16 Catchment values

The Hydrology Impact Assessment (Cardno, 2015) examined the potential impacts of the Project on the surface water, groundwater, existing flood patterns and the river morphology of Echuca-Moama.

The preferred alignment travels along Warren Street and across the Victorian floodplains. It then crosses the Campaspe and Murray rivers and traverses the NSW floodplains adjacent to Moama.

Existing flood conditions for the study area were determined based on a previous study (SKM, 1997) that developed a flood frequency model extrapolated from over 100 years of flood data. These existing conditions were used to build a model to assess the impact of the Project on hydraulic conditions in the study area.

Assuming the implementation of VicRoads standard environmental protection measures and Project-specific environmental management measures, the modelled impact of the Project on existing flood conditions is expected to be minor. The modelling indicates that the flood level during peak flow events would only increase by 3 to 5cm at affected locations near the proposed Warren Street roundabout. This is a very small increase relative to existing peak flood water levels at these locations.

As part of the Project, existing culvert systems under Warren Street would be moved and upgraded to allow for greater efficiency in conveying flood waters across the floodplain, thereby minimising flood impacts.

Water quality impacts to the Campaspe River associated with sedimentation and stormwater runoff during construction and operation are considered to be minor. Construction of the bridge piers adjacent to the Murray River represent the greatest risk to catchment values, through potential adverse impacts on water quality, damage or removal of riparian vegetation and destabilisation of the riverbank. These impacts are however considered to be minor following the implementation of VicRoads standard environmental protection measures and Project-specific environmental management measures, including the incorporation of adequately-sized spill basins.

As the Project would be constructed mainly on fill, it is not expected that groundwater would be impacted due to excavation. The impact on the quality of the groundwater due to the construction of the bridge piers is likely to be minor when appropriate management measures are implemented.

Overall, construction and operation of the Project is not considered to have significant impacts on the function, values or beneficial uses of the Murray and Campaspe rivers, or on groundwater. Flooding impacts would be minor and apply only to specific locations, and the design of Warren Street would increase flood protection for sections of this road. Moreover, the Project would provide a second flood evacuation route up to the 100 year Average Recurrence Interval (ARI) event for the townships of Echuca and Moama.

16.1 EES objectives

The EES objective relevant to the Hydrology Impact Assessment for the Project, as specified in the EES Scoping Requirements Draft Evaluation Objectives, is "*To maintain floodplain functions, hydrology, values of surface water, groundwater… of proximate sections of the lower Campaspe and Murray Rivers*."

This chapter is based on the Hydrology Impact Assessment completed by Cardno (2015) which is included as EES Technical Appendix J. The discussion of existing conditions relating to groundwater is based on the Soils and Geology Impact Assessment completed by VicRoads (2015a), included as EES Technical Appendix K.

The following key issues and requirements as they relate to catchment values, as specified in the EES Scoping Requirements for the Project.

Key issues

- *Potential for the Project to have significant effects on the functions, values and beneficial uses of surface water…of proximate sections of the lower Campaspe and Murray Rivers.*
- *Potential for the contamination of…groundwater from construction and operation activities, including the exposure and disposal of any waste…*

Priorities for characterising the existing environment

- *Identify and characterise relevant surface water and floodplain environments, including in terms of the existing drainage functions…and behaviour.*

Design and mitigation measures

- *Identify proposed measures to mitigate any potential effects, including any relevant features or preventative techniques to be employed during construction.*

Assessment of likely effects

- *Identify potential effects on the functions, values and beneficial uses of surface water…of proximate sections of the lower Campaspe and Murray Rivers.*

Approach to manage performance

- *Identify any additional measures to manage and monitor effects on catchment values and identify likely residual effects.*

The key issues and requirements that relate to soils and geology (geomorphology, geomorphic stability and the potential for the exposure of contaminated soils) are addressed separately in Chapter 17.

The Hydrology and Soils and Geology impact assessments focussed on the preferred alignment. The term 'the Project' is used in this chapter to refer to the preferred alignment only.

16.2 Study area

The study area for the hydrological assessment is shown in Figure 16-1. This study area is significantly larger than the proposed Right-of-Way to enable an appropriate analysis of the interaction between the Murray and Campaspe River catchment under a range of flood flow conditions through to the 200 year ARI design flow.

Due to the low slope of the river channel bed the Murray River and Campaspe River floodplains are sensitive to changes in land form and impacts can be observed kilometres upstream or downstream from the bridge site.

The model encompasses both Victoria and NSW as the Murray River floodplain resides in both states. The study area includes areas of the Murray River floodplain and the Campaspe River floodplain extending approximately 4km north and east from the proposed new roundabout at the Murray Valley Highway.

16.3 Methodology

The Hydrology Impact Assessment is essentially a comparison of existing hydraulic conditions without the Project ('No Project' scenario), against hydraulic conditions with the Project in place. The current assets, values and uses of the land within the study area are known as the 'existing conditions'. These conditions are the baseline against which the potential impacts of the Project have been assessed.

Existing conditions of the broader Murray River and Campaspe River floodplains are relevant in this instance as the impacts of introducing the preferred alignment structure to the floodplains has the potential to impact peak flood depths a substantial distance from the relevant structure, in this case a combination of bridge piers and embankments.

In addition, existing conditions for groundwater were considered. A review of existing literature and groundwater records held by the former Victorian Department of Environment and Primary Industries (DEPI) and NSW Department of Land and Water Conservation was undertaken to understand the hydrogeology of the area. The assessment of impacts to groundwater as a result of the Project was based on the likely construction techniques and activities, and considered the implementation of VicRoads standard environmental protection measures.

For surface water, the comparison of existing conditions and conditions once the Project is in place was achieved by building a hydraulic model of the study area. The process used to develop and utilise this model consisted of the following tasks:

- Review of hydrology studies by SKM (1997) and Cardno (2009, 2010, and 2013) as part of previous investigations of a second Murray River bridge crossing at Echuca-Moama
- Using hydrological information for the area as derived from the SKM (1997) flood study
- Compilation of the existing ground surface elevations using 2008 land survey data provided by VicRoads and a 2001 1m elevation grid (provided by the North Central Catchment Management Authority (NCCMA) but originating from the Murray Darling Basin Authority)
- Building the model using the SOBEK modelling package, which uses existing information including ground surface conditions, river cross sections, bridges and culverts
- Calibrating and validating the model in 2009 based on historical flood events. Re-calibrating and validating the model in 2012 after it was refined and extended to include a larger study area
- Selection of three flood events to model to provide flood levels for existing conditions.

Impact pathways were identified and consequence criteria were developed. Initial risks following implementation of VicRoads' standard environmental protection measures were assessed. Project-specific environmental management measures were developed and an assessment of residual risks was undertaken.

Impacts were assessed by comparing the simulated existing conditions ('No Project' scenario) against simulations of the same flood events with the Project included.

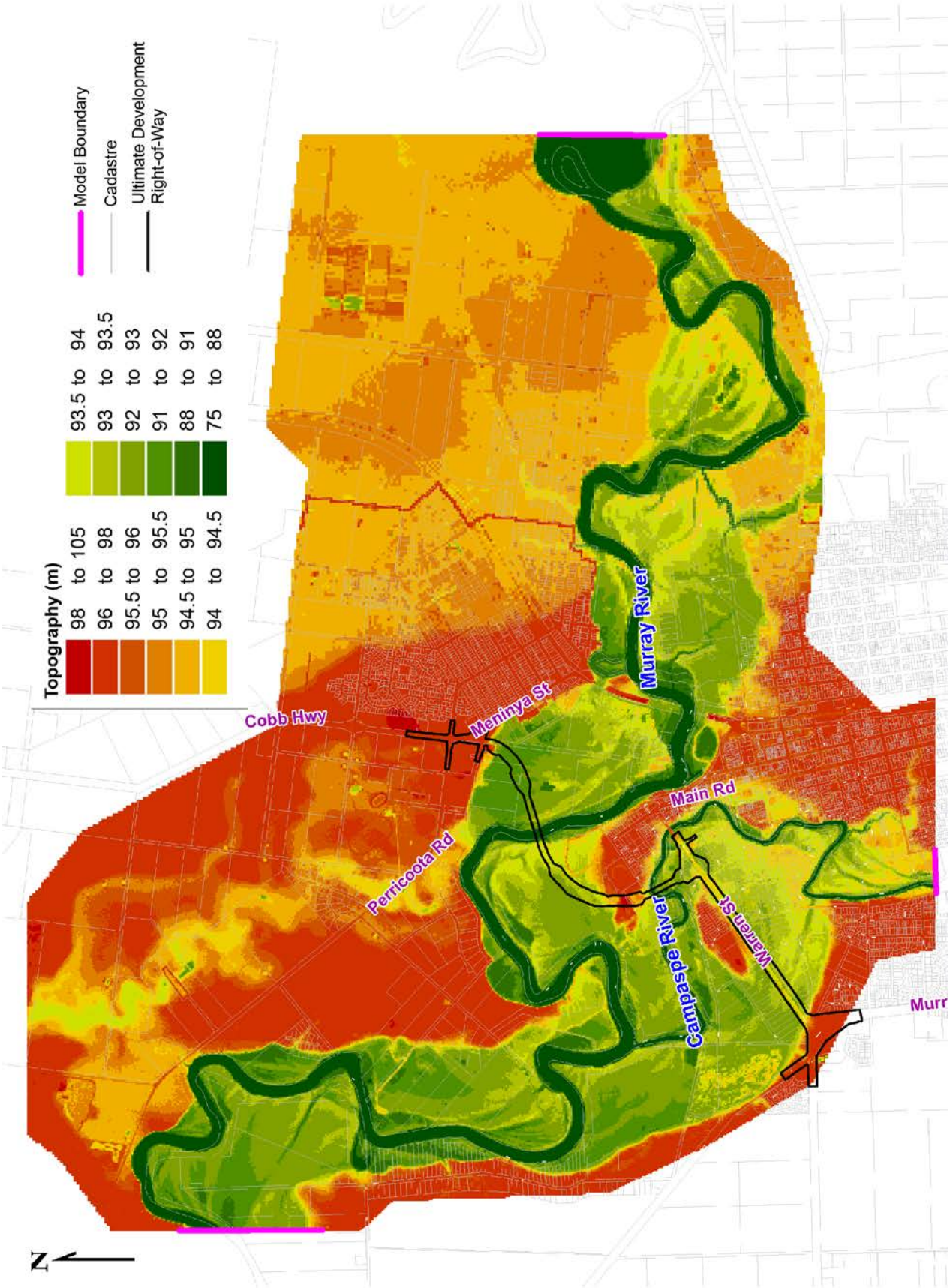


Figure 16-1 Hydrology study area

16.4 Legislation and policy

The relevant legislation and policies for surface water and groundwater are outlined in Table 16-1.

Table 16-1 Legislation and policies relevant to surface water and groundwater

Legislation / policy	Description
State	
Planning and Environment Act 1987 (Vic.)	The Planning and Environment Act establishes a framework for planning the use, development and protection of land in Victoria in the present and long-term interest of all Victorians. The Planning and Environment Act sets out the legislative basis to ensure that standard planning provisions are prepared and approved throughout Victoria. The Act sets out procedures for preparing and amending the Victoria Planning Provisions (VPP) and planning schemes, obtaining permits under planning schemes, settling disputes, enforcing compliance with planning schemes, and other administrative procedures. It provides for a single instrument of planning control in a particular area, the planning scheme, which sets out the way land may be used or developed. The planning scheme is a legal document, prepared and approved under the Planning and Environment Act. The relevant planning scheme for the study area is the Campaspe Planning Scheme.
Water Act 1989 (Vic.)	Any works which intercept waterways and their floodplains must be undertaken in accordance with the requirements of the Water Act and avoid intensifying flooding impacts in land subject to flooding. The NCCMA is the responsible authority for issuing licences for works on waterways within the study area.
Environment Protection Act 1970 (Vic.) – Section 38 and 39	The Environment Protection Act regulates the discharge or deposit of wastes into Victorian waters. Any discharge must at all times be in accordance with declared State environment protection policy or waste management policy specifying acceptable conditions for the discharge or deposit of wastes into waters in the environment.
State environment protection policy (SEPP) (Waters of Victoria) (WoV) 2003	The SEPP (WoV) identifies the beneficial uses of waterways, which must be protected. It also provides guideline targets for water quality for the Murray River floodplain in the Campaspe region. Works undertaken for the Project on or near waterways (i.e. the Murray River and Campaspe River) would need to be managed to reduce the risks to aquatic ecosystems and other beneficial uses of the waterway, as defined by the SEPP (WoV).
State environment protection policy (SEPP) (Groundwaters of Victoria) (GoV) 1997	The SEPP (GoV) was developed to meet community demands for an integrated framework of environment protection goals for groundwater. It aims to maintain and, where necessary, improve groundwater quality to a standard that protects existing and potential beneficial uses of groundwater. It sets a consistent approach to, and provides quality objectives for groundwater protection throughout Victoria. This policy overrides all existing groundwater protection provisions in other SEPPs.
Catchment and Land Protection Act 1994 (Vic.)	The Catchment and Land Protection Act has the objective of establishing a framework for the integrated and coordinated management of catchments that will: ➨ Maintain and enhance long-term land productivity while also conserving the environment ➨ Aim to ensure that the quality of the State's land and water resources and their associated plant and animal life are maintained and enhanced. The Catchment and Land Protection Act provides for the development of Regional Catchment Strategies that must assess the nature, causes, extent and severity of land degradation of the catchments in the region and identify areas for priority attention. Local Planning Schemes must have regard for the Regional Catchment Strategies.
Local	
Campaspe Planning Scheme	A planning scheme sets out objectives, policies and provisions relating to the use, development, protection and conservation of land in the area to which it applies. The applicable planning scheme within the Victorian proportion of the study area is the Campaspe Planning Scheme. A set of standard provisions called the VPP forms a template for all planning schemes. Included in the VPP is the State Planning Policy Framework (SPPF), which covers strategic issues of State importance. Clauses of the SPPF that are relevant to catchment values and strategies within these clauses of relevance include: ➨ Clause 13.02-1 Floodplain management • Relevant strategy: – *Avoid intensifying the impacts of flooding through inappropriately located uses and developments.*

Legislation / policy	Description
	▰ Clause 14.02-1 Catchment planning and management • Relevant strategies: – *Ensure that works at or near waterways provide for the protection and enhancement of the environmental qualities of waterways and their in-stream uses* – *Require the use of appropriate measures to restrict sediment discharges from construction sites* – *Ensure planning is coordinated with the activities of catchment management authorities.* ▰ Clause 14.02-2 Water quality • Relevant strategy: – *Ensure that land use activities potentially discharging contaminated runoff or wastes to waterways are sited and managed to minimise such discharges and to protect the quality of surface water and groundwater resources, rivers, streams, wetlands, estuaries and marine environments.* The Campaspe Planning Scheme also includes a number of zones and overlays of relevance to the Project, as follows: ▰ Clause 37.03 Urban Floodway Zone ▰ Clause 42.01 Environmental Significance Overlay – Schedule 1 (Murray River Corridor) ▰ Clause 44.03 Floodway Overlay Clause 44.04 Land Subject to Inundation Overlay.

16.5 Existing conditions

16.5.1 Overview

The study area is comprised of two river systems, the Murray River floodplain and the Campaspe River floodplain. The Murray River is the larger of the two systems and the Campaspe River confluence with the Murray River is downstream of the Echuca-Moama township.

The Murray River is Australia's longest river at over 2,500km in length. In Echuca the upstream catchment is highly regulated due to large dams, the most significant of which is Lake Hume. The regulated nature of the system and the large catchment area result in long warning times for flooding and a slow rise in peak flood levels. Flood levels can remain elevated for long durations extending into weeks for widespread flood events upstream of Echuca. The Murray River floodplain at Echuca is over 1km wide and the primary gauge at the Echuca Wharf has flood warning levels including:

- Minor at 93.50m (measured from Australian Height Datum (AHD))
- Moderate at 93.90m AHD
- Major at 94.40m AHD.

The most recent large flood was in January 2011 and this flood reached a peak level of 92.85m AHD at the gauge, which was below the minor flood risk at the gauge.

Flood conditions within Echuca are dependent on inflows from local tributaries, the most significant of which are the Goulburn River and the Campaspe River. The Campaspe River catchment extends from the Great Dividing Range in the south to the Murray River in the north, over a total distance of approximately 150km. The catchment has an average width of 25km and a total area of approximately 4,000km^2. The Campaspe River flows a total length of 240km; starting from the headwaters of the catchment near Woodend, joining with the Coliban River at Lake Eppalock, before entering the Murray River downstream of Echuca (NCCMA, 2015).

The Murray River and Campaspe River flow year round, with both rivers being multi-use resources that have the following beneficial uses to be protected:

- Irrigation
- Domestic, industrial and stock water supply
- Recreation and leisure
- Habitat.

16.5.2 Model of Murray and Campaspe systems

The existing hydrological conditions around Echuca-Moama consist of complex interactions between the Murray and Campaspe rivers and their floodplains. These interactions can result in a large range of flood conditions that then affect the flood outcomes at Echuca-Moama.

A Flood Frequency Analysis (FFA) using over 100 years of data (1865-1996) was completed by SKM (1997). SKM then tested the FFA using hydraulic modelling methods.

Key findings of the 1997 analysis included:

- A wide range of Murray River flow rates can create similar peak flood levels at Echuca, depending on flow rates in the Campaspe River
- Peak flood flows in the Campaspe River generally arrive at Echuca prior to peak flood flows in the Murray River (an average lag time of six days between arrival in the Campaspe River and the Murray River was assumed)
- The modelled estimate of flow rate in the Murray River based on a 100 year ARI flood level of 95.45m AHD at Echuca is 1,431m^3/s. Other results reported in SKM (1997) indicate that the flow rate in the Murray River for an equivalent flood level can range between 1,100-1,450m^3/s.

Due to the stability of the Murray and Campaspe rivers systems, SKM's detailed study was still able to be used to provide the basis of the current assessment.

A summary of flood flow rates and corresponding peak flood levels based on SKM's 1997 study is provided in Table 16-2.

Table 16-2 Estimated design flows and levels as per the 1997 SKM analysis

Design ARI (years)	Murray River flow rate (m^3/s)	Peak levels in the Murray River at Echuca Wharf (m AHD)
10	1,055	94.45
20	1,195	94.85
50	1,343	95.20
100	1,431	95.45
200	1,505	95.60

To accurately capture the existing hydrological conditions within the study area, the following three flooding scenarios producing peak flood levels were modelled:

- **Scenario 1**: A high flow event in the Murray River with no flooding in the Campaspe River
- **Scenario 2**: A high flood level in the Murray River with a lower peak flow rate. This scenario represents flood events of longer duration and adequately caters for the effect of flood storage and high tailwater levels that occur during such events
- **Scenario 3**: An event where the Murray River has elevated flood levels when a large Campaspe River event occurs.

Each scenario was modelled for three different ARIs (20, 50 and 100). The results are shown in Table 16-3. The peak flood levels for each of the three scenarios are also shown in Figure 16-2, Figure 16-3 and Figure 16-4.

The modelled peak flood levels shown in Table 16-3 are within +/- 0.02m of the estimated design peak flood levels for Scenarios 1 and 2 as shown in Table 16-2. This comparison between the modelled peak flood levels and the estimated design levels forms the basis of the calibration and validation of the model parameters.

The estimated design and modelled peak flood levels are conservative, as they are well above the peak level reached during the most recent flood in Echuca in January 2011 (refer section 16.5.1).

Table 16-3 Modelled flow conditions in flooding scenarios for the three selected ARIs

	100 year ARI			50 year ARI			20 year ARI		
Scenario	1	2	3	1	2	3	1	2	3
Murray River flow rate (m^3/s)	1,431	1,000	50	1,343	900	50	1,195	780	50
Campaspe River flow rate (m^3/s)	40	40	1,175	40	40	950	40	40	675
Downstream conditions (peak flood level m AHD)	94.2	95.0	95.0	93.65	94.75	94.75	92.6	94.35	94.35
Modelled peak flood level (m AHD)	95.46	95.44	n/a	95.22	95.20	n/a	94.87	94.84	n/a

It is important to note that no two flood events are ever the same. This is due to the complexity of the interaction of catchment, rainfall and river systems. The three scenarios described above capture the most extreme combination of events, which would result in the highest flood levels of the three nominated ARI events. These scenarios therefore represent the worst case peak flood levels under existing conditions experienced by the rivers in the Echuca-Moama area.

Key outcomes of the modelling indicate:

- The Murray River and the Campaspe River floodplains are separated by a ridge that passes through the corner of High Street and Warren Street. This ridge is not overtopped in the 100 year ARI event
- Under existing conditions the Echuca Holiday Park is not flooded in the 20 year ARI event due to a levee surrounding this location

- The Campaspe River floodplain is split into two branches by a raised area around Homan Street and the Echuca Cemetery
- Warren Street is a key hydraulic control in the Campaspe River floodplain. Under existing conditions it is overtopped in the 20 year ARI event
- The velocity of floodwaters in the Murray and Campaspe floodplains is approximately 0.3 and 0.4m/s respectively. Within the actual river channels, velocities are typically between 1.0 and 1.5m/s.

These peak flow rates are not considered to be particularly fast. This is due to the water being spread over such a wide flood area. Whilst there is a great deal of water moving through the system during a flood event, the water is not forced through a small area and therefore is not flowing at a high speed.

16.5.3 Groundwater

Within the study area, groundwater is contained in two shallow aquifers, with another two deep confirmed aquifers.

These aquifers are described below in Table 16-4.

Table 16-4 Groundwater in the area

Aquifer	Depth (m)	Yield	Quality (mg/L TDS*)
Shepparton Formation	-	Low	2,000
Coonambidgal Formation	-	Highly variable	400-20,000
Basement aquifers	10 – 60	Low	100-5,000
Renmark Group and Murray Group Calivil Formation	60 – 130	Moderate to high	400-6,000

*mg/L TDS: milligrams per litre of total dissolved solids

The groundwater likely to be of most concern to the Project is contained in the Shepparton and Coonambidgal formations.

Information included in DEPI's groundwater borehole database indicates there are four recorded boreholes within proximity to the preferred alignment (refer to EES Technical Appendix K – Soils and Geology Impact Assessment for borehole locations).

The majority of water samples from these bores were collected in 1963, 1964 and 1966, with additional samples collected in 2007 and 2008. The quality of these samples ranged from 94 to 6,077mg/L Total Dissolved Solids (TDS). According to the 'Groundwaters of Victoria' SEPP (EPA Victoria, 1997), the groundwater ranges from the highest quality of Segment A1 (fit for human consumption and all other uses) through to Segment C (restricted to stock watering, industrial uses and can be used for swimming/bathing).

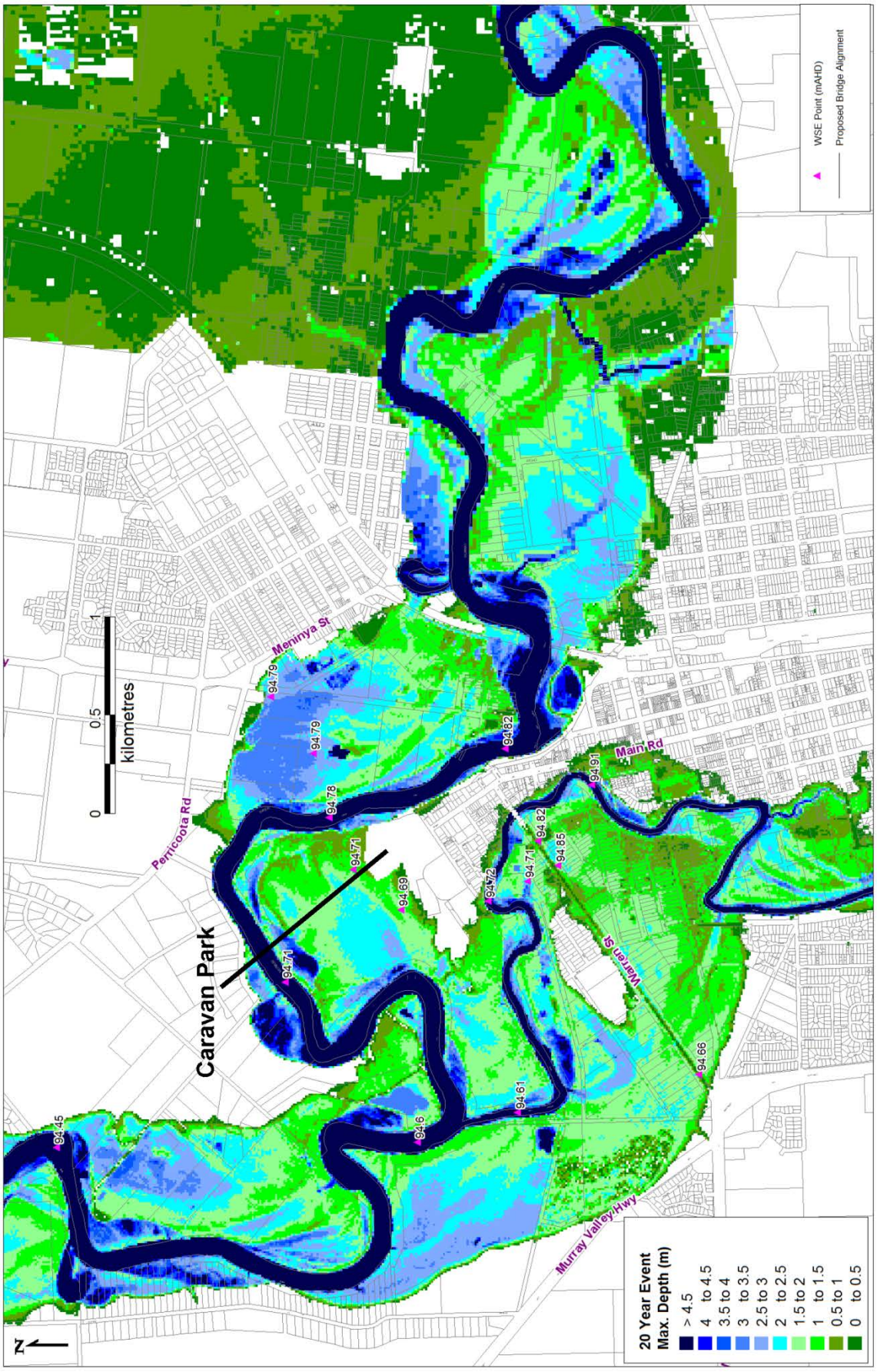


Figure 16-2 Existing conditions – 20 year ARI (WSE = Water Surface Elevation)

