centreline). These are summarised in **Table 4.5.1**, and shown in **Figure 4.5**. They are also shown in **Drawings C101** to **C128**. The majority of these cuttings occur in the southern portion of the project within the higher relief region. However, numerous cuttings of lower height occur in other areas of the project.

Table 4.5.1: Summary of the main railway cuttings (excluding cut and cover sections)

Chainage[1]/ location	Maximum Height (approx)	Length (approx)	Drawing Reference	Comments
84800 South of tunnel under Rose Road, Landsborough	20m	200m	C105	Cut and cover tunnel followed by tunnel portal at north end. The impacts in this area have been significantly reduced by the extension of the tunnel sections, with the addition of a 170m cut and cover component
88100	10m	100m	C109	-
88600	13m	100m	C110	-
88800 North of the proposed Neill Road bridge over railway	11m	100m	C110	-
91600	14m	100m	C114	Road realignment of Eudlo School Road
93000 South of Leeons Road, Palmwoods	16m	100m	C115 and C116	Two cuttings
93700 North of Leeons Road, Palmwoods	19m	150m	C116	-
94500 East of proposed Eudlo Road realignment, Palmwoods	14m	150m	C117 and C118	-
99600 Blackall Range Road, Woombye	14m	100m	C124	At Blackall Range Road- close to existing rail cutting

1 Approximate chainage at the point where the cut reaches a depth of 10 metres

Impact of cuts

The impacts associated with the significant cuts and tunnels include the following:

- a reduction in stability thus resulting in increased erosion (explained in greater detail in **Chapter 5, Geology and soils**) and sensitivity to flooding (more details are provided in **Chapter 14, Water resources** and **Chapter 17, Climate and natural disasters.**)
- extensive cutting can affect the habitat connectivity for a significant number of species (further explained in **Chapter 12, Terrestrial fauna)**
- the formation of a scar from cut and tunnelling activities
- landscape and visual impacts (discussed in **Chapter 6, Landscape character and visual amenity**)
- increased severance effect on land uses (discussed further in **Chapter 3, Land use and infrastructure).**

Proposed mitigation

Design

Cut and cover structures and tunnels have been proposed to minimise the need to excavate extensive cuts. Whilst cut and cover would still require excavation to the same depth as a typical cutting, the footprint of the impact is minimised, as there is no need for stepping of the edges or setbacks. Detailed geotechnical investigation would need to be carried out during the detailed design, to determine the constructability of steeper cuttings; however some preliminary advice based on the geotechnical site observations is included in **Chapter 5, Land: Geology and soils.**

Construction

- Where feasible batter slopes shall be revegetated to aid in stabilisation, to mitigate visual impacts and to prevent the incursion of weeds. This is further discussed in **Chapter 11, Terrestrial flora** and **Chapter 6, Landscape character and visual amenity.**
- Where possible revegetation would be carried out using native species.
- A weed management plan would be followed to avoid the spread of weeds into environmentally sensitive areas.
- Retaining walls are proposed to mitigate the impacts on the residential properties surrounding the railway in Nambour.

Residual impact

The cuts of minor to moderate significance can be effectively mitigated with revegetation. Their impact can be reduced to negligible through the implementation of mitigation measures. The 20 metres deep cut in Dularcha National Park has been reduced by increasing the length of the proposed tunnel under Rose Road. Given the sensitivity of the location, the residual impact is considered moderate adverse. The 19 metres cut to the north of Leeons Road is located in a less sensitive area and will have a minor adverse residual impact.

4.5.2 Embankments

A significant component of the proposed rail alignment is above the existing ground level. However, in most cases, when in excess of 10 metres of formation fill is required, bridge structures or viaducts have been chosen as an alternative to earth structures. In general, the exception to this is in the higher relief and less populated areas, where embankments have been chosen, the most significant of which (those greater than five metres) are summarised in **Table 4.5.2** below and shown in **Figure 4.5**. They are also shown in **Drawings C101** to **C128.**

Table 4.5.2: Summary of main railway embankments associated with the project

Chainage (m)	Length (approx)	Maximum Height (above c/l)	Drawing Reference
83300	300m	8m	C103
87220	10m	6m	C108
87420	40m	8m	C108
88300	200m	9.5m	C109-C110
88940	50m	10m	C110
89860	30m	7m	C111
90260	140m	9m	C112
92360	380m	9m	C115
93420	60m	8m	C116
95380	160m	8.5m	C119
96780	200m	8m	C120-C121
98260	120m	6m	C122
98860	60m	8m	C123
99100	40m	8m	C124
100080	40m	6.5m	C125
101340	60m	6m	C126

