

Environmental Impact Statement

Request for Project Change 4

Volume 3: Technical Reports

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1. Overview

This technical report has been prepared for the Cross River Rail (CRR) Project to assess the environmental effect changes arising from the Proposed Changes in comparison to the Evaluated Project.

Volume 1 describes the Proposed Changes to the design and delivery of the Evaluated Project and Volume 2 provides a set of plans and drawings for approval. In some cases, the Proposed Changes are generally in accordance with the approved plans and drawings set out in the Evaluated Project and within the level of authorised impacts and in compliance with the CRR Project Wide Imposed Conditions. These aspects have been identified and compared and, where it is assumed to be generally in accordance with the approved plans, no further detailed assessment has been undertaken.

Other Proposed Changes that are similar in design and nature to the 2011 EIS, which have previously been evaluated, have also been used for comparison. Detailed impact assessment from the 2011 EIS has been used for context and prediction of impacts where the surrounding environmental values are relatively static. Where there has been a material or significant change in the design or delivery or the existing environmental values, assessment criteria, or the change conflicts with CRR Project conditions, further detailed technical assessments, modelling and surveys have been undertaken.

2. Technical Report: Traffic and Transport

2.1 Introduction

This technical report has been prepared for the CRR Project to assess the potential changes to traffic and transport impacts arising from the Proposed Changes in comparison to the Evaluated Project. Volume 1 describes the Proposed Changes to the design and delivery of the Evaluated Project.

In some cases, the Proposed Changes are generally in accordance with the design and impacts identified for the Evaluated Project or 2011 EIS. Where this is the case, further assessment of the Proposed Changes has not been undertaken.

2.2 Assessment Methodology

The methodology used for this analysis includes:

- Reviewing the approved project scope as described in the 2011 EIS and the Evaluated Project.
- Identify the implications of changing the original scope and assess the potential traffic and transport impacts that may arise from the Proposed Changes.
- Identify new or changed mitigation measures that would be required to mitigate the identified impacts of the Proposed Changes.

SIDRA modelling of critical intersections was conducted for the construction and operational stages to review changes to traffic impacts at these locations.

2.3 Changes to potential impacts

The following sections describe the expected traffic and transport adverse and beneficial impacts arising from the Proposed Changes. This considers effects from both construction and operational changes.

Design changes considered include alignment, stations and surface works.

The following transport modes and facilities have been considered in the traffic and transport assessment for each location:

- Vehicle traffic;
- Pedestrian;
- Cyclists;
- Public Transport;
- Park 'n' Ride / Kiss 'n' Ride;
- Car parking;
- Site/Property access;
- Emergency services; and
- Special events.

Where the Proposed Changes are expected to be generally in accordance with the Evaluated Project or would not result in a changed traffic or transport impact, the transport mode or facility has not been included in the assessment tables.

2.3.1 General impact changes

This section describes overall impact changes, with the impacts specific to each Project area described in Sections 2.3.2 to 2.3.5.

2.3.1.1 Construction traffic

Consistent with the Evaluated Project, additional construction vehicles using the road network has the potential to impact on existing traffic conditions. Construction traffic would be generated from spoil haulage from excavation sites and tunnels, and from the delivery of construction materials including oversized loads.

Spoil volumes generated at tunnelling worksites are detailed in Volume 1. Compared to the Evaluated Project, the total spoil volume from the Proposed Changes is increased. The main increase in spoil volume arises from the tunnelling works associated with the lowering of the Inner Northern Busway and which was not part of the Evaluated Project and increased station cavern sizes to incorporate mezzanine levels.

Peak haulage rates at some locations vary from the Evaluated Project, due to changed construction methodology, program and spoil volumes, as shown in Table 2.1. Where there is a significant increase in estimated peak hourly construction traffic, key intersections have been analysed to identify potential impacts to the road network. The results and impacts identified in the analysis are provided for each location in the following sections.

Table 2.1. Peak hourly construction traffic (one-way movements)

Precinct	Peak traffic movements (loads/hour)	
	Evaluated Project	Proposed Changes
Mayne Yard	8	11
Northern Portal	5	10
Exhibition Station	4	11
Roma Street Station	6	15
Albert Street Station	5	13
Woolloongabba Station	11	23
Boggo Road Station	6	24
Southern Portal	3	9
Fairfield to Salisbury Stations	Max 3 per site	Max 5 per site
Clapham Yard	9	17

At precincts where the worksite location remains unmodified, spoil and materials will be transported from the worksites via the evaluated routes. Where locations have been updated or modified (e.g. access to the Albert Street proposed second entrance or new locations within the Southern Area), new proposed routes will be developed in consultation with the relevant road authority (i.e. the Department of Transport and Main Roads or Brisbane City Council) and will minimise the use of local streets wherever possible.

A Road Safety Assessment (RSA) will be completed for spoil haulage routes before construction and a Construction Traffic Management Plan (CTMP) will be prepared for each site as per the requirements of the approved Project Outline Environmental Management Plan (OEMP). The CTMP will include haulage management requirements. Impacts such as temporary delays caused by construction access points will be mitigated by implementing Traffic Management Control in accordance with current best

practice, including use of GPS tracking for major deliveries where necessary to minimise conflicts and prevent queuing on public roads.

2.3.1.2 Pedestrian and cyclists

Consistent with the Evaluated Project, it is expected that at times in the construction schedule, pedestrians and cyclists would have to follow detours or experience temporary delays due to the construction access and exit points, to ensure the safety of pedestrians and cyclists during heavy vehicle movements in and out of sites. Detailed mitigation measures will be included in the CTMP to manage this impact, including signage, line marking, installation of pedestrian gantries and use of traffic controllers. Non-signalised site access points will be manned to control conflicting movements (i.e. between pedestrians and construction vehicles).

2.3.1.3 Public transport

As identified for the Evaluated Project, temporary disruptions to sections of the rail network are likely during the project. These disruptions will be limited to off-peak shutdowns, and the impact will be mitigated by the implementation of replacement bus services. Similarly, there may be temporary impacts to bus services for example at Roma Street and Exhibition Station as described below for these locations.

2.3.1.4 Car parking

Consistent with the Evaluated Project and the Project OEMP, construction staff parking on local streets will be avoided. A policy of 'No parking on public roads' surrounding the stations will be enforced for each worksite.

The implementation of a ridesharing phone app will be trialled for project personnel, including carpooling and on-demand buses to reduce the use of private vehicles by the workforce. This will free on-site car parking areas so that they may be utilised as Kiss 'n' Ride areas.

2.3.1.5 Site property access

As per the Evaluated Project, surrounding property access requirements will be assessed in the CTMP and construction implications will be coordinated with stakeholders and property owners. Modifications or temporary disruptions to access will be communicated to the public before implementation.

2.3.1.6 Emergency services

Minor impacts to emergency services access may occur during construction as identified for the Evaluated Project. Access and egress routes throughout the demolition and construction periods will be managed in consultation with QR, TransLink and the road authorities.

Modifications to the road network from the Proposed Changes are not anticipated to create additional impacts on the operation of emergency crews compared to the Evaluated Project.

2.3.2 Mayne Area

2.3.2.1 Mayne Yard and Breakfast Creek Bridge

The Evaluated Project included works at Mayne Yard. However, changes are proposed to the alignment and stabling in Mayne Yard, including additional stabling in Mayne Yard North and a new rail bridge crossing at Breakfast Creek.

Construction

Changes to potential impacts to traffic and access during construction are discussed below.

Vehicle traffic

Additional access points to the north of Breakfast Creek identified in the Evaluated Project as optional are now required by the project to facilitate access to the northern area of the worksite.

Construction vehicles accessing Mayne Yard will be met and escorted to the work area or will enter the marshalling areas, or another location agreed with QR. This will ensure that queuing does not take place on public roads and impact on QR regular operations is minimised.

The Proposed Changes to the Project will require approximately 11 trucks per hour, compared to eight estimated for the Evaluated Project. However, when considering these volumes within the cycle times, that is, the time taken to complete one sequence of the operation of traffic signals the maximum increase in vehicle numbers per cycle is one (i.e. assuming 100 seconds cycles, equals 36 cycles in one hour). Taking into consideration the peak frequency of movements, the numerous site entrances and route options, it is not anticipated that there will be significant impacts to the road network.

Car parking

Worksite parking will be provided generally in accordance with the Evaluated Project. The Proposed Changes include an additional satellite office located within Mayne Yard, with up to 50 extra parking bays for construction staff.

Site/Property access

Previously evaluated site entrances through Lanham Street, Mayne Road and Abbotsford Road are required as within the Evaluated Project with no additional impact.

Access via McDonald Road was considered in the Evaluated Project as an optional site entrance. Due to the extension of the construction area to the north of Breakfast Creek, this entrance is now required to facilitate access to Mayne Yard North and Breakfast Creek Bridge. The opportunity to use the current siding bridges for construction vehicles to cross the creek will be explored. This will significantly reduce the number of construction vehicles through Mayne Yard.

Potential impact to the proposed North Brisbane Bikeway

Heavy vehicle traffic is proposed to access the northern side of Mayne Yard from Grafton Street via McDonald Road. Vehicle body sweeps over the existing shared path on the western side of McDonald Road may conflict with the proposed North Brisbane Bikeway project (Stage 2 and 3). This includes the provision of separated pedestrian and cycle facilities along a priority route as identified in the South East Queensland Principal Cycle Network Plan. Potential conflict with the North Brisbane Bikeway project will be addressed in the CTMP.

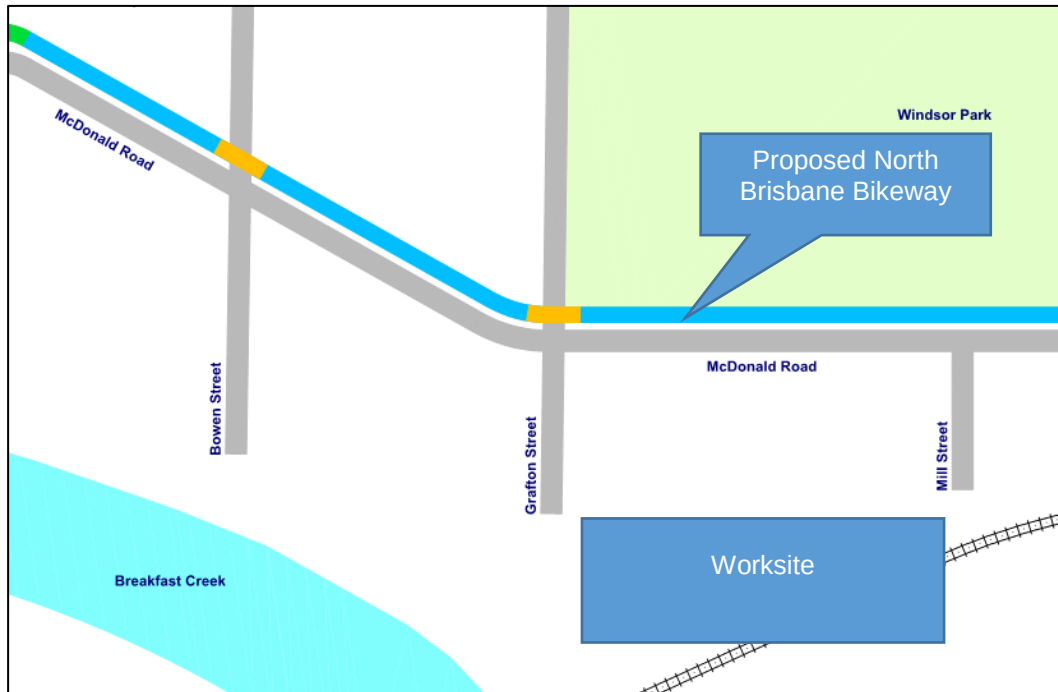


Figure 1: North Brisbane Bikeway location map

Operation

Following construction, consistent with the Evaluated Project, Mayne Yard operation and additional stabling would support the Cross River Rail and broader regional rail network operations. The operation of the yard would not impact the external road network. Minor changes to the internal operation of the yard arising from the Proposed Changes are discussed below.

Car parking and pedestrians

The proposed new permanent carpark will be located within the stabling yard area. It will accommodate 99 car parks, four disabled parks, six motorcycle parks and three truck parking bays. This is to replace the existing carpark impacted by the CRR mains alignment.

Pedestrian paths differ in order to suit the updated car park location and changed grade separated structure. A safe means of access is provided from all stabled trains, with access to end cars and the two middle cars, to the staff car park and train crew building. A pedestrian footpath is additionally proposed below the rail flyover tying into the road limit of works. This allows connectivity from maintenance buildings outside the stabling yard area to the crew building and stabled trains.

Site/Property access

A key benefit of the proposed design is a maintenance access to Mayne North provided by way of a road over rail bridge.

2.3.3 Northern Area

2.3.3.1 Exhibition Station

The Proposed Changes include an upgraded Exhibition Station which will have the similar urban design aspects and visual appearance of other surface stations for the Evaluated Project and improved accessibility.

Construction

The scale of works and construction timeframes will be reduced and staged compared to the Evaluated Project. The material changes to the construction traffic and transport impacts at Exhibition Station for each mode of transport are discussed below.

Vehicle traffic

Compared to the Evaluated Project, the proposed design will lessen construction time, which will reduce the impact on surrounding streets. The Proposed Changes will require approximately 11 trucks per hour, compared to four which was estimated for the Evaluated Project. However, when these volumes are broken down into volumes per cycle time (i.e. assuming 100 seconds cycles, equals 36 cycles in one hour), the maximum increase in vehicle numbers per cycle is one. Taking into consideration these volumes and the numerous site entrances and routes, it is not anticipated that there will be significant impacts to the road network.

Pedestrians and cyclists

As per the Evaluated Project for the Northern Portal worksite, the existing cycle lane on Gregory Terrace, at the Biomedical Technologies access, will be impacted by the project. However, impact to pedestrians and cyclists remains generally in accordance with the Evaluated Project. The temporary shared path around the site proposed in the Evaluated Project remains the same. This path will connect to the existing path infrastructure near Brisbane Parkour Park/Victoria Park and will be monitored by traffic control management during construction.

Public transport

In addition to the workforce parking sites identified for the Evaluated Project, a free bus will be made available to deliver the site team members to their applicable site.

Planned temporary off-peak shutdowns of rail and bus services will be managed by the implementation of replacement services, as per the Evaluated Project.

Worksite access via the western side of Bowen Bridge Road (via Energex) is now proposed as a secondary access, with primary access off Gregory Terrace. This will mitigate impact to public bus services and the Inner City Bypass (ICB) ramp access from Bowen Bridge Road compared to the Evaluated Project.

Car parking

Parking will be provided generally in accordance with the Evaluated Project. All parking will be provided off-street. Workforce might be required to walk short distances from the different car parks.

It is anticipated that there may be some overlap in parking requirements between worksites for the Northern Portal and Exhibition Station which would be coordinated to provide sufficient parking.

Site/Property access

There are multiple accesses proposed for construction of Exhibition Station, and these will change through different construction phases. Construction routes will be determined in consultation with the RNA and in accordance with the CTMP.

It is expected that worksite access will be primarily via O'Connell Terrace, from multiple gates within the RNA Showgrounds. Additional access to the RNA will be required through Gregory Terrace. Although this proposed access was not considered in the Evaluated Project, it is noted that Gregory Terrace is an evaluated route. It is expected that the impact to the road network from this additional access will be minimal and will be manageable with traffic control, including signalisation of the intersection. Worksite

access via the western side of Bowen Bridge Road (via Energex) is now proposed as a secondary access, with primary access off Gregory Terrace.

The evaluated access through Victoria Park (from/to Gregory Terrace) for the Northern Portal construction site has been added to the proposed access points for the Exhibition Station worksite. Access to the site will be controlled by the introduction of a signalised intersection proposed at the Victoria park entrance. A SIDRA analysis has been completed for this new intersection, which shows that the intersection will operate at an acceptable level of service as discussed in Appendix A.

Special events

Consistent with the Evaluated Project, works for upgrade of the station would also impact on the RNA Showgrounds and side show alley. This impact would be managed as per the Evaluated Project by working with RNA and TransLink to avoid negatively impacting the Ekka and other major events at the showgrounds.

However, the proposed design offers improvements, as there is no change to the horizontal or vertical alignment of the track, construction impacts on the RNA Showgrounds would be less than the Evaluated Project.

Operation

Minor changes to operational traffic and transport impacts at Exhibition Station are discussed below.

Pedestrians and cyclists

The proposed design offers improved access for pedestrians compared to the Evaluated Project. An island platform design with a ground level plaza with dual lifts close to the core zone and multiple stair access points to the platform is now proposed to maximise customer circulation and wayfinding is now proposed. This will facilitate dispersal of event patronage.

The changed design provides improved wayfinding, more accessible gradients and a maximised platform width.

Cyclists

The proposed change will include bicycle parking provisions.

Car parking

As part of the proposed design, car parking has been provided for QR staff to the south of the station, adjacent to Bowen Bridge Road. The area identified can accommodate up to 30 parking bays and will predominantly be used to cater for increased staff demand during events.

Site/Property access

The proposed design will alter the existing access and car parking layout at the station. However, equivalent access and capacity will be provided in the final design.

Special events

In the Proposed Changes, improved passenger overflow areas are provided on the island platform to enable better crowd management and to maintain efficient passenger circulation along the platforms. Separate entrance points at the platforms have been provided and could be used to segregate the crowd for separate destinations. This will further mitigate any potential overcrowding impacts on the road network.

2.3.3.2 Minor Civil Structures

A number of civil structural works are required in the Northern Area as described in Volume 1. This includes protection/strengthening works on existing infrastructure and replacement of the train wash subway. These civil works within the rail corridor are generally in accordance with the Evaluated Project and are not likely to result in changed traffic or transport impacts.

2.3.4 Central and Tunnel area

2.3.4.1 Roma Street Station and Inner Northern Busway

Roma Street Station has been shifted to the east to provide street frontage for an open plaza and clear sightlines through to Roma Street. The Inner Northern Busway (INB) would be lowered underground to service both the existing surface rail station and the proposed underground Cross River Rail station.

Construction

The construction impacts of these changed works on the various modes of transport are discussed below.

Vehicle traffic

Access to the Roma Street worksite would be from Roma Street, with an additional egress from Parklands Boulevard. The proposed new design will require approximately 15 trucks per hour (outside of peak periods) during excavation activities, compared to six which was estimated for the Evaluated Project. This includes the additional spoil haulage required for the INB relocation and lowering.

The INB works also require the diversion of buses on to Roma Street during construction as described below for public transport. The strategies to manage this impact are being determined through detailed planning and options assessment which is currently in progress through a working group which includes BCC and TMR (including TransLink). The options analysis is informed by detailed transport modelling and is considering mitigation required to minimise impacts to general traffic as well as bus operations and overall public transport customer journeys. Mitigation includes diversion route options enabled by infrastructure solutions including lane configurations and signalling. Traffic modelling and analysis is being completed by BCC and a final option will be completed before construction.

Pedestrians

The construction methodology in the Evaluated Project recommended reducing the footpath on the northern side of Roma Street. The Proposed Changes would keep this footpath open during most of the demolition and construction periods. Hoarding will be erected at the back of the footpath, and a protection gantry system will be installed above the footpath to reduce the impact on pedestrians.

Pedestrian movement through the station to/from Roma Street will be maintained with some sequential temporary path relocations around the worksite. Temporary arrangements will be implemented to facilitate passenger movements through the station.

The proposed lowering and realignment of the INB would include bus diversion onto Roma Street and the provision of temporary bus stops. The impact of this diversion is being assessed separately by BCC and TransLink, with options being considered to minimise impacts to the Roma Street precinct. For pedestrians, initial analysis undertaken by BCC indicates that changes may be required to the signalised intersections (i.e. including pedestrian crossing points) during the diversions. This is described further below in relation public transport.

The INB construction would require cut and cover tunnel works to the east of Roma Street Station across Parkland Boulevard and through Emma Miller Place which would become a temporary construction

worksite. This will result in incremental but temporary disruption to pedestrian access through this precinct that will be managed through measures in the CTMP.

Public transport

The majority of the works are proposed to be completed away from the rail corridor reducing disruption to peak rail operations and commuters by enabling less intrusive techniques.

Rail service may be temporarily interrupted during off-peak periods. During these times, arrangements for a shuttle bus operation would be made to provide pick up and set down from near to the existing station.

It is anticipated that the functionality and capacity of the relocated coach terminal, as assessed in Request for Project Change (RfPC) 2, will not be affected by this project change. Minor delays to coaches travelling through Roma Street (to and from Parkland Boulevard) are possible due to the Roma Street worksite. However, it is not expected that these delays will represent a major disruption to the overall operation of the coach terminal.

The relocation and lowering of the INB would result in impacts to public transport including diversion of buses from the busway on to Roma Street during the construction period. The strategies to manage this impact depend on detailed planning and options assessment which is currently in progress through a working group which includes BCC and TMR (including TransLink). The options analysis is informed by detailed transport modelling and is considering mitigation required to minimise impacts to general traffic as well as bus operations and overall public transport customer journeys. Mitigation includes diversion route options enabled by infrastructure solutions including lane configurations and signalling.

A range of options have been considered to date. Initial traffic modelling and analysis undertaken by BCC for the INB Diversion indicates that the performance of the various intersections along the diversion route varies, with some levels of service expected to improve and others to worsen for all traffic.

Movements of pedestrians crossing Roma Street during construction of the station will be managed through the implementation of a Construction Traffic Management Plan, developed in consultation with BCC and TransLink and in accordance with the existing conditions.

Car parking

As for the Evaluated Project, this site will have reduced parking capacity for the construction workforce. Provision of temporary spaces will remain at the previously identified capacity. Therefore, those working at Roma Street will be encouraged to travel to and from work using public transport.

The existing QR carpark adjacent to Platform 3 will continue to service QR during construction stages consistent with the Evaluated Project.

Site/Property access

A construction site is proposed on Lot 60 (adjacent to the Hotel Jen), additional to the main site on Roma Street, this was only proposed for use during demolition works by the Evaluated Project (RfPC-3). This site will provide access and egress for personnel, equipment, materials and removal of spoil.

Access to Lot 60 site will be provided by a gate from Roma Street with an exit gate via Parkland Boulevard. Although these are proposed new gates, they are within the evaluated routes and traffic controllers will ensure safety to footpath/road users is maintained during construction without creating significant impacts to traffic.

Lowering and relocation of the INB will extend the construction worksite to the east of the current Roma Street worksite and will require additional accesses from Roma Street. The details of construction

access and mitigation of potential traffic and transport impacts will be subject to further assessment by the proponent in the CTMP based on consultation with BCC and TMR.

Operation

The operational impacts at Roma Street Station on relevant modes of transport and facilities as a result of the Proposed Changes to design are discussed below.

Vehicle traffic

For the Changed Project, Hershel Street will connect to Parklands Boulevard through the extension of Hershel Street across Lot 60, to meet with the existing Parklands Boulevard roundabout. The roundabout will remain a three-legged roundabout, with the existing signalised access to Roma Street removed. Access to Roma Street to/from Parklands Boulevard would be provided via the signalised intersection with Hershel Street. This proposed arrangement has operational benefits by reducing the number of intersections on Roma Street and providing direct access from Herschel Street to Parkland Boulevard.

Traffic analysis has been conducted for the Proposed Changes to the road layout as provided in Appendix A: Traffic and Transport. The analysis shows that general capacity of the surrounding vehicle network will be maintained at an acceptable level of service. This road arrangement has operational benefits by reducing the number of intersections on Roma Street and providing direct access from Herschel Street to Parkland Boulevard.

Pedestrians

The station plaza will provide a main entry for access to the gatelines. Escalators and lifts have been strategically located to assist with an efficient movement of passengers while provided an integrated pathway for independent access.

Along Roma Street, the design allows for increased footpath widths along the CBD approach route on Roma Street. The station plaza will create a safer buffer area to deal with the large passenger movements at peak times and will be used by passengers to orientate themselves as they move towards the station entrance.

Updated forecast number of passengers obtained from the CRR Strategic Transport model has been used in the analysis presented in Appendix A: Traffic and Transport.

Cyclists

The Proposed Changes will add a new bicycle rack at the station plaza. The inclusion of CityCycle stations as part of the project will be determined in consultation with BCC.

Public transport

The proposed design will provide customers with one combined transport interchange that will connect with the Inner Northern Busway, future Brisbane Metro, long distance coach terminal and suburban and regional rail services. This design ensures that entries will be clear with a direct movement route, providing unambiguous wayfinding and reducing the possibility of queuing at the surface that may impact on the road or footpath.

Car parking

Minor modifications to the Evaluated Project include a maintenance on-street parking bay provided on Roma Street that will be signed for the purpose of loading/unloading and for the sole use of the station.

Site/Property access

The design maintains access to Roma Street Station from the north and south. The proposed design includes one entrance parallel to Roma Street that will primarily service the surface rail station. A second entrance perpendicular to Roma Street will service the CRR station. This design will benefit the interchange flow from rail to bus and will also simplify customers experience by ensuring a single ticket environment.

This design ensures that entries will be clear with a direct movement route from the surface to the platform level, providing unambiguous wayfinding. This will reduce queuing at the surface that may impact on the road or footpath.

Special events

A benefit of the Proposed Changes is that the large entrance plaza has programmable spaces that can be used for seasonal events throughout the year. The proposed station will have several spaces allotted for performance artists to entertain passengers without interrupting the day to day operations and pedestrians flow in the station.

The freed-up spaces along George and Roma Street as a result of reclaiming a portion of Herschel Street will provide wider corridors to allow for entertainment and seasonal events through the year.

2.3.4.2 Albert Street Station

The main change to the project is the relocation of the proposed station north along Albert Street. The main entrance to the station would be located on the corner of Albert Street and Mary Street, with a second off-street entrance at 142 Albert Street.

Construction

The construction impacts as a result of this change on the various modes of transport are discussed below.

Vehicle traffic

There are Proposed Changes to the construction methodology from cut and cover to now a mined tunnel approach and the station will be located a block north from the Evaluated Project. This method will be less disruptive to existing surface level retail and commercial activities, pedestrian and vehicular movements, and essential utility services than the Evaluated Project. This also includes less impact on the intersection of Albert and Charlotte Street, and the Myer Car park ramp would be retained (it was removed in RfPC-1).

Albert Street is proposed to be closed between Charlotte Street and Elizabeth Street for the construction phase, except to allow vehicles to access the carpark of the Royal Albert Hotel. This is a change from the Evaluated Project and would result in redistribution of traffic in the CBD network. The proposed new design will require approximately 13 trucks per hour, compared to five which was estimated for the Evaluated Project. Traffic analysis has been conducted for this change (Appendix A: Traffic and Transport- A1 Updated Traffic Impact Analysis – Albert Street) and shows that the road network would continue to function with similar levels of service at key intersections.

The Project OEMP identifies routes within the CBD that are restricted for haulage vehicles, including Elizabeth Street. However, consultation with BCC has indicated that construction heavy vehicles may be able to access the northern Albert Street worksite via Elizabeth Street. This would be confirmed through the development of the CTMP in accordance with the existing Imposed Conditions.

Construction vehicular traffic connecting to the greater Brisbane traffic network would access the CBD from the expressway via Elizabeth (for the northern site) or Margaret Street (for the main site) via Albert Street. Construction traffic would exit via Albert and Mary Streets. SIDRA analysis for the key intersections that would be impacted by this change is provided in Appendix A and shows that the traffic impacts are within the capacity of the existing intersections.

Haulage management will be part of the CTMP and informed by a Road Safety Assessment, to minimise the impacts on the road network. This is consistent with the requirements of the Project OEMP and the existing Imposed Conditions.

Pedestrians and Cyclists

Consistent with the Evaluated Project, safe pedestrian access through Albert Street will be maintained via hoardings around the site, as will shopfront access to neighbouring businesses. Solid hoardings will also be installed at the site perimeter. The construction phase will be completed in stages; pedestrian passages will be relocated overnight between stages to ensure through access is available most of the day demolition and construction.

Key pedestrian pathways will remain open around the Albert Street precinct.

The changed construction methodology from cut and cover to mined cavern is expected to reduce the disruption to pedestrian and cyclists during the works.

Park 'n' Ride / Kiss 'n' Ride

Consistent with the Evaluated Project, no Park 'n' Ride or Kiss 'n' Ride facilities are proposed and the taxi zone on Albert Street (between Charlotte and Elizabeth Street) will be relocated.

Car parking

The modifications to parking bays proposed in the Evaluated Project will remain as part of this Changed Project.

No onsite carparking is proposed and workers will be encouraged to use public transport.

Site/Property access

Works will be coordinated with four gates that will allow for entry and exit access for work vehicles, as opposed to two proposed in the Evaluated Project. The gates will provide specific access points to and from Mary Street and Albert Street. Main site access for heavy vehicles will be provided from two points on the Mary Street frontage with access from Albert and Mary Streets. The third and fourth gates will be located on the north and southern side of Charlotte Street (at its intersection with Albert Street) to provide access the main and the second site. A fifth access/egress gate will be made available at the northern site (142 Albert Street), from Elizabeth Street.

Closure of Albert Street between Charlotte and Elizabeth Street has the potential to impact access to local businesses in this area. Local business access will be provided for through the development of the CTMP.

Special events

As per the Imposed Conditions of the Evaluated Project, the project will reduce, as far as practical, major haulage tasks for worksites during significant events such as Riverfire and New Year's Eve.