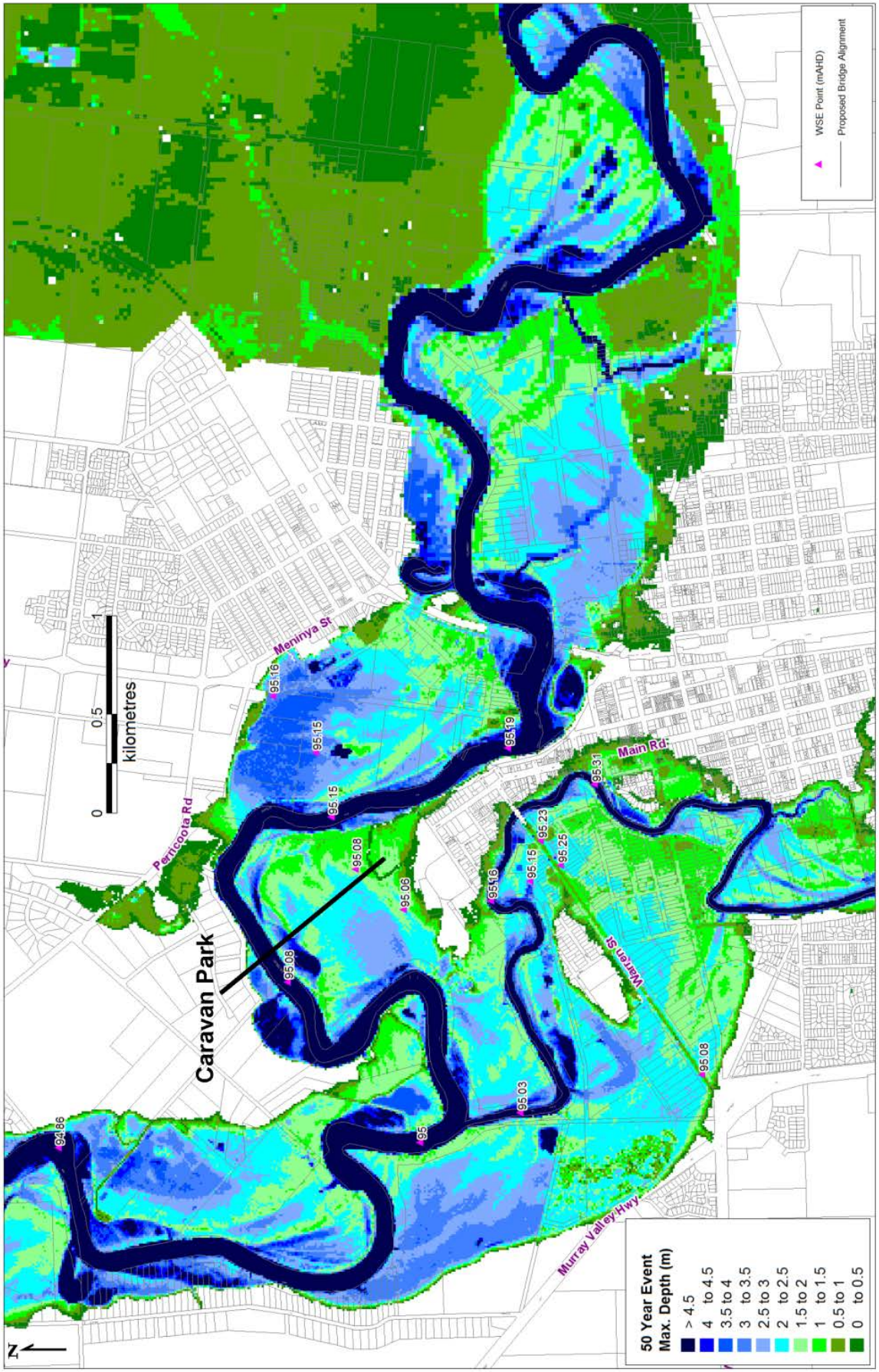


Figure 16-3 Existing conditions – 50 year ARI (WSE = Water Surface Elevation)

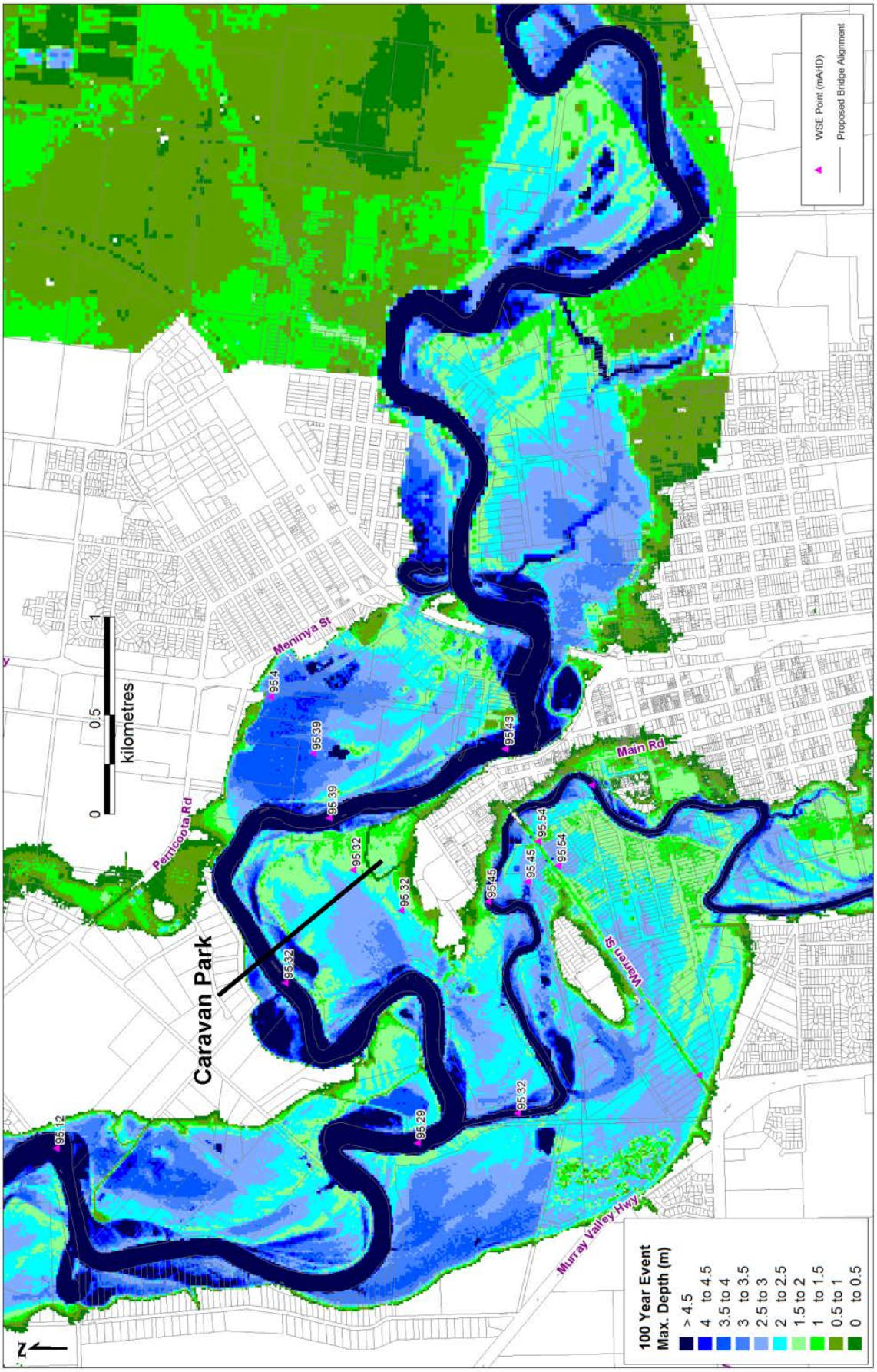


Figure 16-4 Existing conditions – 100 year ARI (WSE = Water Surface Elevation)

16.6 Impact assessment

The Hydrology Impact Assessment in EES Technical Appendix J addressed the potential impacts of the ultimate duplication of the Project on the existing conditions of the Echuca-Moama region. Potential benefits and opportunities were also considered.

The management measures relating to hydrology are identical for both the initial alignment and the ultimate duplication.

16.6.1 Potential benefits and opportunities

Potential benefits of the Project in relation to hydrology include:

- Provision of a second flood evacuation route up to the 100 year ARI event for the townships of Echuca-Moama. This is particularly important for temporary residents (tourists) who may have low flood awareness and preparedness
- Increased flood protection for Warren Street with the implementation of the recommended management measures. The upgrades to the mitigation structures under Warren Street would manage more frequent flood events more efficiently and offer more protection to Warren Street
- Warren Street is to be designed to withstand overtopping. This is an improvement on existing conditions and would reduce the likelihood of damage in a flood event (and associated repair costs). Sections of this road would be raised above the 100 year ARI event to further reduce the likelihood of flood damage.

These benefits address many existing flooding issues within Echuca-Moama.

16.6.2 Potential impacts on surface water

Impacts during construction

Water quality

Construction of the Project has the potential to impact local water quality and environment.

Sediment entering the Murray or Campaspe rivers during construction near waterways or via flooding could have potential water quality impacts. Sediment entering the rivers due to the Project is considered to be a minor impact and whilst it could possibly occur, it is rated as a low risk. This is due to the high sediment loads that already exist in both rivers. Any additional sediment produced by the Project would be considered minimal. Additionally, VicRoads standard environmental protection measures would be implemented to control sediment laden run-off, including the construction of permanent spill or temporary sedimentation basins. Further, where works are in, near or over water, a Construction Environmental Management Plan would be developed.

Bank form and riparian habitat

The Campaspe and Murray River bridge piers would be constructed above the average summer flow level, within the riverbank, but out of the wetted area.

Coffer dams would be installed at pier locations in the Murray River riverbanks in dry conditions if possible, to protect the construction works in the event of high river flow, and to minimise impacts on the environment. However, destabilisation of the riverbanks through construction activity is almost certain to still occur, and is considered to be a medium risk. The risk cannot be avoided but it can be effectively managed via VicRoads' standard environmental protection measures.

At the Campaspe River, bridge piers would be located clear of the riverbanks to the north and south of the river. With the implementation of VicRoads standard environmental protection measures it is expected that impacts to riverbank stability due to construction activities at the Campaspe River would be minor and are unlikely to occur, resulting in a low risk rating.

There is the potential for detrimental impacts to riparian habitat due to native vegetation removal during construction of the Project, as discussed separately in Chapter 10. However, as discussed in section 10.6.8 of Chapter 10, any vegetation that was removed would be outside channel banks and cut off at ground level. This would leave the root mats of the vegetation intact, thereby maintaining bank soil stability. Both temporary and permanent revegetation would also occur throughout construction to further mitigate any impacts.

Floodplain function

The Hydrology Impact Assessment concluded that modification of flood behaviour across the floodplains due to construction activity would be a rare occurrence. Notwithstanding, the construction contractor(s) would monitor weather during construction, and would be required to clear any equipment and blockages from the floodplains to the maximum extent possible prior to a flood event. It is therefore expected that the impact of construction activity on the flood behaviour of the floodplains would be minor, and the risk is negligible.

Impacts during operation

Flooding

The Project would change the flood conditions in Echuca-Moama, and management measures would need to be implemented to maintain existing flood levels and avoid increased flood damage due to changed flood conditions.

One of the main impacts of the Project on floodplain function is the raising of Warren Street. Warren Street is currently a hydraulic control across the Campaspe River floodplain, with culverts placed in the road to divert floodwaters under the street during a flood. To mitigate against impacts of the increased height of the road and to improve water flow in lower frequency events, culverts (or equivalent bridge structures) at the western end of Warren Street would be resized and placed 80m west of their current positions.

The Project would also raise the section of Warren Street near the Warren Street roundabout above the 100 year ARI level. To mitigate the impact of this, culverts would be positioned and sized to allow for flood flows.

The bridge spans across the Campaspe and Murray rivers and their floodplains have also been designed to mitigate any increases in flood levels. The spans allow the flow of flood waters up to the 100 year ARI level, plus freeboard. The impacts on the floodplain have been mitigated through the use of bridge spans over the Murray River and Campaspe River, with additional openings within the embankment between the bridge structures.

Overall, flood behaviour across the floodplains would not be significantly altered due to the Project, and the flood impacts can be mitigated so that existing flood levels are not exceeded. Therefore, flooding impacts are expected to be minor.

To measure the impact of the Project against existing conditions, the peak flood levels were modelled for the Project during the three ARIs nominated for the existing conditions. The peak flood levels modelled for the Project were then compared against the peak flood levels modelled for the existing conditions to create a difference plot. The results are presented in Figure 16-5, Figure 16-6 and Figure 16-7 and show the amount of increase or decrease in flood level for each ARI.

A more detailed analysis of the impacts for each ARI event is presented below.

20 year ARI event

During a 20 year ARI event, the Project would only have a small impact on the peak flood levels around the preferred alignment. Peak flood levels would be increased by a maximum of 5cm at specific locations as shown on Figure 16-5. A specific benefit of the Project is near the Murray Valley Highway end of Warren Street, where there would be a reduction in flood depths of up to 6cm. This is due to increasing the size of the culverts in this area.

50 year ARI event

During a 50 year ARI event, results show that the peak flood levels during operation would largely be maintained at current levels (refer Figure 16-6).

The flood level would increase near the Warren Street roundabout at the start of the preferred alignment, extending out to approximately 120m from the roundabout. However, this increase would be less than +3cm over existing levels.

Properties in this area already experience approximately 0.5-1m of flood water during a 50 year ARI event under existing conditions. An additional 3cm of flood water would not increase the damage to these properties as they would already be severely impacted.

100 year ARI event

During a 100 year ARI event, the Project would have a similar impact on the existing flood level; specifically in the area of Warren Street as described above for the 50 year ARI event (refer Figure 16-7). The area affected extends out approximately 300m from the raised road area near the roundabout. At this point, the current flood depths exceed 1m. The Project would only add a maximum of approximately 5cm to this depth, which is considered to be a very small increase relative to the depth of water in the area during large flood events. The already severely impacted properties east of Warren Street would not experience a significant change.

Scour

Scour impacts are caused when large volumes of flood water, moving at increased velocities, erode soils from the banks of rivers and the base of in-stream structures (abutments, culverts etc.).

Due to the width of the Murray River and Campaspe river floodplains, velocities associated with the largest modelled event (100 year ARI) only reach between 1.0 and 1.5m/s within the river channels. The bridges would be constructed to appropriate design standards such that impacts due to scour are expected to be insignificant.

Water quality

During operation there is potential for a decrease in water quality due to runoff from the road entering the waterway. The inclusion of clay-lined spill basins adjacent to the preferred alignment would provide a buffer between the bridge system and the waterway. These spill basins:

- Would capture and treat runoff to meet the SEPP WoV
- Be lined with clay to prevent infiltration to the soils or groundwater
- Be designed to withstand a heavy rainfall event
- Enable removal or release into the flood plain as required.

The depth, location and number of spill basins would be confirmed during detailed design, based on discussions with the Environment Protection Authority.

Given the inclusion of spill basins, the impact on water quality and river health from runoff from the road is expected to be minor and to occur only rarely. As such this is considered to be a negligible risk.

Other operational impacts to waterways are further discussed in Chapter 10. The Aquatic Flora and Fauna Impact Assessment separately considers the potential water quality impact associated with a chemical spill on the bridge during a major rainfall event and the corresponding impact to aquatic biota.

Impacts on beneficial uses

Vegetation removal during construction may impact upon habitat for terrestrial and aquatic species – this is discussed separately in Chapters 9 and 10.

Impacts on water quality during construction and operation would be managed through implementation of VicRoads standard environmental protection measures and Project-specific environmental management measures, including incorporating spill basins into the design. As such, water quality impacts from the Project are expected to be minor. Beneficial uses such as irrigation and domestic, industrial and stock water supply are not expected to be affected.

The number and duration of temporary closures of the Murray River during construction would be minimised to avoid disruption to major events and for recreational vehicles.

Flooding impacts during operation of the Project are anticipated to be insignificant to minor.

As such, the Project is not expected to affect the identified beneficial uses during operation.

16.6.3 Potential impacts to groundwater

Groundwater along the preferred alignment is located close to the ground surface. This is due to the groundwater levels in the area being controlled by the levels of the Murray and Campaspe rivers, not by the groundwater recharge that occurs through infiltration from rainfall. As the Project would be constructed mainly on fill, it is not expected that groundwater would be impacted due to excavation.

However, the bridge structures include the construction of piers, and these piers would be deep enough to interact with groundwater. The impact on the quality of the groundwater due to pier construction is likely to be minor. VicRoads standard environmental protection measures for sedimentation control would also be implemented for pier construction which would help prevent groundwater being discharged into the rivers, limiting any possible impacts to the river quality.

Overall, the impact on groundwater due to the construction and operation of the Project is minor and is unlikely to occur. Therefore, there is a low risk of any groundwater impacts occurring.

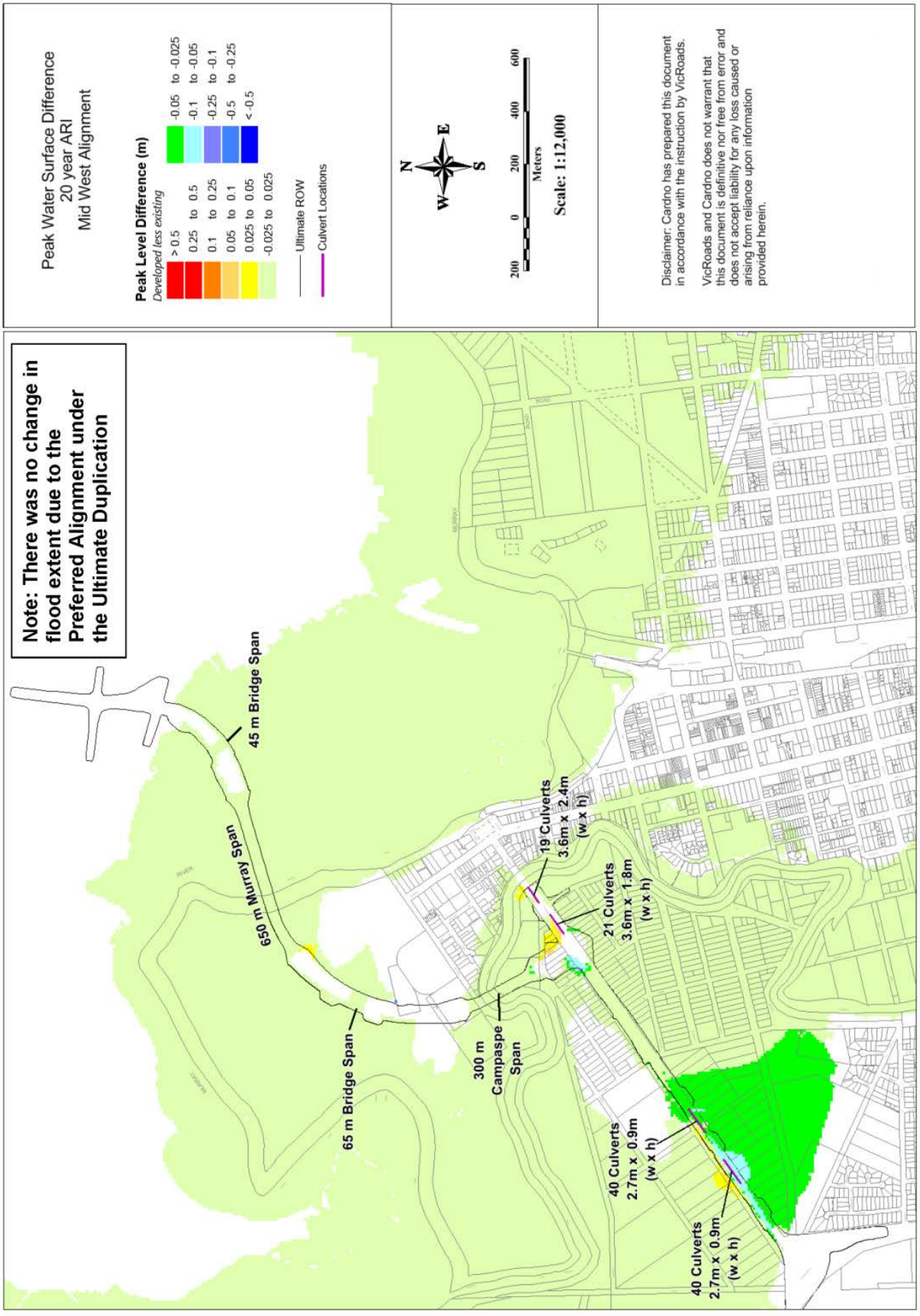


Figure 16-5 Flood impact assessment – 20 year ARI difference plot

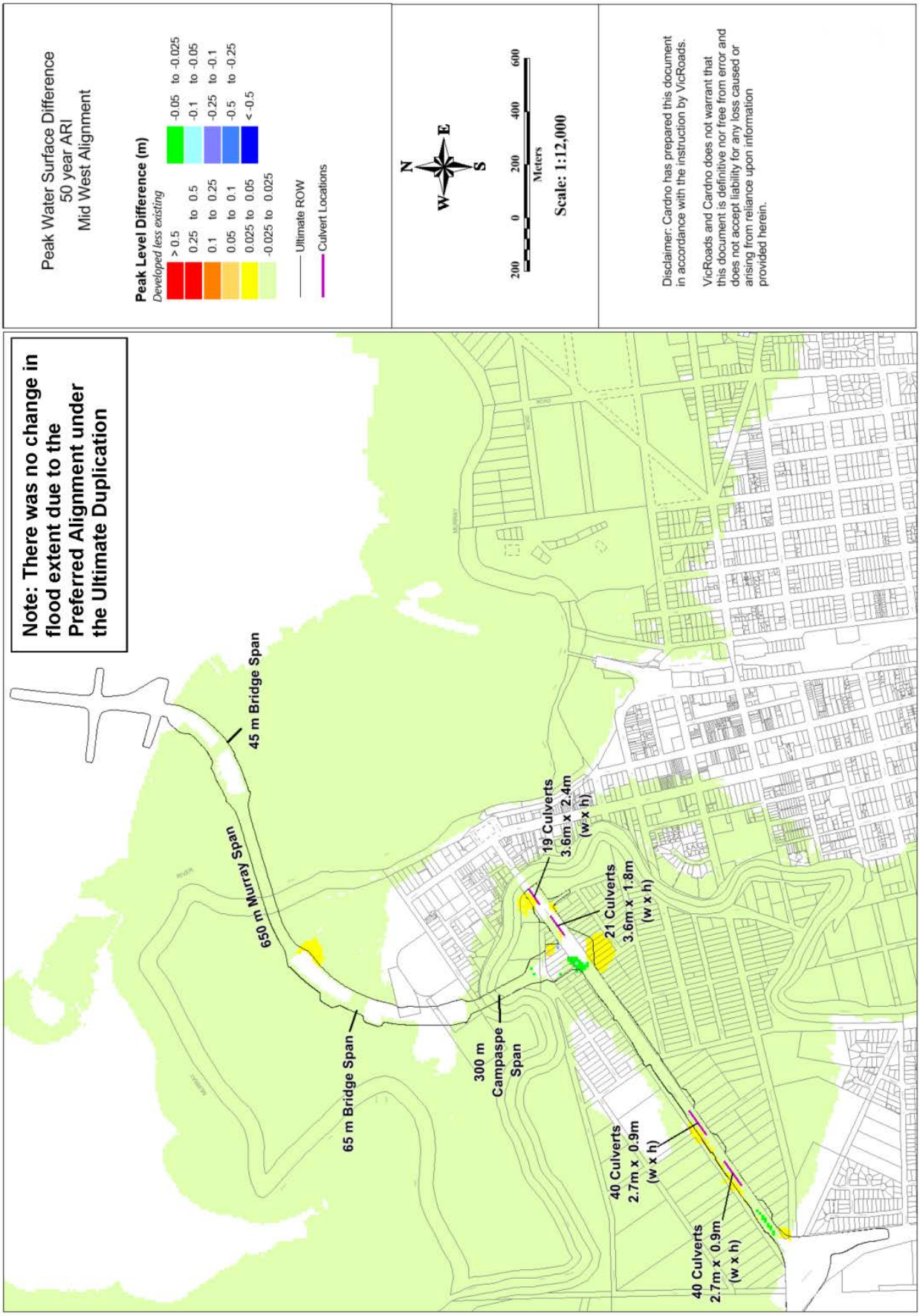


Figure 16-6 Flood impact assessment – 50 year ARI difference plot

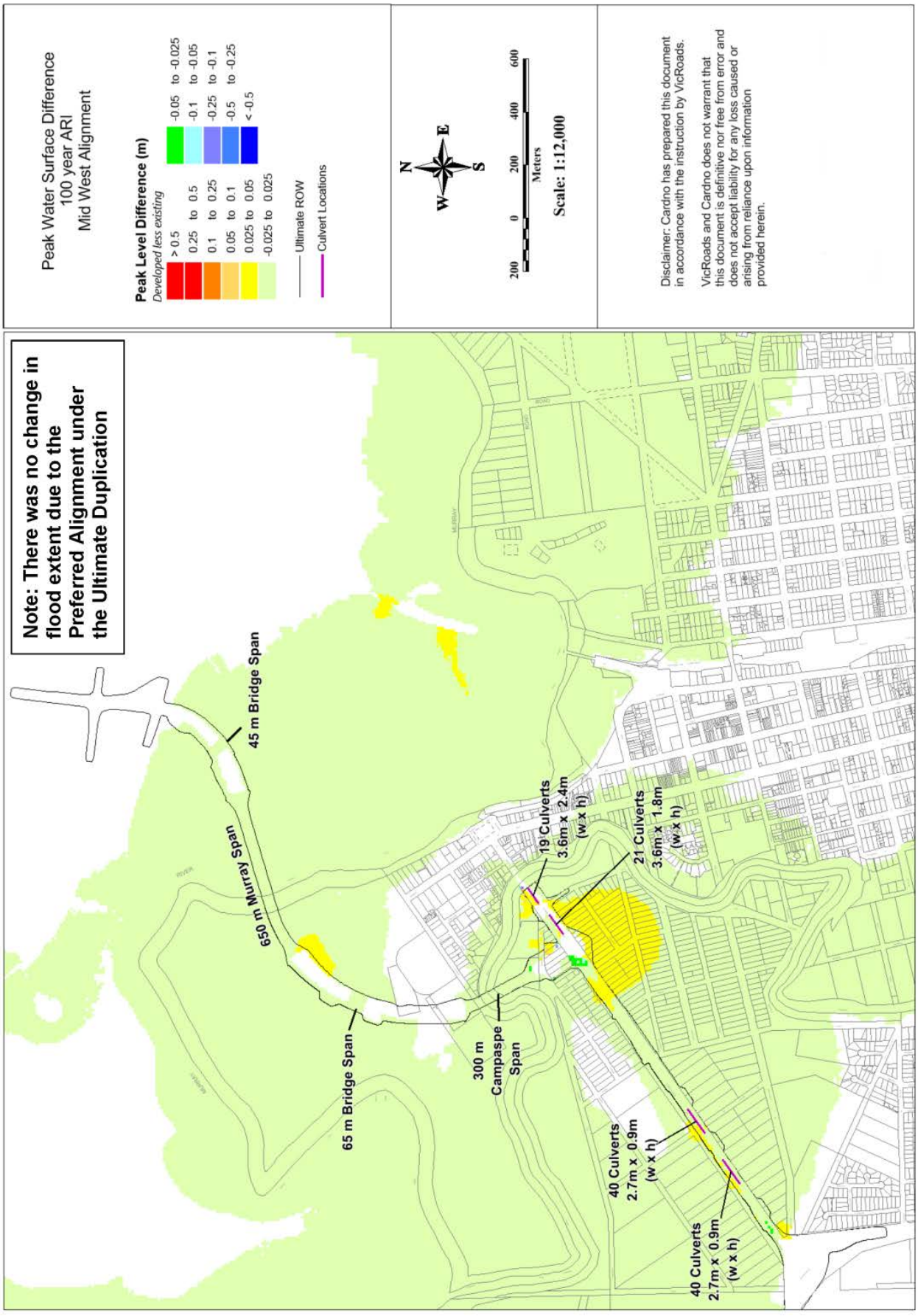


Figure 16-7 Flood impact assessment – 100 year ARI difference plot

16.7 Risk assessment

An environmental risk assessment was undertaken for the preferred alignment to identify key environmental issues associated with the construction and operation of the Project. The methodology for this risk assessment is described in Chapter 5 and details of the assessment are provided in EES Technical Appendix J – Hydrology Impact Assessment. Table 16-5 is a summary for catchment values of:

- The identified impact pathways
- A description of the consequence
- The initial risk rating, prior to the implementation of Project-specific environmental management measures.

