CrossRiver*Rail*

3. Project Development

Cross River Rail

CHAPTER 3
PROJECT DEVELOPMENT

JULY 2011

Contents

3 Project development

3.1 Introduction

This chapter addresses Section 2.3 of the ToR which requires a description of the Project's development. It describes the process for determining the study corridor and reference design, including tunnel alignment and portals, stations, construction worksites and spoil haulage and placement.

The strategic context for the development of the Project is described in **Chapter 2 Project Rationale**. It includes an overview of the strategic assessments of alternative policy and transport mode options considered to determine the need for a heavy rail based solution to address inner city capacity constraints. A range of heavy rail options were assessed as part of the Inner City Rail Capacity Study (ICRCS) (PB et al, 2008), with the study recommending further consideration of three options to address medium term (2016) requirements as well as three options to address longer term (2026) requirements.

Figure 3-1 summarises the project planning and development process undertaken for the detailed feasibility phase, including the process for identifying the preferred corridor and developing the reference design. These are discussed in further detail in the following sections.

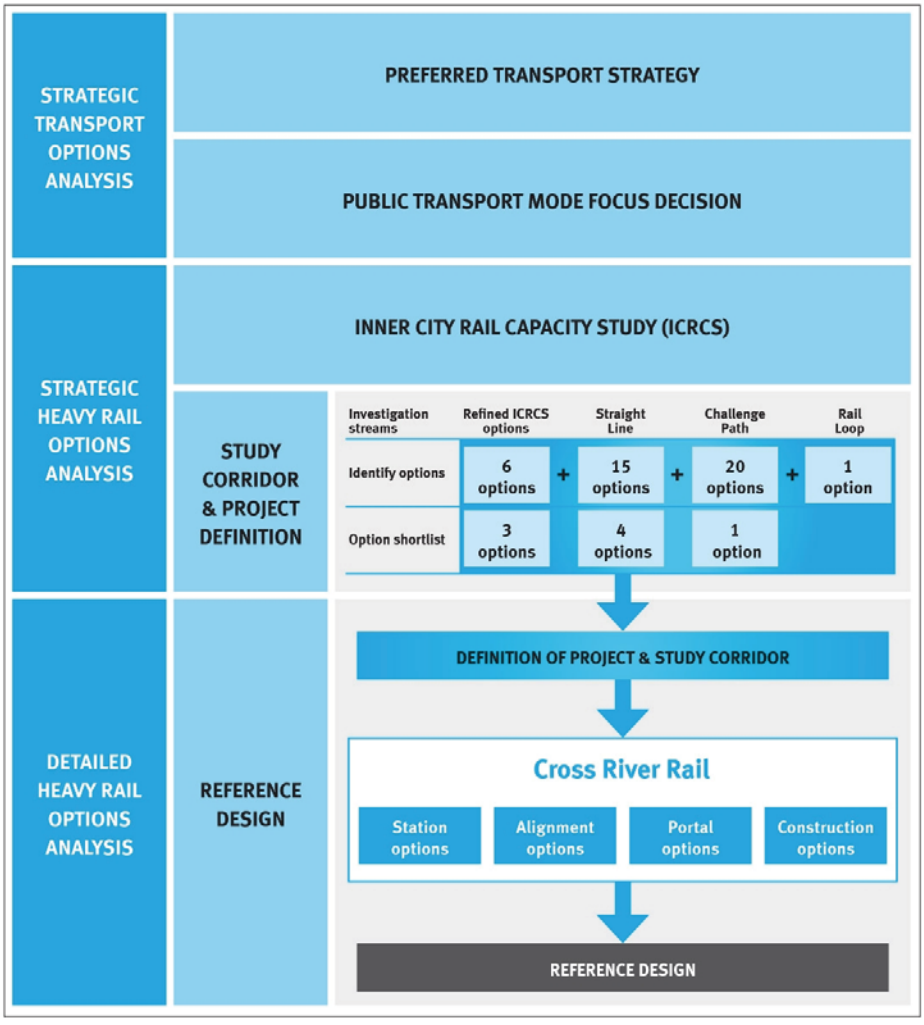


Figure 3-1 Project planning and development framework

3.2 Study corridor definition

The section outlines the process for defining the Cross River Rail study corridor.

Determination of the study corridor involved consideration of the recommended ICRCS options along with five other potential heavy rail options, identified through the straight line pathway and challenge pathway investigation process described as follows.

The three rail options recommended in the ICRCS for 2016 were reviewed against the draft Connecting SEQ 2031 and three revised options were identified for evaluation against other heavy rail options developed through the straight line and challenge pathways. These are shown in **Figure 3-2**, and include:

- Option A1, involving a 10.75 km rail line in tunnel from Fairfield to Wooloowin, with stations at Park Road, Woolloongabba, the central business district (CBD), Spring Hill, Exhibition (RNA Showgrounds) and Bowen Hills
- Option B1, involving a 8.75 km rail line in tunnel from Fairfield to Breakfast Creek, with stations at Park Road, Woolloongabba, CBD, Newstead/Fortitude Valley, Bowen Hills
- Option C2, involving duplication of the existing rail alignment from Park Road to Bowen Hills via a duplicated Merivale Bridge along with a tunnelled portion from west of Roma Street to Bowen Hills and new underground platforms at Central, Roma Street, Fortitude Valley and Bowen Hills stations.

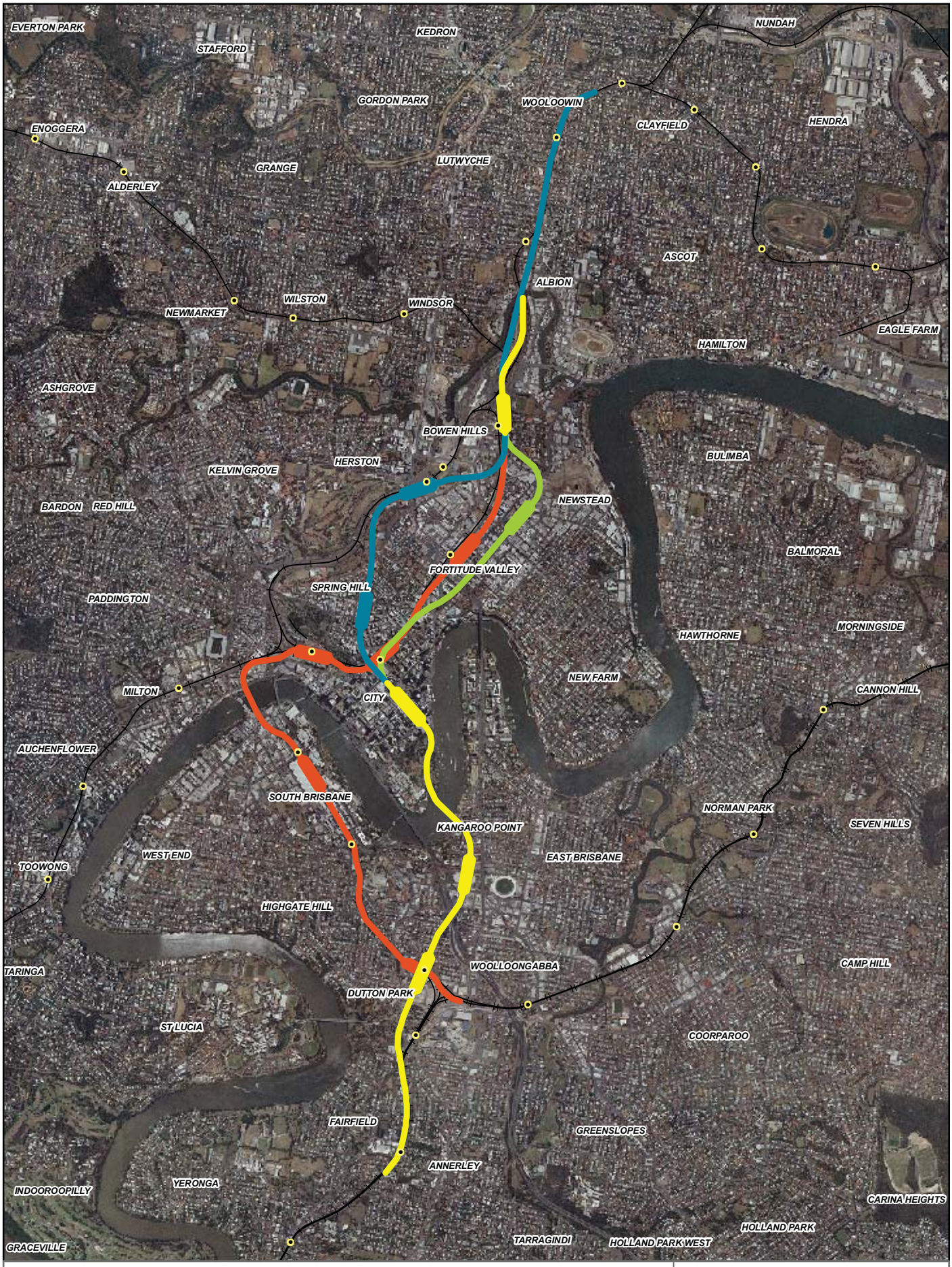
The straight line pathway aimed to identify additional heavy rail corridors through the Brisbane CBD, through the refinement of the ICRCS options to improve affordability and operational effectiveness. This process was undertaken as part of the detailed feasibility phase for the Project and identified four options for further evaluation. These are shown in **Figure 3-3** and include:

- Option SL1, comprising a 6.5 km rail line in tunnel from Fairfield to Exhibition loop with new underground stations at Boggo Road, Woolloongabba and the Brisbane CBD (Edward Street) and an upgraded Exhibition Station at surface
- Option SL2, which is similar to Option SL1 but with an additional station at Roma Street
- Option SL3, which is similar to Option SL2 but with a CBD station at lower George Street and minor adjustment to the location of the Roma Street Station to improve access to Roma Street Parkland
- Option SL3 (bridge), which is the same as Option SL3, but with a bridge across the Brisbane River, rather than tunnel.

The challenge pathway was also undertaken as part of the detailed feasibility phase for the Project and was intended to challenge current thinking and investigate potential alternative options, outside of the constraints of the prefeasibility study.

The aim of this pathway was to identify other feasible alternative options to solve the inner city capacity problem. Twenty potential options were identified and evaluated as part of this process, with one preferred option (CP4) identified for further consideration. The preferred option was considered to be the only option of the potential challenge path options to meet the key requirement of providing sufficient additional capacity to meet demands.

Option CP4 is shown in **Figure 3-4** and comprises a new 4 km surface rail line between Salisbury and Corinda with a new 1.6 km rail loop tunnel in the inner city from Roma Street to the Exhibition Loop via a new “Central North” station in the Brisbane CBD.