Footpaths will remain open to avoid unnecessary detours for pedestrians and other vulnerable road users ensuring minimal impact on pedestrian flow, including during special events such as major events in the CBD.

Operation

The changes to operational traffic and transport impacts at Albert Street Station on relevant modes of transport and facilities as a result of the Proposed Changes are discussed below.

Vehicle traffic

The Proposed Changes will provide a more central station within Brisbane CBD and a closer connection to key destinations and activity areas while reducing the overall public domain footprint.

As opposed to the Evaluated Project, the relocated station would minimise any impact on the Myer Centre car park ramp by retaining its current location. Only minor changes to vehicle movements exiting the Myer car park ramp are required as drivers will have to turn right onto Charlotte St and not straight through (along Albert St) as is the current case.

The proposed design changes will require minor modification to the intersection analysis presented in the Evaluated Project. These modifications and consequent impact are examined in the revised SIDRA analysis, provided in Appendix A: Traffic and Transport. The analysis concluded that modifications required as part of the proposed design include changes to signal personalities and geometric alignments, though the impact remains generally in accordance with the Evaluated Project. Implementation of the Proposed Changes will occur in consultation with BCC and TMR in the detailed design process.

The existing taxi rank on Albert Street between Charlotte and Elizabeth Street will be relocated, consistent with the Evaluated Project. Other Proposed Changes to loading bays remain as per the Evaluated Project.

Pedestrians

Key sections of the footpath along Albert Street will be widened to accommodate additional pedestrian volumes; entrances to the station will be wide and open.

The Proposed Changes will provide Albert Street with a pedestrian public realm between Mary and Charlotte Street, connecting the station precinct with the Botanic Gardens and onto Wickham Park and Roma Street Parklands.

A proposed new underground mezzanine will provide commuters with a safer link between the two entrances. Passengers boarding/alighting will be able to choose to walk above through the public realm or below ground via a mezzanine that connects the southern and northern entries.

A key change from the Evaluated Project is that the passenger gate line is more centralised and has an additional wide access gate, which provides a faster exit point during peak periods, and a more even loading of passengers during peak boarding periods. The centralised mezzanine level will enable passengers to reach the unpaid station area in a shorter time and prevent queuing at the surface.

The entry foyer of the station has been deliberately setback from the corner of Albert and Mary Street to create a large public space, enough to accommodate very high concentrations of pedestrian traffic during peak hours. Escalators and lifts have been strategically located to assist with an efficient movement of passengers while complying with disabled access requirements.

Updated forecast number of passengers obtained from the CRR Strategic Transport model was used in the analysis presented in Appendix A: Traffic and Transport, which demonstrates that the overall capacity of the surrounding intersections will remain at an acceptable level of service. The CRR Strategic Transport Model includes forecast passenger numbers generated by future developments that may impact on the operation of the CRR Project.

Cyclists

As identified in the Evaluated Project, the public realm approach facilitates enhanced integration between the station and the wider pedestrian and cycle network. A benefit of the Proposed Changes in design is the addition of bicycle racks for public use. Relocation of City Cycle stations within the public realm area will be determined in consultation with BCC.

Car parking

Minor modifications to the Evaluated Project include a maintenance on-street parking bay provided on Mary Street that will be signed for the purpose of loading/unloading and the sole use of the station.

Site/Property access

The Evaluated Project had multiple entrances located closer to each other, whereas, the Proposed Changes consolidates these multiple entries into two more efficient combined entrances. This change will free up obstruction in the public realm and will reduce the impact on adjacent properties, creating further opportunities to deliver the proposed BCC's Albert Street Vision.

Special events

A key benefit of the changed design is the large entrance integration with the proposed Albert Street Vision. The proposed new plaza has programmable spaces that can be used for seasonal events throughout the year.

The proposed station will have several spaces allotted for performance artists to entertain passengers without interrupting the day to day operations and pedestrians flow in the station.

The freed-up spaces along Albert Street will provide wider corridors to allow for entertainment and seasonal events throughout the year.

2.3.4.3 Woolloongabba Station

The key change in the proposed design is the shift of the station building to the west, which increases the distance to 320m between the station and The Gabba, providing more space for event crowds, improved busway connection and allows for future Brisbane Metro development.

Construction

The construction impacts at Woolloongabba Station on the various modes of transport as a result of the Proposed Changes to design are discussed below.

Vehicle traffic

As per the Evaluated Project, major lane closures and other impacts to the external road network will be minimised where possible (e.g. undertaken at night or during off-peak periods). Potential lane closures include Stanley Street (e.g. for the construction of the pedestrian plaza bridge) and Main Street.

A maximum of 23 trucks per hour are anticipated at Woolloongabba Station, compared to 11 for the Evaluated Project. The impact of this additional traffic and SIDRA modelling results are presented and discussed in Appendix A. The results show that the impacted intersections do not operate within acceptable limits (with the exception of Leopard St / Stanley St intersection), both with and without construction vehicle traffic. However, it was observed that the addition of the construction vehicle traffic only has a minor impact (<5%) on the intersections, and therefore the impacts are deemed to be within acceptable limits. This will be further assessed during development of the CTMP.

Pedestrians

Although the modified design will require a larger footprint compared to the Evaluated Project, full access to existing perimeter footpaths and access around the Woolloongabba site will be maintained. New wayfinding signage will be installed as required.

An additional 4m wide pedestrian connection will be provided throughout construction to the northern side of the busway pedestrian access overbridge.

During construction of the new pedestrian plaza bridge, pedestrian diversions to the southern side of Stanley Street will be required. The impact will be managed by implementing traffic control as per project requirements.

Public transport

As per the Evaluated Project, the erection of the pedestrian bridge over the busway is proposed to minimise impact to the bus network. This includes undertaking works during night time or off-peak periods where possible, in order to minimise impacts to the busway and bus facilities. Works will be completed as per the Imposed Conditions, including in relation to noise and vibration and lighting for the Evaluated Project.

Car parking

Although on-site parking capacity has been reduced compared with the Evaluated Project (approximately 90 compared to 300 spaces), staff will still be encouraged to take public transport to site and as per the Project OEMP, workforce car parking will be managed to avoid workforce parking on local streets.

Site/Property access

As per the Evaluated Project, site access/egress will remain through Leopard Street, Vulture Street and Main Street. The Leopard Street access caters to construction traffic travelling to/from the Pacific Motorway. The Vulture Street access caters to construction vehicles exiting the site toward Ipswich Road or the Clem 7. The Main Street access caters to construction vehicles entering the site from Ipswich Road or the Clem 7.

The concentration of construction traffic at nearby intersections is dispersed amongst the network due to the multiple proposed site access points.

Special events

Existing footpath widths will be maintained so there will be no loss of capacity for events at the Gabba. Planning and adjustments to construction work and delivery schedules will be required during event times, to minimise the impact on event crowds.

Operation

The operational impacts at Woolloongabba Station on relevant modes of transport and facilities as a result of the Proposed Changes are discussed below.

Vehicle traffic

Although the station location has been shifted within the site (slightly to the west), general vehicle access will remain as per the Evaluated Project (i.e. via the existing traffic intersection at Leopard Street).

Pedestrians

The multiple entrances to the station have been consolidated to one entrance which improves pedestrian legibility. The shift of the station one block west creates a slightly longer walking distance for some pedestrians to the station entrance (e.g. from the busway, from the Gabba), but this assists in the dissipation and regulation of crowd movements on event days. Direct pedestrian connection to Stanley Street is provided via a dedicated 8m wide pedestrian bridge (Stanley Street plaza bridge) from the station to Stanley Street (over the existing busway). There is also a second 18m wide connection to Main Street serving the existing busway station and the stadium.

The CRR Strategic Transport Model showed that pedestrian volumes at Woolloongabba are expected to increase significantly upon completion of construction of the new station. However, these volumes are dispersed to numerous directions within and around the site, including transferring to bus or rail, toward Stanley Street or Vulture Street (east and west), to the Gabba and to the north or the south of the station. Furthermore, when these volumes are broken down into volumes per cycle time (assumed as 100 seconds), the maximum increase in pedestrian numbers per cycle time at the station is approximately 27 in 2026 and 34 in 2036 (compared to the 'Without CRR' scenario). Taking into consideration these volumes and the numerous dispersion directions (including two new pedestrian bridges across Stanley Street and Main Street), it is not anticipated that there will be significant impacts to the path and pedestrian network in the station vicinity as a result of Woolloongabba Station.

Cyclists

Ten undercover bicycle parking spaces and one CityCycle station are proposed on the Stanley Street plaza bridge as a benefit of the modified design. A new dedicated cycle lane along Stanley Street is proposed, as well as direct connection to the plaza bridge.

Park 'n' Ride / Kiss 'n' Ride

The Proposed Changes will provide Kiss 'n' Ride/rideshare/taxi bays consistent with the Evaluated Project. However, the project will include some minor configuration (e.g. line marking) modifications. No significant impacts are expected as part of these modifications.

Car parking

The Proposed Changes will provide one disabled passenger parking bay and temporary staff parking on the northern side of the station building, near the new plaza bridge, which was not included in the Evaluated Project.

Site/Property access

Site/property access is provided on the precinct loop as previously evaluated although some minor geometric modifications will be required to ensure the same level of service. Modifications may include upgrades to driveways, kerbs or footpaths which are not expected to create any changes to the impact identified in the Evaluated Project.

Emergency services

Restructured vehicle access around the station building is provided.

Special events

Shifting the station one block west creates a slightly longer walking distance for pedestrians, which assists in the dissipation and regulation of crowd movements on event days.

2.3.4.4 Boggo Road Station

Boggo Road Station is proposed to be moved approximately 25 metres north and is approximately two metres lower than the Evaluated Project.

Construction

The construction impacts at Boggo Road Station on relevant modes of transport and facilities as a result of the Proposed Changes to design are discussed below.

Vehicle traffic

Heavy vehicle movement will increase from 9 trucks per hour for the Evaluated Project to a maximum of 24 trucks per hour. The impact from the increase of heavy vehicle traffic will be managed by allowing a second entrance via Boggo Road, as opposed to the Evaluated Project's one-way access via Peter Doherty Street, Joe Baker Street and Boggo Road. Discussions are ongoing with BCC regarding the construction of a right-hand turn land from Annerley Road into Peter Doherty Street. A SIDRA analysis has been completed for these critical intersections (refer to Appendix A) and shows that the traffic impacts are within the capacity of the existing intersections.

Pedestrians

The changed construction methodology would include designated pedestrian access paths for the construction workforce that will be provided with separate door access to the site to separate pedestrian and plant working areas as far as practical.

Public transport

By relocating the station, the modified design will reduce disruption to pedestrian access to the Park Road /Boggo Road train and bus station. The change to a mined tunnel for the northern cavern and tunnel extent joining the southern end of the station materially reduces impacts to the surface rail lines and the busway during construction, including 24-hour operational freight lines.

Car parking

As previously identified in the Evaluated Project, due to the site constraints, minimal parking spaces will be available and will be reserved for visitors and yardman vehicles only. The construction workforce will be encouraged to use alternative transportation modes (i.e. public transport or carpooling) to reduce congestion in the area and avoid workforce parking on local streets, in accordance with the existing Imposed Conditions.

Site/Property access

Additional construction access will be made available via Boggo Road, as opposed to the current one-way access via Peter Doherty Street, Joe Baker Street and Boggo Road for the Evaluated Project.

The Proposed Changes will require a long-term partial closure of Joe Baker Road, as opposed to the Evaluated Project, which only required a partial closure of Boggo Road. However, due to the low volume of vehicles that require the use of Joe Baker Road, it is anticipated that traffic control management will be sufficient to mitigate the impact by coordinating access to the driveways on Joe Baker Road. Additionally, the proposed modification to the intersection of Annerley Road and Peter Doherty Street will enhance accessibility to Peter Doherty Street.

Operation

The changed operational impacts at Boggo Road Station on relevant modes of transport and facilities as a result of the Proposed Changes to design are discussed below.

Pedestrians

By extending the station cavern to the north, the entrance has been centralised on the corner of Boggo Road and Joe Baker to improve precinct and multimodal connectivity. This will be complemented with a new stair-free pedestrian and bicycle overpass, instead of the subterranean walkway in the Evaluated Project. This link will provide a safer link from the station to the PA Hospital, Boggo Road Urban Village, Ecosciences and surrounding Universities. Customers will be able to utilise easier, faster and integrated pathway for independent access to the single gateline.

A key departure from the Evaluated Project is the removal of a previously proposed new pedestrian bridge across Park Road Station. This reduces pedestrian connectivity at this location compared to the Evaluated Project, however is expected that this upgrade will be considered in future projects (i.e. BCC Master Plan).

Cyclists

The proposed new overpass will provide the missing piece to connect the South-East Cycleway, Eastern Cycleway and the future upgrade of the Brisbane Veloway on Annerley Road, providing an active transport link to the western suburbs via the University of Queensland and the Eleanor Schonell Bridge.

The proposed station will also provide five undercover bicycle parks. Inclusion of CityCycle in the Boggo Road Station area will be determined in consultation with BCC.

Park 'n' Ride / Kiss 'n' Ride

In the proposed design, the Kiss 'n' Ride zone will remain on Joe Baker Street, albeit shifted to the northern end of the street. However, it will provide similar services and capacity.

Public transport

The modified design will deliver a centrally positioned station that provides clear connections and sight lines between Park Road and Boggo Road Busway. Modifications will also provide a simple layout, fast access for passengers and more efficient operations.

Car parking

The new Kiss 'n' Ride zone will continue to allow for Designated Accessible Parking Bay (DAPB) People with Disability (PWD) parking bays and taxi areas. No further changes identified compared to the Evaluated Project.

2.3.4.5 Southern Portal

The proposed design moves the Southern Portal dive structures slightly south compared to the Evaluated Project. Updates to the Southern Portal are mostly to worksite access. The main location and function of the portal will remain as per the Evaluated Project.

Construction

The construction impacts at the Southern Portal on the various modes of transport as a result of the Proposed Changes to design are discussed below.

Vehicle traffic

At the Southern Portal, a maximum of nine trucks per hour are anticipated, compared to three for the Evaluated Project. Discussions with the Department of Transport and Main Roads are ongoing regarding the possibility of using the existing ramp to enter the worksite. If use of the busway is approved, then

additional civil road works are proposed, including construction of heavy vehicle access from Busway for haulage of spoil from the worksite (eastern side of rail corridor).

The impact of this additional traffic and SIDRA modelling results are presented and discussed in A3. The results show that the impacted intersections do not operate within acceptable limits, both with and without construction vehicle traffic. However, it was observed that the addition of the construction vehicle traffic only has a minor impact (<5%) on the intersections, and therefore the impacts are deemed to be within acceptable limits. Mitigation will be further assessed during development of the CTMP and will be further assessed during development of the CTMP.

Pedestrians and cyclists

The two site access points on Kent Street will be staffed to prevent accidental entry from cyclists.

Public transport

Access and use of the eastern busway on-ramp in the vicinity of the PA Hospital (Kent Street) is required to access the Southern Portal rail yard. It is likely that short term closures of the westbound lanes would be required to facilitate construction vehicle access. This would be undertaken during the night time to minimise disruptions to the bus network. Discussions with the Department of Transport and Main Roads are ongoing regarding the possibility of using the existing ramp to enter the worksite.

If the busway is utilised, then additional civil road works are proposed, including construction of heavy vehicle access from Busway for haulage of spoil from the worksite (eastern side of rail corridor). Discussions are also ongoing with Brisbane City Council regarding the construction of a right-hand turn land from Annerley Road into Peter Doherty Street.

Site/Property access

Two site access points on Kent Street are proposed; one for light vehicles and one for heavy vehicles. Light vehicles are proposed to access the site via the Kent Street / Cornwall Street intersection (the “southern gate”). Heavy vehicles are proposed to access the site from Boggo Road busway and exit from Kent Street (next to the PA Laundry building), in a circular, one-way loop (the “northern gate”). The aim of this is to segregate construction traffic from hospital traffic. This approach means that no closures to the local road, pedestrian or cycle networks are required. The temporary heavy vehicle access bridge proposed in the Evaluated Project is no longer required.

The contaminated ballast storage area is proposed to hold heavy vehicles temporarily.

Operation

No significant operational changes to previously evaluated traffic and transport impacts at the Southern Portal are anticipated as a result of the Proposed Changes to design.

2.3.5 Southern area

Construction works and final design of the Proposed Changes at stations in the southern area (with the exception of Clapham Yard) will be confined within the existing rail corridor. Therefore, no closures or diversion of local streets are expected.

2.3.5.1 Dutton Park Station

Consistent with the Evaluated Project design, the Dutton Park Station platforms have been shifted to the south of Annerley Road to optimise rail operations and significantly reduce construction and interface risk in the southern area works. A covered pedestrian overpass is proposed at the station.

Construction

The construction impacts at Dutton Park Station on the various modes of transport as a result of the Proposed Changes are discussed below.

Vehicle traffic

The changed design would relocate the overpass to a new location setback from Annerley Road. This modification will reduce impacts to Annerley Road and the Dutton Park State School caused by construction activities.

Construction vehicles will access the site during the works for the removal and delivery of materials, however as the station is not a major worksite or spoil haulage location the peak vehicle movements are not expected to impact on the road network. Construction traffic access to the site, heavy vehicle routes and traffic management will be included in the CTMP.

Pedestrians

The proposed new location of the overpass will avoid works on Annerley Road. This will reduce the expected pedestrian detours caused by the construction stage.

Cyclists

The CTMP will identify and mitigate any risks posed to the public, particularly cyclists and pedestrians travelling to and from the Dutton Park State School on Boggo Road.

Public transport

A temporary platform is proposed at Dutton Park Station during the construction period to enable the station to remain operational during construction, this avoids the requirement to close the station for up to two years during construction.

Operation

The operational impacts at Dutton Park Station on relevant modes of transport and facilities would be generally consistent with the Evaluated Project, with the exception of pedestrians. Upgrades to the station are proposed to ensure integrated pathways for independent access. The changed design also allows for longer and wider platforms to accommodate future demands.

Rail users will benefit from a new covered rail overpass to provide direct access to the station from key locations like the PA Hospital. This overpass is independent of Annerley Road Bridge, providing a wider and safer path for people away from this heavily trafficked road. The new pedestrian access at street level and via stairs and lifts at each platform will enhance the overall customer experience.

2.3.5.2 Fairfield Station

The upgrade of Fairfield Station was not part of the Evaluated Project.

Construction

The construction impacts arising from the Proposed Changes at Fairfield Station for each mode of transport are discussed below.

Vehicle traffic

The station is not a major worksite or spoil haulage location and peak vehicle movements of approximately 4 to 5 per hour would not impact on the surrounding road network. Construction traffic access to the site, heavy vehicle routes and traffic management will be included in the CTMP.

Pedestrians and cyclists

Generally, there would be no significant impact to existing pedestrian or cyclist movements on the external road network. General delays and detours will be required during construction and will be controlled with local traffic management.

Public transport

No significant impacts on public transport have been identified concerning construction works at Fairfield Station. Temporary (off-peak) disruption to the rail network are expected to be caused by the project and will be managed through the provision of replacement bus services.

Car parking

Due to the limited space at Fairfield Station, only limited parking will be provided for the construction workforce. Ridesharing and public transport will be promoted within the workforce

There are only two QR commuter parking places and one QR staff parking place to the station's south which will not be affected.

Site/Property access

Construction facilities will be set up next to the station off Equity Street and site access and delivery area will be provided off Mildmay Street for deliveries. Major crane lifts will be undertaken at night to minimise disruptions.

Operation

The operational impacts at Fairfield Station on relevant modes of transport and facilities as a result of the Proposed Changes are discussed below.

Pedestrians and parking

The works at Fairfield Station would include improved access from the station boundary to each platform, including two DAPB's parking and accessible primary path of travel from the DAPB carpark to the proposed new lift. The other side of the station would include a primary path of travel from the proposed new lift to the street.

The existing overpass will be demolished, and a new overpass will be built providing access to the central zone of the station platforms.

Cyclists

An integrated bicycle enclosure will be provided at the station. No bicycle lockers are proposed.

Kiss 'n' Ride

An integrated Kiss 'n' Ride Priority Waiting Area shelter will be provided at the station.

Car parking

The proposed new car parking arrangement will convert the southern standard parallel parking bays on Equity Street to People with Disability (PWD) parking bays. This facility is located centrally to the three station entry locations.

2.3.5.3 Yeronga Station

The upgrade of Yeronga Station was not part of the Evaluated Project.

Construction

The construction impacts at Yeronga Station for each mode of transport as a result of the proposed works are discussed below.

Vehicle traffic

The station is not a major worksite or spoil haulage location and peak vehicle movements of approximately 4 to 5 per hour would not impact on the surrounding road network. Construction traffic access to the site, heavy vehicle routes and traffic management will be included in the CTMP.

Pedestrians and cyclists

Generally, there would be no significant impact to existing pedestrian or cyclist movements on the external road network. General delays and detours will be required during construction and will be controlled with local traffic management.

Car parking

Construction facilities are proposed to be installed on the southern side of the commuter carpark on Fairfield Street. Approximately 10 carparks will be used by the temporary site accommodation area.

Site/Property access

The existing QR access will be used to bring materials to the platform. It is also proposed to establish a delivery point off Fairfield Road (between Devon Street and Cowper Street).

Operation

The operational impacts at Yeronga Station on relevant modes of transport and facilities as a result of the Proposed Changes to design are discussed below.

Pedestrians and parking

Minor footpath upgrades and signage will provide a safe transition to the station entry and incorporate priority seating adjacent to the facility.

The proposed upgrade to the design includes improved access from the station boundary to each platform, including three DAPB's and accessible primary path of travel from the DAPB to the proposed new lift. The other side of the station would include a primary path of travel from the proposed new lift to the street.

Cyclists

An integrated bicycle enclosure will be provided at the station. No bicycle lockers are proposed.

Park 'n' Ride / Kiss 'n' Ride

An integrated Kiss 'n' Ride Priority Waiting Area shelter is proposed at the station.

Car parking

Upgrades include converting the existing non-line marked parallel parking on Lake Street to DAPB's to provide close proximity parking to the station entry. Re-line marking of the road centreline and the introduction of additional signage and yellow line marking will provide safer conditions at this location.

2.3.5.4 Yeerongpilly Station

The upgrade of Yeerongpilly Station was not part of the Evaluated Project.

Construction

The proposed design will provide upgrades to the existing station rather than creating a new station as was proposed in the 2011 EIS. The construction impacts at Yeerongpilly Station for each mode of transport as a result of the changes are discussed below.

Vehicle traffic

The station is not a major worksite or spoil haulage location and peak vehicle movements of approximately 4 to 5 per hour would not impact on the surrounding road network. Construction traffic access to the site, heavy vehicle routes and traffic management will be included in the CTMP.

Pedestrians and cyclists

Generally, there would be no significant impact to existing pedestrian or cyclist movements on the external road network as a result of the proposed works. As discussed, construction traffic vehicle access and egress would be managed to prevent conflicts where pedestrian and cycle routes cross-site access points. General delays and detours will be required during construction and will be controlled with local traffic management.

Public transport

Local bus stops expected to be impacted by the Yeerongpilly Station footprint will no longer be impacted by the project as the proposed design will only include changes within the station, as opposed to the major road re-alignment works proposed in the Evaluated Project.

Park 'n' Ride and Carparking

Temporary site facilities will be installed at the commuter carpark off Wilkie Street, which will reduce the commuter car parking capacity by approximately 12 carparks. These parking spaces will be offset along Wilkie Street alongside the work zone. This small amount of capacity can be re-accommodated within the adjacent local streets.

Site/Property access

Approximately 12 QR commuter carparks (off Wilkie Street) will be used to set up construction facilities. Access to the rail corridor will also be off Wilkie Street. Modifications or temporary disruptions to access will be communicated to the public before implementation. This small number of capacity can be re-accommodated within the adjacent local streets.

Emergency Services

As described previously, construction works at Yeerongpilly Station may have minor impacts on emergency services access. Where necessary alternative access arrangements are to be provided in consultation with QR and other rail operators.

Operation

The operational impacts at Yeerongpilly Station for each mode of transport as a result of the Proposed Changes are discussed below.

Pedestrians

The proposed upgrade to the design includes improved access from the station boundary to each platform, including two DAPB parking and accessible primary path of travel from the DAPB carpark to the existing lift. The other side of the station would include a primary path of travel from the existing lift to the street.

Cyclists

An integrated bicycle enclosure will be provided at the station. No bicycle lockers are proposed.

Public transport

A minor adjustment to the location of the existing bus shelter is required to improve access and priority seating.

Park 'n' Ride / Kiss 'n' Ride

An integrated Kiss 'n' Ride Priority Waiting Area shelter will be part of the station.

Car parking

The proposed new car parking arrangement will convert the northern angle parking bays on Wilkie Street to a combination of standard and parallel DAPB's. This facility is located centrally to the three station entry locations. The remaining angle carparks will be converted to parallel carparks to allow for the proposed accessible primary path.

2.3.5.5 Moorooka Station

The upgrade of Moorooka Station was not part of the Evaluated Project.

Construction

The construction impacts at Moorooka Station on the relevant modes of transport as a result of the proposed design are discussed below.

Vehicle traffic

The station is not a major worksite or spoil haulage location and peak vehicle movements of approximately 4 to 5 per hour would not impact on the surrounding road network. Construction traffic access to the site, heavy vehicle routes and traffic management will be included in the CTMP.

Public transport

Moorooka station will remain operational during construction. This will have a minimal impact to railway users during construction activities while maintaining the operation of the network unchanged (i.e. removing the need for shuttle buses with potential impacts on surrounding roads). However, the rail service may be temporarily interrupted during off-peak periods. Arrangements for a shuttle bus operation during periods of closure would be made to provide pick up and set down from near to the existing station.

Car parking

More than 40 workforce carparks will be provided at the temporary site accommodation area on the western side of the station, off Chale Street (Clapham Yard).

Site/Property access

A large site office is proposed at this station.

Operation

The operational impacts at Moorooka Station for each mode of transport as a result of the Proposed Changes to design are discussed below.

Pedestrians

The Proposed Changes include improved access from the station boundary to each platform, including two DAPB's parking and accessible primary path of travel from the DAPB carpark to the proposed new lift. The other side of the station would include a primary path of travel from the proposed new lift to the street.

Priority seating may not be possible due to the current width between the existing barrier kerb and rail corridor fencing.

Cyclists

Provision of a bicycle enclosure adjacent to the station entry on Ipswich Road appears limited due to available land constraints.

Park 'n' Ride / Kiss 'n' Ride

The Proposed Changes include a Kiss 'n' Ride bay.

Car parking

An area of the unmarked existing parallel parking on Ipswich Road will be converted to two DAPB's and Kiss 'n' Ride bays.

2.3.5.6 Rocklea Station

The upgrade of Rocklea Station was not part of the Evaluated Project.

Construction

The construction impacts at Rocklea Station for each mode of transport as a result of the Proposed Changes to design are discussed below.

Vehicle traffic

The station is not a major worksite or spoil haulage location and peak vehicle movements of approximately 4 to 5 per hour would not impact on the surrounding road network. Construction traffic access to the site, heavy vehicle routes and traffic management will be included in the CTMP.

Car parking

More than ten workforce carparks will be provided at the temporary site accommodation area. Commuter car parks adopted to allow safe access will be offset in the adjacent upgraded car park. Approximately 42 additional parking spaces will remain after the construction of the Project as legacy.

Site/Property access

It is proposed to establish construction facilities on the southern vacant land next to the existing commuter carpark, off Brooke Street. An area to the north has been identified for the major crane lifts and assembly of the new pedestrian overpass. Access to the northern laydown area will be provided via Railway Parade.

Operation

The operational traffic and transport impacts at Rocklea Station as a result of the Proposed Changes would provide improved public access to the station. The operational impacts are discussed below.

Pedestrians

The proposed upgrade to the scope includes improved access from the station boundary to each platform, including three DAPB parking and accessible primary path of travel from the DAPB carpark to the lift. The other side of the station would include a primary path of travel from the lift to the street.

Cyclists

An integrated bicycle enclosure will be provided at the station. No bicycle lockers are proposed.

Park 'n' Ride / Kiss 'n' Ride

There is insufficient space on Brooke Street to permit the construction of a Kiss 'n' Ride facility. Conversion of three Park 'n' Ride parking bays into two passenger short-term parking bays and one shared zone parking bay will assist in providing an equivalent intent in lieu of the Kiss 'n' Ride facility.

Car parking

The existing layout of parking within the carpark may require modification to allow for the proposed DAPB's.

2.3.5.7 Salisbury Station

The upgrade of Salisbury Station was not part of the Evaluated Project.

Construction

The construction impacts at Salisbury Station on the relevant modes of transport as a result of the Proposed Changes to design are discussed below.

Vehicle traffic

The station is not a major worksite or spoil haulage location and peak vehicle movements of approximately 4 to 5 per hour would not impact on the surrounding road network. Construction traffic access to the site, heavy vehicle routes and traffic management will be included in the CTMP.

Pedestrians and cyclists

Generally, there would be no significant impact to existing pedestrian or cyclist movements on the external road network. General delays and detours will be required during construction and will be controlled with local traffic management.

Car parking

Approximately 12 workforce carparks will be provided at the temporary site accommodation area, no commuter carparks will be affected by the works.

Site/Property access

Facilities will be set up off Dollis Street. An additional laydown area is proposed off Fairlie Terrace.

Emergency Access

Construction works at Salisbury Station may have minor impacts on emergency services access. Where necessary alternative access arrangements are to be provided in consultation with QR and other rail operators.