Table 16-5 Surface water and groundwater risks

Risk No.	Impact pathway	Description of consequence	Initial risk rating
SW1	Construction at Murray River impacts on bank form, habitat or waterway health	Localised bank destabilisation at waterway crossings and detrimental impact on riparian habitat	Medium
SW2	Proposed works result in change to hydraulic conditions above acceptable levels	Potential for local disturbance to waterway banks, channels and flow. Potential for reduced aquatic habitat	Low
SW3	Construction at Campaspe River impacts on bank form, habitat or waterway health	Localised bank destabilisation and waterway crossings and detrimental impact on existing habitat	Low
SW4	Sediment from areas disturbed during construction impacts the waterways	Accumulation of sediment in the waterways during construction	Low
SW5	Pollutants in stormwater runoff during operation affect the water quality in the local waterways	Increase of sediment/pollutants in the waterways over time, reducing in water quality and potential impacts on waterway health	Low
SW6	Construction risk of impact on floodplain function during a flood event	Modification of the behaviour of the floodplains during construction	Negligible
GW1	Construction and/or operation impacts on existing groundwater levels	Potential for localised reduction in groundwater levels resulting in either land subsidence or impact to beneficial users	Low
GW2	Intersected groundwater discharges into waterways and impacts on surface water quality	Potential discharge of groundwater into Campaspe or Murray Rivers	Low

16.8 Environmental management measures

VicRoads has a set of standard environmental protection measures, which are typically incorporated into the contracts of road and bridge construction works. These measures were used as the starting point for the assessment of construction-related risks, and are listed in Chapter 20 and described in detail in EES Technical Appendix O – Section 177 Environmental Management. In some instances, additional Project-specific environmental management measures have been recommended by specialists to reduce risks relating to construction and operation.

Project-specific environmental management measures specific to each identified impact pathway for catchment values are outlined in Table 16-6. This table also shows the residual risk rating after the implementation of VicRoads standard environmental protection measures and Project-specific environmental management measures.

Table 16-6 Surface water and groundwater Project-specific environmental management measures and residual risks

Risk No.	Project-specific environmental management measures	Residual risk rating
SW1	Risk would be managed by implementing VicRoads standard environmental protection measures as outlined in Chapter 20 and EES Technical Appendix O – Section 177 Environmental Management. No Project-specific environmental management measures were identified	Medium
SW2	As per risk SW1	Low
SW3	As per risk SW1	Low
SW4	As per risk SW1	Low
SW5	Incorporate spill basins into design as required to capture pollutants	Negligible
SW6	As per risk SW1	Negligible
GW1	As per risk SW1	Low
GW2	As per risk SW1	Low

16.9 Conclusion

In order to assess the existing flood conditions of the Echuca-Moama region, previous studies that incorporated over 100 years of data were used to develop three flooding scenarios. Each of these scenarios was then modelled against three ARI events.

Modelled against these existing conditions, the Project was generally found to have minimal impact on the existing flood conditions and, in some places, would even improve flood management, specifically around Warren Street.

Benefits of the Project in relation to hydrology include:

- Providing a second flood evacuation route that is still accessible up to the 100 year ARI event
- Decreasing the chance of Warren Street being overtopped by increasing the efficiency of the culvert system under Warren Street
- Reducing the possibility of flood damage to the Warren Street roadway.

Most of the risks of the Project are able to be reduced to a level where they are low or negligible. Impacts to groundwater and surface water quality, construction impacts to Campaspe River morphology and habitat, and increases to the existing flooding conditions could largely be avoided and would only have minor consequences. Management of these impacts would be achieved through implementation of VicRoads standard environmental protection measures as well as Project-specific environmental management measures.

The operational risk associated with a chemical spill and/or contaminated road runoff is also reduced to a negligible level by the incorporation of adequately-sized spill basins in the road design.

However, the residual risk associated with the impact of constructing the Murray River bridge retains a medium rating, even after management measures have been implemented. This is due to the proposed location of the Murray River bridge piers, and the possibility of working within the riverbank.

Potential impacts associated with riparian vegetation removal, sedimentation and construction on and within the riverbank at the Murray crossing are considered to be minor, although they are also unavoidable. Management measures such as the construction of coffer dams to contain sediment, timing of construction to avoid works in the wetted area of the waterway and adherence to the SEPP WoV to preserve water quality would not reduce this risk any further.

Overall, construction and operation of the Project is not considered to have significant impacts on the function, values or beneficial uses of the Murray and Campaspe rivers, or on groundwater.

17 Soils and geology

The Soils and Geology Impact Assessment (VicRoads, 2015a) examined the potential for the Project to encounter adverse geological conditions, affect soil stability, damage geomorphology, cause soil erosion and/or potentially expose contaminated materials.

The geomorphology of the Echuca-Moama area is characterised by the extensive, flat floodplains and the deep river channels of the Murray and Campaspe rivers.

There is currently limited information on the soil properties and characteristics of the study area, and specific areas which may be more susceptible to soil settlement cannot be accurately identified.

No historic land uses in the study area indicate the presence of existing land contamination.

The existing geomorphology would be altered by the Project. However, the design of the proposed bridge, abutments and piers would minimise impacts on the geomorphic stability.

There would be a need to import a large amount of fill for the Project. Approximately 350,000m^3 of fill would be required and this fill would be sourced from VicRoads-approved quarries and borrow pits in accordance with VicRoads' standard environmental protection measures to prevent importation of contaminated fill materials.

The potential to encounter or cause soil erosion is considered a low risk. This is because the most erosion-prone areas within the proposed Right-Of-Way are limited to the river crossing points. VicRoads standard environmental protection measures would reduce any erosion caused by the Project so that the environmental impact would be minor. Detailed geotechnical site investigations, supplemented by specific engineering design for the Project, would minimise the potential for soil settlement and erosion.

Phase 1 environmental site assessments (ESAs) would be conducted to test the preferred alignment for contamination. If any contamination was identified, Phase 2 ESAs would be undertaken to locate and classify the contamination. With the information obtained from these ESAs it would be possible to alter the Project's design and minimise the ground disturbance at contaminated sites.

The geologically sensitive area of the sand hill would be protected from any subsurface disturbance.

Five soils and geology risks associated with the Project have been identified:

- Uncovering waste or contaminated material during construction works
- Soil settlement due to poor or soft ground conditions
- The potential for erosion and sediment generation during construction as a result of localised rainfall
- The potential for erosion and sediment generation post-construction
- Potential for uncontained spills or leaks during construction or operation

These risks would be appropriately managed with VicRoads standard environmental protection measures and Project-specific management measures.

17.1 EES objectives

The EES objective relevant to the Soils and Geology Impact Assessment for the Project, as specified in the EES Scoping Requirements Draft Evaluation Objectives, is *"To maintain… geomorphic stability of proximate sections of the lower Campaspe and Murray rivers."*

This chapter is based on the Soils and Geology Impact Assessment completed by VicRoads (2015a) which is included in EES Technical Appendix K. It is a summary of that assessment and includes a discussion of the following key issues and requirements as they relate to soils and geology, as specified in the EES Scoping Requirements for the Project.

Key issues

- *Potential for the Project to have significant effects on the… geomorphic stability of proximate sections of the lower Campaspe and Murray Rivers.*
- *Potential for the contamination of soils… from construction and operation activities, including the exposure and disposal of any waste or contaminated soils.*

Priorities for characterising the existing environment

- *Identify and characterise relevant surface water and floodplain environments, including in terms of the existing drainage functions, geomorphology and behaviour.*

Design and mitigation measures

- *Identify proposed measures to mitigate any potential effects, including any relevant features or preventative techniques to be employed during construction.*

Assessment of likely effects

- *Identify potential effects on the …geomorphic stability of proximate sections of the lower Campaspe and Murray rivers.*

Approach to manage performance

- *Identify any additional measures to manage and monitor effects on catchment values and identify likely residual effects.*

The key issues and requirements that relate to hydrology and groundwater are addressed separately in Chapter 16.

The Soils and Geology Impact Assessment focussed on the preferred alignment. The term 'the Project' is used in this chapter to refer to the preferred alignment only.

17.2 Study area

The study area is the same as the proposed Right-of-Way (refer to Figure 17-1).

17.3 Methodology

A desktop review and site inspections were undertaken to assess the geological conditions of the study area. These comprised the following activities:

- Review of relevant Commonwealth, State and local legislation, policies and guidelines
- Review of maps and publications from Geoscience Victoria and the Geological Society of Australia, and other publically available literature
- Review of historical aerial photographs of the study area, to assist in establishing the Project terrain and topography
- Review of previous materials testing results of local soils
- Site visits undertaken by VicRoads Geotechnical Services to document and photograph site conditions within and around the study area. These site inspections were conducted on:
  - 15 and 16 November 2011
  - 15 March 2012 (focussed on Reflection Bend)
  - 12 and 13 June 2014 (focussed on the preferred alignment).
- Identification of impact pathways, development of consequence criteria and initial assessment of risks following implementation of VicRoads' standard environmental protection measures
- Development of Project-specific environmental management measures and assessment of residual risk
- Assessment of the impacts of the Project against the 'No Project' scenario.

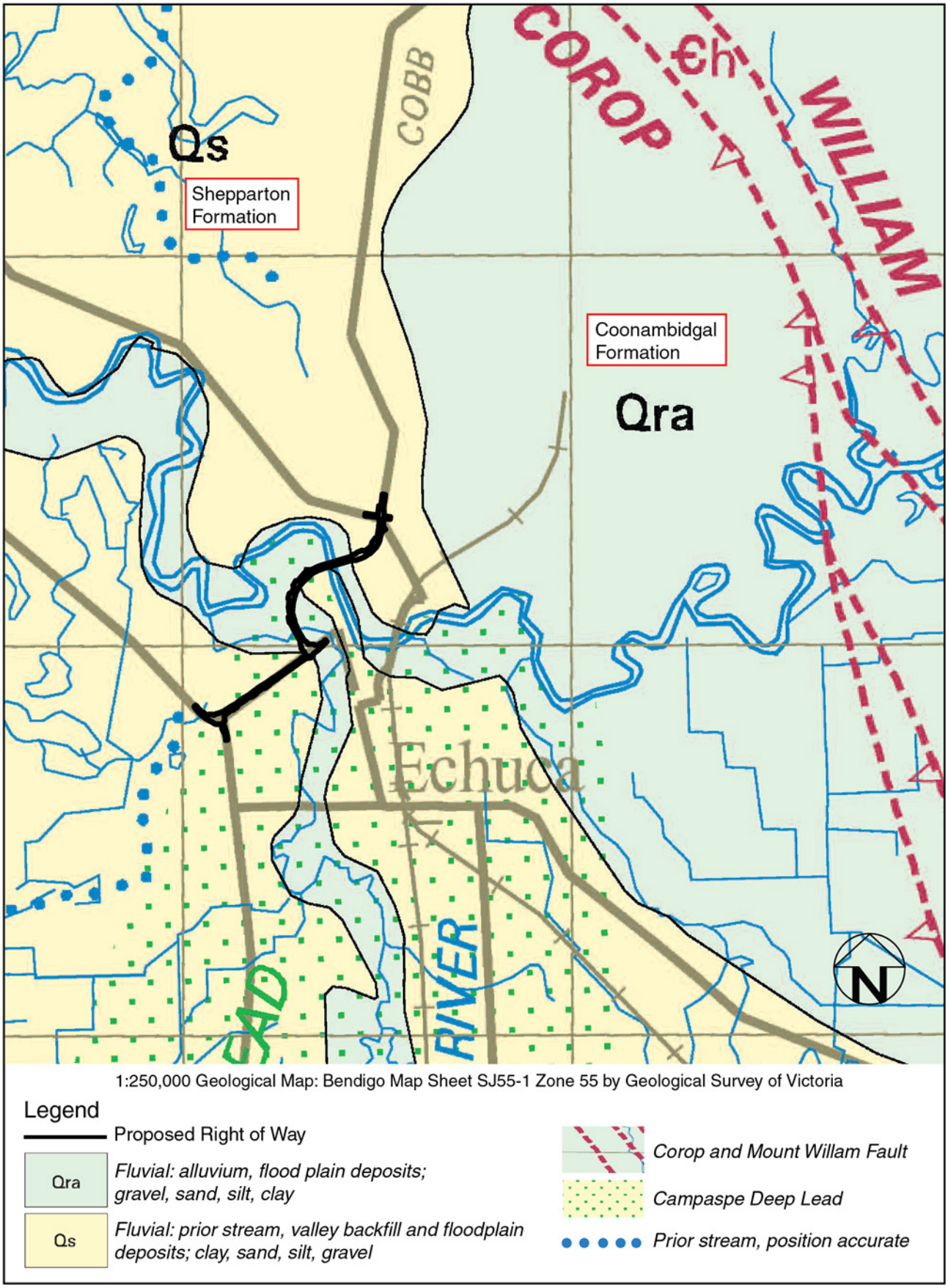


Figure 17-1 Study area

17.4 Legislation and policy

The relevant legislation and government policies for soils and geology are outlined in Table 17-1.

Table 17-1 Relevant soils and geology legislation and policies

Legislation/Policy	Description
State	
Environment Protection Act 1970 (Vic.)	The Environment Protection Act enables the Environment Protection Authority (EPA) Victoria to implement the State environment protection policies (SEPPs). All construction activities must comply with the general performance measures outlined in the legislation. The Act is supported by a series of SEPPs that regulate actions over a range of environmental protection issues. SEPPs are legal documents attached to the Act, which prescribe limits for the quality of the natural assets for which they were written. It is incumbent on all proponents of works to ensure their operations do not contribute to the degradation of these natural assets.
State environment protection policy (SEPP) (Prevention and Management of Contamination of Land) 2002	The SEPP (Prevention and Management of Contamination of Land) establishes general uses of land in Victoria and provides a mechanism for determining whether these uses are being protected, such as indicators and objectives of use in assessing impacts. The SEPP also identifies the links between the environmental audit system and the statutory planning system, ensuring sites that need to be audited are subject to audit, and that any conditions associated with the audit outcome are implemented. The SEPP further sets out requirements for the prevention of contamination, reinforces the role of the waste hierarchy in selecting preferred approaches for site clean-up and identifies measures by which people can access relevant information on site contamination.
Planning and Environment Act 1987 (Vic.)	The Planning and Environment Act establishes a framework for planning the use, development and protection of land in Victoria in the present and long-term interest of all Victorians. The Planning and Environment Act sets out the legislative basis to ensure that standard planning provisions are prepared and approved throughout Victoria. The Planning and Environment Act sets out procedures for preparing and amending the Victoria Planning Provisions (VPP) and planning schemes, obtaining permits under planning schemes, settling disputes, enforcing compliance with planning schemes, and other administrative procedures. The Planning and Environment Act provides for a single instrument of planning control in a particular area, the planning scheme, which sets out the way land may be used or developed. The planning scheme is a legal document, prepared and approved under the Planning and Environment Act. Section 12 of the Act ensures that potentially contaminated land is suitable for the use allowed within the relevant planning scheme. The relevant planning scheme for the study area is the Campaspe Planning Scheme.
Catchment and Land Protection Act 1994 (Vic.)	The Catchment and Land Protection Act provides a framework for the integrated and coordinated management of catchments with regard to long-term land productivity and maintenance of the quality of the State's land and water resources.
Environment Protection (Industrial Waste Resource) Regulations 2009	The Environment Protection (Industrial Waste Resource) Regulations is the key subordinate legislation for the regulation and management of hazardous wastes, known as prescribed industrial wastes (PIW) in Victoria. The title of the Environment Protection (Industrial Waste Resource) Regulations 2009 is intended to recognise and realise the resource potential of industrial wastes, including PIWs. The Regulations allow industrial waste resources to be managed within a risk-based regulatory system, with the key intent being to significantly improve the rates of reuse and recycling of industrial waste resources in a sustainable way. Through the implementation and application of the Regulations, it is intended that greater volumes of PIWs will be avoided, or at least diverted to reuse and recycling, resulting in significant reductions in the volumes requiring landfill disposal. Of particular focus is the reduction of Category B PIWs, with the intent of achieving the State government's objective of eliminating its disposal to landfill by 2020. This regulatory framework is supported by the EPA Industrial Waste Resource Guidelines. These guidelines were developed to consolidate waste publications under the Environment Protection Act and to provide links to useful resources on the following waste-related topics: - Policy and legislation - Avoidance and reduction - Reuse and recycling - Treatment - Waste categorisation - Sampling and analysis - Transport - Disposal.

Legislation/Policy	Description
Industrial Waste Management Policy (Waste Acid Sulfate Soils) No. S125, Gazette 18/9/1999	This policy aims to protect human health and the environment from risks associated with acid sulfate soils by providing a management framework and specific requirements for the management of acid sulfate soils in an environmentally responsible manner.
Local	

Campaspe Planning Scheme	The Campaspe Planning Scheme covers three relevant key environmental risks:
	- Clause 13.03-1 Use of contaminated and potentially contaminated land
	  - Objective – To ensure that potentially contaminated land is suitable for its intended future use and development, and that contaminated land is used safely.
	- Clause 13.03-2 Erosion and landslip
	  - Objective – To protect areas prone to erosion, landslip or other land degradation processes.
	- Clause 13.03-3 Salinity
	  - Objective – To minimise the impact of salinity and rising water tables on land uses, buildings and infrastructure in rural and urban areas and areas of environmental significance, and to reduce salt loads in rivers.
	The planning scheme specifies that all local planning adopts best practice environmental and risk management approaches, which aim to avoid or minimise environmental degradation and hazards.

North Central Regional Catchment Strategy 2013-19	The 2013-19 North Central Regional Catchment Strategy (RCS) provides a long-term vision for natural resource management within the North Central region. The RCS sets regional priorities for the management of natural assets, sets overall direction for investment and coordination of effort by landholders, partner organisations and the wider community. It provides a framework that supports and encourages participation in protecting and enhancing the environment. The vision for land and soils presented in the RCS is that "Land and soils are managed within their capability ensuring agricultural productivity and environmental values are enhanced to maintain the integrity of the catchment."

17.5 Existing conditions

17.5.1 Geology

The study area lies within the Wunghnu Group, which can be subdivided into the Shepparton and Coonambidgal Formations. The Coonambidgal Formation is situated in the current and historic paths of the Campaspe and Murray rivers, and the Shepparton Formation is across the rest of the study area (refer to Figure 17-1).

Underlying the Shepparton and Coonambidgal alluvial deposits are the Palaeocene to Miocene age Murray Group carbonate rocks and Renmark Group lacustrine sandstones, siltstones and coals.

The bedrock strata consist of undifferentiated Palaeozoic Silurian and Devonian siltstone and sandstone rocks.

The Shepparton Formation is present along the Riverine Plain of northern Victoria, consisting of highly variable sediments of fluviatile, overbank and lacustrine origin. These sediments generally include gravels and clays. As is typical of complex river systems, these deposits change laterally from gravel to clay and are vertically and horizontally variable. This causes formations such as sand channels flanked by layers of fine sandy clay deposited as river levees. The upper part of the Shepparton Formation is a 1-3m layer of calcareous clay with the overtopping soils being red brown to yellow brown in appearance.

The Coonambidgal Formation contains more of the river channel deposits that are also associated with lakes and floodplains. Consisting of late Pleistocene age fluviatile deposits, they may have an overprint of an Aeolian environment. Soils are generally yellow grey in colour and are poorly structured.

There are two faults present in the nearby region (Mount William and Corop faults), although they are well outside the study area. These can be seen in the top right-hand corner of Figure 17-1. These faults would not be encountered during construction and are not considered further in this EES.

17.5.2 Geomorphology

Geomorphology refers to the form of the earth, or the form of its surface features.

The land in the vicinity of Echuca-Moama consists of two topographic zones: the Riverine Plain and the Flood Plain of the Murray River.

The Project is situated in the geomorphic region of the Riverine Plain which is present in both NSW and Victoria. Formed following the retreat of the Pliocene Sea from the Murray Basin, it is an extensive and complex alluvial plain that is associated with the Murray River and its tributaries.

The geomorphology of the study area is characterised by the extensive, flat floodplains and the deep river channels that have been formed by the flood regimes of the Murray and Campaspe rivers.

17.5.3 Review of historic aerial photographs

Aerial photography, conducted in 1971, 2008 and 2013, was obtained for the study area to analyse existing and past land uses.

In general, the study area on both sides of the Murray River is relatively flat-lying and mainly consists of semi-cleared undeveloped land. There is evidence of minor earthworks in the area, likely related to dams and unlined irrigation channels for historic agricultural activities. Modification of the topography of the study area by human activity appears to be limited.

Aerial photographs of Warren Street and the section of the proposed Right-of-Way that crosses the Campaspe River indicate that the terrain contains small undulations with relics of small earthworks related to historic agricultural activities.

The Campaspe River has steep-sided banks of 4-6m in height, which are likely to be subject to erosion if exposed without appropriate mitigation.

The terrain further west, through Victoria Park, is flat-lying, with extensive tree cover over dry surface soils.

The aerial photographs identified some areas of grassland near the Murray River, although the land adjacent to the banks of the river is mostly covered by trees. At the proposed river crossing, the Murray River's banks appear to be easily eroded. This has resulted in the installation of retaining structures for short lengths along the Victorian side of the river. The NSW side of the river is apparently unmodified, with stabilisation of the banks provided by the root mass of several River Red Gum trees.

Based on the analysis of the available aerial photographs, no potential areas of contaminated land have been identified.

17.5.4 Material properties of the soil

Erodibility potential and dispersion

Soils in the Echuca-Moama area have variable erosive capacity. Confirmation of the material properties of the soils within the study area, and whether these are prone to erosion, would assist in implementing management measures which are sufficient to prevent a large increase in erosion.

The erodibility potential of soil refers to the likelihood of soils to erode when exposed to water (rain, flood) or wind. The erodibility potential is of particular relevance when land-disturbing activities, such as road and bridge construction, are proposed. Erodibility potential is highest on slopes and is more likely when soils have low plasticity (e.g. silty or sandy soils).

Soil dispersion increases the erodibility potential of soil. Dispersion generally occurs when water dissolves the binding minerals in soil. The more dispersive the soil, the greater its erodibility potential.

Emerson Class numbers, ranging from 1 to 8, are used to measure soil dispersion. Soils measured as Class 1 are considered to be most dispersive (easily erodible) and Class 8 are considered least dispersive.

Soils around Echuca-Moama, belonging to the Coonambidgal Formation, have previously been tested and recorded an Emerson Class range of between 5 and 8, making them unlikely to erode easily. A test of soils conducted at Moira Station (located approximately 25km north of Echuca-Moama) within the Shepparton Formation recorded an Emerson Class range of between 1 and 2, making these soils highly dispersive. The variability in the soils of the Echuca-Moama area means that tunnel and gully erosion cannot be discounted.

During site inspections, observations of soil instability and erosion along the preferred alignment were confined to the banks of the Campaspe and Murray rivers. Some evidence of erosion was observed at the proposed Murray and Campaspe river crossing sites.

Stabilisation of soils along the banks of the Murray River has been attempted, with rock beaching in use on the Victorian side of the river at the Project's proposed crossing site. However, this technique has not proven effective, with scour occurring at the toe of the beaching, resulting in undermining and slippage of the rocks. Stabilisation provided by the root mats of mature River Red Gum trees lining the river is similarly limited. River scour causes the undermining of trees, which then topple into the river, often causing more soil destabilisation as the root mats are pulled up and expose easily erodible soils.

Potential acid sulfate soils

As the study area is not located within a coastal acid sulfate soil area, the likelihood of encountering potential acid sulfate soils is very low and is not considered further in this EES.

Potential saline soils and groundwater

Based on the chemistry of water present, appropriate measures, such as specialised concrete mix designs providing protection against aggressive groundwater, may be necessary in terms of structural design for saline ground and groundwater. This is a standard construction technique. The need for such measures and the nature of the measures required would depend on the outcome of a geotechnical site investigation along the preferred alignment which will be undertaken during the pre-construction phase of the Project.

The potential to encounter saline soils and groundwater is considered unlikely due to the land formations in the study area and the low volumes of material to be excavated for the Project. The potential for any impacts associated with saline groundwater and soils is low and is not considered further in this EES.

17.6 Impact assessment

The Soils and Geology Impact Assessment in EES Technical Appendix K addressed the potential impacts of the ultimate duplication of the Project on the existing conditions of the Echuca-Moama region.

17.6.1 Key issues

The impact assessment addressed the following key issues:

- Exposure to potentially contaminated soils during construction
- Potential for importation of contaminated and/or inappropriate fill material resulting in erosion and/or contamination of land and groundwater
- encountering soft or compressible soil conditions during construction resulting in soil settlement
- Potential for erosion and sedimentation generation during construction and during operation
- Potential for uncontained spills or leaks during construction and operation resulting in contamination of land and groundwater.

17.6.2 Potential exposure to contaminated soils

Although analysis of historical aerial photographs did not reveal any of evidence of potentially contaminating land use activities for the study area, exposure to potentially contaminated soils during construction may occur via the exposure of contaminated materials during earthworks or through the importation of contaminated fill. If not handled appropriately, exposure to contaminated

materials can result in human health and environmental impacts.

For this reason a preconstruction Phase 1 ESA would be conducted as part of the geotechnical investigation. This assessment would include soil contamination testing to identify any contaminated soils. If contaminated material was present anywhere within the construction area, a Phase 2 ESA would be undertaken to locate and classify the contamination. Using the information obtained from these ESAs, it would be possible to alter the Project design and minimise ground disturbance at contaminated sites or to remove the contaminated soil, dispose of it at an EPA prescribed landfill, and replace it with uncontaminated fill. If contaminated material was encountered at any time during construction, it would be managed in accordance with VicRoads' standard environmental protection measures and EPA's Industrial Waste Guidelines.

As such, the impact of encountering contaminated soils, after implementation of all management measures, is considered to be minor.

17.6.3 Fill material

The Project is likely to require a significant amount of imported fill material. The amount of fill likely to be required is around 350,000m^3.

Fill would be sourced only from VicRoads accredited quarries and borrow pits and it would be required to meet the VicRoads specification depending on its proposed use. VicRoads standards exclude the use of any fill that contains contamination or inert material. Given these management measures, any potential impacts such as, contamination or unstable soils, associated with importation of fill are expected to be insignificant.

17.6.4 Soft and compressible soils

Increased soil loadings, such as those resulting from construction of new structures, can induce settlement in soft and compressible soils. This can occur at the time of construction or over a longer period of time.

The construction of the Project's embankments may cause ground settlement, particularly in soils containing silts and clays. Ground settlement has the potential to cause damage to structures. Areas along the preferred alignment that are vulnerable to settlement, such as the embankments, would be identified during the preconstruction geotechnical investigation.

No sensitive receptors or community facilities are located within areas that could be subject to soil settlement.