LEGEND

- A1 Alignment
- B1 Alignment
- C2 Alignment
- Common Alignment
- Station
- Track

CROSS RIVER RAIL
ENVIRONMENTAL IMPACT STATEMENT

Figure 3-2

ICRCS Review Options

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CrossRiverRail

SKM aurecon CRR JOINT VENTURE

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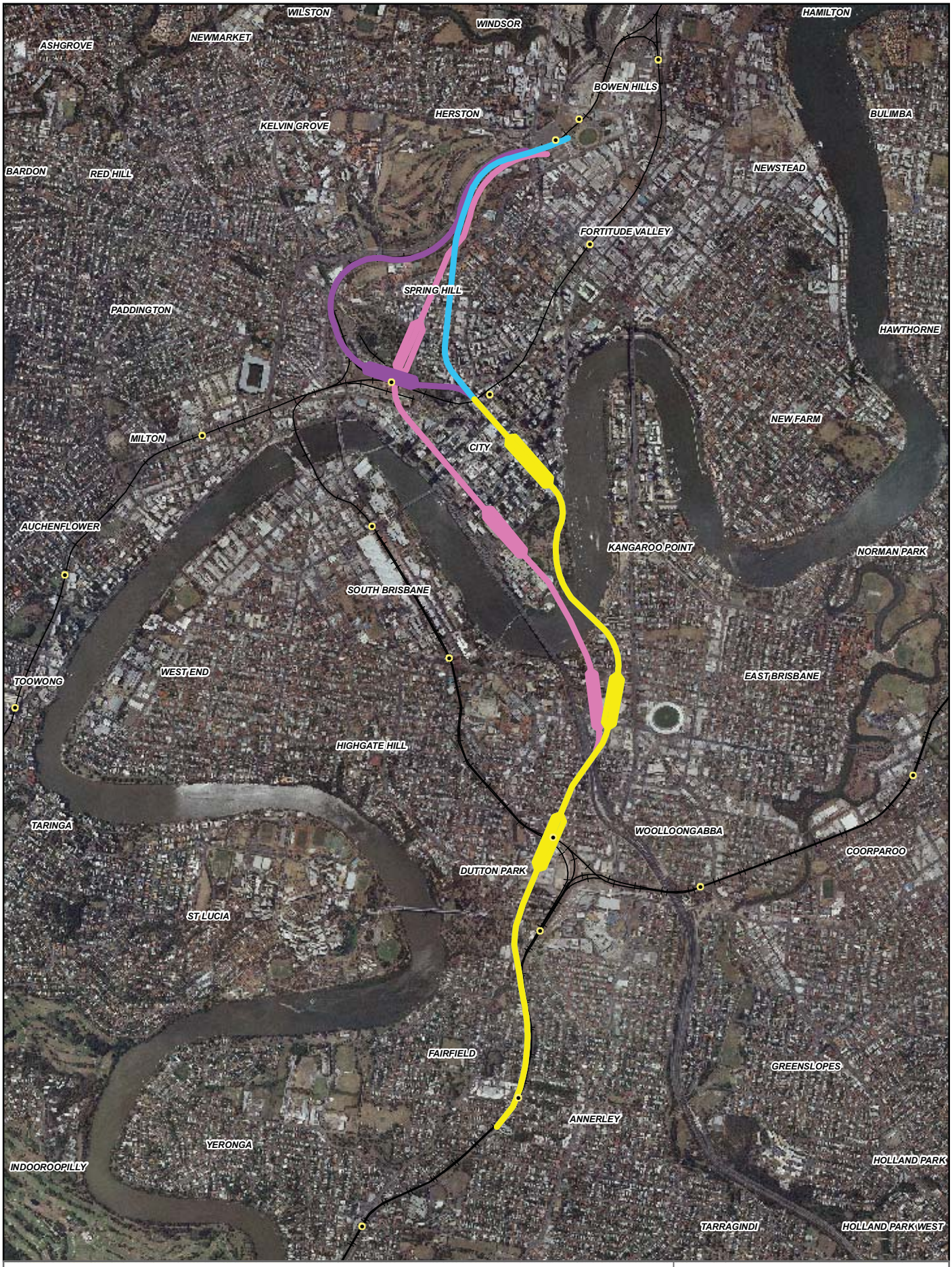

LEGEND

- SL1 Alignment
- SL2 Alignment
- SL3 Alignment
- Common Alignment
- Station
- Track

CROSS RIVER RAIL
ENVIRONMENTAL IMPACT STATEMENT

Figure 3-3

Straight Line Pathway Options

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CrossRiverRail

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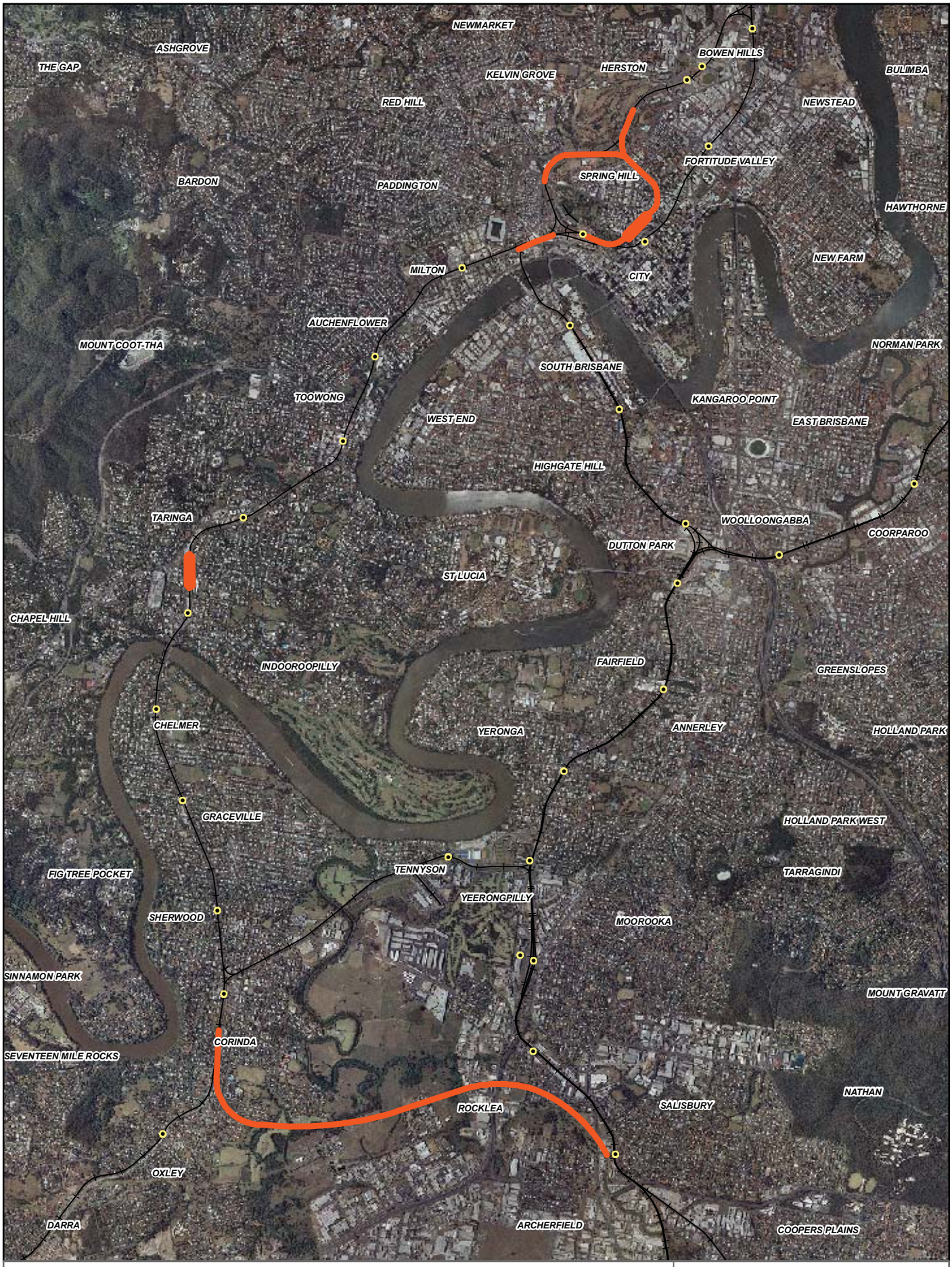

LEGEND

- CP4 Alignment
- Station
- Track

CROSS RIVER RAIL
ENVIRONMENTAL IMPACT STATEMENT

Figure 3-4

Challenge Pathway Options

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Assessment of shortlisted options

An evaluation of the shortlisted options was undertaken as part of the detailed feasibility phase to identify a preferred study corridor for further investigation. The criteria used for the options evaluation is shown in **Table 3-1**. The criteria were changed from that used in the ICRCS phase to ensure it aligned with updated planning and policy.

Table 3-1 Assessment criteria for alignment options

Criteria	Description
Serviceability	Extent to which the option achieves required network capacity and desired rail operating strategy (including freight rail capacity) while avoiding identified inner city track crossing conflicts
Accessibility	Extent to which the option enhances access to existing and planned future inner city trip attractors and generators while also providing new strategic interchange opportunities and supporting the future expansion of the rail network
Sustainability	Extent to which the option minimises impacts on residents/businesses and the environment while also providing a catalyst for sustainable urban redevelopment; improving the public realm; utilising the existing network infrastructure; and providing travel time (and patronage) benefits for public transport
Affordability/ Constructability	Extent to which the option minimises the risk profile of the project in terms of design, cost, and potential adverse impact; allows for staged construction; provides potential for value uplift and capture; minimises exposure of the rail network to disruptions during construction; and minimises adverse impacts on road users during/post construction

The outcome of the assessment of the eight shortlisted options is shown in **Table 3-2**.

Table 3-2 Evaluation of shortlisted alternative heavy rail options

Option	Serviceability	Accessibility	Sustainability	Affordability/ Constructability
Option SL1	Good	Good	Good	Good
Option SL2	Good	Very Good	Very Good	Good
Option SL3	Good	Very Good	Very Good	Very Good
Option SL3(b)	Good	Good	Limited	Good
Option CP4	Poor	Poor	Limited	Limited
ICRCS Option A1	Very Good	Limited	Good	Good
ICRCS Option B1	Very Good	Limited	Good	Good
ICRCS Option C2	Poor	Poor	Poor	Poor

The assessment findings show that while the ICRCS options A1 and B1 were considered the best performing options in relation to serviceability, the straight line options (particularly SL2 and SL3) performed best in relation to accessibility and sustainability criteria. Option SL3 marginally outperformed options SL1, SL2 and A1 against the constructability/affordability criteria.

The three straight line options SL1, SL2 and SL3 were the highest rated options overall. Options SL2 and SL3 in particular were considered to provide the best balance of cost and benefit across all four criteria.

Options SL2 and SL3:

- achieve the required network capacity for 2026 and beyond
- allow for introduction of the tiered rail operating strategy and increased sectorisation defined in draft Connecting SEQ 2031
- increase opportunities for strategic interchange within the public transport network
- offer the best travel time benefits
- have the strongest potential for value uplift and capture from land holdings of the State adjacent to stations along the George Street corridor (SL3 only)
- minimise risk of disruption to the existing rail network during construction
- enhance access to existing inner city trip attractors and generators not currently well served by rail
- provide a catalyst for sustainable urban redevelopment and improve access to current and future planned development precincts.

The comparative evaluation concluded that due to the relatively poor performance of the refined ICRCS options A1, B1, C2 and challenge path option CP4, these options would not be considered further in the detailed feasibility phase.

In light of the options evaluation results, the study corridor identified for investigation for the detailed feasibility phase was based around the straight line options SL2 and SL3 (refer **Figure 3-1**). This corridor is the focus of the Cross River Rail detailed feasibility investigations and within which detailed alignment and station options have been explored in the development of the reference design.

3.3 Design development

3.3.1 Introduction

The development of the reference design considered a range of different project elements within the defined north-south study corridor, such as:

- strategic station locations
- tunnel alignment
- station entrances
- portal locations
- associated tunnel infrastructure relating to flood protection, ventilation and emergency access
- surface work elements.

The reference design development process for each of these elements is discussed in the following sections.

3.3.2 Strategic station locations

A range of station location options were developed based on a common preferred alignment (outlined in **Section 3.2**) that served the RNA Showgrounds/Bowen Hills, the Brisbane CBD, Woolloongabba and Boggo Road. This considered how many stations were required and the preferred location and form of interchange with other services (rail and bus).

Station location options were developed for the RNA Showgrounds, the Brisbane CBD, including Roma Street, Albert Street, Edward Street and George Street, Woolloongabba and Boggo Road. Station location options were identified in collaboration with state and local government agencies responsible for planning and development in inner Brisbane, including Department of Local Government and Planning (former Department of Infrastructure and Planning), Department of Public Works, Urban Land Development Authority, Transport and Main Roads and Brisbane City Council.

The options assessment process relating to the new Yeerongpilly Station is described in **Section 3.3.5**.

RNA Showgrounds

Four surface station options were identified and evaluated for the RNA Showgrounds, in consultation with the RNA and ULDA. These were located along the general alignment of the existing surface tracks. These are shown in **Figure 3-5** and include:

- RNA Central (Option A)
- RNA north/O'Connell Terrace (Option B)
- O'Connell Terrace (Option C)
- Bowen Hills west/O'Connell Terrace (Option D).

