6. Construction

This chapter describes the proposed construction of the project. The chainages referred to throughout this chapter refer to those along the southbound carriageway of the project.

6.1 Construction activities and equipment

Table 6-1 provides a summary of the likely construction phases and associated activities that would occur for the project, and the likely plant and equipment that would be used for those activities. Conventional techniques employed on most highway construction projects would be used during these construction activities.

Table 6-1 Proposed construction phases and activities, and plant and equipment

Construction phase	Activities	Plant and equipment
Environmental Management System (EMS)	▪ EMS development. ▪ Environmental management plans. ▪ Statutory approvals and licensing.	-

Early works	▪ Land acquisition.
	▪ Relocation of farm dams/fencing.
	▪ Survey of construction site.
	▪ Notify residents of commencement of work.
	▪ Site establishment.
	  ▸ Site compounds.
	  ▸ Fencing of site boundaries and areas to be used for stockpile sites.
	▪ Fencing of sensitive environmental and heritage areas.
	▪ Installation of erosion and sediment control (ERSED) outside identified environmental constraint areas.
	▪ Establishment of access tracks where required to allow construction of earthworks.
	▪ Other activities determined by the Environmental Representative to have minimal environmental impact.
		▪ Fences.
		▪ Sheds.
		▪ Fuel storage tanks.
		▪ Graders, rollers and water carts.
		▪ Excavators.
		▪ Generators.
		▪ Concrete batch plants.
		▪ Water tanks.

Construction phase	Activities	Plant and equipment
Service relocations	▪ Service relocations.	▪ Trucks, cranes and excavators. ▪ Elevated platform vehicle. ▪ Backhoes. ▪ Trenchers. ▪ Under boring machines. ▪ Bulldozers. ▪ Small equipment (eg hand tools, compactors).
Site preparation	▪ Clearing and grubbing of vegetation. ▪ Mulching. ▪ Stripping and stockpiling of topsoil. ▪ Establishment of access tracks. ▪ Establishment of temporary and permanent crossovers.	▪ Fences. ▪ Sheds. ▪ Fuel storage tanks. ▪ Graders, rollers and water carts. ▪ Excavators. ▪ Generators. ▪ Concrete batch plants. ▪ Water tanks.
Earthworks	▪ Excavation of cuttings. ▪ Fill embankments. ▪ Rock blasting (if required). ▪ Quarrying. ▪ Rock crushing (if required). ▪ Placement of select materials. ▪ Batter treatments.	▪ Mulching plant and chipper. ▪ Chainsaw. ▪ Rock breaker. ▪ Rock crusher. ▪ Excavators. ▪ Bulldozers. ▪ Trucks. ▪ Scrapers. ▪ Graders. ▪ Water carts. ▪ Street sweepers. ▪ Compactors. ▪ Vibratory rollers. ▪ Drilling and blasting equipment for hard rock cuttings. ▪ Bitumen sprayers. ▪ Rubber-tyred rollers.
Bridges and drainage	▪ Bridges. ▪ Culverts. ▪ Catch drains. ▪ Drainage blankets. ▪ Permanent water quality control basins.	▪ Piling rigs. ▪ Concrete pumps. ▪ Cranes. ▪ Overhead gantry crane. ▪ Excavators. ▪ Trucks.
Interchanges	▪ On-load/off-load ramps.	▪ Scaffolding. ▪ Small equipment (eg hand tools, concrete vibrators, curing equipment).