If soft and compressible soils are encountered within the construction area, the risk associated with ground settlement could be managed through construction methods such as using stone columns and constructing embankments with lightweight expanded polystyrene. Appropriate management measures would not be finalised until the geotechnical report had determined local ground conditions.

The impact of encountering soft and compressible soils during the Project is considered to be minor after management measures are implemented.

17.6.5 Erosion

The geomorphology associated with the flat floodplains of the area would be altered by the construction of the extensive embankments required for the Project. The bridge spanning the Campaspe River and the Murray River would also place abutments and piers into previously flat terrain. The addition of these structures into what is now a stable, and complex, fluvial geomorphic region may cause changes to the level of scour and erosion the area currently experiences, especially during flood events.

Scour impacts addressed in Chapter 16 describe how water velocities associated with a 1 in 100 year flood only reach around 1.5m/s. VicRoads' design standards for the bridge infrastructure would mitigate any scour associated with the water flow.

Geomorphic stability at the proposed crossing locations of both the Murray and Campaspe rivers would be maintained by restricting construction work to the nominated construction area and designing the bridges so that the abutments are set back from the riverbanks and flood velocities are acceptable, minimising scour. These measures used to prevent scour around the piers, abutments and embankments would also assist with limiting any significant changes to the existing geomorphology due to the Project.

Other management measures to reduce erosion include reducing slope batters, geo-fabric matting and leaving root mats of removed trees in the ground to continue stabilising the soil.

The sand hill would be protected from any Project-induced erosion by covering it with a rigid pavement to avoid any disturbance to sensitive Aboriginal subsurface material (refer to Chapter 11). The design of the rigid pavement would ensure the load of the road structure would be evenly distributed on the sand hill, thereby minimising the potential for compression of the underlying sand deposits. It is considered the impact to Aboriginal cultural heritage at this location would be minor.

Potential erosion and sediment generation during Project operation could have an impact on the beneficial uses of surface water. The type of erosion likely to occur would be gully erosion occurring in unstable batters and associated with high intensity rainfall events. The erosion due to the Project would be minor compared to the gully erosion occurring throughout the larger area as a result of a rainfall event. Similarly, the volume of sediment entering the rivers during a high intensity rainfall event would not be expected to increase significantly as a result of the Project. Combined with the existing high sediment load already experienced by both rivers, it is considered that the small increase in sediment load due to the Project would only affect surface water in the short term, resulting in a minor impact.

17.6.6 Uncontained spills and leaks

Spills and leaks of fuels or chemicals could occur during construction and operation resulting in contamination of land and groundwater.

Construction works would be governed by an EMP, which would include specific procedures to prevent any leaks and spills, and to respond rapidly to any leaks and spills so as to minimise any effects. For example, the EMP would specify regular inspections of any chemical storages and equipment fill points.

If there is a spill during the operation of the new road, VicRoads' maintenance contractor(s) are required to have an emergency procedure that details how the spill is to be managed and relevant emergency service agencies (including, CFA, police, EPA) are contacted to help manage the spill and implement appropriate traffic control measures.

Given the implementation of a comprehensive EMP, the risk of impact from chemical and fuel spills during construction is considered to be low.

17.7 Risk assessment

An environmental risk assessment was undertaken for the preferred alignment to identify key environmental issues associated with the construction and operation of the Project. The methodology for this risk assessment is described in Chapter 5 and details of the assessment are provided in EES Technical Appendix K.

Table 17-2 shows a summary of the following for soils and geology:

- The impact pathways identified
- A description of the impact consequence
- The initial risk rating, prior to the implementation of Project-specific environmental management measures.

Table 17-2 Soils and geology risks

Risk No.	Impact pathway	Description of consequence	Initial risk rating
SG1	Waste or contaminated material uncovered during works	Exposure of potentially contaminated soils impacting on human health and the environment	Medium
SG2	Soil settlement due to poor / soft ground conditions	Ground settlement, potential impacts to structures, pavement design life and maintenance issues	High
SG3	Potential for erosion / sediment generation during construction from localised rainfall	Batter instability, maintenance issues and sediment impacts within drainage paths and waterways	Low
SG4	Potential for erosion / sediment generation post construction	Batter instability, maintenance issues and sediment impacts within drainage paths and waterways	Low
SG5	Potential for uncontained spills or leaks during construction or operation	Groundwater, soil and/or surface water contamination impacts on water resources, flora, fauna and/or human health	Low

17.8 Environmental management measures

VicRoads has a set of standard environmental protection measures, which are typically incorporated into the contracts of road and bridge construction works. These measures have been used as the starting point for the assessment of construction-related risks and are listed in Chapter 20 and described in detail in EES Technical Appendix K. In some instances, additional Project-specific environmental management measures have been recommended to reduce risks.

Project-specific environmental management measures specific to each identified impact pathway for soils and geology are outlined in Table 17-3. This table also shows the residual risk rating after the implementation of VicRoads' standard environmental management measures and Project-specific environmental management measures.

Table 17-3 Soils and geology Project-specific environmental management measures and residual risks

Risk No.	Project-specific environmental management measures	Residual risk rating
SG1	Phase 2 environmental site assessment to be carried out to delineate contamination if contamination is encountered. Design to minimise excavation/ground disturbance within the alignment on any defined contaminated sites.	Low
SG2	Ground stabilisation and/or improvement techniques to be employed if required prior to construction. Contractor(s) to adopt best practice techniques for batter construction.	Low
SG3	Risk would be managed by implementing VicRoads standard environmental protection measures as outlined in Chapter 20 and EES Technical Appendix O. No Project-specific environmental management measures were identified.	Low
SG4	Additional erosion management measures if pre-existing measures implemented are identified as being inadequate. Measures may include re-mulching, inserted erosion control mats or seeding with grass (hydroseeding). Undertake surveillance to monitor.	Low
SG5	EMP to include: - Appropriate procedures for containing spills and leaks - Appropriate methods for cleaning up spills and leaks where safe to do so.	Negligible

17.9 Conclusion

The study area is dominated by the river systems, with mostly fluvial and floodplain associated soils and geomorphology. A review of historic aerial photographs indicated a relatively flat-lying area sometimes interrupted by small undulations, moderate tree cover and limited modification of topography due to human activity. Terrain of note is restricted to the Campaspe and Murray river systems, both of which have relatively steep banks and are likely to experience extensive natural erosion. Soft and compressible soils are potentially present, although this would need to be confirmed by a geotechnical investigation.

Groundwater in the study area is relatively close to the ground surface due to the proximity of the Murray and Campaspe rivers. The preconstruction geotechnical assessment would provide more certain data on the soils and groundwater of the area and would help to inform appropriate management measures.

The Soils and Geology Impact Assessment did not reveal any land features that would indicate the potential to encounter land contamination during construction of the Project. In addition, the importation of fill for the Project would be strictly managed by existing VicRoads standards. The potential for exposure of contaminated soils/material during construction of the Project is therefore limited and is considered to be unlikely. The impact of encountering contaminated soils is considered to be medium.

The impact associated with encountering soft and compressible soils during construction is considered to be minor as the extent of vulnerable soils present along the preferred alignment is unknown until such time as a preconstruction geotechnical assessment can be carried out.

The potential impact of erosion during the construction and operation of the Project is considered to be minor. The areas of largest concern are the bridge crossing locations on the banks of both the Murray and Campaspe rivers. These areas already experience erosion and while the construction of the Project is likely to exacerbate the existing processes, with appropriate management measures the risk of batter instability, maintenance issues and increased sediment load to the Murray and Campaspe rivers, is considered to be low.

Impacts to the geomorphic stability at the bridge crossings as a result of the Project would be minimal. The design of the bridge would minimise the potential for scour around the piers, abutments and embankments. These design measures would also assist with limiting any significant changes to the existing geomorphology.

Implementation of VicRoads standard environmental protection measures, along with the Project-specific environmental management measures outlined above, would reduce the residual risk ratings for all identified soils and geology risks to low or negligible. These risk ratings would need to be confirmed after analysing the results of a preconstruction geotechnical investigation.

18 Air and noise

Air

The Air Quality Impact Assessment examined the extent to which the construction and operational phases of the Project would impact on the air quality of the Echuca-Moama region.

A qualitative assessment of the impact of the Project's construction on air quality was undertaken by considering the potential impacts from dust and emissions from construction vehicles and machinery.

The assessment found the Project's construction would have the potential to impact local air quality, although these impacts would be temporary and mitigated using methods applied successfully by VicRoads as part of similar recent road construction projects, in accordance with VicRoads standard environmental protection measures. These measures would include proactive air quality monitoring to ensure that any exceedances are identified and addressed.

To assess the operational impacts of the Project, VicRoads' Air Quality Screening Tool (AQST) was used to determine the likely worst-case concentrations of traffic exhaust emissions, with predicted traffic volumes obtained from the traffic modelling study used in the Traffic and Transport Impact Assessment.

Even at the closest sensitive receptors to the preferred alignment, concentrations of nitrogen dioxide and particulate matter are predicted at less than 10 microns, which would be substantially less than State Environment Protection Policy (SEPP) (Air Quality Management (AQM)) intervention levels.

It is therefore expected the Project would easily meet the SEPP (AQM) levels and objectives for air quality.

The Project would also reduce some congestion on the existing bridge and road network, which would provide more efficient traffic movement and a reduction in total vehicle emissions across the local road network.

Noise and vibration

The Noise Impact Assessment examined the extent to which the construction and operational phases of the Project would impact on nearby sensitive receptors.

The study area for the Noise Impact Assessment encompassed an area within 300m of the centreline of the preferred alignment.

The potential noise and vibration impacts from construction of the Project were assessed by considering the potential for impacts based on the construction activities and equipment likely to be used.

It was found there would be the potential for construction activities to cause noise impacts at the nearest affected sensitive receptors, particularly during corridor clearing and site establishment when heavier machinery is likely to be used such as tub grinders, mulchers, bulldozers, dump trucks and chainsaws.

However, a combination of controls, including restrictions on working hours and implementation of VicRoads' standard environmental protection measures, would reduce noise during construction as far as practicable. It is considered the impacts of noise from construction of the Project would be minor to moderate.

Equipment that is most likely to cause vibration during the Project's construction includes pile drivers, hydraulic rock breakers, jackhammers, bulldozers, vibratory rollers and trucks. With the implementation of VicRoads' standard environmental protection measures and Project-specific environmental management measures, it is considered the impacts of vibration from construction of the Project would be moderate.

Modelling of future operational noise levels for the Project was undertaken for the following scenarios:

- The 'No Project' scenario – predicted noise levels in 2029 without the Project
- The Project – predicted noise levels in 2029 for the initial alignment, without mitigation measures
- The Project – predicted noise levels in 2029 for the initial alignment, with mitigation measures
- The Project – estimated noise levels at the ultimate duplication, following the implementation of mitigation measures.

The Noise Impact Assessment found that, without any mitigation measures, the maximum noise levels permitted to achieve compliance with VicRoads Traffic Noise Reduction Policy (2005) would be exceeded at residential properties in Crofton Street and Echuca Holiday Park.

However, by applying mitigation measures such as low noise asphalt road pavement and noise barriers, the predicted operational noise levels would comply with the VicRoads Traffic Noise Reduction Policy.

In the context of this policy it is considered that the impacts of noise on amenity in residential areas during operation of the Project would not be significant. Whilst the VicRoads Traffic Noise Reduction Policy does not apply to recreational facilities or larger areas of passive use, noise mitigation measures for residential receptors would in some instances also reduce noise impacts to some public open space and parkland areas.

It is noted that, following implementation of mitigation measures, apparent noise levels at some residential receptors and at Victoria Park would still be around twice as loud and apparent noise levels at the Echuca Lawn Tennis Club would be much louder than the 'No Project' scenario. Chapter 14 discusses the social impacts associated with these increased noise levels.

18.1 Air and noise EES objectives

The objective of the Air Quality and Noise impact assessments for the Project, as specified in the EES Scoping Requirements, is *"To minimise adverse noise, air quality and other amenity effects to the extent practicable"*.

This chapter considers both air and noise impacts. It is based on the results of both the Air Quality Impact Assessment undertaken by VicRoads (2015b) included in EES Technical Appendix L, and the Noise Impact Assessment undertaken by Renzo Tonin & Associates (2015), included in EES Technical Appendix M. This chapter includes a discussion of the following key issues and requirements as specified in the EES Scoping Requirements for the Project.

Key issues

- *The potential for increases in noise levels from the project's operation to significantly affect amenity in adjacent residential and parkland areas.*
- *The potential for increased vehicle traffic to adversely affect local air quality, relative to SEPP.*

Priorities for characterising the existing environment

- *Identify sensitive receptors and characterise the ambient noise environment.*
- *Identify sensitive receptors and characterise relevant ambient air quality parameters.*

Design and mitigation measures

- *Describe and evaluate both potential and proposed design responses and/or mitigation measures which could minimise noise, dust or other emissions on sensitive receptors, including relevant techniques or methods to be used during construction.*

Assessment of likely effects

- *Assess likely noises increases at sensitive receptors along the road corridor during its operation, both with and in the absence of the proposed mitigation measures.*
- *Assess likely adverse effects on local air quality relative to SEPP and other relative amenity effects.*

Approach to manage performance

- *Measures to manage other potential effects on amenity and environmental quality, including dust from the project construction, should also be addressed in the EES, including as part of the Environmental Management Framework and identify likely residual effects.*

The Air Quality and Noise impact assessments focussed on the preferred alignment. The term 'the Project' is used in this chapter to refer to the preferred alignment only.

18.2 Air study area

The study area for the Air Quality Impact Assessment is the proposed Right-of-Way (refer to Figure 18-1).

This area was selected as it would be subject to the highest potential air quality impacts from the Project during construction and operation, and is therefore considered to represent a worst-case scenario. This conservative approach is described further in section 18.5.2.

18.3 Air assessment methodology

In order to understand the potential effects of the Project on air quality, the following tasks were undertaken:

- Review of relevant Commonwealth, State and local legislation, policies and guidelines
- Consideration of existing air quality within the study area
- Identification of impact pathways, development of consequence criteria and initial assessment of risks following implementation of VicRoads' standard environmental protection measures
- Development of Project-specific environmental management measures and assessment of residual risk
- Assessment of the impacts of the Project against the 'No Project' scenario, as described in sections 18.3.1 and 18.3.2 below.

18.3.1 Construction impact assessment

A qualitative assessment of the impact of the Project's construction on air quality was undertaken by considering the potential for impacts from:

- The generation of particulate matter (or dust)
- Emissions of combustion exhaust gases from construction vehicles and machinery.

18.3.2 Operational impact assessment

In order to determine the air quality impacts that could arise from the operational phase of the Project, an air quality assessment was undertaken using the VicRoads AQST.

The AQST was developed to provide a rapid appraisal of a wide range of potential road projects. It is pre-programmed with a selected number of variables and default settings for each traffic volume category (e.g. broad assumptions of arterial or freeway with some adjustment for heavy vehicle mix). The AQST was prepared with input from EPA Victoria and approved by EPA Victoria for the purpose of assessing, at a screening level, potential air quality impacts from road projects against the SEPP (AQM).

The AQST consists of a spreadsheet model which uses traffic volume, distance to sensitive receptors and road type to determine a worst case estimate of likely atmospheric contaminant concentrations. This concentration is subsequently adjusted using factors to account for the proportion of heavy vehicles, road gradient and road location (i.e. cutting, at-grade, etc.).

The AQST was applied using the following conservative assumptions:

- A distance of 0m to any sensitive receptors
- Maximum traffic volume for the bridge crossing by 2044 (the AQST assumes a minimum selection of 4,000 vehicles per hour or 20,000 vehicles per day)
- Average speed of travel 30km/h
- A maximum heavy vehicle volume percentage of 13.4% in 2029 and 14.2% in 2044
- A gradient along the preferred alignment of 3.6% incline
- The entire length of the preferred alignment is on fill or at ground levels with no cuttings.

The AQST limits the operational air quality assessment to the particular contaminants of nitrogen dioxide and particulate matter less than 10 microns (PM_{10}). These contaminants were selected in conjunction with EPA Victoria as the components of vehicle emissions that are most likely to exceed the criteria.

Figure 18-1 Air study area

18.4 Air legislation, policy and guidelines

The relevant legislation, policies and guidelines for air are summarised in Table 18-1.

Table 18-1 Legislation, policies and guidelines relevant to air

Legislation/policy/ guideline	Description
Commonwealth	
National Environment Protection (Air Quality) Measure (Air Quality NEPM)	The Air Quality NEPM defines the Commonwealth requirements for national standards of air pollutants criteria in Australia. These aim to establish protection levels for exposure to selected air pollutants. The six key air pollutants relevant to a road project are: • Carbon monoxide • Ozone • Sulphur dioxide • Nitrogen dioxide • Lead • Particulate matter.
National Environment Protection (Air Toxics) Measure (Air Toxics NEPM)	The Air Toxics NEPM establishes 'monitoring investigation levels' for five air toxics: • Benzene • Toluene • Formaldehyde • Xylenes • Benzo(a)pyrene as a marker for Polycyclic Aromatic Hydrocarbons (PAH).
State	
Planning and Environment Act 1987 (Vic.)	The Planning and Environment Act establishes a framework for planning the use, development and protection of land in Victoria in the present and long-term interest of all Victorians. The Planning and Environment Act sets out the legislative basis to ensure that standard planning provisions are prepared and approved throughout Victoria. The Planning and Environment Act sets out procedures for preparing and amending the Victoria Planning Provisions and planning schemes, obtaining permits under planning schemes, settling disputes, enforcing compliance with planning schemes, and other administrative procedures. The Act provides for a single instrument of planning control in a particular area, the planning scheme, which sets out the way land may be used or developed. The planning scheme is a legal document, prepared and approved under the Planning and Environment Act. The relevant planning scheme for the study area is the Campaspe Planning Scheme.
Transport Integration Act 2010 (Vic.)	Part 2, Division 2, section 10 of the Transport Integration Act outlines the transport objectives relating to environmental sustainability. These are: '*The transport system should actively contribute to environmental sustainability by:* • *Protecting, conserving and improving the natural environment;* • *Avoiding, minimising and offsetting harm to the local and global environment, including transport-related emissions and pollutants and the loss of biodiversity;* • *Promoting forms of transport and the use of forms of energy and transport technologies which have the least impact on the natural environment;* • *Improving the environmental performance of all forms of transport and the forms of energy used in transport.*'
Environment Protection Act 1970 (Vic.)	Air quality in Victoria is managed by the Environment Protection Act and the relevant SEPPs created under section 16 of the Act: • SEPP (Air Quality Management) 2001 – SEPP (AQM) • SEPP (Ambient Air Quality) 1999 – SEPP (AAQ).
State environment protection policy (SEPP) (Air Quality Management) (AQM) 2001	Construction dust emissions and operational vehicle emissions (gases and particulates) would be managed by, and would need to comply with, the provisions of the SEPP (AQM). The SEPP (AQM) has been developed under the provisions of the Environment Protection Act (as mentioned above). The criteria against which vehicle emissions from road corridors are to be assessed are referred to in Clause 40 of the policy – 'Management of Large Line and Area-Based Sources of Emissions'. Sub-clause (1) states that EPA Victoria "will develop protocols for environmental management" (PEMs) for large line sources such as road projects. A PEM for road construction and operation has yet to be finalised. In the interim, EPA Victoria has adopted the Intervention Levels (defined by Schedule B of SEPP (AQM)) to apply to specific road projects. Background air pollutant levels are required by the SEPP (AQM) for use in modelling of emissions from the Project. These background values are used as a basis for existing air pollution levels in the Project study area and are added to overall predicted values within the AQST to be compared against the SEPP (AQM) intervention levels.

Legislation/policy/ guideline	Description
State environment protection policy (SEPP) (Ambient Air Quality) (AAQ) 1999	The SEPP (AAQ), developed under the Environment Protection Act, adopts the requirements of the Air Quality NEPM and operates in conjunction with SEPP (AQM). The SEPP (AAQ) is concerned with ambient air quality in Victoria and outlines seven environmental indicators that require measurement and reporting for compliance against State objectives and goals (concentrations within the ambient air shed) and which must be taken into consideration when proposing any changes to the environment, such as this Project.
EPA Victoria's Best Practice Environmental Management Guidelines for Major Construction Sites (1996) (EPA Victoria Publication 480)	EPA Victoria's Best Practice Environmental Management Guidelines for Major Construction Sites provides contractors with a framework within which due diligence obligations can be met and environmental damage can be avoided. It provides guidance on how to implement sound practices that minimise environmental impacts and eliminate health risks and nuisance to residents near a major construction site. The Guidelines outlines suggested measures for managing potential sources of air pollution on construction sites.
Local	
Campaspe Planning Scheme	A planning scheme sets out objectives, policies and provisions relating to the use, development, protection and conservation of land in the area to which it applies. The applicable planning scheme within the Victorian proportion of the study area is the Campaspe Planning Scheme. A set of standard provisions called the Victoria Planning Provisions (VPP) forms a template for all planning schemes. Included in the VPP is the State Planning Policy Framework (SPPF), which covers strategic issues of State importance. Clause 13.04-2 (Air quality) of the SPPF is relevant to the Project. The objective of this clause is "*To assist the protection and improvement of air quality*." Strategies to achieve this objective include: ▰ *Ensure that land-use planning and transport infrastructure provision contribute to improved air quality by:* • *Integrating transport and land-use planning to improve transport accessibility and connections.* • *Locating key developments that generate high volumes of trips in the Central Activity District, Principal and Major Activity Centres.* • *Providing infrastructure for public transport, walking and cycling.* ▰ *Ensure, wherever possible, that there is suitable separation between land uses that reduce amenity and sensitive land uses.*

18.5 Existing conditions for air

18.5.1 Existing air quality

Existing air quality refers to the concentration of indicator contaminants within the study area prior to development of the Project. The SEPP (AQM) states that where there is no appropriate hourly background data, proponents should calculate the 70th percentile of one year's observed data as a constant value. Neither of these was available for the study area so worst-case values were adopted (more akin to urban environments than a rural location).

The AQST adopts a worst-case approach to existing air quality using default background concentrations supplied by EPA Victoria. The default background concentrations of key contaminants incorporated into the tool are shown in Table 18-2.

Table 18-2 Assumed background concentrations of contaminants

Indicator contaminant	Units*	Average period	Default background concentrations
Nitrogen dioxide	µg/m^3	1 hour	28
PM_{10}	µg/m^3	24 hour	36

*µg/m^3: micrograms per cubic metre

Bureau of Meteorology statistics indicate that predominant annual wind direction at 9am is from the south at an average speed of 9.8km/h. At 3pm the predominant wind direction is from the west at an average speed of 12.8km/h.

18.5.2 Sensitive receptors

Eleven sensitive receptors have been identified abutting the proposed Right-of-Way, at distances ranging from 5–60m from the outside edge of the nearest trafficable lane.

It is acknowledged that under some weather conditions during construction and operation, air quality impacts may extend beyond the study area. However, it is considered that implementation of the management measures discussed in sections 18.6 and 18.13 would minimise any potential impacts so that these impacts would be within acceptable levels.

The offset from sensitive receptors to the Project is one of the inputs to the AQST, which calculates the predicted emission concentrations based on the distance between the edge of the paved road surface and the receptor. An offset of 0m distance between sensitive receptors and the edge of the paved road surface was assumed, to determine the anticipated worst case scenario during operation. Where the AQST indicates further interrogation is required, actual distances and receptors further away from the alignment would be considered.

18.6 Air impact assessment

18.6.1 Construction

Potential emissions to air during construction include the generation of particulate matter (or dust) as well as emissions from the use and movement of construction machinery and vehicular traffic. Sources of dust and dust-generating activities during construction include:

- Windblown dust from exposed surfaces e.g. stockpiles, roads, etc.
- Mechanically-generated dust e.g. bulk earthworks, vegetation clearing, handling of soil and aggregate materials
- Vehicular dust from traffic movements on unpaved roads.

The quantity of dust dispersed would depend on the dust generation rate and the drift of dust particles which is influenced by atmospheric stability as well as wind speed and direction. Larger particles generally settle closer to the source while finer particles disperse over greater distances.

Gaseous emissions are associated with the combustion of diesel fuel and petrol from the movement of vehicles and operation of on-site plant and construction machinery. These sources would generate emissions of carbon monoxide, carbon dioxide, oxides of nitrogen, sulphur dioxide and trace amounts of non-combustible hydrocarbons.

The rate of emissions and potential impact would depend on the number and power output of the engines, the quality of fuel used, the condition of the engines and the intensity (engine speed) of use. It should be noted that while a number of plant items would be in use at any one time, not all would be running at full power, thereby substantially reducing the volume of gaseous emissions.

SEPP (AQM) establishes the framework for managing emissions in order to protect the beneficial uses of the air environment and provides a program for achieving Victoria's air quality goals and objectives. In relation to the Project, compliance with the SEPP (AQM) necessitates that short term construction phase impacts are managed in accordance with best practice principles and that emission impacts from the operation of the road are compliant with SEPP (AQM) air quality goals and objectives.

VicRoads' standard environmental protection measures would be used to manage air quality during construction. These are in accordance with the EPA Victoria Best Practice Environmental Management Guideline for Major Construction Sites (EPA Victoria Publication 480) and would be incorporated in the Construction Environmental Management Plan (CEMP) (refer to Chapter 20). The VicRoads standard environmental protection measures include management of dust and emissions from vehicles and plant using methods applied successfully by VicRoads as part of similar recent road construction projects. Dust management measures during construction would include:

- Minimising land clearance and disturbance
- Progressive stabilisation of completed areas
- Roads and haul routes demarcation and maintenance
- Slope design with consideration to the location of roads, haul routes and the potential for runoff and windblown dust
- Watering roads and dust sources at a frequency determined by the emission rate of the source, prevailing meteorology and proximity to receptors
- Minimising the size and number of stockpiles, with consideration of the location and orientation of stockpiles and stockpile surface stabilisation, where possible
- Establishment of a complaints receipt and investigation process for tracking, analysing and following up air quality complaints.

Air quality monitoring would also be undertaken in accordance with VicRoads standard environmental protection measures. Two types of monitoring would be undertaken:

- Dust deposition monitoring:
  - Dust deposition gauges would be established for the duration of construction to measure insoluble solids (nuisance dust) in the air.
  - The contractor(s) would also be required to undertake directional dust monitoring to help determine whether any dust generated is related to construction activities, or is being produced by another source.
  - Dust deposition and directional dust monitoring stations would be located where construction works are likely to have the greatest impact to adjacent sensitive receptors or to create a nuisance to the community.
- Continuous monitoring:
  - Continuous monitoring uses portable laser light scattering instruments to continuously measure dust particles. This proactive control activates an alarm when an air quality target level is exceeded, and would assist the contractor(s) to comply with set dust deposition monitoring objectives.
  - Continuous monitoring locations can be adapted to changes in wind direction and/or construction activities. Continuous monitoring stations would usually be located downwind of construction activities or adjacent to sensitive receptors.

Monitoring would identify whether air quality targets are being met, and any non-compliance would be addressed by the contractor(s) through the review and improvement of controls.

As noted above, vehicles and plant also have the potential to impact on local air quality through emission of combustion exhaust gases. The CEMP would detail the following air quality management practices, in accordance with VicRoads' standard environmental protection measures:

- Maintenance of site vehicles and plant in accordance with the manufacturer's recommendations
- Maintenance of stationary combustion engines in accordance with the manufacturer's recommendations
- Location and hours of operation for stationary combustion engines
- Reactive monitoring for PM_{10}, and dust deposition monitoring to inform the potential for nuisance dust impacts.