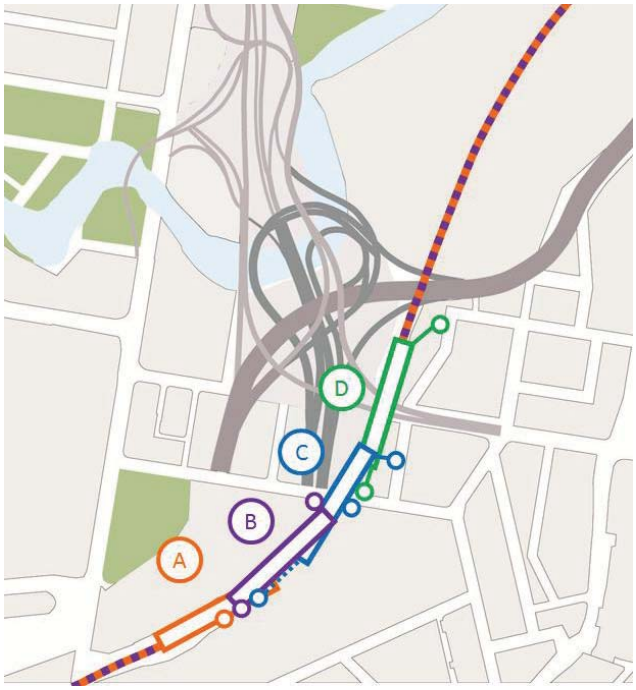


Figure 3-5 Ekka Station location options

Key drivers in the identification of a preferred station location in this area were:

- providing local access to a range of surrounding trip generators and attractors including the Royal Brisbane and Women's Hospital (RBWH), RNA Showgrounds, and "core" of the Bowen Hills redevelopment
- minimising heritage impacts on the RNA site
- integrating with RNA master planning
- maintaining vehicle and train access to Mayne Rail Yard

- promoting O'Connell Terrace as an important urban street and key east-west link
- staging/ sequencing of the renewal of Bowen Hills.

Option B was identified as the preferred option, as it provided direct access to O'Connell Terrace, the RBWH and Bowen Hills via the northern entrance, and the RNA Showgrounds via the southern entrance.

Other options in this area were generally discounted on the basis that:

- Option A provided only one entrance and was too far removed from O'Connell Terrace and the "core" of the Bowen Hills redevelopment
- Option C involved complex engineering works over the Clem Jones Tunnel
- Option D resulted in impacts on key accesses to the Mayne Rail Yard and was considered too close to the existing Bowen Hills Station catchment.

CBD tunnel route and station location assessment

A detailed assessment of the CBD tunnel route and station locations was undertaken that identified and evaluated eight potential rail tunnel and station location options. These are shown in **Figure 3-6** and included several two-station CBD options (on alignments A, B, D, E, and F) and three single CBD station options (on alignments C, G, and H).

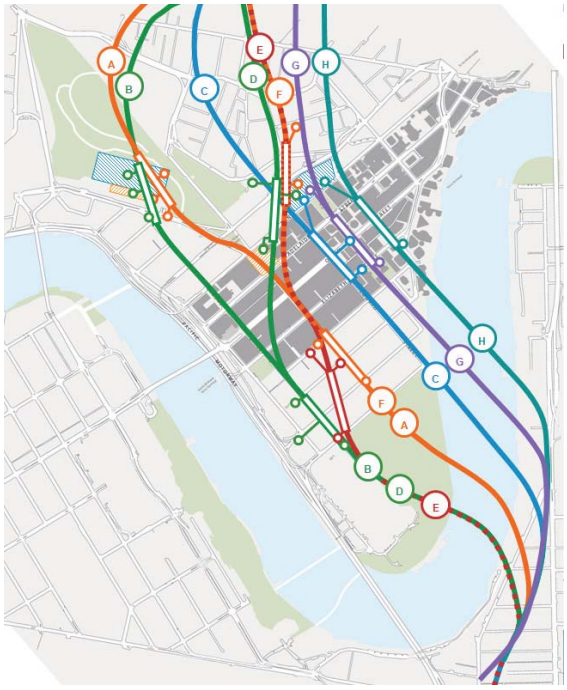


Figure 3-6 CBD route and station location options

Three options were shortlisted for detailed consideration and assessment. These are shown in **Figure 3-7** and include:

- Option A – tunnel under Albert Street, with stations at lower Albert Street and Roma Street
- Option B – tunnel under George Street, with stations at lower George Street and Roma Street
- Option C – tunnel under Edward Street, with a single CBD station under Edward Street at Queen Street.

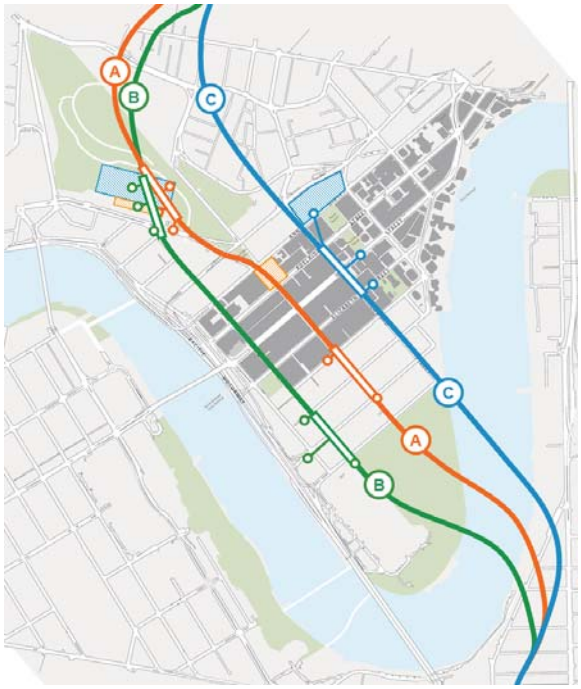


Figure 3-7 Shortlist of three CBD route and station location options

The options assessment considered a range of key project objectives and criteria based on achieving the best outcomes for the region and city in relation to:

- best transport outcome, measured through attributes including passenger experience, maximised interchange opportunity, interchange efficiency and public transport patronage
- best city outcome, measured through a range of attributes including spread of patronage across stations and impacts on transport network capacity, pedestrian catchment size, opportunity for future redevelopment and urban renewal opportunities
- best community outcome, including minimising the impacts of the project during construction and minimising property impacts while providing significant community benefits.

Relative cost and minimisation of risk were also considered as part of the options assessment, although separately to the key project objectives and criteria. Option C (Edward Street) was the least cost option, followed by Option B (George Street). Option A (Albert Street) was considered to be the highest cost option.

The outcomes of the options evaluation are summarised in **Table 3-3.**

Table 3-3 Assessment of CBD station location options

Description of value driver	Option A Albert Street	Option B George Street	Option C Edward Street
Transport outcomes	Excellent	Good	Poor
City building outcomes	Very good	Good	Good
Community outcomes	Good	Very good	Poor
Overall assessment of drivers	Very good	Good	Poor

Compared to the station option at Edward Street, station options at George and Albert streets required longer tunnels and included an additional CBD station at Roma Street. However, the station option at Edward Street was considered to have higher property costs.

Existing under-utilisation of some land in Albert Street, suggested that a station at Albert Street would provide greater opportunities for future redevelopment for commercial, government, residential, retail and other facilities through greater density development. George Street was considered to be the next best option in relation to 'future redevelopment opportunities'.

Overall, Option A, involving stations at Albert Street and Roma Street, was considered the preferred option based on the value driver assessment and relative cost comparison. In particular, Option A was considered to:

- create a better passenger experience eg provision of public realm circulation, quality and clarity of journey
- better service a part of the Brisbane CBD that is currently underserviced by the rail system, including the government, commercial, retail and education precincts
- closely align with Brisbane City Council's City Centre Master Plan, which identifies Albert Street as a "green spine" with an important pedestrian function
- provide increased opportunities for rail-rail and rail-bus interchange via a new Roma Street Station
- more effectively spread passenger movements across the city, supporting broader development of the Brisbane CBD
- provide opportunities for short term redevelopment opportunities and longer term city transformation outcomes.

While flooding was identified as a potential constraint for the development of a station at Albert Street, the potential transport and city building outcomes provided by a station at Albert Street were considered to outweigh potential costs associated with implementing flood mitigation measures as part of the station design.

Gabba Station

Gabba Station is proposed to be located on land owned by the Queensland Government and currently occupied by the Land Centre and Goprint at Woolloongabba. This site has been designated as an urban development area (UDA) and identified for significant future development. Further information on the UDA is provided in **Chapter 9 Land Use and Tenure**.

Consideration was given to the location of the proposed station, to ensure it supported and was consistent with proposed future development of the UDA. Options for locating the station on the site were developed in consultation with key stakeholders such as the ULDA and Brisbane City Council.

Three possible station locations were identified for further investigation and evaluation. These are shown in **Figure 3-8** and include siting the station:

- to the west of the UDA (Option B)
- to the east of the UDA closer to the Brisbane Cricket Ground (Gabba Stadium) (Options D and E)
- centrally within the site (Options A or C).

Figure 3-8 Gabba Station location options

Key drivers identified for the optimum location and design of the station included:

- providing access for future residents, workers and recreational uses
- supporting public transport integration
- catering for demand driven by events at the Gabba Stadium
- preserving flexibility for future planning decisions to accommodate residential and employment growth
- minimising land take for transport infrastructure in order to deliver market ready surplus land for redevelopment.

Option B was identified as the preferred location for the station as it:

- optimises the precinct's development potential by locating the station to the western end of the UDA
- optimises transport integration through potential co-location with the South East Busway station
- provides the ability to disperse peak crowd numbers from the Gabba Stadium along the 300 m route to the station
- facilitates improved active transport modes and opportunities for efficient connection to a range of surrounding destinations such as the Mater Hospital precinct.

Boggo Road Station

A number of critical drivers for the location of the Boggo Road Station were identified by the project team following technical investigations and consultation with key stakeholders. These included:

- integration with the Boggo Road Urban Village and Ecosciences Precinct
- support for the long term strategic planning outcomes for the Princess Alexandra Hospital (PA Hospital), Boggo Road Urban Village and University of Queensland (UQ)
- ability to preserve long term development opportunities and contribute to the strategic design outcomes for the city.

Detailed consideration was given to the location of the proposed station, with the key criteria being integration with the existing Park Road Station and Boggo Road Busway Station, to facilitate intermodal transfer opportunities.

The need to link with major surrounding renewal and regeneration opportunities such as Annerley Road, Boggo Road, Buranda and the PA Hospital was also identified. There were opportunities identified for a new station within the Boggo Road Urban Village to deliver improved east-west and south-west connections between existing and emerging communities.

Four options were assessed for the Boggo Road Station. These are shown in **Figure 3-9** and include:

- Option A – a far western option with a "front door" onto Annerley Road
- Option B – a centrally located station cavern with a single entrance into/interchanging with the existing Park Road Station and Boggo Road Busway Station
- Option C – a southern station option with a northern entrance allowing interchange with the existing rail and busway stations and a southern entrance providing access to Annerley Road and the southern part of the Boggo Road Urban Village
- Option D – an eastern option with northern entrance at the eastern end of the existing Park Road Station and a southern entrance immediately east of the railway and south of the busway close to the PA Hospital.

Figure 3-9 Park Road/ Boggo Road Station location options

Option C was considered the preferred option as it provided:

- good interchange with the existing rail and busway stations to the north with the northern entrance positioned adjacent to the existing footbridge
- the ability to serve the heart of the Boggo Road Urban Village via two entrances within the precinct
- a strong station presence on Annerley Road with the southern entrance located near to Annerley Road, allowing good access to the west, including to the Eleanor Schonell Bridge to the UQ
- the ability to connect to the east via a potential future bridge over the rail track to the PA Hospital.

3.3.3 Tunnel alignment

Tunnel alignment options were driven by a range of inter-dependent factors such as:

- the study corridor definition process (outlined in **Section 3.2**)
- preferred station location considerations (outlined in **Section 3.3.2**)
- alternatives for the tunnel portals (outlined in **Section 3.3.4** and **Section 3.3.5**)
- natural constraints such as rock depth and the Brisbane River
- the preference for the tunnel to follow road corridors wherever possible, to minimise volumetric resumptions and potential conflicts with below ground structures such as basements
- the existing surface rail alignment
- geometric standards including maximum gradient and maximum curve radii, developed in consultation with Queensland Rail.

The alignment was developed during the detailed feasibility study in response to these factors. As such, discrete alignment alternatives were not specifically identified.

3.3.4 Northern portal location

Key considerations in the location for the northern portal included:

- the location and depth of the preferred Roma Street Station and the need to achieve a maximum grade of three per cent north of Roma Street Station
- the need to connect to the Exhibition Loop and tie in with existing railway tracks as quickly as possible
- the need to avoid permanent impact on the Inner City Bypass (ICB) land bridge, requiring the tunnel to surface east of this bridge
- the need to avoid permanent impact on the Northern Busway and Bowen Bridge Road bridges over the rail corridor requiring the tunnel to surface west of these bridges.

Consequently, no significantly different portal alternatives were considered feasible for the northern portal, with the proposed location considered the most pragmatic solution available for the corridor and selected alignment.

3.3.5 Southern portal location and new Yeerongpilly Station

The ICRCS identified a preferred location for the southern portal at Fairfield (shown on **Figure 3-10**) to reduce the overall tunnel length and because of perceived benefits in reducing the cost of the project.