Construction phase	Activities	Plant and equipment
Pavement	▪ Concrete paving (rigid pavements). ▪ Gravel base/sub-base layers and asphalt paving (flexible pavement).	▪ Trucks. ▪ Concrete paver. ▪ Profiler. ▪ Concrete curing equipment. ▪ Concrete saws. ▪ Asphalt paver. ▪ Concrete pumps. ▪ Concrete trucks. ▪ Concrete batch plant. ▪ Stabiliser. ▪ Water carts. ▪ Vibratory rollers. ▪ Rubber-tyred rollers.
Other works	▪ Property access. ▪ Local roads. ▪ Tie-ins.	▪ Graders. ▪ Backhoes. ▪ Excavators. ▪ Trucks. ▪ Water carts. ▪ Vibratory compactors. ▪ Bitumen sprayers. ▪ Vibratory rollers. ▪ Rubber-tyred rollers.
Finishing works	▪ Noise barrier(s) (if required). ▪ Safety barrier(s). ▪ Lighting. ▪ Line marking. ▪ Signposting. ▪ Signage. ▪ Landscaping. ▪ Site clean up.	▪ Trucks, cranes and excavators. ▪ Elevated platform vehicle. ▪ Backhoes. ▪ Trenchers. ▪ Under boring machines. ▪ Bulldozers. ▪ Small equipment (eg hand tools, compactors).

The construction period for the project is expected to be approximately two years. An indicative program of activities is provided in Figure 6-1.