By implementing VicRoads' standard environmental protection measures, it is expected the Project would easily meet the SEPP (AQM) goals and objectives for air quality. If the SEPP (AQM) intervention level were to be exceeded within a localised area during operation the corresponding impact to air quality would be of moderate consequence. However, it is considered that this would only occur rarely (if at all) and therefore the residual risk is low.

18.6.2 Operation

This section summarises the results of the Air Quality Impact Assessment of the operation of the Project undertaken using the VicRoads AQST.

The AQST was used to determine the likely worst-case concentrations of traffic exhaust emissions using the predicted traffic volumes determined in the traffic modelling study (refer to Chapter 8 and EES Technical Appendix B – Traffic and Transport Impact Assessment).

The assessment included consideration of predicted traffic volumes in 2044. The traffic volumes predicted by the tool are highly conservative, regardless of the whether the ultimate duplication has been constructed by 2044. That is, the tool provides for peak daily traffic volumes between 20,000 and 200,000 vehicles per day, and peak hourly traffic volumes between 4,000 and 20,000 vehicles per hour. The peak daily traffic volumes for the Project in 2044 are actually predicted to be 16,368 vehicles, and the peak hourly traffic volumes are predicted to be 1,377 vehicles. Not only would the predicted traffic volumes be less than those used in the AQST to predict near-road impacts, improvements in technology mean that vehicle fleet

emission factors will be lower by 2044 (i.e. the tool only estimates fleet emission levels to 2021).

Other inputs to the model included the fleet composition, specifically the percentage of heavy vehicles, the road gradient and the elevation of the road relative to the surrounding terrain. The results from the AQST are provided in Table 18-3.

Table 18-3 Predicted worst-case operational air quality emissions

Closest receptor location	PM_{10}	Nitrogen Dioxide	Complies with SEPP (AQM)?
	SEPP (AQM) Intervention Level: 60	SEPP (AQM) Intervention Level: 263	
12m	42µg/m^3	125µg/m^3	Yes

An additional AQST assessment was conducted, adopting a theoretical 100 per cent increase in road gradient, traffic volumes and proportion of heavy vehicles to determine the sensitivity of the assessment to change. There was a 90.4 per cent increase in nitrogen dioxide to 238µg/m^3, and a 19 per cent increase in PM_{10} to 50µg/m^3. These results are still less than the corresponding SEPP Intervention Levels.

Moreover, the available inputs to the AQST, including the predicted traffic volumes, mean the outputs of the tool are extremely conservative and represent an overestimation of the likely level of any emissions as a result of the Project. Even at the curb-side areas along the preferred alignment (based on expected traffic numbers and vehicle types), the screening assessment demonstrates that a more detailed assessment is not warranted.

The AQST indicates that highly conservative worst-case concentrations of contaminants in air emissions are substantially less than the levels specified in SEPP (AQM), even at the closest sensitive receptors to the preferred alignment. The concentrations at other receptors would therefore be equal to or lower than these worst case results. In addition, it is predicted that these concentrations would further reduce over time as a result of improvements in fuel quality and engine and emissions standards. The Project would also reduce some congestion on the existing bridge and road network, which would provide more efficient traffic movement and a reduction in total vehicle emissions.

Based on the results of the AQST, no further modelling or mitigation is considered necessary at this stage for operational air quality emissions. Existing procedures established by VicRoads would be followed to track, analyse and investigate any air quality complaints during operation.

With the above management measures in place, it is expected the Project would easily meet the SEPP (AQM) goals and objectives for air quality. If the SEPP (AQM) intervention level were to be exceeded within a localised area during operation the corresponding impact to air quality would be of moderate consequence. However, it is considered that this would only occur rarely (if at all) and therefore the residual risk is low.

18.7 Noise study area

The study area for the Noise Impact Assessment encompassed an area within 300m of the centreline of the preferred alignment (refer to Figure 18-2).

Receptors located within the study area were considered to be potentially sensitive to noise associated with construction and operation of the Project.

The Noise Impact Assessment considered noise and vibration impacts in both Victoria and NSW. This chapter presents a summary of that assessment, focussing on the impacts in Victoria only.

18.8 Noise assessment methodology

In order to understand the potential effects of the Project on noise levels, the following tasks were undertaken:

- Review of relevant State and local legislation, policies and guidelines
- Consideration of existing noise levels within the study area
- Identification of impact pathways, development of consequence criteria and initial assessment of risks following implementation of VicRoads' standard environmental protection measures
- Development of Project-specific environmental management measures and assessment of residual risk
- Assessment of the impacts of the Project against the 'No Project' scenario, as described in sections 18.8.2 and 18.8.3 below.

18.8.1 Description of changes in noise level

Noise is measured in decibels (dB) which is a logarithmic measure of sound pressure level. In this chapter, the measure dB(A) is used which is the sound pressure level statistically weighted so that it approximates the sound level as perceived by humans.

Noise can vary considerably in level over a period of time. One way to describe sound that varies with time is in terms of the level exceeded for a portion of that time. L_{A10} is the level exceeded for 10 per cent of the measurement period, and is often referred to as the average maximum level. VicRoads has adopted the traffic noise descriptor of L_{A10} (18hr) which is defined as the arithmetic average of the noise levels that are exceeded for 10 per cent of the measurement period, measured at the façade of a noise sensitive receptor.

18.8.2 Assessment of noise and vibration impacts during construction

The assessment of potential construction noise associated with the Project was carried out by considering EPA Victoria's Guidelines for Noise Control (2008) (EPA Victoria Publication 1254) and Best Practice Environmental Guidelines for Major Construction Sites (1996) (EPA Victoria Publication 480). As there are no Victorian guidelines for construction vibration, assessment of potential construction vibration associated with the Project was carried out by considering the British Standards BS 6472-1992, Evaluation of human exposure to vibration in buildings (1-80 Hertz) (1992) and BS7385-2:1993: Part 2 Evaluation and measurement of vibration in buildings (1993) as well as the German Standard DIN 4150 – Part 3 – Structural vibration in buildings – Effects on Structures (1999).

A qualitative assessment of the potential noise and vibration impacts from construction of the Project was undertaken by considering the potential for impacts based on the type of construction activities and equipment likely to be used.

18.8.3 Assessment of operational noise impacts

An assessment of existing conditions was undertaken by monitoring noise levels at selected locations in 2008, 2011 and 2014 (refer to section 18.10.2). At locations where the noise environment is dominated by naturally occurring sounds, the noise monitoring results obtained during winter were used to inform a conservative assessment.

Project Objective Noise Levels (PONLs) were derived for each sensitive receptor in accordance with the VicRoads Traffic Noise Reduction Policy. The objectives of the VicRoads Traffic Noise Reduction Policy are summarised in Table 18-5. The PONL is the noise level objective for a road project that is to be achieved for at least ten years after completion of the project. For this Project, ten years after construction of the initial alignment is assumed to be in 2029. The PONL applied to each sensitive receptor was derived from the potentially most affected façade. Only residential receptors adjacent to the Project were specifically considered by the assessment as compliance with PONLs for these receptors implies compliance for receptors located within the balance of the study area.

The PONLs for residential receptors were calculated in accordance with guidance in the VicRoads Traffic Noise Reduction Policy for roads where the noise level adjacent to buildings of a residential nature (Category A buildings) or noise-sensitive community buildings (Category B buildings) is less than 50dB LA_{10} (18hr) prior to undertaking road improvements. The VicRoads Traffic Noise Reduction Policy states that where the noise level adjacent to Category A or B buildings prior to road improvements is less than 50dB LA_{10} (18hr), consideration would be given to limiting the noise level increase to 12dB. Accordingly, PONLs for residential receptors are set at the existing noise level plus 12dB(A).

PONLs for residential receptors immediately adjacent to the alignment are shown in Table 18-4. The Noise Impact Assessment in EES Technical Appendix M provides the PONLs for each individual receptor.

Table 18-4 PONLs for residential receptors

Location	2014 noise level L_{A10}(18hr) dB(A)	PONL
Henry Street	49	61
Crofton Street	43	55
The Echuca Holiday and Caravan Park	42[1]	54

1. Noise monitoring result from 2008 assessment adopted for defining PONL. Ambient noise level at this location would be dominated by naturally occurring sounds and as such assumed to not change during period 2008–2014.

As described in Table 18-5, the Murray Valley Highway and Warren Street section of the Project does not qualify as a new or upgraded road as this section utilises an existing arterial road reservation and does not require demolition of buildings. Accordingly, the VicRoads Traffic Noise Reduction Policy does not apply and a PONL has not been set for this section of the Project.

The United Kingdom Department of Transport Calculation of Road Traffic Noise (CoRTN) algorithm was used to predict future noise levels in the study area from traffic during operation. Traffic volume data was provided by Jacobs. Other inputs to the operational noise model are detailed in the Noise Impact Assessment in EES Technical Appendix M.

Prior to modelling future noise levels, the accuracy of the model was assessed. Validation of the noise model was undertaken by modelling 2014 conditions, and comparing these to the noise monitoring results at locations where noise levels are dominated by traffic. Validation showed that the model could predict noise levels to the required level of accuracy.

In accordance with VicRoads Traffic Noise Reduction Policy, the modelled noise levels were based on predicted traffic volumes 10 years after the construction of the initial alignment, assumed to be in 2029.

Modelling of future noise levels was undertaken for the following scenarios:

- The 'No Project' scenario – predicted noise levels in 2029 without the Project
- The Project – predicted noise levels in 2029 for the initial alignment, without mitigation measures
- The Project – predicted noise levels in 2029 for the initial alignment, with mitigation measures
- The Project – estimated noise levels for the ultimate duplication, following the implementation of mitigation measures.

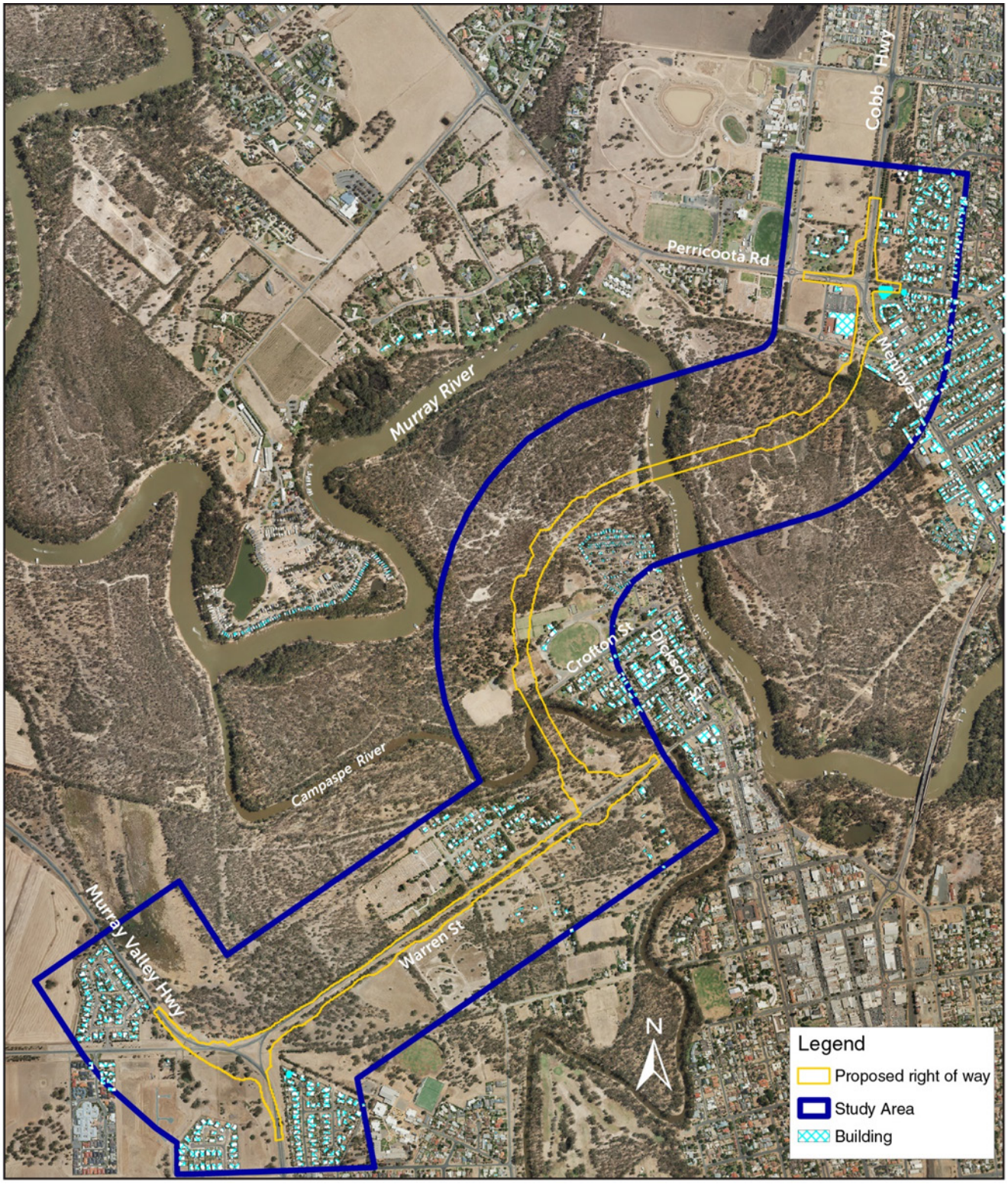


Figure 18-2 Noise study area

18.9 Noise legislation, policy and guidelines

The relevant legislation, policies and guidelines for noise are summarised in Table 18-5.

Table 18-5 Legislation, policies and guidelines relevant to noise

Legislation/policy/ guideline	Description
State	
Planning and Environment Act 1987 (Vic.)	The Planning and Environment Act establishes a framework for planning the use, development and protection of land in Victoria in the present and long-term interest of all Victorians. The Planning and Environment Act sets out the legislative basis to ensure that standard planning provisions are prepared and approved throughout Victoria. The Planning Environment Act sets out procedures for preparing and amending the Victoria Planning Provisions and planning schemes, obtaining permits under planning schemes, settling disputes, enforcing compliance with planning schemes, and other administrative procedures. The Act provides for a single instrument of planning control in a particular area, the planning scheme, which sets out the way land may be used or developed. The planning scheme is a legal document, prepared and approved under the Planning and Environment Act. The relevant planning scheme for the study area is the Campaspe Planning Scheme. Section 4 of the Act sets out the objectives of planning in Victoria, including; c) *to secure a pleasant, efficient and safe working, living and recreational environment for all Victorians and visitors to Victoria."* Section 4 of the Act also sets out the objectives of the planning framework established by the Act, including: d) *to ensure that the effects on the environment are considered and provide for explicit consideration of social and economic effects when decisions are made about the use and development of land.*
Environment Protection Act 1970 (Vic.)	Section 1A of the Environment Protection Act sets out the purpose of the Act, including: *"To create a legislative framework for the protection of the environment in Victoria having regard to the principles of environment protection".*
VicRoads Traffic Noise Reduction Policy (2005)	There is currently no SEPP for road traffic noise along State-controlled roads. Instead, traffic noise along these roads is controlled using VicRoads Traffic Noise Reduction Policy. The policy seeks to regulate noise levels where a new alignment is built or a road is upgraded. A new alignment refers to those areas where a new carriageway is constructed outside the pre-existing road reserve boundary. The policy defines an upgraded road as a road that has been widened by two or more lanes, and where buildings previously protected from traffic noise are exposed to traffic noise by the removal of buildings as required for the road widening. The policy states that noise from new or upgraded roads should be limited to the objectives set out below, or the level that would have prevailed if the road upgrades had not occurred, whichever is greater: - Category A – For residential dwellings, aged person homes, hospitals, motels, caravan parks and other buildings of a residential nature, the noise level objective would be 63dB LA_{10} (18hr). measured between 6am and midnight - Category B – For schools, kindergartens, libraries and other noise sensitive community buildings, the noise level objective would be 63dB LA_{10} (12hr) measured between 6am and 6pm - Where the noise level adjacent to Category A or B buildings prior to road improvements is less than 50dB LA_{10} (18hr), consideration would be given to limiting the noise level increase to 12dB. If the existing noise level is >63dB(A), the objective is to limit the noise level increase to 0dB(A) which in practice is very difficult to achieve. The accepted practice when the existing noise level is >63dB(A) is to limit the increase in noise levels by no more than 2dB(A) or the level that would have prevailed if the road upgrades had not occurred, whichever is the greater. The Murray Valley Highway and Warren Street sections of the Project do not qualify as either new or upgraded roads, as these sections of the preferred alignment use the existing road reserve and the required works do not include the demolition of buildings.
Road Design Note – RDN 06-01, July 2010: Interpretation and Application of VicRoads Traffic Noise Reduction Policy (2005)	This document provides additional detail regarding the interpretation and application of the VicRoads Traffic Noise Reduction Policy (described above).

Legislation/policy/ guideline	Description
VicRoads Traffic Noise Measurement Requirements for Acoustic Consultants (2011)	The Traffic Noise Measurement Requirements for Acoustic Consultants are based on Australian Standard (AS) 2702-1984: Acoustics-Methods for the Measurement of Road Traffic Noise. This Standard sets out methods for measuring the noise emitted by road traffic. The Standard describes minimum instrument requirements, preferred scales of measurements, the location of measurement sites and non-acoustic data which are to be recorded in conjunction with the acoustic measurements. The Traffic Noise Measurement Requirements for Acoustic Consultants have been developed to ensure that all measurements are of high quality and are consistent over time.
VicRoads Noise Guidelines – Construction and Maintenance Works (2007)	These guidelines provide details of the regulatory framework for control of construction and demolition noise in Victoria, outline details of a noise management flowchart to be completed by VicRoads and describe noise management options. The guidelines reference Guidelines for Noise Control (2008) (EPA Victoria Publication 1254) and Best Practice Environmental Guidelines for Major Construction Sites (1996) (EPA Victoria Publication 480).
Guidelines for Noise Control (2008) (EPA Victoria Publication 1254) and Best Practice Environmental Guidelines for Major Construction Sites (1996) (EPA Victoria Publication 480)	These guidelines provide a schedule of working hours and noise limits for construction sites, including for short-term road repair. These are broken up into normal working hours, weekend/evening work hours and the night period. The guidelines make an allowance for unavoidable construction works through the night provided that residents are notified of the intended work, its duration and times of occurrence and provide appropriate mitigation measures for consideration. Further, the guidelines may assist in the resolution of complaints or to avert a possible noise nuisance. The guidelines are designed to be the basis of noise assessment.
Local	

Campaspe Planning Scheme	A planning scheme sets out objectives, policies and provisions relating to the use, development, protection and conservation of land in the area to which it applies. The applicable planning scheme within the Victorian proportion of the study area is the Campaspe Planning Scheme. A set of standard provisions called the VPP forms a template for all planning schemes. Included in the VPP is the SPPF, which covers strategic issues of State importance. Clauses of the SPPF that are relevant to noise include:
	- Clause 13.04-1 Noise abatement:
	  - The objective of this Clause is "*To assist the control of noise effects on sensitive land uses*."
	  - The strategy to achieve this objective is to "*Ensure that development is not prejudiced and community amenity is not reduced by noise emissions, using a range of building design, urban design and land use separation techniques as appropriate to the land use functions and character of the area*."
	- Clause 18.01-2 Transport system:
	  - The objective of this Clause is "*To coordinate development of all transport modes to provide a comprehensive transport system*."
	  - The strategy of most relevance to this Project to achieve this objective is to "*Locate transport routes to achieve the greatest overall benefit to the community and with regard to making the best use of existing social, cultural and economic infrastructure, minimising impacts on the environment and optimising accessibility, safety, emergency access, service and amenity*."

18.10 Existing noise conditions

18.10.1 Identification of sensitive receptors

Certain receptors located within the study area were considered to be potentially sensitive to noise associated with construction and operation of the Project. Table 18-6 shows the number of potentially sensitive receptors located within the Victorian section of the study area and their distance from the preferred alignment.

Table 18-6 Sensitive receptors and distance from preferred alignment

Distance from preferred alignment[1]	Number of sensitive receptors in Victoria
0-25	9
25-50	16
50-75	20
75-100	28
100-125	52
125-150	47
150-175	54
175-200	37
200-225	41
225-250	38
250-275	36
275-300	34
Total no. of sensitive receptors	**412**

1. The distance from the preferred alignment to sensitive receptors is estimated from the centreline of the proposed carriageway.

18.10.2 Assessment of existing noise conditions

An assessment of existing noise conditions was undertaken by monitoring existing noise levels at a number of locations within the study area (shown in Figure 18-4). These locations were selected to be indicative of existing ambient noise conditions in the study area. The measurement of existing noise conditions generally involved the placement of a noise microphone 1m from the centre of the window of the most exposed façade of the lowest habitable level of the building that was under investigation.

Noise monitoring was undertaken in accordance with the VicRoads Traffic Noise Measurement Requirements for Acoustic Consultants (2011) at six Victorian residential locations adjacent to the preferred alignment, between 15 and 29 July 2014. Further noise monitoring was conducted at three nominated public open space areas. No secure monitoring positions were found at the Echuca Lawn Tennis Club, the Campaspe River or Victoria Park. Therefore, short–term, unattended monitoring was conducted at these locations on 15 and 29 July 2014.

The existing noise levels at these locations, based on the monitoring results, are summarised in Table 18-7. Results for public open space areas were derived from short-term unattended monitoring and therefore are considered to be indicative only.

The existing noise levels have been used to calculate the PONLs for residential receptors in applicable locations (i.e. excluding the Murray Valley Highway and Warren Street), as described in section 18.8.3.

Figure 18-3 Example of typical noise monitoring equipment

Table 18-7 Noise monitoring locations

Designation	Address	Measurement point	L_{10}(18hr) dB(A)	PONL
Residential locations				
VIC 1	51 Woodlands Circuit	1m from northeast façade	61	N/A
VIC 2	82 Warren Street	1m from south façade	61	N/A
VIC 3	54 Warren Street	1m from south façade	66	N/A
VIC 4	279 Campaspe Esplanade	1m from north façade	64	N/A
VIC 5	17 Henry Street	1m from south façade	49	61
VIC 6	33 Crofton Street	1m from west façade	43	55
VIC 7	Unit 113, Echuca Holiday Park	1m from north façade	42	54
Public open space areas				
VIC 8	Echuca Lawn Tennis Club	Open area – free field	42	N/A
VIC 9	Campaspe River environment	Open area – free field	45	N/A
VIC 10	Victoria Park passive recreation	Open area – free field	42	N/A

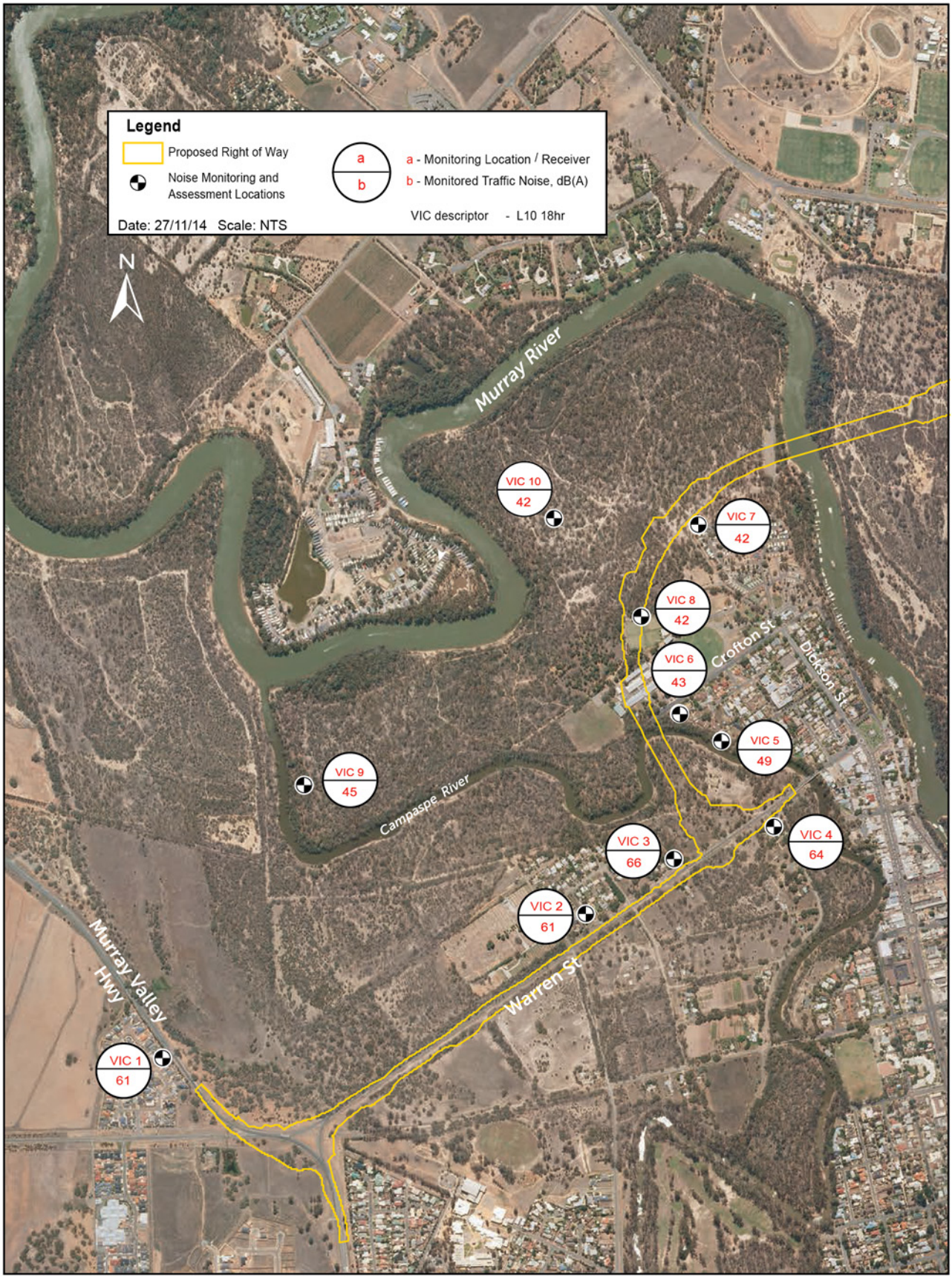


Figure 18-4 Noise monitoring locations

18.11 Noise impact assessment

18.11.1 Construction

Noise impacts during construction

The Project has the potential for temporary adverse noise impacts at some sensitive receptors during construction. The magnitude of these impacts would be dependent on a number of factors, including:

- The intensity and location of construction activities
- The type of equipment used
- Existing background noise levels
- Intervening terrain and structures
- The prevailing weather conditions.

Construction noise impacts have been considered with respect to the VicRoads Noise Guidelines – Construction and Maintenance Works (2007). These guidelines require:

- Noise levels at residential premises not to exceed background noise levels by 10dB(A) or more for up to 18 months after project commencement or 5dB(A) or more after 18 months of project commencement, during the hours of:
  - 6:00 pm to 10:00 pm Monday to Friday
  - 1:00 pm to 10:00 pm Saturdays
  - 7:00 am to 10:00 pm Sundays and public holidays.
- Noise levels not to be above background levels inside any residential premises between 10:00 pm and 7:00 am Monday to Sunday.