Initial investigations into the surface track requirements south of the southern portal indicated that there would be considerable surface impacts as a result of widening the currently constrained rail corridor between Fairfield and Yeerongpilly in particular.

This was also reflected in feedback from community consultation held in April 2010. In particular, community concerns included potential property impacts and changes to local access and amenity associated with a portal at Fairfield. Consequently, alternative portal locations south of Fairfield were investigated, including at Yeronga, Yeerongpilly and Moorooka (as shown in **Figure 3-10**).

The portal option at Yeronga, investigated the possibility of using a large parcel of State Government-owned land at Yeronga TAFE. This option required an additional 2 km of tunnel compared to the Fairfield option.

The Yeerongpilly portal option included a portal just north of Yeerongpilly Station on the eastern side of the existing rail tracks. This option required an additional 3 km of tunnel compared to the Fairfield option.

The portal option at Moorooka, investigated the possibility of using the existing Clapham Rail Yard for the portal and dive structure. This option required an additional 4 km of tunnel compared to the Fairfield option.

The remainder of the rail corridor south of Moorooka provided limited opportunity to locate a portal without significantly increased costs or impacts on existing rail operations or private properties.

Factors considered in the evaluation of the southern portal options included:

- environment considerations, such as existing land use
- engineering requirements, such as topography, ground conditions, flooding and track design
- city-building opportunities, such as the ability of the Project to support proposed future development areas
- rail operations, such as the preferred rail operating strategy and the preferred location of future train stabling requirements
- property impacts, including the number and type of properties affected by surface works
- cost and risk, including costs and risks associated with the design and construction,
- community feedback received during Round 1 and Round 2 consultation undertaken between March and August 2010
- key stakeholder feedback, including outcomes of engagement with stakeholders such as Queensland Rail, TransLink Transit Authority, and the former Department of Infrastructure and Planning.

The outcomes of the assessment of the four southern portal alternatives are summarised in **Table 3-4.**

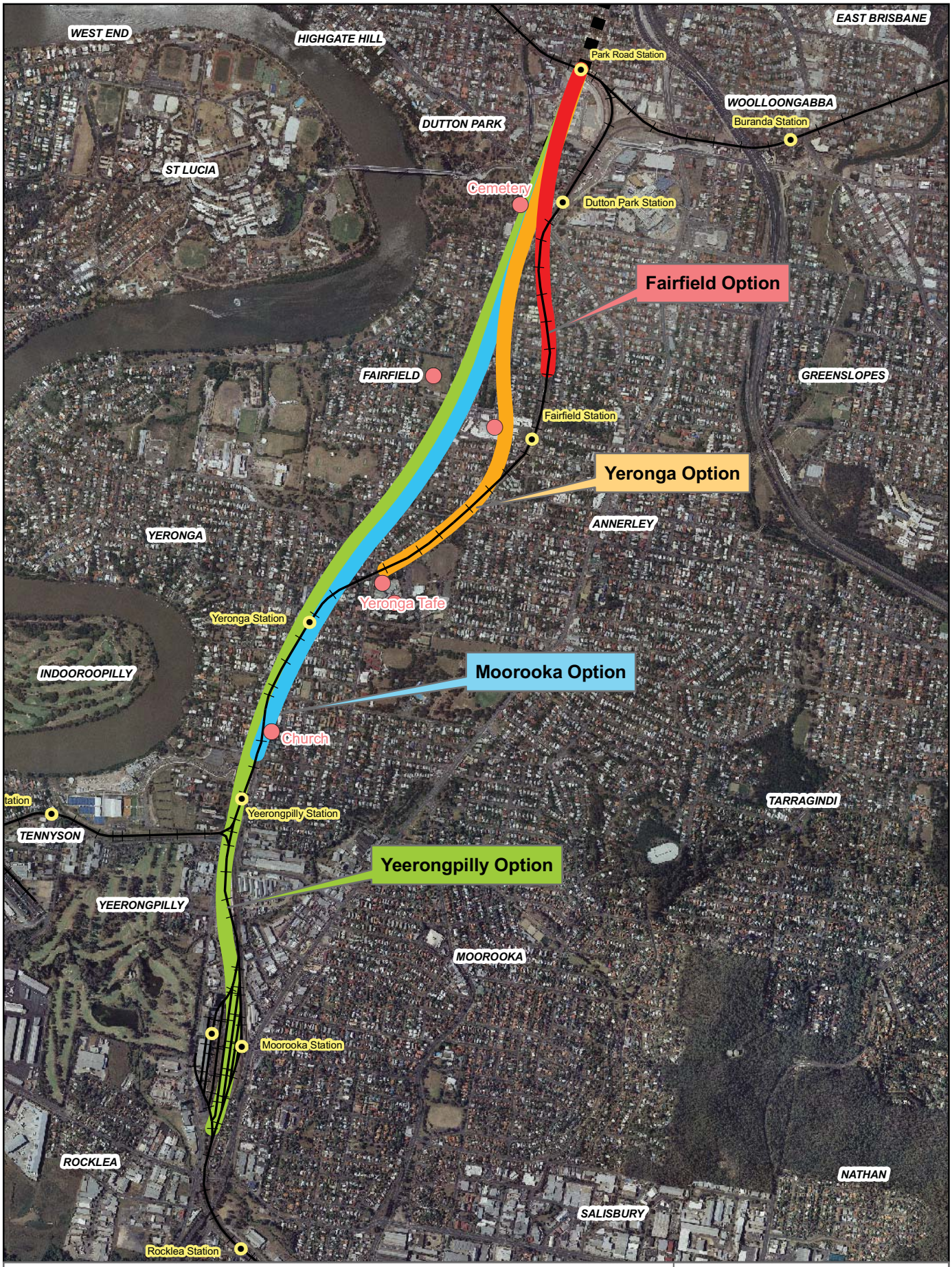
Table 3-4 Southern portal assessment

Assessment	Fairfield	Yeronga	Yeerongpilly	Moorooka
Existing environment	High	High	Medium	Low
Rail operations	Positive	Positive	Positive	Negative
Engineering and design	Negative	Negative	Positive	Neutral
City-building	Positive	Positive	Positive	Negative
Property	High	High	Medium	Low
Community impact	High	High	Medium	Low
Community feedback	Negative	Negative *	Negative *	Positive
Other stakeholder feedback	Neutral	Neutral	Positive	Negative
Cost	Low	High	Medium	High
Risk	High	High	Low	Low

Positive or low impact	
Neutral or medium impact	
Negative or high impact	

Note:

* the majority of community feedback related to Moorooka and Fairfield options, with limited feedback on Yeronga and Yeerongpilly.



LEGEND

- Station
- Track
- Preferred Tunnel Route

Alignment Options

- Fairfield Option
- Yeronga Option
- Yeerongpilly Option
- Moorooka Option

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CROSS RIVER RAIL
ENVIRONMENTAL IMPACT STATEMENT

Figure 3-10

Southern Portal Options

CrossRiverRail

SKM aurecon CRR JOINT VENTURE

Map by: MJS K:\Cross River Rail\600 Environment\619 GIS\Aurecon\205555_CRR\G0125_CRR_Southern_Portal_Options_A4.mxd 06/07/2011 14:13

In summary:

- The Fairfield option had the greatest number of property impacts (197 properties, 376 land owners) and potentially the greatest construction impacts in terms of disruption to the surrounding community and road network. The option was strongly opposed by the local community. This option would support the use of Clapham Rail Yard for train stabling and a new Yeerongpilly Station. Whilst the lowest cost option, there are significant unplanned risks that drive the cost of this option higher, for example, building additional track immediately adjacent to an operating railway.
- The Yeronga option would cost $186 million more than Fairfield. In addition, the unplanned risk would also be high for this option. This option would have significant property impacts (165 properties, 253 land owners) and disruption to the surrounding community and road network. The perceived benefits of utilising the Yeronga TAFE site as a construction site and portal location would not be able to be realised as the topography and geometry of the existing rail line would lead to the majority of works required to be undertaken on the western side of the corridor. This option would support the utilisation of the existing Clapham Rail Yard for train stabling and a new Yeerongpilly Station.
- The Yeerongpilly option would cost $160 million more than the Fairfield option, would have lower surface property impacts (66 properties, 124 land owners) compared to Fairfield and Yeronga and the lowest unplanned risk of all options. This option would cost at least $395 million less than the Moorooka option. This option also utilises the topography in the area to minimise the length of the portal. With a new station provided at Yeerongpilly, this option strongly supports city-building outcomes by supporting the proposed Yeerongpilly Transit Oriented Development (TOD). This option would support the utilisation of the existing Clapham Rail Yard for train stabling.
- The Moorooka option is the highest cost option, at least $555 million more than the Fairfield option. This cost includes an allowance for infrastructure and land to access alternative stabling on a 15 ha site south of Clapham Rail Yard (at least $250 million). This option also provides no access to Cross River Rail from any stations in this section of the corridor, particularly Yeerongpilly. It would have the lowest number of directly impacted properties in the corridor (38 properties, 38 land owners). This option was strongly favoured by the community largely because of the low residential property impacts but this does not account for the need under this option for a new stabling facility that would require 15 ha of land in or near the Cross River Rail corridor.

Yeerongpilly was identified as the preferred location of the southern portal because it:

- locates the southern portal as far south as possible in order to minimise residential property impacts without losing required rail functionality, city building opportunities or adding significant cost
- provides a new surface Yeerongpilly Station with high levels of service
- allows direct access to the new inner city Cross River Rail stations from the Yeerongpilly TOD
- allows the use of Clapham Rail Yard for Cross River Rail train stabling
- preserves the ability to connect from the Tennyson Loop to Cross River Rail at Yeerongpilly without major underground works
- requires a smaller portal structure due to the favourable ground conditions and topography.

Following determination of the preferred southern portal option, detailed development of the Yeerongpilly Station and southern portal location was undertaken. Two key alternatives for the location of the portal and Yeerongpilly Station were considered, namely:

- Western Yeerongpilly option, located on the western side of Fairfield Road in the Yeerongpilly TOD
- Eastern Yeerongpilly option, located on the eastern side of the existing Yeerongpilly Station.

The preferred location for the southern portal and station was on the eastern side of the existing Yeerongpilly Station. Key factors that determined the preferred position of the portal and station on the eastern side were:

- From the north, a grade separation is required up and over the existing suburban lines. The grade separation must land at existing track level just north of the existing stabling yard. The geometry required to achieve this, utilising a maximum grade of 3%, means the northern end of the grade separation must start to climb just north of Lucy Street.
- The northern end of this grade separation needs to be clear of the outbound Cross River Rail track at surface-level (passing on the eastern side), which requires a turn-out immediately south of the proposed Cross River Rail station platform at Yeerongpilly. This geometric constraint essentially sets the limit of how far the proposed station platform can be moved to the south.
- The centre of the proposed platform is aligned approximately 35 m to the east of the existing corridor to provide enough angle of crossing of the grade separation over the suburban lines, providing an efficient arrangement for the bridge structures.
- The proposed Cross River Rail platforms need to be in similar location to the existing platforms, providing an integrated station with good access to the TOD site via a footbridge over Fairfield Road.
- The proposed Cross River Rail platforms need to be compatible with the length of nine-car train sets, and straight, to allow high-level platforms in accordance with disabled access requirements. This geometric feature further limits how far west the proposed platforms can be located.
- The proposed platforms are located clear of the existing rail corridor to enable 'off-line' construction with minimal disruption to rail operations, including freight services.
- The portal is located as far north as possible to allow enough space for trains to surface in time for the northern end of the proposed Yeerongpilly platform.

Southern portal and Yeerongpilly Station refinement

Consultation on the Yeerongpilly Station and southern portal was conducted in November 2010 as part of the wider consultation undertaken on the reference design.

A number of issues were raised during consultation on potential impacts associated with the location, design and construction of the station and southern portal. In response, further investigation was undertaken to avoid or minimise potential impacts of the design and construction.

Four sub-options of the November 2010 reference design were identified, which aimed to reduce the station footprint and residential property impacts, and the construction risks associated with the dive structure and portal between Crichton Street and School Road. Each of the sub-options comprised a two-track grade separation between Yeerongpilly Station and Clapham Rail Yard to access stabling and achieve the required operational track layout. Key differences of each sub-option to the November 2010 reference design were:

- SP01 – changes to the construction method for the dive structure, involving a mined tunnel from the portal to the northern side of Cardross Street and cut and cover construction to the TBM launch box
- SP02 – changes to the construction method for the dive structure as for Option SP01, as well as changes to the station layout
- SP03 – changes to the station layout and construction method for the dive structure, involving a combination of open cut and cut and cover construction
- SP06 – changes to the station layout and retention of the existing Yeerongpilly Station for the non-Cross River Rail suburban tracks, and changes to the construction method for the dive structure, involving a combination of open cut and cut and cover construction.