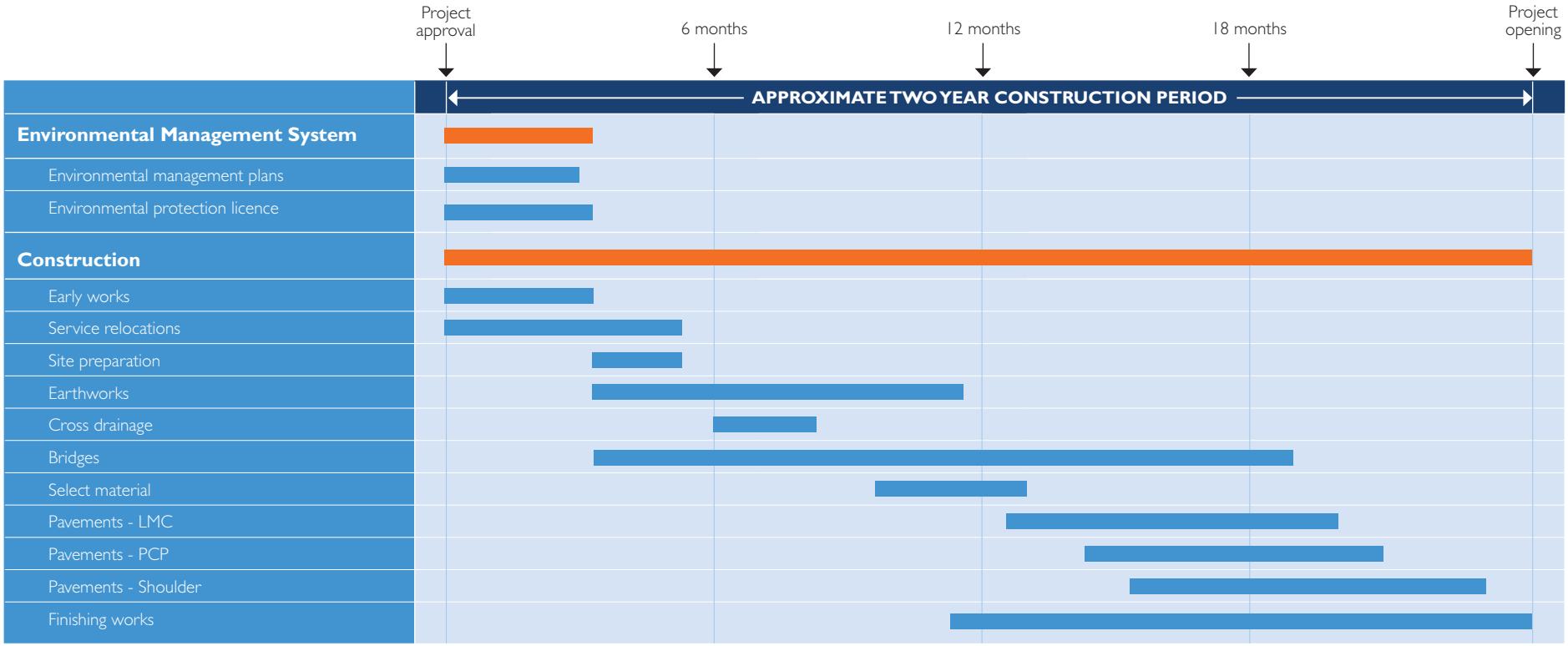

Figure 6-1 **Indicative construction program**

6.2 Construction programming and traffic management

6.2.1 Staging

No staging would be required for the project.

6.2.2 Construction programming

The proposed construction works would be programmed to minimise the interaction between the construction works and the local and regional road network. This would minimise disruption to local and through traffic. Construction of the northern and southern interchanges would enable traffic to be switched between the existing highway and the project to facilitate the continual flow of traffic through and around Tarcutta.

Temporary roadworks would be required during construction to tie the existing road network into the construction works. Locations at which temporary roadworks are likely to be required include the intersections of the existing highway and Mate Street, and Humula and Mates Gully roads. Temporary roadworks may be constructed under traffic and could result in some short-term traffic impacts to users of the existing road network.

6.2.3 Construction traffic management

Standard traffic management measures would be employed to minimise the short-term traffic impacts expected during construction. These measures would be identified in specific traffic management plans and would be developed in accordance with the RTA's *Traffic Control at Works Sites Manual* (RTA 2003a).

A detailed assessment of traffic and transport impacts is presented in Section 9.7; construction traffic impacts are discussed in Section 9.7.3 and measures to manage these impacts are identified in Section 9.7.5.

6.3 Resource consumption

6.3.1 Materials and spoil disposal

The project has been designed with the aim of achieving an overall balance of earthworks to minimise excess spoil and/or the need to import large quantities of fill. It is anticipated that approximately 660,000 cubic metres of cut material would be generated during construction and approximately 750,000 cubic metres of fill would be required to complete the road formation. Accordingly, there would be a need to import approximately 110,000 cubic metres of select fill material. This volume accounts for the shortfall in cut material (90,000 cubic metres) and includes a provision for extra material required by the concept design.

Because large volumes of select fill would be required over a relatively small timeframe, existing quarries are unlikely to be able to provide the required quantities or quality of this select fill. Potential quarry locations within the region are being investigated to supply the select fill material for the project.

Quarry locations would be guided by the following criteria:

- More than 40 metres from waterways.
- Areas of low ecological and heritage conservation value.
- Greater than 100 metres from closest sensitive receiver (unless a negotiated agreement is in place).

Adopting the above criteria would ensure environmental impacts are minimised.

Quarry operations may result in short-term temporary impacts to amenity, including noise and dust, and potential water quality impacts from erosion and sedimentation. Operational impacts would be managed through the implementation of relevant management and mitigation measures as outlined in Chapters 9 and 10, and the draft statement of commitments identified in Chapter 11. Site rehabilitation (eg suitable grading, site stabilisation) would address any long-term potential erosion, and visual amenity and landscape impacts.

Haulage from quarry sites would involve additional truck movements on local and regional roads. Haulage needs would equate to approximately 8000 truck movements over a three month period (approximately 100 to 130 movements per day). Should the provision of access require modifications to the existing road network, any change would be carried out in consultation with the relevant road authority. The impacts of additional truck movements on the local and regional road network would be managed through the implementation of relevant mitigation and management measures as outlined in Section 9.7, and the draft statement of commitments identified in Chapter 11.

Other natural resources required for construction of the project include aggregate for use in concrete batching, sand, aggregate and select material for use as backfill around pipes and production of Portland cement, and densely graded base and sub-base. Where feasible, materials would be sourced from existing regional quarries.

Figure 6-2 shows the locations of existing hard rock and sand quarries in the region.