Similarly, the EPA Victoria Best Practice Environmental Management Guideline for Major Construction Sites (EPA Victoria Publication 480, 1996) provides guidance on minimising nuisance to residents near a construction site and also recommends limiting working hours as a means of achieving this.

Construction noise levels were estimated based on typical construction activities and equipment, as shown in Table 18-8. Estimates were based on a range of scenarios, ranging from the quietest equipment operating alone, to a typical configuration of plant and equipment operating concurrently for each construction activity. Noise levels for each scenario were based on typical distances from road construction activities to noise assessment locations.

Table 18-8 Predicted construction noise level range at receptors

Distance from activity (m)		Noise level from construction activity dB(A)			
	Corridor clearing	Earthworks	Drainage	Pile driving	Pavement
25	72-81	70-86	68-78	75-101	67-80
50	66-75	64-80	62-72	69-95	61-74
75	63-72	61-76	59-69	66-92	58-71
100	60-69	58-73	56-66	63-89	55-68
125	58-67	56-71	54-65	61-87	53-66
150	56-65	54-69	52-63	59-85	51-64
200	53-63	51-66	50-60	57-83	49-62
250	52-61	50-63	48-58	55-81	47-60
300	50-59	48-61	46-57	53-79	45-58
400	49-58	47-60	45-56	51-77	44-57
500	46-55	36-56	42-52	49-75	41-54

These predictions indicate there is potential for construction noise to be audible at residences during working hours, particularly those within 100m of corridor clearing operations. The potential noise impacts associated with specific construction activities are discussed further in the following sections.

Vegetation removal and clearing of the road corridor

Noise levels generated during corridor clearing are likely to be of relatively short duration (three to four weeks) depending on the level of clearing required.

For this activity, the noisiest plant on site is likely to be the tub grinder/mulcher, which can generate levels of 74-78dB(A) at receptors 30 to 50m away from the preferred alignment. It is recommended that where possible, this plant be located 500m or more from sensitive receptors.

Typical activities are likely to include a bulldozer, dump truck and chainsaw operating concurrently. This is likely to produce noise levels of 75-79dB(A) at the nearest receptors 30 to 50m away from the preferred alignment, where there is no shielding provided.

Noise levels between 50-69dB(A) may occur at most residences 100 to 300m from the preferred alignment. Beyond 300m it would be difficult to determine impacts due to other noise sources.

Earthworks and drainage

Earthworks are likely to be the longest duration activities and are likely to produce the highest noise levels. The duration of works in each area would vary depending on the extent of work required.

The noisiest activities would be those associated with removing hard rock from cuttings – rock breaking, ripping and rock crushing. These activities are unlikely to occur on the Project.

It is expected there would be limited shielding provided by the topography from works carried out at grade or fill.

Noise generated by earthworks and drainage are likely to result in noise levels of 70-86dB(A) at the nine Victorian receptors within 25m of earthworks and noise levels of 64-80dB(A) for a further 16 Victorian receptors within 50m of earthworks.

Piling

Piling activities are likely to produce high, transient noise levels. Bored piling activities may generate levels of 69-73dB(A) at receivers 30 to 50m away from the alignment. Impact driven piling activities may generate levels of 95-99dB(A) for similar distances. However, it is anticipated that piling would be required for construction of the bridges piers only. These would be located within the less populated floodplain areas, thereby minimising the number of affected residential properties.

Road pavement

The paving process is likely to be relatively short term in each area. However, some plant, particularly pavement laying machines, is relatively noisy and may cause noise impacts when operating in proximity to residences. Noise generated by the paving process is likely to result in noise levels of 67-80dB(A) for nine Victorian receptors within 25m of pavement works and noise levels of 61-74dB(A) for a further 16 Victorian receptors within 50m of pavement works.

There is the potential for activities for the site compound to cause noise impacts at the nearest affected sensitive receptors, particularly during site establishment, when heavier machinery is likely to be in use. Where there are sensitive receptors nearby, site compounds would be configured such that site sheds and other materials could form a barrier around potentially noise generating activities.

Summary

A combination of VicRoads standard environmental protection measures for the construction activities described above would reduce noise during construction as far as practicable, in accordance with the VicRoads Noise Guidelines – Construction and Maintenance (2007) and the EPA Victoria Best Practice Environmental Management Guideline for Major Construction Sites (EPA Victoria Publication 480, 1996). These VicRoads standard environmental protection measures would include:

- Restrictions on working hours
- Fitting construction vehicles and equipment with appropriate measures and effectively maintaining vehicles and equipment to minimise engine noise
- Enclosing noisy equipment where possible
- Establishing temporary noise attenuation barriers where appropriate
- Scheduling noisy work practices to minimise likelihood of community annoyance
- Use of smart movement alarms for vehicles particularly when working in proximity to noise sensitive receptors or where working outside of normal hours
- Noise monitoring in compliance with EPA Victoria's Guidelines for Noise Control (EPA Victoria Publication 1254, 2008) and management of community complaints.

It is considered that noise from construction of the Project could result in minor consequences (isolated and temporary exceedance of noise standards at a sensitive receptor), including temporarily degraded amenity as construction is undertaken along the preferred alignment in the vicinity of adjacent properties. This consequence was assessed as possible, and has a corresponding low residual risk.

Vibration impacts during construction

There is inherent variability associated with predicting vibration levels from construction activities. Vibration impacts depend on a range of factors, including:

- The type of construction plant/equipment
- Distance to sensitive receptors
- The number and pattern of vibrations
- The stiffness of the impact medium.

Construction equipment that is most likely to cause significant vibration includes pile drivers, hydraulic rock breakers, jackhammers, bulldozers, vibratory rollers and trucks.

The pattern of vibration radiation is very different to the pattern of airborne noise radiation, and is very site specific. Therefore, indicative minimum 'buffer' distances for avoiding human discomfort during daytime hours are shown in Table 18-9.

Table 18-9 Recommended minimum buffer distances for construction plant to avoid vibration impacts

Plant item	Recommended minimum buffer distance (m)
Driven piling	> 100
Bored piling	40
Bulldozers	5
Hydraulic rock breakers – light	10
Hydraulic rock breakers – heavy	30
Compactor	30
Jackhammers	5
Vibratory rollers - light	5
Vibratory rollers – medium	12
Vibratory rollers - heavy	25
Truck movements	10

Where compliance with these buffer distances to avoid human discomfort was achieved, structural damage criteria would also be achieved. The potential for activities to cause structural damage would be assessed by the contractor(s) once construction methods were finalised. Measurement and monitoring of vibration generated by construction activities nearest to sensitive receptors, and inspection of building conditions for structures within 200m of pile driving activities would be undertaken as required to confirm there is no risk of structural damage.

During construction, community complaints would be managed and additional measures would be implemented as required, such as modification of construction methods such as using smaller rock breakers, establishment of buffer distances and, if necessary, restrictions on working hours for the most excessive vibration activities.

With the implementation of VicRoads standard environmental protection measures and Project-specific environmental management measures, it is considered that the impacts of vibration from construction of the Project would be moderate.

There would be a moderate consequence if applicable vibration standards were exceeded in the local area, as the thresholds for human comfort and building damage could potentially be breached. However, it would be rare that this consequence would occur (if at all), and as such the corresponding residual risk is low.

18.11.2 Operation

Noise impacts during operation

Noise impacts during operation have been modelled for the scenarios described in section 18.8.3. The results are summarised in the following sections and presented in detail in the Noise Impact Assessment in EES Technical Appendix M. The change in apparent loudness associated with modelled changes in noise levels is described in Table 18-10.

Table 18-10 Subjective effects of changes in sound pressure levels

Change in sound level (dB)	Change in apparent loudness
-20	Much quieter
-10	Half as loud
-5	Clearly noticeable
-3	Just perceptible
0	No change
3	Just perceptible
5	Clearly noticeable
10	Twice as loud
20	Much louder

Residential locations

Table 18-11 shows the modelled changes in noise level for the initial alignment at residential receptors adjacent to the Project. These modelled changes are shown with and without mitigation measures, when compared to the 'No Project' scenario. It is important to note that this analysis was only undertaken for residential receptors closest to the preferred alignment, and did not include all receptors within the study area.

Table 18-11 Change in noise levels for the initial alignment at residential receptors closest to the preferred alignment within Victoria

Change in noise level compared to 'No Project' (dB(A))	No. of residential receptors	
	Without mitigation measures	With mitigation measures
-5 to -3	1	1
-2 to -1	3	3
0	23	24
1 to 2	28	28
3 to 5	1	5
6 to 10	4	11
11 to 12	4	27
>12	35	0

In residential areas where the PONLs are not applicable (the Murray Valley Highway and Warren Street), noise levels during operation are not expected to increase by more than 2dB(A) when compared to the 'No Project' scenario. This increase is not expected to be perceptible (refer Table 18-10).

Without any mitigation measures, PONLs would be exceeded at residential properties in Crofton Street and within the Echuca Holiday Park.

In order to reduce the predicted noise levels so they were equal to or less than the PONLs, mitigation measures were investigated in accordance with the VicRoads Traffic Noise Reduction Policy. The mitigation measures selected are as follows:

- Adjacent to Crofton Street: 1.5m noise wall on the east side of the preferred alignment having a length of approximately 525m
- Adjacent to Echuca Holiday Park: 2.0m noise wall on the east side of the preferred alignment having a length of approximately 620m
- Stone mastic asphalt on bridge extending 1.7km.

With mitigation measures implemented, compliance with all PONLs is expected to be achieved. That is, no receptors would be subject to an increase of more than 12dB(A).

Although compliance with PONLs would be achieved, it is acknowledged that the Project would result in apparent noise levels being up to twice as loud at some residential receptors, when compared to the 'No Project' scenario.

Noise modelling results and mitigation measures are shown in the following figures:

- Figure 18-5 and Figure 18-6 present the results of noise modelling for the study area during operation of the initial alignment, prior to the implementation of mitigation measures
- Figure 18-7 shows the mitigation measures
- Figure 18-8 and Figure 18-9 present the results of noise modelling for the study area during operation of the initial alignment following the implementation of mitigation measures.

Public open space areas

The VicRoads Traffic Noise Reduction Policy does not apply to recreational facilities or larger areas of passive use. However, Victoria Park and its recreational and sporting facilities are in close proximity to residential properties where noise mitigation measures would be implemented. A proportion of the increase in noise levels would be mitigated by these mitigation measures as shown in Table 18-3.

Following implementation of mitigation measures, apparent noise levels at Victoria Park would still be around twice as loud (refer to Table 18-10) and apparent noise levels at the Echuca Lawn Tennis Club would be much louder than the 'No Project' scenario. Chapter 14 (section 14.7.2) discusses potential social impacts associated with these increased noise levels.

Table 18-12 Predicted traffic noise levels in public open space areas

Location	No Project, 2029[1]	Project without mitigation measures	Project with mitigation measures
	L10(18-hour) dB(A)		
Echuca Lawn Tennis Club	42	67	62
Campaspe River environment[1]	45	47	47
Victoria Park passive recreation[2]	42	55	53

1. 'No Project' noise levels are derived from noise monitoring results as ambient noise levels in 2029. Without the Project the noise environment would be dominated by natural sounds which are assumed not to change during the period 2014 – 2029.
2. The assessment location for predicting noise levels for the Project (with and without mitigation measures) is the same as the noise monitoring location.

Ultimate duplication

Changes in noise levels associated with the ultimate duplication are expected to be imperceptible and therefore insignificant when compared to the initial alignment for the same traffic volume. Table 18-13 shows estimated noise level increases at five residential receptors considered representative of the properties adjacent the alignment. In the initial alignment, the two traffic lanes would be located closer to sensitive receptors along Warren Street, Henry Street, Crofton Street and at the Echuca Holiday Park.

For sensitive receptors to the north of the preferred alignment in Warren Street there would be a net decrease in noise levels because additional lanes would transfer the traffic away, while receptors to the south would experience a net increase in noise levels as a result of the ultimate duplication. The change in noise level on Warren Street would be imperceptible and is therefore considered to be insignificant.

At Henry Street, Crofton Street and at the Echuca Holiday Park, the ultimate duplication would add another two traffic lanes, located further away from the sensitive receptors. Theoretically, this would transfer half of the traffic volume away from these receptors, resulting in a reduction in traffic noise level. However, the change in road configuration would mean that noise walls installed as part of the construction of the initial alignment would no longer reduce the noise to the same extent and as such there would be an increase in the noise level. In each of the three cases the change in noise level would be imperceptible.

Table 18-13 Estimated traffic noise increase due to lane duplication (ultimate duplication)

Location	Lane separation	Mitigation measures	Estimated increase in traffic noise (dB(A))
21b Henry Street	7.6m wide separation between carriageways	Low noise pavement and noise walls	0.0
33 Crofton Street			0.1
Echuca Holiday Park			0.3
54 Warren Street (north of preferred alignment)		No treatment	-0.2
51 Warren Street (south of preferred alignment)			0.3

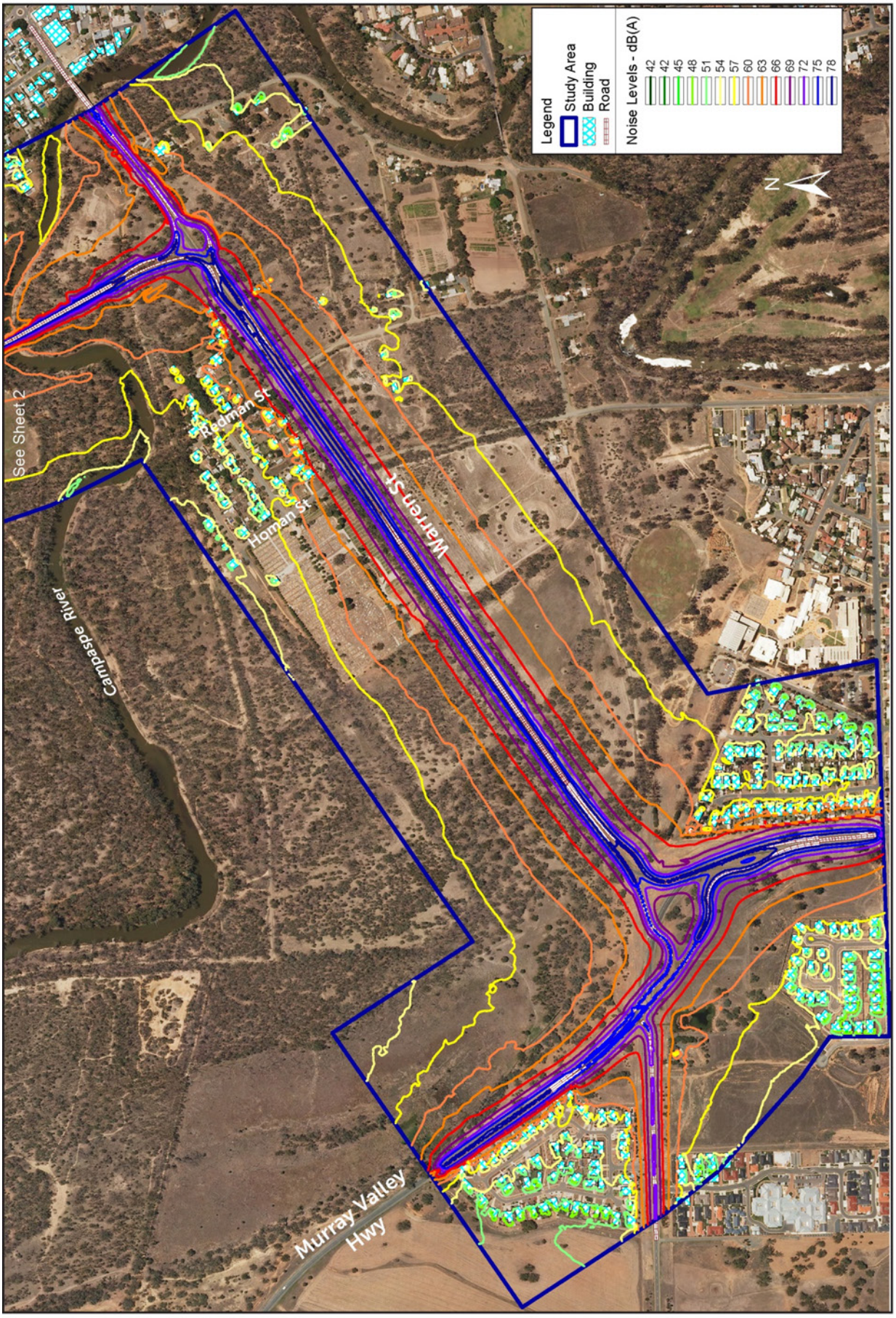


Figure 18-5 Noise contour map for the initial alignment with no mitigation measures (eastern section – Sheet 1)

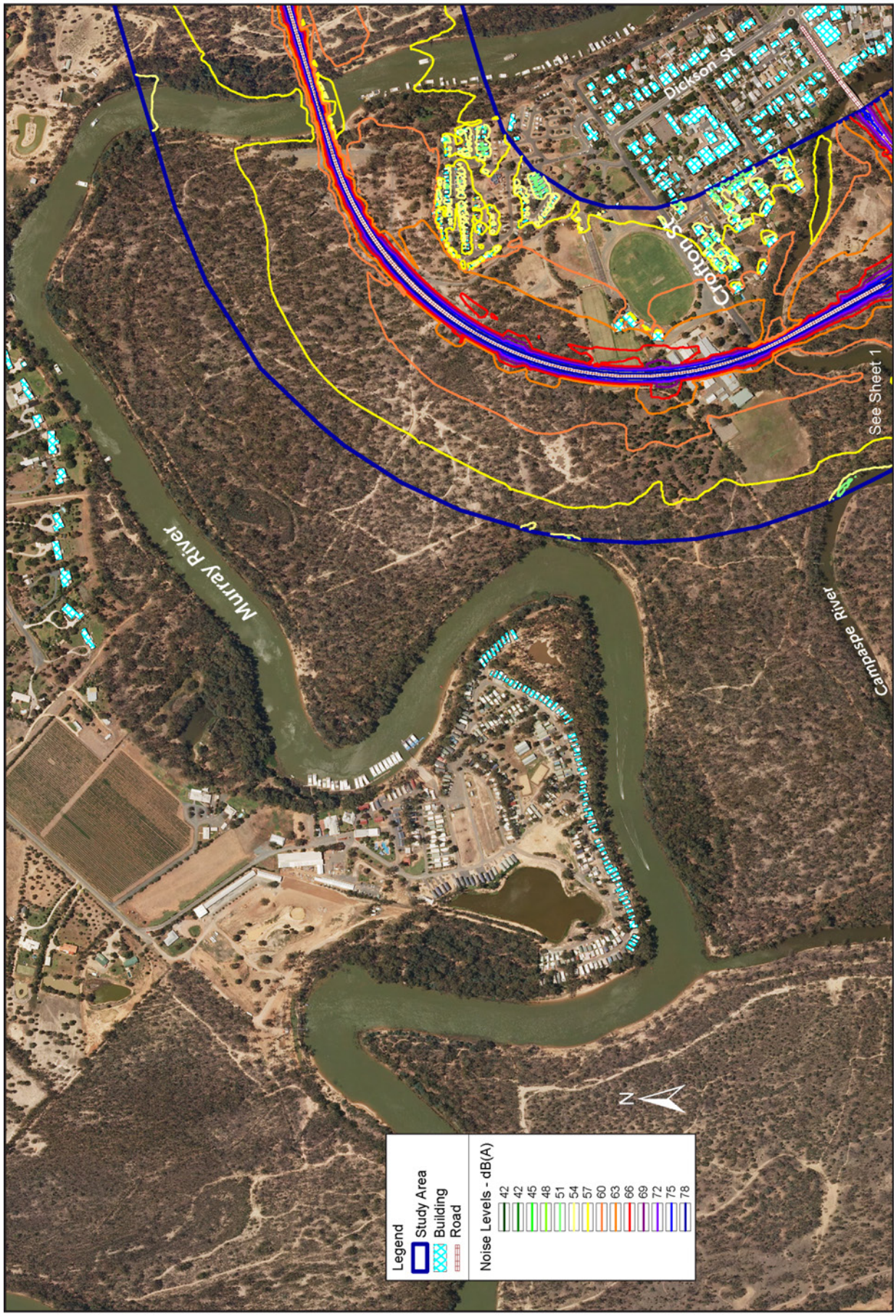


Figure 18-6 Noise contour map for the initial alignment with no mitigation measures (western section – Sheet 2)

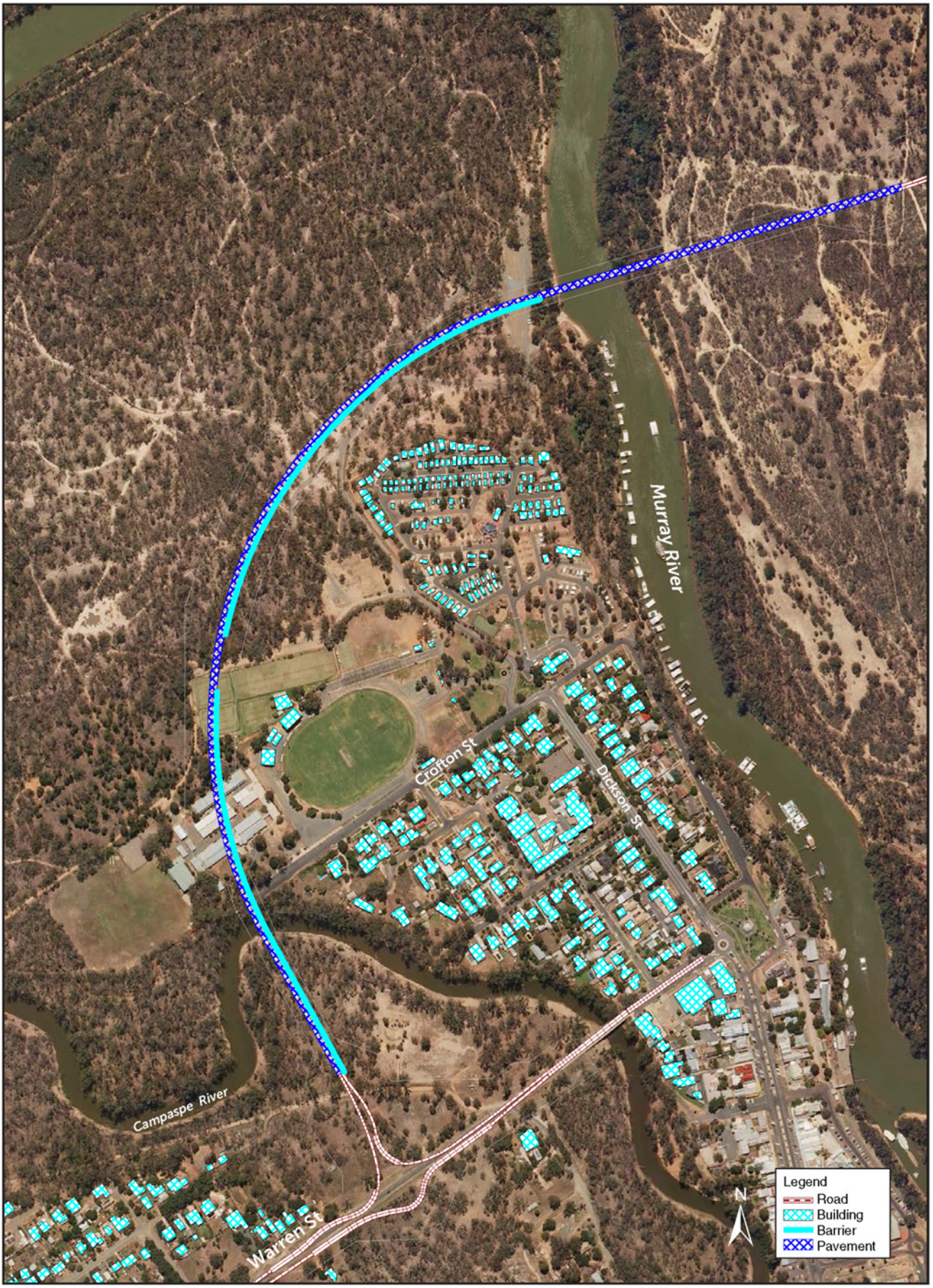


Figure 18-7 Noise mitigation measures

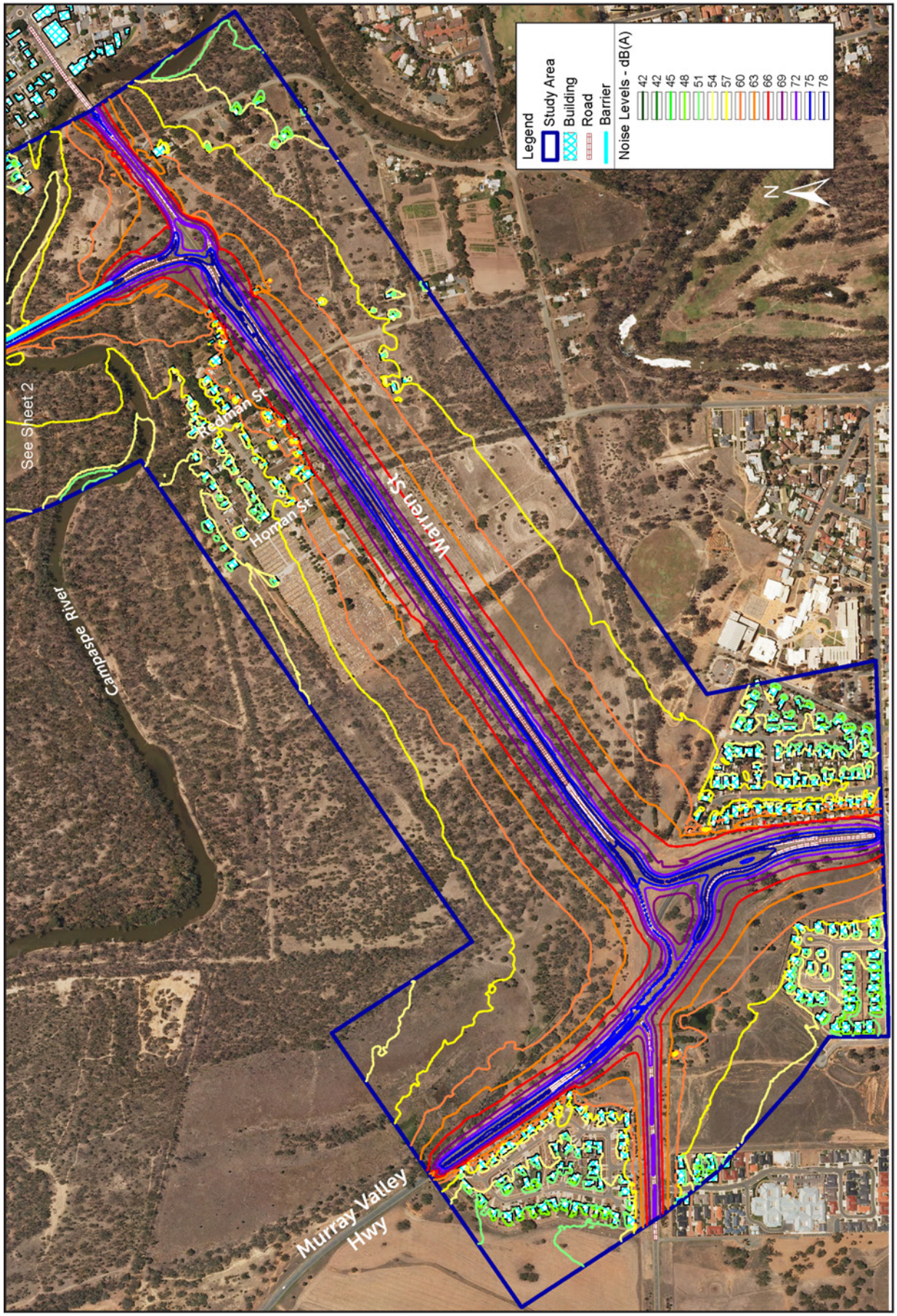


Figure 18-8 Noise contour maps for the initial alignment with mitigation measures (eastern section – Sheet 1)