Operation

The operational impacts at Salisbury Station arising from the Proposed Changes are discussed below.

Pedestrians

Improved access from the station boundary to each platform, including two DAPB's and accessible primary path of travel from the DAPB carpark to the lift. The other side of the station would include a primary path of travel from the lift to the street.

Cyclists

An integrated bicycle enclosure will be provided at the station. No bicycle lockers are proposed.

Park 'n' Ride / Kiss 'n' Ride

An integrated Kiss 'n' Ride Priority Waiting Area shelter is proposed.

Car parking

Existing parallel parking within the carpark will be converted to parallel DAPB's. Minor works to the southern traffic island and line marking will be required to accommodate this facility including signage and priority seating adjacent to the facility.

2.3.5.8 Clapham Yard

No works at Clapham Yard are proposed as part of the Evaluated Project.

Construction

Clapham Yard will provide fundamental stabling facility for the operation of the new CRR services and the existing wider rail network. Principal access routes to the site will remain from Ipswich and Fairfield roads, with the main site access point proposed to the western side of Chale Street. Chale Street will continue to provide for a high percentage of heavy vehicles accessing the surrounding industrial land uses. A maximum of 17 trucks per hour are anticipated at the Clapham Yard site, compared to nine for the 2011 EIS. The impact of this additional traffic and SIDRA modelling results are presented and discussed in

A3 SIDRA analysis of critical intersections with construction traffic and will be further assessed during development of the CTMP.

Works at Clapham Yard will require construction and haulage vehicles to access the site during the construction period. Traffic impacts arising from Clapham Yard works were assessed in the 2011 EIS for a similar scope of work, which found that the peak truck movements would not impact significantly on the surrounding road network and traffic conditions. There would be a significant reduction in the amount of fill proposed to be placed at the yard compared to the EIS assessment, therefore the peak number of trucks would also be reduced from the nine in peak hour that were identified in that assessment.

No impact to pedestrians, cyclists, emergency services or public buses is anticipated as a result of the Clapham Rail Yard worksite.

Operation

The operational impacts at Clapham Yard for each mode of transport as a result of the Proposed Changes are discussed below.

Vehicle traffic

Car parking at the yard would be centralised adjacent to the staff facilities between Fairfield Road and the tracks with modifications to the alignment of Chale Street to access the carpark. Cars entering the site carpark would access from the existing signalised intersection of Chale Street and Fairfield Road. Modifications to signal personalities or minor geometric changes may be required to prevent impacts to the road network at this location and will be determined during detailed design. Vehicle access to the stabling area will be grade separated with road passing over the dual gauge line.

Pedestrians

Footpaths will be delineated from the road network and a footbridge is required to cross the rail corridor from east to west for passenger access to all platforms of Moorooka Station. This footbridge will also be used to provide personnel access and movement through the facility. The main staff facilities will be located adjacent to the landing of the footbridge on the western side of all tracks. Within the yard, walkways are provided on both sides of each stabling track. Crossings of the track are provided clear of the standing points for stabled trains. Wayfinding signs will be provided at key access locations.

Car parking

Car parking would be centralised adjacent to the staff facilities between Fairfield Road and the tracks and would provide approximately 130 car parks. Access to the car park will be via the main entrance to Clapham Yard at the intersection of Fairfield Road and Chale Street.

Site/Property access

Vehicle access to Clapham Yard will be via the existing signalised intersection of Chale Street onto Fairfield Road. Staff facilities are provided outside the main lines to limit the number of vehicles needing to cross the dual gauge lines. Vehicle access to Clapham's northern stabling area is required for maintenance. A grade separated vehicle access is proposed on the alignment of Chale Street with the road passing over the dual gauge line and dual gauge passing loop to the north of the proposed platform.

A perimeter access road is provided around the stabling yard to allow vehicle access for routine maintenance and inspections of the track, associated infrastructure and rail system control equipment. Turn around points are provided at the ends of this access road to minimise any reversing of vehicles.

2.4 Changes to mitigation measures

Recommended mitigation measures for the changed traffic and transport impacts arising from the Proposed Changes are generally consistent with the Evaluated Project requirements as documented in the Project OEMP. A summary of the key relevant mitigation measures are discussed below.

Vehicle traffic

Each construction worksite would have a CTMP prepared to implement measures that avoid, minimise or mitigate, traffic problems arising during the construction phase. The CTMP would be developed in consultation with TMR, BCC and Emergency Service Authorities. The CTMP will include haulage management measures for haulage routes.

Local communities and road users would be notified of proposed changes to local traffic access arising from Project works. This includes, but is not limited to, the provision of clear signage identifying changed traffic conditions, and public advertisements (local and regional newspapers, Project website) describing the proposed changes, the duration of the changes, and possible alternative routes to avoid the impacts of the proposed changes.

Pedestrians and cyclists

Safe and functional access for pedestrians and cyclists would be maintained near Project works for the elderly, children and people with mobility difficulties (including vision and hearing impairments). Access will also consider relevant Crime Prevention through Environmental Design (CPTED) principles.

Public transport

Traffic management measures would be implemented near to Project works to minimise disruption and delays to bus services.

Bus replacement services would be provided should passenger rail operations be interrupted, such as during rail network shutdown periods or temporary closures.

The main changed impact in relation to public transport arising from the Proposed Changes is the diversion of buses onto Roma Street for construction of the Inner Northern Busway and provision of temporary bus stops. The impacts of this change on the traffic network are the subject of detailed study by BCC including consideration of mitigation options. Mitigation would include diversion route options enabled by infrastructure solutions including lane configurations and signalling. Required mitigation measures for the Roma Street precinct would be documented in the CTMP, in consultation with BCC.

Car parking

During construction workforce car parking will be provided and managed to avoid workforce parking on local streets.

Site/Property access

Access to properties adjoining or near to Project works would be maintained. Where changes to property access are required, alternative access arrangements would be identified in consultation with property owners and occupants.

To the extent reasonable and practicable, existing access to the rail corridor for maintenance and emergency service vehicles would be maintained. Where necessary, alternative access arrangements would be provided in consultation with QR and other rail operators.

The design of driveways for the Project would avoid conflicts between construction traffic and cyclists and pedestrians.

Emergency services

Access for emergency services vehicles to project worksites and adjoining properties will be maintained throughout the construction phase. Where necessary, alternative access arrangements are provided in consultation with rail operators.

Special events

Disruption to rail passenger services is to be avoided to the extent reasonable and practicable during major events such as the Ekka or events at Suncorp Station or the Gabba. Where disruptions are unavoidable, bus shuttle services are provided between appropriate stations to the major event venues, or to bypass the disrupted section in the network.

2.5 Cumulative Impacts

The traffic assessment for the Proposed Changes has considered the potential impacts arising from the changes to the Evaluated Project. However, it is recognised that there is the potential for cumulative traffic and transport impacts due to the proposed implementation of other major infrastructure projects in Brisbane. Cumulative impacts are being considered through the following working groups.

2.5.1 CRR Transport Integration Group

The CRR Transport Integration Group (TIG) comprises nominated senior CRR, TMR, QR and BCC representatives to provide oversight of cross-organisational issues that require collaboration to achieve a best for City and State outcome.

The CRR TIG would assess transport/traffic impacts to the public generated by CRR (with cumulative considerations from Brisbane Metro) and focus on:

- CRR Public transport user impacts specific to Roma Street, Woolloongabba, Boggo Road/Dutton Park and Exhibition Precincts;
- Road user impacts;
- Active transport user impacts (cyclists, pedestrians, etc);
- CRR/Brisbane Metro construction impact management and coordination for transport and traffic matters;
- Operational readiness coordination; and
- Schedule coordination for transport and traffic matters.

2.5.2 Brisbane City Centre Coordination Steering Group

Parallel to the CRR Transport Integration Group, Brisbane City Council has created the Brisbane City Centre Coordination Steering Group (BCCCSG) to ensure that open and strategic collaboration is maximized across agencies.

The BCCCSG will have a significant role to play to ensure that Brisbane remains vibrant and strong while the city undergoes substantial change through the myriad major infrastructure and other projects underway and planned over the next decade and beyond.

The BCCCSG will have oversight significant projects within Brisbane, specifically within areas of major growth and investment. These areas include those suburbs in the City Centre Master Plan and suburbs subject to planned major new transport infrastructure such as Cross River Rail and Brisbane Metro.

2.6 Conclusion

An assessment has been conducted on the potential changes to traffic and transport impacts associated with the Proposed Changes compared to the Evaluated Project. This report summarises the identified changes for the different transport modes and components of the road network and describes any significant modifications for the construction and the operation stages. Management and mitigation of potential traffic impacts will be further refined as design and construction planning progresses.

Key Proposed Changes from the Evaluated Project and potential traffic and transport impacts are described below:

Mayne Area

For the construction stage, the overall works have increased; however, the traffic and transport impact changes are still generally consistent with the Evaluated Project. No significant impact changes on the external road network were identified.

For the operation stage, the Project changes are predominantly to the northern yard with alignment reconfiguration, bridge over Breakfast Creek, upgraded and new stabling and supporting facilities. Proposed modifications will provide better accessibility and improved parking capacity.

Northern Area

For the construction stage, traffic and transport impacts were generally similar to those identified for the Evaluated Project. Minor modifications to site accesses and final layouts are not likely to affect the road network significantly.

For the operational stage, the Proposed Changes include upgrade of Exhibition station within the evaluated site. A similar level of service is offered with additional layout improvements to pedestrian and cyclists infrastructure.

Roma Street Station and Inner Northern Busway

Construction work proposed to lower the Inner Northern Busway into the underground increases the work area in the Roma Street precinct and impacts on the operation of the busway, including requiring the diversion of buses onto Roma Street. The duration of the diversion and the strategies to manage this impact will depend on detailed planning and options assessment which is currently in progress through a working group which includes BCC and TransLink.

For the operational stage, the Roma Street Station has been relocated to the east to free up frontage for an open plaza that will provide safer access to the station. The new plaza will provide improved pedestrian capacity and will connect well with the proposed pedestrian crossing at Roma Street. Changes to vehicles and pedestrian movements can be incorporated while maintaining an acceptable level of service. The proposed design of the Roma Street precinct will provide customers with one combined transport interchange that will connect with the Inner Northern Busway, Brisbane Metro, long distance coach terminal and suburban and regional rail services.

A new intersection is proposed to connect Herschel Street directly into Parkland Boulevard, which provides the benefit of reducing the number of signalised intersections on Roma Street and providing connection directly to Parkland Boulevard.

Albert Street Station

Construction methodology has been optimised to reduce impact on pedestrians and the vehicle network. The Proposed Changes and consequent modifications to the road network appears to satisfy minimum required levels of service (based on SIDRA modelling).

For the operational stage, the updated design of Albert Street reduces the impact on the road infrastructure while providing a safer and more efficient movement of pedestrians. The Proposed Changes and consequent modifications to the road network appears to satisfy minimum required levels of service (based on SIDRA modelling), although could require some geometric modifications to cater for 2036 demands.

Woolloongabba Station

There may be some minor interruptions during construction to the road network and the busway. These will be minimised where possible, for example by undertaking lane closures at night or outside of peak periods. The Proposed Changes relocate Woolloongabba Station one block to the west of the Evaluated Project, but still within the Evaluated Project station site. This increases the walking distance to/from the Gabba, which assists in dissipation and regulation of crowd movements on event days. The design proposes to consolidate the station entrance points to one, thus improving pedestrian legibility.

Consistent with the Evaluated Project, the introduction of Woolloongabba Station results in a significant increase in pedestrian volumes in the precinct. However, when these volumes are dispersed around the site and broken down into volumes per cycle time, it is not anticipated that there will be significant adverse impacts on the path and pedestrian network.

Southern Portal

During the constructions stage, there will be an increase in haulage at the Southern Portal and proposed changes to access to the construction worksite which would use the eastern busway onramp. Traffic analysis of surrounding intersections indicates that the impact of increased haulage can be managed through haulage management measures in the CTMP. The design and location of the Southern Portal remains considerably similar to the Evaluated Project, with the addition of improved access to pedestrians into the station.

Boggo Road Station

For the construction stage, the traffic and transport impacts were generally similar to those identified for the Evaluated Project. Mitigation measures include minor geometric modifications to the intersection of Annerley Road and Peter Doherty Street, and the inclusion of a second entrance to distribute worksite through access more efficiently.

For the operational stage, Boggo Road Station has been relocated although it remains within the evaluated footprint. This Proposed Changes include an updated design that replaces the pedestrian underpass with a bridge. This will offer a safer and more efficient connection to the Boggo Road Urban Village, the Hospital and surrounding Universities.

Dutton Park Station

Minor construction modifications are proposed in the Proposed Changes compared to the Evaluated Project and these are not expected to create a significant impact on the road network.

For the operational stage, Dutton Park Station are proposed to enhance accessibility for pedestrians. Upgrades will include a new overpass that will keep users away from the traffic at Annerley Road and will provide an integrated pathway for independent access to the boarding platforms. Upgrades also include improvements to the level of service of the platforms by increasing the loading/unloading areas. The impact on commuters and vehicle traffic has been reduced by relocation the overpass.

Fairfield to Salisbury Stations

The Proposed Changes include upgrades of Fairfield to Salisbury stations for improved accessibility and to provide integrated pathways for independent access. The station works are a change from the

Evaluated Project, however station upgrades at certain stations were proposed in the 2011 EIS. Station upgrades will occur within the existing rail corridor and will incorporate improvements to end of trip/drop-off facilities, including better access for vehicles, upgraded carpark layouts, improved pedestrian travel paths and installation of new platforms.

The station works are not expected to generate large numbers of heavy vehicles therefore would not result in impacts to the road network. Local traffic management will be coordinated with stakeholders to ensure safety to users and construction workers. Operational changes are considered to provide improvements to users of the stations.

Clapham Yard

Construction of the Clapham Yard will generate a number of heavy vehicles accessing the site not anticipated in the Evaluated Project, however, similar to that previously evaluated under the 2011 EIS. Analysis of key intersections near the yard indicates this would not have a significant impact on the road network.

Project changes to Clapham Yard include the reconfiguration of the existing stabling capacity, additional supporting facilities and changed internal road alignments. Upgrades to the yard will provide improved parking capacity and integrated pathways for independent access from the carpark to the boarding platforms (at Moorooka Station). While an increase of vehicular traffic is expected on Fairfield Road due to the provision of additional parking bays at the yard, impacts to the existing road network can be mitigated with modifications to signals personalities and minor geometric changes. The introduction of a formalised station carpark will assist in alleviating parking demands on the local road network.

Overall, the traffic and transport impacts associated with the Proposed Changes provide accessibility upgrades to the proposed design. Identified impact changes can continue to be managed in accordance with the existing Imposed Conditions, including the approved Project OEMP.

3. Technical Report: Property

3.1 Introduction

The key aspects addressed in the technical report include land use types, property requirements, land tenure, new and approved development, post-construction land use, and mitigation measures. Overall, the potential impacts on land use and tenure have slightly increased from the Evaluated Project, although remain less than that approved in the 2012 CGER.

3.2 Changes to Potential Impacts

3.2.1 Land Use Types

As with the Evaluated Project, land uses within and adjacent to the CRR Project reflect inner city and inner suburban land use types. These are a mix of commercial, light industrial, community and open space and residential uses. Key changes include:

- upgrades to existing railway stations between Fairfield and Salisbury to facilitate an integrated pathway for independent access;
- additional land requirements at Clapham Yard;
- additional land requirements for the upgrade of Dutton Park Station;
- an increase in the surface and volumetric land requirements for Boggo Road Station, with the land impacted being predominantly State-owned;
- changes to the horizontal and vertical tunnel alignment north of Boggo Road station through to the Botanic Gardens, resulting in a reduction to the number of volumetric acquisitions and changes to the properties along the alignment affected by volumetric requirements;
- a shift of Woolloongabba Station to the west and changes to the station box and cavern, resulting in increased volumetric land requirements north and south of Woolloongabba Station;
- additional volumetric land requirements associated with an increase to the Albert Street Station cavern;
- additional surface land requirements for the development of a second pedestrian entrance to Albert Street Station;
- a change in underground tunnel alignment between Albert Street and Roma Street Stations, to avoid Brisbane City Hall and the Brisbane Supreme and District Courts Complex;
- re-alignment of part of the Inner Northern Busway at Roma Street;
- changes to the surface and volumetric land requirements at Roma Street Station;
- the construction of a new railway bridge across Breakfast Creek and an extension of works within existing rail corridor to the north of Mayne Yard to Albion; and

- additional roadworks at each of the station sites.

Consistent with the Evaluated Project, construction of some of the below ground infrastructure (eg. stations) may influence future development opportunities at some locations. Key differences to land use impacts from the Proposed Changes compared to the Evaluated Project are summarised in Table 4.1.

Table 4.1. Key changes to land use impacts

Location	Land Use Impacts	
	Evaluated Project	Proposed Changes
Fairfield to Salisbury	Land use impacts from new Yeerongpilly station and upgrades of Moorooka and Rocklea stations were approved in the 2012 CGER and subsequently removed in RfPC-1.	Existing railway stations between Fairfield and Salisbury will be upgraded to facilitate an integrated pathway for independent access, as well as providing additional platform faces to support Cross River Rail and wider rail network operations. Generally, works will be confined to the existing rail corridor and railway stations, with some incidental works to improve access to be undertaken on footpaths and in the existing station car parks. At Yeerongpilly, footpath upgrades are proposed to be undertaken on Wilkie Street. Neighboring land uses include both single unit and multi-unit residential dwellings. At Clapham Yard, additional land is required for the stabling facilities. A portion of the land required is currently used for industrial purposes, with the balance of land being rail corridor land. The land is a mixture of private and State-owned. Neighboring industrial properties may experience additional construction impacts such as noise, dust and increased traffic while works are being carried out.
Salisbury to Dutton Park	Redevelopment works were confined to the existing Dutton Park Station and no further land requirements were identified.	Redevelopment works at Dutton Park Station now include an extension of the rail platform to the south. This extension will necessitate the acquisition of two additional properties located in Cope Street, Annerley. The impacted properties are two multi-unit residential dwellings which comprise a total of thirteen separate allotments.
Dutton Park Station to Boggo Road Station	Permanent surface impacts of the evaluated Boggo Road Station were confined to the Reserve land known as 'Outlook Park', with only temporary surface construction and volumetric impacts on adjacent land.	The updated design of Boggo Road Station results in an increased permanent impact to the surface and subsurface of land zoned as Specialised Centre – Major Education and Research of approximately 4132m², and land zoned as Mixed Use (Corridor) of 481m². Both impacted parcels are owned by the State of Queensland (represented by Department of Housing and Public Works). Impacts to the Eastern Busway have been reduced due to the shift of the underground station box to the west, however, the Ecosciences precinct (which contains sensitive equipment) will now have an increased volumetric impact under the north-eastern corner of the property. An option for additional land for temporary use during construction has been identified on Joe Baker Street, adjacent to the Eastern Busway Station. This may result in a heightened interface with users of the Eastern Busway Station, with potential impacts such as noise, dust and changes to access routes to the Busway Station during construction.

Location	Land Use Impacts	
	Evaluated Project	Proposed Changes
		The ESA village (Leukaemia Foundation) located adjacent to the proposed station site will potentially be impacted by increased noise, vibration and dust impacts due to the change of station location and additional surface works proposed to be undertaken in the adjacent open space. Additional minor roadworks will be required around the Boggo Road Station site in Peter Doherty Street, Joe Baker Street and Boggo Road, which may have temporary impacts on adjacent land users including the ESA village (Leukaemia Foundation), private residents and Dutton Park State School. There has been a reduction in the requirement for a temporary construction area on the northern side of the rail corridor, with two State-owned parcels currently used as commuter and employee parking associated with Park Road Railway Station no longer needed. It is considered that construction land use impacts at this location will be greater than the Evaluated Project due to the increased area and scale of work activities proposed. On completion of construction works, land around Boggo Road Station will be available for future development.
North of Boggo Road Station to Woolloongabba Station	Woolloongabba Station was located on the east section of the old Go-Print site. Residential land from Quarry Street and commercial land on Hubert Street was impacted volumetrically.	The volumetric alignment has shifted slightly east from Quarry Street to Ross Street, however its extent remains unchanged. From Ross Street to Peterson Street, the volumetric alignment straightens, resulting in an overall reduction in impacts to affected properties. The properties impacted by the tunnel alignment at this location are predominantly character residential. From Peterson Street, there is a significant shift in the volumetric alignment to the west, so that residential and commercial properties in Reid Street will be impacted volumetrically. The change in alignment means that commercial properties on Stanley Street which were not previously impacted by the Evaluated Project will now be impacted, with previously impacted properties in this location no longer impacted. The Woolloongabba Station site is proposed to move 70m west within the Go-Print site. The Go-Print building, Landcentre building and former South Brisbane Dental Clinic have been demolished and site remediation works are underway. There will be a greater extent of volumetric impact on the western portion of the Go-Print site, and a reduced volumetric impact on the eastern portion of the Go-Print site, and the Landcentre site.

Location	Land Use Impacts	
	Evaluated Project	Proposed Changes
		The South East Busway station will be impacted by a new overhead pedestrian connection to be constructed from Woolloongabba Station to Stanley Street. Some additional roadworks will be required on Stanley Street, Main Street and Leopard Street to facilitate footpath access and pedestrian flow. Minor roadworks will also be undertaken on the Vulture Street Off Ramp to improve access to the Woolloongabba Station site. On completion of construction works, the land adjacent to Woolloongabba Station will be available for development.
North of Woolloongabba Station to Albert Street Station	An area north of Vulture Street (at the St Nicholas Russian Orthodox Church) was impacted volumetrically. The Evaluated Project alignment volumetrically impacted the predominantly single unit and low rise multi-unit residential area just west of Main Street. Albert Street Station was located in the block between Mary Street and Charlotte Street, with the entire surface of Albert Street between Mary Street and Elizabeth Street required for temporary construction works.	Due to the realignment of Woolloongabba Station to the west of the Go-Print site, the underground tunnel to the north has also moved to the west. The result of this shift is that the St Nicholas Russian Orthodox Church is no longer impacted, however alternative land slightly west on Vulture Street is now impacted. The impacted land is zoned MU1 Mixed Use (Inner City) and the underground tunnel may have an impact on the future development potential of the site. The change in location of the underground tunnel continues under the predominantly single unit and low-rise multi-unit residential area between Leopard Street and Main Street. The tunnel then straightens under the Brisbane River, resulting in a corresponding shift in the alignment slightly to the north-east under the Botanical Gardens. The tunnel alignment then recalibrates with the Evaluated Project alignment in Albert Street. There is a reduction of permanent volumetric impacts on commercial properties in Mary Street to the east of the Albert Street intersection. However, there will be additional temporary volumetric impacts on properties located in Mary Street to the west of the Albert Street intersection and in Albert Street for temporary rock anchoring during construction. Albert Street Station requires the demolition of the same ten small commercial properties located on the north-west corner of the Albert Street intersection with Mary Street and one medium rise commercial building on the south-west corner of this intersection. The development of a second pedestrian entrance to the station in Albert Street near the intersection with Elizabeth Street results in additional permanent volumetric land requirements, as well as surface requirements from two additional properties. The land impacted is zoned PC 1 Principal Centre (City Centre) and the properties are privately-owned medium-rise commercial buildings.

Location	Land Use Impacts	
	Evaluated Project	Proposed Changes
		Some properties which were not previously affected by the Evaluated Project but are adjacent to the second pedestrian entrance are now impacted by volumetric requirements. There are also slightly increased volumetric requirements under properties located in Albert Street between Elizabeth Street and Queen Street. The majority of the road reserve surface of Albert Street between Charlotte Street and Elizabeth Street is now not required for construction purposes. As a result, the Myer Centre carpark exit ramp located in Albert Street will remain in place, with no closure required during construction. Some additional roadworks will be required in Mary Street and Charlotte Street to facilitate changes to traffic signalling and improve pedestrian flow during construction. The changed design supports BCC's Albert Street Vision project proposed along Albert Street by removing the street entrances and having plaza entrances to the station.
West of Albert Street Station to Roma Street Station	The volumetric alignment had volumetric impacts on the Brisbane Supreme and District Courts Complex and mixed commercial and residential sites along George Street between Herschel Street and Makerston Street.	The underground tunnel from Albert Street to Roma Street has been realigned to a more direct route passing under King George Square and Emma Miller Place, thus avoiding Brisbane City Hall and the Brisbane Supreme and District Courts Complex. Land use impacts will be reduced on mixed residential and commercial properties located on George Street between Herschel Street and Makerston Street, however, there will be an increased interface with the Inner Northern Busway during construction. As a part of the Roma Street Station works, the Roma Street section of the Inner Northern Busway will be re-aligned and lowered. To enable re-alignment of this section of the Inner Northern Busway, the reserve land known as 'Emma Miller Place' will be temporarily impacted during construction. The land will also be permanently impacted volumetrically by the underground tunnel as a result of the new alignment. The State-owned land located immediately east of the Brisbane Transit Centre building will be the site of permanent infrastructure associated with Roma Street Station, and accordingly this parcel of land will be required permanently. The increase in land and construction workspaces required to construct Roma Street Station will increase impacts on users of surrounding land, which includes both residential and commercial uses.

Location	Land Use Impacts	
	Evaluated Project	Proposed Changes
		Additional construction areas to facilitate development of the Roma Street Station will be required on land adjoining the existing rail corridor, which is currently used for railway employee carparking, operations and maintenance. Platforms 2 and 3 at Roma Street Station are required to be temporarily decommissioned to facilitate demolition of the coach deck attached to the Brisbane Transit Centre. While closed, new foundations will also be installed in Platforms 2 and 3. To support these works, access will be required to an additional temporary construction area directly adjacent to the State Heritage listed station building. The roadway known as 'Parkland Boulevard' adjoining Roma Street will be the main haulage egress from the station construction site. The roadway will also be temporarily relocated (in a staged manner) during the relocation of the Roma Street section of the Inner Northern Busway. An additional permanent volumetric cavern will be developed at the far western end of what is currently the carpark ramp for the Brisbane Transit Centre. This area will be used as a plant and equipment room for the underground station. Overall, the extent of volumetric impact for Roma Street Station has increased from the Evaluated Project, however, those impacts are confined to State-owned land. Roadworks will be required in Herschel Street, Makerston Street and Roma Street to improve footpaths and pedestrian mobility while construction works are underway.
North of Roma Street Station to Exhibition Station	The 2012 CGER evaluated permanent impacts in Victoria Park for new surface rail and the construction worksite. This impacted area was reduced in RfPC-1 to small areas of the eastern end of Victoria Park and the north and south of the ICB corridor were temporarily impacted as a worksite. Temporary and permanent land use impacts at the RNA Showgrounds by additional rail lines and the new Exhibition Station were evaluated and the authorized area impacted was slightly reduced in RfPC-1.	Additional land at the eastern end of Victoria Park will be required for the widening and extension of access from Gregory Terrace and the establishment of additional construction workspaces on the southern side of the rail corridor. Vegetation will be required to be cleared within Victoria Park to facilitate the additional road and workspace requirements. Potential impacts to adjacent land uses which are commercial in nature may include noise, dust and light during night works. Land use impacts within Victoria Park are expected to be similar or an improvement to the Evaluated Project, as the change to access the rail corridor via the BTS site reduces the overall site impacts. The temporary worksite area to the north of the existing rail corridor on Gilchrist Avenue remains as per the Evaluated Project. Additional access routes through the RNA Showgrounds to the Exhibition Station will be required at various construction stages. These will be agreed with the RNA during construction to minimise impacts to showground operations.

Location	Land Use Impacts	
	Evaluated Project	Proposed Changes
	In the 2011 EIS four vacant properties on the north side of O'Connell Terrace were directly impacted for construction of the new widened road bridge over the tracks.	The proposed temporary construction area adjoining the rail corridor has been relocated from the area known as 'Sideshow Alley' to part of the site fronting O'Connell Terrace. In its new location, the temporary construction area has been expanded to approximately one hectare. Overall, land use impacts on the RNA Showgrounds are considered to be increased compared to the Evaluated Project, however it is expected the relocation of temporary workspaces out of the centre of the site to the perimeter will decrease impacts on the showground operations.
North of Exhibition Station to Mayne Yard	In the 2011 EIS, land was permanently required north of O'Connell Terrace for additional track and realignment, and a feeder station near Mayne Yard. In addition, a viaduct extended through the east side of Mayne Yard to the merge at the Breakfast Creek rail bridge. The Evaluated Project had two individual tracks on different ground level alignments through Mayne Yard and the land use impacts were generally consistent with the 2011 EIS.	The land located on the northern side of O'Connell Terrace which was identified in the Evaluated Project as permanently required will now only be required as a temporary workspace during construction. Land use impacts remain largely as per the Evaluated Project, except for an expanded temporary worksite located in Campbell Street, which is now proposed to include the full subject parcel. The impacted land is freehold land owned by Brisbane City Council and currently vacant. At the eastern end of the site, proposed road and footpath works increase potential for an increased interface with the North Brisbane Bikeway.
North of Mayne Yard	The Evaluated Project does not have works proposed north of Breakfast Creek. The CRR alignment follows the existing rail corridor and extends northwards connecting in to the existing northern lines just south of Albion Station.	Land impacts largely remain within the Queensland Rail Mayne Yard area, however, have extended to encompass the QR rail maintenance center. To the north of Mayne Yard, the demolition of the eastern rail bridge (Suburban mainline bridge) and the construction of a new rail bridge is proposed over Breakfast Creek, which is located on unallocated State land. North of Breakfast Creek, works within the existing rail corridor are extended to the Albion Road underpass. Adjacent land uses around Mayne Yard and Breakfast Creek are industrial, with some commercial and residential properties north of Breakfast Creek. The proposed construction area has increased within the existing rail corridor from the Albion Road underpass to Albion Station. Adjacent land uses include both commercial and residential, with a recently constructed large mixed-use development located at the intersection of Albion Road and Hudson Road known as 'Hudson at Albion Mill'. Potential impacts during construction may include noise, dust and lighting.

