CrossRiverRail

# Environmental Impact Statement

## Executive Summary

July 2011

Australian Government

Nation Building Program

Queensland Government

SINCLAIR KNIGHT MERZ SKM aurecon CRR JOINT VENTURE

# Contents

# 1 Introduction

## 1.1 Cross River Rail proponent

The Proponent for Cross River Rail is the Queensland Government. The detailed feasibility phase for Cross River Rail, including the environmental impact statement (EIS) is being managed by the Director-General of the Department of Transport and Main Roads (TMR).

## 1.2 Environmental Impact Statement

The EIS, of which this summary is a part, is one element of the detailed feasibility phase being undertaken by the Proponent to develop, assess and ultimately decide whether to proceed with Cross River Rail. Other elements of the detailed feasibility phase include:

- the business case
- design studies, including a reference design, transport studies, architecture and urban design, and systems and operational studies
- stakeholder and community consultation.

The EIS has been prepared in accordance with terms of reference (ToR) issued by the Coordinator-General under the *State Development and Public Works Organisation Act 1971* (the SDPWO Act).

The objective for the EIS is to ensure all potential environmental, social and economic impacts of the project are identified and assessed, and to propose measures to avoid, or minimise, mitigate and manage adverse impacts. The EIS is also intended to inform interested parties, including those who would be directly affected by Cross River Rail either in its construction or operation, or both. The EIS provides information important to government agencies and other statutory entities in their planning and delivery of services and facilities.

The EIS comprises:

- this summary
- Volume 1 – chapters responding to the ToR and summarising a range of technical inputs
- Volume 2 – planning layouts for the Cross River Rail route, indicative long-sections and cross-sections, and indicative designs for stations and other structures
- Volume 3 – a compilation of technical reports addressing a range of issues raised either by the ToR, the consultation process or the design development studies.

## 1.3 Consultation

The consultation and stakeholder engagement process has been designed and implemented to inform development of the Cross River Rail reference design and development of the EIS. The EIS has relied upon this process to access information about community values and issues of concern, and to identify stakeholder issues to be addressed through the design, construction and operations phases.

### 1.3.1 Consultation process

The consultation process comprises a preliminary phase, consisting of three rounds of structured community interactions, and a notification phase. The preliminary consultation commenced with the detailed feasibility phase to support development of the ToR, the reference design and prepartation of the EIS.

The notification phase, comprising the fourth round of structured community interactions, runs concurrently with the release of the EIS. Its purpose is to inform the community, government agencies and stakeholders in time for their submissions about the EIS to be made to the Coordinator-General within the period specified.

Figure 1-1 provides an overview of the community and stakeholder consultation process for the Project.

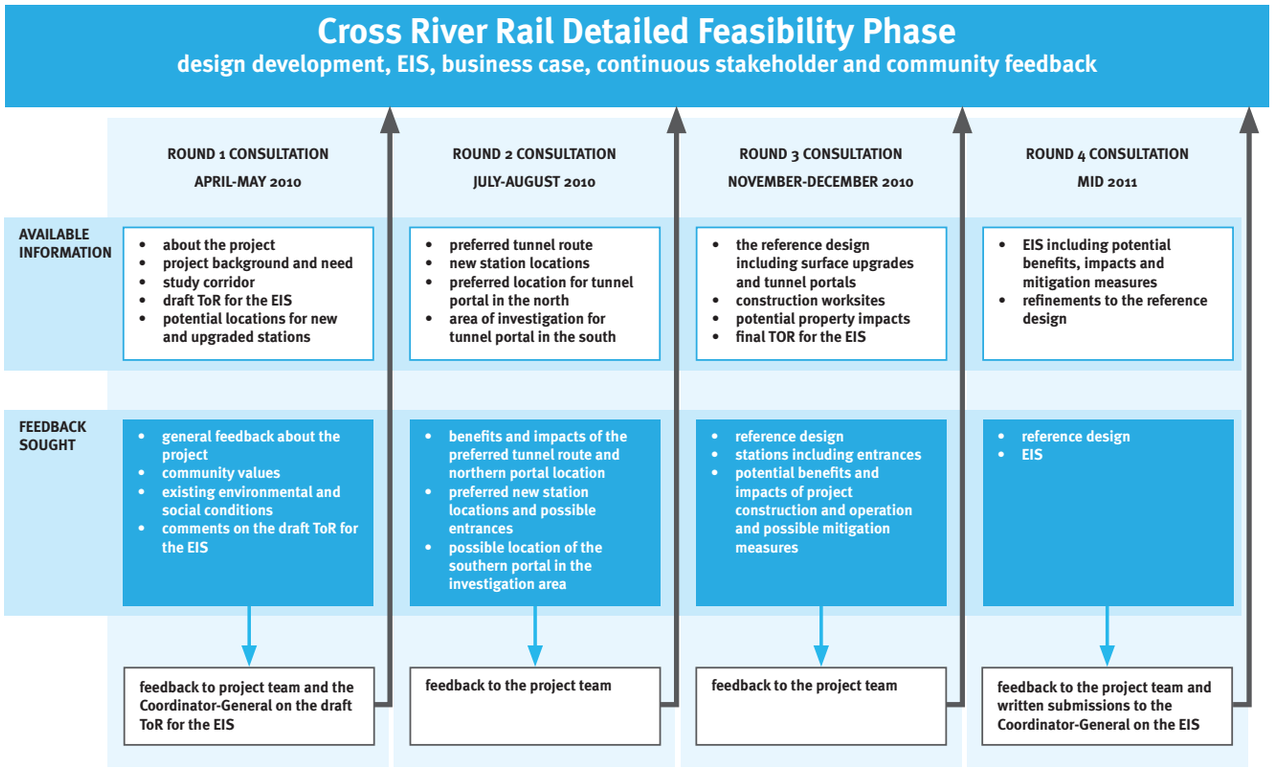



*Figure 1-1 Community and stakeholder consultation*

### 1.3.2 Preliminary consultation phase

The preliminary consultation phase included three rounds of activities including the circulation of newsletters, updates on the project website (www.crossriverrail.qld.gov.au), maintaining a toll-free telephone enquiry service (1800 462 730) and email enquiry service, establishing local advisory groups and hosting community information sessions throughout the study corridor.

Through the preliminary consultation process, local advisory groups were established in the northern and southern sectors of the study corridor. These groups considered information about the Project and provided feedback on design matters. They also assisted the project team identify and understand the significance of issues to particular communities.

The southern group was effective in communicating concerns about the location of the southern portal and about construction impacts such as traffic, noise and dust. The northern group was effective in communicating views about the central business district (CBD) station design and entry locations, as well as potential construction impacts on businesses along and above the tunnel alignments.

The EIS findings are that most of these issues either have been avoided or minimised through design development or through recommended environmental management measures in the draft Outline Environmental Management Plan (EMP). With regards to the construction-related issues, community concerns need to be balanced against the long-term benefits that would be delivered by the Project.

In parallel with these community-based activities, numerous scheduled workshops with government agencies and stakeholders were conducted during design development and preparation of the EIS.

The agency workshops were conducted on an interactive basis and addressed issues relating to the technical studies. Discussions confirmed the methodological approaches, the data sources, assumptions, adoption of specific standards or goals for environmental management, and provided feedback in relation to on-going studies and their findings. The intention underpinning these workshops was to build a high level of rigour into the EIS as it was being developed and to inform the project team of agency requirements ahead of finalising the reference design and the EIS.

Property owners whose land has been identified as being required for the Project, have been notified about the Project. One-on-one meetings have also been held at the request of directly-affected property owners.

Other stakeholder meetings included organisations and service providers whose interests would likely be affected by the Project.

Stakeholders with interests in key sites along the proposed alignment of Cross River Rail include the RNA (RNA Showgrounds and Bovis Lend Lease development), Department of Public Works (Woolloongabba, Boggo Road/Dutton Park, Roma Street Parkland), the Urban Land Development Authority (ULDA) (Bowen Hills/RNA Showgrounds and Woolloongabba), Queensland Rail (Mayne Rail Yard, Exhibition Loop, Clapham Rail Yard and the existing stations and track), and Brisbane City Council (Victoria Park, Brisbane Botanic Gardens and the surface road network).

### 1.3.3 Commonwealth engagement

The Commonwealth Government was consulted in parallel with the preliminary consultation process. The Commonwealth has interests in protecting matters of national environmental significance, under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), as well as protecting its interests in land, including leased land.

A referral of Cross River Rail to the Commonwealth Government was made under the EPBC Act to ascertain whether the Project would be a controlled action. After extensive consultation about the Project, the authorised delegate for the Minister for the Environment determined that Cross River Rail would not be a controlled action if conducted in a particular manner. The decision dated 28 July 2010 required that the following measures be taken to avoid significant impacts on Commonwealth land and Wetlands of International Importance:

- the Swanbank site must be used as the spoil placement site
- the proposed tunnel alignment must not be closer than 200 m from the boundary of any building identified as occurring on Commonwealth land and/or as a Commonwealth Heritage Listed place.

The reference design, on which the EIS is based, satisfies these requirements. The Commonwealth Government also has been engaged in the development of the Cross River Rail concept through the partial (majority) funding of the detailed feasibility phase[1].

[1] *The Commonwealth Government contributed $20 million towards the cost of the detailed feasibility phase under the Nation Building Program.*

### 1.3.4 Notification phase

The notification phase adopts the formal process established under Part 4 of the SDPWO Act for a declared 'significant project'.

The EIS for Cross River Rail is required to be notified with an opportunity for people to view it and to make submissions to the Coordinator-General.

The consultation activities to be undertaken during the EIS notification period include a newsletter, a website update with access to the EIS, meetings with local advisory groups, workshops with agencies and stakeholders, and maintenance of toll-free telephone and email enquiry services. Directly-affected landowners would also be notified to ensure this group is updated on progress with the detailed feasibility phase.

Upon completion of the notification period, the Coordinator-General will consider each submission as part of the evaluation of the EIS. The notification period is of eight weeks duration. Submissions should be made in writing, signed by each person making the submission, state the name and address of each person making the submission, and state the grounds of the submission and the facts and circumstances relied upon in support of those grounds.

Submissions to this EIS should be addressed to:

The Coordinator-General

EIS Project Manager – Cross River Rail

Significant Projects Coordination

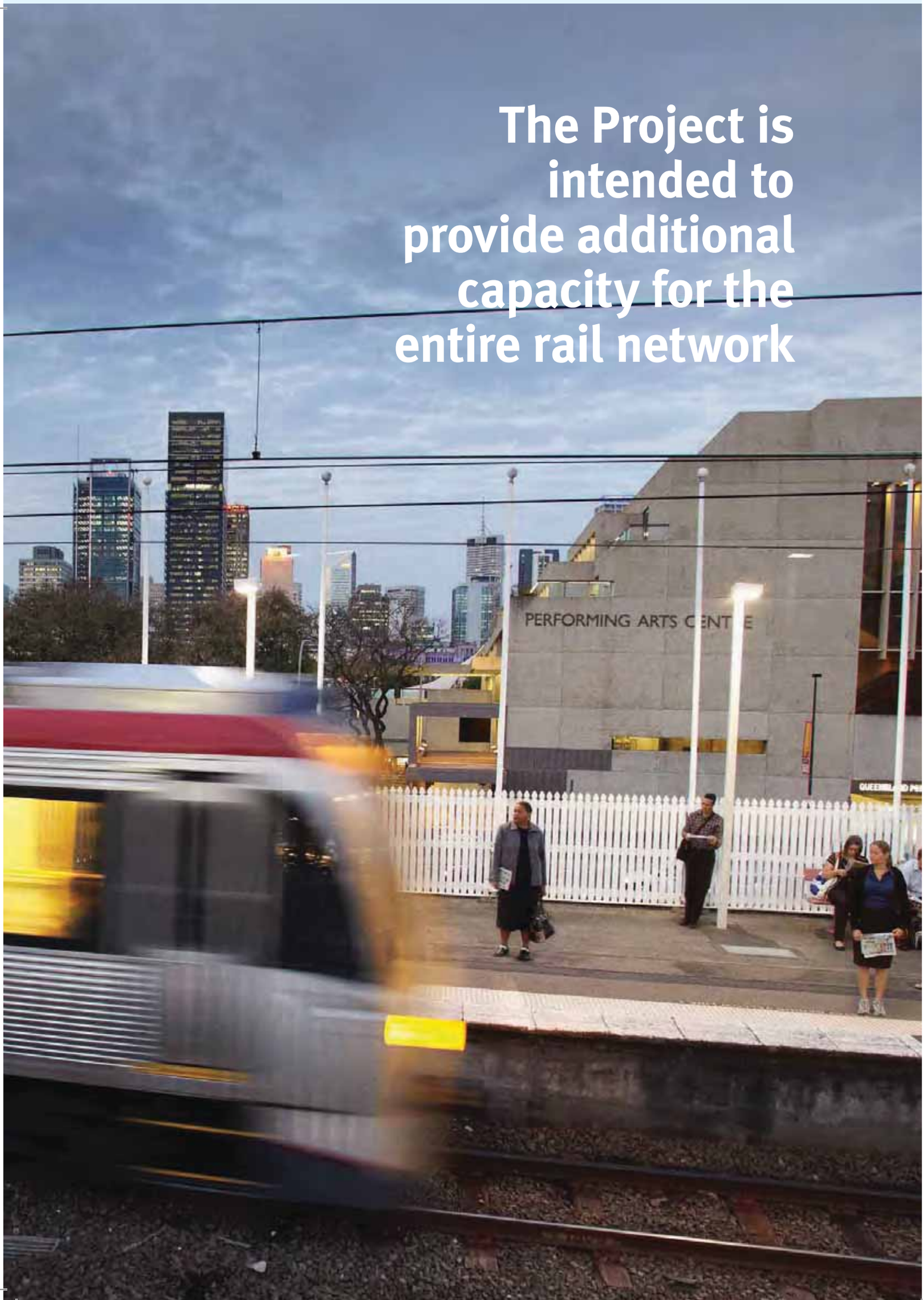
**Department of Employment, Economic Development and Innovation**

Post: PO Box 15517 City East Qld 4002

Fax: 07 3225 8282

Email: crr@cg.qld.gov.au

Submissions can be posted, faxed or emailed.




# The Project is intended to provide additional capacity for the entire rail network

# 2 Cross River Rail

## 2.1 Background

In response to growing patronage on the urban commuter rail network, increasing demand for freight rail services, and in anticipation of continued patronage growth arising from population growth, employment growth and economic development in South East Queensland, the Queensland Government commissioned the Inner City Rail Capacity Study (ICRCS) in 2008. The purpose of the ICRCS was to develop an Inner City Rail Master Plan that "...specifies the projects, estimated costs, staging and timing for the future development options for Brisbane's inner city rail network" (Queensland Transport 2008).

The constrained capacity of the inner city rail network was identified as a critical issue for the potential of rail to address increased travel demand over the planning period to 2031 and beyond. An integrated land use and transport solution was proposed in response to the inner city rail transport constraints.

Cross River Rail is intended to transform the configuration and performance of Brisbane's rail network, with flow-on implications for the South East Queensland rail network, by providing a high-capacity connection between the Gold Coast and Beenleigh lines in the south and the Brisbane inner city rail network, with connections to the Exhibition Loop and the North Coast line in the north. The Project is intended to provide additional capacity crossing the Brisbane River and, consequently, relieve rail traffic congestion on the Merivale Bridge at South Brisbane and through the CBD.

## 2.2 Project goals and objectives

Consistent with the draft Connecting SEQ 2031: An Integrated Regional Transport Plan for South East Queensland (Connecting SEQ 2031), the goals adopted for Project planning relate to:

- economic goals
  - support economic prosperity and employment growth
  - deliver transport efficiently
  - manage congestion
  - develop a resilient transport system
- social goals
  - protect amenity and livability
  - ensure equity and accessibility
  - deliver safety and security
- environmental goal
  - create a low carbon and environmentally responsible transport system.

The Project objectives through which Cross River Rail would address these high-level goals are:

- economic
  - freight and business traffic can move efficiently and effectively
  - transport investment and land use patterns maximise the efficiency of the system, with a focus on getting the best out of the network
  - travel times are reliable and the cost of congestion is not a significant impediment to economic prosperity
  - the transport system has alternative routes available when major incidents or events occur and the vulnerability to reduced supply of oil is reduced.
- social
  - the transport system contributes to making the region a better place to be and enhances amenity in South East Queensland communities
  - people can easily access goods, services, facilities and jobs, with many residents having these available locally or able to easily access them without using a car

**18** kilometre north-south rail line

from Salisbury in the south to Bowen Hills in the north

**10** kilometre underground tunnels

Yeerongpilly, under the Brisbane River to Victoria Park

**4** new underground stations

Albert Street, Roma Street, Gabba, Boggo Road

**2** new surface stations

Yeerongpilly, Ekka

**2** upgraded stations

Moorooka and Rocklea

  - people feel safe and secure using the transport system and there is a steady reduction in the occurrence of crashes on the road and rail network.
- environmental
  - greenhouse gas (GHG) and other environmental emissions are reduced by increasing public and active transport use, reducing overall transport demand, using transport more efficiently and increasing the proportion of fuel-efficient and alternative fuel vehicles in the fleet.

The high-level goals, and more specifically the project objectives informed the development of the Project, and the evaluation of the design options for such foundation elements as the location of the portals, the new stations and how the Project would interface with other transport modes and the existing and planned land use pattern.

## 2.3 Project overview

Cross River Rail would be an 18 km north-south rail line comprised of:

- new tracks in each of twin 10 km tunnels from Yeerongpilly under the Brisbane River to Victoria Park at Spring Hill
- four new underground stations at Roma Street and Albert Street in the Brisbane CBD, Woolloongabba (Gabba Station) and Boggo Road Urban Village (BRUV) at Dutton Park (Boggo Road Station)
- two new surface stations at the RNA Showgrounds at Bowen Hills (Ekka Station) and Yeerongpilly, with existing surface stations at Moorooka and Rocklea to be upgraded
- new surface tracks in the south, between Salisbury and Yeerongpilly, and in the north through the RNA Showgrounds and Mayne Rail Yard to connect with the North Coast Line at Breakfast Creek
- a ventilation and emergency access building at Fairfield.

The Project would provide high-capacity services from the north and the south to the Brisbane CBD via the new stations at Roma Street and Albert Street. Cross River Rail would relieve the existing congestion at Central Station, which is the busiest station in the metropolitan rail network, in terms of passenger movements.

The new underground stations at Woolloongabba (Gabba Station) and Dutton Park (Boggo Road Station) would also support planned urban growth centres as well as provide modal interchanges with the South East Busway and the Eastern Busway respectively. The Boggo Road Station would also complement the link with the Eastern Busway to the University of Queensland at St Lucia.

The new stations at Yeerongpilly and at the RNA Showgrounds at Bowen Hills (Ekka Station) would support other planned urban growth centres in those suburbs. Station upgrades provided at Moorooka and Rocklea would serve residential communities and employment.

The provision of additional tracks for Cross River Rail for services from the Gold Coast and Beenleigh lines, would free up a dedicated dual gauge track for freight between Salisbury and Park Road. This would allow off-peak passenger services to increase without impeding freight paths, and would complete the missing link in the freight rail network between Acacia Ridge and the Port of Brisbane.

New rollingstock being procured separately by Queensland Rail to cater for growth across the rail network would be used on Cross River Rail.

The new underground stations would be designed to meet strategic land use and planning intentions in each location. For example, Roma Street, Woolloongabba and Boggo Road Stations would integrate with surface public transport and also with planned land use initiatives which seek to optimise the value of the infrastructure investment.

The Albert Street Station is planned to service an existing need and to support regeneration of the CBD, while the Ekka Station and new Yeerongpilly Station would support planned redevelopment as part of urban development areas and transit oriented development sites, respectively.

Figure 2-1 provides an overview of the reference design.

*Existing bus – rail interchange, Boggo Road*


*Figure 2-1 Cross River Rail*

## 2.4 Reference design

The reference design for Cross River Rail ultimately would accommodate nine-car train sets which are to be introduced to services in the future. In the interim period, six-car train sets would operate through the Cross River Rail system.

### Surface railway works

Additional surface rail tracks for the Project would accommodate the increased demand for passenger rail services and to separate freight, all-stop passenger services and Cross River Rail limited stop services.

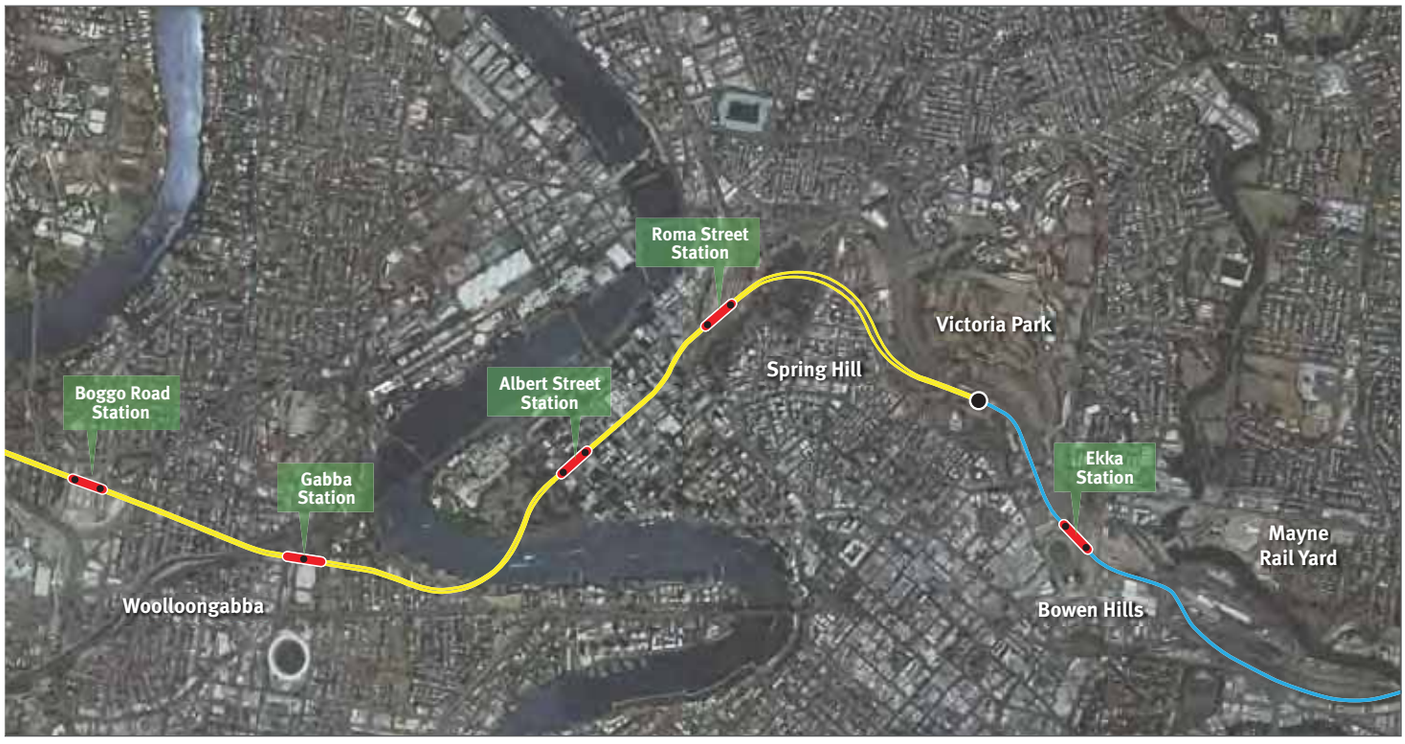
### Northern track works

The northern surface works would extend from the Exhibition Loop, through the RNA Showgrounds to Mayne Rail Yard along the existing rail corridor. Northern rail surface works, including those in Mayne Rail Yard, are shown in Figure 2-2.

The two Cross River Rail tracks would merge with the Exhibition Loop in Victoria Park to the west of Bowen Bridge Road. The Cross River Rail tracks pass through the new Ekka Station with the existing freight tracks relocated to the outside. O'Connell Terrace would need to be raised to achieve a clearance of 6.1 m to the new tracks, consistent with Queensland Rail standards. The O'Connell Terrace crossing of the Exhibition Loop would also be widened to accommodate the additional tracks, and the long-term development of O'Connell Terrace.

After passing under O'Connell Terrace and the Inner City Bypass (ICB), the Cross River Rail tracks would pass through Mayne Rail Yard. The new tracks would be on an elevated structure consisting partly of a viaduct approximately 9.5 m above ground, before rejoining existing tracks of the North Coast Line, south of Breakfast Creek.

*Exhibition Loop, Inner Northern Busway and Inner City Bypass*




## Southern track works

The southern surface works include passenger and freight rail upgrades and modifications.

Two new Cross River Rail passenger tracks are approximately 5 km long and would extend from the existing tracks south of Rocklea Station, through the new Yeerongpilly Station, and into the Cross River Rail tunnels north of Yeerongpilly Station.

The south-bound Cross River Rail track would include a single viaduct extending approximately 710 m in length and 9 m above ground on the eastern side of the corridor from near Moorooka Station to just south of Rocklea Station where it merges with the main surface south-bound track. The north-bound Cross River Rail track would pass to the west of the Clapham Rail Yard but inside the new dual-gauge freight track, before passing through the new Yeerongpilly Station and into the tunnel north of Yeerongpilly Station.

New stabling facilities would be provided for Cross River Rail trains at Clapham Rail Yard south of the new Yeerongpilly Station. The stabling yard would be designed to accommodate both six-car and nine-car trains for use on Cross River Rail and from the north (Sunshine Coast, Caboolture and Moreton Bay). Trains from other services may stable there as needs dictate.

A new dual-gauge freight track would be provided on the western side of the surface corridor from Acacia Ridge to just south of Tennyson junction. Two freight passing tracks would be provided within Clapham Rail Yard. The existing tracks would be modified for new junctions and track realignments between Rocklea Station, Moorooka Station and Yeerongpilly Station.

The new Yeerongpilly Station would be re-developed to provide straight platforms for all tracks, to remove freight and coal trains operating on tracks adjacent to the platforms, and to facilitate the possible future reconfiguration of Tennyson Junction. Southern surface track works are shown in Figure 2-3.

*Open level crossing, Beaudesert Road (service road), Salisbury*


*Figure 2-2 Northern rail surface works*

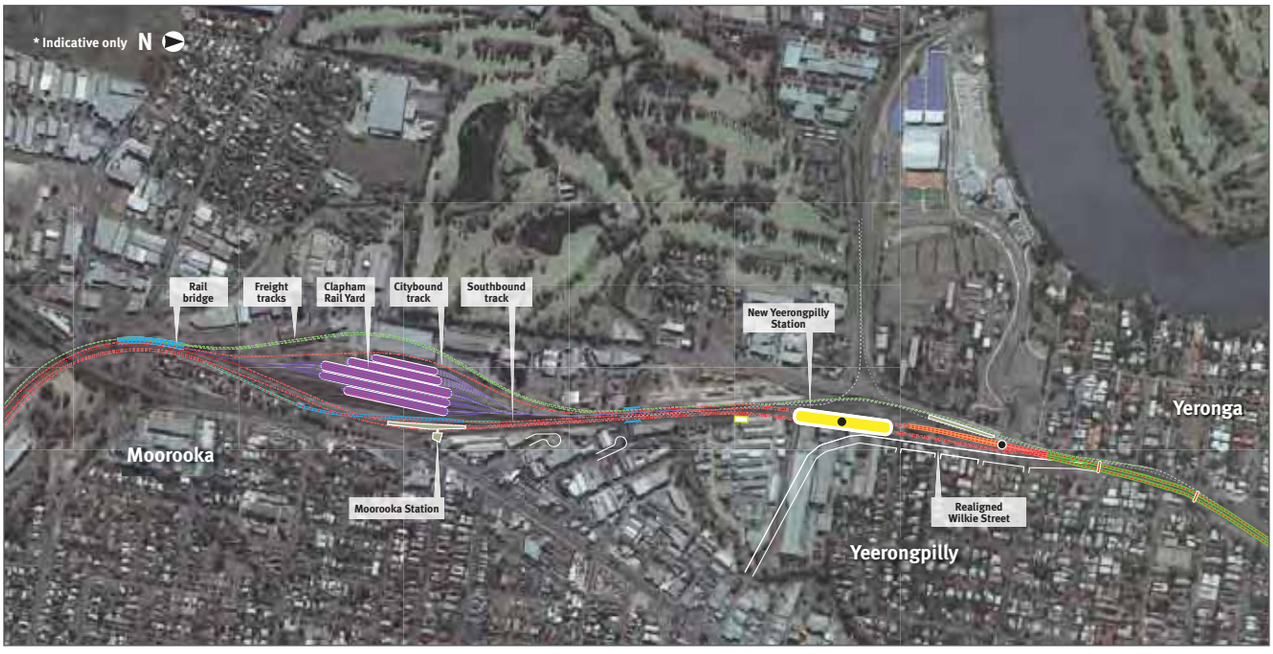



*Figure 2-3 Southern rail surface works*

**Legend**

- Existing rail centrelines
- Narrow gauge track
- Dual gauge track
- Yard tracks
- New platform
- Station entry point
- Train stabling
- Existing station
- Portal
- Power supply
- New works
- Mined tunnel
- TBM tunnel
- Dive/transition structure
- Cut and cover structure
- Embankment
- Bridge/viaduct
- Road bridge

## Southern road works

The widening of the rail corridor for the additional tracks in the southern section requires some changes to the adjacent road network. Some of these road changes would involve major roads and include:

- reconfiguring the Muriel Avenue – Fairfield Road intersection to accommodate a new raised rail bridge adjacent to and west of the existing bridge
- realigning the south-bound ramp on to Ipswich Road, to accommodate the new Cross River Rail track.

Other changes to the local road network, to accommodate Cross River Rail surface tracks, would include:

- cul-de-sacs at Unwin Road and Evesham Road to accommodate the widening of the rail corridor
- reconfiguring the Station Street link under the Ipswich Motorway bridge to accommodate an additional rail line
- reconfiguring the intersection of Railway Parade/Railway Terrace/Fairlie Terrace and the intersection of Fairlie Terrace/Beaudesert Road (service road) as well as realigning Fairlie Terrace
- signalising the intersection of Gladstone Street and Muriel Avenue
- closing the Beaudesert Road (service road) open level crossing and realigning the Beaudesert Road (service road), while providing emergency access to Beaudesert Road for major flood events
- realigning the Heaton Street/Beaudesert Road (service road) intersection
- reconfiguring Tramore Street, to provide two way access and signalising the existing intersection of Beaudesert Road, Tramore Street and Lillian Avenue
- realigning Dollis Street to the west to accommodate an additional rail line within a widened rail corridor.

These changes in local roads would retain local connectivity while closing an open level crossing, and have been the subject of consultation and discussion during the preliminary consultation phase for Cross River Rail.

Southern road works to be undertaken as part of the Project are shown in Figure 2-4.

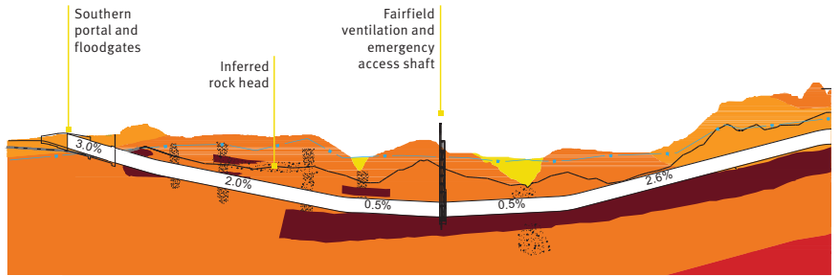

*Figure 2-4 Southern road works*

**Vertical tunnel alignment showing geological formations**

- Alluvium
- Neranleigh-Fernvale Beds (metamorphosed sedimentary rock)
- Brisbane Tuff (ignimbrite)
- Mudstone/Sandstone
- Aspley Formation (sandstone, longlomerate)

**Preferred tunnel boring machine routes**

- Tunnel Boring Machine No. 1 Route
- Tunnel Boring Machine No. 2 Route
- Tunnel Boring Machine No. 3 Route
- Tunnel Boring Machine No. 4 Route
- Cross River Rail Station/Portal locations



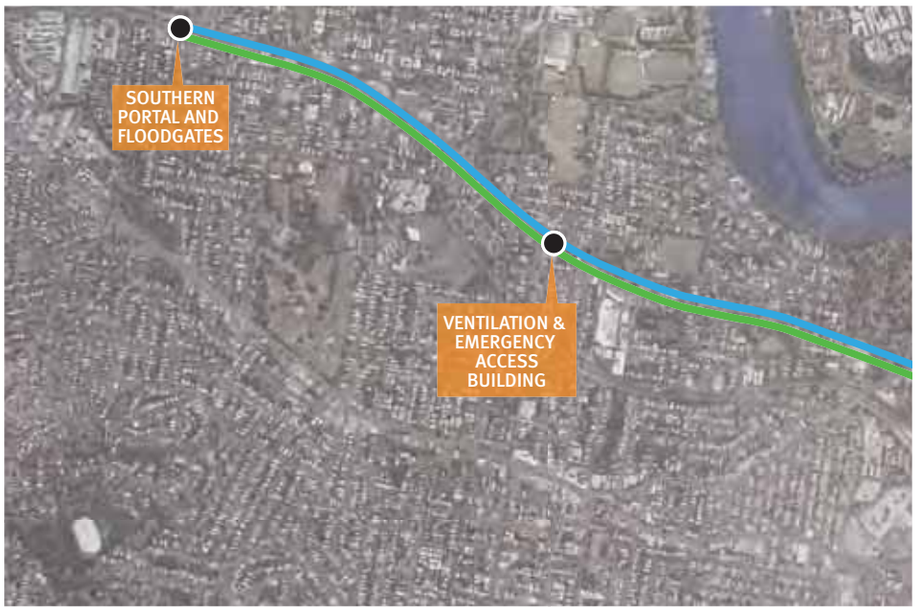
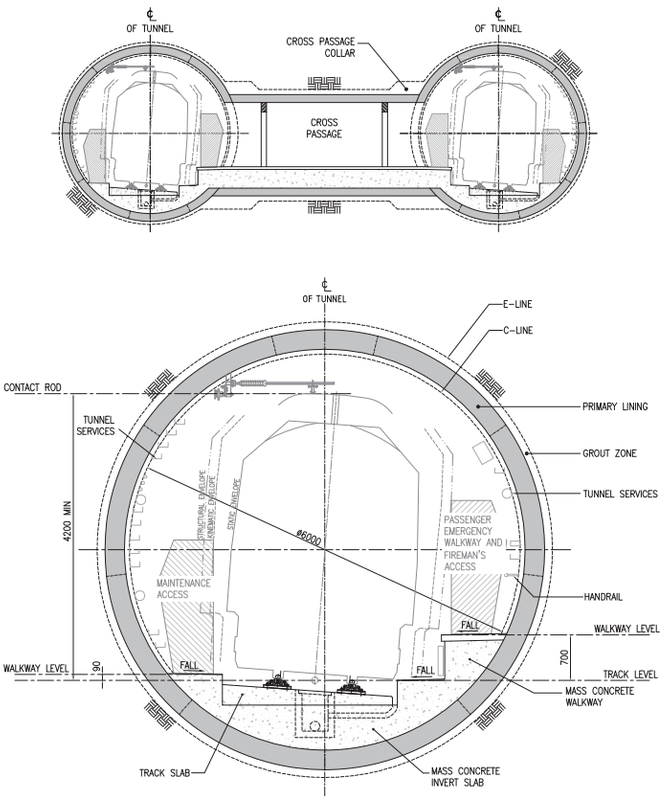




*Figure 2-5 Rail tunnel alignments and geology*




*Typical tunnel cross sections*

## Underground railway and design

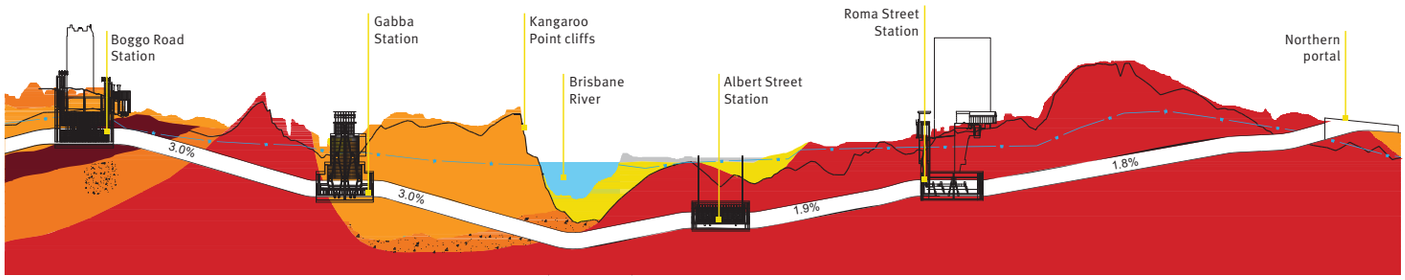
The main underground tracks would be accommodated in twin, single track running tunnels with an internal diameter of 6 m. This dimension is defined by operational, engineering, construction and cost effectiveness requirements for narrow gauge rolling stock. The reference design provides for a train approximately 2.7 m wide and 4.4 m high.

The western tunnel would carry northbound trains and the eastern tunnel would carry southbound trains.

Cross-passages for emergency evacuation would be provided between the main tunnels at intervals of approximately 240 m. Each of the main tunnels would be equipped with emergency systems and services such as communications, evacuation measures and ventilation.

The vertical alignment of the main tunnels is dictated by geological conditions and topography, the location of stations, the gradients for operating railway requirements, and the requirements to connect with the surface rail network. The maximum gradient for Cross River Rail is 3%.

The tunnel gradients are illustrated in Figure 2-5.





There would be two low points, one being under the Brisbane River and one being under Fairfield Road. The tunnel system would be at its deepest points below Spring Hill (50 m) and Kangaroo Point at the cliffs (55 m).

The reference design would accommodate train speeds of up to 130 kph along some sections of track. However, actual speeds would be governed by Queensland Rail operational requirements for Cross River Rail trains inter-facing with the network and surface services.

## Northern portal

The northern tunnel portal and dive structure would be located within the existing rail corridor on the Exhibition Loop, extending into Victoria Park. Both south-bound and north-bound tracks for Cross River Rail would use the common portal and dive structure. The northern portal would be well clear of flood waters associated with a 1 in 10,000 year flood event.

The northern portal allows for a possible future connection of the North West Transport Corridor (NWTC) with Cross River Rail and the surface rail network should the NWTC proceed.

## Southern portal

The southern tunnel portal and transition structure would be located to the east of the existing rail line, south of Cardross Street, Yeerongpilly, with the Cross River Rail tracks achieving 'grade' at or just south of the existing Yeerongpilly Station. The southern portal would transition into separate cut-and-cover tunnels, before the driven tunnels commence south of Cardross Street. A floodgate structure would also be incorporated in the southern portal to provide the desired immunity for a 1 in 10,000 year flood event.

## Ventilation and emergency access building

The length of the Cross River Rail tunnels between Boggo Road Station and the southern portal at Yeerongpilly requires a ventilation and emergency access building at Fairfield to ensure the safety of passengers in the event of an emergency.

This building would be located at Fairfield on property owned by Energex between Bledisloe and Sunbeam streets, and a small area of road reserve at Fairfield Road and Railway Road. The structure would include ventilation equipment for the main tunnels, stairs to the surface for emergency egress, pumps to remove groundwater that may have entered the tunnels, and maintenance and emergency services access.

The ventilation building would be approximately 24 m in length, 7 m in width and 5 m in height. A ventilation outlet, approximately 8.5 m high would also be required to protect the ventilation ducts in a 1 in 10,000 year flood event.

The ventilation equipment would be for emergency use and used occasionally to remove excess heat from the main tunnels.

Figure 2-6 provides a perspective of the building from Fairfield Road.

*Figure 2-6 Indicative view of the ventilation and emergency access building from Fairfield Road*

## Stations

Cross River Rail would include four new underground stations, situated at Roma Street, Albert Street, Woolloongabba and Dutton Park (Boggo Road). Two surface stations would also be constructed at Yeerongpilly and the RNA Showgrounds (Ekka) to achieve desired service requirements. Modifications would be made to existing stations at Rocklea and Moorooka, while the overhead footbridge at Salisbury Station would be extended.

The underground stations would be designed and constructed to key principles, including:

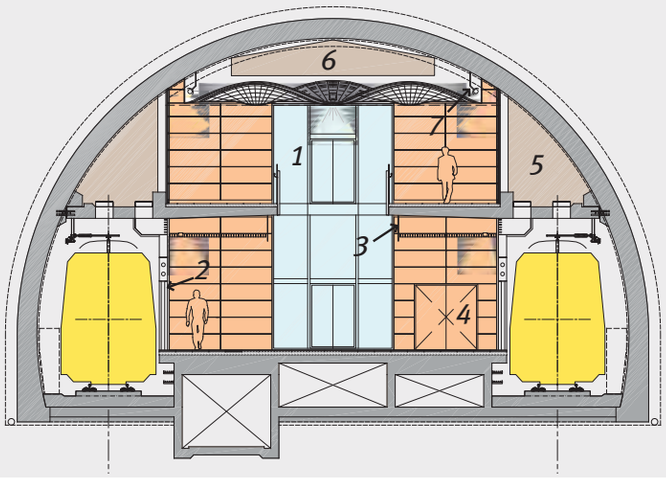
- platforms to be 220 m in length to accommodate future services by nine-car train sets
- capacity to accommodate forecast passengers moving between the surface and the underground platforms in the two hour morning and afternoon peaks
- platform and pedestrian concourses of a size, with sufficient floor space for passenger standing (Level of Service – LOS C) under normal commuter operating conditions
- platforms at each station to be ventilated to maintain passenger comfort at a maximum of 26°C
- platforms at each station to be fitted with automatic platform screen doors for safety, air quality management and passenger comfort
- fully automated passenger information systems
- each station to meet fire and life safety requirements, including emergency access and evacuations
- each station to be immune from inundation in a 1 in 10,000 year flood event as well as specified higher-frequency events
- stations to be designed and equipped with adequate lighting, communications and security systems such as CCTV to create a safe environment for all passengers and employees in all areas of the station.

Environmental design features would be incorporated into both underground and surface stations, including:

- water sensitive urban design (WSUD) measures to contain and manage stormwater runoff
- landscaping for visual amenity and improvement of microclimates
- use of natural light where possible
- ventilation used to manage station temperature and air flow
- canopies to shade and provide pedestrian amenity.

The design and works for surface stations would reflect the environmental context of the local and regional areas.

A typical cross section of an underground station is shown in Figure 2-7.




*1. Passenger lift*
*2. Platform screen door*
*3. Platform ventilation duct*
*4. Fire escape door*
*5. Over track exhaust*
*6. Smoke duct*
*7. Continues indirect light*

*Figure 2-7 Typical underground station – cross-section*

## Ekka Station

Cross River Rail proposes a new station in the RNA Showgrounds precinct, abutting the southern alignment of O'Connell Terrace. The new Ekka Station would have access from O'Connell Terrace as well as from the public areas of the RNA Showgrounds.

The new Ekka Station would operate in normal commuter mode all year, as well as accommodating Ekka events. The new station is shown in Figure 2-8.

The new station would have two entries to maximise the 'walk-up' catchment and to service nearby 'destinations' such as the Royal Brisbane and Women's Hospital (RBWH), the Bowen Hills transit oriented development (TOD) and the RNA Showgrounds.

The surface works associated with the redevelopment of the Ekka Station would include design elements to enhance the interface with the RNA Showgrounds, nearby public transport (bus), and pedestrian and cycle desire lines.

*Figure 2-8 Ekka Station – indicative view towards O'Connell Terrace*

## Roma Street (underground) Station

The new underground station at Roma Street would be aligned across and beneath the existing station's surface platforms to align with the tracks from the new Albert Street Station. The new underground station would effectively become platforms 11 and 12 of the integrated Roma Street Station as shown in Figure 2-9.

The platform in the Roma Street Station would be approximately 25 m beneath ground level and approximately 220 m in length. There would be two entry points to the Cross River Rail platforms. One entry would connect with the underground concourse to the existing surface rail and busway platforms. This concourse also provides access to the Roma Street Parkland, upper Albert Street and Spring Hill.

The second entry would be to the north-west of Emma Miller Place, providing a new entry from Roma Street.

This entry would connect with the potential pedestrian bridge from George Street near the Brisbane Magistrates Court, which in turn links with the Kurilpa Bridge over the river to South Brisbane and South Bank.

Surface works to support the new Cross River Rail infrastructure would include footpath and pedestrian crossing enhancements for increased capacity and improved safety. Other surface works would reconfigure Parkland Boulevard to enable the delivery of the southern Cross River Rail entry and public plaza.

The new Roma Street services and surface works would provide for some future redevelopment of the Roma Street Station site. This development is not part of the Project.

Figure 2-9 shows an indicative cross section of the Roma Street Station.

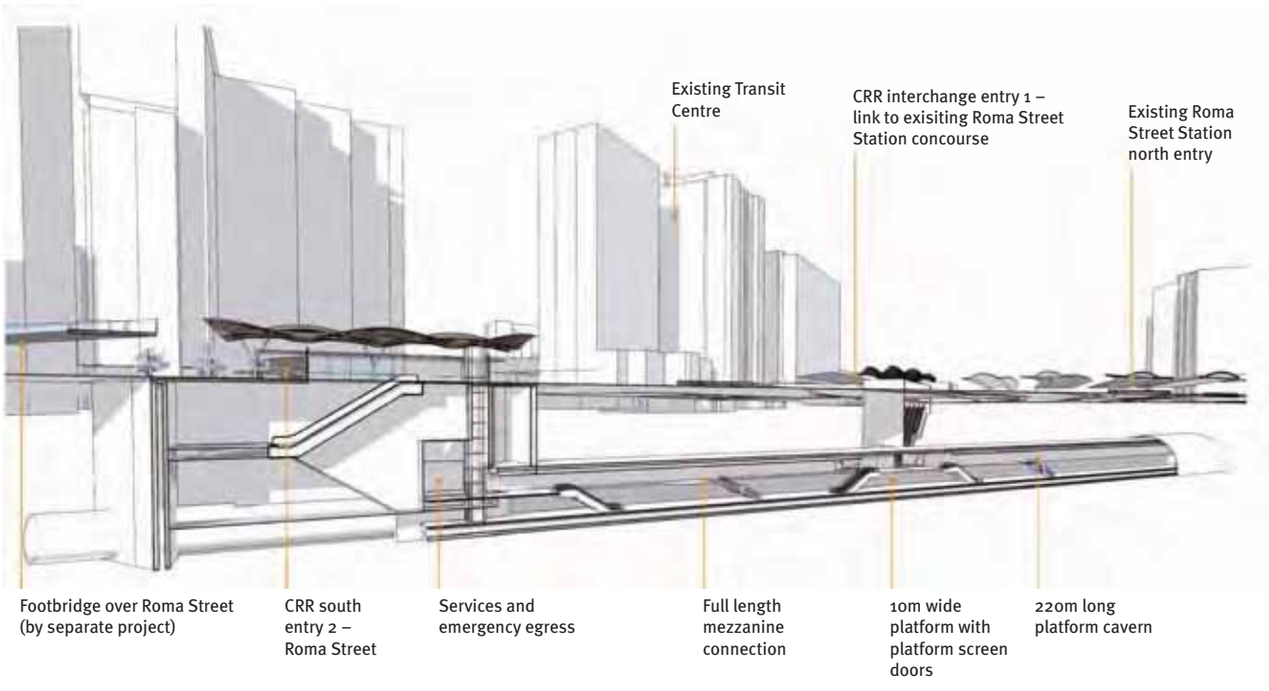



*Figure 2-9 Roma Street Station – indicative cross section*

## Albert Street Station

Albert Street Station would be located beneath Albert Street between Alice Street and Mary Street, in the Brisbane CBD. While the rail tunnels and station cavern would be contained largely within the Albert Street road reserve to minimise impacts on adjacent property, existing buildings and development approvals, the surface elements of the station would occupy the ground level of sites on two street corners.

Figure 2-10 shows an indicative cross section of the Albert Street Station.

The northern station entrance would be situated on the corner of Albert Street and Mary Street, while the southern station entrance would be situated on the corner of Albert Street and Alice Street. A third entrance would be situated on the southern side of Alice Street adjacent to the Botanic Gardens, to provide for passengers bound for or from the Queensland University of Technology (QUT) Gardens Point campus and the parliamentary precinct.

The Albert Street Station would be situated approximately 31 m below Albert Street. The station cavern would be approximately 220 m in length, excluding pedestrian concourses and associated vertical lifting arrangements.

A suite of surface works would be required to accommodate the Albert Street Station and the pedestrian flows it would generate in this part of the CBD. Such works would include a large covered forecourt and public space at Mary Street, footpath widening in key locations both at intersections and some mid-block locations and adjustments to traffic signals to support pedestrian crossings at the intersections of Albert and Mary streets, and Albert and Charlotte streets. Surface works would also require rearranged kerb space to provide for taxis, drop offs, bus stops and loading bays.

The station design allows for possible future high-rise development to occur over the southern end of the station, ie the corner of Albert Street and Alice Street. This development is not part of this Project.

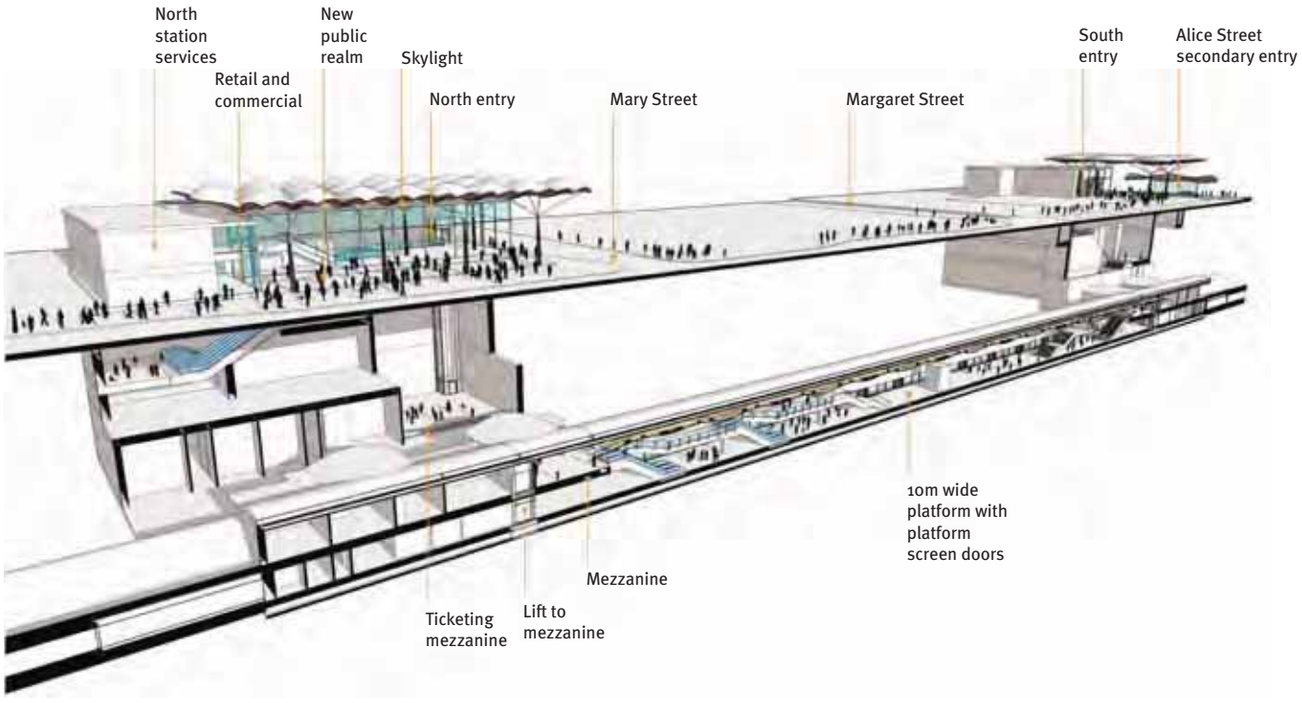



*Figure 2-10 Albert Street Station – indicative cross section*

## Woolloongabba (Gabba) Station

The Gabba Station would be situated in the Woolloongabba urban developement area (UDA) to the east of Leopard Street and bounded by Stanley Street and Vulture Street. It would service the new Woolloongabba UDA, interchange with the busway station and provide a major event station for the Brisbane Cricket Ground ("The Gabba").