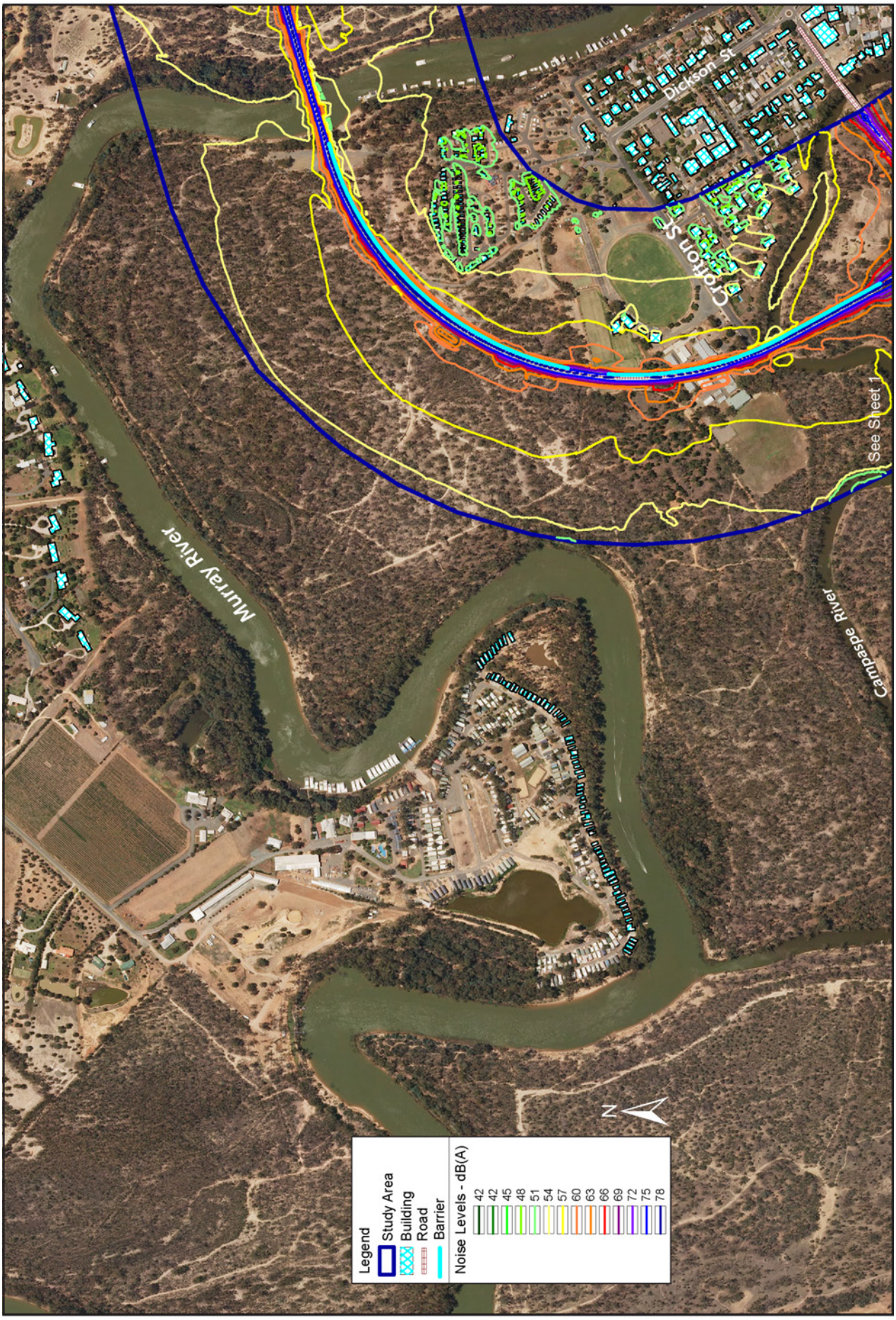


Figure 18-9 Noise contour maps for the initial alignment with mitigation measures (western section – Sheet 2)

Traffic noise reduction

The Project is expected to result in reduced traffic volumes and corresponding reduced traffic noise levels on the existing bridge, High and Heygarth streets as shown in Table 18-14.

Table 18-14 Traffic noise reduction on High and Heygarth Streets

Indicative noise assessment location	Traffic noise reduction dB(A)
575 High Street, Echuca	1.6
541 High Street, Echuca	2.5
47 Heygarth Street, Echuca	4.8
9 Heygarth Street, Echuca	5.7

Predicted noise reductions at Heygarth Street are of a magnitude that would be considered clearly noticeable. Noise reductions predicted at High Street would be imperceptible.

Summary of compliance

The consequence of traffic noise impacts during operation as a result of the Project was assessed according to whether the applicable noise standards would be met. In Victoria, these standards are outlined in the VicRoads Traffic Noise Reduction Policy and PONLs were derived for each sensitive receptor in accordance with this policy.

The noise levels due to traffic during operation of the Project would comply with the PONLs at each sensitive receptor following the implementation of VicRoads standard environmental protection measures (including the construction of noise walls as described earlier in this section). Whilst the VicRoads Traffic Noise Reduction Policy does not apply to recreational facilities or larger areas of passive use, noise mitigation measures for residential receptors would in some instances also reduce noise impacts to some public open space and parkland areas.

It is also acknowledged that the Project would result in apparent noise levels being up to twice as loud at some residential receptors, when compared to the 'No Project' scenario. There would also be a change to amenity in public open space areas as a result of increased noise levels due to the Project; apparent noise levels at Victoria Park would be around twice as loud and apparent noise levels at the Echuca Lawn Tennis Club would be much louder than the 'No Project' scenario. The social impacts of these changes to amenity associated with increased noise levels are discussed in Chapter 14 (section 14.7.2).

18.12 Risk assessment

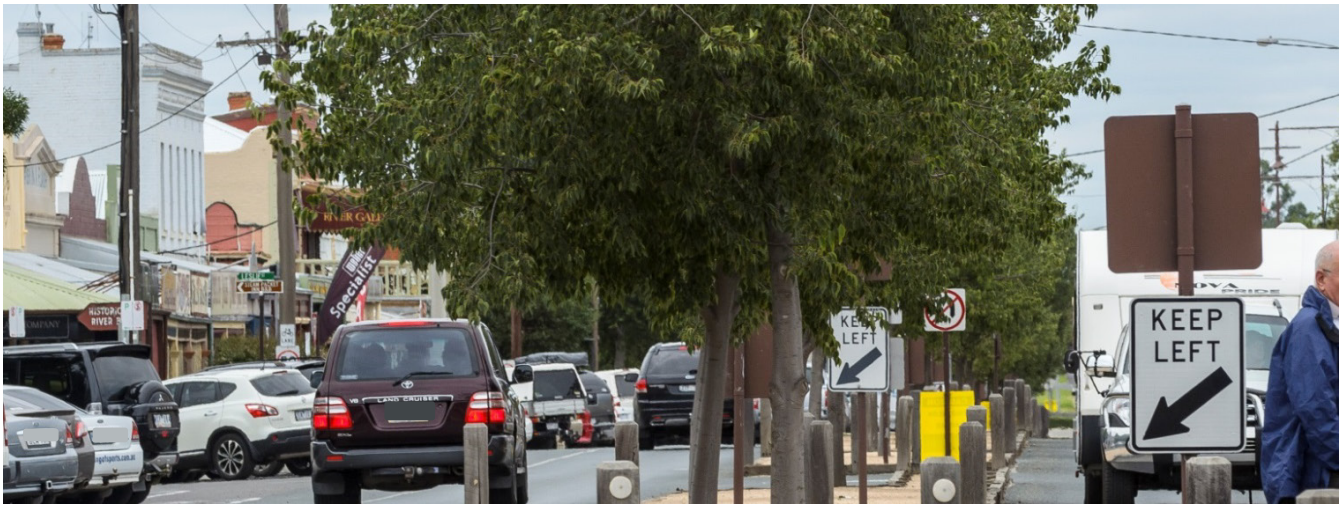
An environmental risk assessment was undertaken for the preferred alignment to identify key environmental issues associated with the construction and operation of the Project. The methodology for this risk assessment is described in Chapter 5. Table 18-15 is a summary for air and noise of:

- The identified impact pathways
- A description of the consequence
- The initial risk rating, prior to the implementation of Project-specific environmental management measures.

Risk N6 as identified in the Noise Impact Assessment report in EES Technical Appendix M is not included here, as it relates specifically to noise levels in the NSW section of the Project. This risk is separately addressed in the Review of Environmental Factors prepared by Roads and Maritime Services for the NSW component of the Project.

Table 18-15 Air and noise risks

Risk No.	Impact pathway	Description of consequence	Initial risk rating
A1	Construction emission impact at a sensitive receptor.	Exceedance of SEPP (AQM) within a small localised area.	Low
A2	Operation of the new road generates emissions from vehicular traffic.	Exceedance of SEPP (AQM) within a small localised area.	Low
N1	Construction of the Project may result in vibration levels beyond human comfort and building damage thresholds limits, particularly where activities (e. g. pile driving for bridge piers at locations near the Campaspe River) occur closer than 50-100m from buildings (most other activities would generally be acceptable if greater than 15-30m from buildings).	Potential for human discomfort and building damage if vibration exceeds associated thresholds.	Medium
N2	Construction of the Project may result in temporarily increased ambient noise levels beyond those that may cause hearing damage at residential properties, recreational and non-recreational areas along the preferred alignment, particularly where activities occur closer than 25m from sensitive receptors.	Damage to hearing of people affected by noise levels exceeding hearing damage thresholds.	Medium
N3	Construction of the Project would result in temporarily increased ambient noise and vibration levels due to construction activities at residential properties, recreational and non-recreational areas along the preferred alignment.	Temporarily degraded amenity at residential properties, recreational and non-recreational areas as construction activities move past properties.	Low
N4	Operation of the Project results in significantly increased traffic noise levels at recreational and non-recreational areas (particularly around Victoria Park).	Degraded amenity for users due to significantly increased noise levels.	Low
N5	Operation of the Project results in significantly increased traffic noise levels in some residential areas, including those on Crofton Street, Henry Street, Warren Street and the Echuca Holiday Park.	Degraded residential amenity due to significantly increased noise levels.	Negligible



18.13 Environmental management measures

VicRoads has a standard set of environmental protection measures which are typically incorporated into its construction contracts for road works and bridge works. These measures have been used as the starting point for the assessment of construction-related risks and are listed in Chapter 20 and described in detail in EES Technical Appendix O – Section 177 Environmental Management. In some instances, additional Project-specific environmental management measures have been recommended by specialists to reduce risks relating to construction and operation.

Project-specific environmental management measures specific to each identified impact pathway for air and noise are outlined in Table 18-16. This table also shows the residual risk rating after the implementation of VicRoads standard environmental protection measures and Project-specific environmental management measures.

Table 18-16 Air and noise Project-specific environmental management measures and residual risks

Risk No.	Project-specific environmental management measures	Residual risk rating
A1	Risk would be managed by implementing VicRoads standard environmental protection measures as outlined in Chapter 20 and described in detail in EES Technical Appendix O – Section 177 Environmental Management. No Project-specific environmental management measures were identified.	Low
A2	As per Risk A1.	Low
N1	Prior to works the contractor(s) should carry out an assessment of potential vibration impacts to buildings within 100m of the works and where necessary implement strategies to ensure compliance with building damage vibration thresholds, such as modification of construction method/equipment or implementation of temporary structural support for sensitive receptors. Further consideration should be given to conducting Building Condition Inspections of structures within 200m of pile driving activities.	Low
N2	Prior to works the contractor(s) should carry out an assessment of noise impacts to potentially occupied buildings and land with respect to hearing damage thresholds. Where necessary, the contractor(s) should implement strategies to ensure compliance, such as modification of construction method/equipment or temporary evacuation of sensitive receptors.	Low
N3	As per Risk A1.	Low
N4	As per Risk A1.	Low
N5	As per Risk A1.	Negligible

18.14 Conclusion

Air

Temporary air quality impacts would be expected during the construction phase of the Project. Construction phase emissions could include windblown dust from exposed surfaces and mechanically generated dust from the operation of plant, equipment and vehicles travelling on unpaved roads. Additionally, exhaust emissions would be discharged from vehicles and plant working at the construction site such as trucks, bulldozers, light vehicles, excavators, cranes, compactors, front end loaders and stationary diesel engines.

Potential impacts from construction of the Project would be minimised through the implementation of VicRoads standard environmental protection measures, which have been successfully employed on other VicRoads construction projects. These measures would include proactive air quality monitoring to ensure that any exceedances are identified and addressed.

The results of the AQST modelling indicate that, during operation, predicted concentrations of nitrogen dioxide and particulate matter (of less than 10 microns) at the edge of the road pavement would be substantially less than SEPP (AQM) intervention levels, despite the worst-case scenario adopted and the conservatism inherent in the AQST. It is expected that concentrations of these contaminants would be even lower at identified sensitive receptors abutting the proposed Right-of-Way, and outside of the study area.

It is expected the Project would easily meet the SEPP (AQM) goals and objectives for air quality. If the SEPP (AQM) intervention level were to be exceeded within a localised area during construction or operation, the corresponding impact to air quality would be of moderate consequence. However, it is considered that this would only occur rarely (if at all) and therefore the residual risks to air quality during construction and operation are low.

Noise and vibration

The Noise Impact Assessment found that construction of the Project would have the potential to cause noise impacts at the nearest affected sensitive receptors, particularly during corridor clearing and site establishment when heavier machinery is likely to be used and during piling activities.

However, a combination of controls, including restrictions on working hours and implementation of VicRoads' standard environmental protection measures, would reduce noise during construction as far as practicable. It is possible that minor consequences could occur, including temporarily degraded amenity resulting in a low residual risk.

Construction of the Project could also cause some vibration impacts. The thresholds for human comfort and building damage could potentially be breached if applicable vibration standards were exceeded in the local area, resulting in a moderate consequence.

However, following the implementation of VicRoads' standard environmental protection measures and Project-specific environmental management measures it would be rare that this consequence would occur (if at all), and as such the corresponding residual risk is low.

It was found that future operational noise levels for the Project would comply with the VicRoads Traffic Noise Reduction Policy if mitigation measures, such as low noise asphalt road pavement and noise barriers, were used to limit noise impacts on residential properties in Crofton Street and Echuca Holiday Park. With these mitigation measures in place, 71 properties adjacent to the preferred alignment would experience a net increase in noise levels compared to the 'No Project' scenario, 44 properties would experience a 1-10dB(A) increase and 27 properties would experience a 10-12dB(A) increase. Noise levels due to traffic during operation of the Project would comply with the applicable PONLs. Residual noise impacts for the initial alignment are shown in Figure 18-8 and Figure 18-9.

Following implementation of mitigation measures, apparent noise levels at some residential receptors and at Victoria Park would still be around twice as loud (refer Table 18-10) and apparent noise levels at the Echuca Lawn Tennis Club would be much louder than the 'No Project' scenario. Chapter 14 discusses the social impacts associated with these increased noise levels.

However, in the context of the VicRoads Traffic Noise Reduction Policy it is considered that the impacts of noise on amenity in residential areas during operation of the Project would not be significant, as applicable noise standards would be met.

Whilst the VicRoads Traffic Noise Reduction Policy does not apply to recreational facilities or larger areas of passive use, noise mitigation measures for residential receptors would in some instances also reduce noise impacts to some public open space and parkland areas.

19 Economy

The Economic Impact Assessment (Essential Economics, 2015) examined the potential effects of the Project on Echuca-Moama's local and regional economy.

The study area encompasses the Shire of Campaspe (Victoria) and the Murray Shire (NSW) and comprises the townships of Echuca and Moama as defined by the Australian Bureau of Statistics (ABS) under the Echuca-Moama Significant Urban Area. This chapter focuses primarily on the potential economic effects of the Project on Echuca-Moama and the Shire of Campaspe.

Over the three-year construction period the Project would generate 4,240 full-time equivalent (FTE) direct and indirect jobs and a wage spending stimulus of approximately $18 million.

In any given year over the construction period, it is estimated that up to 540 direct FTE jobs would be created, and up to 870 indirect FTE jobs would be supported by the Project.

It is expected that most of this labour could potentially be sourced from within the regional workforce, providing employment opportunities for local and regional residents.

Additionally, the Project would provide the opportunity for training and upskilling of the local workforce and for the expansion of local and regional businesses to service the primary contractor and temporary construction workers.

Once operational, the Project would improve access and efficiency for heavy vehicles, which would benefit industry and agricultural operators.

Improved efficiency of movement during peak periods would benefit tourism-related businesses and improve access to and from major events such as the annual Southern 80 Ski Race. The Project would also facilitate the opportunity to develop the Bridge Arts Project in NSW, which is anticipated to become a major tourist attraction for the region.

In addition, removal of heavy vehicles from the Echuca town centre would improve amenity and allow for planning and investment to create a more connected, well-functioning and attractive shopping and dining area.

Potential construction impacts associated with the preferred alignment could include:

- Amenity impacts at Echuca Holiday Park potentially reducing patronage and causing a loss of revenue
- Disruption to river-based businesses such as paddle-steamer and houseboat businesses, causing loss of revenue
- Displacement of local residents and increased rental prices if temporary construction workers enter the rental market.

Potential operational impacts associated with the preferred alignment could include:

- Amenity impacts at the Echuca Holiday Park due to its proximity to the preferred alignment, resulting in loss of patronage and revenue.

As the ultimate duplication of the preferred alignment would not be constructed in the foreseeable future, its potential impacts cannot be determined at this time. However, it is expected that construction and operational impacts of the ultimate duplication would be similar to those determined for the initial alignment.

The potential impacts of the Project would be minimised through the implementation of VicRoads standard environmental protection measures, the Project-specific environmental management measures recommended in other specialist assessments and project commitments outlined in Chapter 6.

19.1 EES objectives

The objective of the Economic Impact Assessment for the Project, as specified in the EES Scoping Requirements, is *"To provide road infrastructure that fosters a viable level of economic performance for the local and regional economy of Echuca-Moama".*

This chapter is based on the Economic Impact Assessment completed by Essential Economics Pty Ltd (2015), which is included in EES Technical Appendix N. It is a summary of that assessment and includes a discussion of the following key issues and requirements as they relate to the regional and local economy, as specified in the EES Scoping Requirements for the Project.

Key issues

- *The proposed new bridge is to reduce economic inefficiencies that exist due to congestion and the limitations on freight crossing the border.*

Priorities for characterising the existing environment

- *Describe existing barriers to traffic movements across the Murray River, including freight.*

Design and mitigation measures

- *Identify potential and proposed design responses and measures to optimise economic benefits of the Project in terms of increased transport efficiency and freight capacity, as well as to reduce any short-term impacts during construction.*

Assessment of likely effects

- *Identify effects on the local and regional economy during construction and operation of the bridge (beneficial and adverse).*
- *Identify further opportunities to be realised through the implementation of the Project.*

The Economic Impact Assessment focussed on the preferred alignment. The term 'the Project' is used in this chapter to refer to the preferred alignment only.

19.2 Study area

The study area for the Economic Impact Assessment comprises the townships of Echuca and Moama as defined by the ABS under the Echuca-Moama Significant Urban Area. Both the study area and a larger area that was used in the consideration of retail spending to more accurately reflect the Echuca-Moama trade area are shown in Figure 19-1.

The value of agricultural production is based on data for the Shire of Campaspe and Murray Shire as no data was available specifically for Echuca-Moama.

Whilst the purpose of this EES is to consider the potential effects of the construction and operation of the Project within Victoria, it is recognised that the regional economies of Echuca and Moama are interdependent and therefore both towns are discussed in this chapter where relevant.

Discussion regarding impacts to specific businesses is limited to those located within Echuca. Impacts to specific businesses within Moama are discussed in the Economic Impact Assessment in EES Technical Appendix N.

19.3 Methodology

In order to understand the potential economic effects of the Project, the following tasks were undertaken:

- Review of relevant State and local legislation and policies
- Description and analysis of the existing economic conditions of the study area. This included:
  - Analysis of existing and projected population levels (by age group) and industry, business and labour force structures
  - Profiles of selected industry sectors, including estimation of the value of the retail sector to the Echuca-Moama region. This was measured by determining the available retail spending of people living in the surrounding catchment, and by Echuca and Moama's town centre retail floor space provisions, level of sales and market share
  - Consideration of the tourism industry and its economic contribution to Echuca-Moama.
- Identification of economic constraints associated with traffic movement across the existing Echuca-Moama Bridge
- Identification and description of potential regional and local benefits, opportunities and impacts as a result of the Project, compared to the 'No Project' scenario. Employment opportunities for the Project were estimated using construction cost information provided by VicRoads
- Recommendation of potential management measures.

The Economic Impact Assessment was not based on an environmental risk framework, as the assessment of economic impact focuses on predicted change rather than the risk of environmental harm, and interpretation of impacts is more qualitative and therefore more difficult to measure.

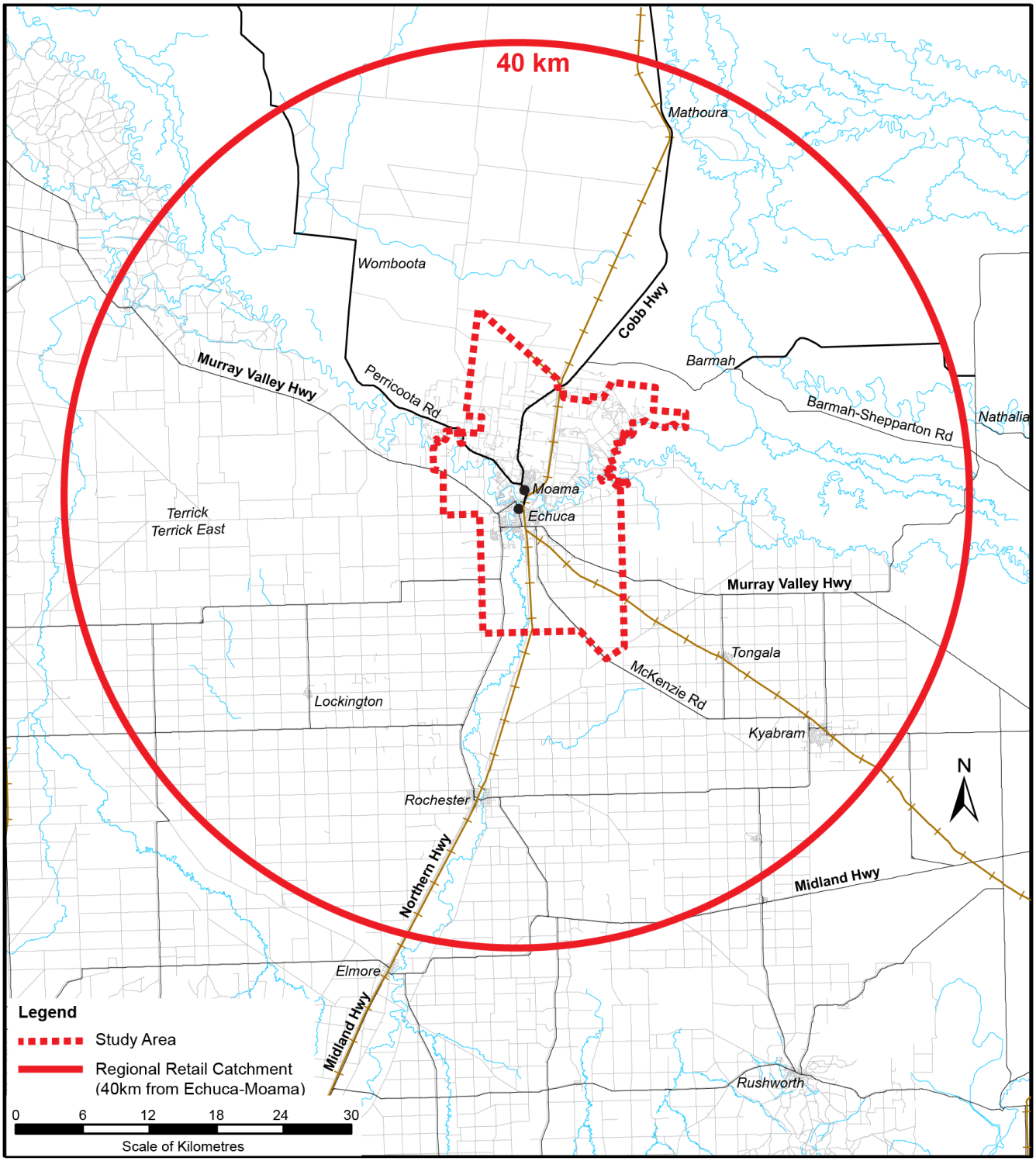


Figure 19-1 Study area – Significant Urban Area

19.4 Legislation and policy

The relevant Victorian legislation and government policies for regional and local economy are shown in Table 19-1.

Table 19-1 Relevant legislation and policies for the regional and local economy

Legislation/policy	Description
State	
Planning and Environment Act 1987 (Vic.)	The Planning and Environment Act establishes a framework for planning the use, development and protection of land in Victoria in the present and long-term interest of all Victorians. The Planning and Environment Act sets out the legislative basis to ensure that standard planning provisions are prepared and approved throughout Victoria. The Planning and Environment Act sets out procedures for preparing and amending the Victoria Planning Provisions (VPP) and planning schemes, obtaining permits under planning schemes, settling disputes, enforcing compliance with planning schemes, and other administrative procedures. The Planning and Environment Act provides for a single instrument of planning control in a particular area, the planning scheme, which sets out the way land may be used or developed. The planning scheme is a legal document, prepared and approved under the Planning and Environment Act. The relevant planning scheme for the study area is the Campaspe Planning Scheme.
The Victorian Freight and Logistics Plan 2013	The Victorian Freight and Logistics Plan (Victorian Government, 2013) outlines the State Government's long-term strategy to improve freight efficiency, grow productivity, and better connect Victorian businesses with their markets, whether local, national or international. The Plan identifies a number of proposals under consideration to support the State's freight networks, which includes new Murray River crossings through the sequenced construction of new bridges at Echuca, Swan Hill and Yarrawonga. The Echuca crossing is confirmed as the initial priority project for the Murray River (p. 79).
Plan Melbourne and Loddon Mallee North Regional Growth Plan 2014	The Loddon Mallee North Regional Growth Plan (RGP) (Victorian Government, 2014) has been aligned with other regional growth plans and the new metropolitan planning strategy, Plan Melbourne, in a way that builds on the interdependence of urban settlements and facilitates their development as a networked 'state of cities'. The RGP sets out a regional approach to land use planning across the five municipalities of Buloke, Campaspe, Gannawarra, Mildura and Swan Hill. The plan identifies opportunities to encourage and accommodate growth and address challenges over the next 30 years. One of the key land use planning directions in the RGP is to '*support road, rail and logistics upgrades to improve economic growth and accessibility'*. Specifically in relation to the Project, the Plan states: "*Murray River bridge crossings are an essential part of the transport network. There are cross-border communities that rely on access to goods, services, education and employment on the other side of the river. Murray River crossings are also important for supporting the national freight network. Planning is currently underway for upgrades to Murray River crossings, including sequenced construction of new bridges at Echuca, Swan Hill and Yarrawonga, with the initial priority at Echuca. These crossings are a key priority over the medium to long term outlined in Victoria's 2012 submission to Infrastructure Australia.*" The RGP also notes that the Project would assist in meeting some of the other strategic directions including the need to improve the local economy. The Project would provide a vital link between Echuca and Moama, and more broadly Victoria and NSW, which would contribute to the facilitation of one of the RGP's key strategies of '*aligning economic and population growth with urban settlement, industry, services and infrastructure'*.