3.2.2 Newly Completed and Approved Development

Since 2016, a number of developments have been approved and constructed within the vicinity of the Evaluated Project, particularly around the sites for the Boggo Road Station, Woolloongabba Station and Albert Street Station. The new developments are mostly residential and mixed-use widely ranging in scale.

Of particular note, is the approved development planned to be undertaken on land located in Reid Street and Hubert Street, Woolloongabba. The approval is for the construction of a mixed-use development over what is currently eight allotments. Overall, the shift in location of Woolloongabba Station to the west means the Proposed Changes have greater beneficial impact to support this future development than the Evaluated Project.

Further information in relation to those developments which may potentially have a cumulative impact on the CRR Project are discussed within the relevant technical reports. These developments have been considered and accommodated within the proposed design changes.

3.2.3 Property Requirements

A total of 224 property acquisitions are required for the Evaluated Project, comprising 29 properties for surface works and 195 for volumetric acquisition for underground tunnel and station works. In the 2011 EIS, a total of 412 properties would have been impacted by a whole or partial acquisition, including 108 properties for surface works and 304 for volumetric acquisition.

Under the Proposed Changes, the number of property acquisitions required is 202, comprising 50 properties required for surface works and 152 for volumetric acquisition. This is a reduction of 43 volumetric acquisitions and an increase of 21 surface acquisitions compared to the Evaluated Project.

A breakdown of surface and volumetric property requirements by land use type is provided in Table 4.2. Overall, this indicates that there are 202 properties (both at surface and below) that require acquisition for Proposed Changes compared to the Evaluated Project, mainly due to the shift in underground tunnel alignment between Boggo Road Station and the Brisbane River, which significantly reduces the number of residential properties impacted volumetrically.

Table 4.2. Number of properties¹ required by land use type

Property Acquisition – Land Use Type	2011 EIS	Evaluated Project	Proposed Changes
Surface Acquisition – number of properties			
Residential	39	0	2
Commercial / Industrial	60	17 ²	31
Other (park, showground, etc)	9	14	17
Total properties requiring surface acquisition	108	29	50
Volumetric Acquisition – number of properties			
Residential	235	141	104
Commercial / Industrial	50	38	33
Other (park, showground, etc)	19	16	15

Property Acquisition – Land Use Type	2011 EIS	Evaluated Project	Proposed Changes
Total properties requiring volumetric acquisition	304	195	152
Total properties requiring acquisition	412	224	202

1- Property numbers based on ownership, development and uses of properties as at March 2019 and exclude existing roads, waterways, busways and railway properties

2- Includes two sites added as part of RfPC 3

3.2.4 Land Tenure

As with the Evaluated Project, properties directly affected and requiring standard or volumetric acquisition for the Proposed Changes comprise a mix of tenure types, including state land lease, freehold, reserves, roads, deeds of grant and tidal waterway. The way in which land tenures are dealt will be consistent with the Evaluated Project and normal practice for rail corridors and stations, and any surplus land.

3.2.5 Post-construction Land Use

The changes in the underground station locations has optimised and increased future land use opportunities within the station precincts. This has significant economic and social benefits by facilitating increased development opportunities. These Proposed Changes include:

- Reduced station and plaza footprints to increase the future over station development and post construction land use;
 - 500m² reduction in infrastructure footprint at Roma Street Station
 - 50m² reduction in infrastructure footprint at Albert Street
 - 400m² reduction in infrastructure footprint at Woolloongabba Station
- The changed construction method of Albert Street Station reduces the need for station buildings and infrastructure above the station box on the corner of Albert and Mary Streets, thus allowing full independent future over station development to occur; and
- Moving the Woolloongabba Station to the west maximises the area of higher value land to the east for future development.

3.3 Mitigation Measures

Mitigation measures which are consistent with the Evaluated Project include the following:

- Ongoing consultation to be undertaken with key stakeholders in relation to future development;
- Ongoing consultation to be undertaken with the RNA with regard to the design, access, heritage and construction schedules;
- Access to adjoining properties and access for delivery vehicles to be maintained, where practicable. Where changes to access are required, alternative access arrangements to be identified in consultation with property owners and local businesses;
- Safe and efficient access to major land uses such as the RNA Showgrounds, Gabba Stadium, Suncorp Stadium and Roma Street Parklands, particularly during major events;

- Implement appropriate environmental measures aimed at reducing potential construction impacts such as noise and vibration, dust, emissions and odours and construction traffic;
- Access for emergency services vehicles to be maintained for the duration of construction works;
- Minimise the size of CRR Project permanent and construction worksite footprints to reduce impacts on existing land uses through design refinement;
- Undertake ongoing consultation with QR regarding post construction use of QR land required for the construction worksites; and
- Undertake ongoing consultation with relevant parties where disruptions to land uses and facilities are required.

3.4 Conclusion

The key changed effects to land impacts as a result of the proposed design changes are:

- there will be increased surface acquisitions required, predominantly to accommodate the northern entry to Albert Street Station and the upgrade to Dutton Park station; and
- there will be reduced and changed volumetric acquisitions required due to the straightened tunnel alignment, primarily associated with the changed tunnel alignment between Boggo Road, through the Woolloongabba Station to Albert Street.

4. Technical Report: Soils, Geology and Geomorphology

4.1 Introduction

This technical report assesses the likelihood of an increased risk of actual or potential environmental harm to land from the Proposed Changes to the Evaluated Project. Key work activities that may increase the risk of environmental harm include:

- construction of additional stabling facilities at Clapham Yard and Mayne Yard;
- upgrading of existing station and track works within the Queensland Rail (QR) corridor;
- relocation or realignment of proposed underground stations; and
- construction of new bridge crossings at Moolabin Creek in the south and Breakfast Creek in the north.

The increased risk of environmental harm results from an increased disturbance of both surface and sub-surface materials. This increase in ground disturbance can then lead to soil erosion, as well as uncovering and incorrectly managing Potential Acid Sulfate Soils (PASS), Actual Acid Sulfate Soils (AASS) or contaminated soil.

Also, the tunnelling and excavation works can lead to land settlement impacts which can pose a risk to infrastructure, utilities and buildings. Settlement is considered ground movement as a result of running tunnels, cross passages, mined station tunnels, caverns station box shafts and portal dive structures. Modelling of potential settlement as a result of the Proposed Changes has been completed to further refine the understanding of any new impacts and required management associated with the existing infrastructure along the alignment.

4.2 Assessment Methodology

Assessment of the changes to erosion risk, further disturbance of PASS/AASS and or contaminated land impacts from the Proposed Changes included:

- Desktop review of soil types along the new alignment to determine
 - Soil erosivity
 - Determine the potential presence of PASS or AASS
- A review of previous contaminated land assessments completed for the Evaluated Project;
- A review of the Environmental Management Register (EMR) and Contaminated Land Register (CLR) was undertaken for the proposed changed alignment which were outside of the PSI footprints; and
- Preliminary Site Investigations (PSI) completed for the Evaluated Project footprint and areas for the Proposed Changes.

The scope of work undertaken as part of the PSI comprised the following:

- Review of site history documentation;
- Review of desktop information;
- Review of legislative changes;
- Site Inspection; and

- Preparation of PSI reports.

Settlement modelling was completed by the Tunnel, Stations and Development contractor to measure the alteration of ground surface settlement contours along the alignment induced by tunnelling and excavation works. To achieve this the proponent used the software program XDisp. The program performs 3D modelling of predicted vertical and horizontal ground movement resulting from tunnelling and open-cut excavations. The model considers cumulative settlement impacts from multiple tunnels in the same area and effects from both construction and temporary and permanent loadings. However, the results are based on greenfield site conditions, meaning the influence of existing structures are not included.

4.3 Changes to Potential Impacts

4.3.1 Erosion Risk

The 2011 EIS had identified, based on soil landscape, Dutton Park to Fairfield as having a moderate erosion risk with a Brisbane River soil landscape being the dominant type. South of Fairfield to Clapham Yard was classified as having a moderate erosion risk with Woodridge soil landscape being the dominate type in this area. South of Clapham Yard has a combination of both Woodridge and Woongoolba soil landscape which have an erosion risk of moderate to high.

The Proposed Changes for the alignment between Dutton Park to Clapham Yard will predominately be station upgrades and trackwork with limited earthworks. While Clapham Yard will require additional earthworks and associated soil disturbance the quantity of imported fill will be less. Based on this, the erosion risk of the Proposed Changes compared to the 2011 EIS are considered to be lower. However, additional detailed planning will be required for the proposed works around Moolabin Creek.

For the Evaluated Project, Dutton Park Station, Southern Portal, Boggo Station and Woolloongabba Station have all been identified as having a low erosion risk, Roma Street Station has a low to moderate risk with the Northern portal a moderate to high risk. Exhibition Station and the general RNA showground have a moderate to high erosion risk. Works within the Mayne Yard and Breakfast Creek will have a moderate to high erosion risk.

The erosion risk from the Proposed Changes compared to the Evaluated Project will remain constant for the majority of the alignment. However, with increased works associated with the INB open cut and cover method and the new bridge works over Breakfast Creek, the erosion risk for these two areas will increase.

Boggo Road Station, Roma Street, while the Northern Portal posed a moderate to high risk. The Proposed Changes will disturb soils within the similar areas and therefore the erosion risk will remain the same.

4.3.2 Acid Sulfate Soils

The Evaluated Project identified potential for disturbance of Acid Sulfate Soils (ASS) at Albert Street Station and Mayne Yard. At the other underground station locations, including Boggo Road, Woolloongabba and Roma Street, the potential for exposure of ASS from excavation was considered low. Based on the Department of Natural Resources and Mines' (DNRM) and Brisbane City Council's (BCC) ASS Mapping, the Proposed Changes for the alignment have potential for additional impacts on ASS materials which have potential to occur at Mayne Yard, Breakfast Creek and Moolabin Creek. With the proposed surface works associated with new Mayne Yard North stabling facility and works for the new Breakfast Creek bridge, there will be an increase in the quantity of potential ASS disturbance compared to the Evaluated Project. Reference to the Queensland DNRM's Acid Sulfate Soils – Tweed Heads to Redcliffe 1:100,000 Map 1, indicates that the Mayne Yard and Breakfast Creek area falls within land mapped as disturbed land likely to contain ASS (limited field investigation completed) and the Moolabin

Creek area falls within the land mapped as land with a low probability of ASS occurrence (limited field investigation completed).

Reference to the BCC's PASS and AASS Overlay Map OM-016.1 indicates the following areas are within the land at or below 5m AHD sub-category and have further potential to contain ASS:

- Albert Street Station and surrounding area;
- Area within the northern section of Mayne Yard and Breakfast Creek; and
- Areas within the southern section at Moolabin Creek, Yeronga, Rocklea and Salisbury.

A reduced impact at Albert Street is predicted as the station is now a fully mined cavern instead of cut and cover station box construction method which reduces the surface area excavated and thus the volume of soil.

4.3.3 Contaminated Land

A desktop review comparing the Proposed Changes against the Evaluated Project was undertaken to identify additional potentially contaminated sites that may be directly or indirectly impacted by the Proposed Changes. Additional land parcels were identified within and adjacent to the changed alignment that were listed on the EMR as a result of registered notifiable activities. Notifiable activities are prescribed under the *Environmental Protection Regulation 2008* and are those that have been identified as being likely to cause land contamination.

The land parcels and respective notifiable activities are listed in Table 3.1. Land that was historically or is currently used for notifiable activities are recorded on the EMR. Notifiable activities considered to be of higher risk include those activities which present a greater risk of generating contaminants that are likely to be mobile in groundwater and land parcels listed on the EMR for hazardous contaminants. Land is listed on the CLR when an investigation has proven that contaminants are present at concentrations that represent a risk to human health. For such sites, action is required to remediate or manage the land to prevent adverse environmental and human health impacts. There are no sites listed on the CLR within the Evaluated Project alignment or impacted by the Proposed Changes.

Table 3.1. Additional sites on EMR Register

Area	Land Parcel	Notifiable Activity
North of Albion Road	Lot 55 on SP214173	Hazardous contaminant
Adjacent to area between Northern Portal and Exhibition Station	Lot 496 on SL12309	Petroleum product or oil storage
Roma Street Station	Lot 23 on SP207218 Lot 24 on SP207219 Lot 37 on SP207218	Railway yards
Adjacent to Roma Street Station	Lot 23 on SL12397	Petroleum product or oil storage
Adjacent to Roma Street Station	Lot 5 on B361	Service stations
Southern Area	Lot 450 on SP117130 (identified in 2011 EIS)	Hazardous contaminant

Area	Land Parcel	Notifiable Activity
Southern Area	Lot 21 on SP117132 (identified in 2011 EIS)	Railway yards
Southern Area	Lot 1 on RP37927 (identified in 2011 EIS)	Hazardous contaminant
Southern Area	Lot 4 on RP42444 (identified in 2011 EIS)	Hazardous contaminant
Fairfield Station	Lot 440 on SP117129	Hazardous contaminant
Yeronga Station	Lot 550 on SP117131	Hazardous contaminant
Clapham Yard	Lot 1 on RP70669 Lot 1 on RP170304	Petroleum product or oil storage
	Lot 2 on RP62500	Chemical manufacture or formulation
	Lot 101 on SP105842 Lot 6 on RP94512 Lots 3-5 on RP94511 Lot 3 on RP107515 (all land parcels identified in 2011 EIS)	Railway yards
	Lot 2 on RP107515 (identified in 2011 EIS)	Petroleum product or oil storage Railway yards
Moorooka	Lot 102 on SP105842 (identified in 2011 EIS)	Hazardous contaminant
Rocklea	Lot 10 on SP122190 (identified in 2011 EIS)	Hazardous contaminant
Adjacent to Rocklea	Lot 1 on RP183641 (identified in 2011 EIS)	Paint manufacture or formulation
Salisbury	Lot 12 on SP122191 (identified in 2011 EIS)	Landfill
Adjacent to Salisbury Station	Lot 6 on SP129451 (identified in 2011 EIS)	Landfill

A list of locations at which contamination is known or may be encountered along the alignment presented in these Proposed Changes is provided in Table 3.2.

In relation to Mayne Yard, an estimated 76,900m³ of material will be excavated for surface works including construction of new stabling facility in Mayne Yard North. Given the historic land use of this site, any

contaminated land would need to be remediated or disposed of to an approved landfill under a Department of Environment and Science (DES) approved soil disposal permit. There may be an opportunity to reuse some of this material on-site depending on the outcome of further contamination assessment by a Suitably Qualified Person (SQP).

It is estimated that most of the excavated material at Clapham Yard will be reused on site through cut and fill balance to achieve flood immunity. Any unsuitable contaminated material would need to be remediated or disposed of to an approved landfill.

Table 3.2. Potential contaminated locations directly impacted by the Proposed Changes

Area	Change in Land Impacts
Mayne Area	
Mayne Yard	Approximately 76,900m ³ of material will be excavated with potential for increased disturbance of contaminated material compared to the Evaluated Project which estimated 36,000m ³ spoil required removal. Additional investigation works presented in the CRR Geotechnical Investigation Report (DTMR, March 2018) identified soils having reported elevated concentrations of iron and aluminium.
Breakfast Creek crossing	New bridge construction. Demolition of existing QR downstream bridge. The notifiable activity for this site includes railway yards and scrap yards.
North of Albion Road	Overhead line equipment (OHLE) and signalling modification works are proposed in the rail corridor. The notifiable activity for this site includes hazardous contaminants.
Northern Area	
Exhibition Station	Consistent with the authorised impacts. Initial limited environmental assessment conducted as part of the works presented in the CRR Geotechnical Investigation Report (DTMR, March 2018) identified concentrations of soil contaminants less than commercial / industrial land use criteria, with historical information indicating concentrations of copper, lead and PAH above residential land use criteria.
Area between Northern Portal and Exhibition Station	Consistent with the authorised impacts.
Tunnel Area	
Northern Portal	Consistent with the authorised impacts. Limited environmental assessment conducted as part of the works presented in the CRR Geotechnical Investigation Report (DTMR, March 2018) reported elevated concentrations of metals in groundwater.
Southern Portal	Consistent with the authorised impacts. Limited environmental assessment conducted as part of the works presented in the CRR Geotechnical Investigation Report (DTMR, March 2018) reported elevated concentrations of iron, aluminium, zinc and total recoverable hydrocarbons.

Area	Change in Land Impacts
Stations	
Roma Street Station	Consistent with the authorised impacts This site now includes additional land parcels associated with road reserve for minor road works (footpath/kerbs) and around Roma Street Station for changed tunnel alignment. Limited environmental assessment conducted as part of the works presented in the CRR Geotechnical Investigation Report (DTMR, March 2018) reported elevated concentrations of PAH and total recoverable hydrocarbons (TRH) in soils along with elevated concentrations of TRH in groundwater. The notifiable activity for this site remains as petroleum products/oil storage and railway yards.
Albert Street Station	Consistent with the authorised impacts. Additional sites nominated on Mary Street and Charlotte Street for minor road works and Elizabeth Street for construction of northern access to the new station. These land parcels are not listed on EMR.
Woolloongabba Station	Woolloongabba Station is now located further west within the same land parcel. Stage two contaminated land investigation completed for this site identified soils having elevated concentrations of heavy metals, total recoverable hydrocarbons, polycyclic aromatic hydrocarbons, per- and poly-fluoroalkyl substances (PFAS) and asbestos above the adopted NEPM assessment criteria for protection of human health and the environment. Groundwater is also locally impacted with heavy metals. Remediation of this site is underway with the intention to remove the site from the EMR. The notifiable activity for this site now includes railway yards, hazardous contaminant and petroleum products or oil storage.
Boggo Road Station	Consistent with the authorised impacts. Additional land parcels on Peter Doherty Street, Joe Baker Street and Boggo Road (road reserve). These land parcels are not listed on the EMR.
Southern Area	
Southern Area	Consistent with the authorised impacts. Additional sites nominated along Cope Street required as part of Dutton Park Station upgrade. These land parcels are not listed on the EMR. Some overhead line equipment (OHLE) and temporary signalling modification during construction is required along Cleveland Line up to Buranda Station within rail corridor.
F2S Area	
Fairfield Station	Proposed works are mostly within QR corridor except for a small area within road reserve. Road reserve is not listed on the EMR. The notifiable activity for this site includes a hazardous contaminant being present on site.
Yeronga Station	Proposed works are mostly within QR corridor except for small area within road reserve. Road reserve is not listed on the EMR.

Area	Change in Land Impacts
	The notifiable activity for this site includes hazardous contaminant being present on site.
Yeerongpilly Station	Reduced impacts compared to 2011 EIS. Proposed station and track works are mostly within QR corridor due to reduced scope and associated footprint compared to the 2011 EIS design, except for small area within road reserve. Road reserve is not listed on the EMR.
Moorooka Station	Consistent with the 2011 EIS impacts except for small area within road reserve. Road reserve is not listed on the EMR.
Clapham Yard	Additional sites nominated along Chale Street. Notifiable activity for this site now includes petroleum product or oil storage and chemical manufacture or formulation.
Rocklea Station	Proposed works are within QR corridor due to reduced scope of construction and laydown areas compared to 2011 EIS. Notifiable activity for this site includes hazardous contaminants.
Salisbury Station	Consistent with 2011 EIS impacts.
Southern Track Works	Consistent with 2011 EIS impacts, however, reduced impact risk with no new CRR main line tracks proposed to be installed under the Proposed Changes.

Impacts may also occur as a result of contamination on adjacent sites which share a property boundary with the proposed CRR Project alignment. The adjacent sites that present a risk of potential contamination are nominated in Table 3.3. These sites are considered to be higher risk due to a higher potential for contamination to migrate via groundwater and/or ground gas.

Table 3.3. Risk of potential contaminated properties adjacent to the construction footprint for the Proposed Changed alignment

Area	Change in Land Impacts
Mayne Area	
Adjacent to Mayne Yard	Consistent with the authorised impacts.
Northern Area	
Adjacent to Exhibition Station	Consistent with the authorised impacts.
Adjacent to area between Northern Portal and Exhibition Station	Energex substation adjacent to Project alignment is identified on the EMR for notifiable activity 'Petroleum product or oil storage'.
Tunnel Area	
Adjacent to Roma Street Station	The proposed minor road works (footpath/kerb) along Makerston Street and Herschel Street are adjacent to EMR listed sites. The notifiable activity adjacent to this site includes petroleum products/oil storage and service stations.

Area	Change in Land Impacts
F2S Area	
Adjacent to Moorooka Station	Consistent with 2011 EIS impacts.
Adjacent to Clapham Rail Yard	Consistent with 2011 EIS impacts.
Adjacent to Rocklea Station	Consistent with 2011 EIS impacts.
Adjacent to Salisbury Station	Consistent with 2011 EIS impacts.
Adjacent to Southern track works	Consistent with 2011 EIS impacts, however, reduced impact risk with no new CRR main line tracks proposed to be installed under the Proposed Changes.

Overall compared to Evaluated Project's soil and land impacts there is an increase in the volume and area of soil disturbance in areas contaminated, potentially contaminated and likely to contain ASS due to the proposed inclusion of a new stabling facility in Mayne Yard North, southern stations works, southern track works and Clapham Yard stabling.

4.3.4 Settlement

Consistent with the Evaluated Project settlement risk occur from tunnel construction, excavation of portal dive structures, open cut station boxes and shafts. Long-term ground settlement may also occur from groundwater drawdown effects result from consolidation settlement of compressible soils due to increases in vertical effective stress. The potential effects on these elements have changed as a result of differences in the Evaluated Project design such as adjusted Southern Portal location, modified station locations and depth and changes to the horizontal and vertical alignment of the tunnels.

When comparing the risk of settlement from the Evaluated Project to the Proposed Change, the analysis demonstrates that overall, the Proposed Changes are predicted to be less with predicted settlement above the mined tunnel typically has reduced impact width and settlement depths less than 10mm compared to the Evaluated Project and up to 60mm above Boggo Road cavern which is 10mm more than predicted in the Evaluated Project. Settlement impacts above station caverns are similar for both the Evaluated Project and Proposed Changes and the recent modelled allowed a 3mm settlement from groundwater draw down resulting from the excavations. The settlement modelling did not include the cut and cover structures required for the Inner Northern Busway at Roma Street, the modelling is currently being revised to incorporate this component. The change in predicted settlement of Proposed Changes from the Evaluated Project is detailed in Table 3.4. Settlement contours from the modelling are provided in Appendix B.

Table 3.4. Comparison of predicted settlement against Evaluated Project

Description of Cross River Rail structure	Evaluated Project			Proposed Changes		
	MAX. Surface Settlement	Design Depth (m)	2016 RISK	MAX. Surface Settlement	Design Depth (m)	2019 RISK
Southern Drive/Portal	25-50mm with 25 m settlement trough from tunnel wall	0 – 10	Slight	5-30	0-12	Slight
Boggo Road Station	25-50mm extending 25m from shaft wall	10 - 14	Slight	5-40mm up to 30m from shaft wall	15 -21	Slight

Description of Cross River Rail structure	Evaluated Project			Proposed Changes		
	MAX. Surface Settlement	Design Depth (m)	2016 RISK	MAX. Surface Settlement	Design Depth (m)	2019 RISK
Mined Tunnels (Woolloongabba-Boggo Road)	15-30mm with a 40 - 50 m width from Park Road Station north to Quarry Street and 50-80m width to Stanley Street.	14-29	Slight	0-5mm with a 20m trough width	21-	Very Slight
Woolloongabba Station	10-25mm up to 25m from shaft wall	27-29	Slight	5-25mm up to 25m from shaft wall	26 - 30	Slight
Mined Tunnels (Woolloongabba-Albert Street)	0-10mm with a trough width of 100 – 150 m.	27-50	Very Slight	0-5mm with a 20m trough width	30 - 42	Very Slight
Albert Street Station	25-50mm up to 30m from shaft wall	31-33	Slight	5-30mm up to 30m from shaft wall	32-34	Slight to Very Slight
Mined Tunnels (Roma Street-Albert Street)	0-25mm with a trough width of 100 – 150 m.	24-33	Slight to Very Slight	0-5mm with a 20m trough width	28 - 35	Very Slight
Roma Street Station	20-25mm up to 25m from shaft wall	24-31	Slight	5-30mm up to 30m from shaft wall	29 - 30	Slight to Very Slight
Roma Street to Northern Portal	15-50mm with a impact width of 50 – 80 m	15-30	Slight	0-5 with a 25m trough width	13 - 29	Very Slight
Northern Drive/Portal	25 - 50mm to 25m from shaft wall of portal.	0-12	Slight	5-20mm to 10 - 15m from shaft wall of portal.	0 -13	Slight to Very Slight

The area with the greatest change is around Roma Street Station, with a reduced impact upon the Brisbane Magistrates Court. With the changes to the alignment moving away and a reduced predicted settlement width and depth the risk of building damage reduces to very slight. Infrastructure impact risk has been determined from these settlement results using the damage categories and methodologies in Mair et al 1996¹. The risk categories defined by Mair et al 1996 are related to maximum ground rotation and surface settlement and outlined below. Infrastructure with a 'slight' risk or above requires further analysis during detailed design.

- Negligible – hairline cracks less than about 0.1mm;
- Very slight – fine cracks which are easily treated during normal decorations with damage restricted to internal wall finishes; and
- Slight – crack widths up to 5mm which are easily slightly with doors and windows may stick slightly.

¹ Mair, R. J., Taylor, R. N. & Burland, J. B. 1996. Prediction of ground movements and assessment of risk of buildings damage due to bored tunneling. In: R. J. Mair & R. N. Taylor (eds), *Geotechnical aspects of underground construction in soft ground*; Proc. intern. symp., London 15–17 April 1996. Rotterdam: Balkema.

Additional settlement surrounding stations as a result of ground water drawdown during excavations is estimated to be less than 3mm and allowed for the settlement contours. Impacts upon specific buildings around station caverns have been assessed as negligible to slight with minor impacts assessed for existing utilities. Over the entire alignment the Contractor's modelling indicates there are 19 buildings categorised as having a 'slight risk' of damage, which will require further analysis during detailed design. Table 3.5 outlines the infrastructure risk from the Proposed Changes within each Project area.

Table 3.5. Settlement analysis within the alignment

Location	Infrastructure	Summary of Predicted Risk and Effects
Northern Portal	Buildings	No infrastructure identified within the zone of influence
	Roads	No infrastructure identified within the zone of influence
	Utilities	Within acceptable effects
	Railways	Existing Railway - estimated settlement up to 30mm
	Tunnels	No infrastructure identified within the zone of influence
	Bridges	Within acceptable effects
Roma Street Station	Buildings	The Police Headquarters at 240 Roma Street has very slight risk. The heritage Roma Street Railway Station building has a slight risk. The BTC and Hotel Jen high rise buildings identified as slight to very slight risk will be demolished as part of the CRR Project.
	Roads	Existing Roma Street Busway – estimated settlement between 5-25mm
	Utilities	Affected utilities are within the immediate footprint of the shafts and to be relocated.
	Railways	Existing railway above and to the north of the station – estimated settlement between 5-30mm
	Tunnels	No infrastructure identified within the zone of influence
	Bridges	Existing Inner Northern Busway over-bridge at the east of station cavern – estimated settlement between 5-30mm
Roma Street to Albert Street	Buildings	Within acceptable effects
	Roads	Within acceptable effects
	Utilities	Within acceptable effects
	Railways	No Infrastructure identified within zone of influence
	Tunnels	No Infrastructure identified within zone of influence
	Bridges	Within acceptable effects
Albert Street Station	Buildings	12 buildings with 'slight risk' were identified and 8 with a very slight risk. Existing basements are present along Albert Street and detailed consideration of ground movements may be necessary as modelling does not consider the influence of existing structures.
	Roads	Albert Street (between south of Mary Street and north to Charlotte Street) and intersection between Albert Street and Elizabeth Street – Estimated settlement between 20-30mm.