Figure 2-11 shows an indicative cross section of the station.

The Gabba Station platforms would be approximately 220 m in length and approximately 28 m below surface level with ticketing at surface level.

There would be one entry point for the station to enable effective crowd management for major sporting events and to serve the local catchment. The central entry would be to the east of Leopard Street and would be visible from Stanley Street. With effective planning for the UDA, a direct line of sight between the station and The Gabba would be achieved.

A range of surface works would be provided with the station to address pedestrian and cycle movements around the site during construction and to address potential capacity issues during major events at The Gabba. The separation distance between the station and The Gabba, would achieve satisfactory dispersal of crowds during events and provide effective station access. A potential pedestrian connection between the Gabba Station and The Gabba is being considered as part of the UDA, and not as part of this Project.

The station design allows for possible future high-rise development to occur over the northern half of the station. While such development is committed at present, any development would be coordinated between the ULDA and TMR and would not be part of this Project.

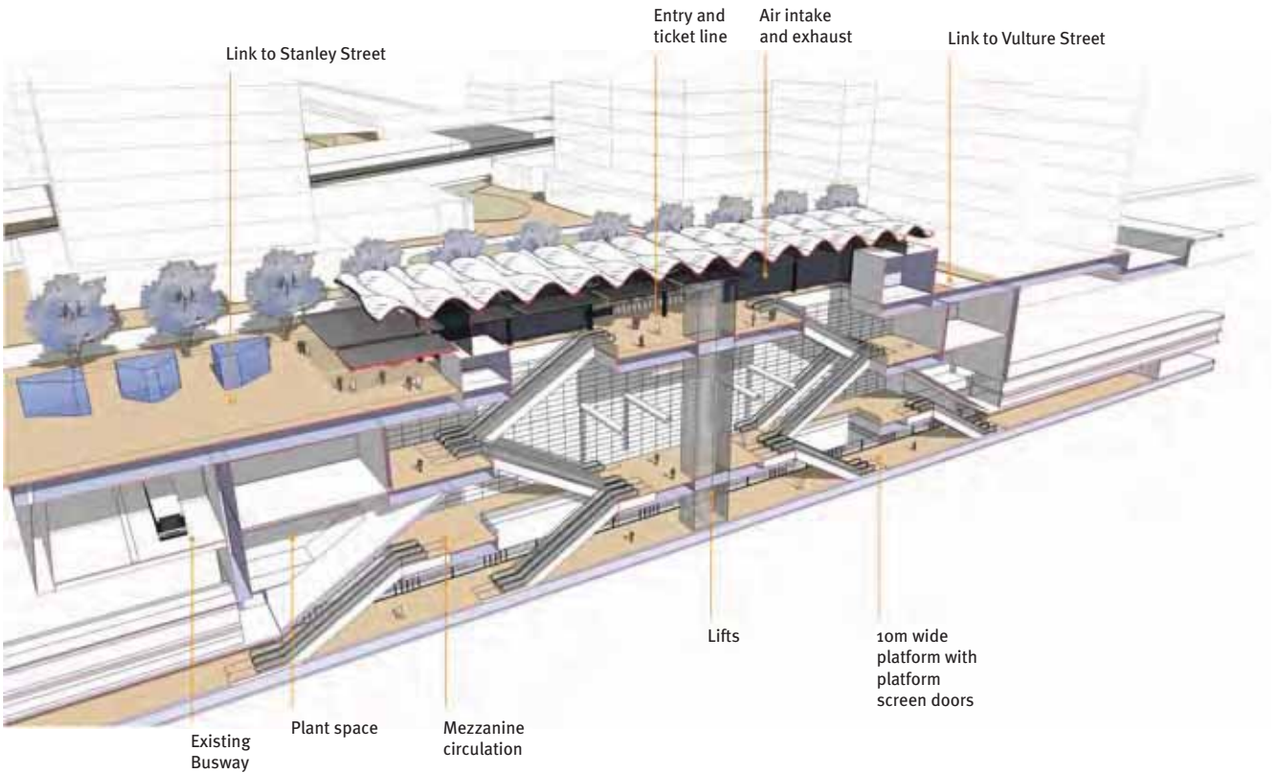



*Figure 2-11 Gabba Station – indicative cross section*

## Boggo Road Station

Boggo Road Station would provide an interchange between Cross River Rail, Park Road Station and the Eastern Busway. The new station would also support the on-going development of the BRUV at Dutton Park. It would be situated between the Boggo Road Busway station to the north and Peter Doherty Street to the south.

The new station would be situated below a pedestrian street located between the Ecosciences building and the former Boggo Road Gaol. The station would be approximately 25 m deep from surface to platform level and would be approximately 220 m in length.

An indicative cross section of Boggo Road Station is shown at Figure 2-12.

One station entry would be adjacent and linked to Park Road Station and the Boggo Road Busway station to allow interchanges between Cross River Rail, the suburban rail services and the busway services. The second entry would be located on the BRUV pedestrian spine to the south-east of the old gaol.

The station would support key destinations such as the Princess Alexandra Hospital (PA Hospital), BRUV and the Ecosciences Precinct, and the University of Queensland. A suite of surface works would enhance pedestrian and cycle movement through the area in the vicinity of the new station.

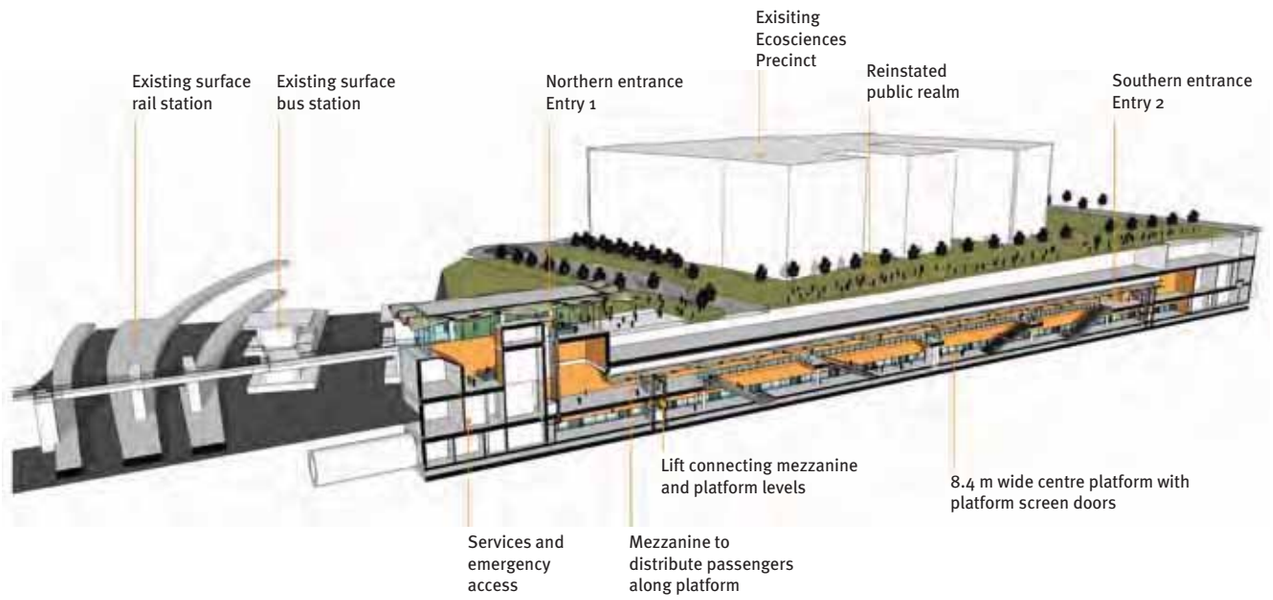



*Figure 2-12 Boggo Road Station – indicative cross section*

## Yeerongpilly Station

A new station would be constructed at Yeerongpilly adjacent to the industrial area south of the existing station, and served by Wilkie Street and Station Road.

The new station would have two side platforms and one island platform linked by a pedestrian overpass. Ticketing and Queensland Rail staff facilities would be located on the eastern side of the station. The island platform and western side platform would be configured to meet the requirements of Cross River Rail, being 220 m long to allow nine-car train sets, while the eastern side platform would be slightly shorter for the suburban services (standard six-car train sets).

The station design would provide a recognisable landmark for Cross River Rail within Yeerongpilly, easily accessed and conveniently located within the existing and future catchment areas.

An indicative view of the new Yeerongpilly Station is shown at Figure 2-13.

While park 'n' ride facilities would not be provided at Yeerongpilly Station as part of Cross River Rail, consideration could be given to the provision of commuter parking in the redevelopment of the Yeerongpilly worksite. This would be undertaken as a separate planning process.

The surface works associated with development of the new station at Yeerongpilly would include reconfiguring Wilkie Street between Cardross Street and Livingstone Street, providing a passenger drop-off and a bus stop adjacent to the new station entry, with another bus stop on Fairfield Road. Facilities for cycle parking would be provided outside the station.


*Figure 2-13 Yeerongpilly Station – indicative view looking west*

### 2.4.2 Project operations

Queensland Rail would manage and operate the Cross River Rail infrastructure and provide the operating passenger trains. Queensland Rail would be responsible for obtaining all necessary operating safety plans, management systems, certificates licenses and approvals, as well as maintaining operational procedures including signalling and fleet maintenance. Scheduling of services would be managed by Queensland Rail in consultation with the TransLink Transit Authority, under current governance arrangements.

The provision of additional rail tracks by Cross River Rail through the inner city would facilitate the separation of the different rail operations (ie express passenger, all-stops passenger) which presently pass through Fortitude Valley, Central and Roma Street stations. Cross River Rail would also facilitate the separation of freight services on the surface tracks from the south and from the north, to the Port of Brisbane.

In its ultimate mode of operation, Cross River Rail would accommodate up to 48 additional trains per hour (two way) through the CBD, creating a combined total throughput of 132 trains per hour. This represents an increase of 57% in train paths compared to the existing maximum capacity of 84 trains per hour through the CBD. With larger platforms, 9-car trains could be accommodated, carrying 50% more passengers on each train.

With such a pronounced change in capacity, the Project would free up surface rail paths at existing bottlenecks such as the Merivale Bridge, enabling additional passenger and freight services to be provided. This enhanced capacity, would facilitate an increase in frequency in passenger services on the surface, while avoiding passenger – freight conflicts in the corridor.

For the operating project, Gold Coast, Beenleigh, Caboolture, Redcliffe and Sunshine Coast services would pass through Cross River Rail, stopping at the new underground stations. All-stop passenger services and freight services would continue to use surface tracks.

Train stabling for Cross River Rail would be provided at new facilities at Clapham Rail Yard and the existing facilities at Mayne Rail Yard. The availability of new stabling facilities at Clapham Rail Yard would remove a major operating constraint in the network by avoiding the need for trains enroute to Mayne Rail Yard from the north, to cross-over the tracks for services from the west, the south and the bayside suburbs.

The proposed operational strategies for Cross River Rail intend to move the network towards a more simple, sectorised future operation involving a service plan focussed on interchange-based delivery of public transport services. This approach is consistent with the high-level intentions of the draft Connecting SEQ 2031. The operating strategies would be supported by the increased capacity provided by Cross River Rail, including the introduction of nine-car train sets to service by 2031.


#### Operations at commencement (est. 2021)

The introduction of Cross River Rail would be based on the following sectors:

- north-south (Cross River Rail) sector – connects the Beenleigh and Gold Coast lines to the Redcliffe and North Coast/Caboolture lines
- east-west sector – connects the Springfield and Rosewood/Ipswich lines to the Airport and Shorncliffe lines
- Brisbane suburban sector – connects the Ferny Grove and Doomben lines to Kuraby and Cleveland/Manly lines.

Table 2-1 compares CBD station peak hour train frequencies in 2009 with those achievable for the morning peak period with the Project in operation.

*Table 2-1 AM peak hour services at CBD stations – 2021*

| Scenario | Services from the south/west to CBD | Services from the north to CBD |
|---|---|---|
| 2009 | 30 | 27 |
| 2021 with Project | 55 | 47 |

In 2021, a total of 47 services would approach the Brisbane CBD from the north during the one hour morning peak. A total of 19 services would approach the city from the west, while 36 services would approach the Brisbane CBD from the south. Of the 36 services that approach the Brisbane CBD from the south, 17 from the Gold Coast and Beenleigh would travel via Cross River Rail and a further 19 would travel via the Merivale Bridge.

The 17 services from the Gold Coast and Beenleigh would operate at four minute intervals during this peak period. At the same time, 24 services from Caboolture and the Sunshine Coast would operate at three minute intervals.

During the off-peak periods, services from the Gold Coast and Beenleigh would operate through Cross River Rail at approximately 10 minute intervals. Services from the Sunshine Coast or Caboolture would operate through Cross River Rail at approximately nine minute intervals.

These operating arrangements represent a substantial increase in and improvement of services, accessibility and convenience for commuters and general passengers across South East Queensland.

Figure 2-14 shows the changes in passenger movements through the CBD stations, ie Roma Street, Central and Albert Street. While in 2021, these stations would each have around 90,000 passenger movements, the growth in CBD passenger movements, to 2031, is pronounced and demonstrates the importance of the proposed Albert Street Station in load sharing.

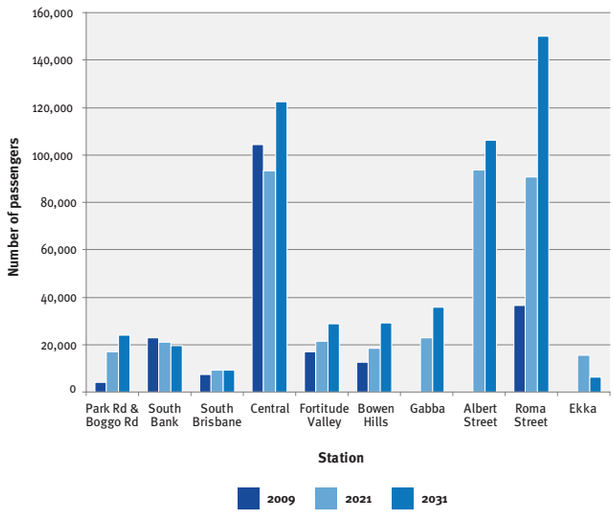



*Figure 2-14 Station boarding and alightings (including transfers)*

## Future operations of Project (2031)

By 2031, the Project would be operating in conjunction with other network enhancements planned in the draft Connecting SEQ 2031. Consequently, more services would be added to the Brisbane rail network, especially from key regional centres such as Strathpine, Caloundra and Redcliffe from the north and Ripley, Flagstone Creek and Elanora from the south.

The 2031 network strategy with Cross River Rail anticipates the introduction of nine-car trains on inter-city/outer suburban sectors and high capacity suburban trains. By 2031, an additional 28 trains would be added to the Brisbane rail network during the morning peak compared to the situation without the Project. This represents a 33% increase in capacity compared to the 'without Project' scenario.

The capacity of the rail system would need to expand to about double its current level to meet peak period demand forecast for 2031. Delivery of Cross River Rail, combined with existing rail infrastructure, new service initiatives and higher capacity trains will make it possible to move up to 240,000 people into the inner city during the two hour peak.

### 2.4.3 Project construction

Construction of Cross River Rail would be a major, complex undertaking involving a number of discrete tasks at numerous worksites along the corridor between Salisbury in the south and Mayne Rail Yard in the north. Careful scheduling is required to ensure the works are completed efficiently and with the least impact. For example, each of the underground stations would need to be excavated in time for the tunnel boring machines to pass through.

## Preliminary works

A range of preliminary activities and works are required for full-scale construction of Cross River Rail to commence. Such activities include:

- communication with the community, and with people living and working adjacent to the works
- detailed design, obtaining necessary approvals for all aspects of the works, and developing site environmental management plans
- property acquisitions
- the relocation of existing services, such as urban infrastructure and rail services (communications, overhead power)
- taking possession of parts of the rail corridor to allow for surface works.

Such preliminary activities and works would progress at different rates for each of the worksites in accordance with an over-arching construction programme developed by the contractor at the time.

## Surface construction works

Cross River Rail would be constructed from a number of surface worksites simultaneously to minimise disruption across the urban area and to the transport network, and to achieve the economies required from an efficient construction programme.

Construction at each worksite would include a range of preliminary construction activities such as worksite preparation, possible demolition of buildings and other structures, earthworks, access and security fencing.

The surface construction works are described briefly in Table 2-2.

*Photo courtesy of Brisbane City Council*

*Table 2-2 Surface construction works*

| Location | Function | Nature of work | Estimated duration (months) |
|---|---|---|---|
| **Mayne Rail Yard** | Construct Cross River Rail viaduct, tie-in and support infrastructure | • Elevated rail on viaduct and reinforced earth structures<br>• Connections with main lines (North Coast Line)<br>• Mayne feeder station | 55 |
| **RNA Showgrounds and O'Connell Terrace** | Construction Ekka Station | • Coordinate with RNA redevelopment<br>• Decommission, demolish Exhibition Station<br>• Construct elevated station<br>• Construct additional surface track<br>• Construct O'Connell Terrace on new vertical and horizontal alignment (widening, raising) | 30 |
| **Victoria Park** | Construct tunnel portals, connections with surface network | • Cut and cover works plus dive structures to establish tunnel portals<br>• Removal of TBMs (Woolloongabba to Victoria Park)<br>• Construct track and connections with surface rail network<br>• Removal of spoil and delivery of materials | 30 |
| **Roma Street** | Construct station, support underground work | • Construct three shafts for station access and station cavern excavation (top-down excavation) near Roma Street, near platform 1 and near platform 10<br>• Construct station cavern (mined excavation)<br>• Surface building works – station entries in Roma Street<br>• TBMs 'walk through' the station cavern<br>• Spoil handling and removal and materials delivery | 59 |
| **Albert Street** | Construct station, support underground work | • Demolition of existing buildings and structures<br>• Construct two shafts for station access and station cavern excavation (top-down excavation) near Alice Street and Mary Street<br>• Construct station cavern (mined excavation)<br>• Surface building works – station entries in Albert Street<br>• TBM 'walk through' station cavern<br>• Spoil handling and removal and materials delivery | 60 |

| Location | Function | Nature of work | Estimated duration (months) |
|---|---|---|---|
| **Woolloongabba** | Construct station, support underground work | • Demolition of existing buildings and structures<br>• Construct station (top-down, cut and cover, piling, drill and blast as required)<br>• Assemble and launch two TBMs northwards toward Victoria Park<br>• Support for underground work – laydown area (segments, general materials) plus deliveries of construction materials<br>• Station entrances, plant and equipment across Stanley Street and Vulture Street<br>• Spoil handling and removal via Vulture Street to Main Street, and materials delivery via Main Street<br>• Both TBMs (Yeerongpilly – Woolloongabba) extracted via station box | 58 |
| **Boggo Road** | Construct station, support underground work | • Construct station (top-down, cut and cover, piling, drill and blast as required)<br>• Construct station lid in advance of station excavation<br>• Station entrances and plant and equipment<br>• Spoil handling and removal and materials delivery<br>• TBM 'walk through' station cavern | 58 |
| **Fairfield** | Construct surface works | • Ventilation and emergency access shaft – construct shaft and building<br>• Spoil removal and material delivery<br>• Install plant and equipment | 15 |
| **Yeerongpilly (Wilkie Street)** | Construct station and surface works | • Building works (station) and station access<br>• Realignment of Wilkie Street and noise barriers<br>• Tunnel dive structures south of Cardross Street<br>• TBM assembly and launch<br>• Spoil conveyor to main site spoil handling and removal by road<br>• Install floodgate plant and equipment<br>• Install noise barriers | 54 |
| **Yeerongpilly (Station Road)** | Major worksite – surface and underground works | • Realign Station Road for site access to Ipswich Road<br>• Site offices and workers' car parking<br>• New tracks (surface) and catenery (overhead power)<br>• Support for underground work – laydown area (segments, general materials)<br>• Spoil receiving, handling and loading facilities<br>• Power and water supply<br>• Handling and installing plant and equipment | 66 |
| **Clapham Rail Yard** | Construct surface works | • Filling and establishing levels for stabling yard – new tracks and catenery<br>• Maintenance facilities<br>• Elevated rail cross-over from Cross River Rail tracks | 42 |
| **Moorooka** | Station upgrade<br>New track | • Station upgrade – building works, station access<br>• Construct new track on viaduct and new track outside Clapham Rail Yard | 42 |
| **Rocklea** | Construct surface works | • Station upgrade – building works, station access<br>• Rail overpass – Muriel Avenue<br>• Road works – Ipswich Road on-ramp<br>• New track – Cross River Rail | 39 |
| **Salisbury** | Support worksite | • Extend pedestrian bridge across new tracks<br>• New track – Cross River Rail<br>• New track – freight | 18 |

Cross River Rail would also entail the construction of additional tracks and associated rail infrastructure on the surface between Salisbury and Yeerongpilly, and between Victoria Park and Breakfast Creek.

In addition to the core activities described for each of the worksites, construction activities for Cross River Rail would entail a suite of standard construction activities and practices including:

- works for the containment, treatment and management of surface water run-off, including stormwater and drainage
- works to mitigate construction impacts such as temporary noise barriers, acoustic enclosures sheds or screens, other screens for night lighting, wheel wash bays, industrial crossings to streets, security fencing and barriers
- for some worksites, spoil storage and handling facilities within ventilated enclosures
- vehicle storage, but excluding vehicle servicing and maintenance
- site offices and construction workforce car parking, including access crossings and driveways
- utilities such as water supply, power, wastewater treatment
- where required, civil works for local access and traffic management.

For some worksites, site establishment activities would entail demolition of existing buildings, earthworks and civil works such as drainage, access, power and telecommunications, as well as relocating utilities.

Acoustic enclosures would be provided for worksites where construction noise is predicted to exceed the requirements for the environmental objectives. For major worksites, such as at Roma Street, Albert Street, Woolloongabba, Boggo Road and Yeerongpilly, construction activities likely to require acoustic enclosures include servicing 24/7 construction underground.

Generally, surface works would occur during day-time hours, ie 6.30 am – 6.30 pm Monday to Saturday. By necessity, surface works, including works in the rail corridor, would need to occur outside these hours. This is to enable the Project to be constructed in a 'live' rail corridor without undue disruption to the normal operation of rail services. Other circumstances would also dictate that surface works also occur outside day-time hours. Where surface works occur outside normal day-time hours, a range of management measures, including regular monitoring, would be required to ensure the environmental amenity and reasonable living conditions for near neighbours are maintained.

## Underground works

The underground works associated with Cross River Rail can be categorised as follows:

- main tunnels and associated works including cross-passages, fit-out, underground track work and catenery
- stations including station caverns, plant and equipment.

A brief description of the underground works is provided in Table 2-3.

*Table 2-3 Underground works*

| Section | Nature of work | Estimated duration (months) |
|---|---|---|
| **Woolloongabba – Victoria Park** | • Driven tunnels at varying depths, including passing beneath the Brisbane River, in rock<br>• Driven tunnels to be constructed by TBMs and supported by pre-cast, reinforced concrete segmental lining<br>• The separation distances between the main tunnels would vary between Roma Street Station and the northern portal to address rail operating radius requirements<br>• Mined cross-passages at 240 m intervals | 14 |
| **Boggo Road – Woolloongabba** | • Driven tunnels at varying depths, constructed by TBMs and supported by pre-cast, reinforced concrete segmental lining – as above<br>• Mined cross-passages at 240 m intervals | 5 |
| **Yeerongpilly – Boggo Road** | • Driven tunnels at varying depths, constructed by cut-and-cover tunnel works then converting to construction by TBMs<br>• Tunnels would be lined with pre-cast, reinforced concrete segments for structural support and water-proofing<br>• Mined cross-passages at 240 m intervals<br>• Ventilation and emergency access building excavated to the level of the tunnels | 9 |

There would be short sections of tunnel constructed by a range of methods, including roadheader and mining (drilling and blasting) and cut-and-cover, on the approaches to each of the underground stations.

For the tunnelling work to be constructed by TBM, the anticipated rate of advance would range from 90 m to 140 m per week, governed principally by the ground conditions through which each machine would pass.

Providing the environmental objectives are achieved, the underground works would progress on a 24/7 basis to achieve the construction programme and to optimise the efficiencies available from TBM construction. Usually, there would be a maintenance period extending up to four hours in the 24 hour working day, during which time the TBMs would not be working. Where underground works are predicted to exceed the goals for relevant environmental objectives (eg noise, vibration), advance consultation with potentially affected people would be required to establish practicable mitigation measures. Careful scheduling of the standard daily maintenance period for the TBMs to the night-time hours would provide an effective reduction in the potential to disturb people and properties along the surface.

*Photo courtesy of Brisbane City Council*

## Construction spoil and transport

Spoil from construction would be generated by both surface works such as transition or dive structures and from underground works such as the driven tunnels and the underground stations. Spoil from such construction activities would 'report' to several of the worksites. The Project would generate a large volume of spoil which would be transported by road in a fleet of project-specific trucks.

A summary of the spoil generation and transport requirements is presented in Table 2-4.

*Table 2-4 Estimated spoil and transport requirements*

| Location | Spoil | Spoil haulage | |
|---|---|---|---|
| | Volume ($m^3$) | Average trucks/ day** | Peak trucks/ day** |
| Yeerongpilly worksite | 375,000 | 86 | 214 |
| Ventilation and emergency access shaft (Fairfield) | 11,500 | 12 | 29 |
| Boggo Road Station | 155,000 | 36 | 89 |
| Gabba Station | 437,000 | 86 | 214 |
| Albert Street north | 60,000 | 9 | 23 |
| Albert Street south | 130,000 | 23 | 57 |
| Roma Street south | 125,000 | 23 | 57 |
| Roma Street central | 15,000 | 9 | 23 |
| Roma Street north | 21,000 | 9 | 23 |
| Victoria Park | 96,000 | 30 | 75 |
| Total insitu cubic metres | 1.4 million $m^3$ | | |
| Total tonnes* | 3.4 million t | | |

*Notes:*

** estimated density of insitu material is 2.4 tonnes/$m^3$*

*** this relates to one way trips*

Spoil from each of the worksites would be transported by road to the nominated placement site at Swanbank. For the worksites situated north of the Brisbane River, the key haulage route would include the ICB for some sites, linking with Milton Road, the Western Freeway/ Centenary Motorway, the Ipswich Motorway and the Cunningham Highway to Swanbank.

For the worksites situated south of the Brisbane River, the key haulage route would include Ipswich Road, the Ipswich Motorway and the Cunningham Highway to Swanbank. The longest trip would be from the Woolloongabba worksite and would entail a return journey of approximately 70 km.

For the Fairfield emergency access and ventilation shaft, spoil would be transported south along the existing freight route of Fairfield Road to the Ipswich Motorway.

With work progressing at different times, and with the different types of construction being progressed at each of the worksites, there is little likelihood that the peak transport task for all worksites would coincide on any day. Combined with the use of different arterial routes across the city, the traffic impacts of spoil haulage would be difficult to discern from the background of daily traffic flows and patterns along most arterial roads.

*Kangaroo Point workshed, Clem Jones tunnel*
*Photo courtesy of Brisbane City Council*

## Hours of work

The hours of work for construction of Cross River Rail would generally be:

- for surface work – 6:30 am – 6:30 pm Monday to Saturday with no work on Sundays and public holidays, except for surface work that by necessity would have to be conducted outside those hours to avoid disruption to the efficient functioning of the City and the region, eg works in the 'live' rail corridor, the surface road network, relocating utilities
- for spoil haulage – on arterial roads, haulage would be 24 hours, seven days per week, for spoil haulage relying on local roads only in day-time hours, and for special circumstances as determined by a specific construction traffic management plan
- for underground works – 24 hours, seven days per week (24/7), including any regular maintenance, providing the relevant environmental objectives relating to noise and vibration can be achieved.

## Workforce

Cross River Rail would generate a demand for a skilled construction workforce in addition to general civil construction labour. At peak demand, the Project would require a workforce of approximately 2,200 and would generate approximately 1,600 full-time equivalent jobs.

An indicative allocation of labour requirements per worksite is provided in Table 2-5.

*Table 2-5 Estimated construction workforce*

| Location | Shaft/surface construction | Tunnel construction | Total workforce | Peak workforce | Peak (single shift) | Peak (single shift – allow for remote staff) |
|---|---|---|---|---|---|---|
| Surface works south | 200 | | 200 | 320 | 200 | 156 |
| Yeerongpilly worksite | 125 | 100 | 225 | 200 | 125 | 98 |
| Ventilation and emergency access building | 50 | | 50 | 80 | 50 | 39 |
| Boggo Road Station | 175 | | 175 | 280 | 175 | 137 |
| Gabba Station | 175 | 100 | 275 | 280 | 175 | 137 |
| Albert Street Station | 175 | | 175 | 280 | 175 | 137 |
| Roma Street Station | 175 | | 175 | 280 | 175 | 137 |
| Victoria Park | 50 | 50 | 100 | 160 | 50 | 39 |
| Surface works north | 200 | | 200 | 320 | 200 | 50 |
| Total | 1,325 | 250 | 1,575 | 2,200 | 1,325 | 930 |

Car parking would be provided for the workforce at the rate of one space per 1.2 workers, except for the inner city worksites (Albert Street, Roma Street) where most workers would rely either upon public transport or the existing available commercial car parking stations.

In some places, such as Boggo Road and Woolloongabba, a worker car parking strategy would be required and would rely upon a combination of dedicated car parking at Yeerongpilly and shuttle transport to the worksite.

A car parking scheme would also be required to prevent construction workers parking in local streets. Car parking spaces at construction worksites is provided in Table 2-6.

*Table 2-6 Car parking at construction worksites*

| Worksite | On-site parking |
|---|---|
| Salisbury (Dollis Street) | 40 spaces |
| Clapham Rail Yard | 50 spaces |
| Yeerongpilly | 420 spaces |
| Ventilation and emergency access building | 14 spaces |
| Boggo Road Station | 30 spaces |
| Gabba Station | 72 spaces |
| Roma Street Station | 40 spaces |
| Victoria Park | 80 spaces |
| RNA Showgrounds | 45 spaces |
| Mayne Rail Yard | 50 spaces |

*Construction, King George Square Busway*

## Construction programme

Construction of Cross River Rail is anticipated to commence in 2015 and extend over a period of 5.5 years, with varying levels of activity at key worksites during this time. The indicative construction programme developed for the Project anticipates peaks in activity (worksite establishment, station construction) and compensating quiet or low intensity periods (eg fit-out, underground works).

An indicative, high-level programme is shown at Table 2-7. Achievement of this programme would result in Cross River Rail commencing operations in 2020.

*Table 2-7 Construction programme*

| Activity | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| Northern portal | | | | | | |
| Southern portal | | | | | | |
| Station construction | | | | | | |
| Tunnel construction | | | | | | |
| Northern surface works | | | | | | |
| Southern surface works | | | | | | |
| Tunnel fit-out | | | | | | |
| Station fit-out | | | | | | |
| Testing and commissioning | | | | | | |

## 2.5 Options development

In 2007-2008, the Queensland Government undertook the ICRCS to identify possible solutions to capacity issues in Brisbane's inner city rail network. The ICRCS found that in order to provide for the growth within South East Queensland, additional public transport infrastructure and services throughout the region would be required.

Specifically, additional rail capacity would be required within the inner city, to relieve the congestion developing around the constrained crossing of the Brisbane River at the Merivale Bridge. The ICRCS identified that an additional north-south river crossing for rail would be needed by around 2016 to cope with the increasing demand for transport services in South East Queensland.

### 2.5.1 Corridor options

As investigations progressed, a number of broad corridor options responding more or less to the identified transport requirement were developed and evaluated. Three broad corridor options were short-listed through a multi-criteria analysis based on satisfaction of the project objectives, and fundamental criteria relating to function, cost and constructability. Each of the short-listed options responded to the need identified in ICRCS for a north-south rail connection through Bowen Hills, the Brisbane CBD and Woolloongabba to be delivered by or soon after 2016.

The three broad corridor options for a north-south rail link included:

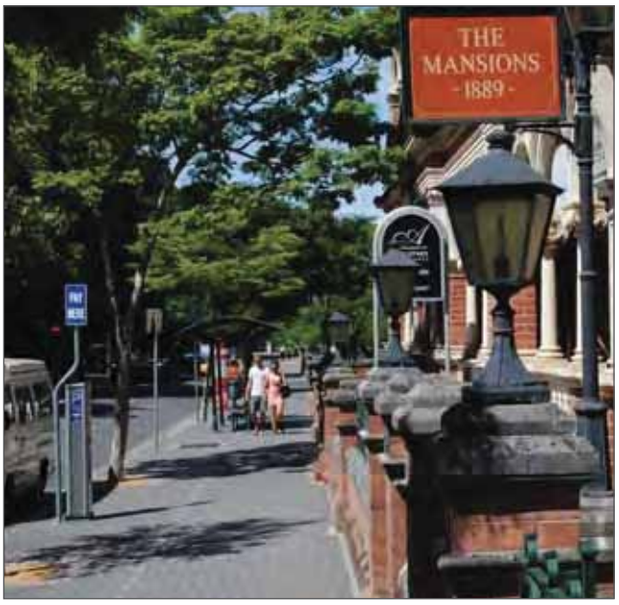
- Park Road, Woolloongabba, Spring Hill, and RNA Showgrounds in tunnels
- Park Road, Woolloongabba, Newstead and Fortitude Valley in tunnels
- Merivale Bridge duplication or tunnel via South Brisbane including a tunnel underneath the existing alignment through the CBD, and quadruplication of the track from South Brisbane to Park Road.

A more detailed examination was then undertaken of technical issues and assumptions including vertical geometric constraints, length of tunnelling required, station locations and dimensions, tunnel design and construction options and probable costs and program requirements. The detailed examination applied multi-criteria analysis further to identify the study corridor for the EIS and to confirm that the Project aligns with the project objectives. The evaluation process included stakeholder review and endorsement from the project steering committee and technical advisory groups.

This process identified the preferred corridor, within which several route options were identified. These route options, within the corridor, were evaluated in relation to the Project objectives and the technical assessment criteria. These route options included:

- a new 6.5 km rail line in tunnel from Fairfield to Exhibition Loop with underground stations at Park Road, Woolloongabba and CBD (Edward Street)
- a new 6.5 km rail line in tunnel from Fairfield to Exhibition Loop with stations at Park Road, Woolloongabba, CBD (Edward Street and Roma Street)
- a new 6.5 km rail line in tunnel from Fairfield to Exhibition Loop with stations at Park Road, Woolloongabba, CBD (Roma Street and George Street).

The third of these options was found to perform best against the wide range of technical evaluation criteria, including its better 'constructability' in an operating rail network. The reference design represents a further refinement of that option, responding to further technical investigations (eg vertical and horizontal alignments, station locations, tie-in points) and to feedback received from stakeholders and the community through the preliminary consultation process.




*George Street, Brisbane CBD*

### 2.5.2 Station options

Drivers in developing Cross River Rail included station locations and tunnel portal locations. Several options for each station were considered at the RNA Showgrounds, the Brisbane CBD, Woolloongabba and Boggo Road. Consequently, a number of options were also considered for the portal locations.

Station location options were identified in collaboration with state and local government agencies, including the Department of Local Government and Planning (former Department of Infrastructure and Planning), Department of Public Works, ULDA, TMR and Brisbane City Council. Also each station location was the subject of stakeholder and community consultation and feedback.

The southern portal at Yeerongpilly was of community interest and was the subject of extensive consultation. The location for the Boggo Road Station was determined by the requirement to integrate with Park Road Station and the busway station.

## CBD station options

The options for stations in the CBD included:

- a site in Edward Street, between Adelaide and Elizabeth streets
- a site in Albert Street, between Mary and Alice streets
- a site in George Street between the parliamentary precinct and the Executive Building (Mary Street).

Each option was considered in relation to the project objectives, technical assessment criteria, transport outcomes, city outcomes and community outcomes. While other aspects, such as cost, constructability and value for money were also considered, the evaluation sought a balanced outcome. The site in Albert Street was identified in providing the best outcome in terms of transport, city building and community benefits, and providing the greatest potential for long term value.

The Albert Street site also enabled connections with the main tunnels north and south on alignments minimising impacts on private property, ie the main tunnels would coincide with the alignment of Albert Street.

The selection of Roma Street Station was dictated by the constrained capacity for passenger growth at Central Station. The selection of Roma Street Station enhances the opportunities for Cross River Rail services to interchange across modes and regional transport services via the Roma Street transit centre.

The alignment of the underground station at Roma Street responds to the alignments of the main tunnel linking with the Albert Street Station.

*Albert Street, Brisbane CBD*

## Woolloongabba station options

The key drivers for locating the station at Gabba Station included the need to integrate with the South East Busway, service travel demand generated by major events at The Gabba and normal demand generated by the Mater Hospital, and the need to support future land use intentions for the UDA.

While the locality for the Gabba Station was identified early in the process as being on State-owned land between Stanley Street, Main Street and Vulture Street, the process of design development identified the preferred site as being that land adjacent to Leopard Street, between Stanley Street and Vulture Street, ie the Goprint site. The alternative was to develop the station further east, closer to The Gabba, ie the Land Centre site.

The preferred site enables an integrated transport station with the South East Busway and also would provide sufficient separation and 'break out' space for pedestrians entering and leaving The Gabba for major events. The preferred site also would enhance future development intentions for the UDA.

## Yeerongpilly station options

Yeerongpilly was adopted as the preferred location for the tie-in, with the consequential requirement to upgrade Yeerongpilly Station.

The options for a new station at Yeerongpilly considered a site in the Yeerongpilly TOD, to the west of Fairfield Road, and a site to the east of the existing station. Specific community input was sought in relation to these options.

A combination of technical design factors, such as geometric design, gradients, alignments, platform requirements and integration with the surface railway, flooding and geotechnical factors, were influential in identifying the eastern site as the preferred station location. The provision of pedestrian linkages to the TOD, and the provision of bus stops on Fairfield Road near both the station and the TOD, would lead to an acceptable degree of land use and transport integration.

### 2.5.3 Portal options

## Northern portal

The preferred location for the northern portal was identified as a consequence of the preferred alignment for Cross River Rail. The requirement to tie-in to the existing railway through the RNA Showgrounds was influential in identifying the proposed site in Victoria Park, to the east of the ICB land bridge.

The site selection process sought to maximise the separation distance between the portal and sensitive receptors, which in this locality include several high schools, the Centenary Pool complex and residential premises to the south of Gregory Terrace.

## Southern portal

A number of options for the southern portal were developed and considered, including Fairfield, Yeronga, Yeerongpilly (Wilkie Street) and Moorooka (Clapham). The factors which influenced the identification of the preferred location in Yeerongpilly (Wilkie Street) included environmental factors, design and construction requirements, operational requirements, potential property effects, community feedback received during design development, and opportunities for an integrated land use and transport development outcome.

The preferred location was identified for the following reasons:

- maintains rail functionality and would facilitate enhanced integration with the surface railway at Yeerongpilly Station
- better ground conditions for construction, leading to a smaller construction footprint than other options
- would minimise property impacts
- would not preclude a possible future connection from Cross River Rail to the Tennyson loop
- would facilitate integration with the planned, future Yeerongpilly TOD.

Further feedback from the community at Yeerongpilly supported design refinements for the southern portal and location of the Yeerongpilly Station. Such feedback related mostly to property impacts, anticipated construction impacts and operational impacts such as commuter car parking. People whose property would be directly affected and living immediately adjacent to the property requirement, were most concerned by the identification of the Yeerongpilly (Wilkie Street) portal.

## 2.5.4 Alternatives for Project construction

The decision in design development to proceed with a north-south corridor providing a direct link between Woolloongabba and the CBD was due to land use and construction concerns. Construction planning addressed various methods for crossing the Brisbane River to connect with an underground station in the CBD. Other construction considerations related to the impact on properties and existing land uses, particularly in the CBD, should either an at-grade or above-grade solution be adopted.

A tunnel system constructed beneath the river was adopted as the feasible and practical approach to minimising the surface impacts of either of the alternatives, ie at-grade, above-grade.

## Tunnelling options

The range of tunnelling methods to cross beneath the Brisbane River included immersed tube tunnels, cut-and-cover tunnels with coffer dams, deep tunnels in rock and shallow tunnels with low rock cover. The construction planning process proposed a deep tunnel crossing, and that such tunnels should be constructed with TBMs installing a waterproof lining with reinforced concrete segments as the works progress.

The TBM method was adopted for the main corridor following a technical assessment of the risks and benefits of constructing sections by roadheader and other tunnelling techniques.

A number of options were considered for the TBM method, including launching from either end of the proposed tunnel alignment and driving to the mid-point, launching in the mid-point and driving to the portals and launching from a portal and the mid-point simultaneously.

Variations on these options were provided by considering Woolloongabba, Boggo Road and Fairfield as alternative mid-points. Woolloongabba was adopted as the preferred mid-point over both Boggo Road and Fairfield, as it provided better access to the major road network, was not as constrained by the proximity of sensitive receptors, and offered a larger worksite within State-owned land.

*TBM break-through, Clem Jones tunnel*
*Photo courtesy of Leighton Contractors*

## Worksites

While Cross River Rail involves the establishment of a number of worksites, construction planning involved a selection of preferred locations for major worksites. Major worksites would be those required to launch the TBMs. TBM launch sites would also receive spoil from most driven tunnelling and also receive the pre-cast, reinforced concrete segments to be used for the installation of the waterproof lining of each tunnel.

None of the tunnelling works north of the Brisbane River would involve launching TBMs. Consequently, the major proportion of tunnel spoil would 'report' back to the launch sites at Woolloongabba and Yeerongpilly (Station Road).

The major worksite north of the Brisbane River would be situated in Victoria Park and would support the construction of the portal, including the structures required for the future NWTC connection and surface works associated with the rail tie-back into the surface railway. The worksite in the RNA Showgrounds would be required for construction of the new surface station and is not a major worksite.

The construction planning decision to launch TBMs from Woolloongabba involved a parallel decision for this site to function as a major worksite. The Boggo Road worksite would be required for construction of the new underground station.

## Construction spoil

Alternative sites for spoil placement were considered in light a number of factors including:

- land tenure and ownership
- existing land use and activities occurring on the site
- adjacent land uses surrounding the site and along the potential haulage route
- haulage routes, and accessibility to major or arterial roads
- haulage distance and travel time
- environmental constraints such as flooding, drainage, topography, flora and fauna
- cultural heritage including location of Indigenous and non-indigenous cultural heritage on or adjacent to the site.

The preferred site for spoil placement is at Swanbank where there are a number of open-cut mine voids suitable for the purpose. Access would be from Redbank Plains Road, Cunningham Highway, Ipswich Motorway and Ipswich Road for most of the worksites. Spoil from the northern worksite would join the Ipswich Motorway via the Centenary Motorway.

Two options for the transport of spoil have been considered, namely by road and by rail. In general terms, transport by road offers the advantages of haulage cost savings, flexibility in accessing placement sites and in scheduling, and comparatively lower establishment and decommissioning costs. Transport by rail offers the advantages of reducing impacts and congestion on busy roads and potentially higher community acceptance.

Apart from Victoria Park, RNA Showgrounds and Yeerongpilly, no other worksite has convenient and practical access to the rail network. While Boggo Road is proximate to the rail network, there is insufficient land available there to establish a spoil handling terminal. Consequently, approximately half of the TBM spoil only (Woolloongabba – Yeerongpilly) potentially could be transported by rail.

A further consideration for rail transport is the need to establish both loading and unloading facilities, including rail sidings, storage bins, conveyors and similar equipment. On arrival at a receiving depot, spoil would then need to be removed from trains and transported to the placement site. This would entail double handling for both the loading and unloading operations.

The following factors were considered for the transport of spoil by road:

- preference for use of State-controlled roads over local roads
- shortest travel distance and time
- proximity of roads to haulage start and end points.

While spoil transport by road has been adopted for the purpose of assessment for this EIS, the option of transporting spoil by rail is being maintained.

Should an alternative spoil placement site to Swanbank be required, further consultation with the Commonwealth Minister for the Environment would be necessary to address the 'particular manner' conditions on Cross River Rail.

# 3 Rationale for Cross River Rail

Cross River Rail would respond to existing constraints in the metropolitan rail network and forecast future conditions arising from population growth and economic development in South East Queensland.

The existing constraints are created by a combination of infrastructure arrangements and operating conditions and are most evident during the busy morning peak period in each working day as people from across South East Queensland commute to work in the Brisbane CBD and the Brisbane metropolitan area.

The demand for public transport across South East Queensland, and specifically, the demand for rail services (passenger, freight) is associated directly with population growth and economic activity, indicated by increased employment and commuter travel, and increased activity through freight movements.

The Queensland Government has planned for and is implementing a range of major transport infrastructure projects in South East Queensland to address the forecast travel demand, and so maintain the region's competitiveness and attractiveness as a place to live, work and do business. The infrastructure projects include:

- on-going improvements to the rail network
- major upgrades to bus transport through the extension of dedicated busways
- continuing improvement in the main road network and
- support for local government investment in local transport initiatives.

Cross River Rail is identified in this strategic planning framework as the priority investment in the transport system to address growth in travel demand across South East Queensland and specifically for access to the Brisbane inner city.

Without augmentation or enhancements, the existing rail system in the inner city is expected to reach capacity by about 2016. A range of supplementary measures are available to enhance capacity beyond that point, in anticipation of the commencement of Cross River Rail. Without further investment, the capacity to meet forecast travel demand is expected to decline. In such circumstances, people would seek alternative means of travelling across the region and freight rail movements would become more constrained by the passenger system.

Cross River Rail also would support planned urban growth areas by providing greatly enhanced accessibility and additional opportunities for people to change modes easily while making trips across the region.

## 3.1 Strategic context

The Commonwealth Government, through Infrastructure Australia, is implementing a Nation Building Program focussed on delivering the National Land Transport Network in conjunction with State and local governments. In this context, the Commonwealth Government contributed $20 million towards the detailed feasibility phase for Cross River Rail.

The Queensland Government's vision for the State in 2020 is outlines in Towards Q2: Tomorrow's Queensland. This sets out a number of ambitions leading to Queensland being a strong, green, smart, healthy and fair place. The vision incorporates a strong economy, based in part, on infrastructure planning and development that anticipates growth. Specifically, transport infrastructure is the key to achieving this economic ambition.

Cross River Rail supports the ambitions identified in Toward Q2 by:

- providing increased public transport capacity to better accommodate future demand
- making public transport an attractive alternative to the car for commuters, by providing improved travel conditions, including improved access times, wait time savings and reduced train crowding
- allowing improved efficiency and performance of freight movements, including to the Port of

Brisbane, by improved separation of passenger and freight rail

- reducing road congestion and road network fuel use, by attracting more car drivers to public transport.

In conjunction with the Commonwealth Government's commitment to invest in the National Land Transport Network, the Queensland Government is managing the sustained rapid growth in South East Queensland through implementation of the South East Queensland Regional Plan 2009 – 2031 (SEQ Regional Plan). For many years, the SEQ Regional Plan has sought to achieve a compact and efficient urban form which maximises use of the existing and planned infrastructure, including transport infrastructure. The desired outcome for compact settlement specifically seeks to establish transit corridors and an integration of future development and transport infrastructure.

The Queensland Government is also undertaking a number of planning investigations which would achieve a better integration of land use and transport infrastructure planning and development. For example, the ULDA is actively involved in planning for the creation of urban villages and transit oriented developments at Bowen Hills and Woolloongabba.

Each of these growth areas would be linked with a new high capacity rail station provided by Cross River Rail. For both Woolloongabba and Boggo Road, a multi-modal transport interchange would be created by Cross River Rail and busway infrastructure. Other interchanges, such as the Roma Street transit centre would be supplemented by the additional high frequency services provided by Cross River Rail.

A key foundation to the regional plan is the South East Queensland Infrastructure Plan and Program 2010 – 2031 (SEQIPP).

SEQIPP anticipates that Cross River Rail would "...unlock South East Queensland's constrained rail network by providing more capacity for the region's rail services, meaning more people can move into and through the city more frequently" (DIP 2010). Subject to further funding through the Commonwealth Government, delivery of Cross River Rail is planned to commence in 2015. The delivery phase would be approximately 5.5 years in duration, reflecting the scale and complexity of the Project.

At the local government level, the Brisbane City Council continues with its programme of investment in public transport and active transport. For example, Cross River Rail would complete a comprehensive, integrated transport hub at Boggo Road, comprised of the Eleanor Schonell Bridge, the Eastern Busway, the surface rail network and Cross River Rail. This hub provides a structural framework for the integration of like activities flowing from the University of Queensland, the BRUV and Ecosciences Precinct and the PA Hospital. Nearby there is the Mater Hospital and associated medical and professional services.

These are significant, city-building relationships with inter-generational benefits in terms of compact, efficient and vital urban centres offering a range of accommodation, employment, services and facilities to both local and regional catchment populations.

Cross River Rail would also support the draft River City Blueprint being developed jointly by the Brisbane City Council and the Queensland Government. The draft River City Blueprint is a cohesive framework to manage growth and infrastructure delivery for the inner city of Brisbane over the period to 2031.

*Merivale Bridge*

Key issues to be addressed by the draft River City Blueprint include:

- preferred locations for new housing and commercial development
- design of the inner city to support a 'sustainable sub-tropical' lifestyle
- possible improvements to open space
- public transport requirements
- location of knowledge based industries near existing research and cultural institutions
- social infrastructure and housing requirements to meet the existing and future needs of residents, workers and visitors.

Cross River Rail would support key outcomes of the draft River City Blueprint through provision of new rail links between the identified growth areas of Woolloongabba, Boggo Road/Park Road, Brisbane CBD and Bowen Hills.

The Brisbane City Council is also implementing its Transport Plan for Brisbane 2008 – 2026 to achieve a balanced land use and transport outcome achieving stated targets for public transport patronage and high levels of accessibility and travel reliability in the transport system. The plan identifies the need for targeting public transport enhancements to address congested transport corridors and improvements to bus, ferry and rail services. The plan also identifies the need for improvements to existing public transport services and new investment in infrastructure as well as the need for additional rail capacity crossing the Brisbane River into the Brisbane CBD.