Three new options were also developed which aimed to test the viability of either a station located in the industrial area at Station Road or to achieve the grade separation within the station itself. These are described as follows.

Option SP04 incorporates a two storey stacked station arrangement, with Cross River Rail tracks located on the lower level and suburban tracks located on the upper level. The station is located approximately 100 metres south of the location proposed in November 2010. The stacked station arrangement achieves the grade separation required to access Clapham Rail Yard. Construction of the dive structure would involve a combination of open cut and cut and cover methods.

Option SP05 relocates the southern portal 110 m south of the location proposed in November 2010 and includes a new Yeerongpilly Station within the industrial area at Station Road, south of the existing station. This option also includes changes to the track arrangement through the station to provide the Cross River Rail tracks on the west and suburban tracks to the east.

A cut and cover dive structure allows the suburban tracks to cross over the Cross River Rail tracks north of the new station, avoiding the need for a grade separation to access stabling within Clapham Rail Yard. However, this option would require a single track viaduct immediately west of the existing Moorooka Station.

Option SP07 includes a new Yeerongpilly Station within the industrial area at Station Road, south of the existing station. The track arrangement through the station is similar to the November 2010 reference design with Cross River Rail tracks located on the east and suburban tracks to the west.

This option would require a two-track grade separation between the new station and Clapham Rail Yard to allow access to stabling and to achieve the required track arrangement south of Muriel Avenue. Construction of the dive structure would involve a combination of open cut and cut and cover methods.

An evaluation was undertaken of the seven options against the reference design released for community and stakeholder comment in November 2010. This considered a range of criteria relating to property and community impacts, rail operations, engineering and design, city building, cost and risk. The criteria used for the evaluation were refined from those used in the original southern portal evaluation, to ensure relevant issues were captured, including those identified through consultation.

The results of the evaluation of the options are summarised in **Table 3-5**.

Table 3-5 Yeerongpilly Station and southern portal – summary of evaluation

Criteria	Sub-options of the reference design				New options		
	SP01	SP02	SP03	SP06	SP04	SP05	SP07
Property							
Community impacts							
General alignment, access to Clapham Rail Yard, maintenance							
Connectivity from Tennyson Loop							
Station functionality							
Pedestrian access							
Ease of public transport interchange							
Flood immunity							
Constructability							
City building							
Cost							
Risk							

No change to November 2010 reference design
Slightly more favourable to November 2010 reference design
Considerably more favourable to November 2010 reference design
Slightly less favourable to November 2010 reference design
Considerably less favourable to November reference design

The preliminary investigation found that both options SP03 and SP05 satisfied all functional and operational requirements. However, SP05 was identified as the preferred option from the evaluation process as it provided greater overall benefits in relation to:

- fewer property impacts
- fewer impacts to the community as the station is now proposed to be located further south in industrial land
- reduced construction risks and shallow tunnelling impacts
- moved the southern portal 110 m south and deeper, allowing the floodgate to be incorporated in the tunnel portal structure, and avoiding the need for a separate floodgate building and construction site at the end of School Road.

The SP05 option was also considered to provide greater opportunity to support possible future redevelopment of the Yeerongpilly construction worksite as a transit oriented development.

3.3.6 Station entrance options

This section outlines the process for identifying the preferred station entrances for each of the underground stations.

Roma Street

A two-entry station entry/egress strategy is proposed for the Cross River Rail station at Roma Street to optimise the walk-up catchment and to provide direct access to a range of nearby destinations and transport integration opportunities. A high level evaluation of station entry options was undertaken to identify a short-list of options for more detailed investigation.

Six options were evaluated (as shown in **Figure 3-11**) based on station and precinct planning objectives, as well as constructability and engineering criteria.

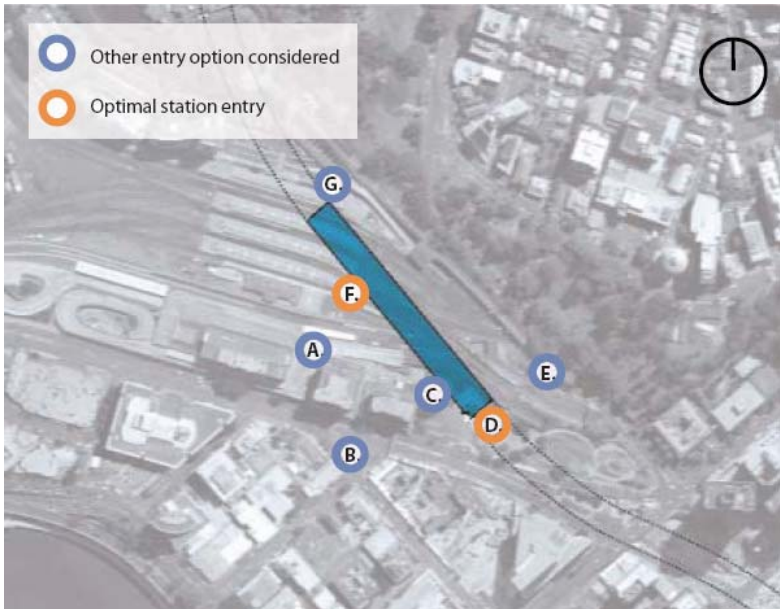


Figure 3-11 Roma Street Station entrance options

Source: Hassell, 2010

Entry Option D was identified as being the most appropriate eastern station entrance, providing a new point of entry from Albert Street and Roma Street adjacent to Emma Miller Place. This entry would provide improved access to the Queen Street Mall and links with the future pedestrian bridge linking the Brisbane Magistrate's Court with Roma Street Station, improving access to the pedestrian route from the northern part of the Brisbane CBD across the Kurilpa Bridge to South Brisbane and South Bank.

Entry Option F was recognised as the most appropriate entry for intermodal interchange, which would be one of the key functions of Roma Street Station. The entrance would provide access into the existing station concourse and interchange with existing surface rail and busway platforms and regional and interstate bus and rail facilities. Other entrance options were discounted due to the complexity of construction or impact on rail operations.

Albert Street

A two-entry station entry/egress strategy is proposed for the Albert Street Station, to optimise station walk-up catchment and provide direct access to local destinations. A high level evaluation of station entry options was undertaken to identify a shortlist of options for more detailed investigation, shown in **Figure 3-12**.

Figure 3-12 Albert Street Station entrance options

Source: Hassell, 2010

Entry Option E was identified as the preferred location for a northern station entry. This is located near the intersection of Mary Street and Albert Street. It would provide the primary access point to the station and accommodate high volumes of passenger movements.

Option E was considered to provide greater opportunities for enhancing footpath capacity than other options, taking advantage of lower traffic volumes in Albert and Mary streets (compared to entry options on Elizabeth or Charlotte streets for example). Option E also presents better construction opportunities given the larger site available.

Entry Option N was identified as the preferred location for the southern station entry. This is located near the intersection of Albert and Alice streets. It is well positioned to service destinations such as QUT, the Queensland Government precinct (around George Street) and the City Botanic Gardens, supplemented by a secondary access on Alice Street adjacent to the City Botanic Gardens entrance gate (P).

Option N was considered to offer greater opportunities for enhancing footpath capacity along the north-eastern side of Albert Street, compared to other southern entrance options.

Woolloongabba

A range of station entry/egress locations were considered for the proposed Gabba Station as shown in **Figure 3-13**. A single station entry/egress strategy was proposed for the Gabba Station, as this provides the safest and most efficient access during events at the Gabba Stadium.

Figure 3-13 Gabba Station entrance options

Source: Hassell, 2010

Entry Option D was identified as the preferred station entry. This is centrally located within the Woolloongabba UDA, and provides high visibility from Stanley Street to the south. While not providing direct access to the southern side of Stanley Street, the development of the UDA and "Kangaroo Point south" precinct north of Vulture Street is expected to shift the centre of the Woolloongabba precinct north. As such, a single entrance on the north side of Stanley Street is considered appropriate to serve both existing and future transport demands.

Option D provides good sight lines and access to the Gabba Stadium to the east and minimises the number of major road crossings, compared to Options A, B or F for example.

Option D also optimises bus-rail interchange, being located approximately 60 m from the existing Woolloongabba Busway Station to the south-east and avoids the need to cross any major roads.

Boggo Road

The preferred strategic station location provides for two Cross River Rail station entrances to improve accessibility and the walkable catchment while promoting efficient rail-rail and rail-bus integration. The specific location options for these two entrances were then developed with the range of station entrance locations considered as shown in **Figure 3-14.**

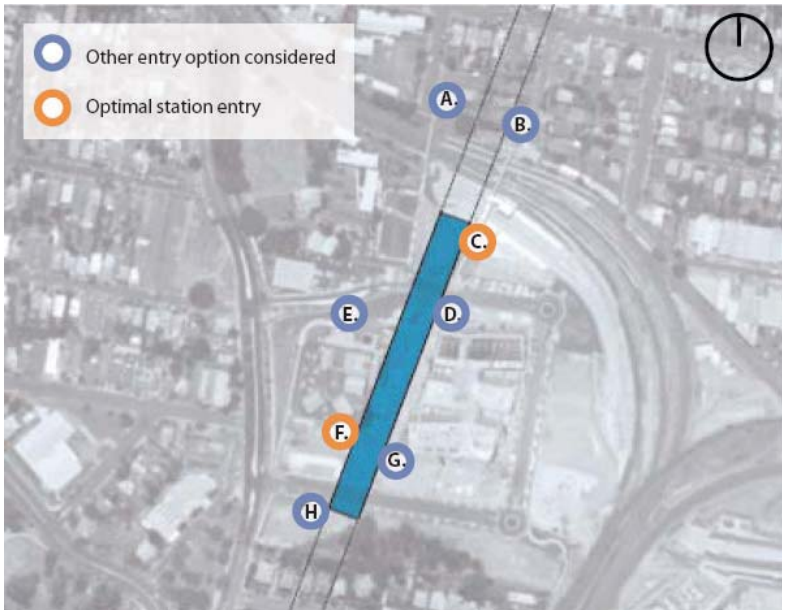


Figure 3-14 Boggo Road Station entrance location options

Source: Hassell, 2010

Entry Option C is the preferred northern station entry. The entry is located at Lot 1 of the Boggo Road Urban Village, and is positioned immediately adjacent to the existing Park Road Station and the Boggo Road Busway Station. It is also positioned south of the existing railway station to preserve future opportunities for the upgrade of the Park Road Station. Lot 1 of the Boggo Road Urban Village is currently the subject of a development proposal.

Entry Option F is the preferred location of the southern station entry, being positioned adjacent to the Boggo Road Urban Village pedestrian spine, and to the south of the Boggo Road Gaol. It provides high visibility from the surrounding road network, improving the presence of the station and promoting easy wayfinding and navigation through the Boggo Road Station precinct. This southern entry location also supports improved access to nearby destinations such as the PA Hospital and the UQ via the Eleanor Schonell Bridge. An entry in this location provides additional opportunities for interchange with local on-street bus services and kiss 'n' ride facilities.

3.3.7 Station design refinement

Following the release in November 2010 of the reference design for community and stakeholder comment a review of the underground station designs was undertaken. The aim of the review was to:

- reduce the overall cost of the stations, whilst being cognisant of the construction program, quality of the customer experience and station operation
- respond to issues raised by the community and stakeholders during consultation on the reference design.

The cost of excavation and both temporary and permanent retaining structures, comprise a major part of construction costs for stations. As such, the majority of refinements achieved cost savings by reducing the total amount of excavation required. Other cost savings were achieved through refinement of the sizing of structural elements, more efficient arrangement of vertical transportation ie escalators, plant space and station services.

Refinements were made to the design of the underground stations at Albert Street, Woolloongabba and Boggo Road following the release of the reference design in November 2010. The following provides a summary of the main refinements made to these stations.

Refinements to the design of the Albert Street Station generally focussed on changes to the station's northern entry to locate the gateline and station accommodation at the mezzanine level. This removes the concourse extension under Mary Street and avoids the need for excavations across Mary Street. Refinements also included relocating the floodgates to street level at the northern and southern entries, providing total protection of the entrance shaft, accommodation, station and underground station up to a 1 in 10,000 year flood event.