Location	Infrastructure	Summary of Predicted Risk and Effects
	Utilities	Those affected are stakeholders in the immediate footprint of the shafts and those in Albert Street between the south of Mary Street and the north of Charlotte Street. Affected utilities to be relocated. The brick-lined sewer that runs down Albert Street is at risk of damage.
	Railways	No infrastructure identified within zone of influence
	Tunnels	No infrastructure identified within zone of influence
	Bridges	Within acceptable effects
Albert Street to Woolloongabba	Buildings	Within acceptable effects
	Roads	Within acceptable effects
	Utilities	Within acceptable effects
	Railways	Within acceptable effects
	Tunnels	No infrastructure identified within zone of influence
	Bridges	Within acceptable effects
Woolloongabba Station	Buildings	Two buildings with 'very slight risk' were identified.
	Roads	Within acceptable effects
	Utilities	Those affected are in the immediate footprint shaft and will be relocated
	Railways	Within acceptable effects
	Tunnels	No infrastructure identified within zone of influence
	Bridges	Within acceptable effects
Woolloongabba to Boggo Road	Buildings	Within acceptable effects
	Roads	
	Utilities	
	Railways	
	Tunnels	No infrastructure identified within zone of influence
	Bridges	Within acceptable effects
Boggo Station	Buildings	Two buildings with a slight risk: 41 Boggo Rd (Eco Sciences precinct) & Park Road Station platform
	Roads	Boggo Road Busway to the east of the station and Eastern Busway north of the station; Boggo Rd Busway facilities to the east of the station box
	Utilities	Those affected are in the immediate footprint of the shaft
	Railways	Existing railway to east, south-east, and north of the station and to the east of the mined running tunnels – estimated settlement of 5-30mm
	Tunnels	No infrastructure identified within zone of influence
	Bridges	Existing flyover bridge to the south and south-east of the Boggo Rd Station – estimated settlement of 5-30mm
Southern Portal	Buildings	Infrastructure identified within the zone of influence includes buildings within QR corridor only. These buildings will be demolished as part of the Project scope.
	Roads	No infrastructure identified within the zone of influence

Location	Infrastructure	Summary of Predicted Risk and Effects
	Utilities	Utilities affected are those within the zones of influence of the mined tunnels and in the immediate footprint of the cut and cover excavations
	Railways	Existing railway to the south of the Boggo Road Station – estimated settlement of 5-30mm
	Tunnels	No infrastructure identified within the zone of influence
	Bridges	Existing flyover bridge to the north-west of the Boggo Road Station – estimated settlement of less than 5mm within the vicinity of the flyover.

As part of the detailed design phase of the Project, design and construction methodology was to be developed incorporating key guiding principles and definitions established for the Project. These included:

- **Existing Property:** Project activities do not have an adverse effect on any existing ground conditions, property or infrastructure located inside or outside the site;
- **Predicted Zone of Influence:** determine the physical extent, including additional buffer zones to account for the limits of accuracy of the prediction method;
- **Predicted Effects:** Predict the effects of the project activities on existing property, having regard to the type, age, and condition of the existing property. The predicted effects must describe the limits of accuracy of the prediction method(s);
- **Acceptable Effects:** determine the extent to which Existing Property may be affected by the Project Activities without the effects causing undue damage; and
- **Actual Effects:** systematically and regularly monitor the actual effects of the project activities on existing properties.

Nevertheless, based on updated technical information, mitigation measures will still apply and be tailored to manage settlement risk along the alignment, as detailed within the Project OEMP and Land Management Plan.

4.4 Mitigation Measures

The Project OEMP contains the following subplans which identify the higher-level mitigation measures proposed to prevent and manage impacts associated with contaminated land, ASS, erosion and sediment control and settlement.

4.4.1 Contaminated Land Mitigation Measures

Although there are changes to the location of contaminated sites intercepted by the Proposed Changes to the alignment, the mitigation measures are generally consistent with the Evaluated Project. These include undertaking further investigations to inform the risk posed from disturbance of contaminated soil and/or groundwater.

Mitigation measures previously identified in the Evaluated Project and no longer relevant to the Proposed Changes, as they have since been completed, include the following:

- Stage 1 (PSI) assessment of the Evaluated Project as these have now been completed.
- Comprehensive geotechnical and groundwater investigations to be undertaken to confirm subsurface conditions and verify locations of potential settlement impacts relating to excavated induced settlement, groundwater drawdown induced settlement and local ground relaxation settlement.

Additional mitigation measures now relevant to the CRR Project from the Proposed Changes and based on additional assessment work undertaken since the Evaluated Project include:

- Initial intrusive works to confirm the contamination status of soil and groundwater (where relevant) to determine potential risks to site users and management requirements for proposed excavation works in areas identified by the Preliminary Site Investigations as having contamination risk.
- Prior to the commencement of intrusive works, a Sampling Analysis and Quality Plan (SAQP) should be prepared to provide a detailed plan of all stages of the fieldwork including fieldwork procedures and WHS procedures to be used.

4.4.2 Acid Sulphate Soils Mitigation Measures

Mitigation measures which are consistent with Evaluated Project include the following:

Further ASS investigations to be undertaken in combination with additional geotechnical surveys focusing on areas below 5 metres (m) Australian Height Datum (AHD), where excavation is proposed or there is soil disturbance.

If further investigations determine the presence of ASS, management and monitoring practices will be implemented including completion of an ASS Management Plan.

The ASS Management Plan will include corrective actions for incident management and remediation and requirements for validation and verification testing of soils and potentially affected waters prior to release from the construction worksite. These management strategies may include:

- Neutralising the soils with alkaline material, such as lime;
- Hydraulic separation via sluicing and/ or hydrocloning;
- Strategic reburial below groundwater table; and
- Stormwater/ groundwater collection, control and treatment measures.

4.4.3 Erosion Mitigation Measures

Mitigation measures which are consistent with Evaluated Project include the following:

- A site-specific Erosion and Sediment Control Plan (ESCP) to be developed;
- The Construction ESCP will be based on the information gathered during site-specific soil investigations at each of the worksites prior to construction;
- Information gathered through these investigations will include confirmation of soil landscapes, soil depth, presence of fill and soil chemical properties. Site-specific soil investigations will, in turn, inform an erosion risk assessment to quantify the erosion potential for each soil type expected to be disturbed during construction;
- Consistent with Evaluated Project, the proposed erosion control measures will be based upon the objective of reducing the risk of erosion during construction by:
 - Avoiding disturbance of vulnerable surface and subsurface soils;
 - Minimising construction worksite clearing and the extent and duration of soil exposure;
 - Identifying proposed spoil storage locations at construction worksites;
 - Installing spoil enclosure sheds at construction worksites, where required;

- Diverting clean waters around disturbed surfaces and spoil storage locations;
- Monitoring the effectiveness of installed control measures;
- Progressive stabilisation and revegetation of disturbed areas, using stored topsoil where practicable; and
- Any damaged erosion and sediment control measures will be repaired or replaced following rainfall events. Additional monitoring and maintenance will be conducted in accordance with the measures specified in the Project OEMP.

4.4.4 Settlement Mitigation Measures

Mitigation measures previously identified in the Evaluated Project and no longer relevant to the Proposed Changes, as they have since been completed, include the following:

- Undertake predictive modelling to identify the settlement trough footprint.

Mitigation measures which are consistent with the Evaluated Project include the following:

- Where predictive modelling indicates settlement may be likely, design and construction measures are to be implemented to manage and mitigate the identified impacts. Detailed design and construction planning are to incorporate measures to limit settlement generally to 25 to 50mm in a worst-case event, measured at any location within 50m of the route centreline or the outer walls of an underground station or excavated structure (excluding designated worksites and surface properties owned by the proponent);
- If necessary, carry out building specific underpinning, strengthening or other protective measures prior to commencement of tunnel construction;
- Establish and implement a monitoring plan, including building monitoring points. This regime is to reference predicted settlements and provide a corresponding action plan;
- Surveys and other monitoring will be used to identify the effects of settlement, if any, as a consequence of the Project;
- Monitoring will be conducted from the commencement of underground construction works and dewatering; and
- If there is a concern that any subsequent ground settlement was caused by the Project, an independent consultant may be engaged to prepare a new building condition survey report and recommendations for repairing building damage established. The actual settlements will be compared to predicted settlements and further mitigating measures implemented where required.

Additional mitigation measures now relevant to CRR Project, include:

- Detailed predications of ground movements are required for specific impact assessments are to be undertaken in the relevant design packages where there are building substructures in predicted settlement zones which could have potential interactions. Results are to be used to refine the settlement monitoring program and identified building pre-condition survey requirements.

4.5 Conclusion

The key changed effects to land impacts as a result of the proposed delivery changes are:

- there will be a minor increase in the disturbance of potential acid sulfate soils around Breakfast Creek, which will be managed in accordance with the approved Outline Environmental Management Plan;

- there will be an increase in the number of properties on the Environmental Management Register directly impacted and adjacent to the works in Mayne Yard, increasing the volume of contaminated soil requiring treatment or disposal; and
- while settlement predictions largely remain the same compared to the Evaluated Project, there will be a reduced risk of settlement to the State law courts complex. There may be minor settlement impacts, not previously identified for the Evaluated Project, along the tunnel alignment between Woolloongabba Station and the Brisbane River.

5. Technical Report: Landscape and Visual Amenity

5.1 Overview

This technical report has been prepared for the CRR Project to assess the potential changes to the landscape, visual and lighting impacts arising from the Proposed Changes in comparison to the Evaluated Project. Volume 1 describes the Proposed Changes to the design and delivery of the CRR Project, which are the subject of this RfPC.

5.2 Assessment Methodology

5.2.1 Landscape and Visual Approach

The landscape and visual impact assessment has been undertaken in three stages;

1. *Impact assessment* - An analysis of the potential landscape, visual and lighting impacts that may arise as a result of the Proposed Changes;
2. *Summary of change from Evaluated Project* - A comparative analysis to identify any potential changes or additional impacts; and
3. *Mitigation* - A comparative analysis to identify any potential additional mitigation measures that would be required to mitigate the changed impact.

Visual

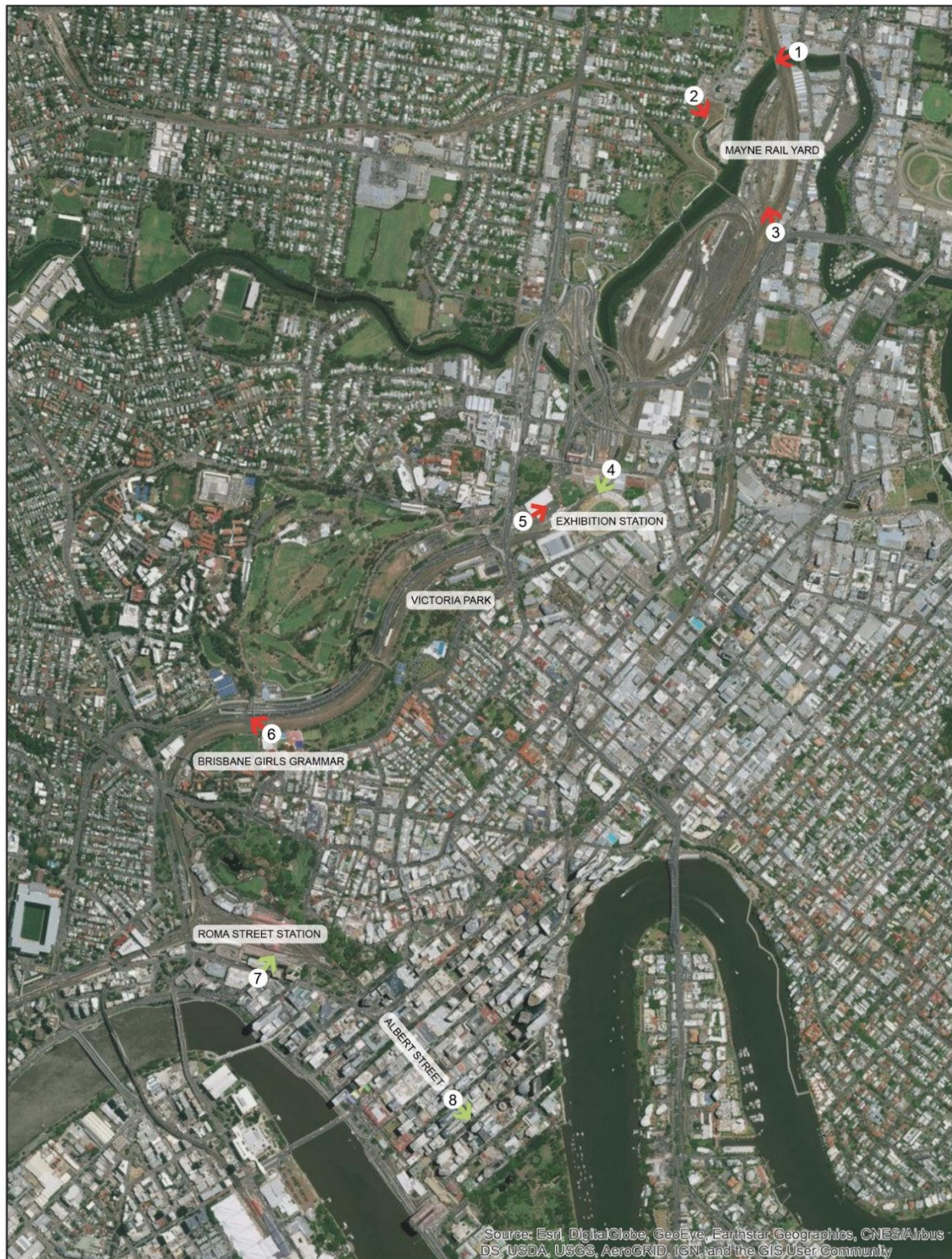
A visual assessment has been conducted through the selection of representative viewpoints. Where possible, the representative viewpoint locations were selected based on previous viewpoint assessments carried out for the Evaluated Project to allow a comparative analysis to be undertaken. Where the Evaluated Project viewpoints were not applicable, viewpoint locations were selected based on analysis of the visual context and potential visual receptors. Refer to Figures 5.1 to 5.3 below.

Landscape

A landscape assessment has been undertaken where the extent of works may result in a physical change to the character of the landscape (from existing condition or from the Evaluated Project), for example, areas of land resumption or rail corridor expansion, including:

- Albert Street Station
- Dutton Park Station
- Clapham Yard

Otherwise only visual impact changes have been assessed.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Context Plan

Mayne Area, Northern Area, Central Area

N
Metres
0 100 200 300 400

→ RIPC-4 Viewpoint locations
→ Viewpoint location (RIPC-1 and RIPC-4)

Scale at A4
1:20,000

©Copyright Information

Coordinate System
GDA 1994 MGA Zone 56

Figure 5.1: Viewpoint locations plan

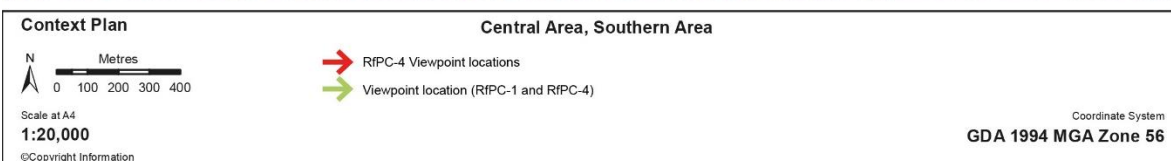
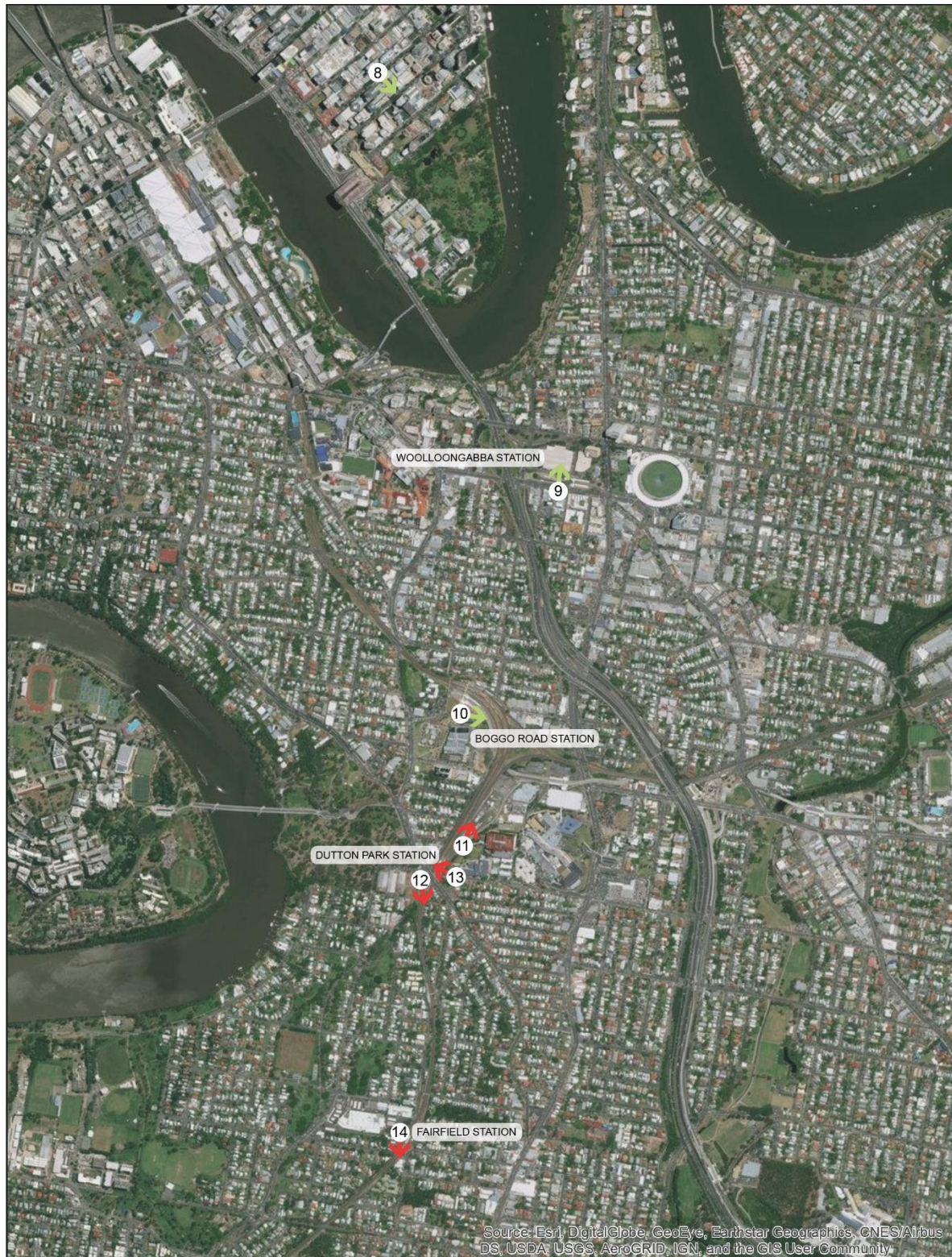


Figure 5.2: Viewpoint locations plan

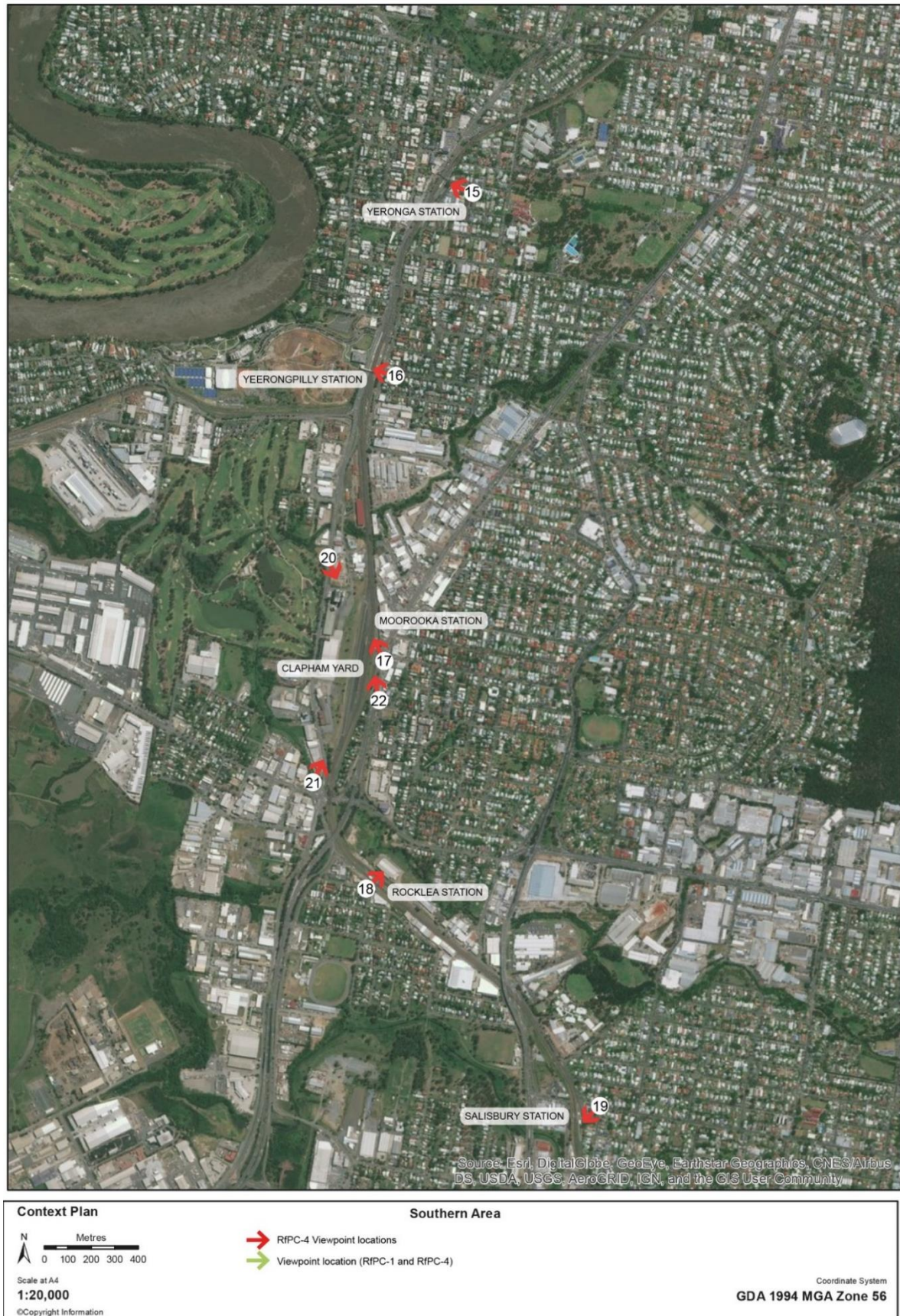


Figure 5.3: Viewpoint locations plan

Impact Assessment

The landscape and visual impact assessment are based on themes of magnitude and sensitivity, as illustrated in Table 5.1. For each of the Proposed Changes the *Summary of Change from Evaluated Project* is also provided to identify if the changed impact is increased, decreased or consistent with the Evaluated Project.

Table 5.1. Assessment Matrix

		Magnitude			
		High	Moderate	Low	Negligible Impact
Sensitivity	High	High Impact	High Moderate Impact	Moderate Impact	Negligible Impact
	Moderate	High Moderate Impact	Moderate Impact	Moderate – Low Impact	Negligible Impact
	Low	Moderate Impact	Moderate – Low Impact	Low Impact	Negligible Impact
	Negligible Impact	Negligible Impact	Negligible Impact	Negligible Impact	Negligible Impact

5.2.2 Lighting

A summary description of the lighting sources and potential lighting impacts that may arise as a result of the construction and operational phases was prepared for the Evaluated Project.

A review of previous lighting impact assessment summaries has been undertaken with any proposed changes documented to assess the potential increases or decreases in overall lighting impacts as a result of the Proposed Changes.

Assumptions and Limitations

Assumptions applicable to this assessment include:

- The lighting assessment is qualitative. The assessment locations have not been visited at night to measure existing light levels.
- Lighting will be generally in accordance with Australian Standard requirements.
- Detailed design and construction planning will further develop the details of Project delivery, and visual impacts will be managed through a visual mitigation plan to minimise visual impact to surrounding receptors.
- Fencing material finishes will affect the extent of visual impact within Mayne Yard and Clapham Yard. Details of fencing materials will be determined prior to construction but have been assumed to be a wire mesh.

5.3 Changes to Potential Impacts

5.3.1 Mayne Area

The Evaluated Project had Mayne Yard being traversed by new CRR lines as well as some track and asset upgrade works. The Proposed changes realign the CRR lines, propose a new rail bridge over Breakfast Creek, new stabling and associated facilities in Mayne Yard North and an elevated road over rail vehicle access to Mayne East and Mayne North. The Evaluated Project also included a trough structure through the northern yard which is now proposed to be removed.

Summary of change from Evaluated Project - Visual assessment summary

Existing context

Mayne Area is predominantly industrial with the commercial buildings to the east blocking prominent views into the rail yard. The residential blocks to the western side of Breakfast Creek are visually protected by the vegetation and are set back behind the industrial lots. The most open view into the rail yard is from the Inner-City Bypass off-ramp down to Abbotsford Road.

Construction impacts

In comparison to the Evaluated Project, the Proposed Changes would increase temporary visual impacts at Mayne Yard North during construction due to the increased scale of works including additional stabling works in this area. Permanent visual impacts will result from the proposed new rail bridge over Breakfast Creek. When reviewing Mayne Yard as a whole, the visual impacts would be generally consistent with the Evaluated Project.

Operational impacts

Due to the scale of additional works within the rail corridor at Mayne Yard North, the operational visual impacts in this part of the yard are likely to increase compared to the Evaluated Project. The Proposed Change includes road over rail bridges in Mayne Yard East and North to provide vehicular access to the stabling yards and supporting train crew facility building.

When comparing Mayne Yard as a whole against the Evaluated Project, the visual impacts would be generally consistent due to the nature of the works within the rail corridor and localised elevated elements.

Viewpoint 1: Mayne Rail Yard - looking west towards rail overpass	
	
Distance to yard from viewpoint	Approximately 90m
Visual sensitivity and context	This is a highly utilised road overpass bridge that connects Burrows St, Bowen Hills and Hudson Rd, Albion over Breakfast Creek. The viewpoint looks towards the creek and riparian buffer, the existing rail bridge overpass which has a background of vegetation. The majority of receptors using the adjacent bridge, and experiencing the view, consist of motorists with a moderate amount of pedestrian traffic along the connecting footpaths. The landscape amenity provides a quality view of the creek and dense mangrove vegetation contributing to the local character of the area. Visual sensitivity is assessed as low based on the existing visual amenity and daily transiting users.
Visual magnitude of change from existing conditions	Construction The Proposed Changes include major works in Mayne Yard would produce a low-moderate visual magnitude of change from this viewpoint as it would be a noticeable change but consistent with the existing rail context, and with periods of increased visual impacts at periods in the construction program. Operation As a result of the existing infrastructure within Mayne Yard and the proposed design layout and surrounding context of industry, the visual magnitude of change to the area from the Proposed Changes would be low-moderate.
Visual impact	Construction The potential visual impact of the Proposed Changes at this viewpoint is assessed as low-moderate due to the low sensitivity of the surrounding receptors and existing rail and industrial context. Operation The potential visual impact of the Proposed Changes at this viewpoint is considered to be low due to the existing rail environment and low sensitivity of the surrounding receptors and context.

Viewpoint 2: Mayne Rail Yard - looking east towards proposed works


Distance to yard from viewpoint	Approximately 190m
Visual sensitivity and context	Viewpoint 2 is located along the North Brisbane Bikeway looking towards the proposed works. The cycle corridor, connecting Chermside to the CBD, consists of a two-way cycle lane and adjacent pedestrian zoned footpath. It is highly utilised, particularly at peak hours by daily cyclist commuters. The bike path is located within Flynn Oval which includes a playing field, a playground and picnic areas. Views towards the proposed works are obstructed by mature vegetation along both sides of Breakfast Creek. Due to the recreational nature of the viewpoint and the contextual location (close to Windsor residential areas), the visual sensitivity is considered moderate.
Visual magnitude of change from existing conditions	Construction Due to the screening of vegetation at this location, the magnitude of change would be low with possible periods of increased visual impacts at certain points in the construction program (for example, the presence of construction equipment may enter this view). Operation As a result of the existing infrastructure within Mayne Yard and surrounding industrial context, the visual magnitude of change to the area would be low.
Visual impact	Construction The potential visual impact of the Proposed Change from this viewpoint is considered to be low-moderate due to the moderate sensitivity of the surrounding receptors and context. Operation The potential visual impact of the Proposed Change from this viewpoint is considered to be low due to the distance from the yard, and existing industrial land uses and vegetation screening.

Viewpoint 3: Mayne Rail Yard - looking north-west towards the site


Distance to yard from viewpoint	Approximately 55m
Visual sensitivity and context	Viewpoint 3 is looking towards the existing Mayne Rail Yard from the on-ramp road leading to the Inner-City Bypass – a major road and highly utilised motorway corridor. The viewpoint is located within a significantly industrialised area with direct sightlines towards the proposed works. Due to the existing dominant transport infrastructure and industrial context of the viewpoint location, the sensitivity has been categorised as low.
Visual magnitude of change from existing conditions	Construction The magnitude of change at this location would be moderate (including mitigation such as screening or hoarding) with periods of increased visual impacts during the construction program when larger equipment or machinery would be visible entering or leaving the site. Operation As a result of the existing infrastructure within Mayne Yard and surrounding industrial context, the visual magnitude of change to the area following construction would be low.
Visual impact	Construction The potential visual impact from this viewpoint is considered to be low-moderate due to the staging of the construction programme and the sensitivity of the surrounding receptors and context. Operation The potential visual impact from this viewpoint is considered to be low due to the existing rail and other transport infrastructure and low sensitivity of the surrounding receptors and context.

5.3.2 Northern Area

5.3.2.1 Exhibition Station

An upgrade to the Exhibition Station is part of the Evaluated Project. The Proposed Changes to this station include the removal of the overpass in the design, an island platform with open plaza under with access to the above platform from lifts and stairs. This station will incorporate urban design elements consistent with the visual appearance of the other CRR Project surface stations and improve the integrated pathway for independent access. The scale of works and the construction timeframes would be reduced compared to the Evaluated Project.