*Central Station*

## 3.2 Existing rail network and capacity

### 3.2.1 Rail network and passenger services

The Queensland Rail passenger rail network extends from the centre of Brisbane, south to Beenleigh and Varsity Lakes on the Gold Coast, north to Ferny Grove, Shorncliffe, Caboolture and Gympie, east to Cleveland, and west to Ipswich and Rosewood.

All in-bound rail trips to the CBD are required to pass through four inner city stations (Bowen Hills, Fortitude Valley, Central and Roma Street). The congestion on this section of the network is compounded by:

- the single rail crossing of the Brisbane River (Merivale Bridge) to service the CBD from the southern regions and bayside suburbs
- the in-bound routes to the CBD being limited to one line from Milton for the western services and one line from Park Road for services from Beenleigh, Gold Coast and Cleveland
- trains from Park Road and Milton needing to merge into two in-bound lines to access the CBD
- the requirement for empty trains enroute to stabling at the Mayne Rail Yard to cross over tracks for services from the western corridor, the southern corridor and the bayside suburbs.

The capacity constraints affecting the inner city rail network are summarised in Figure 3-1.

All services from the north and the south merge into the inner city, and specifically the Brisbane CBD, with 57 services in the morning peak hour stopping at each of Bowen Hills, Fortitude Valley, Central and Roma Street stations. The passenger movements through these stations are illustrated in Table 3-1.

*Table 3-1 Passenger movements, inner city stations, 2009*

| Station | Morning peak (two hours) | Daily movements |
|---|---|---|
| Bowen Hills | 3,600 | 12,700 |
| Fortitude Valley | 4,700 | 16,900 |
| Central | 34,500 | 104,300 |
| Roma Street | 9,300 | 36,500 |

The existing capacity of Central Station in a two hour period is 43,000 passengers. At present, passenger crowding on the platforms and concourses is experienced in short peaks, particularly during the busier morning peak period. Without Cross River Rail, capacity at Central Station for the morning peak period would be reached by 2021 and exceeded by 2031.

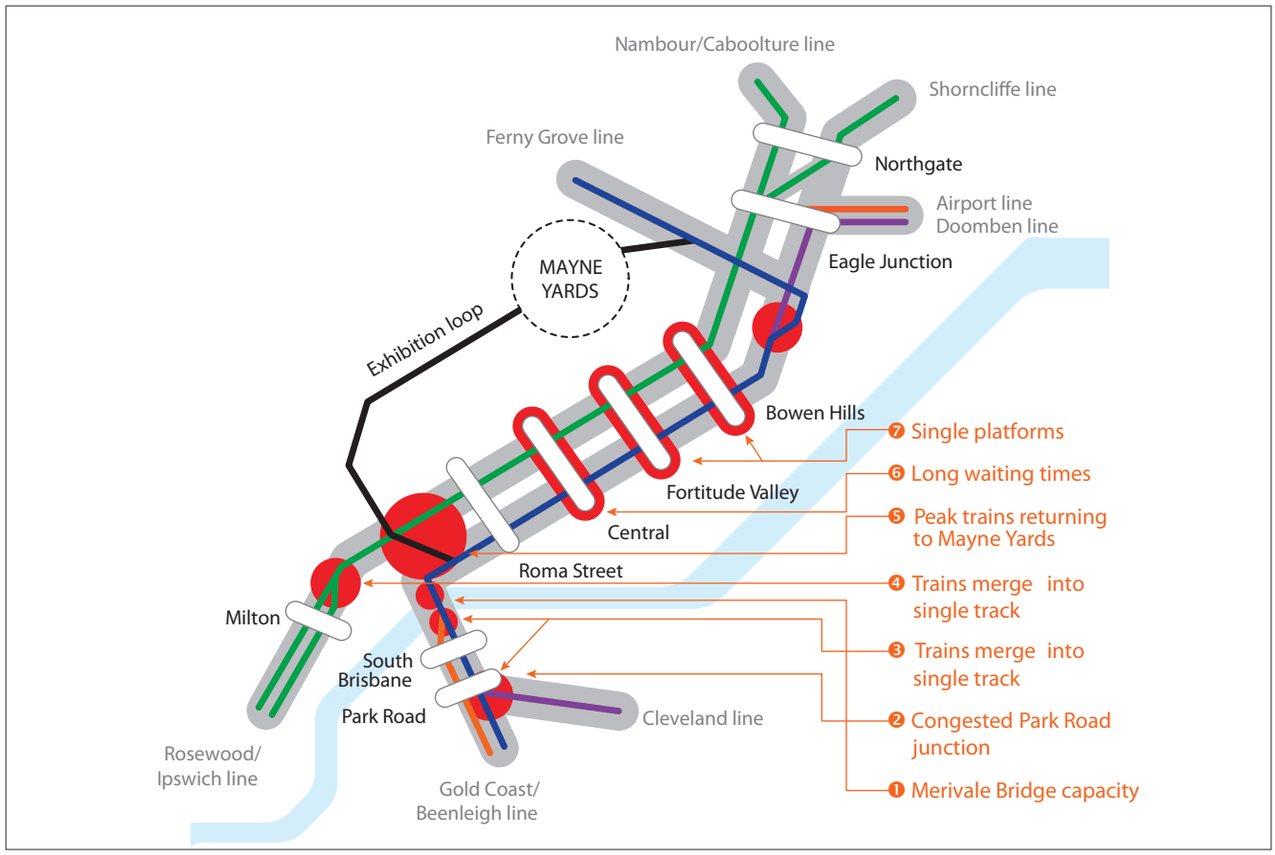



*Figure 3-1 Existing capacity constraints on the Brisbane inner city rail network*

Queensland Rail, in partnership with the TransLink Transit Authority, provides passenger rail services through the Brisbane CBD on both suburban and main (inter-urban) rail lines.

Passenger services generally operate in two sectors, being:

- main sector services, on the main lines to Nambour, Caboolture, Ipswich and Rosewood
- suburban sector services, on the suburban lines to Shorncliffe, Ferny Grove, Airport, Doomben, Cleveland, Beenleigh and Gold Coast.

Interdependencies between the two sectors currently occur, with the sharing of services and tracks between main sector services and suburban sector services. This affects rail network capacity as well as service reliability.

Current rail service plans must accommodate a mix of 'all stops', express and semi-express services on some lines and multiple commencing and termination points on a single line. This constrains passengers from interchanging between services and also reduces network capacity and efficiency.

The lack of 'sectorisation' within the network also reduces schedule robustness and can result in 'knock-on' delays across lines. This can require the use of long-distance rolling-stock for short-distance services, and vice-versa, again reducing capacity on CBD services. Also, long-distance commuters cannot be guaranteed access to appropriate on-board facilities.

### 3.2.2 Freight services

Freight services currently pass through the Brisbane rail network to destinations including Fisherman Islands at the Port of Brisbane, Acacia Ridge Freight Terminal and to regions serviced by the North Coast line.

Currently, there is no dedicated rail freight network in South East Queensland, with passenger and freight rail services sharing network capacity. Passenger services use freight lines in the passenger peak and freight services use the passenger network during the off-peak period. Passenger services are currently prioritised over freight services, with freight trains not operating during peak periods within the Brisbane metropolitan rail network.

There are about 344 freight services each week presently operating through the Brisbane rail network on the narrow gauge lines. These include coal and grain services travelling along the western corridor, intermodal freight services travelling along the North Coast Line and along the Western Corridor.

In addition to the freight services travelling along the narrow gauge lines, there are also 177 weekly freight services operating on the existing dual gauge lines between Acacia Ridge and the Port of Brisbane.

Freight services through the inner city have approached the city on the passenger network and then connected to the Exhibition Loop. This is partially because the inner city stations were not designed to accommodate freight services, and largely because the freight services would cause operational difficulties in the heavily-used inner city corridor between Roma Street and Bowen Hills stations.

The efficiency and performance of non-peak passenger operations are often affected by the need to schedule freight trains in the times available between higher priority passenger train services.

With the demand for additional passenger services, increasing congestion and capacity constraints with other modes of transport, the potential conflict for trains' paths between passenger and freight services will also increase. As passenger peak periods are extended, the availability of freight paths in the network will become more constrained.

Without further enhancement of network capacity, there would be no opportunity to increase the frequency, and reliability, of either passenger or freight services in the rail network.

*Passenger and freight rail on shared track, Yeerongpilly*

### 3.2.3 Other transport modes

Similar to rail services, other modes, such as bus and private vehicles, are also constrained by capacity issues leading to congestion and the consequential issues of increasing trip duration and length, declining travel time reliability, increasing risks (eg crash rates), trip re-distributions and deteriorating urban and environmental amenity.

#### Public transport (bus services)

The bus services in the Brisbane metropolitan area are focussed mostly on the CBD, with over 500 services entering the CBD in the morning peak period. With approximately 285,000 passengers on an average weekday in Brisbane, bus transport accommodates approximately 50% of the total trips made by public transport across the metropolitan area.

Approximately two-thirds of these services access the CBD via either the Inner Northern Busway or the South East Busway. The remainder rely upon the road network, and are susceptible to delays due to congestion, crashes and other incidents. Bus layover space in the CBD is limited, resulting in limitations on scheduling and service planning.

Overall, the bus network at present is experiencing high levels of demand with congestion occurring on several routes causing delays and reliability concerns. Some bus corridors, such as the South East Busway are approaching saturation in peak periods.

#### Road transport (private vehicles)

Over 4 million car and light vehicle trips and approximately 370,000 commercial vehicle (freight) trips occur within the Brisbane metropolitan area on an average weekday (2009). These trips are made within a radial road network with the Brisbane CBD at its centre. While recent transport projects, such as the duplication of the Gateway Arterial Road and bridge, the Clem Jones tunnel and the Go Between Bridge have provided additional cross-river capacity which bypasses the CBD, the arterial roads remain congested in peak periods, with consequential effects on travel time reliability, travel time, road user costs and crash rates.

In the morning peak period, the radial road network is heavily congested with several key road corridors experiencing significant delays and low average travel speeds (LOS E or F). This occurs at sections of:

- Riverside Expressway (both directions)
- Pacific Motorway (Captain Cook Bridge) inbound
- Sandgate Road/Abbotsford Road (north of the ICB)
- Lutwyche Road/Bowen Bridge Road
- Story Bridge (inbound/northbound)
- Coronation Drive and Milton Road (inbound)
- Ipswich Road and the Ipswich Motorway.

Commuter travel by private motor vehicle to the Brisbane CBD is also constrained by the availability of parking, resulting in elevated daily parking charges for commuters and shortfalls in supply for the growing residential population in the CBD and inner suburbs.

### Other modes

Ferry transport caters for a small component of trips in South East Queensland, being confined almost entirely to the Brisbane River and several islands in Moreton Bay. In 2009, ferry transport conveyed approximately 13,000 trips on an average weekday, or less than 3% of the public transport trips.

Travel by ferry in both South East Queensland and the Brisbane metropolitan area would not alleviate pressures on other modes arising from increasing travel demand.

## 3.3 Travel demand

Population growth and employment trends and forecasts are influential factors driving travel demand. The density and distribution of both population and employment are also important to the outputs and transport outcomes of the Project.

### 3.3.1 Population growth

The population of South East Queensland has grown rapidly for more than two decades, placing pressure on infrastructure planning and delivery, and on land use planning to ensure a supply of land. Forward planning must also identify and protect land required for infrastructure. Strong population growth is expected to continue in the region, with the population forecast to increase from 2.8 million people in 2006 to 4.4 million in 2031 and to 6 million in 2056 (DIP, 2009). This growth has exceeded other mainland capital cities in recent years.

### 3.3.2 Employment

Employment growth in South East Queensland over the corresponding period is forecast to increase in step with population growth, ie approximately 54%. Similarly, employment within the Brisbane metropolitan area also is forecast to grow strongly over the planning period to 2031. The Brisbane inner city would remain the primary employment in South East Queensland over the planning period, consistent with the strategies embodied in the SEQ Regional Plan.

### 3.3.3 Demand trends

In 2009, more than 6.7 million person trips were undertaken daily in the Brisbane metropolitan area. Of these trips, public transport accounted for approximately 546,000 trips, or about 8.1% of total trips. Trips made by rail comprised approximately 45% of public transport trips, with rail passengers travelling an average distance of 21 km and spending an average of approximately 30 minutes on board.

The proportion of trips by public transport is planned to increase from approximately 8.1% in 2009 to 10.16% in 2021 and 12.1% in 2031. A significant on-going investment in rail and bus infrastructure is assumed to accommodate this growth and change in mode share.

Table 3-2 provides an overview of the change in transport outcomes including growth in demand for public transport from 2009 to 2031. The highest percentage growth forecast is expected to occur in public transport trips, with almost double the number of trips forecast for 2031, compared to 2009. Vehicle trips are anticipated to grow at a slower rate, increasing by 40% between 2009 and 2031.

Table 3-3 shows the forecast growth in rail patronage in the Brisbane metropolitan area. Both peak period and daily rail trips are forecast to more than double between 2009 and 2031. By 2031, over half a million daily rail trips are expected.

By 2021 and without Cross River Rail, the demand for rail use would be at or exceeding the capacity for train movements within the inner city network during peak periods, ie 84 trains per hour (refer to Figure 3-2).

*Table 3-2 Forecast growth in weekday travel demand in the Brisbane metropolitan area without Cross River Rail*

| Parameter | 2009 | 2021 | 2031 |
|---|---|---|---|
| Total trips by all motorised modes (car and public transport) | 6,700,600 | 8,283,800 | 9,259,900 |
| Total trips by car | 5,533,200 | 7,009,800 | 7,771,700 |
| Percentage growth in trips by car (on 2009) | - | 27% | 40% |
| Public transport trips | 546,000 | 824,200 | 1,074,000 |
| Percentage growth in public transport trips (on 2009) | - | 51% | 97% |
| Public transport mode share | 8.15% | 9.95% | 11.60% |
| Total rail patronage (24 hours) | 243,200 | 421,900 | 529,500 |
| Percentage growth in rail patronage (on 2009) | - | 73% | 118% |
| Rail trips to CBD (morning peak period) | 37,100 | 61,600 | 73,700 |
| Percentage growth in rail trips to CBD (on 2009) | - | 66% | 99% |

*Table 3-3 Forecast growth in rail patronage, Brisbane metropolitan area, 2009 – 2031*

| Time Period | 2009 | 2021 | | 2031 | |
|---|---|---|---|---|---|
| | Passengers | Passengers | Growth | Passengers | Growth |
| AM peak (7.00 am to 9.00 am) | 67,000 | 108,300 | 62% | 141,900 | 112% |
| PM peak (4.00 pm to 6.00 pm) | 58,400 | 104,400 | 79% | 131,700 | 126% |
| Average weekday (24 hours) | 243,200 | 421,900 | 73% | 529,500 | 118% |

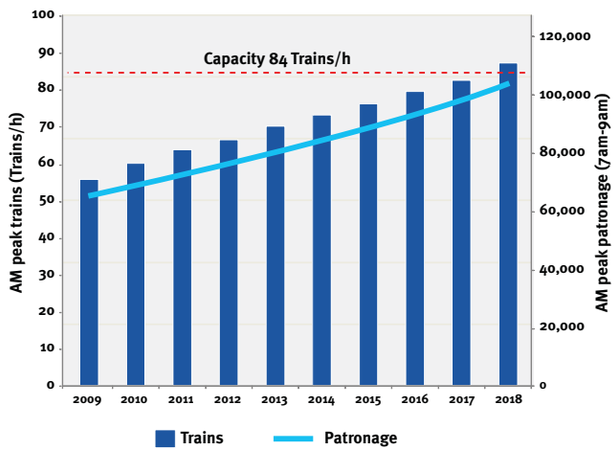



*Figure 3-2 Projected growth in demand against capacity*

Planned upgrades to the network and refinements of operational regimes would allow 17 more trains to be added to the Brisbane network in the peak hour between 2021 and 2031. However, the total available trains, including the 17 additional trains, would be insufficient to cater for the forecast increase in passenger movements on some corridors, even with a shift in some demand for travel to the shoulder peak and off peak periods. Table 3-4 shows forecast morning peak hour train movements without Cross River Rail.

*Table 3-4 Forecast morning peak hour train movements – without Cross River Rail*

| Scenario | Trains from south and west to CBD | Trains from north to CBD |
|---|---|---|
| 2009 | 30 | 27 |
| 2021 without Cross River Rail | 40 | 39 |
| 2031 without Cross River Rail | 42 | 42 |

Travel to the Brisbane CBD is expected to be increasingly met by public transport modes, with minimal growth in vehicle trips, as shown in Figure 3-3.

Rail, bus and ferry are all expected to cater for a greater number of trips, as well as a greater proportion of all trips to the CBD, by 2031 compared to 2009. Car travel to the CBD is expected to plateau at around 40,000 to 45,000 person trips in the morning peak period.

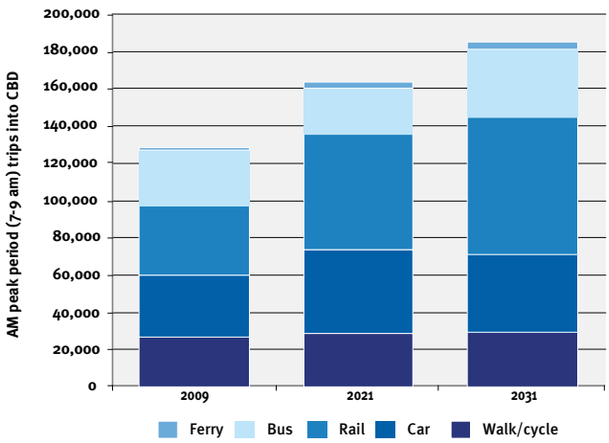



*Figure 3-3 Forecast morning peak period travel demand – Brisbane CBD without Cross River Rail*

By 2031, most inner city and CBD stations are expected to experience a doubling of passenger movements in the morning peak. Daily usage of stations would increase at a higher rate as greater use of the network during off-peak is also forecast. The expected growth in rail passenger movements is presented in Table 3-5.

The demand for passenger arrivals in the CBD in the morning peak period would nearly double from 37,000 in 2009, to almost 74,000 by 2031. This forecast demand would exceed the capacity of Central Station (43,000). Without the Project, much of the growth would 'transfer' to other stations within the CBD, or outside the CBD itself with passengers walking into the CBD. Growth in patronage at Roma Street Station and South Bank Station for example is forecast to be significantly higher than for Central Station.

*Brisbane CBD*

*Table 3-5 Total passenger movements at stations – without Cross River Rail*

| Station | 2009 | 2021 | % growth | 2031 | % growth |
|---|---|---|---|---|---|
| **Morning peak period** | | | | | |
| Bowen Hills | 3,600 | 6,700 | 86% | 7,600 | 111% |
| Fortitude Valley | 4,700 | 7,000 | 49% | 10,800 | 130% |
| Roma Street | 9,300 | 15,300 | 65% | 26,700 | 187% |
| Central | 34,500 | 47,300 | 37% | 49,400 | 43% |
| South Bank | 2,800 | 9,700 | 83% | 9,800 | 250% |
| South Brisbane | 5,300 | 5,900 | 111% | 9,900 | 87% |
| Park Road | 1,200 | 3,800 | 217% | 5,200 | 333% |
| Yeerongpilly | 700 | 1,300 | 86% | 1,900 | 171% |
| **Average weekday (24 hours)** | | | | | |
| Bowen Hills | 12,700 | 25,900 | 104% | 32,000 | 152% |
| Fortitude Valley | 16,900 | 28,600 | 70% | 40,700 | 141% |
| Roma Street | 36,500 | 62,200 | 70% | 94,600 | 159% |
| Central | 104,300 | 152,500 | 46% | 177,600 | 70% |
| South Bank | 23,000 | 62,800 | 174% | 44,300 | 93% |
| South Brisbane | 7,500 | 18,400 | 149% | 25,800 | 244% |
| Park Road | 3,900 | 11,600 | 197% | 17,300 | 344% |
| Yeerongpilly | 1,500 | 3,500 | 133% | 5,800 | 287% |

## 3.4 Transport outcomes without Cross River Rail

Should Cross River Rail not proceed, the likely transport outcomes would include the following scenarios:

- demand for passenger rail services would exceed supply
- progressively poorer levels of service across all modes of public transport would be experienced
- Government policy objectives would not be met.

### 3.4.1 Rail network performance without Cross River Rail

Based on current network capacities, passenger growth rates and train operating regimes, the southern line (Gold Coast and Beenleigh lines) would reach capacity by about 2016. TMR, TransLink Transit Authority and Queensland Rail are currently investigating a further program of initiatives to ensure the rail network has the capacity to meet future demand until Cross River Rail is operational.

If Cross River Rail is not developed, further increases in congestion in the rail network and crowding would be experienced, with adverse consequences for peak service reliability and performance. In effect, access to the CBD by the rail network would be capped.

Other adverse consequences of not proceeding with Cross River Rail include:

- overall, declining levels of service with a potential loss in mode share
- declining rail journey speeds with increases in journey times
- unacceptable delays during system break-downs during the peak and shoulder periods, affecting other modes of transport (bus, car) during the peak commuter periods
- high levels of overcrowding on services, including longer services, eg Gold Coast, Sunshine Coast
- constrained operating conditions in the CBD stations, and most particularly Central Station.

The forecast changes in performance across a number of key rail performance indicators between 2009 and 2031 are indicated in Table 3-6.

These increases in rail passengers, travel times and distances are expected to grow faster in the morning peak than across the overall weekday by 2031. The average rail speed is forecast to increase slightly over time without Cross River Rail due to an increase in the number of longer distance express services.

*Table 3-6 Forecast rail usage – Brisbane metropolitan area – average weekday, without Cross River Rail*

| Average weekday (24 hours) | 2009 | 2016 | | 2031 | |
|---|---|---|---|---|---|
| | | Forecast | % growth | Forecast | % growth |
| Average rail passenger kilometres (km) | 5,178,200 | 9,645,100 | 86% | 12,741,900 | 146% |
| Total rail passenger hours (hours) | 124,400 | 226,200 | 82% | 291,400 | 134% |
| Total rail patronage (pax) | 243,200 | 421,900 | 73% | 529,500 | 118% |
| Average rail trip length (km) | 21.3 | 22.9 | - | 24.1 | - |
| Average rail trip time (minutes) | 30.7 | 32.2 | - | 33.0 | - |
| Average rail trip speed (kph) | 41.6 | 42.6 | 86% | 43.7 | - |

### 3.4.2 Passenger crowding

During the current morning peak periods passenger crowding is experienced on the approaches to the Brisbane CBD. In the future, the degree of passenger crowding is forecast to increase significantly on each line.

Without Cross River Rail, train crowding would increase from 13,200 daily hours (2009) to 48,400 daily hours in 2021, representing an increase of 267% in 12 years. By 2031, the forecast volume of passengers in excess of seated capacity would be critical with train crowding forecast to increase to 67,900 daily hours, representing a further increase of 40%. Such crowded conditions would discourage people from using the rail system during the peak periods.

### 3.4.3 Rail network reliability

Without Cross River Rail, the increased demand for rail services would result in a deterioration of the on-time reliability average to 80% in 2021 and to 65% in 2031, compared with approximately 94% of trains currently (2009) arriving within four minutes of the timetable.

By 2031 all lines, including the Nambour, Caboolture, Doomben, Shorncliffe and Airport lines, would experience a significant reduction in reliability to the extent that no line would meet the service standard. Some lines would likely experience less than 40% on-time reliability. Such poor reliability of rail services would result in passengers continuously experiencing unacceptably late trains across the network.

### 3.4.4 Station operations

At most stations the pedestrian system would have sufficient capacity to cater for the forecast increase in demand for passenger services.

At Central Station, however, the existing arrangement of pedestrian infrastructure would not have sufficient capacity to accommodate forecast passenger volumes without the Project. Capacity at Central Station could be reached by 2021 but would be exceeded before 2031.

### 3.4.5 Freight rail

With the forecast increase in demand for passenger services, there would be few paths available for freight services in the future, without Cross River Rail.

Without Cross River Rail, a dedicated track for freight rail would not be available throughout the day between Salisbury to Park Road. Also the existing dual-gauge track from Salisbury to Park Road would be used by both express passenger rail (Gold Coast) services as well as freight trains between Acacia Ridge or the Western Lines (via Tennyson) and the Port of Brisbane.

The continued presence of passenger rail operations would mean the continuation of curfews on rail freight operation during the peak periods and would also prevent any increase in rail freight during the passenger off-peak frequency on the Gold Coast line. This would constrain the freight throughput between Salisbury and Tennyson and between Tennyson and the Port of Brisbane.

Table 3-7 outlines the shortfall in rail paths anticipated in 2021 and 2031 with 15 minute off-peak passenger services and without Cross River Rail to meet projected demands. By 2021 the majority of freight demand would not be able to be transported by rail, with this situation to deteriorate further by 2031.

Significant demand for rail freight would be unable to be met by the rail network without Cross River Rail, with the excess demand expected to be accommodated by the congested road network.

*Table 3-7 Shortfall in rail freight capacity without Cross River Rail and with 15 minute off-peak passenger services*

| | Freight trains per week (both directions) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2009 | 2021 | | | 2031 | | |
| | | Demand | Without Project | Shortfall | Demand | Without Project | Shortfall |
| North Coast | 206 | 264 | 264 | 0 | 322 | 16 | 306 |
| Salisbury – Tennyson | 137 | 172 | 24 | 148 | 209 | 24 | 185 |
| Tennyson – Port (IM) | 62 | 78 | 3 | 75 | 94 | 3 | 91 |
| Tennyson – Port (Coal) | 133 | 197 | 197 | 0 | 232 | 198 | 34 |
| Tennyson to Port Total | 195 | 275 | 201 | 75 | 326 | 201 | 125 |

## 3.5 Benefits of proceeding with Cross River Rail

The benefits of proceeding with Cross River Rail are extensive and range across the following aspects:

### Transport

Cross River Rail would:

- implement the key infrastructure element of the draft Connecting SEQ 2031 and would provide the additional capacity required to deliver the 'rail revolution' operating strategies
- provide capacity to address growth in travel demand arising from population growth and economic activity, and would almost double passenger rail capacity for the Brisbane inner city and CBD
- support the mode share trend towards rail transport for both passenger services, through increased frequency of services for suburban and main line sectors, ie a 'turn up and go' style of service in the inner city with trains every 5 minutes in the peak periods and trains every 10 minutes in the off-peak periods
- enhance service efficiencies for both the main line and suburban sectors through the separation of operations, and the provision of additional, separate stabling facilities
- relieve demand pressure on other modes (bus, private vehicle) and networks (roads) with capacity and congestion challenges
- relieve demand conflicts between passenger and freight rail services, particularly from the south and west to the Port of Brisbane
- relieve congestion-related pressures on passenger rail services, such as journey times and service reliability, passenger crowding, station capacity at Central Station.

### City building

Cross River Rail would:

- support and implement the intentions of the SEQ Regional Plan for an efficient, compact urban form in which an integrated, high capacity public transport system supports designated growth areas (Bowen Hills, Woolloongabba, Dutton Park/ Boggo Road, Yeerongpilly)
- support the on-going role of the Brisbane CBD as the primary centre in South East Queensland, through the provision of additional capacity in the passenger rail network
- support continued population growth and economic development in South East Queensland through the provision of high capacity public transport as foci for urban renewal (Bowen Hills, Brisbane CBD – Roma Street and Albert Street, Woolloongabba, Dutton Park/Boggo Road)
- provide high quality public transport with minimal disruption to surface land use patterns or land use planning intentions by delivering the infrastructure and stations underground, and confining the surface infrastructure to the rail corridor where practicable
- support existing employment and activity centres through the provision of high frequency, high capacity public transport (RBWH and RNA Showgrounds at Bowen Hills, Brisbane CBD, The Gabba Stadium and Mater Hospital at Woolloongabba, the BRUV including the Ecosciences Precinct and the PA Hospital at Dutton Park,and access to the University of Queensland via the Eleanor Schonnell Bridge).

### Economic

Cross River Rail would:

- deliver significant transport benefits for passenger and freight rail services (travel time savings, on-time reliability, access to freight train paths for service reliability, travel time and operating cost savings for road users)
- deliver indirect economic benefits through increased accessibility across the transport network in South East Queensland and increased efficiency of movement in and around the region and the Brisbane metropolitan area
- deliver employment benefits directly and indirectly through the construction phase, as well as through the operational life of the Project
- deliver a range of wider economic benefits, in terms of land use efficiencies, productivity and amenity
- deliver economic benefits of approximately $9.1 billion for a benefit cost ratio of 1.4, or 1.6 if wider economic benefits are accounted for.

Figure 3-4 provides a summary of the key transport benefits of the Project for Government, transport users and transport operators.

A more comprehensive discussion of the transport effects, including benefits, of proceeding with Cross River Rail is provided in Section 4 of this document and Chapter 5 Transport of the EIS. Similarly, a more comprehensive discussion of the land use effects including benefits is provided in Section 5.7 of this document and Chapter 9 Land Use and Tenure of the EIS, and the economic effects including benefits are discussed in Section 5.6 and Chapter 21 Economic Assessment of the EIS.

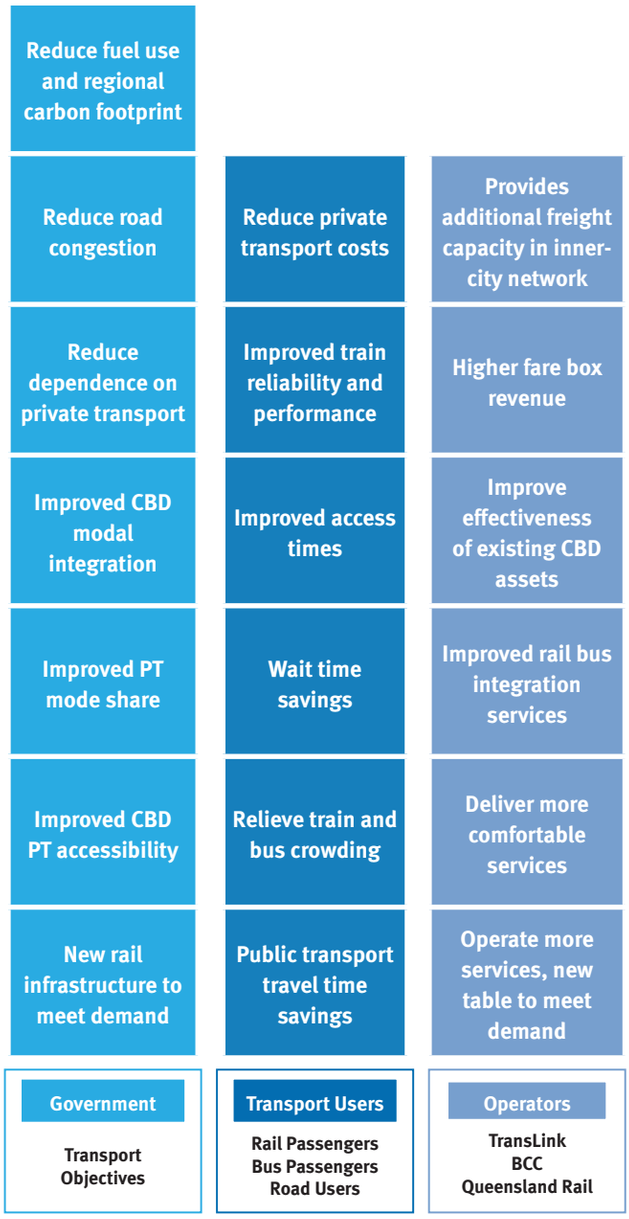



*Figure 3-4 Transport benefits of Cross River Rail*

## 3.6 Alternatives to Cross River Rail

Cross River Rail would provide a robust solution to existing and future capacity constraints in the metropolitan and regional rail networks. The Project derives from an analysis of strategic transport options in response to these constraints and the forecast increases in travel demand. Such travel demand would stem from sustained population growth and economic development.

### 3.6.1 Strategic options analysis

The planning process underpinning Cross River Rail is illustrated in Figure 3-4.

Following the evaluation of the strategic transport options, a preferred strategy was developed to guide investment in transport infrastructure and services across South East Queensland. This investment strategy would be supported by a range of policy measures to encourage more sustainable transport integrated with land use.

The investment strategy is based on:

- a progressive shift to rail as the key element in the region's passenger transport system
- bus performing a local, 'workhorse' function in support of rail, and complementing the coverage of the rail network
- ensuring arterial roads cater for all users, including buses, cars, pedestrians, cyclists and commercial vehicles
- maintaining freight functions and capacity for economic development
- providing for increased active transport.

Four integrated public transport options were developed and assessed against the goals and objectives for Cross River Rail. These were:

- Option 1 – Heavy rail enhancement
- Option 2 – Enhanced bus network
- Option 3 – Light rail
- Option 4 – Metro

Apart from heavy rail enhancement, each of the other options would require trains to turn back at the perimeter of the inner city, and for commuters to transfer to another mode of transport due to constraints in capacity crossing the Brisbane River.

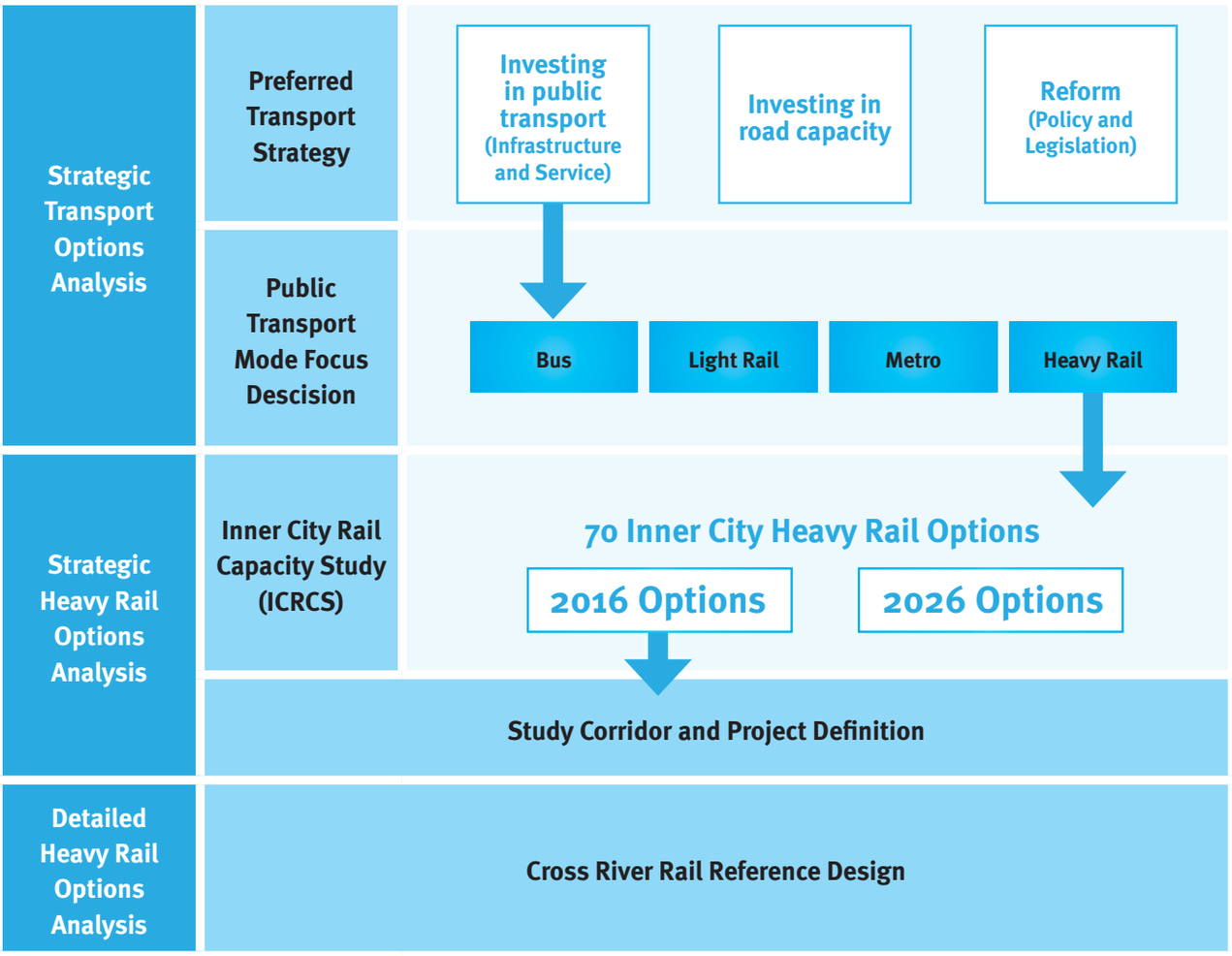



*Figure 3-5 Planning process underpinning Cross River Rail*

### Heavy rail enhancement option

The heavy rail analysis included options derived from the ICRCS and the early detailed feasibility work undertaken for Cross River Rail.

A shortlist of potential heavy rail options for further consideration included:

- Minimal enhancement option – make better use of the existing rail infrastructure
- Alternative option – improve inner city rail capacity by alleviating pressure on key network choke points as a 'lower cost' alternative
- North-south option – (Cross River Rail), proposed as a north-south line in Brisbane's inner city, including new rail tunnels under the Brisbane River and new underground stations in the inner city.

## 3.6.2 Minimal enhancement and alternative options

A range of lower cost measures have been considered to ensure maximum use of the existing rail network capacity, and possibly to defer the timeframe for major enhancement of rail network capacity.

While the 'minimal enhancements' would not provide a long-term viable option to achieving the project objectives, they would defer necessary rail network improvements.

A range of potential initiatives were identified to maximise the capacity of the existing rail network. These included:

- changes in current operational measures such as alternative stabling areas, dwell-time management at congested stations, optimising train headways and re-scheduling some services eg express passenger train (XPT) services

- improved time-tabling and service planning for the same fleet of trains by spreading loads more evenly across services
- increasing shoulder peak services, providing incentives for commuters to travel outside peak periods to take advantage of spare or un-used capacity in the infrastructure
- higher capacity rollingstock, as the combination of a metro-style rollingstock layout and longer trains to deliver around 1,200 passengers (based on four passengers per square metre) – compared with 928 passengers for current fleet
- next generation signalling, to improve both safety and track capacity as trains run closer together while maintaining the required safety margins.

In addition, the following network infrastructure improvements would be required to ensure system performance and trains could be presented reliably to the inner city network paths:

- Lawnton to Petrie third track with Petrie fourth platform included
- Coomera to Helensvale duplication
- signalling upgrades from Ormeau to Beenleigh and duplication of single line sections on the Cleveland corridor for further service increases on these lines
- Cleveland stabling to offset the need for a Park Road grade separation in the short term, without Cross River Rail, with services moving out of these stabling locations in the off-peak to remove a similar crossing move through Park Road junction in the afternoon peak.

Individually, or in combination, these initiatives would supply significant additional passenger capacity. However, these alternative measures may not be accepted readily by the travelling public due to incongruity of scheduled services with preferred travel times, increased crowding and reduced passenger comfort, and limited accessibility to key inner city destinations.

### 3.6.3 Summary – options analysis

The assessment of alternate project options indicates that public transport options which do not include an improvement to the inner city rail network, perform relatively poorly from a financial and economic perspective and in their ability to achieve the identified project objectives.

## 3.7 Relationship to other projects

### 3.7.1 Urban development projects

A range of urban development projects are planned either within or adjacent to the Cross River Rail study corridor. These projects are being managed by entities within the Queensland Government, providing opportunities to achieve high levels of integration between land use and transport planning.

Cross River Rail would provide high capacity, high frequency public transport necessary to realise all the strategic benefits of these projects. Such benefits, which would result in consequential reductions in travel demand to the CBD, include:

- attractive and highly accessible employment centres around but not within the Brisbane CBD
- highly convenient and accessible mixed use ‘villages’ comprising residential, business, entertainment, health and education facilities and services
- high quality public transport interchanges at key nodes, providing enhanced public transport accessibility and convenience well beyond the study corridor
- enhanced public transport services to major activity centres, such as Brisbane’s major teaching hospitals (RBWH, PA Hospital) as well as the Mater Hospital, the University of Queensland and the QUT, The Gabba and the RNA Showgrounds.

The benefits for these projects, and for the over-arching structure and functionality of the city and the region, would be greatly enhanced as a consequence of Cross River Rail.


*Transport infrastructure, Woolloongabba UDA*

## Bowen Hills Urban Development Area

The Bowen Hills UDA is an inner-city transit oriented development providing for residential, commercial, retail, and community and recreational uses. The Bowen Hills Station is the 'heart' of the UDA. Redevelopment of the RNA Showgrounds, consistent with UDA planning, would commence in 2011 and be undertaken in stages over the next 15 years. The new Ekka Station, would provide full transport service to support the Bowen Hills UDA and redevelopment of the RNA Showgrounds, as well as extend a new mode of transport to the RBWH (7,200 employees).

## Woolloongabba Urban Development Area

The Woolloongabba UDA has been identified as a transit oriented development, containing residential, community, recreation and commercial uses. Redevelopment would occur over a 10-15 year period. The new Gabba Station would be within the UDA and would improve accessibility for residents, employees, and patrons of The Gabba stadium.

Planning for Cross River Rail has considered the future development needs of the Woolloongabba UDA in relation to building heights and site layout.

The new Gabba Station for Cross River Rail, would provide a much-needed additional mode of public transport to service major events at The Gabba stadium, as well as extend an additional mode of public transport to the Mater Hospital (7,500 employees).

## Boggo Road Urban Village

The BRUV comprises residential, retail, commercial, research and recreational facilities. The Ecosciences Precinct was recently completed and accommodates approximately 600 workers. At capacity, this precinct will employ approximately 1,000 full-time staff.

A new Cross River Rail station beneath BRUV would support the future development of this area by improving accessibility for residents and workers. The new station would also support the PA Hospital (7,500 employees) and provide an additional mode of public transport for the University of Queensland at St Lucia (approximately 29,500 students and approximately 4,500 staff).

## Yeerongpilly transit oriented development

The Yeerongpilly TOD is located on land adjacent to the Queensland Tennis Centre at Tennyson, near the new Cross River Rail station. Planning had anticipated early development of the TOD would commence in early 2011 and would include residential apartments and office accommodation. Part of the site was inundated in the flood event of January 2011.

A new pedestrian overpass for Fairfield Road has been constructed to connect the Queensland Tennis Centre and the TOD site to the Yeerongpilly Station and residential areas east of the railway line. The TOD would also benefit from the enhanced rail services provided by Cross River Rail and the new station.

*Queensland Tennis Centre*

### 3.7.2 Other transport projects

The draft Connecting SEQ 2031 is the guiding transport planning policy to support the desired outcomes of the SEQ Regional Plan. Cross River Rail is identified as a priority element of the rail strategy in this document and is identified as a catalyst for the transformation of the South East Queensland rail network.

In addition to Cross River Rail, planning for a number of rail projects is under way, including:

- UrbanLink rail services with higher capacity trains operating inbound from Redbank, Strathpine, Loganlea, Ferny Grove, Manly, Springfield, Shorncliffe and the Airport. UrbanLink will have higher frequencies, boosting capacity of the rail network. Services will use new generation, higher capacity trains. These new services will support major regeneration and higher density development along rail corridors.
- ExpressLink services from Ipswich, Beenleigh and Caboolture. The ExpressLink services will provide express services to major transfer locations and activity centres linking the major existing and growth centres including Ripley (via Ipswich), Kippa-Ring (via Petrie), Flagstone (via Salisbury), Ormeau, Caboolture and Cleveland.
- CoastLink services from Brisbane to the Gold Coast and Sunshine Coast. CoastLink services will reinforce the SEQ Regional Plan principal activity centres as key locations for businesses with high-quality connections to the Brisbane CBD and Brisbane Airport. These services will support business growth at these centres and reduce long-distance private vehicle travel due to increased public transport patronage achieved by the new services.
- The ability for higher capacity nine-car trains to stop in the Brisbane CBD for high demand services.
- Additional freight rail capacity by providing a dedicated, dual gauge freight line between Acacia Ridge and the Port allowing more freight to be carried on rail to and from the Port.

Cross River Rail would support the operation of future UrbanLink, ExpressLink and CoastLink services by addressing capacity constraints in the inner city rail network and allow improved rail sectorisation to improve capacity and reliability of the rail network. The "2031 with project" scenario (draft Connecting SEQ 2031) illustrating the proposed future operating strategy is shown in Figure 3-5.


*Figure 3-6 Draft Connecting SEQ 2031: An Integrated Transport Plan for South East Queensland*

# 4 Traffic and transport

## 4.1 Study approach

The existing and future public transport patronage and public transport benefits of the Project were derived from a land use and transport network model specifically developed for Cross River Rail. Most of the analysis, including that relating to station passenger usage, road network congestion and user benefit forecasts, were derived from a transport network-wide model.

Three other integrated transport models were developed to assess the Project – a benchmark model and station simulation model to assist in station design and a rail operations model to develop service plans and to forecast levels of performance on the network. A separate assessment of the effects of the Project on freight movement by rail was also undertaken.

For the purpose of the transport assessment, a base year for Project commencement of 2020 has been adopted.

The draft Connecting SEQ 2031 transport strategy provides for a subway running from Newstead in the east to Toowong in the west, via the CBD. The subway and it's function as an inner city distributor has not been included in the base network of infrastructure projects for either the 2021 or 2031 modelled years. However it was included as a sensitivity test in 2031 and is reported in Chapter 5 Transport of the EIS.

## 4.2 Existing situation

### 4.2.1 Existing rail network and services

The Queensland Rail passenger network in South East Queensland extends from Nambour, Sunshine Coast in the north to Varsity Lakes, Gold Coast in the south, and from Moreton Bay in the east to Rosewood in the west.

The rail network is centered on the Brisbane CBD and serves key travel generators there and the inner suburbs. Generally, passenger rail services in Brisbane are medium to long-distance commuter services, receiving heavy patronage during the morning and evening peak travel times. Queensland Rail and the TransLink Transit Authority provide 57 train services each weekday peak hour through the CBD. These rail services operate on the following sectors:

- Main sector – this includes the Nambour, Caboolture, Ipswich and Rosewood lines
- Suburban sector – this includes the Shorncliffe, Airport, Doomben, Ferny Grove, Cleveland, Beenleigh and Gold Coast lines.

#### Rail services

Services from the northern and southern sections of the study corridor merge to the central study corridor. All services stop at all four stations from Bowen Hills to Roma Street (inclusive). A total of 57 services stop within the CBD during the morning peak hour.

A summary of the morning peak services is presented in Figure 4-1.

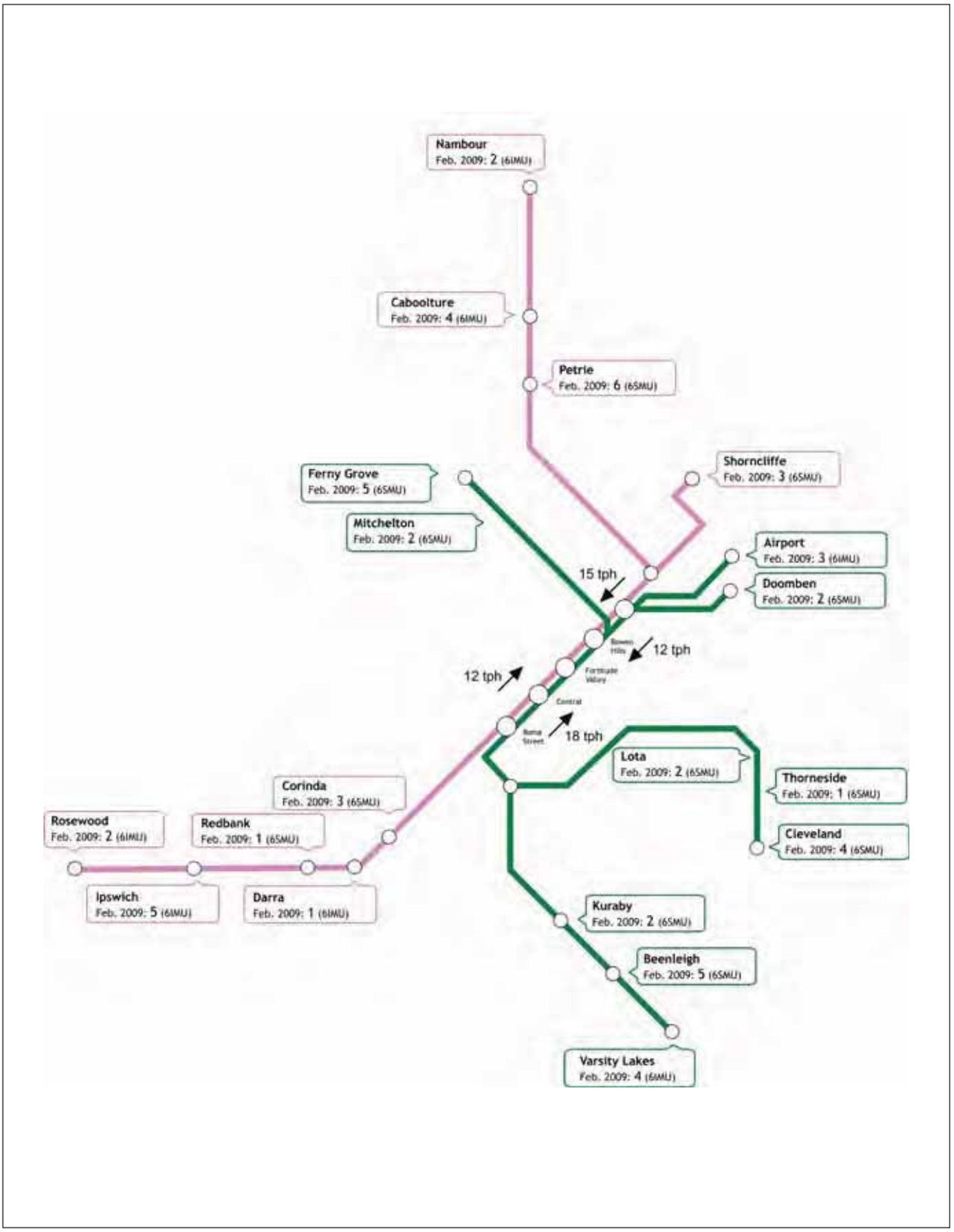



*Figure 4-1 Existing situation – morning peak passenger rail services*

## Freight rail

There is no dedicated rail freight network in South East Queensland. As a result, passenger and freight rail services share a common network and track capacity. Passenger services are prioritised over freight. Freight trains are restricted from using the network in the passenger peak period with freight traffic using train paths on the passenger network in the off-peak.

The freight services currently passing through the Brisbane rail network to destinations including Fisherman Islands (Port of Brisbane), Acacia Ridge freight terminal, and to regions serviced by the North Coast line are shown in Figure 4-2.

There are around 344 freight services per week travelling through the Brisbane rail network along the narrow gauge lines, including:

- 120 coal services travelling along the Western corridor, between Rosewood and the Port of Brisbane (Fisherman Islands) via Corinda and Yeerongpilly
- 16 grain services travelling along the Western corridor, between Rosewood and the Port of Brisbane (Fisherman Islands) via Corinda and Yeerongpilly
- 146 intermodal freight services travelling along the North Coast line, between Nambour and intermodal freight terminals, such as Acacia Ridge and the Port of Brisbane
- 62 intermodal freight services travelling along the Western corridor, between Rosewood and the Port of Brisbane or Acacia Ridge terminal.