Refinements to the design of the Gabba Station generally focussed on:

- positioning the station to maintain the existing South East Freeway off-ramp to Vulture Street and minimise the impacts on the Woolloongabba busway station and busway operations
- further integrating with the Woolloongabba UDA
- reducing the total volume of excavation required for the station by
  - minimising the total width of the station box by minimising the space between trains and the wall
  - reducing the depth of the station by minimising the space beneath the platform
- rationalising station plant and associated distribution, including relocating primary plant rooms within the station box.

Refinements to the station design at Boggo Road generally focussed on the:

- position of the northern station entry, to allow integration with the future development of Lot 1 of the Department of Public Works development
- public space connecting the Boggo Road Station to the existing Park Road Station and Boggo Road Busway Station
- location of station services to allow future development to be constructed above the station box
- siting of the southern entry to allow north south vehicle movement between the Boggo Road Gaol and the Ecosciences Precinct
- reducing the total volume of excavation required for the station by
  - minimising the total width of the station box by reducing platform widths and minimising the space between trains and the wall
  - reducing the depth of the station by minimising the space beneath the platform.

3.3.8 Associated tunnel infrastructure

This section outlines the process for identifying associated tunnel infrastructure elements such as flood protection measures and ventilation and emergency access.

Flood protection

Flood protection of the Project considered the likelihood and magnitude of flood events and the way in which such events can disrupt and/or damage the underground rail system.

Flood protection measures implemented on underground rail systems in Australia and internationally were investigated. A range of methods are used on projects elsewhere to provide flood protection for various flood events, including raising the station threshold and provision of stop block doors at entrances and flood-proof doors.

A range of flood event scenarios were identified for the Project to determine the applicable flood design criteria to be applied to Project infrastructure. These included:

- localised flood events, such as those associated with intense storm events, hydraulic service failure eg ruptured mains water pipe or failure of the stormwater drains
- intermediate flood events, due to prolonged, intense regional rain events, in particular over the Brisbane River catchment area
- extreme flood events, such as a 1 in 10,000 year flood event.

Protection measures were developed for stations, tunnels and other project infrastructure potentially impacted by one or more of the flood event scenarios. These include:

- raising the surface level of entrances to each underground station, to protect against local flood events
- provision of dedicated automated floodgates at major entry points to the Albert Street Station and the southern portal, to protect again extreme flood events.

Surface infrastructure such as the ventilation and emergency access building is also designed to achieve flood immunity in an extreme flood event.

A proposed 6 m high floodgate building was identified at School Road, Yeronga, to accommodate the floodgates for the southern portal. During consultation on the reference design in November 2010, community issues were raised about the size and potential visual and construction impacts of the floodgate building, along with issues about the location and design of the southern portal and new Yeerongpilly Station.

In response, further investigation was undertaken to avoid or minimise potential impacts of the Project in this area. This involved moving the tunnel portal and new Yeerongpilly Station further south. Moving the portal further south and increasing the depth of the portal enabled a new floodgate mechanism to be implemented and incorporated into the portal design ie hinged tilted gate, avoiding the need for a separate flood gate building.

Ventilation and emergency access building

Due to the length of the tunnels between Boggo Road Station and the southern portal at Yeerongpilly, an intermediate ventilation and emergency access shaft and building is required to ensure the safety of trains and passengers in the event of an incident. The most efficient location for the ventilation shaft is about mid-way between Boggo Road Station and the southern portal.

A proposed site for the building was identified in the traffic median between Fairfield Road and Brougham Street at Fairfield. This was located approximately 200 m north of the mid-way point between Boggo Road Station and the southern portal, which was Ashby Street at Fairfield, and avoided long-term impacts on the recreational and landscape values of Robinson Park.

During consultation conducted in November 2010 on the reference design, a number of issues were raised about potential impacts associated with the location, size, operation and scale of the building. The site was also flooded to a height of more than four metres during the January 2011 floods. If operational, this would have cut access to the building and required the flood proof doors to be used.

In response to changes to the location and depth of the southern portal and feedback received during consultation, further investigation was undertaken to avoid or minimise potential impacts of the ventilation and emergency access building.

Three alternative locations were investigated, including two options within Robinson Park and one option at Railway Road between Bledisloe and Sunbeam streets at Fairfield. These are shown on **Figure 3-15**.

Compared to the proposed site at Fairfield Road and Brougham Street, the two options within Robinson Park were considered to provide more space for construction, more space for passengers exiting the building in an emergency and less impact on the road network and visibility for motorists. However, these options were considered to impact on the recreational and landscape values of Robinson Park, including a number of existing large trees. In addition, these options:

- did not provide an opportunity to reduce the building height given the maximum flood level
- required minor alterations to the rail alignment
- were located approximately 300 m to 350 m north of the mid-way point for the revised southern portal location.

Compared to the proposed site at Fairfield Road and Brougham Street, the Railway Road option was considered to:

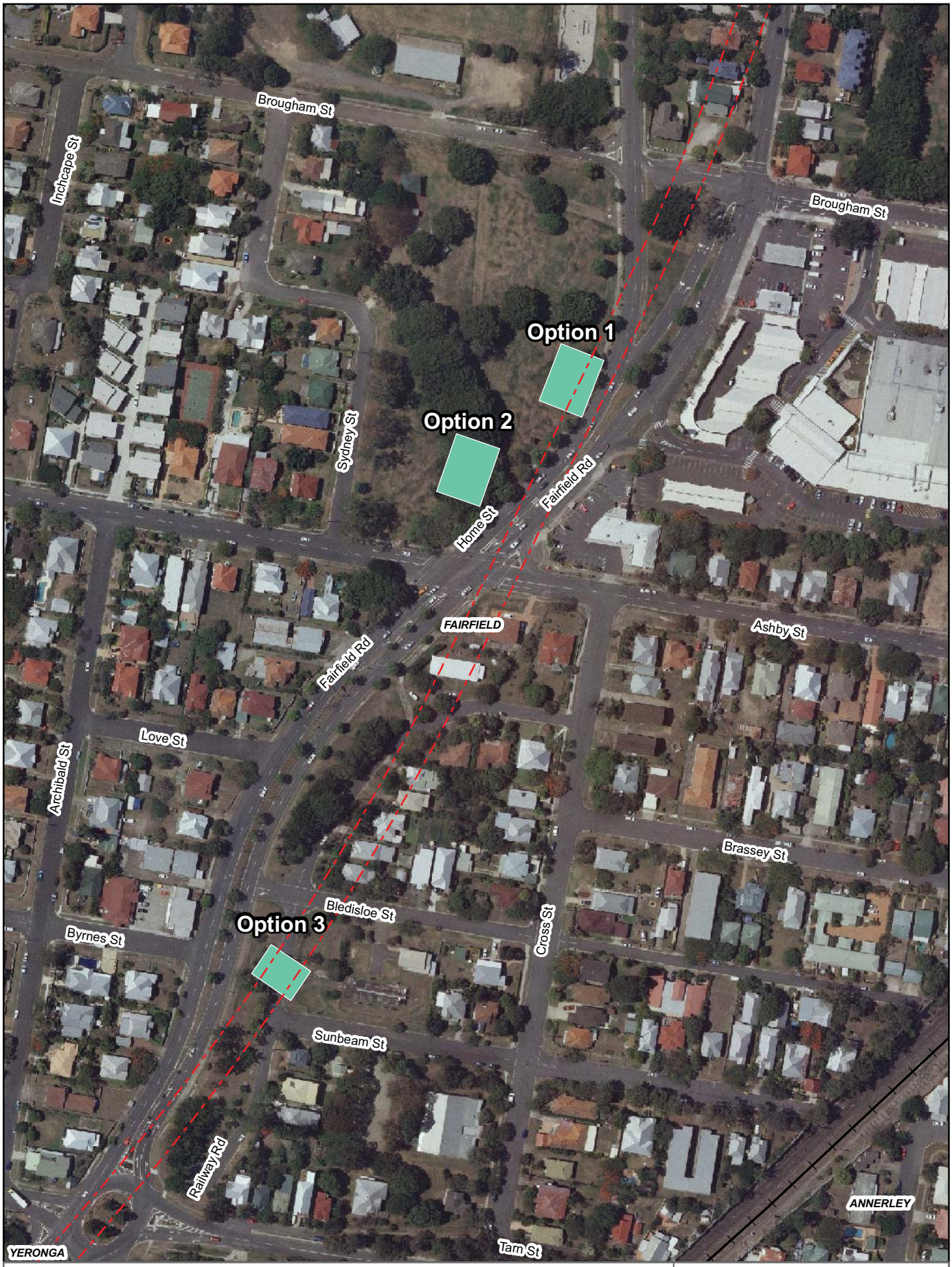
- allow more space for construction
- involve a simpler construction methodology, due to the higher rock level
- provide more space for passengers exiting the building in an emergency
- avoid impacts on visibility for motorists
- provide an opportunity to reduce the building height from 12.5 m to 8.5 m, as it is located on higher ground
- allow the tracks in the running tunnels to be 2 m higher, reducing the trains' energy use.

In addition, this option:

- avoids impacts on Robinson Park, during both construction and operation
- provides an opportunity to create an open space area with the realignment of Railway Road
- avoids the need to alter the horizontal alignment of the tunnels
- is located near to the mid-way point for the revised southern portal location, which is located at Bledisloe Street.

Following the evaluation of the three options, the Railway Road option was identified as the preferred site for the ventilation and emergency access building.

The design of the ventilation and emergency access building and associated shaft was also reviewed following the release of the reference design for comment in November 2010. This resulted in a reduction in the size of the shaft, reducing the amount of spoil required to be removed.



LEGEND

Ventilation and Emergency Access Building - Proposed Location Options

CROSS RIVER RAIL
ENVIRONMENTAL IMPACT STATEMENT

Figure 3-15

Ventilation and Emergency Access Building - Location Options

0 25 50 75 100 125 Meters

1:2,500 at A4

N

CrossRiverRail

SKM aurecon CRR JOINT VENTURE

Map by: MJS K:\Cross River Rail\600 Environment\619 GIS\Aurecon\205555_CRR\G0179_CRR_Southern_Vent_Options_A4.mxd 06/07/2011 14:13

3.3.9 Southern surface rail works

Three rail tracks currently exist between Park Road Station and Salisbury. The section of the rail corridor between Park Road and Yeerongpilly is the busiest freight corridor in the South East Queensland rail network. The existing narrow gauge passenger tracks are currently used as a coal passing track between the Port of Brisbane and Yeerongpilly. The sharing of tracks by freight and passenger services in this section impacts on the reliability and frequency for all services.

Train operations modelling undertaken for the Project identified the need for five tracks between Park Road and Rocklea and four tracks between Rocklea and Salisbury, to cater for future growth in passenger rail transport without restricting the movement of freight.

South of the southern portal, two additional surface tracks would be provided by the Project. This would allow two tracks to be used for Cross River Rail (Gold Coast/Beenleigh) services, two tracks to be used for suburban services and the existing dual gauge track (currently shared by freight and Gold Coast trains) to be used for freight operations and interstate passenger trains.

Allowing the existing dual gauge track to be dedicated to freight services would reduce the crossing conflicts between passenger and freight services between Yeerongpilly and Park Road.