Summary of changes from Evaluated Project- Visual assessment summary

Construction impact

The construction works are anticipated to result in a consistent level of visual impact in comparison to the Evaluated Project as the station would be in a generally similar location and of a similar scale.

Operational impact

The operation of the upgraded Exhibition Station will improve the visual amenity of the area compared to the Evaluated Project with the removal of the overpass structure and enhanced connection to Bowen Bridge Road. The upgrade to Exhibition Station would therefore provide beneficial visual impacts over the Evaluated Project.

Viewpoint 04: Exhibition Station – looking north-east towards the station	
	
Distance from viewpoint	Approximately 35m to the rail corridor.
Visual sensitivity and context	The area around Exhibition Station is a combination of recreational event spaces at the RNA showground, high rise residential lots and commercial development, which surrounds the showground. To the north is major road infrastructure which includes the Inner-City Bypass and Clem Jones Tunnel. This viewpoint is located on the pedestrian footpath of Bowen Bridge Road. This view is experienced daily by predominantly vehicle traffic and pedestrian movement. Due to the width of the road, the main views into the station are from the inbound city lanes. The surrounding context is predominantly infrastructure with some significant cultural buildings and heritage elements nearby. The view has been assessed as low-moderate visual sensitivity.
Visual magnitude of change from existing conditions	Construction During construction, the site will be utilised as a construction compound with heavy machinery and construction activity present throughout the construction period. Fig trees will be impacted with the current design layout as per the

	Evaluated Project. These considerations would result in a moderate visual magnitude of change. Operation The upgraded station and pedestrian connections will improve the overall visual amenity of the view. The operational visual magnitude of change is expected to be low-moderate (beneficial) due to an enhancement of visual amenity to the area.
Visual impact	Construction The potential visual impact from this viewpoint is considered to be moderate due to the visibility from this location and the sensitivity of the surrounding receptors and context. The project will be implemented to minimise impacts on landscape and open space values. Operation The potential visual impact to this viewpoint following construction is considered to be low-moderate (beneficial) impact due to the overall station upgrade, improved connectivity and urban design, and the sensitivity of the surrounding receptors and context.

5.3.2.2 Victoria Park Access

The Evaluated Project includes a construction vehicle access through Victoria Park which is an upgrade of an existing track and enters the rail corridor via the BCC compound. The area surrounding the proposed access is a combination of parkland (Victoria Park), residential properties to the south, mixed land use to the east and a major road and rail corridor to the north.

The area around the access is experienced daily by pedestrians travelling along the footpath which connects Victoria Park to Roma Parkland and through to the city. There are passive views of the rail corridor with some existing vegetation screening the transport corridor to the north. Due to this, along with the regularity of receptors using the thoroughfares, this view is considered to be of moderate visual sensitivity.

The Proposed Changes realign the construction access through Victoria Park which would still be accessed from Gregory Terrace but with an alternative route through the park requiring demolition of the existing Department of Health building.

Visual impacts would arise from minor tree removal and building demolition of the Department of Health Building. This building is much larger than the previously impacted BCC compound building and is listed as local heritage. This property would also serve as a laydown area during construction. The intersection of the access road and Gregory Terrace would be signalised which would result in minor temporary visual impact for users of Gregory Terrace and adjacent residential properties during construction. This access is assessed as having an increased visual impact compared to the Evaluated Project, but impacts will be manageable with the implementation of the mitigation measures in the Project OEMP.

5.3.3 Central Area

5.3.3.1 Roma Street Station and Inner Northern Busway

A new underground Roma Street railway station is part of the Evaluated Project. The Proposed Changes would include lowering and relocating the Inner Northern Busway into the underground station, realignment of station location and changes to design and delivery aspects.

Summary of change from Evaluated Project - Visual assessment summary

Construction impacts

Proposed Changes to the Roma Street Station would result in an overall consistent visual impact during construction compared to the Evaluated Project due to the large-scale construction and similar nature of works. However, there will be a material increase in temporary visual impacts for the lowering of the Inner Northern Busway as a result of changes to road alignments, cut and cover tunnel works and construction worksites. These include temporary impacts to Emma Miller Place from vegetation loss, however, this will be reinstated following construction. The construction of the Inner Northern Busway will also require the installation of temporary bus stops along Roma Street with resulting visual impacts to the streetscape. A minor beneficial change is the removal of the College Close satellite site logistics area from the project as it will not be required during construction. This will avoid the temporary visual impacts to surrounding residents and park users associated with a construction logistics area in this location.

Operational impacts

The overall operational visual impacts of the Proposed Changes would be consistent when compared with the Evaluated Project due to the works being similar in nature and resulting in an upgraded station precinct. Overall, enhancement of the station and improvement of public transport alignment is anticipated to improve the visual amenity of the viewpoint, by removing buses from the surface to the underground and opening up viewpoints to the heritage station building.

Viewpoint 05: Roma Street Station – Corner of George Street and Roma Street looking north-west	
	
Distance to station from viewpoint	Approximately 40m to the rail corridor.
Visual sensitivity and context	The viewpoint is located on the corner of George Street and Roma Street looking towards the main Roma Station Entrances. This view is experienced daily by vehicle traffic and pedestrian movement. The surrounding context consists predominantly of transportation buildings, rail infrastructure, commercial office buildings and residential apartments. The view has been assessed as moderate visual sensitivity.

Visual magnitude of change from existing conditions	Construction Previous visual impact assessments (RfPC-1 and 3) have assessed the demolition of the Brisbane Transit Centre and Hotel Jen. The construction process for lowering the Inner Northern Busway would require the removal of the vehicular ramps to the west of the Transit Centre and additional impacts to Lot 60 to the east of the station with removal of vegetation. The site will include a construction compound with heavy machinery, cranes and continuous activity present. The temporary construction sheds, cranes and heavy machinery will be the most prominent visible construction elements. There will be additional visual impacts during construction as a result of works on the Inner Northern Busway which will require the installation of multiple temporary bus stops along Roma Street These considerations would result in a moderate-high visual magnitude of change due to the scale of construction required. Operation The new Roma Street Station with improved bus and rail integration will enhance public activation and improve pedestrian connections to recreational and commercial areas within the city. These improvements are expected to enhance the overall amenity of the place. The operational visual magnitude of change is expected to be moderate beneficial due to an enhancement of visual amenity to the area.
Visual impact	Construction The potential visual impact at this viewpoint during construction is considered to be moderate-high due to the length of time works will occur, the sensitivity and number of surrounding receptors and city context. Operation The potential visual impact to this viewpoint is considered to be moderate beneficial impact due to the overall station upgrade, improved connectivity and urban design approach, and a beneficial impact to the surrounding receptors and context.

5.3.3.2 Albert Street Station

The Proposed Changes would position the Albert Street Station 80m north along Albert Street compared to the Evaluated Project, with the main entrance on the corner of Albert Street and Mary Street and a second entrance at 142 Albert Street.

Summary of change from Evaluated Project- Landscape Assessment summary

Construction impacts

Albert Street Station works are proposed in the centre of the city (consistent with the Evaluated Project), and there are multiple highly sensitive receptors in the surrounding area. The construction of the CRR Project will directly impact several low-medium height shopfronts and commercial buildings. The existing character will be altered therefore the landscape sensitivity is considered to be moderate-high.

Major construction works are proposed at the site which impacts multiple landholding types. Due to the proposed works being similar in scale and type compared to the Evaluated Project, this would result in a consistent landscape character impact.

Operational impacts

The Proposed Changes will contribute to the delivery of the BCC's Albert Street Vision by consolidating the entry points into two off-street plaza entrances, thus, removing structures from Albert Street. This will have a beneficial landscape impact to the surrounding precinct and be an increased beneficial impact compared to the Evaluated Project. The enhancement of pedestrian movement and improvement of the amenity will result in improved activation for public engagement.

Summary of visual assessment change from Evaluated Project

Construction impacts

The construction works at Albert Station for the Proposed Changes will result in an overall consistent visual impact compared to the Evaluated Project due to the similar scale, location and nature of works proposed.

Operational impacts

The station plaza footprint has been reduced and contained within one lot, allowing the adjacent lot to be fully developable after construction completion. Public verge activation has been improved through consolidated entrances and removal of structures from Albert Street, to contribute to the delivery of the BCC's Albert Street Vision as part of the CRR Project in this area.

In summary, the design intent is similar to the Evaluated Project, however, the visual impact outcomes are beneficial compared with the Evaluated Project due to the improved public realm and visual amenity resulting from the Proposed Changes.

Viewpoint 06: Albert Street – looking south-east down Albert Street at Charlotte Street intersection



Distance to Station from viewpoint	Approximately 40m.
Visual sensitivity and context	The viewpoint is located on the corner of Albert Street and Charlotte Street looking towards the Brisbane Botanical Gardens. This view is experienced daily by vehicle traffic and heavy pedestrian movement. The surrounding context consists of ground level shop frontages, Queen Street Mall, commercial office buildings and residential apartments. The view has been assessed as moderate-high visual sensitivity.
Visual magnitude of change from existing conditions	The project works for the new station, and 2 nd entry point includes an integrated pathway for independent access, pathway connections to recreational and commercial areas and overall improved verge activation.

	Construction The construction would impact shopping outlets and commercial buildings which are currently low to medium height buildings. The site will have a construction compound with heavy machinery, cranes and continuous construction activity present throughout the construction period. The temporary construction sheds, cranes and air ventilation exhausts will be the most prominent visible construction elements. There will be a reduced impact along Albert Street, as construction will be moved from within the street to behind the site hoarding. These considerations would result in a moderate-high visual magnitude of change due to the extents of construction required. Operation The new station design with an additional entry point will facilitate public activation and linking pedestrian connections to recreation and commercial areas within the city which will improve the overall visual amenity of the view. The Myer ramp is not required to be relocated, which reduces overall impacts to Charlotte Street and Albert Street. The integration of the BCC's Albert Street Vision within the CRR development will provide a landscape and visual benefit to the surrounding area. Depending on development timeframes for future over station development for site on the corner of Albert and Mary Streets could be temporarily adversely impacted due to the site being vacant. Temporary activation of this site would mitigate adverse outcome for the empty city lot. The operational visual magnitude of change is expected to be moderate beneficial due to an enhancement of visual amenity in the area.
Visual impact	Construction The potential visual impact of this viewpoint is considered to be moderate-high due to the length of time of construction works and the sensitivity of the surrounding receptors and city context. Operation The potential visual impact to this viewpoint is considered to be moderate beneficial impact due to the overall station upgrade, improved connectivity and urban design approach, and a beneficial impact to the surrounding receptors and context.

5.3.3.3 Woolloongabba Station

The Proposed Changes would move Woolloongabba station approximately 70m west of its location for the Evaluated Project.

Summary of visual assessment change from Evaluated Project

Construction impacts

The proposed construction works at Woolloongabba Station for the Proposed Changes will result in an overall consistent visual impact compared to the Evaluated Project, as although the design for the Evaluated Project was positioned further to the east, the scale of the construction works and mitigation measures are similar (ie inclusion of an acoustic shed at the site). Since the Evaluated Project, early works have occurred at this site therefore the Proposed Changes would occur in an existing construction site.

Operational impacts

The Evaluated Project locates the Woolloongabba Station further east than the Proposed Changes, however the visual impacts to the surrounds would be similar due to the scale and form of the station, making the visual impacts consistent. Overall the new station development and pedestrian connectivity are anticipated to be beneficial and improve visual amenity of the viewpoint.

Viewpoint 07: Woolloongabba Station – looking north towards Brisbane city on Stanley Street	
	
Distance to Station from viewpoint	Approximately 40m to the Station.
Visual Sensitivity and Context	The project site is currently under development as part of the Cross River Rail early works which included the removal of the existing building and supporting elements for future works. The viewpoint is located on Stanley Street looking towards the CBD. This view is experienced daily by predominantly vehicle traffic and heavy pedestrian movement during events at The Gabba. The surrounding context is predominately ground level shop frontages, commercial office buildings and residential apartments. The view has been assessed as moderate visual sensitivity.
Visual magnitude of change from existing conditions	Construction Early works in this area started in 2017 to remove the existing building and prepare the grounds for future works. The project works for the new station include parking, integrated pathway for independent access, pathway connections to recreational areas, linking access to the existing adjacent bus stop. During construction, of the station, the site will have a construction compound with heavy machinery, cranes and continuous construction activity present throughout the construction period. The temporary construction sheds, cranes and air ventilation exhausts will be the most prominent visible construction elements. These considerations would result in a moderate visual magnitude of change due to the extents of construction required. Operation The new station will facilitate public activation, car park spaces and linking pedestrian connections to recreational areas which will improve the overall visual amenity of the view. The operational visual magnitude of change is expected to be low-moderate beneficial due to an enhancement of visual amenity to the area.

Visual Impact	Construction The potential visual impact of this viewpoint is considered to be moderate due to the construction programme and the sensitivity of the surrounding receptors and context. Operation The potential visual impact to this viewpoint is considered to be low -moderate beneficial impact due to the overall station upgrade, improved connectivity and urban design approach, and beneficial impact to the sensitivity of the surrounding receptors and context.
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5.3.3.4 Southern Portal

The visual impacts of the new Southern Portal were not specifically assessed previously as part of the Evaluated Project. However, the location, scale and form of the southern portal would be generally consistent with the Evaluated Project therefore the visual impacts are expected to be consistent, with minor changes to the location of dive structures.

The viewpoint assessment for the Southern Portal is provided below.

Viewpoint 8: Southern Portal - Kent Street looking north	
	
Distance from viewpoint	Approximately 40m to the rail corridor.
Visual Sensitivity and Context	The viewpoint is located on the corner of Kent Street looking north toward Dutton Park Station. This view is experienced daily by vehicle traffic and pedestrian movement. The surrounding context includes residential, medical facilities to the east, and commercial and industrial lots to the west across the rail corridor. The view has been assessed as low-moderate visual sensitivity.
Visual magnitude of change from existing conditions	Construction There will be major works to the area which will involve the use of temporary constructed sheds, cranes and heavy machinery being the most prominent visible construction elements. The portal alignment would result in the loss of Queensland Rail buildings within the rail corridor. These considerations would produce a moderate visual magnitude of change with periods of increased visual impacts at times in the construction program. Operation

	The new southern portal structure following construction works will be an integrated feature within the surrounding context due to its location. The portal would not be elevated which results in reduced views from vehicular traffic and certain views from surrounding mixed land use receptors running parallel to the rail line. The operational visual magnitude of change during operation is expected to be low-moderate due to its location within a heavily modified landscape of road and rail infrastructure.
Visual Impact	Construction The potential visual impact at this viewpoint during construction is considered to be low-moderate due to the length of construction works and the sensitivity of receptors and local context. Operation The potential visual impact at this viewpoint during operation is considered to be low due to the surrounding context of existing rail infrastructure.

5.3.4 Southern Area

5.3.4.1 Boggo Road Station

The Proposed Changes in the design for Boggo Road Station are generally similar to the design for Evaluated Project. A key proposed change is the removal of the pedestrian underpass and the addition of a new elevated surface connection pedestrian and cycle link from Princess Alexandra Hospital to Boggo Road Urban Village. There are existing noise walls adjacent to the rail corridor to the south of the proposed Boggo Road Station. These would be extended and increased in height as part of the Project.

Visual Assessment summary

Construction impacts

The Boggo Station construction site will result in visual impacts relating to elevated works involving cranes and temporary site sheds and the presence of heavy machinery at the site.

The Proposed Changes and the Evaluated Project are both located on the eastern side of Boggo Road adjacent to the railway with new pedestrian links. The Evaluated Project includes an underpass pedestrian tunnel where the Proposed Changes include an overpass which would incrementally increase the visual impact to the area.

Operational impacts

The operational visual impacts for the Proposed Changes would be similar to the Evaluated Project due to the station's built form and location. However, the pedestrian bridge which was underground is proposed to be an elevated span, and residential properties are impacted which would result in an increased visual impact compared with the Evaluated Project.

Viewpoint 9: Boggo Road facing east-northeast


Distance to Station from viewpoint	Approximately 30m to the Station.
Visual Sensitivity and Context	The viewpoint is located on the eastern corner of Boggo Road facing east-northeast over the railway towards Park Road Railway Station. This view is elevated with areas of small linear parkland spaces for local workers and residents looking over the railway eastwards. The surrounding context includes the Boggo Road urban village and commercial Eco Sciences Precinct, Dutton Park Police Station to the west, and Princess Alexandra Hospital to the east. The view has been assessed as moderate visual sensitivity.
Visual magnitude of change from existing conditions	Construction During construction of the station heavy machinery, cranes and continuous construction activity will occur. The temporary construction sheds and cranes will be the most prominent visible construction elements. Taking into consideration, the station is on the eastern slope and would be highly visual from surrounding receptors. These considerations would result in a moderate visual magnitude of change. Operation The operational visual magnitude of change is expected to be moderate (beneficial) due to a consolidated built form for the station and the majority of work being underground. The proposed height extension of the noise walls south of the station location will further screen views towards the rail corridor. Enhanced visual amenity is designed to be reinstated to the station surrounds which will overall improve the surrounding context.
Visual Impact	Construction The potential visual impact of this viewpoint is considered to be moderate due to the length of construction and the sensitivity of the surrounding receptors and context. Operation The potential visual impact to this viewpoint is considered to be a moderate beneficial impact due to the construction of a new station, the provision of visual amenity, and improved connectivity.

5.3.4.2 Dutton Park Station

Dutton Park station upgrade is part of the Evaluated Project however the Proposed Changes will increase the extent of works, including moving the station location to the south, provision of a covered pedestrian overpass, demolition of existing ramp and station building and construction of retaining walls. A temporary platform is required during construction to enable the station to remain operational. This will result in impacts to properties on Cope Street to the south of Annerley Road.

Summary of landscape changes from Evaluated Project

Construction impacts

The Proposed Changes will impact adjacent low-medium height residential lots to the south-east of the station on Cope Street, resulting in a temporary change in land use in this area, in addition to the works at the station and within the rail corridor. There are multiple sensitive receptors (residential properties) in the surrounding area.

The landscape impact has been assessed as low-moderate. The site's sensitivity would be moderate, and the magnitude of change would be low-moderate due to the surrounding context being mostly residential and commercial properties and due to existing screening around the station and Annerley Road, which limits sightlines into the rail corridor. Due to the increase in the number of affected properties (compared to the previously Evaluated Project Dutton Park Station), the landscape impacts would increase in comparison to the Evaluated Project.

Operational impacts

The landscape impact following construction has been assessed as low-moderate impact to the surrounds due to the moderate sensitivity of the surrounding land use types, and the magnitude of the change would be low-moderate. The scale of operational landscape impacts to the surrounding precinct would increase compared to the Evaluated Project however the redevelopment of the impacted lots and the improved accessibility and architectural features at the station would result in a beneficial outcome for surrounding receptors.

Summary of visual impact changes from Evaluated Project

Construction impacts

The proposed construction works at Dutton Station would result in an overall increase in visual impact compared to the Evaluated Project as the works have increased in extent. The majority of works will be within the rail corridor which is below surrounding ground level and less visible from surrounding land uses. However, the elevated pedestrian overpass and retaining walls would likely be visible from adjacent residential areas and roads.

Operational impacts

The visual impact during operation associated with the station itself is considered to be generally consistent with the Evaluated Project due to the nature of the works predominantly in an existing rail environment. Overall enhancement of the station and improved accessibility provided by the new pedestrian overpass infrastructure is anticipated to improve visual amenity of the viewpoint from its existing condition.

Viewpoint 10: Dutton Station – Rusk Street and Cornwall Street looking north-west


Distance to Station from viewpoint	Approximately 60m to the rail corridor.
Visual Sensitivity and Context	The viewpoint is located on the corner of Rusk Street and Cornwall Street looking north-west toward Dutton Park Station. This view is experienced daily by vehicle traffic and pedestrian movement. The surrounding context is predominately residential lots to the west and east, medical facilities to the east, and commercial and industrial lots to the west. The view has been assessed as low-moderate visual sensitivity.
Visual magnitude of change from existing conditions	Construction During construction, installation of the proposed pedestrian overpass to the eastern part of the station and construction works including new platform and station building will be visible from this viewpoint. This will include the introduction of heavy machinery into the rail corridor disrupting predominate views from this location. These considerations would result in a moderate visual magnitude of change. Operation Post construction, the enhanced platform and station infrastructure and pedestrian overpass will improve the overall visual amenity of the view. The operational magnitude of change is expected to be low due to the localised nature of the works and existing rail environment.
Visual Impact	Construction The potential visual impact from this viewpoint is considered to be low -moderate as the works are largely within the rail corridor and due to low-moderate sensitivity of the surrounding receptors and context. Operation The potential visual impact to this viewpoint as a result of the Proposed Changes is considered to be low-moderate (beneficial) as a result of improved access and updated architectural features at the station.

5.3.5 Fairfield to Salisbury Area

5.3.5.1 Fairfield Station

Fairfield station upgrade is not part of the Evaluated Project.

The project works for Fairfield station includes the replacement of existing platform shelters and the station building, upgrades to platform surfacing, the demolition of the existing overpass and replacement of an enhanced pedestrian overpass.

The viewpoint assessment for Fairfield Station is provided below.

Viewpoint 11: Fairfield Station – looking south-east towards the station and overpass	
	
Distance to Station from viewpoint	Approximately 60m to station boundary.
Visual Sensitivity and Context	The area is predominately residential with a multi-use commercial property situated behind the assessment viewpoint. The narrow local roads are undulating, the surrounding residential properties are 1-2 storeys high, and the commercial property is setback, limiting its view to the station. This viewpoint is located on Midmay St looking towards the station platform and overpass from a combination of a residential and commercial edge including an entrance into the Fairfield Shopping Centre. This view is likely to be experienced by local or neighbouring residents entering the shopping precinct, residential properties or the train station. Due to the mixed land uses within close proximity to the viewpoint and shaded, accessible footpath, the sensitivity associated with this viewpoint is moderate.
Visual magnitude of change from existing conditions	Construction During construction, the viewpoint will experience the removal and installation of the proposed pedestrian overpass and station infrastructure. This will include the introduction of heavy machinery into Midmay Street disrupting predominate views from this location. This would result in a low-moderate visual magnitude of change with periods of increased visual impacts depending on the staging of construction. Operation The enhanced platform infrastructure and pedestrian overpass will improve the overall visual amenity of the view. The operational change is expected to be low due to the minimal changes associated with these station works.

Visual Impact	Construction The potential visual impact from this viewpoint is considered to be low -moderate as the works are largely within the rail corridor and due to moderate the sensitivity of the surrounding receptors and context. Operation The potential visual impact to this viewpoint as a result of the Proposed Changes is considered to be low-moderate (beneficial) as a result of improved access and updated architectural features at the station.
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5.3.5.2 Yeronga Station

Yeronga Station upgrade is not part of the Elevated Project.

The project works for Yeronga station include the introduction of enhanced platform infrastructure, the replacement of the existing ramp with an enhanced, compliant footpath, the replacement of the existing overpass with an enhanced pedestrian overpass and the replacement of the station building. The existing noise wall located to the south of Yeronga Station would need to be extended.

The viewpoint assessment for Yeronga Station is provided below.

Viewpoint 12: Yeronga Station - looking west towards the station	
	
Distance from viewpoint	Approximately 15m to the station entrance.
Visual Sensitivity and Context	The area consists of predominately residential properties to the east and multiple mix use commercial property to the west along Fairfield Road. The area is elevated with narrow local roads with the majority of the residential properties being one to two storeys high on the eastern side. This viewpoint is located on the corner of Lake Street and Killarney Street looking towards Yeronga Station from the adjacent footpath. The view is located within a residential landscape character and experienced mainly by local residents. Visual amenity of this viewpoint is considered to be low-moderate based on the sensitivity of the receptors surrounding the viewpoint.
Visual magnitude of change from existing conditions	Construction During construction, the eastern side of the rail corridor will experience removal of a mature tree at Lake Street that currently obstructs views towards the station infrastructure. Demolition and construction of the improved station infrastructure and pedestrian overpass will affect existing views. These

	considerations would produce a low-moderate visual magnitude of change with periods of increased visual impacts during the construction program. Operation The enhanced platform shelters, urban design and reinstated vegetation following construction works will improve the overall visual amenity of the view. The proposed extension of the noise wall will further screen views towards the rail alignment. The operational visual magnitude of change is expected to be low due to the minimal changes associated with these station works.
Visual Impact	Construction The potential visual impact from this viewpoint during construction is considered to be low-moderate as the works are largely within the rail corridor and due to moderate the sensitivity of the surrounding receptors and context. Operation The potential visual impact to this viewpoint as a result of the Proposed Changes is considered to be low-moderate (beneficial) as a result of improved access and updated architectural features at the station.

5.3.5.3 Yeerongpilly Station

Yeerongpilly Station upgrade is not part of the Evaluated Project.

The Proposed Changes at Yeerongpilly Station include enhanced platform infrastructure on both the middle and eastern platforms. Platforms will be raised, shelters will be replaced, and the existing overpass will remain.

The viewpoint assessment for Yeerongpilly Station is provided below.

Viewpoint 13: Yeerongpilly Station – looking west towards overpass and station entrance	
	
Distance from viewpoint	Approximately 20m to the station entrance.
Visual Sensitivity and Context	The area consists of predominately residential properties to the east and new developments underway to the west, including commercial property also to the west along Fairfield Road. To the south the majority of the land is industrial. This viewpoint is located directly across the road from the proposed works on the corner of Wilkie Street and Green Street. The land uses surrounding this viewpoint is predominately residential and likely to be experienced regularly, mostly by

	private residents. The sensitivity associated with this viewpoint is considered to be low-moderate.
Visual magnitude of change from existing conditions	Construction During construction, the existing carpark area, situated along Wilkie Street, is to be removed to assist the construction of the enhanced platform infrastructure and associated works. In addition, the removal of minimal vegetation on the eastern side of the alignment, near Livingstone Street, is anticipated. These considerations and other disturbance during construction would produce a low-moderate visual magnitude of change with periods of increased visual impacts during the construction program. Operation The enhanced platform shelters, urban design and reinstated vegetation following construction works will improve overall visual amenity of the view. The overall operational visual magnitude of change is expected to be low due to the minimal changes associated with these station works.
Visual Impact	Construction The potential visual impact from this viewpoint during construction is considered to be low-moderate as the works are largely within the rail corridor and due to low-moderate the sensitivity of the surrounding receptors and context. Operation The potential visual impact to this viewpoint as a result of the Proposed Changes is considered to be low-moderate (beneficial) as a result of improved access and updated architectural features at the station.

5.3.5.4 Moorooka Station

The upgrade of Moorooka Station is not part of the Evaluated Project.

The Proposed Changes at Moorooka Station include the demolition of the existing footbridge, the installation of a pedestrian overpass connecting to an additional, third platform integrated on the western side of Clapham Yard, the demolition of the existing station building, addition of enhanced station infrastructure and an improved integrated pathway for independent access.

The viewpoint assessment for Moorooka Station is provided below.



Distance from viewpoint	Approximately 35m from the station entrance.
Visual Sensitivity and Context	The area consists of commercial properties to the east and industrial use to the west. Behind the commercial lots to the east are residential properties. The surrounding area has a main arterial road adjoining local roads with residential properties being one to two storeys high on undulating land to the eastern side. To the west, the topography is subtly undulating along the industrial frontage. This viewpoint is located on the eastern side of Ipswich Road and the corner of Keats Street looking north-west towards the proposed works. Adjacent land uses are commercial properties (car sale yards). Ipswich Road is a major arterial connection corridor largely used particularly by motorists during peak hours. Due to the high level of utilisation of the corridor for both motorists and local workers/residents, and the lack of quality visual amenity the sensitivity for this viewpoint is considered to be low-moderate.
Visual magnitude of change from existing conditions	Construction During construction, there will be a temporarily installed construction area to the west of Ipswich Road, directly adjacent to the rail corridor and station. Heavy machinery will be required to install and construct the proposed pedestrian overpass. Additional works will occur on the western side of Clapham Yard to install a third platform. Due to the unobstructed views towards the proposed construction area and the scale of proposed works for this station, this will produce a moderate visual magnitude of change with periods of increased visual impacts during the construction program. Operation The proposed pedestrian overpass will be the most visually dominant impact on this viewpoint. It will increase the visual prominence of rail infrastructure for motorists along Ipswich Road. However, enhanced station, additional platforms and overpass design will improve overall visual amenity of the view. The operational visual magnitude of change is expected to be low due to the minimal changes associated with these station works.
Visual Impact	Construction The potential visual impact from this viewpoint during construction is considered to be low-moderate as the works are largely within the rail corridor and due to low-moderate the sensitivity of the surrounding receptors and context. Operation The potential visual impact to this viewpoint as a result of the Proposed Changes is considered to be low-moderate (beneficial) as a result of improved access and updated architectural features at the station.

5.3.5.5 Rocklea Station

Upgrade to Rocklea Station is not part of the Evaluated Project.

The project works for Rocklea station includes the demolition of the existing overpass and the addition of an enhanced pedestrian overpass, the demolition of existing shelters and the addition of enhanced shelter infrastructure and the widening, raising and resurfacing of the platforms.

The viewpoint assessment for Rocklea Station is provided below.