In addition to the freight services travelling along the narrow gauge lines, there are up to 177 freight services (either standard gauge or narrow gauge) operating along the existing dual gauge lines between Acacia Ridge and Port of Brisbane per week. In addition, 59 standard gauge freight trains travel along the standard gauge-only line south of Acacia Ridge between Brisbane and Melbourne.

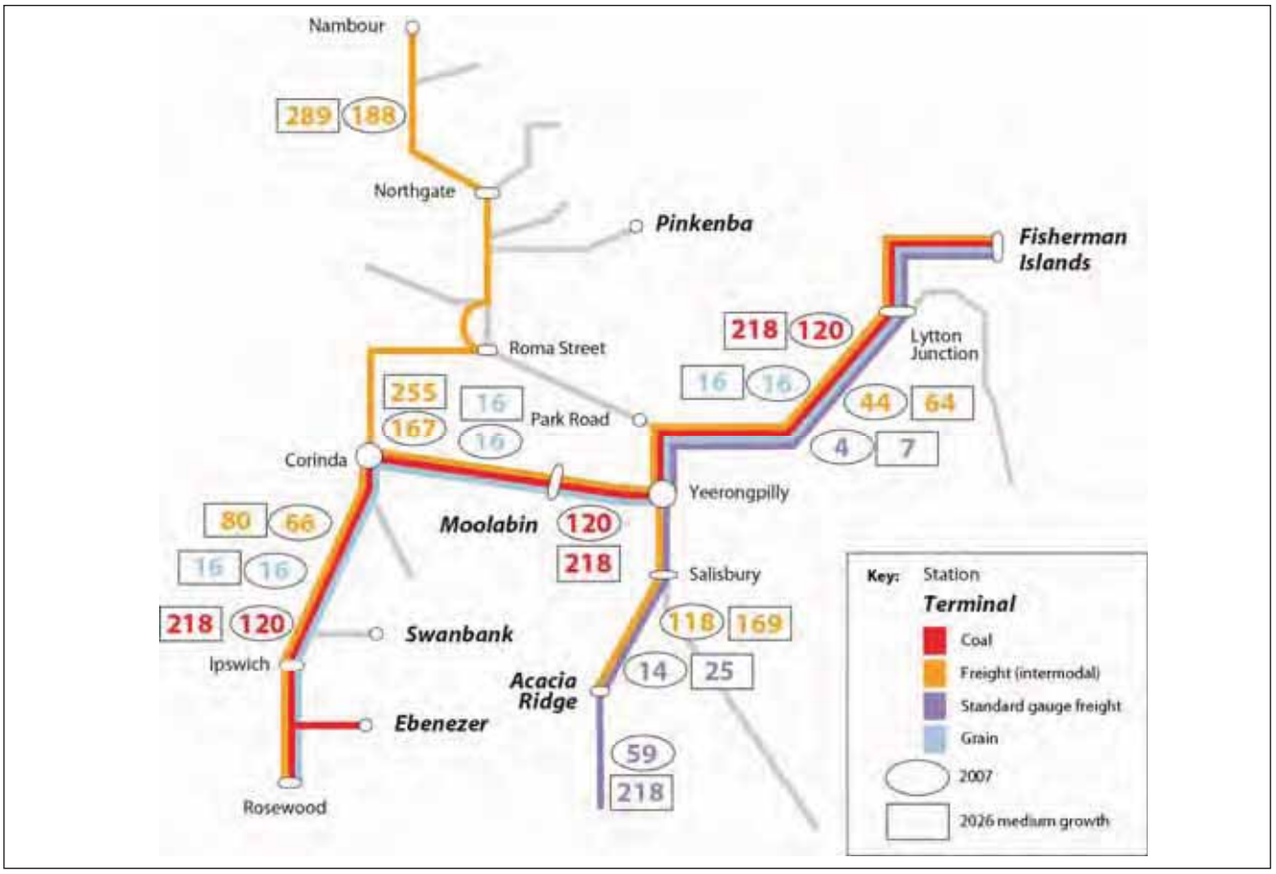



*Figure 4-2 Brisbane freight rail network and weekly services*

*Source: Inner City Capacity Study Pre-Feasibility Study Report, 2008*

## Public transport usage

Table 4-1 provides an overview of existing public transport use in the Brisbane metropolitan area.

*Table 4-1 Surveyed public transport use in Brisbane metropolitan area*

| Mode | Time period | | | | | |
|---|---|---|---|---|---|---|
| | AM peak 7.00 am to 9.00 am | Inter-peak 9.00 am to 4.00 pm | PM peak 4.00 pm to 6.00 pm | Off-peak 6.00 pm to 7.00 am | Total Daily* | Modelled average weekday 2009 |
| Bus | 53,100 | 115,300 | 63,000 | 41,600 | 273,000 | 285,700 |
| Ferry | 2,600 | 5,700 | 2,700 | 2,600 | 13,500 | 17,200 |
| Train | 65,500 | 80,300 | 56,000 | 35, 000 | 236,800 | 243,200 |
| Combined total | 125,800 | 207,600 | 125,500 | 81,900 | 540,700 | 546,000 |

**Note: estimates based on 2006 survey data, combined with 2009 passenger count data*

Currently, approximately 6.7 million person trips are made on an average weekday in the Brisbane metropolitan area, with public transport catering for 8.1% of all weekday person trips in 2009.

Almost 550,000 trips are made by public transport on an average weekday and almost half of the demand for travel occurs during the morning and evening peak. The heaviest demand period for rail occurs in the morning peak period.

Patronage of public transport in South East Queensland has increased by 3.8% per annum over the last 10 years. Bus patronage to the CBD increased twice as fast as rail between 2001 and 2006 (5.8% per annum for bus against 2.9% per annum for rail), due to the major investment in busway infrastructure, as well as the constrained capacity and reliability for rail operations. However, the average growth rate for both modes over the 10 year period was similar.

Public transport patronage (commuting) to the Brisbane CBD[2] grew in volume by 4.1% per annum (50% cumulative increase over the ten year period). Employment growth in the CBD for the same period was 24%, accounting for only half of the growth in commuting by public transport.

Based on current passenger growth rates and the existing train operating patterns, the inner city rail network is expected to reach its capacity in 2016 or soon after.

## 4.3 Operational effects – with Cross River Rail

### 4.3.1 Changes to rail passenger capacity

The development of Cross River Rail allows for a fundamental transformation in rail capacity to and through the CBD. Cross River Rail would allow up to an additional 48 trains per hour (two way) through the CBD, creating a combined total throughput of 132 trains per hour. This equates to a 57% increase in train paths compared to the current infrastructure's maximum capacity of 84 trains per hour through the CBD. With such a step change in capacity, Cross River Rail would free up surface rail paths at existing bottlenecks such as the Merivale Bridge, enabling additional passenger and freight services to be provided.

*Table 4-2 Forecast morning peak train numbers at CBD stations*

| Scenario | Trains from south/west to CBD | Trains from north to CBD | Total (two-way) |
|---|---|---|---|
| 2009 | 30 | 27 | 57 |
| 2021 without the Project | 40 | 39 | 79 |
| 2021 with the Project | 55 | 47 | 102 |
| 2031 without the Project | 42 | 42 | 84 |
| 2031 with the Project | 57 | 55 | 112 |

[2] *In this context, the CBD includes Spring Hill, Fortitude Valley and South Brisbane, and accounts for just under 20% of all Brisbane employment.*

In 2021, with Cross River Rail, an additional 15 peak period trains would be accommodated from the Gold Coast, Beenleigh and Cleveland corridors. This represents a significant increase in services within the newly created intercity/outer suburban sector along the Gold Coast/Beenleigh corridor.

By 2031, with Cross River Rail and other planned network enhancements (eg NWTC, branch lines and extensions), more services would be added to the Brisbane rail network, especially from key regional centres such as Strathpine, Caloundra and Redcliffe from the north and Ripley, Flagstone Creek and Elanora from the south.

The 2031 strategy with Cross River Rail would also allow the introduction of nine-car trains on inter-city/outer suburban sectors and high capacity suburban multiple unit trains on suburban sectors increasing passenger throughput. This would add a further 28 trains, or a 33% increase in capacity, to the Brisbane rail network during the morning peak compared to the situation without Cross River Rail.

The anticipated change in rail patronage, with Cross River Rail, is significant, and is demonstrated in Table 4-3 for average week day trips and and Table 4-4 for morning peak trips.

Furthermore, there is expected to be a decrease in average trip length and average trip time with the Project, compared to the 'without project' scenario, in both 2021 and 2031 This correlates to higher average trip speeds with the Project compared to without the Project in 2021 (almost 5% faster) and 2031 (over 10% faster).

*Table 4-3 Average weekday patronage – Brisbane (with and without Cross River Rail)*

| | 2009 | 2021 | | | 2031 | | |
|---|---|---|---|---|---|---|---|
| | | Without Cross River Rail | With Cross River Rail | % change | Without Cross River Rail | With Cross River Rail | % change |
| Public transport trips | 546,000 | 824,200 | 841,800 | 2.13% | 1,074,000 | 1,120,800 | 4.36% |
| Rail mode share | 8.15% | 9.95% | 10.16% | | 11.60% | 12.10% | |
| Total rail patronage (24 hours) | 243,200 | 421,900 | 454,200 | 7.66% | 529,500 | 595,400 | 12.45% |
| Rail trips to CBD (AM peak) | 37,100 | 61,600 | 72,800 | 18.24% | 73,700 | 95,100 | 29.04% |

*Table 4-4 Morning peak rail patronage*

| AM peak | 2021 | | | 2031 | | |
|---|---|---|---|---|---|---|
| | Without Cross River Rail | With Cross River Rail | % change | Without Cross River Rail | With Cross River Rail | % change |
| Total rail patronage | 108,300 | 122,600 | 13.18% | 141,900 | 174,000 | 22.62% |
| Average rail trip length (km) | 21.2 | 20.7 | -2.0% | 24.0 | 22.5 | -6.3% |
| Average rail trip time (min) | 31.7 | 29.8 | -6.0% | 34.8 | 29.4 | -15.4% |
| Average rail trip speed (km/h) | 39.98 | 41.69 | 4.3% | 41.36 | 45.8 | 10.8% |

By 2021, over 24,000 passengers would use Cross River Rail between Albert Street and Roma Street stations during the morning period. By 2031, the busiest peak period section would be between Gabba and Albert Street stations where almost 40,000 passengers would use Cross River Rail.

Overall, the busiest section of the Project would be between Gabba and Albert Street stations. In 2021 this section of the Project would carry 91,000 passengers per day increasing to almost 125,000 passengers in 2031. Cross River Rail would significantly reduce passenger crowding on some parts of the network in the morning peak period, as shown in Table 4-5.

*Table 4-5 Forecast change in rail patronage with Cross River Rail – morning peak period (two hours)*

| Segment | Average weekday morning peak passengers (two hours) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2009 | 2021 | | | 2031 | | |
| | | Without Cross River Rail | With Cross River Rail | % change | Without Cross River Rail | With Cross River Rail | % change |
| **Cross River Rail** | | | | | | | |
| Ekka – Bowen Hills | - | - | 22,500 | | - | 6,600 | |
| Roma Street – Ekka | - | - | 22,700 | | - | 7,100 | |
| Roma Street – Alderley | - | - | 0 | | - | 22,700 | |
| Albert Street – Roma Street | - | - | 24,300 | | - | 33,200 | |
| Gabba – Albert Street | - | - | 21,900 | | - | 39,300 | |
| Park Road – Gabba | - | - | 18,600 | | - | 33,500 | |
| Yeerongpilly – Park Road | - | - | 16,400 | | - | 31,100 | |
| **Surface** | | | | | | | |
| Valley – Bowen Hills | 27,400 | 40,600 | 21,100 | -48% | 52,600 | 32,700 | -38% |
| Central – Valley | 28,000 | 41,900 | 23,300 | -44% | 53,300 | 35,800 | -33% |
| Roma Street – Central | 25,200 | 41,400 | 35,200 | -15% | 51,100 | 42,600 | -17% |
| South Brisbane – Roma Street | 15,200 | 25,400 | 17,200 | -32% | 32,500 | 18,100 | -44% |
| South Bank – South Brisbane | 17,600 | 29,300 | 18,700 | -36% | 39,000 | 19,600 | -50% |
| Park Road – South Bank | 17,700 | 29,300 | 18,500 | -37% | 37,800 | 18,900 | -50% |
| Dutton Park – Park Road | 11,200 | 17,600 | 7,000 | -60% | 23,700 | 7,900 | -67% |

### 4.3.2 Changes in rail passenger services

Cross River Rail would be delivered as part of an over-arching implementation of rail network enhancements in South East Queensland. Such enhancements would encompass:

- revised rail operating strategies and service plans – to respond to peak demands, encourage travel in shoulder and off-peak periods (ie peak spreading), more efficient stopping patterns and standardised sectorisation for high growth lines routing through Cross River Rail
- upgraded rolling stock – to transition from six-car trains in 2021 to higher capacity nine-car trains by 2031 on high growth and high demand lines
- further development of the rail network – to provide additional capacity through rail

infrastructure enhancements for existing bottlenecks in the network, eg additional tracks, upgraded signalling, additional or enlarged platforms at key stations, implementation of the rail component in the NWTC.

The key operating change with Cross River Rail in 2021 would be the creation of a new sector servicing areas between the Gold Coast and Kuraby in the south, connecting via Cross River Rail to growth areas in the north. With this new sector, three stand alone sectors would operate with the Project in 2021 (compared to two sectors without the Project) as follows:

- North-south Cross River Rail sector connecting Beenleigh and Gold Coast services to Petrie services to the Redcliffe and North Coast/ Caboolture services. Nambour services would turn back in the south at Clapham Rail Yard (Yeerongpilly).
- East-west interurban sector connecting Springfield and Rosewood/Ipswich services connecting to the Airport and Shorncliffe services. Airport services would no longer be connected to the Gold Coast services.
- Brisbane suburban sector connecting Ferny Grove and Doomben services to Kuraby and Cleveland/ Manly services.

The indicative service plans with Cross River Rail for 2021 for the morning peak hour are shown in Figure 4-3.

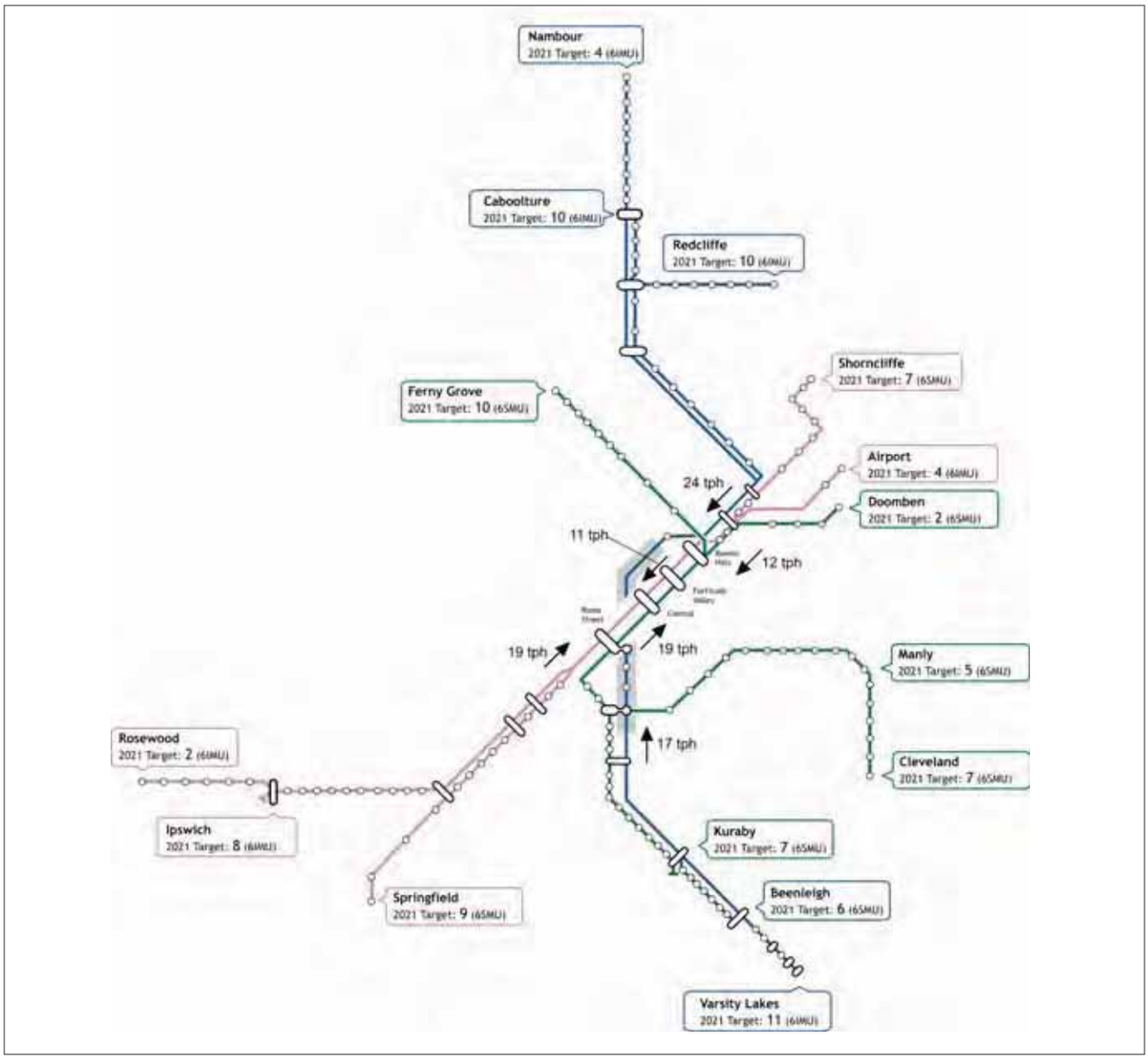



*Figure 4-3 2021 passenger rail service plan with Cross River Rail – morning one hour peak*

In 2031, the operating strategy proposed with Cross River Rail includes the creation of four sectors, compared to two sectors without the Project. The indicative service plan with Cross River Rail for 2031 for the morning peak hour showing these four sectors are illustrated in Figure 4-4.

In 2021, with Cross River Rail, the morning peak one hour timetable would provide 47 services to approach the CBD from the north (eight more than without the Project), and 19 from the west, two more than without the Project. Thirty-six services in the peak hour would arrive from the south and east, compared to 23 without the Project.

Of these 36 trains from the south and south-east, 17 services would travel via the Cross River Rail tunnel and 19 services would travel across the Merivale Bridge. This would involve four less trains using the Merivale Bridge than without Cross River Rail. The Project would free up line capacity and would improve reliability for the Cleveland, Beenleigh and Gold Coast services.

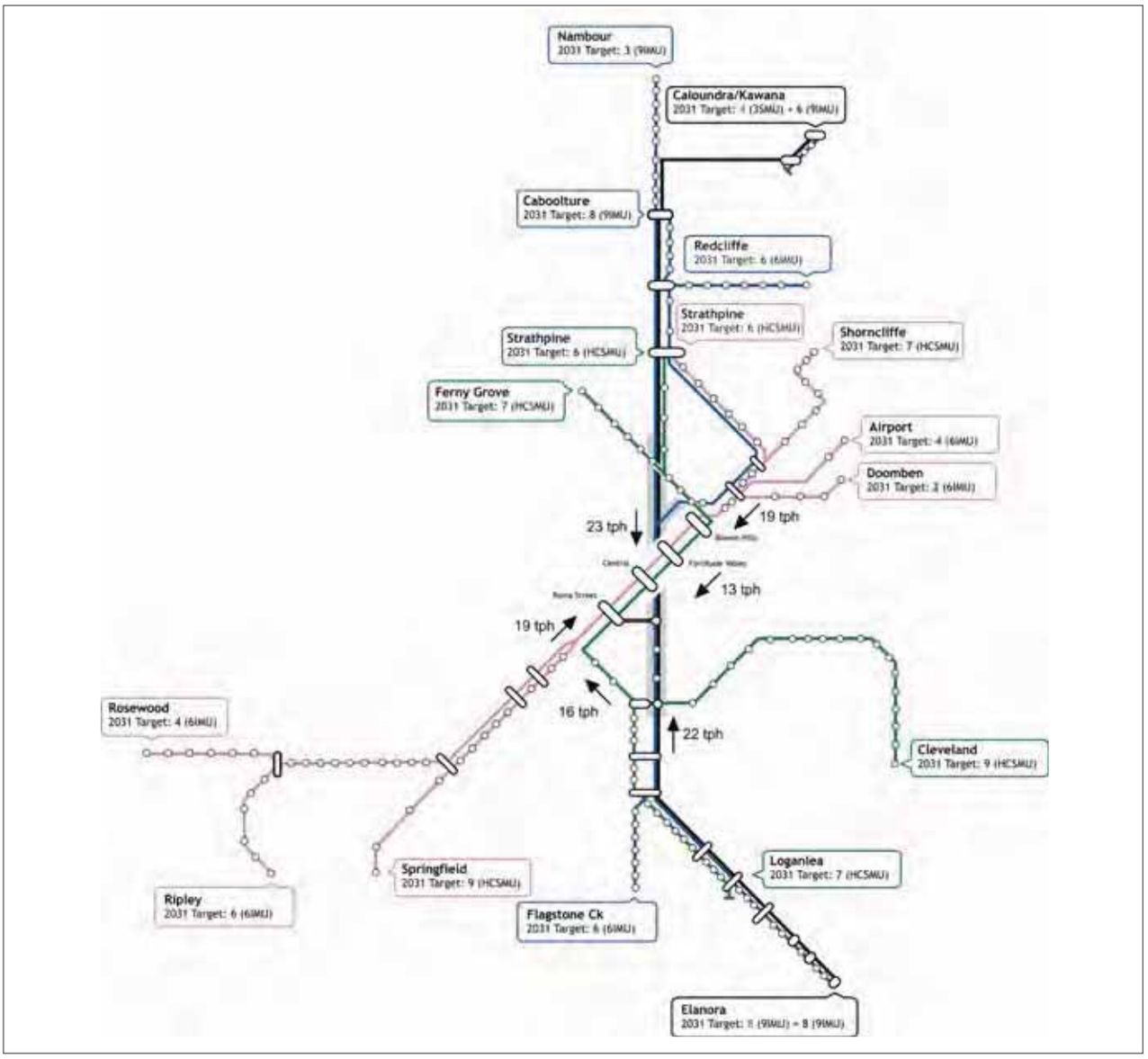



*Figure 4-4 2031 passenger rail service plan with Cross River Rail – morning one hour peak*

### 4.3.3 Rail network journey times

With Cross River Rail, journey times would reduce across the network due to efficiencies in the new sectorisation and express running patterns for some services. Reductions in journey times of 10 minutes from the Gold Coast and five minutes from the Sunshine Coast would be delivered with Cross River Rail. The travel time savings on some other journeys would be significant, for example:

- a trip from The Gabba to the CBD would take approximately two minutes
- a trip from Yeerongpilly to the CBD would take about 10 minutes, or approximately half the time taken at present.

By 2031, with Cross River Rail and with the NWTC, passenger travel times to the CBD would improve further for the North Coast line, with a reduction in journey time of up to 15 minutes (Nambour or Caloundra to Central). Direct connections between North Coast/Caboolture and Gold Coast/Beenleigh would provide a reduction in travel time of up to 10 minutes with Cross River Rail.

### 4.3.4 Passenger crowding

The introduction of Cross River Rail is forecast to reduce passenger crowding on numerous lines during peak periods providing significantly improved capacity to manage future growth in public transport demand.

With the introduction of Cross River Rail in 2021, crowding would decrease significantly on the Beenleigh and Gold Coast, Ipswich and Cleveland lines as well as crowding relief on the northern lines between Northgate and Albion.

By 2031, significant crowding relief to a large portion of the network is forecast, including the Beenleigh and Gold Coast lines, the Ferny Grove line, the North Coast line through Wooloowin and Albion, the Cleveland line and on the Merivale Bridge. Significant crowding inbound from Park Road and Bowen Hills during the morning peak also would be reduced.

### 4.3.5 Rail network reliability

Rail network reliability for passenger services is measured in terms of services running 'on time', or within four minutes of schedule.

By 2021, Cross River Rail would deliver improvements in rail network reliability, or punctuality, for trips to the Brisbane CBD during the morning peak period. A 10% to 12% improvement of on-time reliability is estimated. This improvement would occur because Cleveland and Kuraby services no longer would interact with Beenleigh and Gold Coast services on the suburban lines.

In 2031, further and significant reliability benefits (39% to 57% improvement) would accrue for northern services (Caboolture, Redcliffe, Nambour and Kawana). This is because the additional services delivered with Cross River Rail reduce overcrowding and allow shorter dwell times at stations, especially in the inner city.

The improvements in network reliability, illustrated in Figure 4-5, are critical to rail patronage as an attractive alternative to private vehicles, especially for commuter travel.

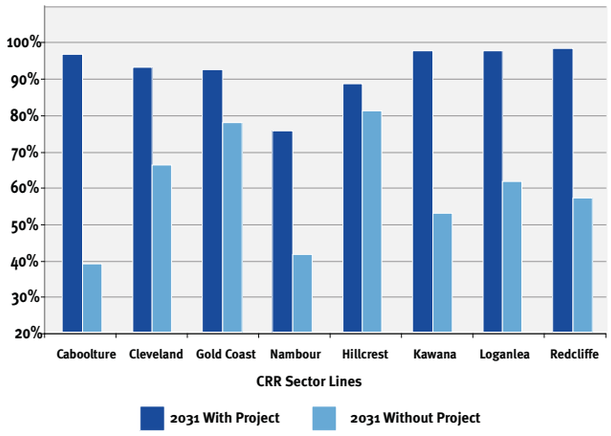



*Figure 4-5 Comparison of on time reliability at CBD with and without Cross River Rail in 2031*

### 4.3.6 Cross River Rail impacts on freight rail

By providing additional passenger tracks in the southern corridor, Cross River Rail would free up a dedicated dual gauge freight track from Salisbury to Park Road. This freed-up surface dual gauge track would complete the dedicated freight route from Acacia Ridge to the Port of Brisbane. This freight line would provide significant advantages for freight rail operations, including removing peak period limitations and allowing all projected 2031 freight demand to be accommodated on rail.

By 2031, the freight rail capacity north of Salisbury would increase from 24 to over 200 services. Table 4-6 compares the freight operability outcomes with and without Cross River Rail.

*Table 4-6 Freight rail operability comparison*

| | Weekly freight services – within Cross River Rail scope only | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2009 | 2021 | | | 2031 | | |
| | | Demand | Without Cross River Rail | With Cross River Rail | Demand | Without Cross River Rail | With Cross River Rail |
| North Coast | 206 | 264 | 264 | 264 | 322 | 16 | 322 |
| Salisbury–Tennyson | 137 | 172 | 24 | 172 | 209 | 24 | 209 |
| Tennyson–Port (IM) | 62 | 78 | 3 | 78 | 94 | 3 | 94 |
| Tennyson–Port (Coal) | 133 | 197 | 197 | 197 | 232 | 198 | 232 |
| Tennyson–Port Total | 195 | 275 | 201 | 275 | 326 | 201 | 326 |

*Note: demand paths assume current length consists and 15 minute off-peak passenger services*

While forecast availability of freight paths would be able to match the requirement for all lines, the actual paths available could be greater due to such factors as:

- lower off-peak frequencies pre-morning peak and post-evening peak
- lower off-peak frequencies on weekends
- increased capacity of freight services (length or carrying capacity)
- flighting, ie running trains close together in one path
- less restrictions on freight operating hours.

Without the capacity to meet freight rail demand, Cross River Rail would avoid a major shift of freight from rail to road.


*Freight rail, dual gauge track, Yeerongpilly*

### 4.3.7 Cross River Rail impacts on stations

#### Existing stations

The passenger movements through inner city and CBD stations during the morning peak period in 2021 and 2031 with the Project are forecast to increase significantly particularly at Roma Street, Park Road and Yeerongpilly. Daily usage of these stations would increase at a greater rate due to an increase in the number of off-peak rail trips made. Other changes arising from the Project are summarised as follows:

- overall in the CBD, approximately 95,000 passengers would alight during the morning peak in 2031 compared with 74,000 without the Project
- an even distribution of usage across the three CBD rail stations is expected, with significant reductions in cross-town pedestrian movements
- as passenger loads are shared across the three CBD stations, activity at Central Station would be lower in the morning peak with Cross River Rail. In 2021, passenger numbers would be 30% lower and 16% lower by 2031. This change would relieve existing and forecast crowding in the station and the surrounding pedestrian precinct
- a high number of rail-to-rail transfers is expected at Bowen Hills Station and Roma Street Station between Cross River Rail services and surface rail services in both 2021 and 2031

- Park Road and Boggo Road stations would become strategic rail hubs in the south west of Brisbane, served by Cross River Rail services and surface rail services from Kuraby and Cleveland, leading to significant interchanging activity
- rail-to-rail transfers would increase at Salisbury Station by 2031, particularly due to the ability to interchange from services on the future Flagstone Creek line to the Gold Coast line services
- South Brisbane and South Bank stations are forecast to have reduced passenger activity with Cross River Rail reflecting the attractiveness of Albert Street Station to access the southern precincts of the CBD.

On the northside at Wooloowin, Albion and Bowen Hills stations, the existing pedestrian infrastructure would adequately cater for the forecast increase in passenger demand at a minimum pedestrian LOS D. On the southside, at Dutton Park, Yeronga, Fairfield, Moorooka and Rocklea stations passenger activity changes are small with the Project and would not have a significant impact on the level of pedestrian service. The existing pedestrian infrastructure would have sufficient capacity.

## New Cross River Rail stations

The impact of Project operations at the new stations created for Cross River Rail include:

- Ekka Station – a new surface station providing adequate widths at the walkways and stairs to perform better than a level of service D under modelled peak conditions
- Roma Street Station – with Cross River Rail, would comprise a key regional multi-modal hub, accommodating 46,300 passengers, of which 20,500 would access the station by rail in the morning peak in 2031. This compares with 9,300 passengers in 2009
- Albert Street Station – an underground station forecast to cater for over 37,000 passenger movements in the morning peak in 2031, with most arriving or departing on foot
- Gabba Station – an underground station forecast to cater for approximately 11,000 passengers in the morning peak in 2031. Gabba Station would also integrate with the Woolloongabba Busway station to provide a major bus-rail interchange, as well as supporting transport requirements for major events at the Gabba Stadium
- Boggo Road Station – an underground station forecast to provide for approximately 2,000 passengers in the morning peak in 2031, within a total of 8,400 passenger movements across all modes. Boggo Road would become a strategic transport hub for the southern metropolitan area, linking with the Eastern Busway and the Boggo Road Busway
- Yeerongpilly Station – a new surface station would provide for 3,200 passengers in the morning peak in 2031, compared with 700 in 2009.

*Indicative image of Albert Street Station*

### 4.3.8 Cross River Rail impacts on transport mode share

With the implementation of the Project, rail would become the dominant transport mode for CBD access in the future, and would cater for over half of all travel demand. By 2031, with Cross River Rail in operation, 59% of CBD trips made by motorised modes are forecast to use rail.

Compared to the existing situation, car travel would reduce proportionally, with growth in travel demand increasingly served by public transport modes. Although bus travel would reduce in significance as a mode of access to the CBD in the morning peak, buses would still carry more overall trips than currently throughout the metropolitan area.

The forecast changes to overall CBD mode share in the morning peak with and without Cross River Rail are illustrated in Figure 4-6.

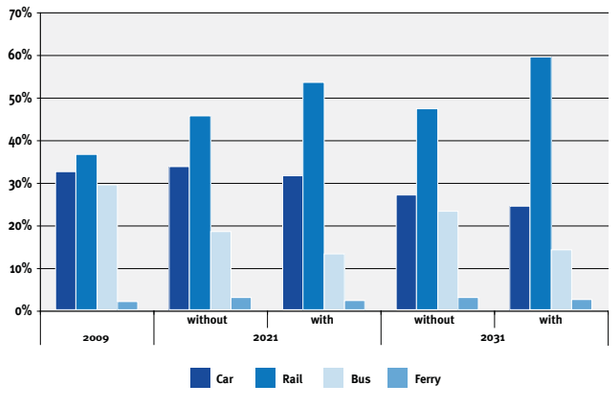



*Figure 4-6 Forecast change in mode share (morning peak) to Brisbane CBD with Cross River Rail*

Cross River Rail would also deliver a shift in mode to rail for cross-river trips to the CBD, in preference to both bus and private motor car. The predicted shift in mode share, where rail would provide for almost as many trips as by road in 2031 in the CBD (from the Go Between Bridge to the Story Bridge), including major bypass roads not serving the CBD.

Within and surrounding the study corridor, road traffic volumes crossing selected screenlines to the CBD in the morning peak period would be less with Cross River Rail than without the Project. The reduction in vehicle trips across the CBD cordon would be 2,300 vehicles by 2031 during the morning peak period.

### 4.3.9 Summary of key transport benefits

Cross River Rail would provide a significant increase in passenger rail capacity through the inner suburbs and CBD stations in both 2021 and 2031. This increase in capacity would deliver the following key strategic benefits:

- timely response to significant growth in travel demand to the CBD arising from rapid population growth and sustained economic activity
- relief for congested inner city rail bottlenecks at the Merivale Bridge and the section with the network directing all CBD traffic through Bowen Hills, Fortitude Valley, Central and Roma Street Stations
- removal of major operating constraints in the existing network with the introduction of sectorisation for services across the network and provision of additional stabling facilities at Clapham Rail Yard
- support for other modes of passenger transport (bus, private vehicle) which also are affected by constraints on capacity particularly on the surface road network, resulting in a significant shift in mode share to passenger rail for commuter traffic into the Brisbane CBD in the busy morning peak
- significant improvements in public transport (rail) on-time reliability, reduced journey times on key routes, reduced crowding, increased station capacity, and availability of a 'turn up and go' service for both Cross River Rail and surface stations
- relief of rail traffic congestion, particularly between Salisbury and Park Road, allowing the unconstrained movement of rail freight.

## 4.4 Construction traffic

The scale of Cross River Rail in its construction phase would lead to the creation of 15 worksites along the study corridor. Of those, the Yeerongpilly worksite and the Woolloongabba worksite are each proposed to support the launching and operation of two TBMs to construct the long driven tunnels of the Project.

The functioning of each worksite has the potential to impact on local roads and local traffic operations. The duration of construction works at some of the worksites would also complicate these potential traffic impacts as other development projects commence in the vicinity (eg RNA Showgrounds) or as major events take place (eg RNA Showgrounds, The Gabba stadium).

Anticipated construction traffic impacts would be addressed through preparation of specific Construction Traffic Management Plans prior to the commencement of work.

For traffic management, general working hours for construction works on or above the surface would typically be consistent with those established in the Construction EMP (CEMP).

Works within the rail corridor and on major roads would have to be conducted outside standard hours, peak rail operating periods and peak traffic periods.

Underground works generally would be continuous, providing the environmental objectives can be achieved.

Spoil haulage from the major worksites at Yeerongpilly and Woolloongabba is proposed to occur continuously (24 hours) on designated arterial routes. Spoil haulage would occur continuously on local roads between 6.30 am Monday to 6.30 pm Saturday. There would be no spoil haulage on local roads on Saturday night, on Sunday or public holidays.

There would be haulage of major construction equipment, materials and components outside these hours to avoid the impacts on day-time traffic flows.

### 4.4.1 Construction impacts on rail operations

Much of the surface works for Cross River Rail would interface with the existing rail network. Construction would occur while both passenger and freight rail services operate. Underground works would have minimal impact on current rail operations. Of the proposed underground stations, only construction at Roma Street would impact on the existing rail network.

The extent of surface works would be significant within the rail corridor south of the portal at Yeerongpilly and north of the portal at Victoria Park. Generally, passenger and freight services would continue to operate, except when the Project required possession of the tracks through scheduled night-time, weekend and other periods of rail shut-downs. Agreement with and approval from Queensland Rail, as the rail operator, would be required for any rail possession and for rail shut-downs.

For Project works south of Yeerongpilly passenger services generally would continue uninterrupted, with the exception of a temporary closure of Moorooka Station for up to 12 months. There would be no impact on freight operations that use the Tennyson Loop to access the rail corridor at Yeerongpilly.

The extent of Project works in Mayne Rail Yard is significant and complex, and includes track relocations and construction of an elevated track including a viaduct, connecting Cross River Rail with the existing network just south of Breakfast Creek. Such works would require regular, frequent rail service shutdowns at night and on weekends. Longer shut-down periods at certain periods (eg Easter) may also be required.

At present, passenger services are provided for up to two weeks each year in August to service 'the Ekka'. Construction is likely to result in Exhibition Station being closed for at least one Ekka period. Otherwise, construction works, which would impact on show activities, would cease temporarily when the Ekka is held.

Cross River Rail construction works would not impact on the existing railway stabling and maintenance regime at Mayne Rail Yard as all rail facilities and staff access points to maintenance facilities would be maintained throughout the construction period.

### 4.4.2 Construction impacts on road network

Construction activities would have potential impacts on the major road network (eg haulage routes) and the local road network, eg in the vicinity of worksites.

#### Construction traffic

The construction traffic expected to be generated from each of the worksites for both daily and hourly peak flows is presented in Table 4-8.

*M3 surface works, Clem Jones tunnel*
*Photo courtesy of Leighton Contractors*

*Table 4-8 Construction traffic generation*

| Worksites | | Peak spoil movements (daily) | Peak delivery (daily) | Peak total (daily) | Peak total (hourly) | Sum of each worksite |
|---|---|---|---|---|---|---|
| **Worksites** | | | | | | |
| Northern Portal | | 75 | 20 | 95 | 8 | 8 |
| Roma Street | North | 23 | 6 | 29 | 2 | 10 |
| | Central | 23 | 6 | 29 | 2 | |
| | South | 57 | 15 | 72 | 6 | |
| Albert Street | North | 23 | 6 | 29 | 2 | 8 |
| | South | 57 | 15 | 72 | 6 | |
| Woolloongabba | | 214 | 57 | 271 | 14 | 14 |
| Boggo Road | | 89 | 24 | 113 | 9 | 9 |
| Ventilation and emergency access building | | 29 | 8 | 37 | 3 | 3 |
| Yeerongpilly | | 214 | 57 | 271 | 14 | 15 |
| **Surface worksites** | | | | | | |
| O'Connell Terrace | | - | - | 60 | 4 | 4 |
| Mayne Rail Yard | | - | - | 143 | 9 | 9 |
| Clapham Yard | | - | - | 143 | 9 | 9 |

*Source: AECOM (tunnel worksites) and SKM-Aurecon estimates (surface worksites)*

Each of the major worksites at Yeerongpilly, Boggo Road, Woolloongabba, Albert Street and Roma Street, would require changes to local traffic arrangements to function effectively. Specific construction traffic management plans would provide measures to mitigate the effects of construction traffic. Such plans would address safety aspects, the movement of pedestrians and cyclists around worksites, the relocation of bus stops and taxi ranks where required, and measures to mitigate the effects of lane closures if and when they might be required.

Construction haulage routes have been determined to minimise the impact of truck operations from the proposed works.

The key haul routes for worksites south of the Brisbane River include a combination of Ipswich Road and Ipswich Motorway. For spoil haulage, the route would continue to Swanbank via the Cunningham Highway to Redbank Plains Road and then Swanbank Coal Road. Apart from Ipswich Road and Swanbank Coal Road, all other roads are State-controlled roads.

The key haulage routes for worksites north of the Brisbane River include the Riverside Expressway for Albert Street, and a combination of the ICB, Hale Street to Milton Road and the Centenary Motorway, before joining the Ipswich Motorway and onwards to the spoil placement site at Swanbank.

The impact of construction traffic, including spoil haulage and deliveries of plant and equipment, has been assessed. Critical intersections on the haul road routes have also been assessed to determine changes resulting from the proposed construction traffic. The assessment shows that peak hour haulage operations have a minimal and insignificant impact on base case peak traffic operation. Consequently, no restriction to trucking operations during the peak traffic periods is warranted.

## Construction workforce car parking

The provision of car parking for the construction workforce engaged at each worksite would include a combination of on-site parking and overflow parking supported by shuttle services to worksites where parking capacity is constrained. For some sites, such as the Yeerongpilly worksite, implementation of a car parking management scheme would address community concerns about parking overflow in local streets. A summary of the anticipated parking demand, supply and duration is provided in Table 4-9.

*Table 4-9 Construction workforce car parking*

| Site | Peak number of vehicles | Length of peak | Suggested car park site |
|---|---|---|---|
| **Surface works south** | 156 | Peak at 50-75% of timeline | Clapham Rail Yard (west of Fairfield Road) – 50 car parks<br>Salisbury (Lillian Avenue/Beaudesert Road) – 40 car parks |
| **Yeerongpilly worksite** | 118 | Peak at 50-75% of timeline | Yeerongpilly construction site (capacity for over 400 vehicles) with access from Ipswich Road to Station Road<br>Propose traffic area in Yeerongpilly to prevent workforce on-street parking |
| **Ventilation and emergency access building** | 39 | Peak at 60-85% of timeline | Construction site – 14 car parks |
| **Boggo Road Station** | 137 | Peak at 50-75% of timeline | Construction site – 30 car parks<br>The majority of the workforce would use a shuttle bus from the Yeerongpilly construction site<br>On street car parking discouraged due to Dutton Park traffic area |
| **Woolloongabba Station** | 137 | Peak at 50-75% of timeline | Construction site – 72 car parks<br>Excess workforce would use a shuttle bus from the Yeerongpilly construction site<br>On-street car parking discouraged due to Gabba traffic area |
| **Albert Street Station** | 137 | Peak at 50-75% of timeline | Minor number (12) of car parks on site. Majority of workforce to use off-street public car parks. On street car parking discouraged through Brisbane Central traffic area |
| **Roma Street Station** | 137 | Peak at 50-75% of timeline | 45 car parks on site. Excess workforce to use off-street public car parks. On street car parking discouraged through Brisbane Central traffic area. |
| **Victoria Park** | 39 | Peak at 60-85% of timeline | 80 car park accessible from Gregory Terrace and Bowen Bridge Road |
| **Surface works north** | 156 | Peak at 50-75% of timeline | Provision for 45 car parks at O'Connell Terrace and 100 at Mayne Rail Yard construction sites |
| **Total** | 1,056 | | |

*Note: assumes all workforce drive to construction site. Workforce source: AECOM Construction haulage routes*

## Impacts on road pavements

The impact of construction traffic has been assessed to measure the likely contribution towards the reduction of road pavement life spans. The contribution of project construction traffic is predicted to be less than 5% increase in the equivalent axle loadings, to the existing loadings for most of the construction routes proposed. For three roads, the predicted increase in equivalent axle loadings range from 11 to 15%. Considering the short duration of construction in the context of pavement design lifespan, the predicted level of impact is considered acceptable.

## Impacts at worksites

Each worksite has been examined to determine the potential impact of construction on pedestrians and cyclists, buses, parking, adjacent development and access, emergency services, special events and impact on general traffic operation. Specific mitigation measures have been proposed for each worksite where the impacts are considered to be significant. Overall, the impacts of construction are considered to be acceptable, with a minimum of change to existing traffic conditions. Any significant worksite specific traffic impacts have been summarised in Table 4-10.

*Table 4-10 Worksite specific, significant traffic impacts*

| Location | Impacts | Remedial measures |
|---|---|---|
| **Mayne Rail Yard** | • Use of Abbotsford Road bus bay for construction vehicle access to Queensland Rail property gate<br>• Adjustment to traffic, pedestrian and parking arrangements<br>• Mayne Rail Yard Adjustment to emergency service access to Queensland Rail buildings and building evacuation routes<br>• Small increase in heavy vehicle volumes on site access and egress routes | • Consultation with Queensland Rail, emergency services and Brisbane City Council |
| **O'Connell Terrace/RNA Showgrounds** | • Staged construction resulting in traffic delays at the intersection of Sneyd and Lanham streets with O'Connell Terrace<br>• Removal of some off-street car parking spaces and reconfiguration of car park in RNA Showgrounds<br>• Closure of direct driveway access to RNA Showgrounds east of rail overbridge | • Communications plan<br>• Detailed construction traffic management plan<br>• Reconfiguration of existing RNA Showground parking<br>• Consultation with RNA, Bovis Lend Lease, ULDA and Brisbane City Council |
| **Northern Portal (Victoria Park)** | • Construction traffic turn right directly off Gregory Terrace into worksite driveway<br>• Removal of on-street parking adjacent to and along worksite driveway<br>• Closure of shared cycle/pedestrian path at worksite<br>• Minor increase in traffic including heavy vehicles in Gregory Terrace, between worksite and Bowen Bridge Road | • Local traffic management measures<br>• Provide alternative cycle/pedestrian path past worksite<br>• Consultation with Brisbane City Council |
| **Roma Street** | • Removal station master's car park between platform 7 and 8<br>• Parkland Boulevard - closure of pedestrian access, removal of roundabout, changes to access to long distance platform, potential for minor delays<br>• Removal of some car parking spaces in College Crescent car park<br>• Station evacuation plans likely to require adjustment<br>• Minor increase in heavy vehicle flows on arterial and local road network | • Construction traffic management plan<br>• Provide pedestrian detour through Roma Street Station<br>• Provide vehicle detour on Parkland Boulevard/Parkland Crescent<br>• Consultation with Brisbane City Council and Queensland Rail |
| **Albert Street** | • Removal of some on-street parking in Margaret Street and Mary Street<br>• Change taxi rank in Alice Street, east of Albert Street<br>• Closure of footpaths in Albert and Mary streets<br>• Removal of street furniture including bike racks and seats in Albert Street<br>• Management of traffic in Alice Street at key times | • Construction traffic management plan<br>• Communications plan<br>• Pedestrian detours<br>• Taxi stand relocated if required<br>• Consultation with Brisbane City Council |
| **Woolloongabba** | • Closure of access from Vulture Street into worksite (Goprint), and reconfiguration of access for direct access to/from Vulture Street<br>• Traffic management in Woolloongabba Busway resulting in minor increase to running time for buses<br>• New driveway access from Ipswich Road northbound into worksite<br>• Closure of footpath on southern side of Vulture Street off-ramp including connection with Leopard Street | • Communication plan<br>• Construction traffic management plan<br>• Consultation with Brisbane City Council and ULDA |

| Location | Impacts | Remedial measures |
|---|---|---|
| **Boggo Road** | • Removal of on-street parking in Peter Doherty Street and Boggo Road<br>• Closure of Peter Doherty Street (south)<br>• Closure of footpaths – adjacent to Gaol and Ecosciences Precinct, and northern side of Peter Doherty Street<br>• Boggo Road – temporary diversion of pedestrian access, potential detours and one way working<br>• Increase in heavy vehicle traffic in the BRUV<br>• Minor increase in congestion at Boggo Road/Annerley Road intersection | • Construction traffic management plan<br>• Consultation with Brisbane City Council, Dutton Park State School, Department of Public Works and Leightons |
| **Fairfield ventilation and emergency access building** | • Access to site to and from Bledisloe Street from a left in/left out arrangement onto Fairfield Road<br>• Re-alignment of Railway Road, which will be diverted approximately 10 m to the east between Bledisloe Street and Sunbeam Street<br>• New right turn from one way northbound section of Fairfield Road adjacent to Brougham Street for construction U-Turns only<br>• Closure of through vehicle access along Railway Road during construction, requiring detour for destinations in Sunbeam Street (affecting five residences)<br>• Closure of footpath on southbound side of Fairfield Road<br>• Relocation of bustop approximately 150 m to the north (north of Bledisloe Street) during construction | • Pedestrian detour routes to be established<br>• Construction traffic management plan<br>• Consultation with Brisbane City Council |
| **Southern Portal (Yeerongpilly)** | • Realign Wilkie Street to maintain local traffic flows during construction and prevent through access from Fairfield Road to Station Road<br>• Short term pedestrian and vehicle detours during the reconstruction of Wilkie Street | • Communication Plan<br>• Local detours and diversions to be signposted<br>• Construction traffic management plan<br>• Consultation with Brisbane City Council |
| **Clapham Rail Yard** | • Close Moorooka Station and provide shuttle service, with pick up and set down passengers in Ipswich Road<br>• Minor increase in the volume of heavy vehicles on Ipswich and Fairfield roads | |

In addition to specific mitigation measures, strategic whole-of-project mitigation measures to manage traffic safety and network impacts are required and have been proposed. These macro-level measures would address the methods for traffic management, stakeholder consultation and communications with road users.

The combination of whole-of-project and specific worksite management measures proposed would minimise construction impacts to existing traffic conditions, and provide a feasible way to manage the construction traffic impacts of the Project.

## 4.6 Transport conclusions

Without the Project, expected growth in rail network passenger use and peak commuter demand to the Brisbane CBD would reach the capacity of the inner city rail network within the next six to eight years. This is due to the increasing commuter traffic growth from southern dormitory suburbs using the Gold Coast, Beenleigh and Cleveland lines.

The capacity of the inner city rail network would also be exhausted for services from all lines north of the river by 2021.

Progressively declining levels of rail service, including high levels of train crowding on the long-distance commuting trains and increasing train unreliability would continue without investment in the Project. Rail commuters would be forced to take off-peak trains, use alternative transport or change trip making decisions.

The expected growth of the Brisbane CBD as an attractive destination, for accommodation, employment, commercial, administrative, cultural and social activities, would put increasing pressure on the existing inner city rail network. There is a real risk that if rail services fall short of this demand:

- the CBD growth in employment and overall commercial competitiveness would decline
- car dependency to access the CBD and other inner city activity centres would increase
- transport and sustainability policy objectives, such as public transport mode share, greenhouse and reduced dependency on fossil fuels, would not be met
- inefficient CBD transport would lead to declining city life styles and liveability.

The key transport benefits are savings in passenger journey times, reduced train overcrowding and reduced wait time.

*Fortitude Valley Station*


Albert Street Station

# 5 Environmental conditions and impacts

The Cross River Rail study corridor and adjacent areas have been studied to gather baseline information for the assessment of potential environmental impacts and from which to develop the reference design. Environmental attributes relevant to the impact assessment for Cross River Rail include:

- climate change and sustainability
- topography, geology, geomorphology and soils
- land contamination, land use and tenure
- visual amenity and lighting
- nature conservation
- hydrology
- air quality and GHG emissions
- noise and vibrations
- waste
- cultural heritage (Indigenous and non-Indigenous)
- social values
- economics
- hazard and risk.

## 5.1 Climate change and sustainability

Climate change is recognised in Queensland's planning system as a critical aspect of sustainable development. There is the need for public transport to adapt to the impacts of climate change, taking into account extreme weather events, sea level rise, increased rainfall and increased temperatures. Climate change has begun to have measurable impacts on communities and is increasingly likely to affect physical infrastructure, as well as human behaviour, including travel behaviour. Climate change is a key consideration for the planning of transport infrastructure, with urban transport systems and inefficient settlement patterns a major contributor to GHG emissions.