Manufactured items, including reinforcing steel, pre-cast bridge components, and stormwater pipes and pits, would also be required for the project.

All material from cuts would be re-used as fill, where practicable, in accordance with the waste hierarchy. As the current design of the project has a shortfall of fill material, excess spoil material is not anticipated to be generated during construction. Any spoil found unsuitable for reuse would be disposed of in accordance with the *Waste Classification Guidelines: Parts 1 and 2* (DECC 2008a).

6.3.2 Water

Water would be used during construction, including for dust suppression, washing of plant and equipment, drinking water, hand washing, toilets, watering of landscaped areas, compaction and pavement stabilisation during earthworks, and concrete batching. Water for the construction of the project could be supplied from a number of sources (in order of preference):

- Sediment basins: Water stored in the sediment basins installed for construction of the project would be re-used wherever practicable.
- Groundwater: The RTA holds an existing groundwater extraction licence under section 115 of the *Water Act 1912* for an allocation of 150 megalitres per 12 month period. This allocation relates to the hard rock aquifer. Should additional groundwater be required it may be sourced through the Riverina Water County Council or existing groundwater users in consultation with landholders and the Department of Environment, Climate Change and Water.
- Other surface water: Water from local dams may be sourced for use during construction in consultation with landholders.

- Off-site: Water could be transported to the site from an off-site source. Water would need to be obtained through the Murray-Darling Basin water trading market due to the current embargo on obtaining new water licences within the basin. This may be in the form of a temporary or permanent water licence.

Above-ground pipes may be used to deliver water across the construction site. These pipes would be small (approximately 150 millimetres in diameter) and temporary, and would be located to avoid impacts on the environment.

Any groundwater extraction required for the project would be undertaken in accordance with Part 5 (groundwater) of the *Water Act 1912*. Section 9.4.4 addresses the potential impacts of water requirements for construction on water sources and surrounding water users.

6.3.3 Estimated quantities of natural resources

Table 6-2 lists the estimated quantities of natural resources required for construction of the project. These quantities are indicative and are subject to change during detailed design.

Table 6-2 Estimated quantities of natural resources for construction

Material	Estimated quantity required
Select fill	110,000 cubic metres
Concrete	68,000 cubic metres
Asphalt	30,000 tonnes
Base/sub-base	23,000 cubic metres
Water (non-potable and potable)	200 megalitres

Figure 6-2 **Existing quarry locations in the region**

6.4 Erosion and sediment control

Potential erosion and sedimentation of waterways and the landscape is assessed in Section 10.1. An assessment of site constraints was undertaken to identify the nature of soil, landform and hydrological constraints associated with the project. The assessment has enabled the identification of indicative temporary sediment basin locations along the project. These sediment basins would be designed and maintained in a manner consistent with the measures identified in Section 10.1.5 to avoid impacts on the surrounding environment. A number of these construction sediment basins may be retained as permanent spill containment basins during operation of the project. The remaining temporary basins would be removed and rehabilitated upon operation of the project.

Figure 6-3 shows the indicative locations of temporary sediment basins required for construction.

6.5 Workforce and working hours

6.5.1 Construction workforce

The construction workforce would vary depending on the phase of construction and associated activities. The workforce would include construction and design personnel. An on-site workforce of approximately 250 persons would be engaged at any given time during the construction period.

6.5.2 Construction working hours

The majority of construction activities would take place from 6am to 7pm, Monday to Friday and 7am to 4pm Saturday (the daytime period), with no work on Sunday or public holidays. However, certain activities would be required to take place during the evening and night-time periods due to:

- Technical considerations (such as the need to meet particular quality specifications for placement of concrete pavement).
- The climatic environment (cold winters and hot summers).
- An accelerated construction program.

The proposed working hours and associated activities are outlined in Table 6-3.