Viewpoint 15: Rocklea Station – looking east towards the station	
	
Distance to Station from viewpoint	Approximately 40m from the overpass.
Visual Sensitivity and Context	The area is a mixture of commercial, industrial and residential properties to the south-west and isolated industrial use to the east. Behind the commercial lots to the south-west are residential properties. The surrounding area has a main arterial road adjoining local roads with residential properties being one to two storeys high on undulating land on the western side. To the northeast, the topography is undulating behind the industrial buildings which are situated parallel to the Rocky Water Hole creek system. This viewpoint is from Brooke Street looking east towards Rocklea station. The viewpoint is located within a residential street and in close proximity to commercial areas. Street trees lined along the western edge of the station carpark contribute to the local visual amenity of the street. This view is experienced by local residents and visitors entering the station carpark. Due to the existing mix of land uses at the location, the sensitivity of this viewpoint is considered low-moderate.
Visual magnitude of change from existing conditions	Construction During construction, the station carpark is proposed to be extended to the left of the viewpoint to accommodate space for construction access. Additionally, the material laydown area is located off Brooke Street to the right of the carpark. Heavy machinery will access from the carpark entrance to install and construct the proposed pedestrian overpass. Due to the unobstructed views towards the proposed construction area and the scale of proposed works for this station, this will produce a moderate visual magnitude of change with periods of increased visual impacts during the construction program. Operation The proposed pedestrian overpass will be the most visually dominant impact on this viewpoint. It will increase the visual prominence of rail infrastructure to residents located on Brooke Street. However, enhanced station and overpass design will improve overall visual amenity of the view. The operational visual magnitude of change is expected to be low due to the minimal changes associated with these station works.
Visual Impact	Construction

	The potential visual impact from this viewpoint during construction is considered to be low-moderate as the works are largely within the rail corridor and due to low-moderate the sensitivity of the surrounding receptors and context. Operation The potential visual impact to this viewpoint as a result of the Proposed Changes is considered to be low-moderate (beneficial) as a result of improved access and updated architectural features at the station.
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5.3.5.6 Salisbury Station

Upgrades to Salisbury Station are not part of the Evaluated Project.

The Proposed Changes at Salisbury station include the demolition of the existing overpass and the addition of an enhanced pedestrian overpass, the demolition of existing shelters and the addition of enhanced shelter infrastructure, the addition of a platform to the west of the existing platform, the widening and raising of the platforms and the enhancement of existing footpaths to be compliant.

The viewpoint assessment for Salisbury Station is provided below.

Viewpoint 16: Salisbury Station – looking south-west towards the station	
	
Distance from viewpoint	Approximately 88m from the pedestrian overpass.
Visual Sensitivity and Context	The surrounding area has industrial land use to the west and residential land use to the east. The surrounding area has a main arterial road adjoining local roads with large industrial lots. To the east, the topography is elevated heading away from the station and generally flat to the west where the industrial buildings are situated. Due to most of the works being undertaken within Queensland Rail or Brisbane City Council owned property, the character of the area is not deemed to be significantly impacted. This viewpoint is from Lillian Avenue looking south-west towards the proposed station upgrades from a residential edge. Mature vegetation located within, and surrounding, the station carpark obstructs direct views to station infrastructure and provides quality visual amenity and distinct local character of the area. This view is experienced by local residents and visitors entering the station carpark. The street has residential land uses, and the sensitivity of this viewpoint is considered low-moderate.
Visual magnitude of change from	Construction

existing conditions	During construction, the site compound area and the location for site deliveries would be located along Dollis Street, adjacent to the rail corridor. This may increase traffic entering and exiting the construction site impacting surrounding views. Heavy machinery will also be present at the site to construct the overpass. Due to the intermittent views of the existing station infrastructure, this will produce a low visual magnitude of change with periods of increased visual impacts during the construction program. Operation The proposed pedestrian overpass will be the most visually dominant impact on this viewpoint. It will increase the visual prominence of rail infrastructure to residents located on Lillian Avenue. However, enhanced station and overpass design will improve overall visual amenity of the view. The operational visual magnitude of change is expected to be low due to the minimal changes associated with these station works.
Visual Impact	Construction The potential visual impact from this viewpoint during construction is considered to be low-moderate as the works are largely within the rail corridor and due to low-moderate the sensitivity of the surrounding receptors and context. Operation The potential visual impact to this viewpoint as a result of the Proposed Changes is considered to be low-moderate (beneficial) as a result of improved access and updated architectural features at the station.

5.3.5.7 Clapham Station

The Clapham Yard stabling facility and track works were assessed as part of the 2011 EIS, however, this component was subsequently excluded in the Evaluated Project.

The Proposed Changes at Clapham Yard are similar to that assessed in the 2011 EIS, including new stabling facilities, cleaning, maintenance and inspection facilities and northern (and limited southern) access for rollingstock. Other surface works are also similar in nature to those assessed in the 2011 EIS, including removal and installation of utilities, new crew facility and civil works.

Proposed Changes at the site include new staff car park, train storage area and supporting utilities, embankment along Fairfield Road, new bridges, elevated pedestrian crossing that ties in with Moorooka Station and resumption of industrial lots to the west of the yard.

The Proposed Changes would result in an increased visual impact compared to the Evaluated Project.

Landscape Assessment

Construction impacts

During construction, heavy machinery will be present at the site and fluctuating volumes of vehicle traffic entering and exiting the site. Service infrastructure will be installed, and earthworks are anticipated to change the immediate character of the existing site. The landscape impact has been assessed as low-moderate impact. The site's sensitivity would be low, and the magnitude of change would be low-moderate due to the surrounding context and an increase compared to the Evaluated Project.

Operational impacts

The operational landscape impact has been assessed as low due to the surrounding context and pre-existing rail infrastructure. The Proposed Changes would result in a low-moderate landscape impact to the surrounds due to the low sensitivity of the surrounding land use types, and the magnitude of the change would be low-moderate rating due to the surrounding context. The overall operational landscape impacts of the Proposed Changes to the station would increase compared with the Evaluated Project which did not include works at Clapham Yard.

The viewpoint assessment for Clapham Yard is provided below.

Viewpoint 17: Clapham Yard – looking east towards works from Fairfield Road	
	
Distance to Yard from viewpoint	Approximately 175m from rail corridor.
Visual Sensitivity and Context	The area has industrial land use to the west and commercial use to the east with residential blocks behind. Ipswich Road is a main arterial road adjoining surrounding local roads and commercial and large industrial lots. To the east, the topography is elevated heading away from the station and generally flat to the western side where the industrial buildings are situated. Beyond the industrial area, to the west, there is a large recreational golf course which has thick vegetation adjacent to Fairfield Road blocking major views towards the proposed works. This viewpoint is on Fairfield Road looking towards Clapham Yard. To the right of the viewpoint, there is a golf course which is well screened and protected with mature vegetation and fencing. Direct views into the rail yards are experienced from this location with minimal variation in topography, street tree planting and built form. The view lacks landscape and quality visual amenity as is dominated by industrial land use and infrastructure. It is heavily experienced by motorists, local workers and residents. The sensitivity of this view is therefore considered to be low-moderate.
Visual magnitude of change from existing conditions	Construction During construction, traffic entering and exiting the construction site may impact surrounding views into the rail yards. Heavy machinery will also be required to construct the overpass. Earthworks will be undertaken on the site including the introduction of large batters changing the levels and existing topography of the site. Due to the largely unobstructed views of the rail yards and existing station infrastructure, this will produce a moderate visual magnitude of change with periods of increased visual impacts during the construction program. Operation The proposed pedestrian overpass will have a dominant visual impact in this location. During operation, screening is anticipated to be installed around the rail

	yards, reducing the direct views into the site. Arriving from Moorooka Station (east of the site) users of the pedestrian overpass will experience a direct view into the rail yards. The operational visual magnitude of change is expected to be low-moderate due to the Proposed Changes occurring in an existing rail yard surrounded by industrial land use.
Visual Impact	Construction The potential visual impact at this viewpoint during construction is considered to be low-moderate as the works are largely within an existing rail environment and due to the low-moderate sensitivity of the surrounding receptors and context. Operation The potential visual impact to this viewpoint following construction is considered to be low as the works are largely within an existing rail environment and will be consistent with the existing context.

Viewpoint 18: Clapham Yard – looking north-east from Sherwood Road



Distance to Yard from viewpoint	Approximately 100m from the rail corridor.
Visual Sensitivity and Context	This viewpoint is experienced from a green edge adjacent to Sherwood Road and Rocky Water Hole Creek looking towards Clapham Yard. The right of the viewpoint shows the rail bridges over Muriel Avenue. Sherwood Road, the main vantage point for which this viewpoint will be experienced, and Muriel Avenue are highly utilised road corridors and a key connector for motorists. This viewpoint is dominated by riparian vegetation surrounding the waterway which improves the quality of visual amenity for this location. To the left of the viewpoint, industrial warehouses occupy the view, and adjacent land uses. This viewpoint is heavily experienced by motorists, local workers and residents, and the sensitivity of this view is considered to be low-moderate.
Visual magnitude of change from existing conditions	Construction During construction, the viewpoint will experience insignificant impacts due to the distance from the construction works. The rail bridges over Muriel Avenue, to the right of the viewpoint, may involve minimal construction works slightly impacting existing views. However, existing fencing will screen the proposed construction. Therefore, the overall visual magnitude of change from this viewpoint is anticipated to be low. Operation During operation, boundary fencing is anticipated to be installed to obstruct views towards the site. Therefore, the operational visual magnitude of change is expected to be low due to the works occurring in an existing rail environment, the

	distance of the viewpoint from proposed construction and the screening effect of fencing.
Visual Impact	Construction The potential visual impact at this viewpoint during construction is considered to be low-moderate due to the distance from the works and as the works are largely within an existing rail environment with low-moderate sensitivity of the surrounding receptors and context. Operation The potential visual impact at this viewpoint following construction is considered to be low as the works are largely within an existing rail environment and will be consistent with the existing context.

Viewpoint 19: Clapham Yard – looking north-west from Ipswich Road	
	
Distance to Yard from viewpoint	Approximately 40m from Clapham Yard.
Visual Sensitivity and Context	This viewpoint is looking towards Clapham Yard from the eastern edge of Ipswich Road adjacent to the car sale yard. Ipswich Road is a major arterial connection corridor largely used particularly by motorists during peak hours. Due to the high level of utilisation of the corridor for both motorists and local workers/residents, and the lack of quality visual amenity the sensitivity for this viewpoint is considered to be low-moderate.
Visual magnitude of change from existing conditions	Construction During construction, the viewpoint will experience an increase in traffic entering and exiting the construction site impacting surrounding views into the rail corridor. Heavy machinery will also be required to construct the overpass. Due to the largely unobstructed views of the rail yards and existing station infrastructure, this will produce a moderate visual magnitude of change with periods of increased visual impacts during the construction program. Operation During operation, boundary fencing is anticipated to be installed to obstruct views towards the construction works. The pedestrian overpass will have a greater visual impact due to the elevation of the structure. However, enhanced overpass design will improve overall visual amenity of the view. The operational visual magnitude of change is expected to be low-moderate.

Visual Impact	Construction The potential visual impact at this viewpoint during construction is considered to be low-moderate as the works are largely within an existing rail environment and due to the low-moderate sensitivity of the surrounding receptors and context. Operation The potential visual impact at this viewpoint following construction is considered to be low as the works are largely within an existing rail environment and will be consistent with the existing context.
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5.3.6 Lighting

Potential change

Potential changes to lighting for construction and operation have been reviewed in comparison to the lighting proposed for the Evaluated Project.

Construction impacts

Consistent with the Evaluated Project the construction programme will require nighttime construction works to be conducted at multiple locations. The installation of permanent and temporary lighting will be required to assist in site works, security risks and ensure safety requirements are met for all personnel. A majority of the project sites will require surface level lighting with the use of acoustic sheds and screening measures were applicable to minimise glare to the surrounding receptors.

The extent of lighting requirements at specific project locations may be visible by nearby surrounding receptors. The temporary lighting works will be focused on project elements and points of interest however, this may still result in light spill being visible to adjacent receptors.

Consistent with the Evaluated Project, residential receptors with minimal vegetation or lack of high screen fencing within the line of sight of the construction night works could be prone to lighting impact and passing glare from construction vehicles. Due to the staged construction program at each site, these impacts will be limited to a short period over the whole programme length.

Areas with increased construction lighting requirements compared to the Evaluated Project would include Mayne Yard due to the increased extent of works, and at the Fairfield to Salisbury Stations which would be an increase compared to the Evaluated Project. There would also be an incremental increase to the extent of construction works and associated lighting at Roma Street due to the proposed lowering of the Inner Northern Busway and associated road works.

Operational impacts

Consistent with the Evaluated Project, the Proposed Changes would increase the frequency of trains operating along the network. As a result, operational lights associated with train movement could increase lighting impacts on surrounding receptors when compared to the Evaluated Project.

Lighting situated along surface track alignments will be in accordance with Queensland Rail lighting requirements to minimise impact to surrounding receptors. The upgrade to stations will use more focused light options on points of interest and thoroughfares which will be coordinated with existing light elements.

5.4 Mitigation Measures

Mitigation measures which are consistent with the Project OEMP and apply to the Proposed Changes include the following:

- A visual impact mitigation plan should be prepared prior to construction to mitigate potential visual impacts of noise barriers and hoardings, where appropriate.
- Ensure that the design and siting of construction worksites considers topography, vegetation, scale, character of construction and construction materials, proximity to surrounding sensitive land uses and the duration of its use.
- Where possible, adopt pruning and selective trimming of mature trees in preference to their removal.
- Where possible, fence and protect trees of particular significance that fall within construction worksites and laydown areas.
- A suitably qualified arborist should be consulted regarding the management of mature vegetation to be retained.
- Provide noise barriers and hoardings around construction worksites to mitigate the views of construction works, incorporating landscaping and urban design measures where appropriate.
- Where possible, external night time construction activities and traffic movement within the worksites will be minimised.
- Where possible, design noise barriers to incorporate high quality materials, urban design treatments and landscape elements such as low, massed plantings.
- Project lighting to be designed in accordance with relevant standards.
- Construction phase works to minimise night-time impacts of lighting on residential properties where practicable.
- Place hoarding and visually impermeable barriers around worksites to minimise views of stockpiles and construction activities, particularly where worksites are visible to residential or recreational users.
- Where appropriate, use directionally-controlled, shielded lights that are mounted at a sufficient height to minimise light spill to surrounding properties.
- Restore, rehabilitate, and where appropriate enhance open space and public areas disturbed or damaged by construction as soon as practicable following construction.

5.5 Conclusion

A landscape and visual assessment has been conducted for the Proposed Changes to determine the extent of changes compared against the Evaluated Project.

Key changes compared to previous Evaluated Project for construction and operation include:

- **Mayne Yard** - project changes are predominantly to the northern yard with a reconfiguration of alignment, bridge over Breakfast Creek upgraded and new stabling and supporting facilities. The north yard works have increased, however, overall when compared against all of Mayne Yard the visual impact changes are still contextually consistent with the Evaluated Project.
- **Northern Area** – the upgrade of Exhibition Station and minor civil works are likely to have consistent landscape and visual impacts as those identified for the Evaluated Project due to the similar extent of changes required, including removal of fig trees. Revised access through Victoria Park is likely to

have a minor increase in visual impacts compared to the Evaluated Project due to demolition of the BTS building and signalisation of access off Gregory Terrace.

- **Central Area** – Roma Street Station works have increased in scale due to the addition of the Inner Northern Busway works. The Proposed Changes would result in an incremental increase in visual impacts at this precinct when compared with the Evaluated Project, with a beneficial outcome during operation due to the upgraded form and function of the station and surrounds. The Proposed Changes for Albert Street Station would include consolidated entry points and reduction in structures on Albert Street to contribute to the Albert Street vision in this location. Therefore, the works would have increased beneficial visual impacts compared to the Evaluated Project
- **Southern Area** – Additional land resumption requirements and associated landscape impacts will result from the Proposed Changes for Dutton Park Station. The visual impacts of the Proposed Changes would be an increase for Boggo Road Station due to the new pedestrian overpass and an increase for Dutton Park Station due to the increased scale of works and land resumption compared to the Evaluated Project.
- **Fairfield to Salisbury Stations** – station upgrades as part of RfPC-4 involve localised works largely within the rail corridor. The Evaluated Project does not include Fairfield to Salisbury Station upgrades therefore the Proposed Changes would be an increase compared to the Evaluated Project. The visual impacts for the station have been assessed as being low-moderate.
- **Clapham Yard** – Proposed Changes to the yard include the reconfiguration of existing stabling requirements and additional supporting facilities which are not part of the Evaluated Project but were assessed in the 2011 EIS. The visual impact has been assessed as being low-moderate.

The extent of project changes are still in accordance with the Coordinator General's Imposed Conditions for the Evaluated Project. No additional or changed Imposed Conditions are recommended.

6. Technical Report: Nature Conservation

6.1 Introduction

Nature conservation aspects addressed within this technical report relate to native flora and fauna, as well as pest and weed species. The CRR 2019 alignment traverses a highly urbanised area, with limited ecological value for significant species or vegetation communities recognised at local, State or National level. The study area comprises mostly developed urban lands but includes some areas of urban parkland with planted landscape trees of both native and exotic origin. These brownfield habitats hold limited ecological value, due to the general lack of structural diversity and important habitat characteristics (hollow-bearing trees, accumulations of leaf litter, woodland debris, canopy tree maturity and understorey complexity). The absence of these critical habitat features limits the availability of niche habitats that are necessary for supporting native fauna species. In particular, locally occurring threatened species.

This technical report focuses on the ecological values present within the areas where Project changes are proposed, with altered impacts to four areas along the alignment including the Mayne Area, Northern Area, Central Area and Southern Area.

6.2 Assessment Methodology

Numerous studies including desktop and field assessment have been conducted over the alignment since 2011. More recently in 2017 field assessments relating to the revised project alignment were completed by BAAM. This technical chapter is based on the results of these ecological assessments.

6.2.1 Vegetation and Flora Assessment

Desktop Assessment

The desktop assessment comprised a search of online mapping and databases and an analysis of information for conservation significant vegetation communities and flora species with reference to the study area locality. The information relied upon included:

- The Commonwealth EPBC Protected Matters Search Tool to identify any matters of national environmental significance (MNES) protected under the EPBC Act that may occur within the study area.
- The Queensland Wildlife Online, Atlas of Living Australia, Queensland Herbarium HERBRECS and Australian Virtual Herbarium databases to identify any flora species listed as endangered, vulnerable or near threatened (EVNT) under the EPBC Act or NC Act that have been previously recorded in the vicinity of the study area.
- State mapping of regulated vegetation to identify any vegetation of state environmental significance currently recognised as occurring within the study area.
- Review of previous mapping for the Project area, as seen in the current Environmental Impact Statement (EIS).
- The Brisbane City Council's Planning Scheme Biodiversity overlay.
- The Bowen Hills Urban Development Area Development Scheme (ULDA 2009).

Field Assessment

Locations identified by the desktop assessment as having the potential to contain significant flora and vegetation were assessed with a rapid field assessment methodology to quantify and map the areas of

vegetation. Vegetated areas were traversed on foot to identify and record the locations of protected vegetation, including significant landscape trees. The field survey included a systematic search of all vegetation that will be directly or indirectly impacted as part of construction works across the Project works area.

Remnant vegetation communities within the survey area were mapped at a scale of 1:5000 using aerial photograph interpretation with information collected from site plots. Site plots collected information on the vegetation structure, floristics and condition using a detailed quaternary site assessment method.

6.2.2 Fauna and Habitat

Desktop Assessment

The desktop assessment comprised a search of online mapping and databases and an analysis of information for conservation significant terrestrial vertebrate fauna species with reference to the study area locality. The information relied upon included:

- The Commonwealth EPBC Protected Matters Search Tool to identify any matters of national environmental significance protected under the EPBC Act that may occur within the study area;
- The Queensland Wildlife Online database, which incorporates records from the Queensland Museum to identify any fauna species listed as endangered, vulnerable or near threatened (EVNT) under the EPBC Act or NC Act that have been previously recorded in the vicinity of the study area;
- State mapping of essential habitat and Koala (*Phascolarctos cinereus*) habitat values within the study area; and
- Review of previous mapping for the Project area included in the Environmental Impact Statement (EIS) for the Project.

Field Assessment

Locations identified by the desktop assessment as having the potential to provide habitat values for significant fauna species or breeding places were assessed with a rapid field assessment methodology to quantify and map the resources present for native fauna. Potential habitat areas were traversed on foot to identify and record the locations of:

- Foraging, roosting, nesting or movement/corridor resources that are known or likely to be used by significant fauna species within the study area;
- Any animal breeding places; and
- The field survey included a systematic search of all vegetation and structures such as culverts, revetment walls and other infrastructure that will be directly or indirectly impacted as part of construction works across the Project works area.

6.2.3 Arborist Assessment

Tree Assessment

All trees with a Diameter Breast Height (DBH) >15cm were assessed within the Proposed Changed area. Trees were allocated a unique number, identified to species level where possible and the DBH (at 1.4m above ground level) measured. Height and spread of the crown were estimated during this survey. Palms were not included as part of this tree assessment. Trees were assessed as groups when access to stands of trees was not possible, such as the BCC compound within Victoria Park.

All trees were assessed by the Visual Tree Assessment (VTA) method (Mattheck & Breloer 1997). This method involves inspecting the trees from ground level and identifying any external signs of decay, physical damage, or growth-related structural defects. The prevailing site conditions where the tree was growing were also noted. The results of the VTA method will determine whether there is need for a more detailed inspection of any part of the tree.

Data collected during the site assessment were used to calculate the Tree Protection Zone (TPZ) of all trees surveyed. The TPZ assists with the protection of retained trees from mechanical injury to the trunk, severing of roots, or alterations of the soil environment in the immediate vicinity of tree roots (i.e. compaction or loss of organic matter).

Data gained through the tree assessment also assisted with the determination of a tree retention value for each tree. The tree retention value of trees was determined with the use of the IACA Significance of a Tree, Assessment Rating System (STARS) (IACA 2010). The STARS approach involves defining a tree's significance in the landscape (as high, medium or low) and using a decision matrix of the assigned significance rating and estimated life expectancy (i.e. long (>40 years), medium (15 – 40 years), short (<15 years), dead) to determine its retention value (IACA 2010).

6.2.4 Weed Assessment

Desktop Assessment

The desktop assessment comprised a search of online mapping and databases and an analysis of information for local, state and federally listed weed species with reference to the study area locality.

Field Assessment

The Proposed Changed area was traversed on foot to quantify and map the location of weeds in the Project area. The field survey included a systematic search of all vegetation that will be directly impacted as part of construction works across the Project works area.

6.3 Changes to Potential Impacts

6.3.1 Mayne Area

Mayne Rail Yard is a Queensland Rail (QR) stabling yard approximately 33 ha in area, located at Bowen Hills between the Inner City Bypass and Breakfast Creek. The western boundary adjoins fringing mangroves of Breakfast Creek, while the eastern boundary adjoins commercial properties on Abbotsford Road and Burrows Street. There are very few trees within the yard itself, with most of those present occurring in association with administrative buildings and carparks. At the southern extent, adjoining QR land between the yard and Breakfast Creek supports a narrow band of native vegetation.

Flora

Similar to the Evaluated Project, the proposed alignment is within close proximity to areas of Regulated Vegetation. Specifically, there are two areas mapped as Regulated Vegetation that are classified as 'Least Concern' (12.1.3) and 'Of Concern' (12.3.11) Regional Ecosystems (REs). These REs occur as narrow bands located on the western boundary of the site following the Breakfast/Enoggera Creek riparian corridor. The 'Least Concern', RE 12.1.3 (Mangrove shrubland to low closed forest on marine clay plains and estuaries) occurs on the western boundary of Mayne Yard, adjoining Breakfast Creek. The 'Of Concern' community coincides with a small patch of mapped RE 12.3.11 (*Eucalyptus tereticornis* +/- *Eucalyptus siderophloia*, *Corymbia intermedia* open forest on alluvial plains usually near coast) opposite the Mayne Yard administration building.

The field assessment of these mapped REs confirmed current mapping is largely correct. However, the small patch of RE 12.3.11 which coincides with neatly landscaped areas and dominated by mature trees

of two introduced species: *Corymbia torelliana* and *Ficus benjamina*. This area is non-remnant and incorrectly mapped as RE 12.3.11.

Outside of remnant mapped areas, vegetation consistent with RE 12.1.3 occurs as narrow strips on the banks of Breakfast Creek. This vegetation is dominated by *Avicennia marina* (Grey Mangrove) in the tree canopy layer and *Aegiceras corniculatum* (River Mangrove) in the shrub layer. While small, narrow patches of trees consistent with RE 12.3.11 occur in places along the landward edge of RE 12.1.3 (adjoining the Project area boundary), the extent of this vegetation is too narrow to map as remnant vegetation.

While remaining well within the confines of Mayne Yard, the Proposed Changes sees the north-bound track pass closer to the Remnant riparian vegetation of Breakfast/ Enoggera Creek than the previous alignment. While the alignment will miss these remnant mapped areas, the proposal will result in the clearing of marine plants at the crossing of Breakfast / Enoggera Creek. Impacts to marine plants are discussed separately below.

Marine Plants

Assessment was completed on the potential impacts upon marine plants within the alignment at Breakfast Creek in 2017. Activities requiring interference with mangroves and any other marine plants along relevant sections of Breakfast Creek will require consideration of the *Planning Act 2016* and *Planning Regulation 2017* including accepted development criteria. Table 6.1 list marine plants present within the project footprint.

It is estimated that the impacts will be both temporary and permanent due to the nature of the development:

- Temporary impacts are associated with construction, including within the footprint of the proposed temporary falsework bridge; and
- Permanent impacts include the direct project footprint as well as the requirement for ongoing maintenance of vegetation-free buffers to the new bridge structure in accordance with Queensland Rail operational and safety standards.

Table 6.1. Marine Plants present within the Project Area

Vegetation Description or Regional Ecosystem	Dominant Species Types	Density (Number of Stems)	Overall Health
RE 12.1.3 - Mangrove shrubland to low closed forest on marine clay plains and estuaries.	<i>Avicennia marina</i> <i>Aegiceras corniculatum</i>	891 stems (58 / 25m ²)	Good – minor degradation associated with rubbish and debris
Previously cleared non-remnant scattered mangrove regrowth	<i>Avicennia marina</i> <i>Aegiceras corniculatum</i>	263 stems (28 / 25m ²)	Poor – previously cleared and maintained near existing bridges, with rubbish and debris
Marine couch with common sedges on riverbank	<i>Sporobolus virginicus</i>	N/A	Moderate – degradation associated with erosion, rubbish and debris, and weeds
Tidal drainage channel with common reed and exotic grasses	<i>Phragmites australis</i>	N/A	Poor – previously cleared and maintained with heavy weed infestation, and rubbish and debris

Fauna

A fauna survey was conducted by BAAM in 2017. The primary objectives of this assessment were to identify any areas of fauna habitat that have the potential to be used by species of significance and that may be subject to direct or indirect impacts as a result of the construction or operation of the Project; and any active animal breeding places.

The riparian vegetation along Breakfast/Enoggera Creek adjacent to Mayne Yard has the potential to support Black Flying Fox (*Pteropus Alecto*) and is identified as a flying-fox roost site on the Queensland Department of Environment and Science (DES) flying-fox roost location mapping (current and historical roosts). Since May 2014 the roost site for Black flying-fox has been used sporadically with greatly reduced numbers recorded. A site survey on 16 December 2015 by ARUP recorded a mixed colony of Black Flying-fox and Grey-headed Flying-fox (listed as vulnerable under the EPBC Act) roosting at the southern end of the suitable roosting habitat. During a flying-fox assessment in July 2016 only three Black flying-fox were recorded. No flying-foxes were roosting at the roost site during the BAAM 2017 survey, however the assessment notes the roost site also has the potential to be used seasonally by Little Red Flying-fox (*Pteropus scapulatus*).

The Black, Grey and Little Red Flying fox are all listed as significant fauna species under the Brisbane City Plan 2014 Biodiversity areas overlay code. The use of roost sites by flying-foxes is known to vary seasonally as flying-foxes move around to exploit seasonally variable food resources. As such, future construction works should consider the potential for the above flying fox species to be present.

One fauna species, listed as a significant fauna species under the Brisbane City Plan 2014 - Biodiversity areas overlay code, was recorded in the study area during the field survey: Bush Stone-Curlew. This species was present on the western edge of Mayne Rail Yard. Bush Stone-Curlew feeds at night in open areas and nests on the ground in open areas or under trees. In addition, a Rainbow Lorikeet (*Trichoglossus haematodus*) nest was located within a small tree hollow. This animal breeding place will require consideration during site construction activities.

Overall the Proposed Changes to the alignment would not have significant impact upon fauna within the Mayne Yard. The Mayne Yard has limited environments that can provide habitat for threatened and common fauna.

6.3.2 Northern Area

The Brisbane Showgrounds flank either side of the rail line in this location. Vegetation present includes a number of large fig trees and landscape plantings. Bowen Park, on the corner of O'Connell Terrace and Bowen Bridge Road, is a 1.7 ha heritage listed Brisbane City park with historic landscape plantings.

Victoria Park is a 27 ha heritage listed Brisbane City park bordered by Gregory Terrace to the east and is bisected by the QR rail line and Inner City Bypass, which form a 150m wide corridor through the park. The study area in this location is confined to the edges of the QR rail corridor and land adjacent to the western boundary of the rail corridor and the proposed construction access route.