Cross River Rail has the capacity to help reduce the carbon footprint of urban transportation in South East Queensland, by moving people more efficiently over longer distances and by supporting infill urban development, leading to reduced urban sprawl.

Sustainable transport infrastructure is also critical to the prosperity and functioning of Brisbane. The design and construction decisions for Cross River Rail will influence transport choices, mobility patterns, access and connectivity, land use and economic development for decades, and future generations. The assessment and mitigation of impacts described in each chapter of the EIS contributes to achieving the overall sustainability outcomes for the Project.

### 5.1.1 Existing conditions

#### Climate change

It is predicted in the report *Climate Change in Queensland: what the science is telling us* (QOCC 2010) that South East Queensland is likely to experience climate change effects such as increased inundation as a result of more intense weather systems, along with associated storm surges and higher sea levels. The Australian Bureau of Meteorology (BOM) and CSIRO also forecast the potential for an increase in the number of days over 35°C annually, possibly affecting human health and peak energy demand (CSIRO and BOM 2007; QOCC 2010). Predictions also highlight that Queensland may experience reduced water availability to support urban activities, industry, agriculture and natural ecosystems and conditions may become more favourable for plant diseases, weeds and pests (CSIRO and BOM 2007; QOCC 2010).

The Intergovernmental Panel on Climate Change (IPCC) identified South East Queensland as one of the six 'hot spots' in its assessment of the vulnerability of Australia to climate change impacts, noting that on-going development is likely to be exacerbated by large losses to the built environment from rising sea level, storm surges and flooding (IPCC 2007a).

### 5.1.2 Predicted impacts and mitigation measures

## Climate change

The key climate change risks to the Project arise from:

- impacts on power supply due to a range of possible events
- heat impacts on mechanical and electrical systems
- accelerated deterioration of facilities and infrastructure due to changed operating conditions, eg increase in days over 35°C
- inundation due to intense rainfall events
- sea level rise and storm surge affecting critical infrastructure, eg Mayne Rail Yard.

Mitigation measures for climate change risks include:

- asset management plan to ensure climate factors are considered, eg upgrading rollingstock, potentially accelerated deterioration of infrastructure
- station design to consider heat load and include appropriate cooling measures
- operations management plans to address the potential for power failures
- emergency response plan
- local flood mitigation and stormwater management
- determining flood immunity of critical infrastructure and designing measures to address increased risk of major flooding events
- station design and above-ground structures to withstand higher wind loads anticipated from climate change effects.

## Sustainability

Cross River Rail would support the transport outcomes in the SEQ Regional Plan and SEQIPP by fostering compact urban form and connecting communities. In terms of assisting South East Queensland to move towards a more sustainable basis, Cross River Rail would:

- assist in managing capacity limitations already impacting on the functionality of the inner city rail network. Increased capacity would assist in promoting the attractiveness and viability of rail within South East Queensland as well as facilitating forecast population growth and economic development of the region
- maximise the long-term viability of the rail network and to achieve a compact and sustainable urban form (TMR 2010)
- integrate at key locations with other transport modes such as bus and active transport networks to support greater accessibility and connectivity by public transport services across the region
- enhance the efficiency of rail freight by improving capacity between Salisbury and Yeerongpilly, effectively separating freight from the tracks required for the high-demand passenger services
- support the preferred land use pattern established in the SEQ Regional Plan, including maintaining the on-going role and function of the Brisbane CBD as the primary centre for commerce and employment in Queensland
- support a number of regionally significant employment centres and community uses that form the planned network of regional centres
- contribute to a reduction in South East Queensland's carbon footprint through reduced motor vehicle use, supporting transport mode shift through increasing capacity on the inner city rail network and enabling increased densities within inner city areas.


Sustainability measures incorporated in the reference design include:

- measures to reduce energy demand and minimise lifecycle energy consumption, eg single track tunnels for ease of construction, reduced gradients for lower energy operations, platform screen doors for safety and station temperature control
- measures to reduce water demand, eg minimising the use of potable water in construction, measures to protect water quality and reducing

the risk of flooding, eg tunnel and station design and waterproofing to limit movement of groundwater

- measures to implement effective waste management beyond regulatory compliance, eg reuse of some excavated material at Clapham Rail Yard and if encountered, remediation of contaminated land on site
- measures to maintain and, where possible, enhance the quality of the built environment through urban design, ie neighbourhood improvements, street widening
- measures to integrate with existing transport nodes, other infrastructure and land use to maximise efficiency in travel, patronage and viability
- measures to enhance health and social well-being and to improve passenger comfort, access to the rail network and station capacity during major events
- measures to enhance safety and security, eg Crime Prevention Through Environmental Design (CPTED) measures, compliance with the *Disability Discrimination Act 1992* (DD Act)
- measures that contribute to economic growth in Brisbane and South East Queensland, eg enhanced public transport and accessibility, enhanced capacity for rail freight, and integration with land use and redevelopment.

Future sustainability measures to be considered and advanced (where feasible) through the detailed design process include:

- incorporate energy efficiency and renewable energy alternatives, eg improve air conditioning efficiency, use of solar panels or photovoltaic cells, motion-activated lights and heat-activated ventilation and air conditioning, where feasible
- maximise water efficiency, eg plumbing fittings, rainwater harvesting, design reviews
- identify potential waste streams and implement a waste management hierarchy
- minimise spoil generation and optimise potential for re-use of spoil in construction of Cross River Rail
- incorporate biodiversity values into detailed landscape design
- review relevant neighbourhood plans and incorporate design objectives into the Cross River Rail detailed design where feasible
- identify opportunities for community involvement in the design of public open spaces
- investigate opportunities to create links from the stations to the existing cycle network and pedestrian network
- investigate CPTED measures for station design.

## 5.2 Topography, geology, geomorphology and soils

The investigation of topography, geology, geomorphology and soils, in the study corridor identified the existing land form, dominant geological units, soil landscape characteristics and significant features of in-situ material likely to be encountered or disturbed during construction. Areas of potential stability and erosion risk were identified within the study corridor, and recommendations made for further investigations through geotechnical and soil condition assessments prior to the completion of detailed design.

*Woolloongabba Busway Station adjacent to Cross River Rail Station worksite*

### 5.2.1 Existing conditions

The topography of the study corridor is generally characterised by undulating terrain with a number of prominent high and low points. The highest point within the study corridor is on Wickham Terrace in Spring Hill at 55 m Australian Height Datum (AHD) and the lowest point is within the Brisbane River channel at less than 0 m AHD.

Topography within the study corridor has influenced the reference design, and particularly the tunnel sections. It has been necessary to position the tunnel sections within suitable, competent geological units and at the same time achieve safe design gradients for rail operations. Topography has also influenced the design

and placement of surface structures associated with the Project, such as stations, station access locations, the emergency access and ventilation shaft, feeder station building locations and their position above flood levels.

Key findings in respect of the geology and soils in the study corridor are summarised as follows:

- The underlying geology within the study corridor is dominated by the Mesozoic Aspley and Tingalpa Formations, the Palaeozoic "Brisbane Metamorphics", consisting of the Bunya Phyllite and Neranleigh-Fernvale Formations (immediately prior to the volcanic ash falls of the Brisbane Tuff) and the Mesozoic sediments of the Woogaroo Subgroup. Further detailed geotechnical investigation is required to inform detailed design and to quantify and assess in detail the geological/geotechnical conditions likely to be encountered during construction.
- Erosion risk would be highest in areas where surface and sub-surface soils would be disturbed on steep slopes (greater than 10% gradient). This would affect surface works between Mayne Rail Yard and the northern portal, Woolloongabba and Dutton Park, but is unlikely to result in significant impacts in the southern section of the study corridor.
- Acid sulphate soils (ASS) are present within low lying areas within each section of the study corridor. There is limited potential for these soil types to be disturbed by surface works between Mayne Rail Yard and the northern portal, in the vicinity of the Albert Street Station and between the southern portal and Clapham Rail Yard.

### 5.2.2 Predicted impacts and mitigation measures

Any potential impacts to geology and geomorphology values within the study corridor as a result of tunnelling works for the Project would be associated with geological stability, eg settlement. Loss of fossil material not previously identified is unlikely.

As with all tunnel construction, there is a potential risk of geology and soil impacts due to settlement resulting from tunnel excavation/construction, which include:

- elastic ground settlements due to excavation of the tunnel
- consolidation settlements caused by dewatering of porous rock formations or compressible soil layers that are hydraulically connected to groundwater drawn down into the tunnel excavations.

The risk potential for such impacts is considered to be low, having regard to the design and construction methods proposed for the mainline tunnels, the cross-passages and the underground stations. The mainline tunnels would be lined with pre-cast, reinforced concrete rings to provide a high level of ground support and waterproofing immediately behind each TBM. The cross-passages would be lined with a waterproof membrane and supported with a cast in-situ concrete lining, again for ground support and waterproofing. Each of the underground stations would be constructed with cut-off walls and sealing structures into rock to achieve a waterproof solution.

There is also the potential to impact on surface and groundwater systems as a result of drawdown if tunnelling activities intercept significant water-bearing geological discontinuities that cause groundwater inflows to either of the tunnels. Having regard for the proposed design and construction of the tunnels and underground stations, this risk is considered to be low and manageable, but will require further survey work prior to completion of detailed designs.

The potential for wide-spread disturbance of ASS sediments as a consequence of Cross River Rail construction is also considered to be low and manageable. Field investigations would be required to support detailed design, to confirm the presence/absence and status of ASS and to manage the potential impacts on both surface water and groundwater. There are well-established protocols for the identification and management of construction works where ASS would be encountered.

Further sampling and geotechnical analysis would be undertaken as part of detailed design and construction planning and to assess the physical and chemical conditions of surface and subsurface soils likely to be encountered during construction.

During construction, an on-going monitoring programme would address both ground movement and groundwater inflow to tunnel works and station excavations.

## 5.3 Land contamination

### 5.3.1 Existing conditions

Known and potentially contaminated sites within the study area were identified from a number of sources, including a review of data in the Environmental Management Register (EMR) and Contaminated Land Register (CLR) provided by the Department of Environment and Resource Management (DERM), current and historical aerial photographs and Queensland Rail contaminated land information.

A roadside inspection of listed commercial/industrial properties and properties identified as being potentially contaminated, based on the assessment of past land uses, was also undertaken.

The groundwater study area included a buffer extending beyond the study corridor to account for potential drawdown of groundwater into the tunnels and underground stations. The risk is low for there to be significant groundwater movements as a consequence of the Project. Some 2,972 land parcels in the study area are listed on the EMR, of which 506 land parcels are located in the study corridor itself. These included:

- 432 land parcels identified with notifiable activities which are considered to be of higher risk
- 74 land parcels identified with notifiable activities which are considered to be of lower risk
- 14 land parcels managed under a Site Management Plan (SMP).

Some 108 additional properties were identified in the study corridor which are not listed on the EMR and potentially contain contamination. Of these:

- 46 land parcels were identified with notifiable activities considered to be of higher risk
- 62 land parcels were identified with notifiable activities considered to be of lower risk.

There were 74 land parcels identified as containing potential soil or groundwater contamination. Areas identified as being of key interest for the Project in relation to contaminated land include:

- Mayne Rail Yard, which has confirmed hydrocarbon groundwater contamination
- rail corridor land, which is likely to be contaminated from past management practices involving the use of pesticides, including arsenic, and other solvents and oils
- Goprint site, which was a former rail yard
- Roma Street Parkland, which is the site of the former Roma Street goods and freight yards and which may contain contamination
- various properties within the Brisbane CBD which are listed on the EMR for the notifiable activity of "petroleum product or oil storage"
- 50 land parcels within the study area that are listed on the EMR for the notifiable activity of "landfill", and an additional 21 properties identified from historical information as potentially being used for land filling activities.

There are no operating landfills within the study area.

### 5.3.2 Potential impacts and mitigation measures

The Project may have the following potential impacts during the construction and operation phases:

- disturbance of potentially contaminated soils
- contamination from potentially contaminated sites adjacent to the Project
- disturbance of unexpected contamination
- disturbance of asbestos containing materials.

The potential for impact during construction would be greatest at the worksites, where surface soils would be disturbed. Having regard for the preliminary investigations undertaken for this EIS, construction activities such as shafts for underground stations and ventilation, tunnel dive structures and portals, mostly occur within rail corridors or in areas where contaminated land might be present. Further potential would arise at such locations where construction would likely intercept shallow aquifers, such as in the Brisbane CBD and possibly the Fairfield ventilation and emergency access shaft.

In accordance with the *Environmental Protection Act 1994* (EP Act) and its regulations and associated policies, construction activities relating to the disturbance, excavation, removal or disposal of contaminated soil or groundwater must ensure that environmental harm is prevented. Where contaminated soil is encountered, specific mitigation measures must be developed and implemented prior to the commencement of site activities.

Minimum requirements include:

- provision of barriers to prevent public access to construction areas
- management and prevention of dust emissions
- appropriate erosion and sediment controls and staging of site activities to minimise the potential run-off from contaminated soils
- measures to minimise the exposure of humans and the environment to potentially contaminated soils during excavation activities
- measures to mitigate odour emissions from excavation activities, such as use of water sprays, odour suppressants and/or the odour causing material covered by plastic or mulch
- controls for material haulage, such as covering loads or wetting material to reduce dust emissions

- documentation of all contaminated material during transport operations (including the descriptions of processes, personnel and organisations involved in the removal, transportation and placement of contaminated material)
- monitoring of contaminated material movement and disposal
- application for permits for removal of contaminated soil under the EP Act
- appropriate workplace health and safety procedures.

Where contaminated groundwater is encountered, additional measures to those above would be required including:

- mitigation of groundwater inflow to the works, through the installation of cut-off walls and other waterproofing measures
- consult with DERM, and if necessary the CHEM Unit, to agree the level of hazard and the appropriate response
- collecting groundwater entering the works, either at designed sumps or through pumping, and if feasible, treating on-site prior to removal and disposal
- providing measures for the safe removal and disposal of contaminated groundwater.

As part of detailed construction planning, detailed investigations would be carried out prior to commencement of the Project works in accordance with the Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland, and National Environment Protection (Assessment of Site Contamination) Measure. In accordance with the EP Act, a DERM disposal permit would also be required for the removal and disposal of contaminated soil from land which is recorded on the EMR or CLR to an off-site location.

Appropriate planning documentation, including a contaminated land management procedure and a Construction Occupational Health and Safety (OH&S) Plan would be prepared and incorporated into the CEMP.

## 5.4 Land use and tenure

### 5.4.1 Existing conditions

The land use and planning context for the Project is guided by both State and local planning frameworks. These planning frameworks provide an overarching view that transport networks within South East Queensland and Brisbane need to be improved in order to accommodate future population growth and economic development.

#### Existing land uses

Land uses within the study corridor reflect the inner city and inner suburban location. Land uses comprise a broad mix and generally include areas of residential, commercial, community, open space and light industry.

The study corridor contains a mix of densities with the highest densities located within the Brisbane CBD. Other areas that contain higher density development are situated at key employment areas, such as Woolloongabba, Spring Hill, or around key transport nodes. Apart from the Brisbane CBD, residential is the prominent land use within the study corridor. Industrial land is primarily located in Bowen Hills and in the southern section of the study corridor, ie Yeerongpilly, Moorooka, Rocklea and Salisbury. Commercial uses are predominantly located within the Brisbane CBD area.

The northern section of the study corridor between Wooloowin to Bowen Hills includes a number of large community uses and low-medium density residential and industrial uses.

The Bowen Hills and Spring Hill section of the study corridor includes a number of large transport, entertainment, construction and health uses. Industrial, residential and commercial uses also feature prominently. Several uses of regional and local importance are located within or near to the study corridor, including Mayne Rail Yard, RNA Showgrounds and RBWH. Other hospitals in this section include St Andrews Hospital and Brisbane Private Hospital. Cross River Rail would serve this area with enhanced capacity at Roma Street Station.

Several secondary schools of regional significance are also situated in this part of the study corridor including St Joseph's College Gregory Terrace, Brisbane Girls Grammar School and Brisbane Grammar School.

The Centenary Aquatic Centre is situated within Victoria Park, adjacent to the proposed location of the northern portal for Cross River Rail.

The Brisbane CBD contains a high density mix of retail, commercial and residential uses. Major land uses within the Brisbane CBD provide a range of education, entertainment, government, recreation, retail and transport functions. Cross River Rail would serve both Spring Hill and the CBD through the new underground stations at Roma Street and Albert Street.

The Woolloongabba section of the study corridor contains a diverse mix of uses at a range of different

densities, including entertainment, retail, transport and community activities. The proposed station site would be situated close to major activities including The Gabba and the Mater Hospital, as well as growing medium and high density residential areas. The Gabba is a significant influence on development and activities in this area. Cross River Rail would serve this key activity centre with the new Gabba Station at Leopard Street.

There are a number of key land uses in Dutton Park including BRUV and the Ecosciences Precinct, PA Hospital, Dutton Park State School, South Brisbane (Dutton Park) Cemetery and the Boggo Road Gaol Museum. While residential land use is characterised by detached, character dwellings, new higher density residential is planned for BRUV.

The southern section of the corridor includes Fairfield, Yeronga, Yeerongpilly, Moorooka, Rocklea and Salisbury. Generally this section of the study corridor is defined by a mix of low density residential dwellings, industrial and community uses, as well as some higher density uses and the Queensland Tennis Centre.

Residential uses in this part of the corridor are typically detached character housing and low to medium density accommodation adjacent to the existing rail stations at Fairfield, Yeronga and Yeerongpilly. Industrial activity is characterised by light industry, warehousing, motor vehicle and machinery repairs and some light manufacturing.

The Clapham Rail Yard and Queensland Rail track plant are also located in this part of the study corridor.

## State planning

At the State level, land use and development is governed by the *Sustainable Planning Act 2009* and guided by State planning instruments, including the SEQ Regional Plan and SEQIPP.

The SEQ Regional Plan encourages transport and land use integration to assist in reducing reliance on private motor vehicles for travel, through shorter journeys and increasing accessibility to employment, education and services. The SEQ Regional Plan seeks to establish and support the integration of activity centres, including employment, cultural, administration, education health care and community facilities, with high capacity public transport corridors. Transit oriented development is important to achieving a sustainable land use pattern.

Cross River Rail supports the desired regional outcomes of the SEQ Regional Plan through the provision of new public transport opportunities that would improve movement and accessibility to identified high growth areas and major activity centres. There are several development nodes that would be supported by the high capacity public transport delivered by Cross River Rail. These nodes include:

- the Bowen Hills UDA declared in March 2008
- the Woolloongabba UDA declared in April 2010
- the BRUV including the Ecosciences Precinct
- the Yeerongpilly TOD site.

Future residents and employees in each key site would have enhanced accessibility to the city and South East Queensland through the Project and its integration with other modes of transport.


## Local planning

At the local level, the land use and planning context for the study corridor is guided by Brisbane City Plan 2000 (City Plan), the Brisbane CityShape Implementation Strategy (City Shape) and Brisbane City Council local laws. The draft River City Blueprint is an expression of planning intentions shared and being developed by the Queensland Government and the Brisbane City Council. The draft River City Blueprint when released in mid-2011, is expected to provide an integrated strategic plan addressing existing plans, strategies, major infrastructure and development projects within a 5 km radius of the CBD.

City Shape outlines Brisbane City Council's vision for the city and provides direction to the projected future pattern of development including new growth and development areas, growth corridors, employment precincts, centres and major industrial areas. The Project will support the strategies identified within the CityShape Strategy, through facilitating improved transport and land use integration, and supporting increased densities within the inner city area, specifically surrounding the identified growth areas of Brisbane CBD, Bowen Hills, Woolloongabba and Boggo Road.

Supporting these higher-order plans are a number of local and neighbourhood plans for areas in the Cross River Rail study corridor. There are local plans for

Bowen Hills and Petrie Terrace and Spring Hill, West End – Woolloongabba, Stephens District and Moorooka District.

There are neighbourhood plans for the city centre, Woolloongabba Central and a draft Neighbourhood Plan for Kangaroo Point South.

### 5.4.2 Potential impacts and mitigation measures

The potential impacts of Cross River Rail upon land use in Brisbane would include the acquisition of land either at the surface or volumetrically, stimulus for increased development activity in the declared UDAs, TODs and urban villages, and rejuvenation of the inner suburbs arising from greatly enhanced accessibility and levels of service by public transport.

#### Acquisition of land

The Project would impact on land use both during its construction and operation. Overall, the Project would require the acquisition of approximately 108 properties, for surface works, including worksites, stations and ancillary infrastructure, mostly in the southern parts of the study corridor. These properties include private, State and Council owned land.

In addition, volumetric acquisition would be required on a further 303 properties. Volumetric acquisition of titles required for the Project would be located mainly within the central section of the study corridor. Residential properties would be most affected by volumetric acquisition.

Key properties required wholly or in part for the Project through surface acquisition include:

- a small portion of Victoria Park
- a small parcel of land within the RNA Showgrounds
- site at the corner of Albert and Alice streets, containing the Royal on the Park Hotel
- site containing commercial uses located at the corner of Mary and Albert streets
- State land in Woolloongabba, including the Goprint site
- a small area of Council land off Fairfield Road and an adjacent parcel in Bledisloe Street, Fairfield
- residential land to the east of Wilkie Street Yeerongpilly and to the west of Ipswich Road, Moorooka adjacent to Clapham Rail Yard
- industrial land located to the south-east of Yeerongpilly Station, around Station Road.

At Bowen Hills, land would be acquired for both the new Ekka Station and the construction worksite in the north of RNA Showgrounds. Acquisition of land for the station would result in the loss of a number of existing structures and features. Land would also be required for surface works between the new Ekka Station and Mayne Rail Yard, as well as within Mayne Rail Yard itself.

A number of residential properties would be acquired along Wilkie Street, Yeerongpilly to make way for the realignment of Wilkie Street and the southern portal, south of Cardross Street.

Key areas where volumetric acquisition would be required are situated in the Brisbane CBD, BRUV, Kangaroo Point and Woolloongabba, the corridor including Dutton Park, Fairfield, Yeronga and Yeerongpilly.

Upon completion of the Project works, land required for worksites would be rehabilitated and would be available for redevelopment subject to conventional planning and development assessment procedures.

Within the Brisbane CBD, land use impacts would be primarily commercial, with impacts also on residential and open space uses. The Project would result in the permanent loss of 22 businesses for the establishment of Albert Street Station accesses. The subsequent redevelopment opportunities including retail facilities around the proposed civic space at the Albert Street Station access would assist in off-setting the loss of CBD retail space. Such development would be assessed under the provisions of City Plan, and separately to this EIS.

*Albert Street, Brisbane CBD*

The proposed Roma Street and Albert Street underground stations, with the enhanced accessibility to these parts of the CBD, would support and stimulate changes to density and mix of nearby land uses. An intensification of both commercial and residential uses around both Roma Street Station and Albert Street Station should be expected as a consequence of Cross River Rail.

### Development activity in the declared UDAs, TODs and urban villages

At the completion of the new Ekka Station, the RNA Showground facilities affected by the Project works would be rehabilitated for some subsequent use consistent with the Master Plan. The reference design reflects the intentions of the RNA Showground Master Plan. Any additional development not covered by the existing Master Plan would need to be approved by the ULDA.

*Woolloongabba*

At Woolloongabba, State land adjacent to the proposed station is proposed for redevelopment as part of the UDA initiative. Successful integration of land use and transport would be achieved through the UDA. This would support major events at The Gabba, and the planned urban rejuvenation south of Stanley Street in response to the Woolloongabba Centre Neighbourhood Plan and to the north in the Kangaroo Point South Neighbourhood Plan.

Cross River Rail would support BRUV as a highly accessible, high density, mixed use precinct. Such enhanced accessibility would stimulate further residential and commercial activities in the precinct. The connections between the University of Queensland and the Ecosciences Precinct would be strengthened as a consequence of Cross River Rail. An opportunity exists for this transport and functional linkage to extend to the PA Hospital.

### Suburban rejuvenation

Yeerongpilly and Moorooka would be affected by surface land acquisitions for construction, rail station and road realignments. These requirements would result in the loss of residential and industrial land from use. The Project would support rejuvenation of areas surrounding the new station at Yeerongpilly. The strategic connection of the new station with the Yeerongpilly TOD and the Queensland Tennis Centre would enhance the viability of both Cross River Rail and these development areas.

## 5.5 Visual amenity and lighting

### 5.5.1 Existing conditions

The study corridor traverses a well-established urban environment, including the Brisbane CBD and inner suburbs. Views throughout the study corridor are of a developed landscape of varying intensity interspersed with green spaces and planted streetscapes. Transport infrastructure is a recurring visual element in the study corridor with road and rail infrastructure being prominent.

The study corridor is mostly well-illuminated, particularly within commercial areas and along road corridors. Residential and open space areas are lit to the extent required to provide satisfactory navigation and public safety.

### 5.5.2 Potential impacts and mitigation measures

#### Visual amenity: Wooloowin to Bowen Hills

Cross River Rail would deliver a new elevated viaduct extending from a point south of Breakfast Creek to the new track at grade to the north of the ICB. For much of its length, this viaduct would run roughly parallel with the ICB. The existing visual context of the Bowen Hills

and Mayne Rail Yard areas is highly compromised by elevated structures associated with the ICB, Clem Jones tunnel, Northern Busway, Inner Northern Busway and Airport Link.

The alignment of the elevated tracks, in Mayne Rail Yard, alongside the ICB would aid in mitigating its visual impact, but would add to the overall visibility of transport infrastructure in this locality.

Long-term changes in the visual context of Bowen Hills would flow from the removal of some buildings along the northern edge of the RNA Showgrounds. Such changes would flow from redevelopment consistent with the intentions of the approved master plan. Views of the Cross River Rail Ekka Station, elevated rail tracks and elevated O'Connell Terrace Bridge would be possible, altering views of heritage and culturally important features.

## Visual amenity: Spring Hill to Dutton Park

The worksite at Victoria Park would be the most visually prominent component of the Project in Spring Hill. The worksite would cause the removal of mature vegetation and would be visible to park users. Once operational, the Project would be located in the rail corridor adjacent to the park and would be much less visible. The northern portal and the surface tracks would deliver minimal change to the visual context of the existing rail corridor.

At Roma Street Station, the worksite in Emma Miller Place would be highly visible to pedestrians, traffic and nearby commercial and hotel premises. The two worksites contained within the station complex would be primarily confined to locations within the immediate vicinity. The satellite worksite would be visible from Roma Street Parkland and nearby apartments as well as the rail corridor. The visual effects would be temporary and for the duration of construction works.

Post-construction, the proposed changes to the urban environment along Roma Street and underground station accesses would be consistent with the visual environment.

The demolition of the Royal on the Park Hotel and the shops between Charlotte and Mary streets for the Albert Street Station would change the visual environment in the CBD. The indicative station design for Albert Street Station would deliver a positive effect on the streetscape and enhance local amenity with high quality architecture, and the provision of spacious entry plazas and improved pedestrian and cycle infrastructure.

The demolition of the Goprint building would be the most significant change to the visual context in Woolloongabba. The demolition would increase temporarily the level of visibility between Vulture and Stanley streets. This view would close once Project construction commences and worksite noise barriers are erected.

The indicative designs for the Gabba Station provide for a generous pedestrian plaza sufficient to meet demands for major events at The Gabba. The indicative design in combination with necessary streetscape works would contribute to the on-going maturity and enhancement of Woolloongabba as a desirable destination. The indicative design for the Gabba Station entry is shown in Figure 5-1.

During construction, the Boggo Road worksite would be visible from Annerley Road, the Ecosciences Precinct, Dutton Park State School, police station and residential properties north of Rawnsley Street. However, apart from the station entry structures, there would be little change to the visual context of this precinct post-construction. The existing architectural themes of the heritage gaol and the Ecosciences Precinct would continue to dominate the precinct.

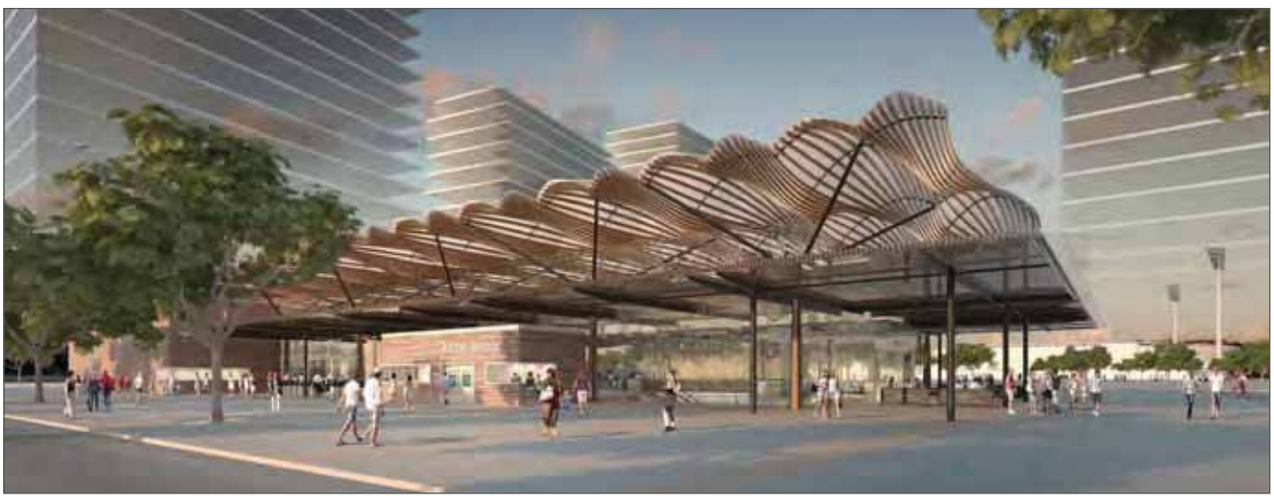


*Figure 5-1 Representative view of Gabba Station from Leopard Street (potential UDA developments visible)*

## Visual amenity: Fairfield to Salisbury

An emergency access and ventilation building is proposed to be located at Fairfield Road, Fairfield, on land currently used for a landscape median and substation, between Bledisloe Street and Sunbeam Street.

Construction of the emergency access and ventilation building would require the realignment of Railway Road closer to the existing Energex substation. Construction of the shaft and building would also require the removal of some existing vegetation currently located on land between Fairfield and Railway roads.

The building footprint would be approximately 24 m by 7 m by 5 m, and include an 8 m high outlet. The building is proposed to be architecturally designed and treated to minimise potential impacts on the visual amenity in this location and would be sufficiently offset from Fairfield Road to allow for vegetation to be planted between the building and the roadway. The indicative design for the ventilation and emergency access building is shown in Figure 5-2.

*Figure 5-2 Representative view of ventilation and emergency access building in Fairfield*

The Yeerongpilly worksite would cause a significant change to the visual context of the area as some of the existing industrial buildings are demolished and replaced by worksite features, such as acoustic barriers, cranes and spoil handling facilities. Some industrial building along the northern edge of this worksite would be retained to provide both acoustic and visual screening of the worksite to the adjoining residential area. The visual effect would be for the duration of construction, estimated to be at least 5.5 years. The worksite extending north in parallel with Wilkie Street would also be evident for this period, due to the acoustic enclosure and construction equipment

Further south, the construction works at Clapham Rail Yard would also contribute a change to the visual context of the Fairfield Road industrial area.

Post-construction, the Project would be visually evident in Yeerongpilly, due to the Yeerongpilly Station. The most visible components of the Yeerongpilly Station would be the station access from the realigned Wilkie Street (Figure 5-3), the station concourse and pedestrian overpass.

The new station at Yeerongpilly would contribute positive changes to the visual environment of the local area. The indicative station architecture would seek to provide an attractive contemporary built form, fitting in with the surrounding scale and character of the existing residential area. The portal would have limited visibility to surrounding residences or travellers. It would be located lower than the natural ground level and would be enclosed to the west of the rail corridor by noise walls.

Cross River Rail would provide an upgrade and refurbishment of existing infrastructure at Moorooka Station. The upgrade of Moorooka Station would require the removal of buildings between Unwin Street and Ipswich Road. The upgrade of the station would enhance the visual and physical experience immediately around the station.

The proposed rail viaduct for the Cross River Rail south-bound track would cross the existing tracks just south of Moorooka Station and would be visible from Ipswich Road. The new infrastructure would reinforce the visual character of this important transport corridor. In the visual context of Ipswich Road and the Clapham Rail Yard, the visual effect would be to provide a harder, more definite edge to the corridor. This effect would be softened by the existing mature plantings in the median of Ipswich Road.

At Rocklea and Salisbury, additional surface tracks would be required including a new bridge over Muriel Avenue, realignment of the Ipswich Motorway on-ramp from Fairfield Road and new pedestrian overpasses at Rocklea Station and at Salisbury, near Nyanda State High School. The existing pedestrian overpass at Salisbury Station would also be extended to the west to allow for the widened rail corridor. The upgrade of Rocklea Station would enhance accessibility in this location.

The provision of a new rail bridge over Muriel Avenue and the realignment of the Ipswich Motorway on-ramp would change the visual environment of these locations. The rail bridge is proposed to be at a higher height to the existing bridges over Muriel Avenue. The realigned on-ramp would require trees within the south-eastern embankment of the motorway to be removed, impacting on the landscape amenity of this road corridor.

*Figure 5-3 Representative view of Yeerongpilly Station access from the proposed realignment Wilkie Street*

## Lighting

During construction, all worksites would require security lighting to ensure the safety and security of personnel and property. Works undertaken at night, such as works in the rail corridor or on major roads, would require temporary lighting. Headlight glare from construction traffic accessing worksites also may impact nearby sensitive receptors.

Worksites which are proximate to light-sensitive receptors are located in the southern part of the study corridor at Fairfield, Yeerongpilly and Rocklea. Other worksites, such as those in the CBD and at Woolloongabba, would be situated in areas of higher ambient light and which are already subjected to increased night lighting.

Security lighting for the Fairfield worksite would increase the ambient light for near neighbours and would require mitigation. There is low potential for direct intrusion of security lighting into internal living areas for this lighting.

Night works in the rail corridor at Rocklea would be similar to routine maintenance works. Ambient lighting in this area is higher than other residential areas due to the proximity of major transport corridors and industrial premises. Without mitigation, light spill from night works at the Rocklea Station would impact on the facing residential areas of Brooke Street, Dawn Street, Annie Street and Pegg Road. During construction, a range of measures would be provided to avoid or minimise potential lighting impacts. These include:

- directional night lighting for security purposes, with such lighting to be placed on the boundary of the worksite and directed away from light-sensitive receptors
- limit the use of intense lighting plant (eg 'daymakers') for works in the rail corridor and on major roads
- anti-glare screens that allow views, while limiting penetration of potentially distracting lightbarriers to screen views of worksites
- specific measures at light-sensitive receptors if and when required in consultation with property owners and occupants
- restoring worksites to pre-existing grades and condition upon completion

Once operational, the Project's lighting requirements would be similar to existing lighting requirements on Brisbane's rail network. Lighting along surface tracks would be consistent with current Queensland Rail lighting requirements for above-ground tracks. Consequently, the additional surface tracks provided north of the northern portal and south of the southern portal would not generate light impacts on sensitive receptors.

Headlight glare from traffic on the ICB and from trains on the Mayne Rail Yard viaduct would require screening to avoid adverse two-way impacts and to maintain traffic safety in each corridor.

Surface stations would be illuminated at the platform, mezzanine, concourse and entrance areas. In coordination with other security measures, lighting also would be used as a deterrent to crime. Consultation with near neighbours during detailed design and fitout would resolve potential, specific lighting impacts through direct mitigation measures.

The external lighting for the underground stations primarily would be required to provide safe and equitable access into the stations. Due to the ambient

light conditions of each station location, the entrance lighting would not present any additional impacts.

Other measures to address potential operation lighting issues from Cross River Rail include:

- the use of barriers that minimise light spill from project infrastructure
- design treatments to avoid intrusive light spill from the ventilation and emergency access building at Fairfield.

## 5.6 Nature conservation

### 5.6.1 Existing conditions

Areas within the study corridor with the potential to provide habitat to native fauna and support native flora principally are within the parklands and riparian vegetation associated with the two major waterways; the Brisbane River and Breakfast Creek/Enoggera Creek. Artificial waterbodies in the Botanic Gardens, Roma Street Parkland and York's Hollow in Victoria Park also provide some habitat value. Fragments of urban bush, such as that at Lagonda Street provide locally valuable habitat.

Site surveys undertaken to determine the presence of any protected and threatened species within the study corridor found that most species are common and widespread within the Brisbane metropolitan area. The most significant fauna species observed was the Grey-headed flying-fox, which is listed as Vulnerable under the EPBC Act. No roosts were located within the study corridor.

*Victoria Park, adjacent to northern portal*

The only significant flora species found within the study corridor was a number of Plunkett mallee specimens at Dutton Park and Fehlberg Park. This species is listed as Rare under the *Nature Conservation Act 1992* (NC Act). A single specimen of Macadamia nut was also found which is also listed as Rare under the NC Act and the EPBC Act. Both the Plunkett mallee and the Macadamia appear to have been planted in the locations where they were identified. Consequently, they are not considered to constitute wild populations or naturally occurring and are not protected under legislation.

No Ramsar sites, National Parks, Conservation Parks, Nature Refuges or Marine Parks listed under legislation are located within, or directly adjacent to the study corridor. Similarly, no such attributes would be impacted by Cross River Rail in either its construction or operation.

### 5.6.2 Potential impacts and mitigation measures

The study corridor is located within a highly urbanised landscape, which has limited conservation value. Areas which do hold some nature conservation value have either been avoided by the Project, through design or they are situated above the tunnels and would not be disturbed. Overall, the impact of the Project on flora and fauna would be minor.

Areas which would be directly impacted by the Project include Victoria Park at the northern portal, border fig trees along the fence line of the Botanic Gardens (Mianjin) adjacent to the entry to Albert Street Station, and the green space located along Railway Road between Bedisloe Street and Sunbeam Street, in Fairfield, which is required for the construction of the ventilation and emergency access building.

The construction worksites may cause minor, localised temporary displacement of common and widespread adapted species which occur in urban environments. Construction activities also have the potential to cause impacts on nearby waterways through sedimentation. Clearing and construction activities also have the potential to increase weed infestation through topsoil disturbance and vehicle movements.

The movement and disturbance of topsoil also holds a risk of spreading the Red Imported Fire Ant (RIFA) which is a notifiable pest. The RIFA restricted areas in the study corridor include Fairfield, Yeronga, Yeerongpilly, Moorooka, Rocklea and Salisbury.

The impacts on flora and fauna would be mitigated using a range of measures, including:

- a weed management plan for the prevention of pest species proliferating within the study corridor
- protecting native flora and fauna with visible exclusion fencing in areas adjacent to construction worksites
- preparing a Construction Erosion, Sediment and Drainage Control (EDSC) Plan to reduce potential for sediment to enter creeks, drainage lines and stormwater systems

- preparing a vegetation rehabilitation plan for construction worksites, particularly in Victoria Park, Yeerongpilly (Station Road), Rocklea and Salisbury, due to their proximity to watercourses
- providing a qualified fauna spotter and catcher prior to and during the initial clearing to capture and relocate any fauna that is disturbed
- developing and implementing a RIFA Risk Management Plan.

## 5.7 Groundwater

The hydro-geological regime of the study area comprises two broad aquifer types, from oldest/deepest to youngest/shallowest:

- fractured rock (secondary porosity) aquifer systems comprising Neranleigh-Fernvale Beds, Bunya Phyllite, Brisbane Tuff, Aspley and Tingalpa Formations, Woogaroo Sub-Group
- alluvial (primary porosity) aquifer systems overlying bedrock aquifers.

In fractured rock aquifers, groundwater is typically stored in geological structural features such as fractures, joints, bedding planes and cavities of the formation. The availability of water in these systems is largely dependent of the nature of the fractures (size, geometry, hydraulics) and their degree of interconnection. Groundwater in primary porosity systems exists within pores between grains of the sedimentary rock.

Recharge to the alluvial aquifers is controlled by climate and geology. Direct vertical recharge in the alluvial aquifer is likely to occur from rainfall or overland flows. The primary source of recharge is considered to be via in-stream recharge. As most of the streams and rivers in the study area are tidal, both recharge and discharge processes are likely to occur within the alluvial aquifer and with the tidal cycle, where hydraulic connections exist.

In an urban environment, there is significant potential for additional recharge from leakage from water mains, shallow stormwater drains and sewage pipes. Within the Brisbane CBD, basement dewatering occurs. This is to some extent an additional source of discharge for the surrounding aquifers.

Groundwater levels in the alluvial aquifer are understood to range from 0.52 m to 8.22 m below ground level (BGL). Groundwater levels in the Aspley and Tingalpa Formations range from 1.59 m to 9.81 m BGL. The groundwater levels in the Brisbane Tuff ranges from 0.03 m to 24.5 m BGL. The Bunya Phyllite groundwater levels range from 0 m to 20.70 m BGL. Groundwater levels in the Neranleigh-Fernvale Beds vary from 0.065 m to 20.7 m BGL. Groundwater levels in the alluvium and bedrock along or close to the Brisbane River will mostly be at river level and will be influenced by tidal fluctuations, while groundwater levels in the CBD are controlled by artificially modified recharge, leakage and the level of the Brisbane River.

In general, the quality of groundwater within the Bunya Phyllite is considered poor, ranging from fresh to brackish. Available pH data indicate that groundwater pH ranges from acidic to neutral conditions. Similar trends were noted in the Neranleigh-Fernvale Beds and the Brisbane Tuff.

Groundwater within the alluvial aquifer is fresh to brackish, with the pH ranging from acidic to slightly alkaline. Groundwater quality in the alluvial aquifers is variable and depends on the proximity of creeks or rivers and associated tidal influences, including saline intrusion.

Groundwater quality monitoring indicates a marked difference in water quality along the study corridor, as the Project intersects a variety of geological units and passes under the Brisbane River.

The groundwater quality results indicate that groundwater quality in the fractured rock will be generally of poor quality that is unsuitable for drinking. In the older, highly urbanised areas, nutrient levels can also be expected to be high due to the application of fertilisers on gardens.

Groundwater quality in the alluvial areas is variable and depends on the proximity of the creek to tidal influence and hence saline intrusion.

The contaminated site investigation identified the presence of a number of sites within the study corridor with an existing or historical land use with the potential to cause land contamination. It is highly likely that groundwater is contaminated within the vicinity of contaminated sites in the study corridor. Hydrocarbon and nutrient contaminants have been identified in Norman Creek, Brisbane River and Breakfast Creek. Areas of groundwater contamination, particularly of petroleum hydrocarbons are likely to be located in the rockmass along the study corridor.

### 5.7.1 Potential impacts and mitigation measures

Any construction involving the excavation of rock underground has the potential to draw groundwater to the void. Where the void is below other construction, or below other waterbodies, then a potential for groundwater drawdown is created. The potential for groundwater drawdown with Cross River Rail would be

created by the main tunnels, the cross-passages and the underground stations.

Groundwater level drawdown has been predicted using modelling studies for one year, five years and 10 years following tunnel construction. The risk of groundwater drawdown to the main tunnels will be minimised by adopting a construction method which uses a reinforced, waterproof lining. The predicted inflow of groundwater with this system of construction is low and less than 1 litre per second. This inflow is sufficiently small enough to be considered to represent a 'dry' tunnel.

Modelling shows that the potential for groundwater drawdown is greatest at the underground stations at Albert Street and Roma Street in the CBD, at Woolloongabba and at the ventilation and emergency access shaft at Fairfield. The extent of drawdown is not expected to exceed 5 m over the first 10 years post construction.

The main mitigation measures are the design and method of construction for the main tunnels and the underground stations. Groundwater monitoring would also be carried out to monitor changes in groundwater levels and quality during the construction and operation phases of the Project.

With the cross-passages, the method of construction will also act as an effective mitigation to groundwater inflow. It would include the installation of a waterproof membrane behind a concrete lining. For the underground stations and the ventilation and emergency access shaft, the proposed construction method includes 'cut-off' walls or sheets to intercept and contain groundwater in the shallow aquifers. This approach is considered to be effective and practicable for the circumstances of each structure.

Groundwater-dependent ecosystems are present along the Brisbane River in the vicinity of the Botanic Gardens and the Kangaroo Point cliffs. The risk of adverse impacts on these ecosystems is considered to be low and would be mitigated by the proposed construction method. The risk of disturbing potential ASS as a consequence of the Project is considered to be negligible.

Groundwater monitoring would be required to inform the detailed design and would be maintained during construction to address issues pertaining to drawdown and quality. During operation, groundwater inflows would be monitored for quality, to determine and manage appropriate treatment, prior to release to the environment. The water quality values and objectives of Queensland Environmental Protection Policy (Water) (EPP (Water)) would apply to any release.

## 5.8 Surface water

### 5.8.1 Existing conditions

Waterways passing through the study corridor include:

- the Brisbane River, which crosses near the Brisbane CBD
- Breakfast/Enoggera Creek, in the northern part of the study corridor
- Oxley Creek and its tributaries of Moolabin Creek, Rock Waterholes Creek and Stable Swamp Creek, located in the southern part of the study corridor.

Some surface water features, such as artificial ponds and lakes are found at the Botanic Gardens, Roma Street Parkland and York's Hollow at Victoria Park. The study corridor also crosses the catchment boundaries of Kedron Brook in the north and Norman Creek in the south. Waterways within or near to the study corridor are located within the lower Brisbane catchment or the Oxley Catchment.

*Rocky Waterholes Creek, Rocklea*

Existing water quality data for those waterways in the study corridor shows that:

- streams within the lower Brisbane catchment and Oxley Creek catchment are in poor condition and generally failed to meet ecosystem health guidelines
- freshwater quality for Enoggera/Breakfast Creek is generally good, although estuarine water quality for Enoggera/Breakfast Creek is generally poor
- freshwater quality in Oxley Creek is moderate-good, while water quality at estuarine monitoring sites is very poor
- Moolabin Creek, Rocky Waterholes Creek and Stable Swamp Creek generally have moderate

to very good water quality, although Rocky Waterholes Creek demonstrated potentially toxic pH values

- freshwater quality in Kedron Brook and Norman Creek is generally good, while estuarine water quality is moderate in Kedron Brook and poor in Norman Creek
- streams within the Bremer Catchment are generally in poor condition, although recent indicators of water quality provided better grades than previous years.

### 5.8.2 Potential impacts and mitigation measures

Potential impacts on surface water quality, associated with Cross River Rail, could result from:

- use of water, including recycled water, for environmental management purposes and construction activities
- changes to surface water flow
- sedimentation and surface water run-off
- disturbance of ASS
- disturbance of contaminated land
- introduction of litter or toxicants from spills or the accidental release of pollutants.

The construction phase would require water to be used for a range of activities, including the operation of the TBMs, the wash down of vehicles and equipment, the production of grout and shotcrete, and dust suppression on surface work areas. Any water to be discharged from construction areas and worksites has the potential to impact on nearby waterways if not appropriately managed.

A new rail viaduct would be constructed and track re-laid in Mayne Rail Yard, raising the potential to disturb surface soils and possibly ASS. The scale of earthworks required would be small and readily managed on-site. The construction works in Victoria Park to establish the northern portal and tie-in to the Exhibition Loop would involve more extensive earthworks. Consequently, more extensive site drainage and stormwater management measures would be required to achieve water quality objectives.

The Project requires new bridges to be constructed across Moolabin Creek and Rocky Waterholes Creek. Works associated with the construction of these bridges have the potential to impact on the flow of surface waters and consequently water quality.

A Soil Erosion and Sediment Control Management Plan would be prepared and implemented for each worksite, as part of the CEMP, to avoid or minimise the transfer of sediment or other pollutants from construction activities to waterways or drainage lines. A range of mitigation measures would be used, including:

- the use of effective erosion, sediment, dust and stormwater controls
- considering flood affected areas, drainage lines and waterways during the stockpiling and placement of spoil and other materials
- implementing WSUD measures at construction worksites for mitigating erosion, controlling sediment and site drainage
- implementing appropriate practices and procedures for the handling, storing and management of chemicals and hydrocarbons
- minimising vegetation clearing
- rehabilitation and restoration of cleared areas, particularly at new waterway crossings.

Appropriate measures for the collection, treatment and disposal of groundwater entering a worksite would be required. Groundwater would not be discharged directly to the environment, nor would it be discharged directly to either the stormwater or sewerage systems unless it was found to satisfy the water quality parameters.

A water quality monitoring programme would be in place prior to construction, to ensure compliance with water quality objectives and to manage potential impacts on surface water quality. This would include targeted baseline monitoring of receiving waters prior to construction to identify baseline water quality conditions. The monitoring programme would be included in the CEMP and would involve the collection and analysis of surface water samples at selected locations in the study corridor.

During operation, the use of water sensitive urban design measures would enable the effective integration of water cycle management. Alternatives would be investigated and developed during the detailed design. These include:

- grassed/vegetated swales
- permanent settlement ponds and detention basins
- use of stormwater quality improvement devices such as gross pollutant traps, gully pit baskets and nets, to filter stormwater and prevent pollution of surface waters
- oil/grit separators to remove hydrocarbons and coarse sediments.

Permanent water quality treatment control devices would be designed for the adequate control of pollution and sediment and other coarse materials during flood events. An operational monitoring programme would be established to assess and manage potential long-term impacts of the Project on surface waters.

## 5.9 Flood management

### 5.9.1 Existing conditions

Numerous overland flow paths occur along the study corridor. These are drainage lines that convey water, but are not part of a creek, river or waterway. These are usually dry and are typically activated by short duration, high intensity rainfall events.

Breakfast Creek/Enoggera Creek is a tributary of the Brisbane River. It extends almost 39 km from the Brisbane Forest Park to its confluence with the Brisbane River at Newstead. Upstream of Three Mile Scrubs at Kelvin Grove, the waterway is known as Enoggera Creek, while the lower tidal reaches are known as Breakfast Creek. Breakfast Creek has a long history of flooding, affecting both residential and commercial properties. This has required regular dredging of the creek mouth to improve flood conveyance and lower flood levels.

Numerous bridges, elevated structures and surface works have recently been constructed, are under construction or are proposed to be constructed in the Breakfast Creek floodplain upstream of the Brisbane River confluence.

The Campbell Street drain, in Bowen Hills, is a piped drainage system located west and east of the ICB. The underground drainage network in this catchment accommodates flood events to a certain size and frequency, with excess flows from larger, rarer events accommodated by overland flow paths in the sports fields west of the ICB tunnel, the RNA Showgrounds and through Newstead.

The Brisbane River has a long history of flooding with records extending back to the 1840s. Flooding from the Brisbane River can result in inundation of parts of the Brisbane CBD. This can occur from the back-flow of floodwaters through the pipe drainage system surcharging into the Botanical Gardens and surrounding area. During a Brisbane River flood event, rainfall on the CBD while the river is at or near peak levels can also result in ponding of water in the lower parts of the Brisbane CBD. The Brisbane River experienced a major flood event in mid-January 2011.

Moolabin Creek is a tributary of Oxley Creek. It is located approximately 2 km upstream of the Brisbane River outlet for Oxley Creek. The creek intercepts the study corridor at Moorooka. Peak flood levels in this section of the corridor result from short duration flood events in Moolabin Creek, with some coincident flooding in Oxley Creek.