Numerous embankments are proposed which are less than 5 m in height. These are shown on **Drawings C001** to **C028.**

Embankments have not been proposed in areas identified as subject to potential flood risk. Where embankments intersect natural drainage lines, culvert structures or fauna passages are proposed. These are also shown on **Drawings C001** to **C028**, and are further discussed in **Chapter 12, Terrestrial fauna**, **Chapter 13, Aquatic biology** and **Chapter 14, Water resources.**

Impact of embankments

The impacts associated with the significant embankments and structures include the following:

- high embankments can restrict habitat movement for a significant number of species
- a reduction in stability thus resulting in increased erosion (explained in greater detail in **Chapter 5, Geology and soils**) and sensitivity to flooding
- visual and aesthetic impacts (discussed in **Chapter 6, Landscape character and visual amenity**)
- increased stormwater runoff due to varying gradients on embankments
- water flow restriction due to unnatural formations.

Proposed mitigation

Revegetation using native species is to be introduced for batter stabilisation and to mitigate visual impacts. A weed management plan is included in the environmental management plan in **Chapter 22, Environmental management plans**, to avoid the spread of weeds into environmentally sensitive areas, after clearing and earthworks are conducted.

Structures

Structures are preferred to embankments as the impact to the natural terrain is reduced.

Structures (or bridges) are proposed in the following locations and are shown in **Figure 4.5** and on **Drawings C101** to **C128**:

- chainage 82600 – north of Vidler Court (approx of 4.5 metres above surface level, and 40 metres long abutment to abutment)
- chainage 86100 - tributary of the South Branch of the Mooloolah River (approximately six metres above the river bed, and approximately 45 metres long)
- chainage 86300 - South Branch Mooloolah River (approximately eight metres above the river bed and 55 metres long)
- chainage 87000 - Mooloolah River (maximum height above the river bed of 10.5 metres, and 300 metres long)
- chainage 90400 - Eudlo Creek floodplain (maximum height above surface level of nine metres, approximately 600 metres long)
- chainage 91300 - Eudlo Creek (maximum height above the river bed of 12 metres, approximately 220 metres long)
- chainage 92700 - Paskins Road/Culgoa Road property accesses (maximum height eight metres, 20 metres long)
- chainage 95600 - new Palmwoods station to Spackman Lane (ranging in height between six metres and 14.5 metres above surface level, 800 metres long)
- chainage 97200 - area adjacent to Paynter Creek (maximum height of around 4.5 metres, approximately 260 metres long
- chainage 98800 - Paynter Creek in Woombye (maximum height of around nine metres above the creek bed, approximately 100 metres long)
- chainage 101000 - area adjacent to Petrie Creek (maximum height of approximately nine metres, but over undulating terrain, approximately 470 metres long)
- chainage 102000 - Arundell Avenue (maximum height approximately seven metres, providing vehicle clearance of at least 5.5 metres, approximately 25 metres long).

The provision of bridges at waterway crossings will reduce the impact of the project on water flows (see **Chapter 14, Water resources** and **Chapter 13, Aquatic biology**). Bridging the rail over existing roads would limit the operational impacts of the project on the road network, which is further discussed in **Chapter 7, Transport**.

4.5.3 Residual impact

The project traverses an area of challenging topography, including steep ridges and significant floodplains. The topographical impacts of crossing these areas result in a permanent change to the natural surface, and therefore topographic impacts were best addressed during the selection of the preferred route for the proposed rail corridor and the preliminary design phase. The preferred route for the project was selected on the basis that it avoided areas of steep slope requiring significant cuts and tunnels, wherever feasible. It also was selected on the basis that it was considered to have the shortest crossing of floodplain areas and that these issues could be mitigated through design. Cut and cover tunnels and tunnel sections have been incorporated into the design to reduce the areas affected. Therefore the residual impact of the project on the topography of the project area is as follows:

- locally- moderate adverse
- regionally- negligible.

4.6 Summary and conclusions

The project would have a minimal impact on the topography and effective mitigation measures have been included in the design. Further geotechnical investigations will be required in the detailed design phase to refine the batter slopes (i.e. steepness) and suitability of existing materials for use in the construction of embankments and cuts.