Table 6-3 Construction working hours and associated activities

Day	Time	Activity
Monday to Friday	Daytime (6am to 7pm)	▪ Compound operation. ▪ Earthworks. ▪ Blasting (if required). ▪ Structures. ▪ Drainage. ▪ Ancillary/finishing works. ▪ Concrete paving. ▪ Asphalt paving. ▪ Concrete saw cutting. ▪ Concrete batch plant operation. ▪ Pre-cast yard operation. ▪ Deliveries. ▪ Maintenance activities.
	Evening (7pm to 10pm) And Night-time (10pm to 6am)	▪ Compound operation. ▪ Concrete paving. ▪ Concrete saw cutting. ▪ Concrete batch plant deliveries. ▪ Concrete batch plant operation. ▪ Pre-cast yard. ▪ Maintenance activities.
Saturday	Daytime (7am to 4pm)	▪ Compound operation. ▪ Earthworks. ▪ Structures. ▪ Drainage. ▪ Ancillary/finishing works. ▪ Concrete paving. ▪ Asphalt paving. ▪ Concrete saw cutting. ▪ Concrete batch plant deliveries. ▪ Batch plant operation. ▪ Pre-cast yard operation. ▪ Maintenance activities.
Sunday	No scheduled work	

Construction activities not identified above would be undertaken during the daytime or, if in the evening and night-time periods, only if:

- Works do not cause construction noise to be audible at any sensitive receiver; or
- Delivery of materials is required by the Police or other authorities for safety reasons; or
- Work is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or

- On a case-by-case or activity specific basis, which would be subject to consultation with the Department of Planning, DECCW and affected sensitive receivers (eg the continuous concrete pour of cast *in situ* bridge decks).

6.5.3 Justification for activities in the evening and night-time periods

Concrete paving

The RTA has specifications for placement of concrete pavement that relate to temperature and rainfall. For jointed concrete base, the specifications prohibit the placement of concrete during rain or when the ambient air temperature is below 5°C or above 32°C. As hot weather affects the quality of concrete pavement, in this climate paving in the early evening and into the night is preferred as it takes advantage of cool night temperatures. For cold weather concreting, early morning paving is recommended, to take advantage of daytime solar radiation and heat generation to promote concrete strength.

It is highly likely that concrete paving would need to be carried out during summer. Due to the climatic conditions experienced in the region during summer months, where daytime ambient temperatures often exceed the maximum temperature threshold of 32°C, concrete paving would need to occur during the day, evening and night-time periods as indicated in Table 6-3.

Concrete saw cutting

The project would use plain concrete pavement (PCP), which is an unreinforced pavement. To manage cracking associated with drying shrinkage, saw cutters are used to cut the pavement (usually in 4.2 metre sections). The timing of concrete cutting is governed by the hydration rate of the pavement, and may require cutting at any time within 4 and 24 hours after paving, with a 'cutting window' as short as 30 minutes. As the timing of cutting is critical to the quality of the pavement and acceptance of the finished product, concrete saw cutting may be needed at any time, including outside normal construction hours. Concrete saw cutting is a construction activity that is transient in nature, and each 'saw cut' would be of a short duration.

As mentioned above, concrete paving is highly likely to be carried out during summer months. Following concrete paving, concrete saw cutting would need take place within 4 and 24 hours, during the day, evening and night-time periods as indicated in Table 6-3.

Concrete batch plant

Section 6.6.1 identifies that a concrete batch plant is proposed as part of the project. In addition to normal daytime operation for concrete products (drainage structures etc), the concrete batch plant would need to operate in conjunction with concrete paving works during the evening and night-time periods as indicated in Table 6-3.

The concrete batch plant would also supply concrete to a number of other project components (eg pre-cast beams and parapet barriers (see below)), for which concrete may need to be supplied out of normal working hours.

Although yet to be confirmed, there is likelihood that some bridge may be cast *in situ*, which would require the batch plant to provide concrete continuously for up to 24 hours. This may occur on three separate occasions.