Rocky Waterholes Creek is a tributary of Oxley Creek. The creek intercepts the study corridor at Rocklea. Peak flood levels along this part of the corridor result from short duration flood events in Rocky Waterholes Creek with some coincident flooding in Oxley Creek.

Stable Swamp Creek is a tributary of Oxley Creek. The creek intercepts the study corridor at Salisbury. Peak flood levels in this section of the corridor result from the back-up of Brisbane River flood events in Oxley Creek and Stable Swamp Creek, as well as local flood events for Stable Swamp Creek.

Oxley Creek is a major tributary of the Brisbane River with its confluence at Tennyson. With its tributaries, Oxley Creek has the potential to inundate parts of the corridor in Rocklea and Yeerongpilly.

*Brisbane River, Kangaroo Point*

### 5.9.2 January 2011 Flood in Brisbane River

The Brisbane River experienced a major flood event in mid-January 2011.

The January 2011 flood resulted in a peak flood level at the Port Office gauge of approximately 4.46 m AHD. This is higher than the flood level for the designed flood event, but is comparable with the designed flood event under a climate change scenario. This scenario is accommodated by the reference design.

In the January 2011 flood, there were some sections of the proposed alignment that flooded while the majority of the alignment was unaffected.

The main areas affected were:

- the western portion of rail embankment at Clapham Rail Yard

- Moolabin Creek rail crossing and the proposed Yeerongpilly worksite
- Fairfield, including the vicinity of the ventilation and emergency access building in Railway Road
- Albert Street adjacent to the proposed station.

The existing rail crossing of Moolabin Creek was affected by flood waters in January 2011 to an estimated level of 8.6 m AHD*. The proposed Cross River Rail crossing of Moolabin Creek is designed at a level of approximately 9.0 m AHD or about 0.4 m clear of the January 2011 flood event.

A part of the proposed Yeerongpilly worksite was flooded in the January 2011 floods in addition to the railway crossing of Moolabin Creek. The worksite would be developed to the height of the 1 in 20 AEP** local creek flood level, well above the estimated level for the January 2011 flood of approximately 8.6 m AHD.

The proposed Albert Street Station would have an entry level at RL 4.45 m*** and would incorporate floodgates in its design. The floodgates would be designed to withstand a 1 in 10,000 AEP event, equivalent to approximately 7 m of water above Albert Street. Had the Albert Street Station been in place in January 2011, normal operating procedure would have required the floodgates to be activated before the peak levels were reached and would have protected the station from inundation. While the station entry would have been closed off in that event, Cross River Rail would have been protected from inundation and would have remained available for operation.

### 5.9.3 Potential impacts and mitigation measures

Flood modelling was undertaken to assess potential impacts on the flood behaviour of watercourses from the construction and operation of the Project.

The Project is not expected to change flood behaviour for Breakfast Creek, as the proposed works for the additional rail embankment would be above the 1 in 100 AEP flood level. Under a climate change scenario, flood levels in Breakfast/Enoggera Creek are predicted to increase by 0.8 m to 4.2 m AHD.

Depending on the level of the infrastructure, this may result in a minor loss of flood storage in the 1 in 100 AEP flood event under the climate change scenario, but is unlikely to result in any flood level increases or changes to flood behaviour.

Construction works are not proposed in the area subject to local flooding in the Campbell Street drain catchment. The Campbell Street drain overland flow is also not expected to be affected under a climate change scenario.

While the entrances to the Albert Street Station would be raised, the Project is not expected to change existing ground levels in Albert Street. Consequently, Cross River Rail would not affect the capacity or flood behaviour of overland flow paths in this area. Conveyance of the overland flow would also not be affected by the surface works in this area. The Albert Street Station would raise the station access points to 450 mm above street level to protect against local flooding. Any potential loss of floodplain storage would have minimal effect on flood levels.

Changes to 1 in 100 AEP peak flood levels for the Brisbane River from a reduction in the flood storage area due to the Project, would not be greater than 0.01 m. In addition, the Project is not expected to affect flood velocities during a Brisbane River flood event, once operational under the construction and operation phase.

In the 1 in 100 AEP Brisbane River flood event under climate change conditions (ie higher rainfall intensities, higher sea levels), the Botanic Gardens would experience an increase in flood level from the Project of up to 0.02 m.

The ventilation and emergency access building at Fairfield would be designed to be protected from an extreme flood event (ie 1 in 10,000 AEP flood event), removing a small volume from the available flood storage in a Brisbane River flood event. The effect on flood levels would be negligible.

The Project requires the filling of Clapham Rail Yard to 9.5 m AHD, compared with the 1 in 10,000 AEP flood level from the Brisbane River of 7.0 m AHD in that location. The filling of those parts of Clapham Rail Yard below 9.5 m AHD would remove a small volume of flood storage of the Brisbane River floodplain. Changes to 1 in 100 AEP peak flood levels for the Brisbane River from a reduction in flood plain storage would be no greater than 0.01 m, with no change in flood velocities expected.

Project works would not be located in the floodplain affected by a 1 in 100 AEP flood event for Oxley Creek. Consequently, Cross River Rail would not change the flood behaviour for this creek, even if subject to climate change conditions.

A bund is proposed at the Yeerongpilly (Station Road) worksite on the Moolabin Creek floodplain to prevent floodwater from entering in a 1 in 20 AEP local creek flood event. Changes to flood levels in a 1 in 5 AEP flood event are expected to be negligible (less than 0.01 m). The bund would be removed following the completion of construction.

*AHD: Australian Height Datum for a measurement of altitude relative to sea level for a defined year*
**AEP: Annual Exceedance Probability for a given rainfall event in any one year*
***RL: Reduced Level to a common datum for a nominated site reduced to zero (eg sea level)*

In a 1 in 20 AEP flood event, changes in flood levels are expected to be in the order of 0.04 m, while potential changes to flood levels would be in the order of 0.09m in a 1 in 100 AEP flood event. Flood velocities in Moolabin Creek would not be affected during a 1 in 100 AEP flood event.

The reference design includes 12 additional piers for a new railway bridge in the floodplain of Moolabin Creek. One pier would be located in the waterway. The design level for the railway bridge is approximately 9 m AHD. The new bridge is expected to have a negligible impact on peak flood levels (less than 0.01 m) for the 1 in 5 AEP, 1 in 20 AEP and 1 in 100 AEP flood events. Changes to flood velocities from the Project are expected also to be negligible.

For both construction and operation, flood levels in Rocky Waterholes Creek are predicted to increase by up to 0.04 m at Muriel Avenue for a 1 in 100 AEP flood event. The climate change scenario anticipates a change of approximately 0.03 m. The Project is not expected to increase flood levels on private property in this area for the 1 in 100 AEP or result in noticeable changes to flood velocities in the creek.

At Salisbury, filling would be undertaken to raise the Beaudesert Road (service road) north of Dollis Street to the level of Beaudesert Road to allow emergency egress from the area during flood events. Existing ground levels along the proposed service road vary between 6.1 m AHD and 10.6 m AHD.

The Stable Swamp Creek flood level is approximately 6.2 m AHD. The Project would cause a minor reduction in floodplain storage in Stable Swamp Creek. This minor reduction is not predicted to change flood levels in this area.

Flood mitigation measures proposed include:

- culverts required to be extended to accommodate project infrastructure and a wider rail corridor to be designed to ensure no increase in upstream flood levels
- changes to the road network that require the creation of new cul-de-sacs to be designed to ensure no reduction in floodplain storage
- construction sites located in the floodplain to be either bunded or filled to a height above the 1 in 20 AEP flood level plus 300 mm, or protected by a bund on that level
- detailed flood modelling during detailed design to ensure the Project infrastructure avoids potential flood impacts under the climate change scenario.

## 5.10 Air quality and greenhouse gas emissions

### 5.10.1 Existing conditions

The meteorology of the study area is characterised by winds from the north-east during summer and spring and winds from the south-west during autumn and winter. Existing air quality within the study area has been collected from data recorded by the DERM at Rocklea, South Brisbane and Brisbane CBD (QUT) between 2005 and 2009, and data recorded for the Airport Link project at Kedron and Bowen Hills.

Air quality guidelines are specified by the DERM in the Queensland Environmental Protection Policy (Air) 2008 (EPP (Air)). The air quality objectives in the EPP (Air) are targets expressed as a maximum ambient concentration to be achieved, either without exception, or with a permitted number of exceedances within a specified timescale. If the actual measured concentration averaged over time exceeds the specified maximum ambient concentration, then the event is called an exceedance.

Air quality objectives are set for particulate matter, which comprises very small liquid and solid particles floating in the air. Of concern to public health are the particles small enough to be inhaled. Particles less than 10 microns in diameter are known as $PM_{10}$. Concern about the potential health impacts of $PM_{10}$ has increased over recent years. Increasingly, attention has also turned towards the smaller particle fraction, known as $PM_{2.5}$.

The ambient air quality goals for the construction and operations phases are presented in Table 5-1 and Table 5-2.

The ambient air quality data collected from existing data records shows the following:

- the Bowen Hills data shows that particulate matter (PM) concentrations ($PM_{10}$ and $PM_{2.5}$) are below the air quality goals ($PM_{10}$ goal of 50 µg/m$^3$ and $PM_{2.5}$ goal of 25 µg/m$^3$, averaged over 24 hours), with the exception of four exceedances for $PM_{2.5}$ in 2004
- the data from Brisbane CBD monitoring station show that $PM_{10}$ concentrations are below the air quality goal of 50 µg/m$^3$, except in 2009 when major dust storms resulted in seven exceedances
- the South Brisbane monitoring station data shows that $PM_{10}$ concentrations are below the air quality goal of 50 µg/m$^3$, except in 2009 when major dust storms resulted in 14 exceedances

- air quality monitoring data from Rocklea monitoring station show that $PM_{10}$ and nitrogen dioxide ($NO_2$) concentrations are below the air quality goals, except in 2009 when major dust storms resulted in 10 exceedances of the $PM_{10}$ goal of 50 µg/m³. Exceedances of the 24 hour ambient air quality goal for $PM_{2.5}$ were recorded in 2005, 2007, 2008, and 2009. The annual goal for $PM_{2.5}$ was also exceeded in 2009 due to major dust storms.

Overall, the existing data shows good air quality in the study area, with concentrations of most pollutants well below the ambient air quality goals. However, $PM_{2.5}$ levels in Brisbane are already exceeding the air quality goals, even at locations with low levels of air emissions. Regional sources of $PM_{10}$ such as controlled burns or dust storms, also typically result in one or two exceedances of the air quality goal recorded each year.

Typically, the major contributors of particulates, including fine particulates ($PM_{2.5}$), are motor vehicle emissions from road transport and at the regional level, power generation by coal-fired thermal power stations. In its operations phase, Cross River Rail would not contribute to increases of fine particulates at the local level and the implications at the regional level would be so small as to be difficult to measure.

## 5.10.2 Potential Impacts and mitigation measures

### Construction impacts

The ambient air quality goals for the construction phase are presented in Table 5-1.

During construction of Cross River Rail, potential air quality impacts would most likely be from dust emissions from the worksites, and possibly from haulage of spoil. Construction activities with the potential to cause dust-related impacts include:

- earthmoving plant and equipment exposing and moving soil and other material
- wind erosion from exposed surfaces
- wheel-generated dust from vehicles travelling along unpaved or dirty paved surfaces
- the handling and transport of spoil.

Dust emissions from large construction projects are typically greatest during periods of significant earth moving activities. The construction worksites with potential for the highest dust emissions are at Yeerongpilly and Clapham Rail Yard. Other worksites with potential to cause dust-related impacts include the northern portal in Victoria Park, Woolloongabba and Boggo Road.

During construction, total suspended particulates (TSP) and $PM_{10}$ concentrations are predicted to remain below the ambient air quality goals in the EPP (Air). However, when ambient $PM_{10}$ concentrations are added to Cross River Rail concentrations, there is the potential for exceedances of the $PM_{10}$ goal for some nearby sensitive receptors.

Effective mitigation measures would be required throughout the construction period to minimise the potential for dust nuisance. A construction dust monitoring plan would be required as part of the CEMP. The CEMP would need to specify measures for avoiding and managing nuisance dust impacts and measures to control exhaust emissions from fixed or stationary plant and equipment with diesel motors. Likely sources of diesel exhausts include stationery power generators, and some construction vehicles including spoil trucks, if idling while queuing to enter a worksite.

Regular monitoring of TSP, $PM_{10}$ and dust deposition levels at the nearest sensitive receptors to the worksites, and locations representative of the worksites would be required to assess compliance with appropriate criteria.

*Table 5-1 Air quality goals – construction*

| Objective | Air Quality Indicator | Goals | Averaging Period | Allowable exceedances |
|---|---|---|---|---|
| **Human Health** | Total Suspended Particulates | 90 µg/m³ | 1 year | |
| | Particulate matter ($PM_{10}$) | 50 µg/m³ | 24 hours | 5 exceedances per year |
| **Nuisance** | Total Suspended Particulates | 80 µg/m³ | 24 hours | |
| | Deposited dust | 120 mg/m²/day | 30 days | |

## Operational impacts

The operational impacts of Cross River Rail on air quality would influence two key air emission sources in Brisbane which arise from motor vehicles and trains.

For the assessment of potential impacts of the Project on the air environment, existing guidelines and regulatory measures for air quality were canvassed:

- air quality goals for ambient air quality established in EPP (Air)
- the National Environment Protection Measures (NEPM) for Ambient Air Quality (2003).

Generally, the NEPM standards and the EPP (Air) air quality objectives are consistent with each other.

The goals for ambient air quality during operation are presented in Table 5-2.

*Table 5-2 Air Quality Goals – operation*

| Air Quality Indicator | Objectives | Averaging Period | Allowable Exceedances |
|---|---|---|---|
| Total Suspended Particulates | 90 µg/m³ | 1 year | none |
| Particulate matter ($PM_{10}$) | 50 µg/m³ | 24 hours | 5 days each year |
| Particulate matter ($PM_{2.5}$) | 25 µg/m³ | 24 hours | none |
| | 8 µg/m³ | 1 year | none |
| Carbon monoxide (CO) | 11,000 µg/m³ | 8 hours | 1 day each year |
| Nitrogen dioxide ($NO_2$) | 250 µg/m³ | 1 hour | 1 day each year |
| | 62 µg/m³ | 1 year | none |
| Sulphur dioxide ($SO_2$) | 570 µg/m³ | 1 hour | 1 day each year |
| | 230 µg/m³ | 24 hours | 1 day each year |
| | 57 µg/m³ | 1 year | none |

The Project would result in changes to motor vehicle use and emissions at both the local and regional scales. With the Project in operation in 2031, there would be a reduction in vehicle kilometres travelled on the South East Queensland road network of some 275 million kilometres, with direct reductions in motor vehicle emissions as a consequence. The air quality impacts are predicted at the regional scale on motor vehicles:

- the Project would result in a 0.4% decrease in vehicle kilometres travelled (VKT) in 2021 and a 0.9% decrease in VKT in 2031
- with respect to changes in air emissions from motor vehicles, all identified pollutants would be approximately 0.4% lower in 2021 with the Project, and 0.8% in 2031 lower with the Project.

Overall, the predicted change to air emissions at the regional scale with the Project would be an improvement of 0.4%. Measured concentrations of air pollutants from motor vehicles are unlikely to change as a consequence of implementing the Project.

The Project proposes an increase in passenger train movements on Brisbane's rail network and would free-up capacity for freight rail traffic. Projected freight rail movements with and without the Project have assessed the potential change in air emissions due to changed freight rail traffic. Without Cross River Rail, more freight would transition from the rail network to the road network, with consequential increases in motor vehicle emissions. Table 5-3 shows projected weekly freight rail movements with and without Cross River Rail, and by rail line and train type. The freight train types include electric and diesel-electric units.

*Table 5-3 Predicted train volumes per week*

| | Trains per week (both directions) | | |
|---|---|---|---|
| | Demand | Without Project | With Project |
| **2009** | | | |
| North Coast (E) | 206 | | |
| Salisbury – Tennyson (E) | 137 | | |
| Tennyson – Port (IM) | 62 | | |
| Tennyson – Port (Coal) | 133 | | |
| **2021** | | | |
| North Coast (E) | 264 | 264 | 264 |
| Salisbury – Tennyson (E) | 172 | 24 | 172 |
| Tennyson – Port (IM) | 78 | 3 | 78 |
| Tennyson – Port (Coal) | 197 | 197 | 197 |
| **2031** | | | |
| North Coast (E) | 322 | 16 | 322 |
| Salisbury – Tennyson (E) | 209 | 24 | 209 |
| Tennyson – Port (IM) | 94 | 3 | 94 |
| Tennyson – Port (Coal) | 232 | 198 | 232 |

*Note: E = Electric, IM = Intermodal (freight)*

The relative contributions of railway emissions to 'other mobile sources', as well as all sources in the South East Queensland region are shown in Table 5-4. Railway emissions as a percentage of all sources emissions have then been derived for nitrogen oxides (NOx), $PM_{10}$ and Volatile Organic Compounds (VOCs).

Table 5-4 shows that railway emissions are a small contributor to total emissions in South East Queensland. The predicted changes to regional air quality as a consequence of freight rail traffic with the Project would be negligible.

*Table 5-4 Contribution of Railway Emissions to South East Queensland Emissions*

| | NOx | PM10 | VOC |
|---|---|---|---|
| Railway emissions (% of "other mobile sources") | 6.3% | 1.7% | 0.5% |
| Emissions from "other mobile sources" (% of all sources) | 9.3% | 3.5% | 1.5% |
| Railway emissions (% of all sources) | 0.6% | 0.1% | 0.01% |

The contribution of emissions from rail traffic associated with Cross River Rail to regional emissions would be insignificant and unlikely to be measurable.

With respect to the operation of underground stations, concentrations of dust (both $PM_{2.5}$ and $PM_{10}$), carbon monoxide (CO) and carbon dioxide ($CO_2$) can be higher than the above-ground ambient air quality. Predictions of typical in-tunnel particulate matter concentrations were made to assess potential health impacts on people working in, and using the rail tunnels and underground stations.

The results show that the health of individuals at the underground stations would not be adversely affected for the assumed maximum exposure period of eight hours. The proposed platform screen doors at underground platforms would also physically separate air in the rail corridor from air in the stations. Combined with effective station ventilation systems, this barrier would likely reduce exposure to users from dusts and other air-borne contaminants.

Air within the rail tunnels and underground stations would be exhausted to the surface by ventilation systems at the underground stations and at the ventilation and emergency access building. Ventilated air would exhibit similar concentrations to in-station and in-tunnel air quality. Heated air from the rail tunnels would be captured through the ventilation system, and released above ground via the ventilation outlets for each of the stations. The design and siting of the ventilation outlets would avoid increases in ambient air temperature at ground level.

The proposed location for the ventilation outlet at Boggo Road Station is sited to the north of the station and directed into the Boggo Road Busway. The ventilation outlet would be located approximately 80 m from Dutton Park State School. The ventilation system for Cross River Rail would be unlikely to have significant or measurable impacts on ambient air quality on the surrounding environment including Dutton Park State School.

## Greenhouse gas emissions

The main sources of GHG emissions arising from construction are associated with:

- direct $CO_2$ emissions from fuel combustion in construction equipment
- indirect $CO_2$ emissions due to consumption of electricity.

The construction of Cross River Rail is estimated to result in approximately 0.65 Mt $CO_2$-e of greenhouse gases, or approximately 0.13 Mt $CO_2$-e per year, based on a five-and-a-half year construction period (refer to Table 5-5). The annual GHG emissions during construction of Cross River Rail represent 0.02% of Australia's 2008 total GHG emissions.

*Table 5-5 Greenhouse gas emissions during construction of the Project*

| Emission Source | Value | Units | GHG Emissions (t CO2-e) |
|---|---|---|---|
| **Excavation of tunnels, shafts and caverns** | | | |
| Electricity Consumption | 196,250,000 | kWh | 174,663 |
| Diesel Fuel Consumption | 8,125 | kL | 21,922 |
| **Site preparation, surface works and station construction** | | | |
| Electricity Consumption | 275,026,000 | kWh | 244,773 |
| Diesel Fuel Consumption | 78,235 | kL | 211,089 |
| Total | 652,447 | | |

The GHG emissions associated with the operations phase of Cross River Rail mostly would be for electricity consumption for both traction power to run the trains and for ventilation of the stations and tunnels. Other potential sources of GHG emissions from operations include leakage of refrigerants in electrical switchgear, and fuel/electricity usage associated with maintenance activities.

The potential increase in electricity consumption as a result of the Project operations has been estimated for 2021 and 2031 and is presented in Table 5-6. The estimated electricity consumption and associated GHG emissions for the operation of Cross River Rail services and stations are presented in Table 5-7.

*Table 5-6 Train electricity consumption*

| Year | Train journeys/day | Train journeys/year | Electricity consumption (kWh/year) |
|---|---|---|---|
| 2021 | 634 | 231,410 | 70,348,640 |
| 2031 | 1,106 | 403,690 | 122,721,760 |

*Table 5-7 Greenhouse gas emissions and energy consumption – operation of Cross River Rail only*

| Year | Electricity consumption (kWh/yr) | Greenhouse Gas Emissions (t $CO_2$-e/yr) |
|---|---|---|
| Stations (per annum) | 38,029,709 | 33,846 |
| Trains | | |
| 2021 | 70,348,640 | 62,610 |
| 2031 | 122,721,760 | 109,222 |

The Project is predicted to reduce GHG emissions from changes in road network performance by:

- 22.5 kt $CO_2$-e in 2021
- 91.5 kt $CO_2$-e in 2031.

The predicted reduction in GHG emissions of 87.5 kt $CO_2$-e represents approximately 0.8% of Queensland's transport GHG emissions in 2008 (11 Mt $CO_2$-e). The Project aligns with the Queensland Government's policies to reduce GHG emissions from the transport sector by improving traffic flow to reduce emissions.

Queensland Rail would be responsible for operating services on the Project and would be required to estimate and report annual GHG emissions under the NGER System. The Proponent would produce an off-set for a proportion of GHG emissions generated from the construction and operation of the Project. The plan would be prepared prior to the start of construction.

## 5.11 Noise and vibrations

### 5.11.1 Existing conditions

Existing noise levels were recorded at 20 residential and special uses, such as educational or medical buildings, at representative intervals along the study corridor. Table 5-8 shows the noise monitoring results for each measurement location.

*Table 5-8 Existing Background Noise Levels*

| Monitoring Location | | Rating Background Levels (RBL), LA90 (dBA) | | |
|---|---|---|---|---|
| | | Day (7.00 am – 6.00pm) | Evening (6.00 pm – 10.00pm) | Night (10.00 pm – 7.00am) |
| 1 | 1/19 Chalk Street | 54 | 45 | 38 |
| 2 | 28 Bridge Street | 49 | 45 | 38 |
| 3 | St Josephs College | 50 | 48 | 40 |
| 4 | Brisbane Girls Grammar | 61 | 60* | 46 |
| 5 | St Andrew War Memorial Hospital | 55 | 53 | 51 |
| 6 | Parkland Crescent | 54 | 50 | 47 |
| 7 | 191 George Street | 58 | 57* | 54 |
| 8 | QUT Gardens Point | 49 | 48 | 46 |
| 9 | 58 Leopard Street | 53 | 50 | 46 |
| 10 | 143 Park Road | 43 | 39 | 34 |
| 11 | Dutton Park State School | 44 | 40 | 35 |
| 12 | 19 Dutton Street | 43 | 42 | 37 |
| 13 | 4 Fenton Street | 39 | 38 | 34 |
| 14 | 17 Lagonda Street | 42 | 41 | 39 |
| 15 | Yeronga State High School | 43 | 41 | 36 |
| 16 | 3 Cardross Street | 42 | 37 | 33 |
| 17 | 1223 Ipswich Motorway | 53 | 48 | 46 |
| 18 | 2/59 Brook Street | 50 | 43 | 42 |
| 19 | Nyanda State High School | 54 | 50 | 46 |
| 20 | 14 Bellevue Avenue | 45 | 45 | 44 |

**Note: background noise levels reaching or exceeding construction noise level*

The results of noise monitoring showed that some inner city locations, such as Brisbane Girls Grammar School, St Andrew's Hospital and 191 George Street, have high ambient noise levels typical of their locations with high density road traffic, pedestrian activity and nearby mechanical noise. In some locations, these levels, once adjusted for facade corrections, are approaching the goals that would achieve the environmental objectives.

Monitoring in suburban locations indicated lower ambient noise levels representative of the locations with greater separations from dominant noise sources. For most locations, including the suburban locations distant to major roads, road traffic noise dominates background noise levels.

Those monitoring locations near major connector roads experience higher ambient noise levels.

Existing vibration levels were also measured at 11 residential and special uses such as educational, research or medical facilities, along the study corridor.

The results for each measurement location are provided in Table 5-9.

The background vibration levels (V90) measured during the day-time, evening and night were below the stringent goal adopted for Cross River Rail for the avoidance of sleep disturbance (0.5 mm/sec peak particle velocity – PPV). Maximum vibration levels (V1) for the residential monitoring locations were in the range of 0.11 mm/s to 2.69 mm/s.

The high vibration levels were monitored at some residential dwellings and wooden floors, indicating that normal activities (eg closing doors, walking, moving around) in light-weight (wooden) structures generate high vibration levels.

For locations with vibration sensitive equipment, background vibration levels (V90) of 0.02 mm/s to 0.03 mm/s and maximum vibration levels (V1) of 0.03 mm/s to 0.17 mm/s, were measured.

Noise and vibration impact assessment goals were established for the construction and operation phases using appropriate Australian Standards, international standards and guidelines.

*Construction , Clem Jones tunnel*

*Table 5-9 Measured Existing Ambient Vibration*

| Monitoring Location | Average Minimum Vibration V90 (mm/s) | | | Average Maximum Vibration V10 (mm/s) | | | Maximum Vibration V1 (mm/s) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Evening | Night | Day | Evening | Night |
| 1 Wooloowin | 0.07 | 0.04 | 0.02 | 0.66 | 0.20 | 0.14 | 2.31 | 0.82 | 0.49 |
| 2 Spring Hill | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.08 | 0.05 | 0.05 |
| 3 Spring Hill | 0.03 | 0.03 | 0.02 | 0.08 | 0.05 | 0.04 | 0.17 | 0.08 | 0.06 |
| 4 City (Roma Street) | 0.04 | 0.04 | 0.03 | 0.06 | 0.05 | 0.04 | 0.07 | 0.07 | 0.06 |
| 5 City (Gardens) | 0.02 | - | - | 0.02 | - | - | 0.03 | - | - |
| 6 Kangaroo Point | 0.01 | 0.01 | 0.01 | 0.04 | 0.14 | 0.02 | 0.16 | 0.57 | 0.16 |
| 7 Woolloongabba | 0.04 | 0.04 | 0.04 | 0.06 | 0.10 | 0.05 | 0.19 | 0.49 | 0.10 |
| 8 Dutton Park | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 | 0.31 | 0.04 | 0.04 |
| 9 Fairfield | 0.04 | 0.06 | 0.04 | 0.70 | 0.84 | 0.23 | 2.69 | 1.61 | 0.71 |
| 10 Fairfield | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.04 | 0.11 | 0.08 | 0.13 |
| 11 Rocklea | 0.10 | 0.04 | 0.03 | 0.30 | 0.22 | 0.21 | 1.50 | 0.50 | 0.35 |

### 5.11.2 Potential impacts and mitigation measures – construction

During construction, activities likely to generate significant noise include the demolition of existing buildings, excavation using rockbreakers and other construction plant, earthworks, removal of spoil and station construction. The TBMs and roadheaders would operate underground over a 24 hour period, including a daily maintenance period when operations would cease temporarily. It is also anticipated that night-time construction works would be required at most worksites at some stage.

At each location where construction activities are proposed, noise levels were predicted at the nearest noise sensitive buildings for typical and 'worst case' scenarios.

#### TBM launch sites

The TBM launch sites located at the Woolloongabba worksite and at the Yeerongpilly worksite would be established using cut-and-cover methods.

Mitigation measures proposed at both the Woolloongabba and Yeerongpilly worksites include:

- high performance acoustic enclosures and hoarding
- quietest available mobile plant operating
- temporary tunnel ventilation noise sources to be located down in the shaft with appropriate ducting to the surface (silencers may be required depending on the type of ventilation used)
- acoustic louvres at ventilation points on the acoustic enclosure.

With these mitigation measures combined with careful worksite management, construction works at Woolloongabba generally would achieve the environmental objectives and satisfy the noise criteria. Additional mitigation measures may have to be developed in conjunction with noise monitoring for the initial works, such as piling, and preliminary rock excavations for the station box. The equipment required for these activities would exceed the height of the acoustic hoarding. For the reference project, both the piling works and preliminary rock excavation for the station box and TBM launch box would have a short duration (approximately seven weeks) each.

*Tunnel boring machine , Clem Jones tunnel*

#### Tunnel portals

The predicted noise levels for construction works at the northern portal site indicate the potential for small exceedances of the relevant noise goals at the nearest residential receivers, due to the separation distances between the worksite and residences. However, greater exceedances of the stringent noise goals are predicted at the Centenary Aquatic Centre.

Installation of a 6 m high hoarding or noise barrier around the worksite, or the noise sources within the worksite, would achieve the environmental objectives and satisfy the noise goals at all sensitive receivers except for the Centenary Aquatic Centre and the nearest Gregory Terrace residences. Noise exceedances at the residential receivers would be managed through the hours of excessively noisy work, use of the quietest available construction plant and consultations with property owners. The duration of the preliminary portal excavation works would be approximately 10 weeks. As excavation works progress deeper into the portal structure, noise levels would diminish at the residential properties along Gregory Terrace to meet the construction noise goals.

At the southern portal site, noise levels for short-term site establishment works are predicted to exceed the daytime noise goals. The predicted noise levels for spoil removal along Station Road during TBM operation at the southern portal site indicate noise exceedances during the night-time period at the nearest residential receivers.

Mitigation measures would include the retention of some existing industrial buildings and the use of acoustic enclosures, managing the work hours and consultation with residents. With mitigation measures in place, combined with careful management of all heavy vehicle movements, the noise goals would be achieved at the southern portal site. The exceptions would be for the initial demolition works and work requiring possessions of the live rail corridor in the vicinity of the southern portal. Such works would be approximately six weeks in duration. In these circumstances, advance notice and consultation with potentially affected owners and occupants would be required to determine suitable mitigation measures.

## Underground station construction

In the CBD at both Roma Street and Albert Street, measured background noise levels are approaching the goals for the environmental objectives. Allowing for some facade correction in commercial buildings and residential apartments, some premises may be experiencing background noise levels at or near the goals.

The predicted construction noise levels for Roma Street Station works would exceed the noise goals for only a small number of sensitive buildings during the day time and night time period. The predicted construction noise levels indicate that with mitigation, such as a 6 m high hoarding around each site, night-time construction noise levels would be within 1 dBA of the sleep disturbance noise goal. The predicted construction noise for these premises would be unlikely to interfere with sleep. Predicted ground-borne noise and vibration levels from rock breaking indicate the environmental objectives would be achieved and the relevant criteria satisfied.

The predicted noise levels for site establishment works, including demolition of the existing buildings at the two Albert Street Station sites indicate the noise goals would be exceeded, at the nearest residential buildings, for day time and night time construction works. The initial stages of excavation of the Albert Street shafts would exceed the night-time noise goals for several residential buildings and for one residential building during the day-time. Mitigation measures, such as controls on hours of work, would be required at these locations, in consultation with property owners.

Construction works on other CBD building sites, in both Roma Street and Albert Street, would not be subject to noise controls, other than limitations on the hours of work. Consistent with other CBD construction projects, Cross River Rail would progress with noisy works in day time work hours, with night works restricted to works within an acoustic enclosure or limited to the noise goals established in the draft Outline EMP in the EIS.

Any night-time works for the Project in the CBD would be monitored against the goals for the environmental objectives, and mitigation measures developed as required.

At Woolloongabba, the predicted 'worst case' construction noise levels for the demolition of the Goprint building show that noise goals would be exceeded at the nearest residential receivers during the daytime over a period of approximately six weeks. Noise exceedances are also predicted in the 'worst case' for piling works, which are anticipated to occur during the daytime for approximately seven weeks. Noise predictions for shaft excavation, spoil removal and TBM support operations would meet the goals with an acoustic enclosure over the worksite.

With the acoustic enclosure in place, combined with careful management of heavy vehicles on the worksite, compliance with the noise goals for all time periods would be achieved, with the exception of the initial demolition and piling works. Early consultations with nearby sensitive receivers would be conducted to minimise concerns during the demolition and piling works and to consider options for mitigation.

The predicted noise levels for site establishment works at the Boggo Road Station worksite would exceed the noise goal for day-time works at the nearest residential receivers in Rawnsley Street. The specific construction tasks at this site are complicated by the proximity of the Boggo Road Gaol, Dutton Park State School and the Ecosciences Precinct, such that special methods for noise mitigation would be developed on the basis of detailed designs and detailed construction planning. The most intense works, such as piling (approximately 12 weeks) and early rock excavation (approximately nine weeks), would be finite activities following which, construction works would progress with much lower noise emissions.

*Worksite Cross City Tunnel, Williams Street, Sydney*

Mitigation measures would be required at Boggo Road, in consultation with property owners. Restrictions on working hours during the initial stages of shaft excavation would also be required, together with a high performance acoustic enclosure.

Predicted ground-borne noise and vibration levels from rock breaking indicate compliance with the relevant criteria for all sensitive receivers with the exception of the transmission electron microscope (TEM) located at the Ecoscience building. Mitigation measures for this equipment would need to be developed in consultation with the operators, eg coordinating hours of works to avoid hours of TEM operation.

## Ventilation and emergency access building, Fairfield

The predicted noise levels for some elements of construction works at Fairfield would exceed the daytime construction noise goals for those sensitive receptors closest to the worksite. The 'worst case' construction noise scenario for this site would be the installation of piles to support the shaft. If required, piling would occur over a period of approximately five weeks and would proceed during daytime hours only.

Should predictive modelling confirm the noise goals would be exceeded, consultation with potentially affected people would assist in identifying options for mitigating the noise impacts.

## Surface track works

Surface track works for the Project would require the use of typical Queensland Rail rollingstock for the delivery of construction materials to site and specialised plant including switch tampers, mainline tampers, ballast regulators, rail grinder and overhead wiring plant.

High noise levels may result from track work as it occurs over short distances. In addition to limiting, where practicable, the duration of track construction works near sensitive receivers, mitigation measures would be applied, consistent with the measures listed in Queensland Rail's Code of Practice.

The predicted noise levels at Clapham Rail Yard also indicate compliance with the Queensland Rail noise goals without specific noise mitigation measures in place. Vibration impacts are not anticipated.

## Surface station works

The predicted noise levels associated with the Ekka Station construction works indicate the Queensland Rail noise goals would be achieved with the exception of the nearest residences in Tufton Street. Mitigation, in the form of an acoustic hoarding around the worksite, would satisfy the adopted noise goal. Predicted vibration levels at the nearest heritage listed building within the RNA Showgrounds would satisfy the goal of 2 mm/s PPV for heritage places.

Noise levels predicted for Yeerongpilly Station construction works, without mitigation, would satisfy the Queensland Rail noise goals, with the exception of the nearest residences to the east of Wilkie Street. Mitigation, in the form of an acoustic screen along the eastern boundary of the worksite would satisfy the adopted noise goal. Vibration impacts are not anticipated in this location due to the separation distances between the works and the nearest sensitive receptors.

Construction noise predicted in the 'worst case' (ie no mitigation measures) for the upgrading of Moorooka Station would satisfy the Queensland Rail noise goals with the exception of the nearest residences east of the worksite. These residences are expected to be acquired for the Project. An acoustic barrier along the eastern boundary of the worksite would satisfy the adopted noise goal. Due to the separation distances between the works and the nearest sensitive receptors, vibration impacts are not anticipated for works at Moorooka Station.

The predicted noise levels for upgrade works, without mitigation, at Rocklea Station would satisfy the Queensland Rail noise goals with the exception of the nearest residences to the west of the site on Brooke Street. Again, mitigation in the form of an acoustic barrier along the western boundary of the worksite would satisfy the adopted noise goal. Vibration impacts are not anticipated as a consequence of works at Rocklea Station due to the separation distances between the works and the nearest sensitive receptors.

## Surface structures

Piling for viaduct piers and viaduct construction would be required at Mayne Rail Yard. The predicted noise levels for construction of the Mayne Rail Yard viaduct would satisfy the Queensland Rail noise goals. Specific noise mitigation measures would not be required and vibration impacts are not anticipated.

Surface works for realigning the Ipswich Motorway on-ramp would be outside the rail corridor. The Queensland Rail Code of Practice would not apply for these works. Having regard for the important transport function of the Ipswich Motorway in this location, the key considerations for construction are to complete the works quickly and safely, and with minimal disruption to road traffic. Consequently, the works on the Ipswich Motorway would occur during both day-time and night-time hours, with scheduling to avoid peak periods and to minimise disruption.

Although temporary disruption to the amenity of the nearest residential receivers is an inevitable consequence of roadworks of this nature, best endeavours would be employed. eg early community engagement, selecting inherently quiet plant and construction methods and switching off mobile plant when not in use.

## Tunnel construction works

Tunnel construction works have the potential to impact on properties on the surface by:

- ground-borne, or regenerated noise within internal living and work areas
- vibration from steady-state sources, such as TBMs and roadheaders, and vibration from transient sources, such as drilling and blasting.

The predicted ground-borne noise for buildings in some locations along the tunnelling works would exceed the goals for sleep disturbance. The duration of the predicted exceedance for residential receivers from each TBM 'pass-by' would be approximately five to seven days with each TBM 'pass-by'.

Ground-borne noise at some hotels in the CBD is predicted to exceed the night-time ground-borne noise goal for up to 10 days. This is due to the structural connection of these buildings with the rock underlying the CBD, through which the TBMs would pass. The predictions for ground-borne noise relate to the ground floor and are unlikely to exceed the goals above the fourth floor in these buildings.

Early and on-going consultation with properties in those locations (CBD – Albert Street) predicted to experience strong ground-borne noise would be employed to develop mitigation measures to assist people during the short duration of the TBM 'pass-by'.

The modelling undertaken for tunnel construction works indicate the vibration goals would be satisfied for the environmental objectives for avoiding damage to both residential and heritage buildings. Some exceedances of the night-time residential vibration goal (sleep preservation) are predicted in some locations where the tunnels pass closer to the undulating topography. These predicted exceedances would be of short duration (five to seven days), correlating with the 'pass-by' of each TBM.

Predicted ground-borne vibration from works at Boggo Road Gaol would be well below the vibration goal for heritage buildings.

Should the maximum predicted ground-borne vibration for works at the Boggo Road station box exceed the operating limits for the electron microscope in the Ecosciences building, consultation with the microscope operators would be required to develop effective mitigation measures. Such measures could include variable hours of work, alternative construction methods or modifications to the microscope workstation.

## Low frequency noise assessment

An assessment of potential annoyance due to infrasound (dBG) and low frequency noise (LpA,LF) indicates driven tunnelling works for offset distances[3] of approximately 100 m may arise for some people. The variation in effect would be determined by the combination of topography, tunnel alignment, and the ground conditions through which the tunnelling works would be passing.

To mitigate the potential for low frequency noise impacts, the noise and vibration management plan would include public information on tunnelling progress and subsequent likely (temporary) exposure periods.

## Construction traffic

The preferred spoil haulage routes are confined mostly to major roads, being arterial roads, highways and motorways linking the worksites with the spoil placement sites. Local roads would be used for spoil haulage only if designated in an approved construction traffic management plan.

Spoil traffic would not increase average traffic noise levels on spoil routes that pass residential receivers by more than 0.3 dBA for existing road corridors between 6.30 am and 6.30 pm. Changes in noise levels of 2 dBA or less are undetectable to the human ear. At these levels, the noise impact of spoil traffic would be negligible.

For 24 hour operations at the Woolloongabba worksite, the modelling predicts an increase in road traffic noise of 0.8 dBA for the night-time peak (12.00 midnight to 6.00 am). Most people would not detect this change in noise level.

Fully-loaded trucks travelling on properly maintained public roadways would not generate significant ground vibration at buildings adjacent to spoil routes.

## Construction noise and vibration management

A range of noise and vibration mitigation measures would be developed in consultation with DERM and other stakeholders, and implemented prior to construction.

*[3] Off-set distance includes a combination of the vertical and horizontal dimensions*

These mitigation measures include:

- early and on-going consultation with people living and working adjacent to the construction worksites and along the tunnel alignment
- selection of the quietest plant and equipment that can economically undertake the work, wherever possible
- regular maintenance of equipment to ensure that it remains in good working order
- avoiding the coincidence of plant and equipment working simultaneously close together near sensitive receivers where possible
- fitting mobile plant such as excavators, front-end loader and other diesel powered equipment with residential class mufflers
- using localised noise barriers for particular noisy operations such as pile boring, rock breaking and blasting
- the installation of barriers or acoustic enclosures, where residential dwellings are in close proximity to the worksite
- conducting pre and post-construction building condition surveys where predictive modelling indicates a potential for cosmetic (superficial) building damage from construction-related vibration
- comprehensive advance notice of intended tunnelling activities in the localities near the tunnel alignment
- noise and vibration monitoring at the duration of tunnelling
- minimising night-time surface construction activities and spoil removal where possible.

The following management measures would be required where drilling and blasting is proposed:

- adopting the latest available blasting technology
- pre-blasting condition survey of adjacent buildings
- appropriate attention to blast design and commence blasting with a low Maximum Instantaneous Charge (MIC) to develop a site law (ie blast design model) based on measurement data from the site
- monitoring of blast emissions.

Construction noise and vibration monitoring procedures would be developed to assist in planning the excavation and construction works. Monitoring would be particularly important where work activities are within 100 m of residential properties or other noise sensitive receivers and in locations where predictive modelling indicates a potential for exceedances of either the noise or vibration goals.

Pre-condition surveys would be required for buildings and historical items in vibration sensitive zones prior to commencement of construction.

### 5.11.3 Potential impacts and mitigation measures – operations

#### Ground-borne noise and vibration

The operation of trains on underground rail systems has the potential to transmit ground-borne noise to buildings above the tracks, particularly those buildings with foundations in rock and in proximity to the tracks. This issue is more likely to arise in the CBD and inner city locations where tall buildings with basements into rock are more prevalent. By comparison, the light-weight construction of the 'Queenslander' dwelling and its shallow footings, provide increased mitigation against the transmission of ground-borne noise. As with ground-borne noise from construction, potential operational impacts would diminish in buildings as they rise above ground floor.

Three trackforms are proposed to achieve the ground-borne noise objectives. These comprise:

- a "Direct Fixation" trackform incorporating standard "stiff" rail fasteners (ie not specifically designed for vibration isolation – merely track durability)
- "Resilient" trackform incorporating moderately resilient rail fasteners
- "Highly Resilient" trackform incorporating highly resilient rail fasteners.

*High performance track fastening for noise and vibration control*

The Resilient and Highly Resilient trackforms are specifically designed to reduce vibration and ground-borne noise propagation. The ground-borne noise modelling and predictions show that the selection of appropriate trackforms would achieve compliance with the ground-borne noise goals at all sensitive receivers.

The predicted ground-borne vibration levels with the Project trackform are more than a factor of three below the residential vibration goal at the nearest sensitive locations. Ground-borne vibration levels from train pass-bys are unlikely to be perceptible within nearby buildings. The predicted ground-borne vibration levels also comply with the instrument-specific vibration criteria given for the electron microscope at the Ecoscience Precinct.

## Airborne noise assessment – train operations

In the northern section, all sensitive locations are predicted to comply with Queensland Rail's operational noise criteria in both Year 2021 and Year 2031. Therefore, no mitigation measures are required.

In the southern section, some 28 sensitive locations are predicted to exceed Queensland Rail's operational rail noise criteria in Year 2021 and 37 sensitive locations are predicted to exceed the criteria in Year 2031. Both assessments include the existing noise barriers supplied by Queensland Rail. Three noise barriers have been designed for these locations at Salisbury, Rocklea and Yeronga to achieve compliance with Queensland Rail's operational rail noise criteria. The noise barriers at Rocklea and Yeronga would be up to 4.5 m in height, whilst the noise barrier at Salisbury would vary between 5 m to 7 m in height.

The existing surface tracks between the portals in Yeerongpilly and Victoria Park would not be changed as part of Cross River Rail. However, the Project would free-up capacity on these surface tracks by redirecting a significant portion of the passenger rail operation through the rail tunnels. While there would be a reduction in the daily passenger train traffic, the increased and available capacity would permit an increase in freight train traffic on the surface tracks between the portals.

The modelling predicts that the LAeq (24 hour) noise emission levels would increase by up to 2 dBA due to the change in freight train traffic for the Year 2031. Changes in noise levels of 2 dBA or less are undetectable to the human ear. The predicted increase in noise from surface rail traffic at sensitive locations would be negligible.

The maximum noise level during train 'pass-by' would not change due to the potential increase in freight train traffic. There would only be a change to the number of train pass-by events. Over time, it is likely that the maximum noise levels from train pass-by would be reduced, as new generation rollingstock are progressively introduced into operation.

The noise contribution from the stabling yard operations to the overall rail noise emissions is predicted to be negligible. There are no predicted exceedances of Queensland Rail's operational criteria adjacent to either stabling yard.

## Airborne noise – mitigation measures

The operational noise levels in Year 2031 are predicted to exceed Queensland Rail's noise criteria in three areas of the southern section. Noise barriers would be required at Salisbury, Rocklea and Yeronga to comply with Queensland Rail's noise criteria. Urban design measures would be required to off-set the visual and amenity concerns some people have about the installation of noise barriers.

The reference design would create a 'cut' immediately south of the southern portal and adjacent to the existing Yeerongpilly Station, such that the track level would be below the level of Wilkie Street. Queensland Rail's noise criteria would be satisfied for sensitive receptors along Wilkie Street for both the Cross River Rail tracks and the realigned surface tracks.

The possible sleep disturbance caused by the noise emission from the air-conditioning units after stabling and before pick-up of trains can be mitigated by careful management of the Clapham stabling yards.

## Airborne noise assessment – ancillary facilities

Three 25 kV feeder stations are proposed for the power supply to the tunnel section. These would be located at Mayne Rail Yard, near the northern portal in Victoria Park and near the Yeerongpilly Station. The predicted noise levels at sensitive locations nearest to each of the feeder stations would be below the existing background noise level for all sensitive receivers at the feeder station locations. Further noise studies carried out during the detailed design would confirm or refine the noise predictions.

Noise generated during underground train 'pass-by' has the potential to 'escape' via the tunnel ventilation outlet. Train noise break-out through the ventilation outlet at Fairfield would not exceed the noise goals and would be quieter than road traffic noise from Fairfield Road.

Mitigation measures would be required for some underground station mechanical plant and ventilation shafts in order to achieve the Project noise goals. Mitigation measures that may need to be considered at some locations include appropriate equipment selection, in-duct attenuators, noise barriers, acoustic enclosures

and the strategic positioning of critical plant away from sensitive receivers. The location and design of the mechanical plant, air exhaust and intakes for the Project would be assessed as part of the detailed design.

## 5.12 Waste

The Project has the potential to generate a range of liquid and non-liquid waste materials, in both construction and operations phases.

### 5.12.1 Existing conditions

The key waste streams for the Project include:

- construction and demolition waste, which may include concrete, timber, plasterboard, bricks, tiles, steel reinforcing, cardboard, plastic wrap and general waste
- operational waste, including waste collected from cleaning activities on trains and in public and commercial areas, groundwater inflow and wash down water from underground pavements and tunnels, which may contain contaminants and waste generated by infrastructure maintenance activities, including off-cuts, solvents, paints, cleaning fluids, greases, acids and alkali materials.

In addition to these waste items, some hazardous materials may be encountered during demolition works in the rail corridor such as:

- asbestos in service pipes and older buildings as well as hydrocarbons, chemicals and paints
- creosotes and arsenic in wooden sleepers, ballast and soils within areas of surface works inside the rail corridor.

The Project's projected waste streams can be further categorised into general solid waste, inert, green waste, recyclable and regulated waste.

### 5.12.2 Predicted impacts and mitigation measures

Waste-related environmental impacts from the Project would only occur as a result of poor management of waste materials. These potential impacts include:

- dust resulting from the inappropriate storage, handling and disposal of excavated material
- soil and water (surface water and groundwater) contamination from material spills during handling and haulage
- soil and water overflows from sediment control structures and sediment ponds during extreme rainfall events
- soil and water (surface water and groundwater) contamination from inappropriate storage, handling and disposal of solid and liquid waste and materials separated for recycling, reuse or recovery
- an increase in the incidence of vermin, insects and pests resulting from the inappropriate storage and handling of putrescible waste
- an impact on social amenity during construction as a result of poor housekeeping in construction areas
- the inefficient use of resources.

Waste and resource recovery activities associated with the Project would not pose a significant risk to the environment or public health with the implementation of effective waste management and resource recovery control measures.

A waste management and resource recovery plan would be developed for the demolition and construction, and operations phases to provide measures to mitigate the potential impacts. This plan would include the following components:

- training and awareness of waste management procedures for segregation of recyclable materials, storage of waste and identification opportunities to avoid waste generation and reuse material during construction
- waste stream assessment – prior to commencement of waste producing activities, specific waste management strategies would be developed for each waste stream
- identification of opportunities for resource recovery including the proposed destination for recovered materials – engage a salvaging specialist to identify opportunities for the reuse, recycling or recovery of materials that are not able to be reused in the project
- identification of recycling/reuse facilities that would be used to segregate and recover demolition and construction waste for reuse and/or recycling
- prequalification requirements for waste/recyclables receiving facilities
- management of waste storage areas to prevent pollution
- supply chain management actions to minimise generation of solid waste and encourage recycling of unused product and off-cuts

- clarification of Project roles and responsibilities relating to waste management and resource recovery
- monitoring, auditing and reporting requirements of the Recycling Policy for Building and Civil Infrastructure (2009) and the guidelines are to be included within the Waste and Resource Recovery Management Plan to demonstrate that reasonable avoidance, reuse, recycling and recovery measures have been undertaken to reach the agreed by weight reduction target. This target will be identified and confirmed in the detailed design phase
- procedures for review and update.

## 5.13 Indigenous cultural heritage

### 5.13.1 Existing conditions

The potential effect of the Project on existing Indigenous cultural heritage has been assessed in accordance with the guiding principles of relevant Commonwealth and Queensland legislation.

Records contained within the Aboriginal Cultural Heritage Register and Cultural Heritage Database and other relevant sources were searched to identify Indigenous places or items of local, State or national significance. Surveys of the study area were also undertaken by the Traditional Owner groups, namely the Jagera People and the Turrbal People, as the Project would pass through their traditional lands.

Seven places on the Queensland Indigenous Cultural Heritage Database are located within the study corridor. The database includes two sites at York's Hollow which is the most important Aboriginal cultural heritage site known within the study corridor. York's Hollow includes the area now covered by Victoria Park, the RBWH, and the RNA Showgrounds. Prior to 1890, Breakfast Creek flowed through York's Hollow. York's Hollow was a useful food gathering spot, but there are also suggestions that it also held spiritual significance. Groups of up to 800 people gathered at York's Hollow for ceremonial and trading purposes from as far away as the Blackall Ranges.