An overview of the proposed track arrangement and number of services in the peak hour is shown in **Figure 3-16.**

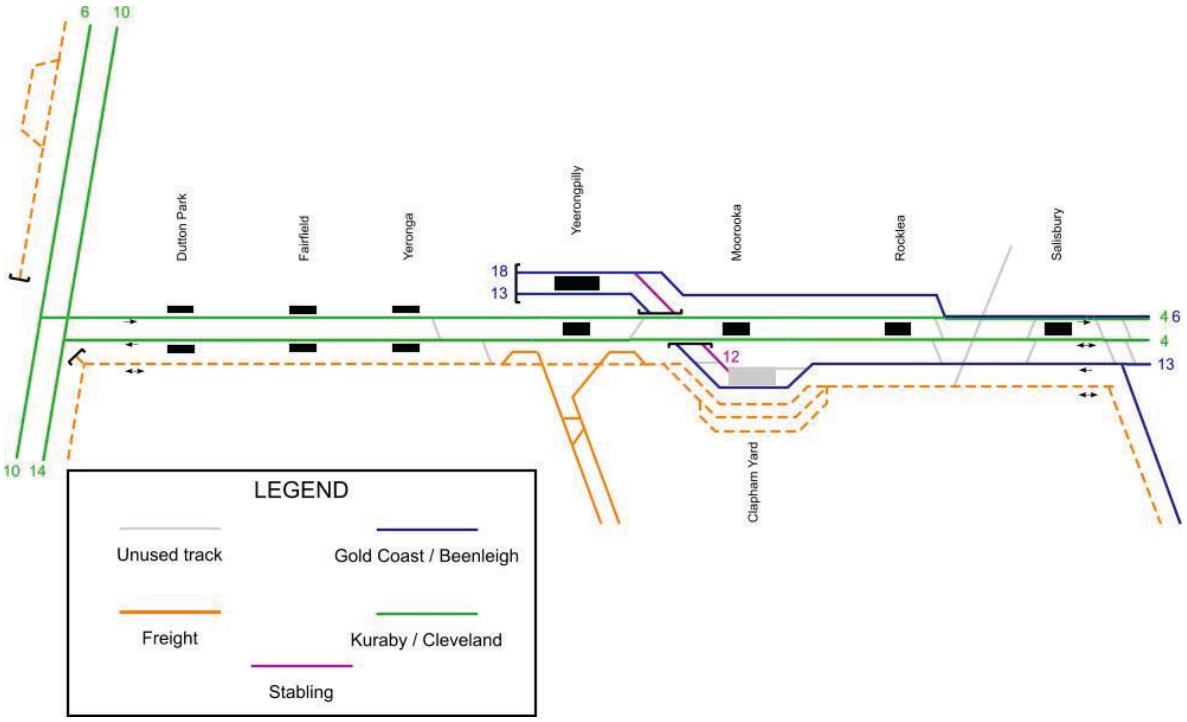


Figure 3-16 Southern surface works

3.3.10 Northern surface works

The location of the northern portal on the existing Exhibition Loop allows the development of a new Ekka Station and provides access to Mayne Rail Yard for Cross River Rail trains, but also poses challenges regarding the complexity of operations in this area of the network, as well as space constraints. A new pair of tracks is required on the Exhibition loop to connect to the existing corridor north of the Ferny Grove flyover, creating three corridors south of the Ferny Grove flyover.

Mayne Rail Yard is the primary daytime stabling location for many of the existing Queensland Rail CityTrain rollingstock fleet. Initial proposals for Cross River Rail attempted to place new running lines on the existing footprint of the Mayne Rail Yard. However, it is desirable to separate internal movements to maintenance and stabling within the yard from main operations.

Whilst access to Mayne Rail Yard was desirable for daytime stabling, the new pair of tracks could not adversely impact on the existing Mayne Rail Yard operations. Due to space constraints and potential junction conflicts, a grade separated alignment was considered to provide the most appropriate solution. Locating the new pair of tracks around the Exhibition Loop in the centre of the new quad track, would provide the same access to Mayne Rail Yard as currently provided, as well as conflict-free access between passenger services. Therefore, the station arrangement at the new Ekka Station allows for an island platform with two passenger tracks, whilst two freight tracks are provided on the outside of the two inner passenger tracks. The Cross River Rail passenger tracks rejoin the existing North Coast line quad track south of Breakfast Creek.

The proposed sectorisation between Albion and Bowen Hills requires two different sectors to operate on the mains pair of tracks on two different sections of the tracks. This would be difficult to schedule, and would not provide much operational and scheduling flexibility for freight services. A new pair of tracks from the Exhibition loop to Breakfast Creek has been provided to ensure that intermodal freight from the North Coast is only required to operate with the one sector to the north of the inner city.

3.4 Construction methodology

A range of alternatives were considered for various elements associated with the Project construction. These include:

- tunnelling methodology
- location and extent of construction worksites
- spoil haulage and spoil placement locations.

The proposed construction methodology for the reference design was determined based on consideration of these alternatives.

3.4.1 Tunnelling

The principal tunnelling construction methods considered for the Project included cut and cover and bored or mined tunnelling.

Cut and cover construction is generally cheaper than underground excavation, particularly where depths are shallow. However, cut and cover construction results in significant surface disruptions and increased surface property acquisition.

Driven tunnel construction, using tunnel boring machines (TBMs) or road headers is the proposed construction method for the majority of the mainline tunnels. Driven tunnelling reduces surface impacts compared to cut and cover construction. TBMs are proposed, where rock quality and depth allow, due to cost, speed, constructability and safety advantages over road header or other mined tunnel techniques.

Brisbane River crossing

Construction methods considered specifically for that section of tunnel under the Brisbane River included:

- immersed tube tunnels, where prefabricated tunnel segments are lowered into a dredged trench before being sealed and drained
- cut and cover construction, using cofferdams to allow construction of a cut and cover box to proceed in a “dry dock” type environment
- deep (mined or TBM) driven tunnels in rock
- shallow (mined or TBM) driven tunnels in soil/mixed ground/low-rock cover.

The immersed tube and cut and cover tunnel methods were considered to carry considerable risks, associated with powerful river currents and flooding events as well as environmental disturbance. Shallow TBM tunnelling was also considered to carry risks due to likely poor and unpredictable ground conditions.

Deep TBM driven tunnels in rock were considered the preferred approach for this section of the tunnels. This construction method allows greater control of risks and provides finished tunnels that are waterproof. Deep TBM driven tunnels also minimise disturbance to the river and surrounding environment.

The approaches to the river crossing are also proposed to be constructed using TBMs due to the nature of TBM tunnelling, which requires the manufacture of specialised equipment and the need to launch and retrieve the tunnel machine in suitable locations. From the south, driven tunnels using TBM would extend from the TBM launch site at Yeerongpilly, while to the north, the driven TBM tunnels would extend to the northern portal at Victoria Park.

General corridor tunnelling (underground works)

A number of options for construction of the running tunnels were considered based on the need to minimise:

- construction costs, while achieving other reference design objectives
- the construction program, but not where this would adversely affect the overall Project cost
- land-take
- disruption to existing road and rail traffic and businesses and residents
- construction risks, particularly those associated with potential third-party impacts
- environmental impacts.

Based on these criteria, six alternative tunnelling strategies were developed for consideration, involving:

- two TBMs driven north from the southern portal at Yeerongpilly to Victoria Park (two TBMs in total)
- two TBMs driven north from the southern portal at Yeerongpilly to Woolloongabba and two TBMs driven south from northern portal at Victoria Park to Woolloongabba (four TBMs in total)
- two TBMs driven north to Victoria Park and two TBMs driven south to Yeerongpilly from Woolloongabba (four TBMs in total)
- two TBMs driven north from the southern portal at Yeerongpilly to Woolloongabba and two TBMs driven north to Victoria Park from Woolloongabba (four TBMs in total)

- two TBMs driven north to Victoria Park and two TBMs driven south to Yeerongpilly from the Boggo Road Urban Village (four TBMs in total)
- two TBMs driven north from Fairfield to Victoria Park and a third TBM driven south to Yeerongpilly twice (three TBMs in total).

The use of two TBMs from Yeerongpilly driven north to Woolloongabba and two TBMs from Woolloongabba driven north to Victoria Park was identified as the preferred tunnelling strategy. This approach provided a reliable time and cost effective solution, and was considered to have the following advantages over alternative tunnelling options:

- maximises TBM tunnel drives, resulting in an overall program cost-advantage
- allows for efficiencies with respect to the overall program, with the use of four TBMs for the tunnel drives
- uses industrial land south of the Yeerongpilly Station for a major spoil extraction site. This land is required to support the southern portal and southern surface rail upgrade works, and consists of a number of large industrial sites, buffered from residential properties and with direct access to Ipswich Road.
- takes advantage of the government owned Goprint site at Woolloongabba for the second TBM launch and spoil extraction site. This site is required for station construction and provides direct access to Main Street/Ipswich Road.

3.4.2 Construction worksites

The availability of suitable construction worksites was a key consideration in the development of tunnel alignment options and tunnelling methods. An evaluation was undertaken of the location and suitability of possible worksites for a range of construction activities within the study corridor. The identification of worksites considered a range of factors, such as:

- access to Cross River Rail, with preference to be as close as possible to the alignment
- access to major arterial roads, for material and spoil haulage
- access to the existing rail corridor
- minimising property impacts, including use of sites already required for permanent works
- minimising potential impacts on neighbouring properties
- reducing construction risk, including ensuring sufficient site area for materials storage and handling of tunnel spoil.

The use of existing greenfield or undeveloped sites was generally preferred over built-up sites, with sites used for industrial or commercial uses preferred over residential uses.

Possible construction worksite options were considered for construction activities at:

- Spring Hill/ Herston, for the construction of the northern portal
- Roma Street
- Albert Street
- Woolloongabba
- Boggo Road
- Yeerongpilly/Moorooka.

Worksites are also required at Bowen Hills, the RNA Showgrounds, Fairfield, and Salisbury/Rocklea for construction of surface infrastructure. Alternate construction worksite options to those identified for the reference design, were not considered for construction activities in these locations. Proximity to proposed construction works and availability of suitable land were key to the identification of worksites in these locations. Further information on these worksites is provided in **Chapter 4 Project Description**.

Northern portal

Four sites were examined to support construction activities at the northern portal, including:

- Victoria Park, east of the existing rail corridor and north of the ICB land bridge
- the playing fields west of the ICB, as a potential satellite site for spoil placement activities
- the existing rail corridor, generally extending from the ICB land bridge to Brisbane Grammar School, as a potential siding for spoil placement by rail
- Victoria Park, adjacent to the ICB land bridge, to support possible bridge strengthening works.

The construction worksite identified in the reference design for construction of the northern portal is located within Victoria Park, east of the existing railway corridor and north of the land bridge. This site has existing vehicle access via Gregory Terrace and direct access to the existing railway corridor. The site west of the ICB was considered too complicated to access, while the site further south within the rail corridor, was considered too remote from construction works.

Roma Street

Six potential worksites were examined at Roma Street to support station construction activities, including:

- part of Emma Miller Place, between the busway corridor and Roma Street
- the open space area located east of the transit centre
- the Queensland Rail car park, adjacent to Platform 3 of the existing Roma Street Station
- the baggage handling facility adjacent to Platform 10 of the existing Roma Street Station
- the Queensland Rail car park north of the existing Roma Street Station
- the Roma Street Parkland car park, as a potential satellite site to support the station construction.

Four sites are required for construction activities in this location. The main station construction site is to be located partly within Emma Miller Place and was preferred due to its location immediately above the station cavern and on land identified for the southern station entrance. A construction site adjacent to Platform 3 of the existing Roma Street Station is also required to support the construction of the central access and station interchange shaft. A northern construction site adjacent to Platform 10 (baggage handling area) is required for the construction of the northern shaft. This site aligns with the northern end of the station cavern and provides for the permanent location of emergency egress and station services. A satellite worksite in the Parkland car park (off Parkland Boulevard) is also required as a site compound and worker parking area.

Albert Street

Seven sites were considered to support construction of the Albert Street Station, including:

- the site of the Royal on Park hotel at the corner of Albert and Alice Streets
- the northern side of Albert Street, at the corner with Mary Street
- at land on the southern side of William Street, between Margaret and Alice Streets

- within the City Botanic Gardens
- the southern side of Albert Street, between Alice and Margaret streets
- the southern side of Albert Street, at the corner with Mary Street.

Two worksites are required for construction of the Albert Street Station. The primary worksite for construction of the station is located at the site of the “Royal on the Park” hotel. This site was considered to currently have a relatively low level of development density and would provide a large area of land. Alternative construction sites in this location were considered too small, or, in the case of the City Botanic Gardens, subject to major heritage constraints and community sensitivity.

The Albert Street northern shaft was identified as being on the north-eastern corner of Albert and Mary Streets. This site currently includes existing low rise development. The site was considered large enough to support a shaft and underground concourse. Alternative sites were considered too small, too highly developed or too remote from the station cavern.

Boggo Road (Dutton Park)

Nine possible construction worksite options were identified at Boggo Road, including:

- private residential property, west of the existing rail corridor and generally located between Rawnsley and Pound streets
- private residential property located west of the existing rail corridor at Rawnsley Street
- land owned by the Department of Public Works, on the southern side of Peter Doherty Street at the Boggo Road Urban Village
- land located between the Ecosciences Precinct and the Boggo Road Gaol, and adjacent to Peter Doherty Street at the Boggo Road Urban Village
- land located between the Boggo Road Busway Station and Boggo Road and east of the Dutton Park State School, at the Boggo Road Urban Village
- Queensland Rail land east of the existing rail corridor, between Kent Street and the rail corridor, as a potential site for spoil disposal activities
- land between the Eastern Busway the existing rail corridor, north of the PA Hospital, as a potential site for spoil disposal activities
- land within the Queensland Rail corridor, south of the Cleveland rail line, as a potential site for spoil disposal activities
- land between the Ecosciences Precinct and the Boggo Road busway.