To keep up with materials demand during these peak periods of concrete production, the batch plant would require materials deliveries outside of normal working hours. Due to the regional location of the project, the timing of deliveries may be determined by the pattern of supplier fleet movements (ie at night).

The number of deliveries would be dependent on the size of the batch plant and its storage capabilities. There is potential for up to three (approximate one hour) deliveries per night during peak periods.

The concrete batch plant would be operational for the entire construction period (approximately two years). Within that period, concrete batch plant deliveries may be undertaken during the evening and night-time periods between the hours 12am to 6am and 7pm to 12pm Monday to Friday.

Pre-cast yard

A pre-cast yard is proposed for the project as the construction of bridge structures to traverse Tarcutta and Keajura creeks would require in the order of 250 pre-cast beams (or super-tees). Section 6.6.1 provides a description of the proposed pre-cast yard.

Heat accelerated curing of the pre-cast beams is required to accelerate their early strength gain. The curing process would need to occur during the day, evening and night-time periods, after the beams have been cast to enable removal of the shutters the following day. This method of pre-casting and curing would provide for the most efficient production of pre-cast beams for the project.

The pre-cast yard would be in operation for approximately one year. In this time, the 'noisy' operations would occur during daytime working hours. However, the boiler and a small laboratory would operate during the following evening and night time hours:

- 12am to 6am and 7pm to 12pm Monday to Friday.
- 12am to 7am Saturday.

Maintenance activities and site compound operation

Maintenance and operation of the site compound would be required to support the activities described above.

Management of impacts

An assessment of likely noise impacts resulting from these activities has been undertaken and is presented in Section 9.5. Specifically, Section 9.5.6 identifies the management measures that would be implemented to minimise these impacts.

6.6 Ancillary facilities and temporary works

A range of ancillary facilities and temporary works would be required during construction of the project. These are identified and discussed in the following sections.

6.6.1 Construction work sites

Construction work sites would be required for a main site compound, satellite compounds, a concrete batch plant and a pre-cast yard.

The proposed locations of construction work sites have been assessed against the following environmental criteria:

- More than 40 metres from waterways.
- Areas of low ecological and heritage conservation value.
- No significant clearing of native vegetation beyond that already required for the project.
- Minimises impact on amenity of the closest sensitive receiver (unless a negotiated agreement is in place).

- Of relatively level ground.

Adopting the above criteria would ensure environmental impacts are minimised.

The location for any ancillary facilities not identified in this environmental assessment would be located to comply with the above criteria.

The likely construction work sites are shown in Figure 6-3 and would be located within the construction site boundary. The construction site boundary defines the likely extent of the area required for construction of the project.

Operation of the construction work sites would have the potential to result in some noise and vibration, traffic, water quality and air quality impacts. These have been addressed in Sections 9.5, 9.7, 10.1 and 10.3 respectively. Mitigation measures would be implemented as required to manage these impacts.

Main site compound

The main site compound for the project is likely to be located to the south-west of the northern interchange. It would be approximately 4.5 hectares (200 by 225 metres) in size and would include:

- Site offices.
- Traffic office.
- Lunch room.
- First aid room.
- Amenities.
- Workshop.
- Crib shed.
- Car parks.
- Soil lab.
- Plant yard (including plant maintenance).
- Laydown area.
- Septic system.
- Fencing and security.
- Erosion and sediment controls.
- Rainwater tank(s).

Access to the main site compound would occur off the proposed northbound on-ramp at the northern interchange.