Legislation/policy	Description
Local	
Campaspe Planning Scheme	A planning scheme sets out objectives, policies and provisions relating to the use, development, protection and conservation of land in the area to which it applies. The applicable planning scheme within the Victorian proportion of the study area is the Campaspe Planning Scheme. A set of standard provisions called the VPP forms a template for all planning schemes. Included in the VPP is the State Planning Policy Framework (SPPF), which covers strategic issues of State importance. Clauses of the SPPF that are relevant to the regional and local economy of Echuca-Moama include: ➨ Clause 11.11-2 A diversified economy: • This Clause includes a strategy to '*Support investment in infrastructure, freight and logistics and increased availability of natural gas within the Loddon Mallee North regional growth area.*' ➨ Clause 17 Economic Development: • This Clause states that: '*Planning is to contribute to the economic well-being of communities and the State as a whole by supporting and fostering economic growth and development by providing land, facilitating decisions, and resolving land use conflicts, so that each district may build on its strengths and achieve its economic potential.*' ➨ Clause 18 Transport: • This Clause states that: '*Planning should ensure an integrated and sustainable transport system that provides access to social and economic opportunities, facilitates economic prosperity, contributes to environmental sustainability, coordinates reliable movements of people and goods, and is safe.*' Also included in the planning scheme is the Local Planning Policy Framework (LPPF) which sets a local and regional strategic policy context for the municipality. The Port of Echuca Heritage Policy forms Clause 22.03 of the Campaspe Planning Scheme. The key objectives of the policy are: ➨ *To create the Port of Echuca as a nationally significant heritage tourism precinct* ➨ *To protect the heritage character and integrity of the historic port and environs* ➨ *To create a multi-layered tourism experience, including activities specific to the particular attractions and features of Echuca and the region* ➨ *To consolidate the port precinct as a well-serviced tourism centre, including alternative accommodation types and improved entertainment and services* ➨ *To consolidate a unified heritage precinct and town centre, including stronger pedestrian links* ➨ *To protect key environmental and urban elements through policy, development control mechanism, incremental relocation of river boat infrastructure, and improved coordination with Murray Shire Council* ➨ *To identify key development sites for preferred uses* ➨ *To extend and consolidate the pedestrian network, including extensive avenue planting and new pavement works* ➨ *To implement the recommendations of the Echuca Heritage Precinct Master Plan* ➨ *To ensure that development enhances the broad boulevard of High Street and which entrenches its strong visual and physical role in the area* ➨ *To encourage sympathetic commercial signage and advertising appropriate for an area of State significance* ➨ *To encourage elements which reflect the character of the area including signage, fences, plant and equipment, and paint colour schemes* ➨ *To ensure that streetscape works enhance the cultural significance of the area with respect to street trees, tree guards, public seating, pavement materials, public light and car park furniture.* These objectives highlight the importance of the Port of Echuca Precinct, particularly in the context of the recent completion of the $14.2 million Port of Echuca Restoration Project and the importance of addressing existing issues relating to traffic flows and heavy vehicle access to this prime tourist area.

19.5 Existing conditions

19.5.1 Population

Echuca's population is forecast to grow over the coming decades. The predicted increase in the town's total population is from 13,830 people in 2011 to 16,260 people in 2031. The combined population of Echuca–Moama is also estimated to increase from 19,410 people in 2011 to 23,140 people in 2031, which represents an average annual growth rate of 1 per cent.

19.5.2 Industry structure

Echuca-Moama's industry structure shows a strong focus on:

- Retail trade (13.6% of employed persons in Echuca-Moama)
- Manufacturing (12.8% of employed persons in Echuca-Moama)
- Healthcare and social assistance (12.8% of employed persons in Echuca-Moama)
- Accommodation and food services (11.6% of employed persons in Echuca-Moama)
- Construction (9.4% of employed persons in Echuca-Moama).

In comparison to the broader Victorian and NSW industry structures, Echuca-Moama has significantly greater proportions of residents employed in agriculture, forestry and fisheries, manufacturing, construction, retail trade and accommodation and food services. However, Echuca-Moama has lower proportions of residents employed in wholesale trade, transport, postal and warehousing businesses and media and telecommunications, finance, professional, scientific, technical and administration services.

In line with this industry structure, of the 1,942 businesses in Echuca-Moama as of June 2013 (percentages are rounded to the nearest decimal point):

- 631 (32.5% of all businesses) are town centre services such as retail trade, financial and insurance services, rental, hiring and real estate services, and accommodation and food services
- 401 (20.6% of all businesses) are construction-related businesses
- 248 (12.8% of all businesses) are agriculture, forestry or fisheries businesses
- 220 (11.3% of all businesses) have a specific reliance on the movement of goods, including transport, postal and warehousing services, manufacturing and wholesale trade
- 109 (5.6% of all businesses) provide professional, scientific and technical services
- 102 (5.3% of all businesses) provide other services
- 89 (4.6% of all businesses) provide health care and social assistance
- 22 (2.9% of all businesses) are focussed on administration, including public administration and safety and administrative and support services
- 41 (2.1% of all businesses) are unknown
- 18 (0.9% of all businesses) are arts and recreation services
- 15 (0.8% of all businesses) provide education and training
- 7 (0.4% of all businesses) are related to information media and telecommunications
- 6 (0.3% of all businesses) are utility services (electricity, gas, water and waste).

Further discussion of the existing industry and business structures can be found in EES Technical Appendix N – Economic Impact Assessment.

19.5.3 Labour force

Echuca-Moama has an unemployment rate of 6.3 per cent, compared to the Victorian average of 6.2 per cent, with 575 labour force participants unemployed in June 2014 (Department of Employment, 2014).

Participants in the Echuca-Moama labour force are involved in a wide range of industries. There is a high level of employment in occupations related to construction and manufacturing, including technicians and trades, machinery operators and drivers, and labourers.

While the majority of the resident labour force of Echuca-Moama works within their respective localities (Echuca or Moama) approximately 1,640 workers cross the bridge each day to access their place of employment. This figure is expected to increase significantly as the region's population and labour force expands in the coming years.

19.5.4 Industry sector profiles

Town centre services

The provision of town centre services is important for economic activity in Echuca and Moama, although Echuca is the major regional centre.

Echuca services a catchment of 40,790 people who visit the town for regular shopping needs. This catchment, which is forecast to grow to more than 48,600 people by 2031, includes people from Murray Shire in NSW as well as the Shire of Campaspe.

Echuca's town centre includes a full range of major retailers (such as Woolworths, Coles, Big W, Dan Murphy's and Aldi), business services (real estate, insurance, and legal), accommodation, entertainment and dining options.

Retail sector sales in the catchment were estimated at approximately $525 million per annum in 2014. This is expected to increase to approximately $845 million per annum by 2031 (in 2014 prices), which represents an average annual growth rate of 2.8 per cent over the period. This spending growth in real terms would lead to a requirement for additional retail floor space on both sides of the river in the long-term.

Commercial accommodation

Echuca-Moama offers a significant supply and range of commercial accommodation with approximately 40 hotel/motels and 15 caravan/holiday parks within the area. ABS and RACV data show that Echuca-Moama has a commercial accommodation capacity of 1,460 rooms/cabins/powered sites and 4,200 bed spaces. A significant number of unpowered caravan sites, bed and breakfasts, private holiday house lettings and other options including riverboat accommodation are also available.

Housing rentals

Echuca-Moama currently has limited supply of housing rentals, with high demand for housing leading to extremely low vacancy rates. As of March 2014, Echuca's vacancy rate was less than 1 per cent (Real Estate Investar, 2014), with only 60 properties listed for lease in September 2014.

Tourism

The Echuca-Moama tourism sector attracts 1.2 million visitors each year and generates an estimated $300 million per annum for the regional economy through visitor spending, in both Echuca and Moama, on accommodation, dining, shipping, sightseeing, events and tours. Key tourist attractions include:

- Echuca's Historic Port and shopping precinct
- The region's local produce and wine
- The world's largest collection of paddle-steamers
- Sharps Magic Movie House
- Southern 80 Ski Race
- The Riverboats Music Festival
- Winter Blues Festival
- Echuca Steam Rally and the Heritage Steam Festival
- Murray River and associated activities.

The Port of Echuca recently underwent a major revitalisation, with $14.2 million funding from Commonwealth, State and local government contributions. Campaspe Shire Council estimates the Port is responsible for 40 per cent of the region's visitation, and its revitalisation would attract an additional 22,000 visitors.

Industrial services

Both Echuca and Moama have significant industrial areas that contain many businesses involved in:

- Food processing
- Transport and storage
- Engineering and auto-mechanics
- Rural supplies
- Plumbing supplies
- Manufacturers (cabinets, tanks, pumps, silos)
- Wholesales and distribution.

There is strong interdependence between the industrial nodes of Echuca and Moama, which is evident by analysing deliveries, truck and machinery repairs and other business activities.

Agriculture

The Shire of Campaspe has a diverse agricultural sector, with an estimated Gross Value of Agricultural Production of $500 million per annum. The primary types of agriculture within the Echuca-Moama region are cropping and grazing.

The agricultural industry accounts for approximately 13 per cent of all jobs within the Shire of Campaspe and directly employs approximately 2,240 people across both the Shire of Campaspe in Victoria and the Murray Shire in NSW (ABS, 2011).

Key agricultural and food processing businesses located in the Echuca-Moama region include Fonterra, Kagome, Heinz Wattie's, and Simplot.

19.6 Economic constraints associated with traffic movement across the existing Echuca-Moama Bridge

19.6.1 Overview

The existing Echuca-Moama Bridge is located on the Cobb Highway, central to the town centres of both Echuca and Moama. Three major highways intersect at Echuca-Moama, namely the Northern Highway and Murray Highway in Victoria and the Cobb Highway in New South Wales. These highways are significant transport routes, particularly for:

- Local trade, as Echuca is the main centre. It services a catchment of some 41,000 residents, which is set to increase to 49,000 residents by 2031
- Tourism, noting that Echuca-Moama receives 1.2 million overnight and daytrip visitors per year, many of whom cross the bridge for accommodation, sightseeing and other recreational purposes
- Daily trips to work, which account for 1 million bridge crossings each year
- Access to markets/ports generated from the strong agricultural, construction, transport and manufacturing sectors in the broader region.

At present, VicRoads estimates peak daily traffic volumes of approximately 18,000 vehicles per day on the existing bridge. However, traffic volumes can reach approximately 25,000 vehicles per day in peak seasons or during the staging of local events, causing traffic gridlock and extensive delays.

Security of crossing is an important issue for all bridge users. The existing bridge is the only crossing of the Murray River in the immediate area, leaving industry and visitors vulnerable should the bridge be closed for any period of time due to traffic accidents, maintenance requirements or other unforeseen events.

19.6.2 Agriculture and industry

The existing bridge is an important link connecting the industrial precincts on either side of the border, as well as agricultural industries in the broader region across both states. The bridge provides access to ports and markets in both Victoria and NSW.

Constraints associated with the existing bridge that are relevant to agriculture and industry include:

- Restricted speed limit of 60km/h
- Restriction of the movement of over-dimensional loads to off-peak periods of the day and the need to close the traffic lane in the opposite direction to allow oversized vehicles to cross
- Restriction on height, weight, speed and width of commercial vehicles, including vertical (5.2m) and horizontal (7.3m) – constraints which limit the size of over dimensional loads
- Transport inefficiencies associated with congestion on the bridge during holiday and event periods
- Delays and operational inefficiencies during bridge maintenance or traffic incidents, given the lack of viable alternative options
- Unnecessary movement of trucks through Echuca and Moama town centres, where the ultimate destination of these movements is located outside both centres. These kinds of truck movements are inefficient and add to safety and amenity issues in both towns.

19.6.3 Tourism-dependent businesses and retail and commercial businesses

The existing bridge is of critical importance to businesses that are dependent on tourism, with most tourists spending time in both Echuca and Moama. Additionally, a number of tourism-related businesses are located on, or close to, the existing bridge routes and are dependent (to some extent) on passing trade to support their business.

The existing bridge plays a vital role in servicing many commercial businesses on either side of the river, particularly businesses that receive daily deliveries from regional and interstate locations. The bridge is also important for professional services and businesses such as real estate agents, who hold many open house inspections in Echuca and Moama and their rural hinterlands.

Based on discussions with stakeholders, constraints associated with the existing bridge for tourism, retail and commercial businesses include:

- Heavy congestion levels during holiday periods and events, leading to inefficiencies at these peak times for businesses in both Echuca and Moama
- Amenity impacts associated with commercial vehicles passing through the town centre, potentially contributing to safety concerns and reducing the appeal of the area to visitors.

19.7 Impact assessment

The following section outlines the potential benefits and impacts the Project may have on the existing local and regional economy, assuming that VicRoads standard environmental protection measures are implemented, along with any Project-specific environmental management measures.

19.7.1 Benefits and opportunities

Construction

Employment opportunities

The Project would generate significant employment opportunities during construction of the initial alignment, with approximately 4,240 FTE jobs supported during the three-year construction period. This number would be comprised of 1,630 direct FTE jobs and 2,610 indirect FTE jobs.

In any given year over the construction period, it is estimated that up to 540 direct FTE jobs would be created, and up to 870 indirect FTE jobs would be supported by the Project.

Direct jobs relate to employment that would be intrinsically linked to the Project such as project management, engineering, site preparation, machine operation and labouring. Echuca-Moama's strong construction sector would provide a pool from which skilled labour could be sourced for the Project. However, it would be likely that some specialist skills would be sourced non-regionally.

Indirect jobs relate to employment generated by businesses as the demand for their products and services increase due to the requirements of the Project. For example, new jobs in construction, material manufacturers, transport firms, financial services businesses. These jobs would be supported at a local, regional, metropolitan or interstate level, and in some cases, overseas (for example, importing specialised parts or equipment).

The Project would also provide opportunities for training and upskilling the local workforce, including new apprenticeships created to support the Project.

Additionally, the potential permanent relocation of non-local project workers and their families would benefit Echuca-Moama by bringing additional skills and disposable income to the region and supporting population growth.

Business opportunities

While it is envisaged that a major or specialist contractor would be engaged to construct the Project, there would also be significant business opportunities for local operators to act as subcontractors. This would potentially provide cost and transport efficiencies for the primary contractor and could also stimulate local business growth.

Business opportunities would be similar during both the construction of the initial alignment and the ultimate duplication. However, actual opportunities arising during construction of the ultimate duplication would depend on industry, business and occupation structures and the labour force existing at the time.

Wage spending stimulus

New spending would be generated in Echuca-Moama's local economy through the temporary resettlement of non-regional construction workers during the construction period. The expected level of employment would inject an estimated additional $6.1 million per annum into the local and regional economy.

Spending would likely include the following:

- Accommodation expenditure such as hotels, motels, caravan parks and private rental dwellings
- Retail expenditure such as supermarket items, clothing and homewares
- Recreational spending such as at restaurants and pubs and on daytrips and gaming
- Personal, medical and other services such as local prescriptions and GP fees, household cleaning services, fuel and vehicle maintenance.

This level of personal spending would support approximately 30 FTE (indirect) jobs in the services sector for each year of the Project.

The wage spending stimulus would be similar during the construction of the ultimate duplication. However, benefits would depend on the labour market conditions at the time, including the likely need to source some workers from outside the region.

Operation

Agriculture

Based on consultation with transport stakeholders, the use of B-double vehicles and High Productivity Freight Vehicles (HPFVs) to transport livestock has increased significantly over recent years. However, their use in the Echuca-Moama region is currently limited by height and weight restrictions on the existing bridge. The Project would enable over-dimensional loads to be transported across the Murray River 24 hours a day and would provide an alternative river crossing option should a closure occur on the existing bridge. The Project would also reduce pressure on existing roads through the town centre.

Industry

The Project would be expected to have the following benefits to industry:

- Reduced travel cost (in time and fuel), particularly for businesses and industries seeking to bypass Echuca and Moama
- Reduced risk to industrial and business operations through the availability of a viable alternative cross-border route
- Removal of restrictions on the movement and size (height, width and weight) of over-dimensional loads
- Provision of a High Mass Limit (HML) compliant bridge
- Allowance for greater flexibility and efficient movement of freight and the use of HPFVs and vehicles with HML.

Tourism-dependent businesses

The Project would be expected to reduce traffic on the existing bridge during peak periods. This would have the following benefits on tourism-dependent business within the area:

- Improved amenity and safety of the Echuca town centre and historic Port of Echuca area through a 41% reduction in traffic passing through the area
- More efficient cross-border movement during peak holiday periods, facilitating movement of tourists to and from attractions and accommodation, particularly Echuca Caravan Park
- Facilitation of the proposed Bridge Arts Project (refer to Chapter 6, section 6.17.2) which would involve local business identities, artists, educators and representatives of the Yorta Yorta Nation. The Bridge Arts Project would potentially provide another major tourist attraction for local, regional, interstate and international visitors.

Retail and commercial businesses

The Project would create more efficient movement and flexibility of choice for operators servicing major businesses (such as supermarkets) on either side of the border. Additionally, improved amenity from the anticipated reduction in traffic in the Echuca town centre and the historic Port of Echuca would be likely to increase visitation and investment opportunities in the town centre.

Further, reduced heavy traffic flows through Echuca town centre would allow for improved connectivity between the historic Port of Echuca and the main shopping and dining areas. It is anticipated that new business opportunities would emerge at the northern end of High Street due to improved amenity and accessibility.

Similar benefits would be expected from construction of the ultimate duplication, which would increase overall vehicle capacity. However, actual benefits would depend on the business environment, population characteristics and tourism sector at the time.

19.7.2 Potential impacts

Compared to the 'No Project' scenario, the following potential economic impacts have been identified for the construction and operation of the initial alignment.

As the construction and operation of the ultimate duplication is not likely to occur in the immediate future, it is not possible to accurately assess its potential economic impacts. However, it is assumed the impacts would be similar to those identified for the initial alignment, as outlined below.

Impacts during construction

Business disruption

The movement of construction-related vehicles could create additional traffic congestion in Echuca and Moama, including across the existing bridge. This could have a negative impact on business operators, particularly during peak season periods (i.e. passengers missing paddle-steamer cruises, increased travel time for CBD suppliers etc.) and may potentially result in the loss of revenue for some businesses.

The Echuca Holiday Park would be directly affected by construction of the Project, due to its close proximity to proposed works. Amenity impacts associated with construction works could lead to a loss of patronage (and associated revenues) to competing caravan parks. However, it should be noted there may also be an opportunity for the Echuca Holiday Park to capture a share of the visiting construction worker market.

River-based activities

The Port of Echuca and the Murray River are the main attractions for most visitors to the region. The major river-based businesses are Echuca Paddle-steamers and Murray River Paddle-steamers.

During the peak holiday season up to 50 cruises per day (in both directions) occur along the Murray River past the proposed river crossing.

The river area north of the proposed river crossing is critical to both paddle-steamer operators as it is popular for weddings and functions and attracts many visitors. Any construction that disrupted access to this area would be detrimental to both businesses.

In addition, houseboat operators, fishing tours and water sports operators could all be negatively impacted and could suffer a loss in revenue if access near the proposed bridge was significantly restricted during the construction period.

Event disruption

The Southern 80 Ski Race is the most important tourism event for the region, attracting approximately 90,000 visitors and competitors and generating approximately $10 million in economic benefit to the regional economy.

The race finishes at the Victoria Park boat ramp. The area around the boat ramp, including the car park, is used to provide food, drink, merchandise and other services during the race weekend. Access to the boat ramp and its broader area is critical to the successful staging of the event.

If construction works on the bridge component of the Project were suspended for two weeks to allow for the race site to be set up and then dismantled, there would be no impact on the race. VicRoads would incorporate provisions within the Project contract to ensure construction works would not impact on the staging of the event or interfere with access to the Victoria Park boat ramp.

Labour supply

Construction of the initial alignment would require the supply of approximately 540 FTE positions per year, of which approximately 405 FTE positions (or 75 per cent of the labour force requirement) could potentially be sourced from within the regional economy. This figure of 405 FTE represents a significant proportion of Echuca-Moama's workforce (14 per cent) that is currently employed in occupations relating to construction and manufacturing.

Additionally, the neighbouring municipalities of Greater Bendigo and Greater Shepparton contain approximately 24,000 people also employed in the construction industry, which represents a significant labour force within commuting distance of the Project.

Two major infrastructure projects (Bendigo Hospital and the Goulburn-Murray Water Connections Project (formerly the Northern Victorian Irrigation Modernisation Project)) would be nearing completion around the anticipated start date for construction of the Project, freeing up many regionally-based construction workers.

Accordingly, it is considered that Echuca-Moama and the broader region would have sufficient, relevant labour force capacity for the Project without having detrimental flow-on effects to the economy.

Accommodation supply

Echuca-Moama has a significant and varied commercial accommodation sector. It is assumed that approximately 135 rooms would be required to support non-regional construction workers who would temporarily relocate to the region to work on the Project.

ABS Tourism Accommodation data for 2013 shows average peak occupancy rates (January) are around 60 per cent for hotels, motels and serviced apartments and 85 per cent for caravan park accommodation (cabins/powered sites). However, in the low season (June) these rates decline to approximately 45 per cent and 70 per cent respectively.

This indicates that sufficient commercial accommodation is available to cater for a relatively small number of construction workers temporarily relocating to Echuca-Moama. However, during peak holiday periods there is a limited supply of caravan park accommodation and therefore some consideration is required as to how to manage demand from both tourists and construction workers during these periods.

If construction workers moving to the region were to occupy rental properties it would place further pressure on an already tight housing market. As discussed in section 19.5.4, there is a limited supply of housing rentals available in Echuca-Moama; Echuca's vacancy rate was less than 1 per cent in March 2014 (Real Estate Investar, 2014). Demand from construction workers may also lead to rental inflation as landlords seek to 'cash in' on potentially higher rental returns. This could cause displacement of local residents and potentially force people to move out of the area to seek rental opportunities.

Impacts during operation

Loss of passing trade in Echuca

It is unlikely that businesses in Echuca would experience loss of trade as a result of the Project. No additional restrictions would be placed on vehicles using the existing bridge, and road users would still have the choice to travel through the Echuca town centre if they desired.

As noted earlier, increased efficiency of movement for residents and visitors and opportunities for Council to implement access and amenity improvements in the Echuca town centre are likely to enhance the operating environment for businesses.

Echuca Holiday Park

Operation of the Project has the potential to adversely impact on the Echuca Holiday Park through visual and noise impacts. While these impacts alone might not threaten the business viability of the facility, the regional accommodation market is highly competitive, with many alternative options available on either side of the river for those seeking caravan park accommodation. Consequently, the Echuca Holiday Park may experience some financial loss as visitors might be deterred from using the facility in favour of other options that provide a higher level of amenity.

Moama Water Sports Club – Southern 80 Ski Race

No negative impacts on the Southern 80 Ski Race are anticipated during the operation of the proposed bridge as no structures would be constructed in the water and the bridge height clearance would be sufficient to allow ski race activities to continue unimpeded.

Improved traffic flows and reduced congestion for competitors and visitors would be a major benefit for the event. Additionally, there is the possibility of using the bridge structure to mount temporary GPS timing equipment for the race.

19.8 Environmental management measures

VicRoads has a standard set of environmental protection measures which are typically incorporated into its construction contracts for road works and bridge works. These measures have been used as the starting point for the assessment of construction-related risks and are listed in Chapter 20 and described in detail in EES Technical Appendix O – Section 177 Environmental Management. In some instances, additional Project-specific environmental management measures have been recommended by specialists to reduce risks relating to construction and operation.

The assessment of economic impacts considered the implementation of:

- VicRoads standard environmental protection measures
- The Project-specific environmental management measures recommended in other specialist assessments and outlined in Chapter 20
- Project commitments outlined in Chapter 6, including those relating to:
  - In consultation with river-based businesses, minimising the number, extent and duration of river closures during construction of the proposed bridge. This would include providing sufficient and safe access for all river users (especially paddle-steamers) outside of river closures during construction
  - Suspension of construction works in the vicinity of the Southern 80 Ski Race over the two-week period required for event set-up, event staging and decommissioning of the site
  - Encouraging discussion between the contractor(s), the Campaspe Shire Council and Murray Shire Council regarding suitable options for the accommodation of workers who would be temporarily living in Echuca-Moama during construction of the Project.

Following the implementation of these management measures, there are not expected to be any significant detrimental economic impacts as a result of the Project.

19.9 Conclusion

The Project would provide significant economic benefits to the local and regional economy of Echuca-Moama.

Following construction of the Project, industry and agricultural operators would benefit from significantly improved access and efficiency of movement for heavy vehicles across the Murray River.

Through a reduction of existing vehicle traffic in the Echuca town centre, locals and visitors alike would experience improved efficiency of travel and improved amenity and safety at key destinations. This would provide improved trading conditions and increase business opportunities for operators in the town centre.

In any given year over the construction period, it is estimated that up to 540 direct FTE jobs would be created, and up to 870 indirect FTE jobs would be supported by the Project. Over the three-year construction period of the initial alignment the Project would generate a wage spending stimulus of approximately $18 million. Much of this labour force would be sourced from the local and regional workforce, providing employment opportunities for local residents. It is considered that Echuca-Moama and the broader region would have sufficient, relevant labour force capacity for the Project without having detrimental flow-on effects to the economy.

Additionally, the Project would provide the opportunity for training and upskilling of the local workforce and for the expansion of local and regional businesses to service the primary contractor and temporary construction workers.

Sufficient commercial accommodation is available to cater for a relatively small number of construction workers temporarily relocating to Echuca-Moama. However, during peak holiday periods there is a limited supply of caravan park accommodation. Moreover, if construction workers were to occupy rental properties it would place further pressure on Echuca-Moama's tight housing market and could potentially force people to move out of the area to seek rental opportunities.

If non-local construction workers and their families relocated to Echuca-Moama permanently, this would bring additional skills and incomes to the region, as well as support population growth.

The Project would also facilitate the opportunity to develop the Bridge Arts Project in NSW, which is anticipated to become a major tourist attraction for the Echuca-Moama region.

However, there is potential for the construction of the Project to have a negative impact on amenity at the Echuca Holiday Park due to the facility's close proximity to the preferred alignment, which has the potential to lead to loss of patronage and associated revenue.

Construction of the proposed bridge may also cause some temporary disruption to river-based businesses, such as paddle-steamers, houseboats, fishing tours and other water sports operators. These businesses could suffer a loss in revenue if access near the proposed bridge was significantly restricted during the construction period.

VicRoads has confirmed that works would be scheduled to avoid any impact on the staging of the Southern 80 Ski Race and that works would be undertaken to minimise disruption to other river-based activities.

VicRoads would manage any potential impacts through the use of standard and Project-specific environmental management measures.