*York's Hollow*

### 5.13.2 Predicted impacts and mitigation measures

Heritage places that would be required to accommodate Project elements on the surface include the two registered sites identified at York's Hollow. Aboriginal parties have also identified the area of Moolabin Creek with potential Aboriginal cultural heritage significance. This creek will also be required to accommodate Project elements on the surface.

A Cultural Heritage Management Plan (CHMP) would be required between the Proponent and both Aboriginal Traditional Owner parties.

All work would conform to the requirements of the *Aboriginal Cultural Heritage Act 2003* and the CHMP.

In addition, the following items have been identified by Traditional Owners for consideration in the detailed design phase of the Project:

- consideration of opportunities to celebrate and commemorate Aboriginal cultural heritage within the Project study area, including interpretive signage, public art and traditional plantings
- consideration of opportunities to address issues related to inequity for Aboriginal people, through employment and traineeships with the Project should be considered, as well as the potential use of land or property acquired for the Project prior to or post construction.

## 5.14 Non-Indigenous cultural heritage

### 5.14.1 Existing conditions

A number of registered non-Indigenous heritage places are located within the study corridor. This includes sites on the National Heritage List, the Commonwealth Heritage List, the Queensland Heritage Register, the City Plan Heritage Register, or a combination of these.

The places registered on the National Heritage List are the Commissariat Store and Old Government House in the Brisbane CBD. Four places registered on the Commonwealth Heritage List are the Brisbane General Post Office, the Queensland Postal Honour Board, the Naval Offices, and Victoria Barracks. None of the places on the Commonwealth Heritage List would be affected by the Project.

Nineteen places are also listed on the Queensland Rail Heritage Register.

Prominent heritage sites within the northern section of the study corridor include the RNA Showgrounds which held its first exhibition in 1876. The RNA Showgrounds cover an area of approximately 22 hectares and have numerous structures and facilities associated with the annual Exhibition.

Prominent heritage sites within the central section of the study corridor include Victoria Park, Roma Street railway station and platform shelter, the Botanic Gardens, Boggo Road Gaol and South Brisbane Cemetery.

The southern section of the study corridor contains heritage sites located in Killarney Street and Dublin Street in Yeronga, Rocklea Station and footbridge, and Salisbury Station and footbridge.

*Former Boggo Road Gaol*

### 5.14.2 Predicted impacts and mitigation measures

A number of heritage places would be required to accommodate the various Project elements and could be subject to direct impacts. Heritage places that would be required to accommodate the various Project features on the surface include:

- RNA Showgrounds
- Victoria Park
- Roma Street Station
- Boggo Road Gaol
- Rocklea and Salisbury stations.

Sub-surface works also have the potential to impact on a number of heritage registered places from noise, vibration and settlement associated with tunnel construction.

The Project would impact on the RNA Showgrounds, involving surface works that would substantially alter the fabric of parts of the complex. Changes include realignment of the Exhibition loop tracks to accommodate the new Ekka Station and Cross River Rail tracks and changes to the vertical alignment of O'Connell Terrace to accommodate an increase in the clearance of the rail bridge.

Coincidentally some of the heritage values that would be affected by the Project at the RNA, would be affected by the planned redevelopment of the RNA Showgrounds. The actual impact would accrue from the project which proceeds first. On-going liaison with key stakeholders such as the ULDA, the Queensland Heritage Council and the RNA would be required, as part of a coordinated management approach to maintain the cultural values attached to the RNA Showgrounds.

Construction works would be undertaken in the rail corridor adjacent to and within Victoria Park. Earthmoving in Victoria Park has the potential to unearth archaeological materials of interest.

Construction at Roma Street Station would involve the demolition of a car park and platform. The Project would also involve the creation of emergency vehicle access to the heritage-listed platform. The connection of the access to the new platforms with the existing Roma Street subway would require excavation works. Such works would be monitored in case any archaeological materials of interest were uncovered.

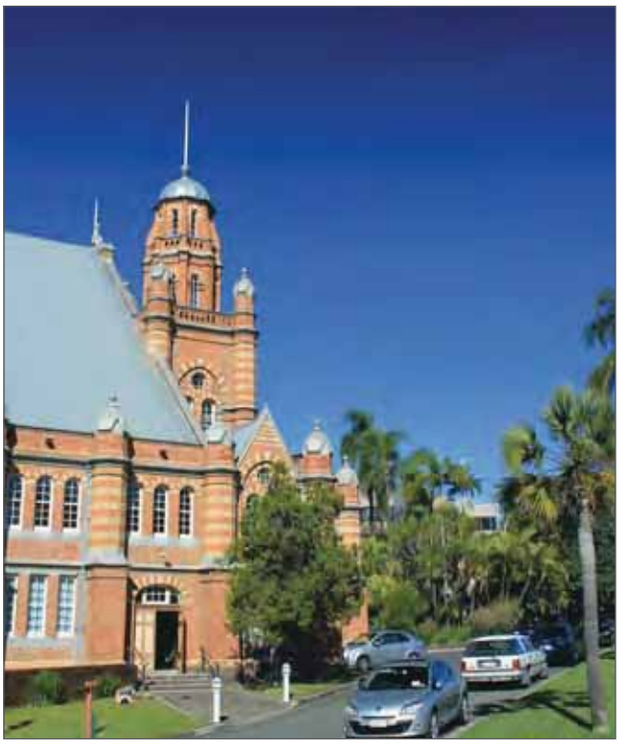
The street network in the vicinity of the Albert Street Station is part of the historic fabric remaining from early Brisbane. In response to the depth of the construction works for Albert Street Station and the historic background of the locality, monitoring of the early construction works in the surface soils would be required.

Boggo Road Station would be located immediately adjacent to the heritage-listed remnants of Boggo Road Gaol. While construction of a new underground station, the tunnels and surface infrastructure has the potential to impact the heritage fabric, the probability of this outcome is low. The construction management measures required to address the operational requirements for the TEM microscope at the nearby Ecosciences Precinct are more stringent in terms of vibration controls and more demanding of the Project than the vibration requirements for the gaol.

Where Project works would impact on heritage-listed structures, a full photographic and descriptive report would be prepared prior to construction. Works would

be conducted in accordance with cultural heritage management plans.

Where the potential for archaeological places or artefacts exists, the discovery of any important historical archaeological place or artefact must be reported to the DERM.



*Old Queensland Museum, Bowen Hills*

## 5.15 Social values

### 5.15.1 Existing conditions

#### Population

In June 2009, approximately 79,000 people lived in the study corridor, representing 1.8% of Queensland's population. Annerley and Moorooka contain the largest number of residents whilst Dutton Park had the smallest population, reflecting its small geographic area and mixed land use pattern.

After several years of population decline, the inner city suburbs now are experiencing increasing growth, based on the 20 to 54 age groups. Students, young and middle-aged professional workers also are moving to these suburbs. All suburbs in the study corridor experienced population growth between 2004 and 2009. Since 2008 Yeerongpilly has experienced the highest growth in population of all suburbs in the study area of 7.1%.

From 2006 to 2031, the Queensland population is predicted to increase by 53.4%, with the Brisbane area projected to grow by 23.1%. The population in the study area is forecast to increase by approximately 34.9% over the same period. High population growth in the inner city suburbs is projected with the highest population growth forecast for Bowen Hills, Albion, Dutton Park and Woolloongabba. Population growth in the southern suburbs of Moorooka, Salisbury and Rocklea would be less vigorous, due to constraints on higher density housing availability.

In the five years between 2001 and 2006 less than 12% of the City residents (City inner and remainder) had the same address. This high level of mobility results in the whole of study area data showing higher levels of mobility than the Brisbane and Queensland averages. However, there are relatively stable populations in Salisbury, Moorooka, Yeronga and Dutton Park.

#### Age profile

The age structure of the study corridor shows considerable variation, depending on proximity to the CBD. Overall, the study corridor had a lower proportion of children aged under 15 years, a higher proportion of working age people and a smaller proportion of people over 65 years, than the populations of Brisbane and Queensland. Suburbs close to the CBD had the highest proportion of working age residents. The highest proportions of young people (aged 15 years and under) were in the southern suburbs of Moorooka, Salisbury, Yeerongpilly and Yeronga, and the largest proportion of those over 65 years of age were in Salisbury, Rocklea, Dutton Park, and Moorooka.

#### Cultural diversity

The proportion of Aboriginal and Torres Strait Islander people in Dutton Park and Woolloongabba was the highest in the study corridor and above the Brisbane average. At the 2006 Census, 812 people identified as being Aboriginal or Torres Strait Islander, representing 1.1% of the total population of the study corridor. This was lower than the proportion of Aboriginal and Torres Strait Islander people in both the Brisbane Local Government Area (LGA) and the Queensland populations.

#### Housing and family types

Compared to the Brisbane average, the study corridor contained fewer families with children and more people of working age, reflecting the high number of professionals, students and singles in the inner city suburbs, close to major business and educational facilities.

The study corridor includes a mix of high density residential combined with low density character housing, with higher than average housing costs in those suburbs nearest to the CBD and also those along the Brisbane River. The study corridor generally had low rates of owner occupants and higher rates of renters compared to the Brisbane average, with almost half of the dwellings being rented.

Overall, the predominant form of housing in the study corridor is the detached dwelling. This is most pronounced in Rocklea and Salisbury with more than 90% detached dwellings, compared with the Brisbane LGA of 73.7%.

## Advantage and disadvantage

The Australian Bureau of Statistics (ABS) produces four Socio Economic Indices for Areas (SEIFA) based on Census data for local areas. These indices identify areas of relative advantage and disadvantage.

Each of the Statistical Local Areas (SLAs) in the study corridor ranks highly on the SEIFA index, with all value ranges above those for Brisbane.

In 2006, the highest value on the SEIFA index within the study corridor was the 'City-Inner' area which had a higher proportion of people with tertiary qualifications (73.3 per cent) and a median weekly household income of $1,461 (2006). The lowest value on this index within the study corridor is Dutton Park (941) which has a lower proportion of people with post-school qualifications (62.0%) and a median weekly household income of $772 (2006).

## Social infrastructure

The study corridor includes a wide range of local community services and facilities to service the needs of local communities, including community support, education and training, sport and recreation, cultural, health, and emergency facilities and services. In addition, there is a range of district and regional social infrastructure, servicing the needs of the broader district, and communities in South East Queensland, interstate and internationally, including health and medical, open space, sport and recreation, and education facilities. The study corridor also includes a range of commercial and retail centres which cater for local and regional communities.

## Community values and sensitivities

Community values are the elements held as important to quality of life and well-being. They include tangible (physical) elements such as parks, landscape and pedestrian connectivity, and intangible qualities such as sense of place and community cohesion. Social infrastructure, such as churches, schools, public places and community centres are highly valued in local communities, as are demographic characteristics and local features.

*Centenary Aquatic Centre, Victoria Park*

Sense of place refers to the relationship between people and their environment, and denotes the existence of special characteristics which define a place's character and identity.

Environmental amenity refers to natural or physical qualities and characteristics of an area that contribute to a person's appreciation of the surroundings. Environmental amenity in the study corridor is high, with a range of public transport modes providing access to quiet neighbourhoods within easy reach of services, employment and the Brisbane CBD. There is also easy access to facilities of state and regional significance. Environmental amenity in the study corridor is being challenged by traffic congestion resulting in reduced accessibility and loss of quiet neighbourhood character.

Community cohesion refers to the connections and relationships between individuals, groups, and neighbourhoods, and is encouraged by the existence of local community facilities, a sense of local identity and belonging, population stability and opportunities for community participation. Residents in the study corridor enjoy and live in cohesive communities.

Preserving a sense of community safety is important for residents. This includes ensuring Brisbane is a place where everyone feels safe, without fear of their personal safety or property security, either in their homes, streets, and parks and travelling through the city. Improving community safety was frequently identified in the Project consultations as a corridor-wide issue.

Overall, residents in the study corridor place a high value on community cohesion, parks, open space, and recreation, character housing, and the household and community security of their suburbs.

During the rounds of consultation with the community to inform the development of the reference design and the EIS, an understanding of the community's values and sensitivities to particular aspects of Cross River Rail was developed. That understanding is summarised in Table 5-10.

*St. Fabian's Church, Yeerongpilly*

*Table 5-10 Community sensitivities*

| | Southern (surface) | Southern (portal) | Central (main lines) | Central (Boggo Road) | Central (Gabba) | CBD (southern) | CBD (northern) | Northern (portal) | Northern (surface) |
|---|---|---|---|---|---|---|---|---|---|
| **CONSTRUCTION** | | | | | | | | | |
| **Worksites, surface works** | | | | | | | | | |
| local access and construction traffic routes | | | | | | | | | |
| construction workers' car parking | | | | | | | | | |
| noise, vibration, air quality, water quality | | | | | | | | | |
| heritage places | | | | | | | | | |
| hours of work, duration of work | | | | | | | | | |
| **Underground works** | | | | | | | | | |
| noise and vibration – sensitive receptors | | | | | | | | | |
| spoil and material handling | | | | | | | | | |
| hours of work, duration of work | | | | | | | | | |
| **Surface building works** | | | | | | | | | |
| visual, amenity | | | | | | | | | |
| near neighbours | | | | | | | | | |
| construction site issues | | | | | | | | | |
| **Property** | | | | | | | | | |
| directly affected | | | | | | | | | |
| volumetric | | | | | | | | | |
| **OPERATIONS** | | | | | | | | | |
| noise and vibration – underground services | | | | | | | | | |
| noise and vibration – surface services | | | | | | | | | |
| increased services on surface | | | | | | | | | |
| increased freight services | | | | | | | | | |
| station access | | | | | | | | | |
| commuter car parking | | | | | | | | | |
| Community sensitivity | High | | Medium | | | Low | | | |

### 5.15.2 Predicted impacts and mitigation measures

Cross River Rail would support the achievement of the transport and transit outcomes in the SEQ Regional Plan by fostering compact urban form and connecting communities. The Project supports a sustainable approach to population growth, and the on-going role and function of the Brisbane CBD as the primary centre for commerce and employment in Queensland.

The Project also would service several regionally-significant employment centres and community facilities. These areas include Bowen Hills, RNA Showgrounds and the Royal Brisbane and Women's Hospital; Brisbane CBD including QUT Gardens Point; Woolloongabba, Mater Hospital and The Gabba; BRUV, PA Hospital, Ecosciences Precinct and the University of Queensland; and the Queensland Tennis Centre.

*Princess Alexandra Hospital, Buranda*

Support for this planned intensification in the urban form through the extension of high quality passenger rail services would be consistent with strategic planning at both the State and local government levels. Future, sustainable population and employment growth in these areas would require high quality public transport connections offered by the Project.

Services and infrastructure delivered by the Project would meet the needs of people with mobility and sensory difficulties, such as older people and people with disabilities as per the DD Act.

While the Project would provide many community benefits at the State, regional and local levels, its construction and operation would have some impacts on the surrounding residents and communities. Likely social impacts would include the influx of construction workers, the scale and intensity of construction itself and its duration, the realignment and alteration of local access roads, and site-specific impacts, such as noise and vibration impacts.

There are also community and social impacts from other large infrastructure and land development projects (eg Northern Busway, Northern Link, Bowen Hills and Woolloongabba UDAs, RNA redevelopment, BRUV and Yeerongpilly TOD). The communities in these areas may be particularly sensitive or vulnerable to project-related impacts due to the duration of major infrastructure works in their communities.

In recognition of these various impacts, a range of mitigation measures have been developed, and would be refined during detailed design and construction planning.

One of the key mitigation measures would be the provision of timely and clear information (in appropriate languages and using a range of mediums) about the Project works and support to residents. This would reduce stress and anxiety levels, and increase local safety in areas around the worksites (eg consultation and information to be provided to specific groups such as the blind residents in Fairfield, and translated or interpreted information if required).

A comprehensive suite of integrated mitigation measures would address predicted impacts on the environmental amenity of neighbourhoods within the study corridor. The EIS presents a draft Outline EMP for both the construction and operations phases of the Project to guide the approach to impact mitigation, management and reporting.

Mitigation measures which would maximise the benefits to the communities living and working in the study corridor would include initiatives such as public art programs at the new stations, the involvement of bushland and park regeneration management groups in revegetation projects, ongoing communication of construction activities and time frames to impacted people and where possible staging construction works to minimise impacts.

Once operational, communities close to new stations, new structures and renewed stations would benefit from the enhanced accessibility provided by the Project, but would also experience some changes to local road access and possibly to commuter car parking pressures.

The Project would impact on some parkland, especially in Victoria Park and Roma Street. Allocations of open space at key locations, such as the Albert Street Station plaza, the Gabba Station plaza and public space linking with The Gabba and a riparian corridor within the Yeerongpilly worksite would address the loss of open space to Project infrastructure.

## 5.16 Economic analysis

### 5.16.1 Existing conditions

The primary economic objective of Cross River Rail is to enhance the economic efficiency of rail public transport by providing further physical capacity in inner Brisbane. This would also deliver additional benefits to other modes of transport, in the form of freed capacity for rail freight and on road network for buses and private vehicles. Cross River Rail would deliver broad economic benefits to industries, communities and economic hubs closely linked to the study corridor.

The Brisbane economy is a critical contributor to Queensland's Gross State Product (GSP), accounting for approximately 46% of GSP, at a value of $98 billion (2009). Brisbane's CBD accounts for an estimated $27 billion per annum or nearly 13% of GSP. Census-based estimates between 2001 and 2006 highlight that Brisbane accounted for 13.5% of total economic growth which was more than the rest of Queensland combined.

Much of this increase in economic growth has resulted from rapid population growth but also from increased productivity in labour. The Brisbane economy is predominantly service-driven with property and business services, and finance and insurance services leading the way as industries with the most employment. Brisbane is a key employment generator, providing 9.5% of the nation's total workforce. Of the 0.2% growth in employment for 2009, the Brisbane region contributed 0.18 percentage points. This share was largely the result of increased job opportunities in public services, business services and other services which together contributed approximately 12,500 jobs.

#### Brisbane CBD

The CBD consists of the City-inner and City-remainder SLA giving a geographical area of 2.2 km$^2$ with a resident population of 13,299 persons in 2006. The average household size was 1.9 which is lower than the rest of the study area which averages 2.3. Population growth is forecast to continue in the area as more high density housing is brought to the market and people take advantage of the high order services and proximity to employment.

Located on the northern bank of the Brisbane River, the CBD comprises a number of precincts identified by clusters of activity, such as the legal and financial precinct in Eagle Street, the administration and government precinct in George Street, the shopping precinct in Queen Street, and the residential precinct between Elizabeth and Alice streets. There are other less obvious precincts, including the business services and shopping precinct north of Queen Street and the hotel and restaurant areas being close to the river on both the eastern and western edges of the CBD.

The dominant industries of employment in 2007 in the Brisbane CBD were property and business services (45.1%), finance and insurance (24.4%), and retail trade (6.0%) out of the 7,995 businesses across 16 industries. Other notable industries included construction, and health and community services. The average taxable income for the same year was estimated to be $49,069 per annum.


*Albert Street, Brisbane CBD*

#### Inner Brisbane

The areas of the Inner Brisbane SLA within the study corridor consist of Bowen Hills, Woolloongabba and Dutton Park. A combined geographical area of 5 km$^2$ would be within the 'service range' of the Project, with a population of 8,144 persons (2006) and an average household size of 2.1 compared with the average household size of Queensland of 2.6.

The main industries of employment (2007) in terms of numbers of businesses were property and business services (33.5%), retail trade (13.1%), and finance and insurance (9.3%) out of 1,737 registered businesses in the area. Employment in the wholesale trade and construction sectors were also strongly represented. The average taxable income in the Inner Brisbane area was $44,478 for the same year with Bowen Hills being significantly higher averaging $52,642 per annum.

The Inner Brisbane areas within the study corridor had a work force of 3,860 in 2007 with the main sectors being professional workers (26.1%), intermediate clerical, sales and service workers (17.4%), and labourers and related workers (10.3%).

Managers and administrators, as well as elementary clerical, sales and service workers were significant in numbers with shares of over 8%.

### Inner South East

Suburbs within the study corridor within the Inner Southeast SLA include Fairfield, Yeerongpilly, and Moorooka, representing a combined geographical area of 8 km$^2$. The population in 2006 was 14,200 with an average household size of 2.4 people.

Significant employment industries were property and business services (28.4%), retail trade (17.2%), and construction (15.7%) out of 1,341 registered businesses across 16 industries. Other notable employment sectors included transport and storage, and manufacturing. The average taxable income for this area was $42,643 in 2007.

### Outer South East

The SLAs of Rocklea and Salisbury are also within the study corridor for the Project. The combined areas account for a geographical area of 13.8 km$^2$ and had a population of 7,067 persons at the time of the 2006 Census. The average household sizes are higher relative to the other suburbs within the study corridor at 2.4 people for the same year.

Property and business services (21.1%), wholesale trade (15.2%), and manufacturing (14.9%) were the dominant employment sectors out of 1,692 businesses in 2007. Other notable sectors of employment included retail trade and construction. The average taxable income of the corridor was $38,076 per annum in 2007.

## 5.16.2 Economic justification

A high quality public transport network will be required in the near future to ease the growing commuter congestion, and to maintain Brisbane's long term competitiveness as a leading place to live and work. Cross River Rail would greatly enhance the economic efficiency of transportation between the Brisbane city and inner city suburbs, by establishing new rail stations at the RNA Showgrounds at Bowen Hills to the north, Roma Street and Albert Street within the city, and Woolloongabba, Boggo Road and Yeerongpilly to the south, and upgrades of existing stations at Moorooka and Rocklea.

The provision of improved inner city public transport is expected to provide substantial broader economic benefits to industry and the broader community in Brisbane and South East Queensland. Key amongst those benefits is the enhanced accessibility provided to support the region's primary centre, namely the Brisbane CBD.

Forecasts prepared for the Brisbane's Economic Development Plan show the population of Brisbane Statistical Division will grow from 1.8 million persons in 2006 to 2.4 million persons in 2026. Employment is forecast to grow from 585,000 persons to about 1.1 million persons by 2031.

At a discount rate of 7%, the economic analysis indicate a positive economic return for Cross River Rail with a net present value (NPV) of $2.3 billion and a benefit cost ratio (BCR) of 1.42. The BCR increases to 1.63 when the wider economic impacts for the Project are included. The main contributor to the wider economic impacts is agglomeration benefits, with the remainder largely accounted for by labour supply effects.

The largest component of benefit is perceived benefits to public transport users (time savings, improved amenity from reduced crowding) which accounts for 39% of benefits. The next largest component is travel time and cost savings to private transport users who gain from the reduction in road congestion leading to higher commuting speeds and reduced operating costs.

In addition to passenger-related travel benefits, Cross River Rail also would deliver benefits to rail freight by moving passenger trains (Gold Coast and Beenleigh) to Cross River Rail tracks and 'freeing-up' dedicated rail freight paths between Acacia Ridge and the Port of Brisbane. This would allow more intermodal freight to be transported by rail rather than by road as under existing conditions. Consequently, there would be operating cost, externality, and crash cost and road decongestion benefits (SAHA 2010).

Economic modelling (CGE) reinforce the economic effects of Cross River Rail on the Queensland economy. During a typical construction year (2016), real GSP for Queensland is estimated to increase by $653 million, while employment across a range of sectors is projected to increase by over 5,900 positions. Post construction (2031) modelling indicates an additional $937 million to GSP, and 5,000 jobs within the economy. The CGE modelling forecasts positive economic impacts and aggregates for the Queensland economy.

Cross River Rail would require the acquisition of residential and commercial premises to accommodate the portals and connections with the existing surface network. In addition to the direct financial costs associated with the property acquisitions, there would be economic costs in terms of businesses and jobs potentially lost during the course of displacement. In the locality of the acquisitions there would also be a loss in the availability of residential accommodation.

Notable acquisitions include the Albert Street area, where 19 existing businesses supporting approximately 70 to 100 employees would be displaced, and the section from Yeerongpilly to Salisbury where over 100 businesses supporting 480 to 600 employees would be displaced.

## 5.17 Hazards and risk

### 5.17.1 Existing conditions

The study corridor extends for nearly 19 km through the inner and ring suburbs of Brisbane, traversing the Brisbane River and including the Brisbane CBD. Residential, commercial, industrial and open space and recreation land is included within the study corridor.

In its construction phase, Cross River Rail would include tunnelling works, underground station works, surface track works, surface station works, and temporary and permanent changes to the surface road networks and infrastructure services in some areas.

Receptors within the study corridor that would be potentially subject to hazardous events include:

- residential communities and other sensitive land uses adjacent to the tunnel portals, worksites, surface works locations, transport routes and soil placement areas
- rail commuters and people using rail facilities
- motorists, pedestrians and cyclists on adjacent roads and paths during construction
- the construction workforce
- groundwater and surface water catchments including the Brisbane River, Breakfast Creek and Oxley Creek, as well as smaller watercourses including Moolabin Creek, Stable Swamp Creek and Rocky Waterholes Creek
- ecological communities of the Brisbane River as well as urban bushland and parks.

### 5.17.2 Predicted impacts and mitigation measures

Potentially hazardous activities or events which may occur during the construction and operations phases of the Project and which present a risk to people and property are listed below.

#### Construction

Potentially hazardous activities or events during the construction phase include:

- operation of vehicles and construction equipment in a confined tunnel space
- the storage of dangerous goods, including oils and fuels, in relatively compact construction worksites
- the use of oils, fuels and other dangerous goods including explosives, and their transport to construction areas
- transportation of spoil to spoil placement areas offsite
- working with electricity and working within close proximity to electricity (ie existing operational rail corridors and facilities)
- construction failures or incidents resulting in tunnel collapse or subsidence, flooding or inundation
- changes to surface road and services networks.

A comprehensive range of safety measures would be put in place for the construction phase, as part of the CEMP, which would include Containment and Hazardous Goods Management Plan and an Incident Management Plan. These would deal with procedures in the event of spillage of fuels and other dangerous goods as well as the provision of access and aggress of emergency vehicles, particularly inside the rail tunnels. Workforce and public safety would also be addressed through accredited OH&S plans prepared and approved prior to the commencement of works.

#### Operation

Potentially hazardous activities or events during the operations phase include:

- train incidents both above ground and underground
- maintenance works on the rail line (surface and underground) and ancillary infrastructure
- collapse, subsidence or failure of tunnel and other structural components
- flooding and inundation from both surface and groundwater sources
- acts of terrorism leading to major fires, explosions or other hazardous consequences.

The main operational hazards identified with a residual risk rating of ‘extreme’ result from external influences including acts of terrorism/vandalism, abnormal weather events and unauthorised access to the rail line. In addition to standard safety in design measures adopted for the Project, the inclusion of automatic platform screen doors in the underground stations would enhance public safety and comfort. The reference design for the underground platforms and access to the underground platforms also provides sufficient capacity to avoid crowding, and the hazards associated with crowding.

Identification of the risks during the design of the Project would allow for an integrated approach to

management of an event at the underground stations and tunnels.

The operations phase also requires the development and implementation of an effective and coordinated emergency management plan to facilitate evacuation of the infrastructure during an incident occurring due to external influences or an operational failure of the Project.

### Risk management

Risk management is a continual process which requires monitoring and review. The Project has committed to an on-going process of risk management, which includes the development of a risk management plan in consultation with relevant agencies and stakeholders.

## 5.17.3 Health and safety

The health assessment considers environmental factors with the potential to affect human health, public safety and quality of life, such as air pollutants, odour, worksite lighting, impacts to amenity, dust, noise, vibration and water quality.

### Project construction workforce

The health and safety values of the construction workforce are associated with their exposure to and use of safe construction practices. Safe construction practices are critical when the workforce is required to work under the following conditions:

- at heights
- in the vicinity of or operating heavy equipment
- within confined spaces
- within operational rail and road corridors
- with electricity
- with chemicals/dangerous goods
- manual labour including the use of tools and heavy lifting.

### Project operational workforce

The health and safety values of the operational workforce are related to safe working environments and the safe and efficient operation of Cross River Rail. The main risks to people during the operations phase of the Project are associated with:

- collision on the line due to maintenance activity or unknown track obstruction
- infrastructure malfunction
- emergency evacuation
- an act of terrorism.

### Community and stakeholder values

An indication of the existing health and safety values of the community and stakeholders has been identified through the preliminary consultation process. These values have been categorised according to the primary environmental aspect of the health and safety values identified:

- air quality
- noise and vibration
- access
- amenity/quality of life
- human and public health.

## Air quality

Community values relating to health and safety aspects for air quality are likely to be associated with:

- dust and vehicle particulate emissions
- generation of odours and vapours
- emissions from portals.

Dust and particulate generation is the predominant health and safety issue during both construction and operation of Cross River Rail. Dust, particulates, odour and vapour generation would be significantly more apparent during the construction than the operations phase of the Project. Impacts would be greater with increasing proximity to construction sites, areas of surface works within the rail corridor or associated facilities, road works and spoil transport offsite.

In its operations phase, Cross River Rail would be a 'low emissions' project for people living and working adjacent to the rail corridor. The demand for electricity would result in emissions at distant, thermal power stations. On a whole, the Project is expected to have net benefits in terms of air quality, as its focus is on the promotion of public transport use.

## Noise and vibration

Community values relating to health and safety aspects of noise and vibration during construction are likely to be associated with:

- tunnel construction (TBM operation, roadheader operation, drilling and blasting)
- construction vehicle movements both on worksites and on the road network
- time and duration of construction activities.

Community values relating to health and safety aspects of noise and vibration during operation are likely to be associated with:

- underground train movements
- potential increases surface rail traffic, particularly rail freight.

Operational noise impacts would result from the altered alignment of the surface track south of Yeerongpilly resulting in changes to the proximity of new sensitive receptors. The community south of Park Road has expressed concerns about the impacts of increased rail freight services as a consequence of Cross River Rail.

The modelling and analysis undertaken indicates that construction noise and vibration effects would impact on some properties and their owners and occupants. Mitigation measures proposed in the draft Outline EMP in most circumstances would address such effects.

Alternative measures for some properties would be required and would be negotiated with the owners and occupants of such premises.

A key finding of the EIS relates to the importance of early and on-going consultation with people about construction activities and their duration, and about the mitigation measures proposed. Consultation also would be required in relation to monitoring, and addressing complaints and corrective actions in the event of an exceedance of the goals adopted for the Project.

*Roma Street Station and Transit Centre, Brisbane*

## Access

The health and safety aspect of access is a concern of the community. Access impacts could result from changes to the road networks and existing public transport facilities during both the construction phase and operations phase of the Project. Community values include:

- adequate safety measures implemented during construction in the vicinity of nearby schools and other community facilities, including churches
- safe access for pedestrians and cyclists around all construction sites
- traffic congestion, delays and disruptions in the vicinity of construction sites and haul routes
- safe access to and around stations for commuters
- safe access around rail infrastructure for pedestrians and cyclists
- adequate access for persons with a disability.

Safety for people moving around construction sites is of critical importance for any project. For Cross River Rail, detailed construction traffic management plans and site management plans would be required for each worksite prior to the commencement of works. Active traffic management for worksites would be required to address the potential for conflict between construction vehicles and local traffic, pedestrians and cyclists.

Safety in design, including CPTED measures, has been incorporated in the reference design, and would be advanced through the detailed design phase to address community concerns regarding safe access to stations for commuters, pedestrians and cyclists.

### Amenity/quality of life

Community values relating to health and safety aspects of amenity and quality of life due to changes in rail and road networks, station access and operation of construction sites during construction are likely to be associated with:

- changes in the road network including temporary and permanent closures
- rail network alterations and service disruptions including temporary station closures
- land clearing for worksites
- visual impacts of the rail infrastructure (temporary and permanent)
- nuisance resulting from construction site activities
- community severance.

Measures to retain and enhance existing characteristics of the areas affected by Cross River Rail have been integrated into the Project through urban design. Implementation of mitigation measures identified within the draft Outline EMP for traffic and transport management, nature conservation, nuisance generation and social impacts aim to reduce the impact to the amenity of the affected areas and the quality of life of the community.

### Human and public health

Community values relating to health and safety aspects of human and public health during the construction and operation of the Project are likely to be associated with:

- transport, use and offsite disposal of hazardous substances
- waste generation, disposal and treatment
- transmission of disease/vectors within the community and commuter populations.

The handling, use and transport of hazardous substances would be strictly in accordance with approved management plans prepared in consultation with DERM and DES. Such management plans would be required to provide measures for the containment and remediation of incidents, such as spills during use or transport, as well as emergency responses in such circumstances.

## 5.17.4 Emergency management plan

Emergency planning and response procedures are to be developed with State and local emergency service providers during the development of the Construction and Operation EMP. The procedures must include strategies to address:

- evacuation routes from tunnel and above and underground stations including disabled access
- procedures in the event of a fire, spillage or flooding event
- procedures in the event of a collision within the tunnel
- acts of terrorism
- roles and responsibilities
- effective communication systems/channels in the event of an emergency
- traffic management/control systems.

*Botanic Gardens, opposite Albert Street Station site*

### 5.17.5 Conclusion

The preliminary risk assessment identified a number of potential hazards to people and property as a result of the construction and operation of Cross River Rail. The application of mitigation measures or safeguards would reduce the risk rating of the hazard and lower the residual risk.

The most significant risks identified in this assessment are associated with the evacuation of the underground tunnel and stations in the event of emergency whether from natural causes, structural or operational failures or an act of terrorism.

The risk assessment process is intended to be continuous, and carried forward through the different phases of the Project. Without limiting innovation, the preliminary risk assessment provides a framework for further more detailed hazard identification and risk analysis, evaluation and treatment.

The health and safety values of the community, stakeholders and workforce have been identified and are addressed by the relevant chapters within the EIS.

## 5.18 Cumulative impacts

In Brisbane, there would be a number of major infrastructure and development projects at some stage in construction concurrent with Cross River Rail and with the potential to impact on the same communities.

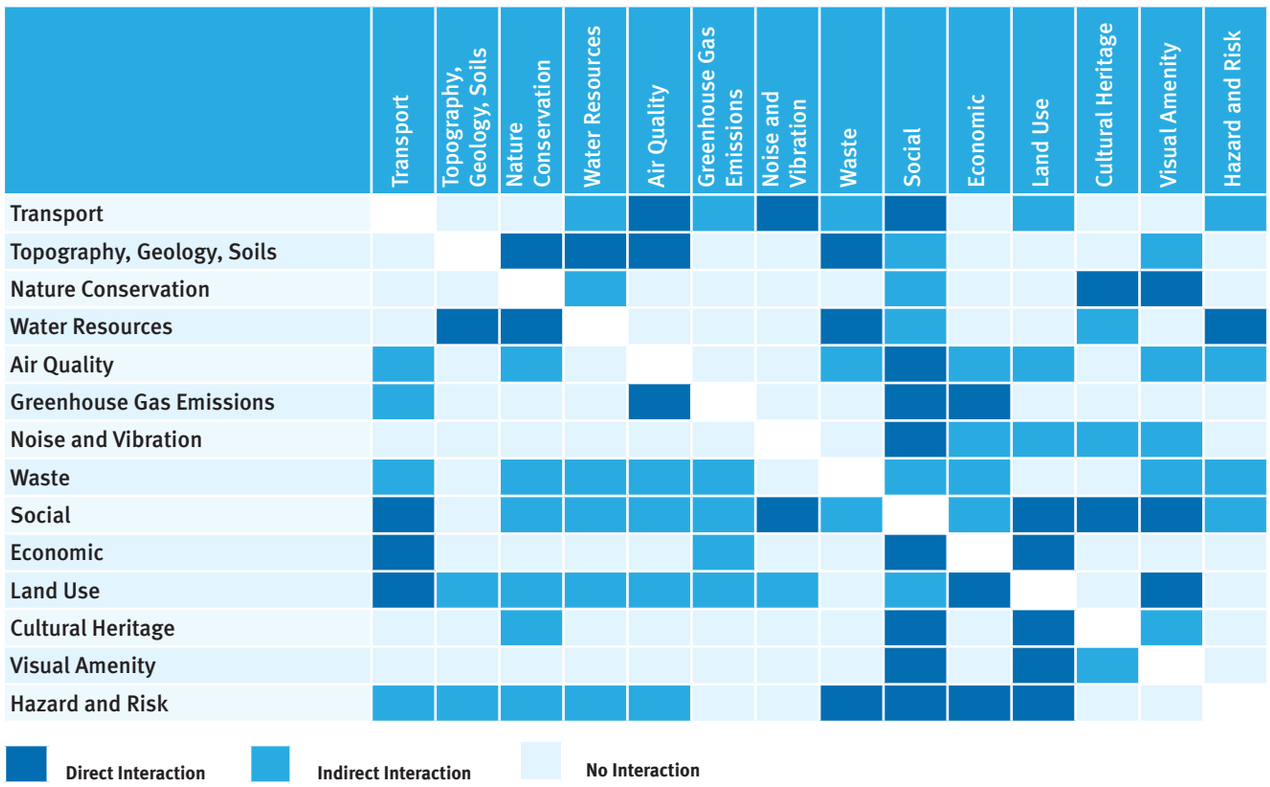
The cumulative impacts of the Project with respect to other current or planned developments have been considered with reference to the SEQIPP, draft Connecting SEQ 2031, Brisbane City Council Planning and Development, master plans, the ULDA, Department of Public Works, the Department of Infrastructure and Planning and the TMR.

### 5.18.1 Interaction of direct Project effects

The ToR has requested information on the overall impacts of the Project and a discussion of the inter-relationships of these impacts.

The potential for cumulative impacts arises from both the interaction of direct Project effects and the interaction with other concurrent projects. The anticipated interaction of direct Project effects is summarised in Table 5-11.

*Table 5-11 Environmental Impact Interaction Matrix*



## 5.18.2 Cumulative construction impacts

Table 5-12 shows an indicative programme of significant projects that have overlapping construction timeframes with Cross River Rail and are located in or adjacent to the Cross River Rail study corridor. Projects that could potentially increase construction impacts on the community are Legacy Way, urban development areas at Bowen Hills (including RNA Showgrounds) and Woolloongabba, Yeerongpilly TOD and BRUV. There would be varying potential for cumulative construction impacts to arise with some of these projects.

While the indicative programme in Table 5-12 identifies a number of projects with overlapping construction timeframes, none of these projects is sufficiently advanced in its planning and detailed design to compare specific aspects of construction. For example, site establishment for Cross River Rail at both Woolloongabba and Boggo Road would precede site works for the UDA and urban village development projects. In that scenario, the overlap of similar activities leading to cumulative effects would be diminished. However, the cumulative effect would be to extend the duration of construction works generally in each of these locations.

Further development of the Yeerongpilly TOD, other than private sector development that may be committed, would be subject to further investigation. There would be some potential for overlap, should construction works in the TOD commence during the Project works at Yeerongpilly.

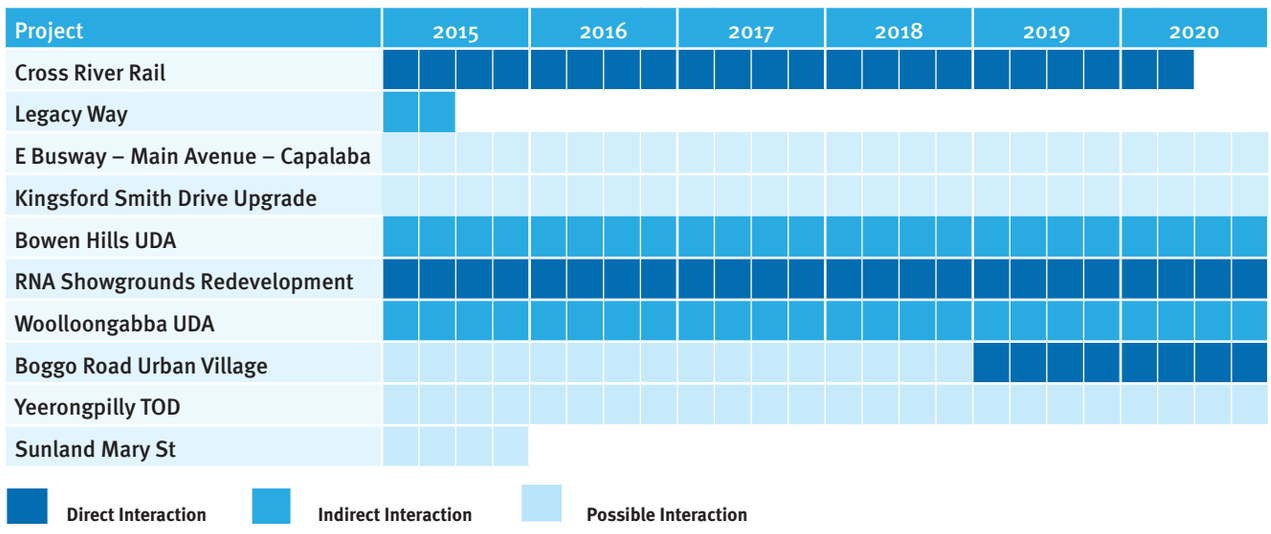
The construction and operation of the Project would generate additional demand and employment in the steel, concrete, tunnelling equipment, utilities, labour and contractor sectors. Cross River Rail construction would impact on the road transport network for the transport of goods and labour, peaks in such impacts coinciding with site establishment and tunnel construction. At the same time, Cross River Rail potentially would impact on the receiving environment with noise and vibration, dust, stormwater and construction waste. An integrated approach to the mitigation and management of such potential impacts would be required through implementation of the CEMP.

Similar impacts and effects would arise from other major projects. Providing they also were to be managed according to comprehensive, integrated CEMPs, short-term adverse environmental consequences would be minimised.

Construction activities for Legacy Way are expected to be completed in mid 2015. Although on the northern side of the ICB, the eastern worksite for Legacy Way would be located within close proximity to the Cross River Rail construction site at Victoria Park. Construction impacts associated with both projects would be managed through the comprehensive coordination of construction activities and traffic management.

Specific community implications for the RNA Showgrounds relate to the effects of Project works and worksites on major events and the potential for cumulative impacts on heritage values at the RNA Showgrounds. Access arrangements during major events at the RNA would be addressed in the Cross River Rail construction traffic management plan, in consultation with the RNA. Careful coordination with RNA and ULDA would to minimise any adverse cumulative impacts to non-Indigenous heritage values at the site.

*Table 5-12 Construction timeframes for proposed significant projects*



Overall, the cumulative effect of Bowen Hills UDA (including RNA Showgrounds), Woolloongabba UDA, BRUV and Yeerongpilly TOD and the Cross River Rail Project would have a positive long-term effect on the local and broader community through provision of accessible and robust public transport systems that are integrated with urban development. Cross River Rail would facilitate and support redevelopment in these locations through a planned and coordinated integrated transport framework.

### 5.18.3 Cumulative operational impacts

Post-construction, improvements to the transport system through the Cross River Rail Project has the potential to impact on the economy through a number of different mechanisms, including changes in prices, economic output, labour supply, imports and exports. Improved public transport capacity, connectivity and accessibility would lead to broader benefits to the efficient functioning of the labour market and business productivity, including:

- increased efficiency in labour markets
- companies utilising improved transport would experience lower costs
- additional labour supply, as the result of improved time and reduced cost in getting to a place of work, as an incentive to work
- more productive jobs, with better access to city centres and growth in employment in highly productive locations
- benefits to rail freight as a result of providing dedicated rail freight paths to the port as well as to Acacia Ridge.

The cumulative operational impacts of the projects addressed above would be the realisation of the strategic intentions for sustainable population growth and economic development advanced through the SEQ Regional Plan, SEQIPP, City Plan and the draft RiverCity Blue Print. The urban form around each of the Cross River Rail stations, in the long term, would continue to change and develop as the advantages of a high quality, integrated public transport system were sought by people in preference to the continuation of urban expansion and transport-dependent land use patterns.

There are well-established processes in legislation and planning development and assessment frameworks to address the on-going effects of redevelopment in Brisbane, focussed on the transport hubs facilitated by Cross River Rail and the busway network.

# 6 Environmental management

A draft Outline EMP has been prepared that sets out the Project approach to environmental management. It establishes environmental design principles for the Project and environmental objectives and performance criteria for the construction and operation phases of the Project. It also provides outline mitigation measures to maintain the environmental values of the study corridor.

The draft Outline EMP comprises a draft Outline CEMP, which outlines the approach to environmental management for the Project's construction phase, as well as a draft Outline Operations EMP (OEMP), which outlines the approach to environmental management for the Project's operations phase.

The draft Outline EMP is intended to guide the development of more detailed EMPs and relevant sub-plans prepared by the Proponent (or its agent or contracted entity) prior to commencement of the Project's construction and operations phases. In preparing the detailed EMPs and sub-plans, the Proponent (or its agent or contracted entity) must consider any conditions imposed by the Coordinator-General as part of the Coordinator-General's Evaluation Report. Any conditions imposed by the Coordinator-General would prevail over any provision in the draft Outline EMP.

The draft Outline EMP establishes a broad framework which would be reflected in the Project Construction and Operation EMPs as they are developed. The framework consists of the following core elements:

- Roles and responsibilities – identifies the proponent and provides a clear line of responsibility for the detailed design, construction and operational phases of the Project. Responsibilities include design approvals, monitoring, corrective actions, reporting.
- Community engagement – establishes a process and programme of activities for effective engagement of communities situated in localities potentially affected by the Project works or its operation.
- Approvals – identifies the range of approvals, permits, authorities or licenses that would be required for the construction and operation of Cross River Rail.
- Environmental design guidelines – establishes design principles and requirements for the Project to assist in avoiding, or minimising and mitigation impacts.
- Construction – provides an integrated framework of environmental objectives and performance criteria to be addressed in the CEMP, and implemented throughout the construction phase.
- Operation – provides an integrated framework of environmental objectives and performance criteria to be addressed in the CEMP, and implemented throughout the operations phase.

*Moolabin Creek, Yeerongpilly*

# 7 Conclusion and key findings

With the declaration of Cross River Rail as a significant project, the Coordinator-General determined that an EIS was required to describe the scope of the Project, to identify the potential benefits and impacts, and to describe the mitigation measures required to address such impacts. The Coordinator-General established and released ToR for the assessment of Cross River Rail in August 2010.

The Commonwealth Government, through the then Minister for the Environment, Water, Heritage and the Arts, determined that Cross River Rail would not be a controlled action under the EPBC Act if conducted in the manner specified in conditions advised.

The investigations for the development of the Cross River Rail design and for the preparation of the EIS have extended beyond the matters raised in the ToR to include matters raised during the preliminary consultation process and during the design development phase.

The conclusions drawn from the design studies and the EIS relate to:

- the strategic need for Cross River Rail to address existing constraints and to respond to patronage growth on the urban commuter rail network
- the potential benefits and impacts of Cross River Rail on the environment of the study corridor, in both its construction and operation
- the scope of community and stakeholder interest in Cross River Rail
- the range of mitigation measures available to address predicted environmental impacts and community and stakeholder issues.

## 7.1 Rationale for Cross River Rail

The population of South East Queensland has grown rapidly for several decades, and is expected to continue with the population forecast to increase from 2.8 million people in 2006 to 4.4 million in 2031 and to 6 million in 2056 (SEQ Regional Plan).

As the regional and urban populations continue to grow, with corresponding growth in employment, the demand for intra-regional travel will also increase. While all modes of transport will need to develop additional capacity to support this growth in travel demand, public transport and particularly rail provide a sustainable solution for employment-based travel, with the Brisbane CBD and regional centres as key destinations.

### Passenger increases

In 2009, more than 6.7 million person trips were undertaken daily in the Brisbane metropolitan area. Of these, public transport trips accounted for approximately 546,000 trips, or about 8.1% of total trips. Trips by rail comprised approximately 45% of public transport trips, with rail passengers travelling an average distance of 21 km and spending an average of approximately 30 minutes per trip.

In response to population and employment growth, public transport trips are forecast to grow to approximately 824,200 trips in 2021 and almost 1.1 million trips in 2031. This represents an increase in public transport trips of nearly 97% between 2009 and 2031, more than double the rate of growth in total trips.

The share of trips by public transport is predicted to increase from approximately 8.1% in 2009 to almost 10% in 2021 and 11.6% in 2031.

Peak period and daily rail trips are forecast to double, with approximately 529,500 daily rail trips forecast by 2031. Over the same period, most inner city and CBD stations are expected to experience a doubling of passenger movements in the morning peak. Of these stations, capacity at Central is the most constrained. Central Station's capacity of 43,000 passengers in a two hour period is predicted to be reached soon after 2016. With CBD passenger movements forecast to reach 75,000 in the morning peak, Central would become a constraint in the rail network.

Additional rail capacity would be required within the inner city, specifically to relieve the congestion developing around the Merivale Bridge over the Brisbane River. An additional north-south river crossing

for rail would be needed soon after 2016 to cope with the increasing demand for transport services in South East Queensland.

## Freight

Demand for rail freight services is expected to double by 2020 (Queensland Transport, 2008), again in response to population growth and economic development. The efficient movement of freight is essential for economic growth.

By 2021, without the Project, and with 15 minute off-peak passenger services much of the freight demand between Salisbury and Tennyson would not be able to be transported by rail (some 86%) while around 30% of freight demand between Tennyson and the Port of Brisbane would not be able to be transported by rail.

By 2031, anticipated increases in off-peak passenger rail frequency would limit freight movements on the North Coast line and between Salisbury and Tennyson, and Tennyson and the Port of Brisbane. The shortfall in train paths to meet rail freight demand on the network without Cross River Rail would be in the order of 222 trains per week in 2021, and 616 per week in 2031.

This outcome would have significant, far-reaching consequences for the regional economy as the Port of Brisbane becomes constrained, and as freight demands transition to road transport.

## Constraints in the rail network

The existing rail network in South East Queensland and the Brisbane metropolitan area is focussed on the Brisbane CBD, with all passenger services required to pass through the four inner city stations of Bowen Hills, Fortitude Valley, Central and Roma Street. On present trends, Central Station would approach its capacity for passenger movements soon after 2016.

The congestion on the inner city section of the network is compounded by:

- the single rail crossing of the Brisbane River (Merivale Bridge) to service the CBD from the southern regions and bayside suburbs
- the in-bound routes to the CBD being limited to one line from Milton for the western services and one line from Park Road for services from Beenleigh, Gold Coast and Cleveland
- trains from Park Road and Milton needing to merge into two in-bound lines to access the CBD
- the requirement for empty trains enroute to the Mayne stabling yards to cross over tracks for services from the western corridor, the southern corridor and the bayside suburbs.

Other constraints arise from:

- services on the main line sectors and the suburban sectors sharing of services and tracks which in turn affect rail network capacity as well as service reliability
- rail service plans needing to accommodate a mix of 'all stops', express and semi-express services on some lines and multiple commencing and termination points on a single line
- the use of long-distance rollingstock for short-distance services, and vice-versa, again reducing capacity on CBD services. Also long-distance commuters cannot be guaranteed access to appropriate on-board facilities
- the lack of a dedicated freight track between Salisbury and Park Road requiring the sharing of tracks for passenger and freight services, with the passenger scheduling bias constraining the movement of freight to the Port of Brisbane by rail.