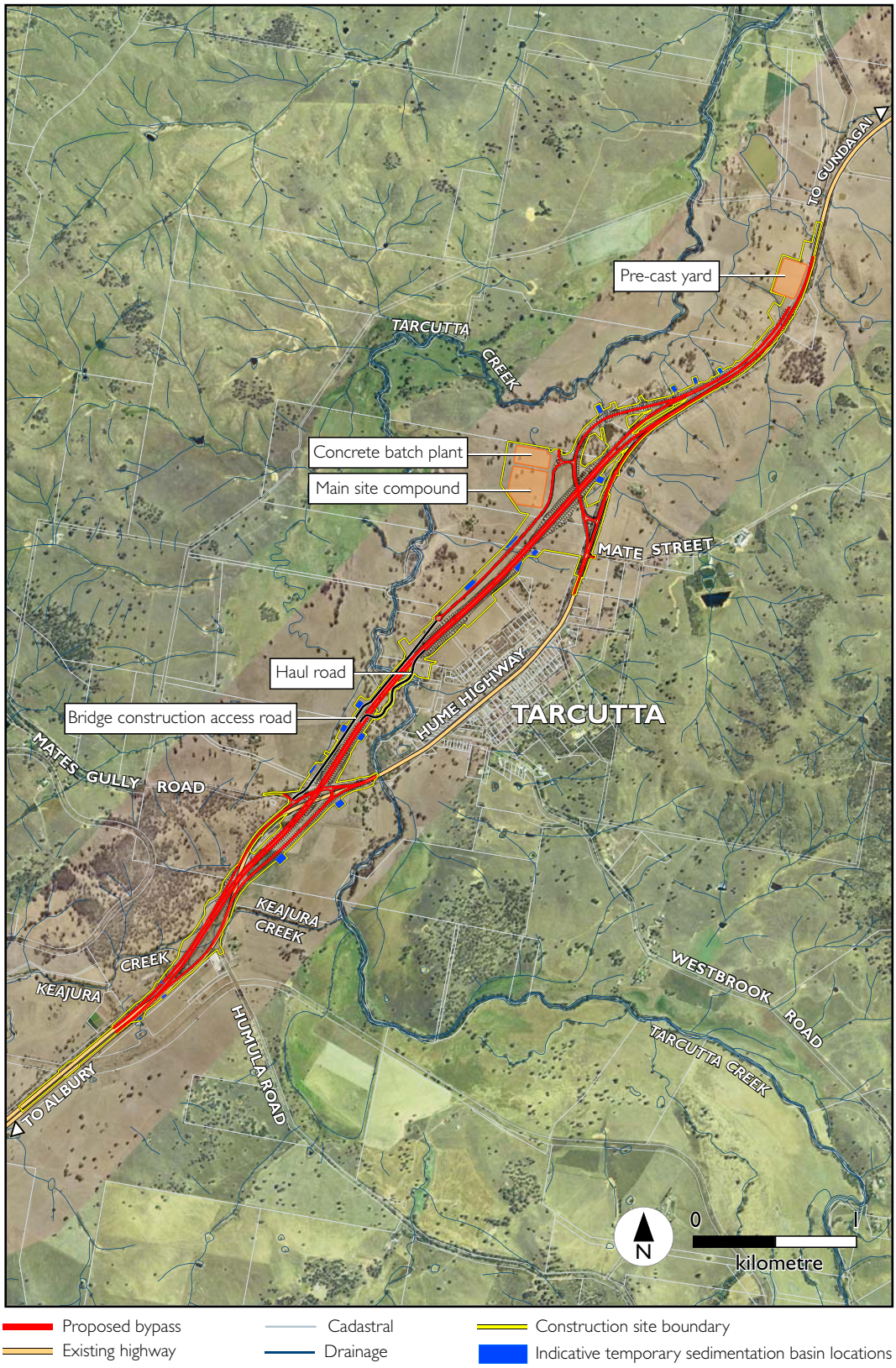

Figure 6-3 **Proposed construction site boundary and ancillary facilities**

Satellite compounds

It is likely that six temporary satellite compounds would be required for the project. These satellite compounds would be approximately 0.25 hectares (50 by 50 metres) in size and would include:

- Hardstand placed across the entire area.
- Two shipping containers for tools and equipment.
- Crib shed(s).
- Portable toilets.
- Generators.
- Bunded storage of chemicals (eg fuel).
- Laydown/storage of materials, scaffold and other materials.
- Fencing and security.
- Erosion and sediment controls.