A number of these sites were identified to support activities associated with the tunnelling option described in **Section 3.4.1** that involved TBMs driven north and south from the Boggo Road Urban Village.

Several of the worksite options were considered to have unacceptable impacts on surrounding sensitive receptors, such as the Dutton Park State School and residents. The preferred worksite for construction activities in this location is situated between the Boggo Road Gaol and the Ecosciences Precinct. This worksite is intended to support construction of the Boggo Road Station only.

Yeerongpilly/Moorooka

Five possible worksite options were considered at Yeerongpilly and Moorooka to support construction activities associated with the new Yeerongpilly Station works, southern portal, southern surface works and TBM launch and spoil removal activities. They included:

- land identified for the Yeerongpilly TOD west of Fairfield Road
- industrial property at Station Road, Yeerongpilly
- industrial properties at Wilkie Street, Yeerongpilly
- residential properties at Wilkie Street, Yeerongpilly
- residential properties at School Road and Cardross Street, Yeronga, for the construction of the floodgate building
- commercial land between Clapham Rail Yard and Fairfield Road at Yeerongpilly.

A number of properties would need to be acquired in this area that are potentially directly affected by the reference design. These sites represented an opportunity to support construction activities.

The main Yeerongpilly worksite is located east and south-east of the new Yeerongpilly Station. The site has direct access to the tunnel and portal, and allows this infrastructure to be built off-line from the current rail operations. Direct access to Ipswich Road is also provided via a signalised intersection with Lucy Street to minimise the need for trucks using local roads.

3.4.3 Spoil placement and haulage

Cross River Rail is anticipated to produce in the order of 1.4 million m^3 of in situ material from tunnelling activities, which would require approximately 3.4 million tonnes of excavated spoil to be disposed of off-site. A number of potential spoil placement sites and associated haulage routes were considered for the Project.

Spoil placement

A high level investigation of a range of potential spoil placement sites was undertaken to identify possible areas to accommodate spoil generated from the Project. These included existing or disused quarries, large parcels of State land or sites that are or have previously been used for other large scale infrastructure projects, located within an area up to about a three hour round trip from the construction worksites. Factors considered in identifying potential spoil placement sites, included:

- 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 Indigenous and non-indigenous cultural heritage on or adjacent to the site.

Thirty two sites were initially identified as potential spoil placement sites. Of these, a number were eliminated due to potential environmental constraints. These were shortlisted to seven potential spoil placement sites including:

- Brisbane Airport (parallel runway)
- quarry at Kremzow Road, Warner
- decommissioned quarry/mine site, Paradise Road, Larapinta
- undeveloped (vegetated) state owned land at Waterford-Tamborine Road, Buccan
- unused state lane, Cedar Road, Redbank Plains
- unused (vegetated) state land alongside Ipswich Motorway, Redbank
- Swanbank Enterprise Park, Swanbank Road, Swanbank.

A summary of the outcomes from the evaluation of spoil placement sites is presented in **Table 3-6**.

Swanbank was identified as the preferred location for spoil placement following the evaluation of the shortlisted options. Swanbank was considered to have the greatest capacity to accommodate the volumes of spoil from the Project, with a number of open-cut mine voids suitable for the purpose located at the site. The site offers few constraints in relation to surrounding land uses and environmental considerations. The site is also located within an acceptable haulage distance from construction worksites and offers the opportunity for spoil to be transported by rail with its own rail spur from the Ipswich line.

A referral made on the Project under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) identified Swanbank as the potential spoil placement site. A decision was made on 28 July 2010 by the authorised delegate for the Australian Government environment minister that Cross River Rail would not be a controlled action if conducted in a particular or specified manner. This included the use of Swanbank as the spoil placement site.

Table 3-6 Summary of spoil placement site evaluation

Location	Land tenure & ownership	Existing land use and activities	Surrounding land uses	Environmental constraints	Cultural heritage	Haulage routes	Haulage distance and travel time	Comments
Parallel Runway Project, Brisbane Airport								■ Further investigation into the suitability of spoil for the runway base would be required. ■ Possible environmental concerns. ■ Proposed haulage route via Kingsford Smith Drive. Potential construction works associated with the upgrade of Kingsford Smith Drive may constrain spoil haulage. ■ Approximate haulage distance and travel time – 21.7 km, 34 minutes (one way).
Quarry, Kremzow Road								■ The site is not located within a residential area. An existing transmission line runs across the southern site. Potential constraints of the transmission line would need further investigation. ■ Access to the site is from Kremzow Road and Old North Road. Alternative haulage routes include Gympie Arterial and Enoggera Road/South Pine Road. The haulage route option of Enoggera Road/ South Pine Road travels through residential areas. ■ Approximate haulage distance and travel time – 24 km, 43 minutes.
Decommissioned quarry/ mine site, Paradise Road, Larapinta								■ The site is situated within a neighbourhood planning area. Planning for future residential development is currently being undertaken. ■ The site is located on Paradise Road, off of the Logan Motorway. The route is a defined freight route surrounded by industrial areas/freight dispatch uses. ■ Approximate haulage distance and travel time – 30.3 km, 32 minutes.
Undeveloped state land, Waterford Tamborine Road, Buccan								■ There is no direct access to this site although it is located adjacent to a disused rail easement. Further investigation would be required to determine if this could be used to provide access to the site. Haulage route to the site would be via South East Freeway/ Loganlea Road/Nerang Street/Waterford Tamborine Road. ■ The site is surrounded by large lot residential uses. ■ The site is currently undeveloped and vegetated. Council mapping has a vegetation overlay over the site. ■ Approximate haulage distance and travel time – 36 km, 41 minutes.

Location	Land tenure & ownership	Existing land use and activities	Surrounding land uses	Environmental constraints	Cultural heritage	Haulage routes	Haulage distance and travel time	Comments
Unused State land, Cedar Road, Redbank Plains								■ The site is located north of the recently constructed Centenary Highway. ■ Surrounding land uses include a hard rock quarry and vacant land. ■ Access is currently from Cedar Road via Queen Street/Redbank Plains Road/Cedar Road. Some residential uses are located along Cedar Road. Access opportunities from Centenary Highway may be possible, although subject to further investigation. ■ The site is vegetated and contains a small hill. ■ Approximate haulage distance and travel time – 29.5 km, 41 minutes.
Unused State land, Ipswich Motorway, Redbank								■ The site is located at Redbank, immediately south of the Ipswich Motorway. ■ The site is currently unused, although Smiths Road is currently being extended across the site as part of the Ipswich Motorway Upgrade project. Surrounding land uses include residential uses and a substation. ■ It is vegetated and traversed by a waterway corridor which may have environmental constraints. ■ Approximate haulage distance and travel time – 29.9 km, 30 minutes.
Swanbank Enterprise Park, Swanbank Road, Swanbank								■ Land has been designated for industrial purposes and is restricted due to safety overlays. Land has been mined and contains multiple mine-void areas that have potential to be filled. ■ Access is provided via Ipswich Road/Ipswich Motorway/ Cunningham Highway ■ Approximate haulage distance and travel time – 36.1 km, 40 minutes.

Low impact
Medium impact
High impact

Spoil haulage

Two options for the transport of spoil have been considered for the Project, 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, as well as comparatively lower establishment and decommissioning costs.

Transport by rail offers the advantages of reducing impacts and congestion on busy roads, flexibility to avoid congestion on busy roads, potentially higher community acceptance and less impact on road surfaces.

Most of the tunnel spoil would be removed from the major worksites at Woolloongabba and at Yeerongpilly. Spoil would also be generated at the other worksites for underground stations, the ventilation and emergency access shaft, and the portals and dive structures.

Apart from Victoria Park, Exhibition and Yeerongpilly, no other worksite has convenient and practical access to the rail network. Consequently, approximately a quarter 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.

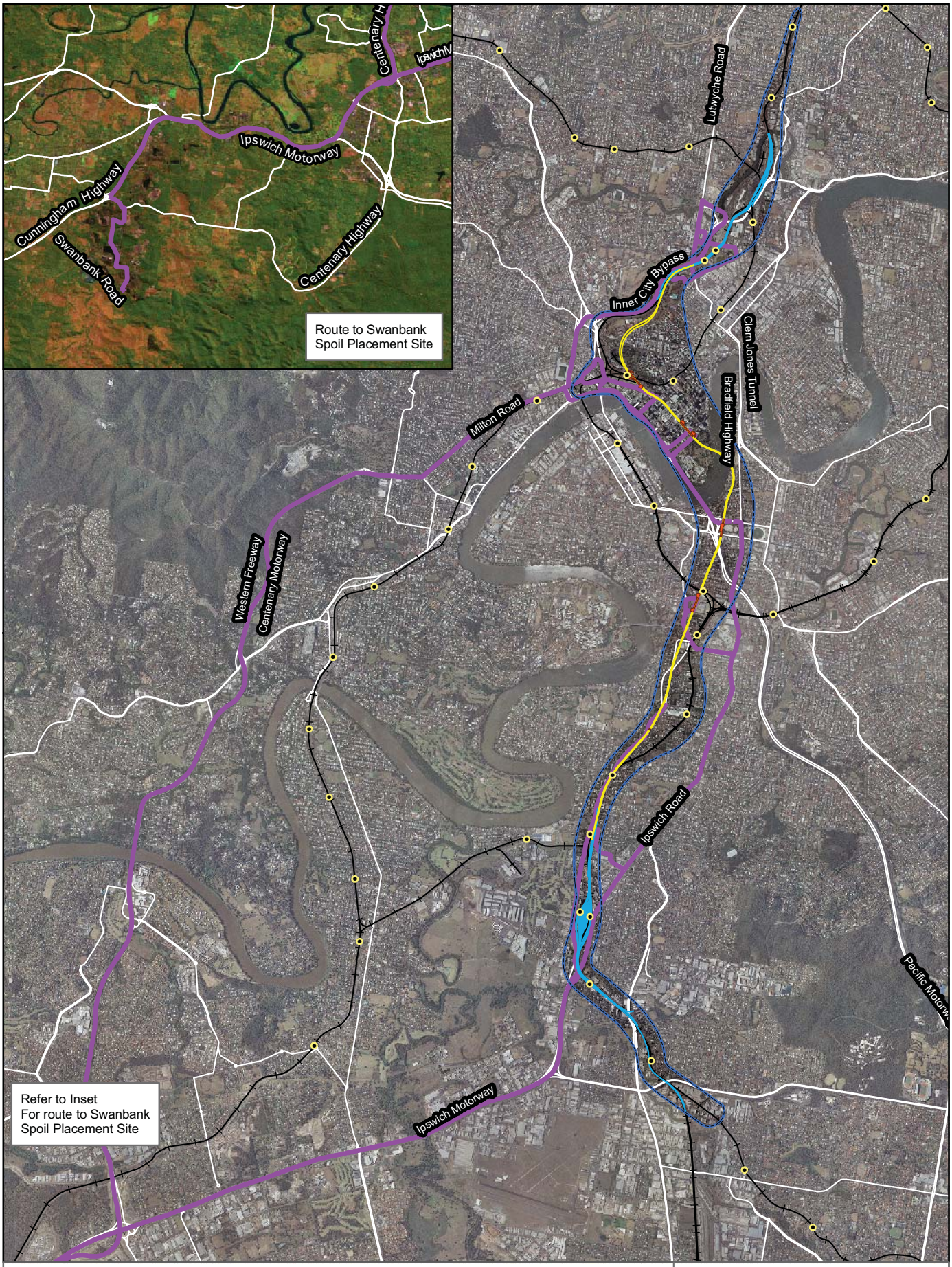
The following factors were considered for the transport of spoil by road:

- 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.

The proposed road haulage routes shown in **Figure 3-17** have been identified in consultation with Brisbane City Council and the Department of Transport and Main Roads. For the worksites situated north of the Brisbane River, the key haulage route would include the Inner City Bypass 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 be Ipswich Road, the Ipswich Motorway and the Cunningham Highway to Swanbank.



LEGEND

- Study Corridor
- Haul Route
- Station
- Track
- Underground Station

Alignment

- Above Ground
- Underground

CROSS RIVER RAIL
ENVIRONMENTAL IMPACT STATEMENT

Figure 3-17

Combined Haulage Routes

0 1 2 3 4 Km

1:75,000 at A4

N

CrossRiverRail

SKM aurecon CRR JOINT VENTURE

Map by: MJS K:\Cross River Rail\600 Environment\619 GIS\Aurecon\205555_CRR\G0114_CRR_Haulage_Routes_A4.mxd 06/07/2011 14:15