Without Cross River Rail, the ability to increase rail freight services and provide a regular 15 minute frequency for off-peak passenger services is constrained by these infrastructure limitations. Additional infrastructure is required to avoid rail network inefficiencies with consequential limitations on economic development and regional competitiveness.

## Other modes of transport

- The bus network at present is experiencing high levels of demand with congestion occurring on several routes causing delays and reliability concerns. Some bus corridors, such as the South East Busway, are approaching saturation in peak periods.
- Over 4 million private vehicle trips are made each weekday within a radial road network with the Brisbane CBD at its centre. While recent

road infrastructure projects have provided additional cross-river capacity bypassing the CBD, the arterial roads remain congested in peak periods, with consequential effects on travel time reliability, travel time, road user costs and crash rates, for both private vehicles and public transport (bus).

- Ferry transport caters for a small component of trips in South East Queensland, being confined almost entirely to the Brisbane River and several islands in Moreton Bay. Travel by ferry in both South East Queensland and the Brisbane metropolitan area would not alleviate pressures on other modes arising from increasing travel demand.

### Sustainable transport outcomes

Sustainable transport infrastructure is critical to the prosperity and functioning of Brisbane. Cross River Rail would provide a high quality rail service to meet forecast travel demand, rather than default to road transport and the private motor vehicle.

Cross River Rail would deliver transport mode shift through increasing capacity on the inner-city rail network and supporting increased population growth and economic activity within inner city areas. Increased capacity would enhance the viability of rail transport within South East Queensland as well as facilitating the continued growth and development of the region. The Project will also increase the efficiency of rail freight by improving freight movement capacity through Brisbane.

The Project would support forecast growth in population and employment in planned extra-CBD centres, with a high quality integrated public transport (rail) service. These planned growth areas include Bowen Hills and the RBWH, Brisbane CBD, QUT Gardens Point, Woolloongabba, PA Hospital, BRUV and the Yeerongpilly TOD and Queensland Tennis Centre.

Cross River Rail would influence transport choices, mobility patterns, access and connectivity, land use and economic development for decades, and for future generations. Planned, designed and delivered with sustainability in mind, the Project would enhance its contribution to the economic, environmental and social well-being and prosperity of neighbourhoods across Brisbane and the wider region.

A comprehensive, integrated approach to identifying, mitigating and managing Project impacts would contribute to the overall sustainability outcomes for Cross River Rail and the South East Queensland community.

## 7.2 Overview of Project benefits

The benefits of proceeding with Cross River Rail range across transport, land use and economic factors. Cross River Rail would:

### Transport

- provide capacity to address growth in travel demand arising from population growth and economic activity, particularly for the Brisbane inner city and CBD. Cross River Rail would cater for additional demand of 66,000 passengers per day in 2031
- support the trend towards rail transport for both passenger services, through increased frequency of services for suburban and main line sectors. Cross River Rail would provide for 134% growth in public transport kilometres by 2031, and would assist in increasing public transport mode share to 12.1% over the same period
- enhance service efficiencies for both the main line and suburban sectors through the separation of operations by establishing new sectors, and the provision of additional, separate stabling facilities so that trains would not have to cross over main line tracks to access stable yards, causing delays to both suburban and main line services
- relieve demand pressure on other modes (bus, private vehicle) and networks (roads) with capacity and congestion challenges
- relieve demand conflicts between passenger and freight rail services, particularly from the south and west to the Port of Brisbane, allowing sufficient capacity to meet forecast demand for

*Park Road and PA Hospital Busway Station*

freight rail services. Road freight routes through established urban areas would not have to accept additional heavy vehicle traffic to cater for freight transport demand

- relieve congestion-related pressures on passenger rail services, such as journey times and service reliability, passenger crowding, station capacity at Central Station. Waiting times would be reduced progressively from 2021 to 2031. Over the same period, crowding levels would be relieved substantially (54% reduction in 2021 and 49% reduction in 2031)
- enhance accessibility to the Brisbane CBD and designated growth centres by providing an additional 52 trains into the CBD in the morning peak period in 2031.

### City-building and land use

- support and implement the intentions of the SEQ Regional Plan for an efficient urban form in which an integrated, high capacity public transport system supports designated growth areas (Bowen Hills, Woolloongabba, Dutton Park/Boggo Road, Yeerongpilly)
- support the on-going role of the Brisbane CBD as the primary centre in South East Queensland, through the provision of additional capacity in the passenger rail network
- support continued population growth and economic development in South East Queensland through the provision of high capacity public transport to key locations (Bowen Hills, Brisbane CBD - Roma Street and Albert Street, Woolloongabba, Dutton Park/Boggo Road)

*Roma Street Parkland and apartments*

- provide high quality public transport with minimal disruption to surface land use patterns or land use planning intentions by delivering the infrastructure and stations underground, and confining the surface infrastructure to the rail corridor where practicable
- support existing employment and activity centres through the provision of high frequency, high capacity public transport (RBWH and RNA Showgrounds at Bowen Hills, Brisbane CBD, The Gabba Stadium and Mater Hospital at Woolloongabba, the BRUV including the Ecosciences Precinct and the PA Hospital at Dutton Park).

### Economic

- deliver significant transport benefits for passenger and freight rail services (travel time savings, on-time reliability, access to freight train paths for service reliability, travel time and operating cost savings for road users)
- deliver indirect economic benefits through increased accessibility across the transport network in South East Queensland and increased efficiency of movement in and around the region and the Brisbane metropolitan area
- deliver employment benefits directly and indirectly through the construction phase, as well as through the operational life of the Project
- deliver a range of wider economic benefits, in terms of land use, productivity and amenity
- deliver economic benefits in excess of $9 billion for a benefit cost ratio of 1.4, or 1.6 if wider economic benefits are accounted for.

## 7.3 Summary of Project benefits and impacts

In its construction, Cross River Rail would present a massive transport infrastructure undertaking extending across and beneath a large part of the inner suburbs of Brisbane, including the Brisbane CBD. While the scale and intensity of the construction undertaking is significant on a national scale, the impacts would be of limited duration (ie 5.5 years), compared with the operational benefits. The operational benefits stemming from Cross River Rail would coincide with the operational life of the Project (ie 100 years).

An overview of the key impacts and benefits for both construction and operations is presented in Table 7-1.

*Table 7-1 Cross River Rail – Impacts and benefits*

| Impacts/Benefits | Benefit/ impact | Significance | Duration | Mitigations | Residual |
|---|---|---|---|---|---|
| **CONSTRUCTION PHASE** | | | | | |
| **Socio-economic effects** | | | | | |
| Property acquisitions – people and business relocating | | ◪ | ■ | Compensation, consultation, reference design | ◪ |
| Land use – worksites | | ◪ | | Land use change, transport outcomes | □ |
| Heritage (non-Indigenous; Indigenous) | | ◪ | ◪ | Reference design, CHMP, consultation | □ |
| Visual – noise barriers, worksites (sheds, cranes) | | □ | ◪ | Barrier design, worksite layout and rehabilitation | □ |
| Changed access – roads, paths, connections | ~ | □ | ◪ | Worksite layout and rehabilitation, urban design | □ |
| **Bio-physical effects** | | | | | |
| Roads – changed traffic conditions, add traffic | ~ | ◪ | □ | Traffic and parking management plan, signage, consultation | □ |
| Noise and vibration – tunnels and stations | | ■ | □ | EMP – barriers and enclosures, hours, consultation | □ |
| Air quality – surface works, transport, GHG | | □ | □ | EMP – site and dust management | □ |
| Water quality – surface water, groundwater | ~ | □ | □ | reference design, EMP – site management | □ |
| **OPERATIONAL PHASE** | | | | | |
| **Socio-economic effects** | | | | | |
| Public transport – service, availability, access | | ■ | ■ | Operational plan – optimise, land use planning | ■ |
| Transport – capacity increased, improved level of service | | ■ | ■ | Operational plan – optimise, land use planning | ■ |
| Transport – improved freight capacity | | ◪ | ■ | Freight plan – optimise, barriers, monitoring | ◪ |
| Land use – integration with public transport, planned growth centres | | ◪ | ■ | Integrated transport and land use plans | ■ |
| Economic – enhanced competitiveness, services, property | | ◪ | ■ | Optimise land use outcomes | ■ |
| **Bio-physical effects** | | | | | |
| Air quality – reduced vehicle emissions, GHG | | □ | ◪ | Design, integrated transport management | ◪ |
| Noise and vibration – reduced traffic, underground | | □ | ◪ | Design, integrated transport management | □ |
| Noise and vibration – rail freight on surface | ~ | □ | ◪ | Monitoring, barriers, barrier design, consultation | □ |
| Water – groundwater balance | | □ | ■ | Design, monitoring | □ |

| Benefits/Impacts | | Significance | | Duration | | Residual effect | |
|---|---|---|---|---|---|---|---|
| Benefits | | Low | □ | Short ‹ 5yrs | □ | Low | □ |
| Impacts | | Moderate | ◪ | Medium 5 – 10yrs | ◪ | Moderate | ◪ |
| Neutral | ~ | High | ■ | Long › 10yrs | ■ | High | ■ |

### 7.3.1 Construction phase

The key findings with regards to the anticipated Project impacts are summarised as follows:

- Impacts generally would be temporary and finite (ie less than five years duration) and would be confined mostly to the locality of the worksites.
- Impacts would be greatest in the vicinity of the major worksites at Yeerongpilly, Woolloongabba, Albert Street and Roma Street.
- Wider ranging impacts such as construction transport reduce in intensity rapidly with distance from the major worksites.
- Impacts from tunnel construction, such as ground-borne noise and vibration, would last for approximately five to seven days for each TBM 'pass-by', except for tunnelling under the CBD, where each passby would take longer (eg seven to ten days).

Implementation of the mitigation measures, in combination with advance and on-going consultation with potentially affected owners and occupants of properties would address most if not all impacts.

### 7.3.2 Operational impacts

The likely operational impacts from Cross River Rail are summarised as follows:

- Impacts would be mostly beneficial and would extend well beyond the study corridor to the Brisbane metropolitan area and South East Queensland.
- The localities around the major worksites would benefit directly from the Project through greatly enhanced transport service and accessibility to metropolitan and regional facilities and services.
- Benefits would be of long-term duration (ie greater than 10 years) and would bring about inter-generation change to land use, transport of people particularly commuters and would support more sustainable population growth and economic development in South East Queensland.
- Benefits would need to be optimised by supporting the effects of Cross River Rail through on-going integrated land use and transport planning and disciplined development management.
- Potential localised impacts on some properties adjacent to the surface stations and adjacent to the surface rail corridor south of Park Road would be reduced if not avoided through detailed design, in response to the environmental design principles in the EIS. Such impacts would include the potential for noise break-out from public address systems, commuter traffic and parking near stations, and increased rail freight on the existing surface tracks.

*Ecosciences building, Boggo Road Urban Village*

### 7.3.3 Construction impacts and mitigation measures

The construction impacts anticipated with the delivery of Cross River Rail would be most obvious in the vicinity of the worksites, and less obvious along the alignment of the tunnelling works, the materials supply lines, the spoil placement sites and the haulage routes. The major worksites include:

- Yeerongpilly – for the establishment of tunnelling activities including the assembly of two TBMs for the drive of two parallel tunnels through to Woolloongabba, and support of surface works at the Yeerongpilly station
- Woolloongabba – for the establishment of tunnelling activities including the assembly and launch of two TBMs for the drive of two tunnels through to Victoria Park, and construction of the Woolloongabba station
- Albert Street – consisting of two shafts and supporting worksite for the construction of the underground station and receipt of the TBMs passing through from Woolloongabba to Victoria Park
- Roma Street – consisting of three shafts for the construction of the underground platform and pedestrian concourse linking back to the existing station.

Other worksites supporting substantial construction activities include:

- Rocklea – for the upgrade of Rocklea station and support of the on-ramp works for the Ipswich Motorway
- Moorooka – for the upgrade of the Moorooka station and associated surface track works including the viaduct for the south-bound Cross River Rail track
- Clapham Rail Yard – for the construction of the new stabling yards, including filling of the land
- Fairfield – for the construction of the emergency access and ventilation shaft
- Boggo Road – for the construction of the underground station and receipt of the TBMs passing through from Yeerongpilly to Woolloongabba
- Victoria Park – for the construction of the northern portal and retrieval of the two TBMs arriving from Woolloongabba, as well as supporting surface track works for the tie-in with Exhibition line
- Bowen Hills and RNA Showgrounds – for the construction of the new surface station and for the construction works associated with the realignment of O'Connell Terrace
- Mayne Rail Yard – for the construction of the viaduct for the new Cross River Rail tracks through to Breakfast Creek to tie-in with the North Coast line.

The more significant construction impacts likely to arise from construction works for Cross River Rail, and the proposed mitigation measures, for each of the major worksites are summarised in Table 7-2(a) to (d).

*Yeerongpilly, east of the station*

Table 7-3 provides a summary of the more significant impacts likely to arise as a consequence of constructing the main tunnels and cross-passages, while the more significant impacts likely to arise from construction activities at other Cross River Rail worksites, and the proposed mitigation measures, are summarised in Table 7-4(a) to (f).

*Table 7-2(a) Cross River Rail – Construction impacts and mitigations – major worksites*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **ROMA STREET STATION** | | | |
| **Land use** | | | |
| • proximity to Roma Street Parkland, apartments<br>• George Street/Roma Street precinct | ☐ | • EMP (construction – overall)<br>• maintain safe vehicular and pedestrian access around worksites | ☐ |
| **Traffic and transport** | | | |
| • construction traffic accessing site to/from Roma Street<br>• interface with Roma Street traffic function<br>• access to/from Roma Street Parkland and apartments | ◪ | • reference design and construction planning<br>• maintain capacity in Roma Street – peak periods<br>• maintain safe vehicular and pedestrian access around worksites<br>• construction traffic management plan | ☐ |
| **Settlement** | | | |
| • Up to 10 – 25 mm extending 25 m from station shaft wall | ☐ | • reference design and construction planning<br>• monitoring | ☐ |
| **Hydrology** | | | |
| • worksite drainage – local events<br>• groundwater inflow to station works<br>• reference design – groundwater interception, progressively waterproof station void<br>• site drainage works | ■ | • EMP (water quality, sediment and erosion) | ◪ |
| **Noise and vibration** | | | |
| • site establishment – earthworks<br>• station excavation – rock-hammering, roadheader, drill and blast, spoil removal – three shafts | ☐ | • EMP (noise and vibration, construction traffic)<br>• station construction – materials, plant and equipment<br>• early provision of acoustic barriers and enclosures<br>• selection of technique, plant and equipment<br>• hours of works (surface) and monitoring<br>• early, on-going consultation | ☐ |
| **Air quality** | | | |
| • dust – site establishment, exposed earthworks, spoil handling<br>• construction traffic and site access | ◪ | • EMP (air quality)<br>• cover loads<br>• manage site access, street sweeping | ☐ |
| **Heritage** | | | |
| • Roma Street Station – building, platform<br>• Emma Miller Place | ◪ | • EMP (noise and vibration, groundwater)<br>• reference design and support for heritage structures<br>• monitor vibration, settlement<br>• worksite rehabilitation, refurbish Emma Miller Place | ☐ |
| **Social** | | | |
| • proximity and duration of construction works – business, residential<br>• disruption to transport – delays on journey to/from work, elsewhere | ◪ | • EMP (construction – overall)<br>• maintain safe pedestrian access around worksites<br>• consult with TransLink and Queensland Rail to maintain peak period transport services | ☐ |

**Significance**
Low ☐
Moderate ◪
High ■

**Residual effect**
Low ☐
Moderate ◪
High ■

*Table 7-2(b) Cross River Rail – Construction impacts and mitigation measures – major worksites*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **ALBERT STREET STATION** | | | |
| **Property acquisitions** | | | |
| • worksite – corner Albert and Alice streets, corner Margaret and Albert streets<br>• volumetric – station support 'zone of influence' | ◪ | • land acquisition process (*Acquisition of Land Act 1967*)<br>• early, on-going consultation | ☐ |
| **Land use** | | | |
| • loss of businesses – site acquisition<br>• amenity for businesses in Albert Street, Margaret Street and Alice Street adjacent to worksite | ◪ | • City Centre Local Plan<br>• reference design and construction planning<br>• monitoring – construction impacts<br>• on-going consultation | ◪ |
| **Traffic and transport** | | | |
| • temporary possession of traffic lanes in local streets<br>• construction traffic accessing site<br>• interface with Alice Street bus layby and traffic function<br>• access to/from commercial areas – Albert Street, Margaret Street | ■ | • construction traffic management plan<br>• no loss of capacity in Alice Street/Albert Street<br>• early, on-going consultation including BCC<br>• hours of work (deliveries, spoil) to/from site | ◪ |
| **Settlement** | | | |
| • Up to 25 – 50 mm extending 30 m from station shaft wall | ◪ | • reference design and construction planning<br>• monitoring and additional ground support as required | ☐ |
| **Hydrology** | | | |
| • worksite drainage – local events<br>• groundwater inflow to station works | ◪ | • reference design – groundwater interception, progressively waterproof station void<br>• site drainage works<br>• EMP (water quality, sediment and erosion) | ☐ |
| **Noise and vibration** | | | |
| • site establishment – demolition works, earthworks<br>• station excavation – rock-hammering, roadheader, drill and blast, spoil removal – two shafts<br>• station construction – materials, plant and equipment | ■ | • EMP (noise and vibration, construction traffic)<br>• early provision of acoustic barriers and enclosures<br>• selection of technique, plant and equipment<br>• hours of works (surface) and monitoring<br>• early, on-going consultation | ◪ |
| **Air quality** | | | |
| • demolition – potential for contaminants<br>• dust – site establishment, exposed earthworks, spoil handling<br>• construction traffic and site access | ◪ | • pre-demolition – investigate pre-80s buildings for asbestos and other contaminants<br>• cover loads<br>• manage site access, street sweeping<br>• EMP (air quality) | ☐ |
| **Heritage** | | | |
| • Botanic Gardens – entrance, fig trees in Alice Street<br>• Historic streets | ◪ | • reference design and construction planning<br>• avoid Botanic Gardens fig trees<br>• CHMP (Indigenous and Non Indigenous) | ☐ |
| **Social** | | | |
| • displacement of jobs through property acquisition<br>• changes in local connectivity, circulation and access – Albert Street, Botanic Gardens<br>• proximity and duration of construction works – residential, commercial | ◪ | • early, on-going consultation<br>• monitor construction impacts and adjust mitigation<br>• maintain safe pedestrian access around worksites at all times<br>• manage hours and type of work at times of day/night | ◪ |

**Significance**
Low ☐
Moderate ◪
High ■

**Residual effect**
Low ☐
Moderate ◪
High ■

*Table 7-2(c) Cross River Rail – Construction impacts and mitigation measures – major worksites*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **WOOLLOONGABBA** | | | |
| **Land use** | | | |
| • loss of Goprint<br>• amenity for businesses in Stanley and Vulture streets | ◪ | • implement Woolloongabba Development Scheme (UDA)<br>• observe Woolloongabba Local Plan (BCC)<br>• reference design and construction planning | ☐ |
| **Traffic and transport** | | | |
| • construction traffic at Main Street, Stanley Street Vulture Street and Ipswich Road (materials, spoil)<br>• construction works under Stanley Street and Vulture Street<br>• workforce car parking additional to Mater Hospital, businesses and major events at The Gabba | ◪ | • Construction traffic management plan<br>• reference design and construction planning – works in road reserves under peak traffic conditions<br>• off-site workforce parking and shuttle service from Yeerongpilly and other sites | ◪ |
| **Settlement** | | | |
| • up to 10-25 mm extending 25 m from station shaft wall | ■ | • reference design, construction planning<br>• monitoring | ◪ |
| **Hydrology** | | | |
| • worksite establishment and drainage<br>• groundwater inflow to station box | ◪ | • EMP (water quality, sediment and erosion)<br>• reference design – groundwater interception, progressively waterproof station void<br>• site drainage works | ☐ |
| **Noise and vibration** | | | |
| • site establishment – demolition works, piling, earthworks<br>• mining station cavern – cut-and-cover, drill and blast, spoil removal | ◪ | • EMP (noise and vibration management)<br>• early provision of acoustic barriers and enclosures<br>• hours of works (surface) and monitoring<br>• early, on-going consultation | ☐ |
| **Air quality** | | | |
| • demolition of Goprint – potential for contaminants<br>• dust – site establishment, exposed earthworks, spoil handling | ■ | • EMP (air quality management)<br>• detailed investigations at Goprint before start<br>• cover loads and spoil handling | ◪ |
| **Social** | | | |
| • relocation of jobs (Goprint) from Woolloongabba to another location<br>• proximity and duration of construction works – business, residential<br>• disruption to transport – delays on journey to/from work, elsewhere | ◪ | • refer land use and planning mitigation measures<br>• early, on-going consultation<br>• monitor – construction traffic management plan including workforce parking<br>• monitor travel times through Woolloongabba<br>• consult with TransLink to maintain peak period transport services | ☐ |

**Significance**
Low ☐
Moderate ◪
High ■

**Residual effect**
Low ☐
Moderate ◪
High ■

*Table 7-2(d) Cross River Rail – Construction impacts and mitigation measures – major worksites*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **YEERONGPILLY** | | | |
| **Property acquisitions** | | | |
| • widen the rail corridor, realign Wilkie Street, redevelop Yeerongpilly station<br>• worksite establishment, laydown areas, plant and equipment | ◪ | • land acquisition process (*Acquisition of Land Act 1967*)<br>• consultation about process, timing, outcome<br>• worksite rehabilitation<br>• reference design | ◪ |
| **Social** | | | |
| • displacement of people and jobs through property acquisition<br>• changes in local connectivity, circulation and access<br>• proximity and duration of construction works | ■ | • EMP (construction)<br>• reference design and construction planning<br>• early and on-going consultation<br>• possible compensation for directly affected owners<br>• worksite rehabilitation | □ |
| **Traffic and transport** | | | |
| • changes at Wilkie Street and Cardross Street<br>• construction traffic at Station Road and Ipswich Road<br>• workforce car parking additional to station demand<br>• rail corridor possessions for track realignment and station works | ■ | • construction traffic management plan<br>• realignment of Wilkie Street and Station Road in early works packages<br>• provide workforce parking with early works<br>• consultation with Queensland Rail and with community | □ |
| **Settlement** | | | |
| • dive structure, cut-and-cover and tunnel portal<br>• up to 25 – 50 mm up to 25 m from tunnel wall | ◪ | • reference design and construction planning<br>• monitoring and additional ground support as required | □ |
| **Hydrology** | | | |
| • worksite establishment and drainage<br>• stormwater drainage<br>• flooding of part of worksite along Moolabin Creek | ◪ | • EMP (sediment and erosion management)<br>• site drainage works, including water treatment, for design storm event<br>• predictive flood modelling to determine effect of proposed flood mitigation measures | □ |
| **Noise and vibration** | | | |
| • site establishment – demolition works, earthworks<br>• earthworks – tunnel dive structure, cut and cover, drill and blast, spoil removal | ◪ | • EMP (noise and vibration management)<br>• early provision of acoustic barriers and enclosures<br>• hours of works (surface) and monitoring<br>• early, on-going consultation | □ |
| **Air quality** | | | |
| • dust – site establishment, exposed earthworks, spoil handling | ◪ | • EMP (air quality management)<br>• minimise area of earthworks<br>• cover loads and spoil handling | □ |
| **Land use** | | | |
| • loss of commercial and industrial businesses<br>• amenity for near neighbours | ◪ | • work with BCC to develop Local Plan<br>• mitigate construction impacts for near neighbours | □ |

**Significance**
Low □
Moderate ◪
High ■

**Residual effect**
Low □
Moderate ◪
High ■

*Table 7-3 Cross River Rail – Construction impacts and mitigation measures – tunnel construction*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **RAIL TUNNELS AND CROSS-PASSAGES** | | | |
| **Noise and vibration** | | | |
| • roadheader tunnelling – tunnel approaches to underground stations, station caverns<br>• TBM tunnelling – main tunnels, especially where depth to surface is less than 20 m<br>• cross-passages – drill and blast, some roadheader<br>• sensitive receptors along the main alignment (eg TEM microscope at Boggo Road, some residential, some commercial) | ■ | • EMP (noise and vibration)<br>• monitoring – progressive capture 'real' data for different rock types for predictive modelling<br>• 'pre- and post-' building condition surveys<br>• early, on-going consultation to agree mitigation measures<br>• hours of works (sections with shallow cover) and monitoring<br>• building condition surveys for properties where exceedances are predicted | □ |
| **Property** | | | |
| • volumetric acquisitions of properties within the 'zone of influence' along entire main tunnels and cross-passages<br>• development sequence of some CBD properties (ie pre or post Cross River Rail construction works) | ◪ | • comprehensive information and consultation regarding effects of volumetric acquisition<br>• land acquisition process<br>• consult with owners of potential development sites | □ |
| **Hydrology** | | | |
| • groundwater inflow to main tunnels, cross-passages<br>• mobilisation of contaminated groundwater<br>• impact on groundwater-dependent ecosystems | □ | • EMP (groundwater)<br>• reference design – undrained main tunnels, waterproof membranes in cross-passages<br>• groundwater monitoring – flows, quality | □ |
| **Settlement** | | | |
| • up to 25 mm extending in a zone 75 m – 150 m wide<br>• up to 10 mm extending up to 150 m from tunnels along Albert Street | □ | • reference design and construction planning<br>• monitoring | □ |
| **Heritage, historical precincts** | | | |
| • Victoria Park (York's Hollow) – Indigenous interests<br>• William Cairncross building facade, Albert Street<br>• Boggo Road Gaol – vibration<br>• character housing, Yeerongpilly | □ | • EMP (noise and vibration, groundwater)<br>• CHMP (Indigenous and non-Indigenous)<br>• reference design and support for heritage structures<br>• monitor vibration, settlement | □ |
| **Social** | | | |
| • concerns regarding volumetric property acquisitions<br>• amenity impacts associated with noise and vibration<br>• disruption if mitigation for impacts is temporary relocation | ◪ | • EMP (construction – overall, noise and vibration)<br>• consultation with regards effects of volumetric acquisition<br>• monitoring, complaints service, corrective actions for exceedance of goals if required | □ |

**Significance**
Low □
Moderate ◪
High ■

**Residual effect**
Low □
Moderate ◪
High ■

*Table 7-4(a) Cross River Rail – Construction impacts and mitigation measures – other worksites*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **RNA SHOWGROUNDS** | | | |
| **Property acquisitions** | | | |
| • widen the rail corridor, relocate RNA station<br>• worksite establishment, laydown areas, plant and equipment | ◪ | • consultation about process, timing, outcome in relation to RNA master plan and UDA scheme<br>• land acquisition process in relation to RNA<br>• reference design and construction planning<br>• worksite rehabilitation | □ |
| **Land use** | | | |
| • Cross River Rail works concurrent with development of RNA master plan and development of Bowen Hills UDA<br>• constraints on RNA events, above those imposed by RNA master plan and Bowen Hills UDA development | ◪ | • RNA master plan and Bowen Hills UDA development scheme<br>• integrate new development with Cross River Rail transport benefits, extending to RBWH complex<br>• consult with stakeholders to coordinate and management cumulative construction impacts | □ |
| **Social** | | | |
| • disruption of major events (exhibition, shows, entertainment)<br>• changes in circulation and access during events and for RBWH<br>• proximity and duration of construction works | ◪ | • EMP (construction)<br>• reference design and construction planning<br>• early and on-going consultation (RNA, RBWH, DComm Safety, ULDA)<br>• worksite rehabilitation | ◪ |
| **Heritage** | | | |
| • in conjunction with RNA redevelopment, removal of listed pavilions, impact on Dairy Ring 2 and surrounding fig trees, and pedestrian underpass<br>• works in listed place concurrent with development of RNA master plan | ◪ | • CHMP for heritage places and features impacted directly by Cross River Rail works<br>• consult with stakeholders to avoid cumulative impacts on other heritage features<br>• EMP (construction) | ◪ |
| **Traffic and transport** | | | |
| • realignment of and worksite access from O'Connell Terrace<br>• construction traffic at O'Connell Terrace, Bowen Bridge Road, ICB<br>• workforce car parking additional to RBH and Fortitude Valley demand<br>• rail corridor possessions for track realignment and station works | ■ | • construction traffic management plan<br>• realignment of O'Connell Terrace outside major RNA events<br>• provide workforce parking with early works<br>• consultation with RNA, Queensland Rail and with community | ◪ |
| **Noise and vibration** | | | |
| • site establishment – demolition works, earthworks<br>• station construction works<br>• roadworks – O'Connell Terrace | ◪ | • EMP (noise and vibration management)<br>• acoustic barriers – Tufton Street residential, equipment modification (cranes)<br>• hours of works and monitoring<br>• early, on-going consultation | □ |

**Significance**
Low □
Moderate ◪
High ■

**Residual effect**
Low □
Moderate ◪
High ■

*Table 7-4(b) Cross River Rail – Construction impacts and mitigation measures – other worksites*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **VICTORIA PARK** | | | |
| **Land use** | | | |
| • worksite occupation of Victoria Park, including pedestrian/cycle path | ◪ | • EMP (construction – overall)<br>• maintain safe vehicular and pedestrian access around worksites<br>• worksite rehabilitation, design and landscaping | ☐ |
| **Social** | | | |
| • permanent and temporary loss of parkland<br>• proximity to off-leash area, playground, Centenary Aquatic<br>• proximity and duration of construction works – recreational areas | ☐ | • EMP (construction – overall)<br>• maintain safe pedestrian access around worksites and permanent works<br>• worksite screens<br>• early, on-going consultation – park user groups | ☐ |
| **Traffic and transport** | | | |
| • construction traffic accessing Gregory Terrace, using ICB past Northern Link worksite | ☐ | • construction traffic mgt plan<br>• construction planning<br>• maintain safe vehicular access to worksite<br>• early, on-going consultation – local residents, nearby schools | ☐ |
| **Heritage** | | | |
| • Victoria Park – indigenous heritage values, proximity to York's Hollow | ◪ | • CHMP<br>• monitor site earthworks for artefacts, archaeological and heritage values<br>• worksite rehabilitation | ☐ |
| **Settlement** | | | |
| • up to 25 – 50 mm extending 25 from portal structure and tunnel wall | ◪ | • reference design and construction planning<br>• Monitoring and additional ground support as required | ☐ |
| **Noise and vibration** | | | |
| • site establishment – earthworks<br>• portal and dive structure – rock-hammering, roadheader, drill and blast, spoil removal | ◪ | • EMP (noise and vibration, construction traffic)<br>• early provision of acoustic barriers and enclosures<br>• hours of works (surface) and monitoring<br>• consultation (schools, residential) | ☐ |
| **Air quality** | | | |
| • dust – site establishment, exposed earthworks, spoil handling<br>• construction traffic and site access | ◪ | • EMP (air quality)<br>• cover loads<br>• manage site access, street sweeping | ☐ |

**Significance**
Low ☐
Moderate ◪
High ■

**Residual effect**
Low ☐
Moderate ◪
High ■

*Table 7-4(c) Cross River Rail – Construction impacts and mitigation measures – other worksites*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **BOGGO ROAD STATION** | | | |
| **Land use** | | | |
| • location within BRUV – on-going development<br>• proximity to the Ecosciences building, Boggo Road Gaol, Dutton Park State School and Dutton Park residential | ◪ | • EMP (construction – overall) to address temporary amenity impacts<br>• maintain safe vehicular and pedestrian access around worksite<br>• maintain access to Dutton Park Station and busway | ◪ |
| **Traffic and transport** | | | |
| • construction traffic accessing site to/from Annerley Road<br>• workforce car parking – competing with PA Hospital, Ecosciences building, Gabba, Mater<br>• haul routes through inner suburbs to connect with major roads (Ipswich Road, Fairfield Road south of Venner Road)<br>• interface with existing transport modes (Dutton Park Station, busway) | ■ | • Construction traffic management plan – avoid use of local roads where feasible<br>• reference design and construction planning<br>• workforce car parking – shuttle from Yeerongpilly, use of Public Transport, management scheme<br>• maintain safe vehicular and pedestrian access around worksites and to Dutton Park Station and busway | ◪ |
| **Settlement** | | | |
| • up to 25 – 50 mm extending up to 25 m from station shaft wall | ■ | • reference design and construction planning<br>• Monitoring and additional ground support at Boggo Road Gaol and Ecosciences building as required | ◪ |
| **Noise and vibration** | | | |
| • site establishment – earthworks<br>• station excavation – rock-breaking, drill and blast, spoil removal – proximity to TEM microscope, heritage gaol, residential, community facilities<br>• station construction – materials, plant and equipment | ■ | • EMP (noise and vibration, construction traffic)<br>• early provision of acoustic barriers and enclosures<br>• selection of construction methodology, plant and equipment<br>• hours of works (surface) and monitoring<br>• early, on-going consultation – Ecosciences building | ◪ |
| **Air quality** | | | |
| • dust – site establishment, exposed earthworks, spoil handling<br>• construction traffic and site access | ◪ | • EMP (air quality)<br>• enclose station box as soon as practicable, cover loads<br>• manage site access, street sweeping | □ |
| **Heritage** | | | |
| • station excavation immediately adjacent to Boggo Road Gaol | ◪ | • EMP (noise and vibration)<br>• reference design and support for heritage structures<br>• monitor vibration, settlement<br>• worksite rehabilitation | □ |
| **Social** | | | |
| • proximity and duration of construction works – Dutton Park school and other community facilities (future Leukaemia Foundation), residential (Rawnsley Street) | ◪ | • EMP (construction – overall)<br>• maintain safe pedestrian access around worksites<br>• early, on-going consultation about construction programme and progress | ◪ |

**Significance**
Low □
Moderate ◪
High ■

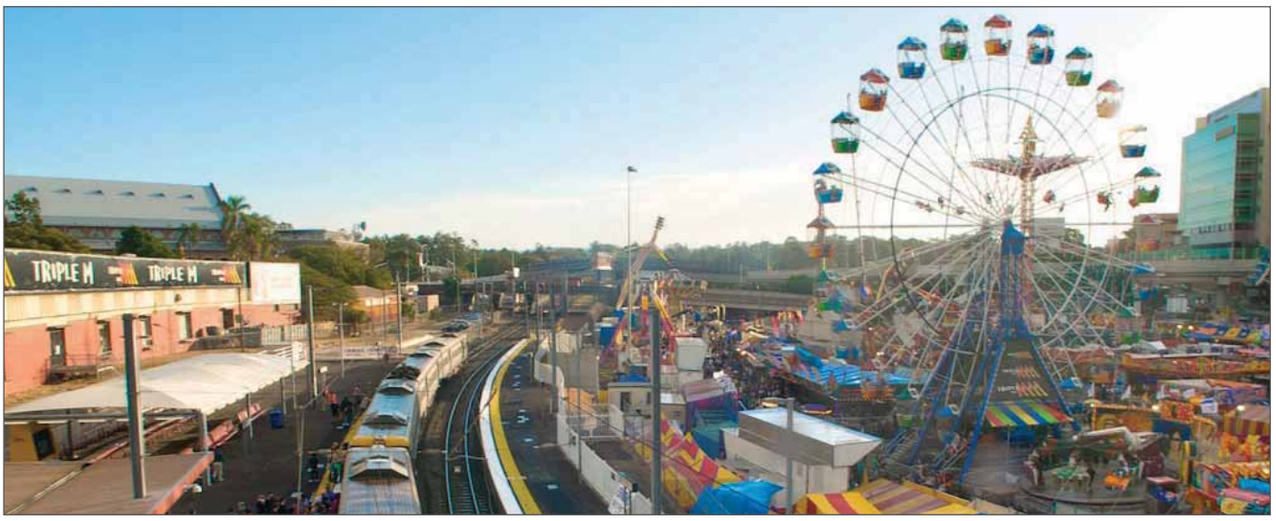
**Residual effect**
Low □
Moderate ◪
High ■

*Table 7-4(d) Cross River Rail – Construction impacts and mitigation measures – other worksites*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **VENTILATION AND EMERGENCY ACCESS BUILDING** | | | |
| **Land use** | | | |
| • proximity to residential and commercial premises<br>• partly situated with road reserve (Fairfield Road, Railway Road) | ◪ | • EMP (construction – overall)<br>• maintain safe vehicular and pedestrian access around worksites<br>• worksite rehabilitation, design and landscaping | ☐ |
| **Social** | | | |
| • proximity of construction works – sensitive receptors<br>• visual impact within a wide landscaped buffer to Fairfield Road | ◪ | • EMP (construction – overall)<br>• maintain safe pedestrian access around worksites and permanent works<br>• on-going consultation re construction progress and programme<br>• site rehabilitation and landscaping | ◪ |
| **Traffic and transport** | | | |
| • construction traffic accessing Fairfield Road south to Venner Road and to Clapham Rail Yard<br>• use of Fairfield Road to turn construction vehicles back (south) to site | ◪ | • construction traffic mgt plan<br>• construction planning to avoid peak periods on Fairfield Road and to allow movement of buses | ☐ |
| **Hydrology** | | | |
| • groundwater inflow to main tunnels, cross-passages<br>• impact on groundwater-dependent ecosystems | ◪ | • EMP (groundwater)<br>• reference design – undrained main tunnels, waterproof membranes in cross-passages<br>• groundwater monitoring – flows, quality | ☐ |
| **Settlement** | | | |
| • up to 25 – 50 mm extending 25 m from vent shaft wall | ☐ | • reference design and construction planning<br>• monitoring | ☐ |

**Significance**
Low ☐
Moderate ◪
High ■

**Residual effect**
Low ☐
Moderate ◪
High ■




*Exhibition Station*

*Table 7-4(e) Cross River Rail – Construction impacts and mitigation measures – other worksites*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **MAYNE RAIL YARD** | | | |
| **Traffic and transport** | | | |
| • worksite access off Lanham Street, Bowen Hills, concurrent with works in O'Connell Terrace<br>• temporary track possessions impacting on efficiency of Mayne Rail Yard for commuter train stabling<br>• workforce car parking at Mayne Rail Yard – access, safety | ■ | • construction traffic management plan<br>• temporary access from O'Connell Tce, via Lanham Street<br>• consultation with Queensland Rail, BCC, RNA and with community | ◪ |
| **Hydrology** | | | |
| • worksite establishment and drainage<br>• potential to disturb ASS for viaduct and track works | ◪ | • EMP (sediment and erosion, ASS, water quality)<br>• site drainage works, including water treatment, for design storm event<br>• site investigations to determine ASS risk | □ |
| **Noise and vibration** | | | |
| • site establishment – earthworks<br>• construction noise – viaduct structure, track realignments | ◪ | • EMP (noise and vibration)<br>• provision of acoustic barriers where necessary<br>• hours of works (surface) and monitoring<br>• early, on-going consultation | □ |
| **Air quality** | | | |
| • dust – site establishment, exposed earthworks | ◪ | • EMP (air quality management)<br>• minimise area of earthworks<br>• progressive worksite rehabilitation | □ |
| **Property** | | | |
| • land requirement for worksite in northern Mayne Rail Yard<br>• temporary possession of tracks and land in Mayne Rail Yard<br>• land requirement for re-configuration of Lanham Street intersection with O'Connell Terrace | ◪ | • reference design and construction planning<br>• early, on-going consultation with Queensland Rail on possessions and worksite area requirements<br>• land acquisition process | □ |

**Significance**
Low □
Moderate ◪
High ■

**Residual effect**
Low □
Moderate ◪
High ■

*Table 7-4(f) Cross River Rail – Construction impacts and mitigation measures – other worksites*

| Worksite and predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **CLAPHAM RAIL YARD** | | | |
| **Traffic and transport** | | | |
| • worksite access off Fairfield Road, Yeerongpilly, possibly concurrent with works at Yeerongpilly TOD<br>• use of Fairfield Road as haul route for fill material from the north (eg Boggo Road and Fairfield worksites)<br>• workforce car parking at Clapham worksite – safe access | ■ | • construction traffic management plan<br>• haulage hours on Fairfield Road, to avoid peaks and night-time periods – consider alternative routes (eg Ipswich Road)<br>• consultation with BCC and with community | ◪ |
| **Hydrology** | | | |
| • worksite establishment and drainage<br>• floodplain impacts on Moolabin Creek floodplain and for Brisbane River flooding if filling | ◪ | • EMP (sediment and erosion, water quality)<br>• in detailed design, predictive flood modelling to determine and mitigate effects of earthworks<br>• site drainage works, including water treatment, for design storm event | □ |
| **Noise and vibration** | | | |
| • site establishment – earthworks<br>• construction noise – viaduct structure from Yeerongpilly to Clapham Rail Yard, track construction and realignments | ◪ | • EMP (noise and vibration)<br>• provision of acoustic barriers where necessary<br>• hours of works (surface) and monitoring<br>• early, on-going consultation | □ |
| **Air quality** | | | |
| • dust – site establishment, exposed earthworks | ◪ | • EMP (air quality management)<br>• minimise area of earthworks<br>• progressive worksite and stabling area rehabilitation | □ |
| **Property** | | | |
| • land requirement for worksite in Clapham Rail Yard and adjacent industrial land<br>• temporary possession of tracks and land in and adjacent to Clapham Rail Yard | ◪ | • reference design and construction planning<br>• early, on-going consultation with Queensland Rail on possessions and worksite area requirements | □ |
| **Land use** | | | |
| • loss of industrial land between Clapham Rail Yard and Fairfield Road | ◪ | • use of land for expansion of Clapham Rail Yard stabling area – to support Cross River Rail benefits | □ |

**Significance**
Low □
Moderate ◪
High ■

**Residual effect**
Low □
Moderate ◪
High ■

### 7.3.4 Operational impacts and mitigation measures

The operational impacts generated by Cross River Rail are mostly beneficial and have been described above in relation to project justification and rationale. The Project benefits accrue for both local and regional communities and populations.

Comparatively, there would be a small number of properties and people directly affected (ie acquired) to accommodate the Project works. The process for the acquisition of land enables a person whose land or interest in land is acquired to claim compensation. However, there would remain the residual impact of relocation for them, and the exposure of other properties to daily traffic and activity.

The main adverse impacts would be limited to local areas and would include:

- increased pedestrian movements in the vicinity of Albert Street Station requiring changes in the existing footpath configuration and consequential changes in the existing streetscape and amenity. A similar impact would arise with pedestrian movements from Roma Street Station
- increased commuter traffic around the new station at Yeerongpilly and changes in local access arrangements at Salisbury
- increase in freight trains on the existing surface tracks south of Park Road, leading to a marginal increase in background noise levels
- increased rail corridor noise for sensitive receptors in several locations south of Yeerongpilly (eg Rocklea, Salisbury)
- the siting of some Project infrastructure in particular locations, such as the ventilation and emergency access building in Fairfield.

#### Rail corridor noise

In the southern section of the study corridor, sensitive receptors between Yeerongpilly and Salisbury, would likely experience noise in excess of Queensland Rail's operational rail noise criteria in 2021 and 2031.

Additional noise barriers would be required for these locations to achieve compliance with Queensland Rail's operational rail noise criteria. The noise barrier height required at Rocklea to comply with the Queensland Rail noise criteria would be 4.0 m to 4.5 m, while the noise barrier required at Salisbury would be 5.0 m to 7.0 m in height.

Urban design treatments, in consultation with near neighbours, would be required to mitigate the effects of the noise barriers in terms of visual, breeze and pedestrian movements.

#### Project infrastructure

The Fairfield emergency access and ventilation building would occupy land between Fairfield Road and Railway Road, Fairfield. Its construction would require the removal of several immature fig trees which provide a green element to this locality. The proposed building would be approximately 8 m in height.

Effective architecture, sympathetic to local architecture, combined with landscaping, would be required to mitigate this change in the visual context of the intersection. A strong architectural 'statement' would not suit this location.

*Rail corridor noise attentuation, Fairfield*

*Table 7-5(a) Cross River Rail – Operational impacts and mitigation measures – rail freight*

| Predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **Economic benefits** | | | |
| • greater capacity for freight through to Port of Brisbane | ■ | • optimise benefit through scheduling passenger services | ■ |
| **Noise and vibration** | | | |
| • increased freight train pass-bys leads to increased background noise (LAeq) for properties adjoining surface corridor between Salisbury and Park Road<br>• increased pass-bys do not increase peak noise effects (LAmax) | ◪ | • EMP (noise and vibration)<br>• provision of acoustic barriers where indicated by modelling<br>• monitoring for year 1 and year 10 after commencement | □ |
| **Visual** | | | |
| • proximity and height of acoustic barriers along rail corridor (Rocklea, Salisbury) | ◪ | • urban design treatment to barriers to reduce visual, breezes and pedestrian constraints | □ |

*Table 7-5(b) Cross River Rail – Operational impacts and mitigation measures – CBD stations*

| Predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **Pedestrian movements – Albert Street** | | | |
| • significant influx of pedestrians to station (27,000 movements in AM peak period in 2021) | ■ | • increase footpath and intersection capacities in vicinity of Albert Street Station (intersections with Mary Street, Charlotte Street, investigate Elizabeth Street) | □ |
| **Pedestrian movements – Roma Street** | | | |
| • increased pedestrian movements (14,500 people in AM peak period in 2021)<br>• increased risk of uncontrolled pedestrian movements from station entrance on Roma Street | ◪ | • EMP (noise and vibration)<br>• provision of additional pedestrian crossings in conjunction with new pedestrian bridge from George Street courts precinct (separate project)<br>• increase footpath and intersection capacities in Roma Street (northern side)<br>• further investigations for local traffic management | ◪ |
| **Visual** | | | |
| • change in visual context and amenity of Albert Street | ◪ | • urban design treatment to Albert Street to re-create a new, attractive urban setting on approach to the station entrance<br>• adopt CPTED techniques to ensure pedestrian safety in off-peak periods | □ |

**Significance**
Low □
Moderate ◪
High ■

**Residual effect**
Low □
Moderate ◪
High ■

*Table 7-5(c) Cross River Rail – Operational impacts and mitigation measures – local traffic*

| Predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **Changed road network – Albert Street** | | | |
| • changes in lane configuration – Albert/Mary Street intersection<br>• use of redundant kerbside capacity in Alice Street near Albert Street<br>• relocate taxis – Albert Street to Mary Street<br>• other minor alterations | ■ | • minimal changes in levels of service, if any<br>• local traffic management measures (parking, loading zones, taxis)<br>• early, on-going consultation with BCC and local stakeholders | □ |
| **Increased commuter traffic – Yeerongpilly** | | | |
| • realignment of Wilkie Street<br>• provision of limited kiss 'n' ride facilities<br>• increased bus bays on Fairfield Road<br>• increased pressure for on-street car parking<br>• increased incidence of kiss 'n' ride movements | ◪ | • implement local parking scheme for local streets<br>• consultation with local community about parking scheme operation<br>• integration of parking scheme with traffic management for Yeerongpilly TOD and Tennis Centre | ◪ |
| **Changed road network – Salisbury** | | | |
| • closure of surface level crossing on Beaudesert Road (service road)<br>• closure of Dollis Street – Norbury Street connection and realignment of Dollis Street<br>• change in local circulation patterns | ◪ | • local traffic management required at Beaudesert Road<br>• changes in local access to resolve emergency access (flood events) for Salisbury (south) | □ |

*Table 7-5(d) Cross River Rail – Operational impacts and mitigation measures – rail corridor noise*

| Predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **Operational noise – Rocklea to Salisbury** | | | |
| • Queensland Rail criteria for rail operations noise exceeded at Rocklea and Salisbury | ◪ | • provide acoustic barrier – 4.0 m to 4.5 m at Rocklea, 5.0 m to 7.0 m at Salisbury | □ |
| **Visual** | | | |
| • height and length of acoustic barriers required at Rocklea and Salisbury | ◪ | • urban design treatment to address visual, breezes and CPTED issues | □ |

*Table 7-5(e) Cross River Rail – Operational impacts and mitigation measures – Project infrastructure*

| Predicted impacts | Significance | Proposed mitigation measures | Residual |
|---|---|---|---|
| **Fairfield emergency access and ventilation shaft** | | | |
| • building on land between Fairfield Road and Railway Road<br>• building height at 8 m – visually obvious in local setting<br>• loss of several immature fig trees, loss of green element | ◪ | • architectural treatment and site landscaping to be sympathetic with locality – an architectural 'statement' would exacerbate the visual impact of the structure | □ |

**Significance**
Low □
Moderate ◪
High ■

**Residual effect**
Low □
Moderate ◪
High ■

## 7.4 Recommendations

Cross River Rail, as described in the EIS, would meet the objective of improving rail services by increasing the capacity of the inner city rail system, as well as improving rail access to key inner city destinations. The Project would support sustainable population growth and economic development in South East Queensland by extending a high quality, high capacity rail transport system to the Brisbane CBD and designated growth centres in the inner suburbs. Cross River Rail would also free up the surface rail network and so provide enhanced capacity for rail freight accessing the Port of Brisbane and the Acacia Ridge multi-modal freight terminal.

Additional lifestyle benefits Brisbane and SEQ residents would derive through enhanced accessibility to high-order facilities and services in the Brisbane CBD and inner suburbs. The Project would alleviate commuter pressure on the road network and the busway network arising from population and employment growth.

While Cross River Rail would lead to a wide range of transport, socio-economic and community benefits for Brisbane, there would be some likely adverse impacts for local communities residing in close proximity to key project worksites, particularly at Yeerongpilly.

Having regard to the findings of the EIS with respect to the benefits and impacts of Cross River Rail, the following recommendations are made to the Coordinator-General:

### Recommendation 1

That Cross River Rail should be approved to proceed subject to:

(i) project development adopting and implementing a sustainability framework consistent with the Queensland Government's objectives for sustainable development and with the framework presented in the EIS

(ii) detailed design embracing an innovative approach in seeking to resolve, to the extent feasible, the potential or predicted impacts of the reference design, particularly with regards to construction impacts on local residents

(iii) developing and implementing detailed environmental management plans for the construction and operational phases of the Project, where such plans adopt the principles objectives and performance criteria, set out in the draft outline EMP presented in the EIS

(iv) developing, implementing and maintaining effective mitigation measures to address and mitigate the impacts of the Project on local communities.

### Recommendation 2

It is further recommended to the Coordinator-General that:

(i) all necessary approvals and permits be obtained for the Project, including, but not limited to, those required under the *Sustainable Planning Act 2009*, the *Transport Infrastructure Act 1994* and related Acts, the *Aboriginal Cultural Heritage Act 2003* and the *Environmental Protection Act 1994* .

(ii) the Queensland Government investigates measures to coordinate the construction and delivery of Cross River Rail concurrently with a number of other major projects, including Northern Link (Legacy Way), the BRUV, the Woolloongabba and Bowen Hills UDAs and the Yeerongpilly TOD.

The Coordinator-General is requested to assess the EIS, and in preparing an evaluation report:

(i) recommend that Cross River Rail proceed

(ii) state the conditions for the Project under section 39 of the *State Development and Public Works Organisation Act 1971*

(iii) recommend under section 43 of the *State Development and Public Works Organisation Act 1971*, the requirements for inclusion in the designation of the study corridor or land required for parts of the Project as 'community infrastructure' under the *Sustainable Planning Act 2009*

(iv) where there is no other relevant approval, impose conditions on the Project where identified as relevant environmental mitigation and management measures identified in this EIS, under section 54B of the *State Development and Public Works Organisation Act 1971*.

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