Concrete batch plant

A temporary concrete batch plant is likely to be required for the project because there are no existing commercial batch plants sufficiently close to the project that could supply the concrete requirements.

The concrete batch plant is likely to be located adjacent to the main site compound, south-west of the northern interchange. It would be approximately three hectares (230 by 130 metres) in size and would include:

- 'Wet mix' mobile batch plant.
- Diesel generator.
- Silos.
- Security fencing.
- Water storage tanks.
- Storage areas.
- Site office.
- Amenities.
- First aid room.
- Car park.
- Sealed access road.
- Erosion and sediment controls, including a sediment pond.
- Waste water system.
- Septic system.

Pre-cast yard

A pre-cast yard is likely to be required for the project to supply the many pre-cast concrete beams and parapet concrete safety barriers required.

The pre-cast yard is likely to be located at the north-western end of the project. This is an area that was used for a temporary concrete batch plant for the Hume Highway duplication to the north of this project. It would be approximately two hectares (100 by 200 metres) in size and would include:

- Site office.
- Lunch room.
- First aid room.
- Amenities.
- Crib shed.
- Car park.
- Boilers.
- LPG tank.
- Laydown/plant yard.
- Beam production area.
- Barrier production area.
- Beam/barrier storage area.
- Loading and unloading facilities.
- Erosion and sediment controls.
- Fencing and security.
- Rainwater tank(s).

6.6.2 *Storage and stockpile areas*

Several stockpile sites are likely to be required for the project to store, prepare and distribute materials.

The proposed locations of temporary stockpiles would be assessed against the following environmental criteria:

- Of low ecological and heritage conservation value.
- Constructed on the contour at least 40 metres from waterways.
- Outside the 1 in 10 year ARI floodplain.
- Of relatively level ground.

Adopting the above criteria would ensure environmental impacts are minimised.

6.6.3 *Haul roads, bridge access roads and temporary crossings*

A haul road is likely to be required to cross Tarcutta Creek (on the eastern side of the project) to:

- Allow safe earthworks operation by clearly separating the load and haul operation from the construction teams working on bridges.
- Ensure the slope of the road is appropriate for the safe operation of earthmoving equipment in the vicinity of the northern abutment.

The haul road would be approximately 15 metres wide to enable haul vehicles to safely pass each other. An indicative route for the haul road has been identified (refer Figure 6-3). The route has been selected to minimise impact on native vegetation and would be finalised during detailed design.

A bridge access road would be required across Tarcutta Creek on the western side of the project to allow clear and separate access to the bridge site, and to provide a stable platform for the safe operation of piling rigs and cranes for the construction of the Tarcutta Creek bridges. This road would have a series of 'fingers' that protrude out from the access platform to each pier and abutment. An indicative route of the access road has been identified (refer Figure 6-3). The route has been selected to minimise impact on native vegetation and would be finalised during detailed design.

The haul road and bridge access road would require temporary crossings of Tarcutta Creek.

A haul road and temporary crossing across Keajura Creek are also likely to be required. The route would be selected to minimise impact on native vegetation and would be determined during detailed design.

All temporary creek crossings would be designed in accordance with the Department of Industry and Investment (formerly the Department of Primary Industries) (2003) *Policy and Guidelines for Fish Friendly Waterway Crossings* and in consultation with the Department of Industry and Investment. The crossings would be designed to accommodate a 1 in 2 year flood event, and the roads would be designed and constructed to allow water to safely overtop in a larger flood event and to prevent erosion of the road surface.

Portions of the haul roads and bridge access road may be retained during operation to provide permanent access to infrastructure such as spill containment basins and bridge abutments.