Flora

The Proposed Changes at the exhibition ground are similar to that of the Evaluated Project. However, there is now further refinement in the design options which requires the removal of two existing fig trees, pruning of a third fig tree and ongoing tree management of the remaining four fig trees surrounding the boundary of Show Ring 2. The process of removing, instead of relocating, these the two-nominated trees has been based on their poor health and form. These trees have also been identified as having limited ecological values, however due to their cultural significance further discussion is provided under Section 10: Technical Report: Heritage. The impact to these trees is consistent with the Previous Evaluated project but was only considered at a high level.

The Project requires the construction of access to the railway corridor and Northern Portal through Victoria Park. A detailed flora and tree survey were completed within the park. The general Victoria Park area within the vicinity of the Project works was identified as having general ecological significance Under the Brisbane City Plan 2014 Biodiversity Overlay and a mixture of native and exotic tree species. While the design has been developed to minimise the loss of trees and impact on the ecological significance of the area, the altered alignment will result in the removal of two low value trees and other minor vegetation. This is a reduction in impact when compared to Evaluated Project.

Fauna

Proposed Changes to the exhibition ground will have a low level of impact on the current and potential fauna habitat. There will be the removal of two of the hollow bearing fig trees, but these will be replaced following the construction period. There will also be an increase in construction traffic movement within this site which also has the potential to cause additional disturbance to local nesting fauna within the site. Assessment of this site only identified one Common Ringtail Possum.

The changes to the access through Victoria Park to the adjacent existing railway corridor will result in additional disturbance of local animal breeding sites. Two active animal breeding places were identified in this area, including a Rainbow Lorikeet (*Trichoglossus haematodus*) nests located in a nest box, and one Noisy Miner (*Manorina melanocephala*). These two species are listed as least concern under the NC Act. The assessment also described inactive nests in several trees and one inactive nest mound of Australian Brush-Turkey (*Alectura lathami*). Other potential nest sites included other nest boxes in trees in Victoria Park.

The assessment of potential microbat refuge sites (roosting and breeding) included a microbat box located in a tree and an underground conduit at the entrance to a walkway near Victoria Park. Other, potential refuge sites that may be used by reptiles for nesting or laying eggs include a hollow bearing log in Victoria Park and nest boxes.

6.3.3 Roma Street Station and Inner Northern Busway

The Proposed Changed area incorporates street plantings and gardens outside Roma Street Rail Station, an approximately 1 ha area of parkland at the junction of Roma Street and Albert Street, landscape plantings on Parkland Boulevard and carparks and works areas at the intersection of Kelvin Grove Road and Musgrave Road, within the north-western extent of Brisbane City's Roma Street Parklands.

A desktop assessment was completed for the Roma Street and Emma Miller Place areas. From this assessment it was identified there have been no Regional Ecosystems and remnant vegetation of significance or regulated vegetation recorded. Following the completion of a site survey it was confirmed the sites are covered by a combination of both native and exotic tree species with DBH of less than 250mm. Impacts from the proposed Roma Street surface works and Roma Street section of the Inner Northern Busway (INB) relocation will include the disturbance of this vegetation during the construction phase of works. Once these works are completed, the Emma Miller Place will be landscaped and rehabilitated to its former condition.

No fauna habitat features were identified during the desktop or field assessments for the Roma Street area.

6.3.4 Albert Street

The Albert Street precinct includes street plantings within a 300m section of Albert Street between Margaret and Elizabeth Streets in the Brisbane CBD, and also includes street plantings within a 60m section of Mary Street. Surrounding land uses are primarily commercial, with many sidewalk cafes at ground level.

Flora

No trees within the Albert Street precinct were identified as having high retention value. The existing trees were likely to have their growth moderately restricted by above and below ground influences associated with street plantings. The street plantings along Albert Street contain both native and exotic species. All trees will be removed as part of the construction process.

Fauna

Only one inactive bird nest was identified in one of the street plantings during the site assessment. This tree will need to be included in site clearing works to ensure a suitable construction footprint is provided.

6.3.5 Boggo Road

This portion of the study area includes outside edges and between rail lines within the QR corridor between Princess Street at Dutton Park and Merton Road at Woollongabba. It also includes vacant land associated with the Queensland Government Ecosciences Precinct at Boggo Road, Dutton Park, and two properties located between the Eastern Busway and the existing QR Cleveland Line Rail Corridor. Surrounding land uses are a mix of transport, commercial, hospital and residential.

Flora

Various native and exotic species were identified within the Boggo Road and Princess Alexandra (PA) Hospital precincts. Of these species, eight species within the Boggo Road area were identified as having high retention value and one was identified as having a medium retention value. All trees identified within the PA Hospital area were identified as having a medium to low retention value except for two groups of Queensland Kauri which were identified as having a high retention value.

Fauna

Of the vegetation recorded within the Boggo Road and PA Hospital precincts, no suitable fauna habitat features were identified.

6.3.6 Fairfield to Salisbury (F2S) Area

The identified scope for the Fairfield to Salisbury Station (F2S) works, includes station upgrades at Fairfield, Yeronga, Yeerongpilly, Moorooka, Rocklea and Salisbury, track work at Yeerongpilly and Clapham Yard, works at the Moolabin substation and underground power feed and a second bridge at Moolabin Creek. The majority of these works have been nominated within the existing QR corridor with limited disturbance of local street plantings outside of the corridor. No environmental threatened and or significant landscaping trees were identified within the QR corridor. Regulated vegetation has been identified along the banks of the Moolabin Creek. While this vegetation will be impacted during the construction of the new bridge structure, due to the location of the new bridge being constructed between existing bridges, the impact on this vegetation will be minimized.

Biosecurity - F2S Stations

Fire Ant Biosecurity Zones (FABZ) are in place in areas of Queensland to restrict the movement of materials that could spread fire ants. Under the *Biosecurity Act 2014*, individuals and organisations whose activities involve the movement or storage of fire ant carriers will have a general biosecurity obligation to take all reasonable steps to ensure they do not spread fire ants. The F2S Area includes station upgrades of Fairfield, Yeronga, Yeerongpilly, Moorooka, Rocklea and Salisbury. Table 6.2 describes these stations in relation to the fire ant and biosecurity zone mapping. All works within the FABZ areas will need to

adhere to the requirement of the Biosecurity Act and associated Regulation as per the approved Project OEMP and future Construction EMP.

Table 6.2. Biosecurity Areas

Stations	Fire Ant Biosecurity Zone
Fairfield	No Zoning
Yeronga	Fire Ant Biosecurity Zone 2
Yeerongapilly	Fire Ant Biosecurity Zone 2
Mooroka	Fire Ant Biosecurity Zone 2
Rocklea	Fire Ant Biosecurity Zone 1
Salisbury	Fire Ant Biosecurity Zone 2

Other pest plants, such as Chinese Celtis (*Celtis sinensis*), Camphor Laurel (*Cinnamomum camphora*), Cat's Claw Creeper (*Macfadyena unguis-cati*) and Singapore Daisy (*Sphagneticola trilobata*) are located within parklands, including Dutton Park, Wickham Park, Roma Street Parklands, Victoria Park and the RNA Showgrounds. The changed project does not change the dispersion risk impacts already identified for the CRR Project. Nor will the Proposed Changes result in actions that increase the distribution or occurrence of identified invasive fauna species.

Biosecurity - Clapham Yard

Earthworks are required at Clapham Yard to improve flood immunity of the site. There is approximately 35,000m³ fill and 27,300m³ cut proposed, with no net import of material. However, due to some sites being on EMR and others not there may need to be the removal of contaminated material offsite and import of equivalent volume of material to site.

6.4 Changes to Mitigation Measures

The project works have been designed to minimise impacts the native flora and fauna species. Where potential impacts occur, management and mitigation measures are described and will be implemented as per the requirements of the Project OEMP and Construction Environmental Management Plans (CEMP).

Mitigation measures which are consistent with CRR Project include the following:

- Consulting with an arborist in relation to fig tree relocation at the RNA Showgrounds;
- Develop a suitable landscaping and rehabilitation plan for Emma Miller Place to ensure the area is returned to an agreed state following the temporary construction program;
- Undertake a pre-construction fauna survey within and around worksites to identify any species for which a species management plan needs to be developed;
- Developing and implementing a Rehabilitation Plan, Landscape Plan, Pest and Weed Management Plan;
- Adopting erosion and sediment control measures and soil hygiene procedures including completion of an ESCP;
- Reducing impacts from light dispersal on nearby sensitive receptors especially near Breakfast/Enoggera Creek and Victoria Park, whilst still providing lighting for public safety;

- Obtaining necessary clearing permits and clearly marking 'no-go' areas;
- Capturing and relocating fauna (fauna spotter/catcher) as required during construction works;
- Undertaking environmental incident reporting as required;
- Employing a suitably qualified person for vegetation rehabilitation and on-going monitoring of fauna/flora and ESCP;
- Undertaking any operational works within designated areas to further reduce vegetation/fauna disturbance;
- Impacts placed upon fauna can be managed and mitigated via the implementation actions within the Nature Conservation Management Plan consistent with the approved Project OEMP;
- If there are any active breeding places for EVNT, special least concern or colonial breeding species it may be necessary to submit a 'Species Management Program for tampering with animal breeding places – high risk of impacts – all protected wildlife including special least concern animals and colonial breeders' to DES for approval. Alternatively, DES may allow the works to be carried out under a Damage Mitigation Permit;
- Development and implement a Biosecurity Risk Management Plan;
- Material being moved within and across Fire ant biosecurity zones must be managed under a biosecurity instrument permit and in accordance with General Biosecurity Obligations; and
- All project sites receiving fire ant carriers must ensure that a Biosecurity Instrument Permit is provided by the supplier, or a Biosecurity Queensland certified inspection certificate is supplied for fire ant carriers. The origin of all vehicles and equipment must be checked to see if they have come from declared biosecurity zones, and that the vehicle or machinery is visually clean and has maintained good vehicle hygiene.

6.5 Conclusion

Following assessment of the nominated areas of impact resulting from the Proposed Changes along the Project alignment, and comparison to the impacts from the Evaluated Project, it has been identified the impacts can be suitably mitigated to ensure each area is returned to its current ecological value, and in some cases improved ecological values. A detailed landscape and rehabilitation plan will need to be developed for each specific area to ensure the optimal outcomes are achieved.

7. Technical Report: Hydrology

7.1 Introduction

7.1.1 Overview

This technical report has been prepared for the CRR Project to assess the potential changes to flooding and drainage impacts arising from RfPC-4 in comparison to the Evaluated Project. Volume 1 describes the Proposed Changes to the design and delivery of the CRR Project, which are the subject of RfPC-4.

In some cases, the Proposed Changes are generally in accordance with the design and impacts identified for the Evaluated Project. Where this is the case, further assessment of the RfPC-4 works has not been undertaken.

7.1.2 Assessment Methodology

Interrogation of existing TUFLOW models, reports and other available information has been conducted by the Contractor and findings have been provided in this report. For some Project locations, hydrologic and hydraulic modelling were used the Contractor to assess local flood risk to estimate flood levels for required design immunity.

Further hydrology and hydraulic assessment is proposed in the detailed design phase to confirm design requirements, mitigate potential flood impacts and anticipated influence of climate change on such impacts. Climate change considerations are relevant to the operational phase but not construction due to the short-term construction duration relevant to climate change projections.

Flood events in this report are expressed in Annual Exceedance Probability (AEP) which is the probability of a flood event occurring in any given year.

7.1.3 Changes to Legislation and Policy

7.1.3.1 Hydrology

Flooding and drainage information presented in the 2011 EIS and Evaluated Project was established based on legislation, guidelines and associated references applicable to the Project at the relevant time.

Since RfPC-1, several national and state-wide flooding legislation, guidelines and associated references have been updated. These have been incorporated into the assessment carried out for the Proposed Changes.

A summary of key legislation and guidelines applicable to the Project at the time of writing this document is provided below:

- Australian Rainfall and Runoff, Geoscience Australia, 2016
- Guide to Bridge Technology Part 8: Hydraulic Design of Waterway Structures, Austroads, 2018
- Guide to Road Design Part 5, Austroads, 2018
- City Plan Amendment v09.00/2018, Brisbane City Council, 2018
- MD-12-708 Stabling Yards and Facilities in Network SEQ Design Guide
- Queensland Urban Drainage Manual, IPWEAQ, 2017
- South East Queensland Regional Plan, 2017

- State Planning Policy, *Planning Act 2016*
- Department of Transport and Main Roads Road Drainage Manual, 2015
- Queensland Rail Safety and Environment Management System (SEMS) / Policy Centre flood immunity and drainage requirements

A summary of flood study references applicable to the Project current at the time of writing this document is provided below (some were also applicable for the Evaluated Project):

- Breakfast Creek Flood Study, Brisbane City Council, 2014
- Breakfast Creek Rail Bridge Design – Hydraulic Assessment, WMA Water, 2017
- Brisbane River Catchment Flood Study (BRCFS), Queensland Government, 2017
- Citywide Creek and Overland Flow Path Flood Study, Brisbane City Council, 2018
- Moolabin and Rocky Water Holes Creeks Flood Study, Brisbane City Council, 2015
- Oxley Creek Flood Study, Brisbane City Council, 2014

7.1.3.2 Climate Change

Since RfPC-1 was prepared, the Queensland Government has released the Queensland Climate Adaptation Strategy 2017-2030 and associated Sector Adaptation Plan for the Built Environment and Infrastructure. These documents recognise the impact of climate change on infrastructure and the need for adaptation planning to be incorporated in infrastructure projects. This is consistent with the Coordinator General's (CG) condition that the Project is designed to be adaptable to conditions that may arise as a result of climate change, including accommodating increases in rainfall intensity and the predicted 1.0m sea level rise scenario in 2100 (upper range).

The BRCFS was released after RfPC-1 and now forms the basis for the determination of flood levels in Brisbane including consideration of sea level rise and increase in rainfall intensity. Therefore, mapped flood extents and depths in Brisbane are increased compared to previous studies.

Unless stated, flood levels/extents described in this report are based on the BRCFS existing flood surfaces (excluding climate change). Where climate change flood levels/extents are provided, this is based on the BRCFS scenario incorporating a 0.8m increase in sea level, with additional 0.2m to account for 1m sea level rise as per the CG condition. Further flood modelling is proposed in detailed design to confirm relevant design requirements with consideration of climate change.

7.2 Changes to Potential Impacts

7.2.1 Mayne Area

7.2.1.1 Mayne Yard and Breakfast Creek

The Mayne Yard area design change includes a new bridge over Breakfast Creek (and demolition of the existing eastern truss bridge), reconfiguration of rail alignment within Mayne Yard, and upgraded / new stabling facilities in Mayne Yard.

There is an open drain between Mayne Yard and adjacent industrial land uses which drains to Breakfast Creek. The site generally falls from east to west towards Breakfast Creek with a mean level of

approximately 4m AHD. Currently all runoff in Mayne Yard East and West drains to the existing stormwater pipe network and discharges to Breakfast Creek.

Construction

Mayne Yard

Consistent with the Evaluated Project, no works at Mayne Yard are proposed within the 1 in 100 AEP flood extents of the Brisbane River and Breakfast Creek. Mayne Yard area is however, affected by local overland flows. Construction activities within Mayne Yard area will be planned and implemented to avoid the redirection of uncontrolled surface water flows outside of worksites. This is consistent with the performance criteria stipulated in the Project OEMP.

Breakfast Creek Bridge

New construction and demolition works are proposed at Breakfast Creek for the proposed new bridge crossing and removal of the existing eastern truss bridge. This was not previously assessed as part of the Evaluated Project. The new bridge would require the use of temporary structures within the waterway during construction as well as the permanent structures. Temporary structures in the creek would have the potential to increase peak flood levels and extents in upstream areas.

The dominant flooding mechanism in Breakfast Creek at the location of the bridge up to 1 in 100 AEP is creek flooding.

A previous hydraulic assessment was conducted by WMA Water for the proposed replacement of the existing Breakfast Creek Bridge (2017), and included flood modelling for an indicative construction methodology (including use of a temporary bridge during construction). Based on findings of the WMA Water study, approximate increases in peak flood levels in the order of 50 mm to 100 mm in private properties upstream of the temporary crossing were observed during a modelled construction scenario, in floods ranging from 1 in 5 to 1 in 100 AEP at Breakfast Creek. The results of the WMA Water study indicate that afflux upstream of the bridge on private properties is possible during construction, depending on the construction methodology.

Detailed flood assessment will be undertaken during the detailed design in order to quantify potential flood impacts arising from the proposed construction methodology and identify suitable mitigation. Construction staging and other mitigation measures would be developed in consultation with stakeholders and approval agencies to comply with the Project Imposed Conditions including implementation to avoid afflux.

Operation

Mayne Yard

Consistent with the Evaluated Project, no works are proposed in Mayne Yard that will be located in the 1 in 100 AEP flood extent of the Brisbane River or Breakfast Creek or which would impinge on the current floodplain or flood behaviour (flow direction, potential for concentrated flow paths and/or water velocities) of the creek. All facilities located within Mayne Yard would have 1 in 100 AEP flood immunity.

No changes to flood impact are anticipated compared to those previously assessed.

A new drainage system is proposed for the east of Mayne Yard East and Mayne Yard North to capture runoff for discharge to Breakfast Creek. This new drainage system would receive runoff from access roads and carparks. The existing gross pollutant traps are retained in Mayne Yard East and Mayne Yard West. Bioretention pods (small bio retention basins) and other water sensitive urban design considerations will also form part of the design where appropriate for the site conditions. Consistent with the Project Environmental Design Requirements, the project design will be developed in order to achieve the water

quality objectives referred to in the Environmental Protection (Water) Policy 2009 for water released from Project infrastructure.

Breakfast Creek Bridge

The Breakfast Creek floodplain is heavily constrained with several existing structures crossing the waterway. Any modification to these structures has the potential to cause flood impacts upstream or downstream. The replacement bridge will therefore need to provide similar waterway constriction to the existing truss bridge for events up to and including the 1 in 100 AEP event. The location, skew, soffit level and orientation of the bridge are proposed to be optimised to achieve acceptable flood mitigation. The new deck soffit is proposed to be above the lowest existing deck level and the piers will align with the existing bridge to minimise afflux.

Additional mitigation may also be required to avoid or minimise upstream afflux from the new bridge, and would be confirmed in detailed design through detailed flood modelling to inform subsequent approvals. Consistent with the Project Imposed Conditions and Environmental Design Requirements, the project will be designed to avoid afflux and not cause property damage from flood impacts to third parties for events up to and including the 1 in 100 AEP flood event.

7.2.2 Northern Area

7.2.2.1 Exhibition Station

Exhibition Station is outside areas of mapped riverine, creek or storm surge flood inundation (including with climate change), however is located within an overland flow path so is affected by overland flooding. The station upgrade would be generally consistent with the Evaluated Project and no significant changes to flooding or drainage impact are expected during construction or operation. All station facilities and the walkway connecting to street level are at platform level (RL 12.5 -13.5m) providing greater resilience in flood conditions. Construction activities will be undertaken to avoid redirection of uncontrolled surface water flows outside of worksites, consistent with the approved Project OEMP.

7.2.3 Central / Tunnel Area

7.2.3.1 Roma Street Station and Inner Northern Busway

Hydrologic and hydraulic modelling was conducted to assess local flood risk for the purpose of estimating flood levels for required design immunity at Roma Street. A qualitative assessment was undertaken to define the flood impacts that may arise from the Project at this location.

Riverine Flood (Brisbane River)

Roma Street Station is susceptible to Brisbane River flooding in the 1 in 10,000 AEP, with flood levels approximately 3.7m above the entry level of the proposed station. Deployable flood protection devices (demountable barriers) are proposed to protect against the regional 1 in 10,000 AEP flood event plus sea level rise. This improves flood immunity from the 2011 EIS (1 in 100-year event) and Evaluated Project (1 in 10,000 year event) design.

The design for the Inner Northern Busway relocation and lowering would comply with drainage design criteria and the design flood immunity specified for the Brisbane Metro Project.

Local Overland Flood

The Roma Street Station design floor level is set at 14.4m AHD, providing passive flood immunity up to 1 in 1,000 AEP.

The station is located outside of the 1 in 100 AEP flood extents, will be built within an existing building footprint, and is therefore unlikely to alter existing flow regimes. Works proposed around the junction of Herschel, George and Roma Street may impact overland flow paths, however the potential drainage catchment at this location is relatively small (0.6ha) and the works will be implemented to avoid afflux.

Drainage

A drainage model was used by the Contractor to review the existing drainage system at Roma Street and identified that the existing system has the required capacity to accommodate the changed drainage arising from the Project. Therefore, there is expected to be negligible increase in hydraulic gradients. Changes to the drainage regime as part of the Project are minor. At Roma Street Station precinct there is insufficient space to provide bio-retention basins therefore an underground treatment unit is proposed to reduce nutrient discharge. Consistent with the Project Environmental Design Requirements, the project design will be developed in order to achieve the water quality objectives referred to in the Environmental Protection (Water) Policy 2009 for water released from Project infrastructure.

7.2.3.2 Albert Street Station

Albert Street Station is situated within the 1 in 100 AEP ponding on Albert Street (in existing conditions and with climate change). The Evaluated Project design for Albert Street Station proposed three levels of flood protection depending on the flood event.

Riverine Flood (Brisbane River)

Albert Street Station is susceptible to Brisbane River flooding in 1 in 10,000 AEP.

The street level at the junction with Elizabeth Street is higher than the previous station entrance which was further south. This reduces flood risk. The station design level is above the 1 in 100 AEP riverine flood levels and requires deployable flood protection against riverine flood for 1 in 10,000 AEP (plus sea level rise). Various flood protection options have been considered to provide flood protection up to the 1 in 10,000 AEP and the preferred solution will be determined during detailed design.

Local Overland Flood

Albert Street is an overland flow path. The station will be built within an existing building footprint therefore works are unlikely to alter existing runoff rates. Flood immunity for an overland flow event of 1 in 100 AEP plus climate change and sea level rise is provided by setting the north entrance level 300mm above the design flood levels, and south entrance at 4.55m AHD.

The pedestrianisation of a section of Albert Street as part of the Project could impact overland flow paths to adjoining roads. The risk of generating afflux is high where proposed works are located within the overland flow path. Therefore mitigation measures will be implemented such as gutter and stormwater networks designed to replicate existing flow paths and avoid afflux.

Drainage

A drainage model was used by the Contractor to review the existing drainage system at Albert Street Station and identified that the existing system between Elizabeth Street and Charlotte Street is expected to have the required capacity therefore will not require significant upgrade to accommodate the Project. However, this will be re-confirmed through further modelling. The drainage system on Albert Street between Charlotte Street and Mary Street is undersized and would require augmentation as part of the Project. Slotted drains would be provided on Albert Street to accommodate undergrounding of the overland flow.

At Albert Street Station precinct there is insufficient space to provide bio-retention basins therefore an underground treatment unit is proposed to reduce nutrient discharge. Consistent with the Project

Environmental Design Requirements, the project design will be developed in order to achieve the water quality objectives referred to in the Environmental Protection (Water) Policy 2009 for water released from Project infrastructure.

7.2.3.3 Woolloongabba Station

Riverine Flood (Brisbane River)

Woolloongabba Station location is susceptible to flooding in 1 in 10,000 AEP. For the Evaluated Project, Woolloongabba Station was designed to be above the 1 in 10,000 AEP design flood level. The design of the station entrance level for Proposed Change is above the 1 in 10,000 AEP flood levels plus sea level rise, removing the need for deployable defences.

Woolloongabba Station will be built on a raised platform within a previous building footprint, therefore the precinct will be filled to levels higher than existing.

Local Overland Flood

The final landform of the station will be refined during detailed design and the entrance level will be set above 1 in 100 AEP local flood levels. Depending on the extent of final landscaping, the design may have potential to impact a minor existing overland flow path. Detailed design of the drainage system will seek to mitigate any undesirable afflux, replicate the existing attenuation of flood water on the site where feasible and maintain the current discharge point into the BCC stormwater network.

Drainage

The drainage design will discharge runoff from roofs and paved areas to bio-basins where feasible and overland flow will be discharged to the existing street drainage system.

7.2.4 Southern Area

7.2.4.1 Boggo Road Station

Riverine Flood (Brisbane River)

Boggo Road Station is outside of the 1 in 10,000 AEP riverine flood extents, consistent with the Evaluated Project.

Local Overland Flood

The design surface level is set at 300mm above the 1 in 100 AEP for local overland flood. The local catchment draining to the station is small and the overland flow risk is low during construction and operation at this location. The risk of generating afflux is low as the potential drainage catchment is relatively small. There is a minor flow path down Boggo Road and Joe Baker Street. Any changes to the vertical or horizontal alignment of either road will seek to replicate the existing flow path and discharge point into the existing BCC network.

The relatively small increase in impermeable area arising from construction of Boggo Road Station is unlikely to contribute to significant increases in runoff that would be required to be addressed as defined by Brisbane City Plan 2014 – SC 6.16 Infrastructure Design Planning, however runoff retention will be considered in detailed design.

Drainage

Initial drainage modelling indicates the existing pipe network has spare capacity during the 1 in 10 AEP design flow. This will be confirmed in detailed design. A bio-retention basin is proposed at Boggo Road Station for nutrient reduction.

Flooding and drainage impacts would be generally consistent with the Evaluated Project.

7.2.4.2 Dutton Park Station

Riverine Flood (Brisbane River)

Dutton Park Station is outside the regional 1 in 10 000 AEP event extent therefore is not at risk of flooding from the Brisbane River.

Local Overland Flood

A TUFLOW model was developed by the Contractor to represent existing overland flooding mechanisms for local flooding.

Dutton Park Station is to be protected against ingress of overland flow from external catchments in a 1 in 2000 AEP event. The maximum flood level is near the northern end of the station and modelling indicates there may be localised areas of water ponding near the station however none will exceed the station floor levels.

Drainage

Dutton Park Station will largely remain within the footprint of the existing site and flooding and drainage impacts during construction and operation would generally be consistent with the Evaluated Project. Modifications required to existing station drainage as a result in changes to platforms and roof drainage will be minor.

7.2.4.3 Southern Portal

Riverine Flood (Brisbane River)

The southern portal is outside the 1 in 10,000 AEP Brisbane River flood extents, consistent with the Evaluated Project.

Local Overland Flood

The existing rail track is currently inundated in the 1 in 100 AEP local flood. To provide 1 in 100 AEP immunity for the track and portal, it is proposed to divert the external catchment's stormwater around the trough structure with retaining walls, and intercept runoff via new underground stormwater pipes/culverts. Potential afflux issues (such as diversion of flow onto land outside the rail corridor) will be further assessed and mitigated through detailed design to the achieve the Project Environmental Design Requirements.

Flooding and drainage impacts generally consistent with the Evaluated Project are anticipated.

7.2.5 Fairfield to Salisbury Area

7.2.5.1 Stations

Upgrades to Fairfield to Salisbury Stations is not part of the Evaluated Project. Station upgrades were proposed in the 2011 EIS at Rocklea and Moorooka Stations, and a new station was proposed at Yeerongpilly.

The dominant flooding mechanism for the stations is riverine flooding from the Brisbane River.

Construction

Minor construction worksites would be required at all stations for the upgrade works.

For all Fairfield to Salisbury stations except Rocklea, the worksites would be located outside of the 1 in 100 AEP flood extent. Rocklea Station is within the 1 in 100 AEP flood extent.

For all station works, the works will be designed and implemented to avoid inundation from stormwater due to a 2 year (6hr) Annual Recurrence Interval (ARI) rainfall event and flood waters due to a 5 year ARI rainfall event, consistent with the Imposed Conditions.

For all stations, construction activities will be further developed during delivery phase and implemented to avoid the redirection of uncontrolled surface water flows outside of worksites, consistent with the performance criteria stipulated in the Project OEMP.

Operation

The immunity of the Fairfield to Salisbury Stations will remain unchanged from the existing conditions. All stations except Rocklea are located above the 1 in 100 AEP Brisbane River flood level (without climate change). The existing flood immunity of Rocklea Station is between 1 in 100 and 1 in 50 AEP (without climate change). Fairfield and Yeronga Station have a flood immunity (existing ground level) of 1 in 200 AEP (with climate change). Yeerongpilly Station is above the 1 in 100 AEP (with climate change). Moorooka, Rocklea and Salisbury Station are below 1 in 100 AEP (with climate change). At these locations, the design will ensure all critical rail systems assets will have flood immunity above 1 in 200 AEP and that the proposed station and rail alignment's flood immunity would not be less than the existing case.

Raising of the platforms at Fairfield to Salisbury Stations is not expected to cause flooding impacts due to the negligible loss of storage.

Flood impacts will be further tested during detailed design phase to demonstrate the design does not result in unacceptable flood impacts.

Existing drainage regimes will be maintained, and the risk of local drainage impacts is negligible. Bio-retention ponds would be incorporated into the station and landscape area for stormwater treatment at all Fairfield to Salisbury Stations. Consistent with the Project Environmental Design Requirements, the project design will be developed in order to achieve the water quality objectives referred to in the Environmental Protection (Water) Policy 2009 for water released from Project infrastructure.

7.2.5.2 Clapham Yard

The Clapham Yard Stabling area was part of the Project design for the 2011 EIS but excluded for the Evaluated Project. Filling of Clapham Yard to achieve 1 in 100 AEP immunity was proposed in the 2011 EIS with resulting minor reduction in flood storage in the Brisbane River floodplain in the 1 in 100 AEP event.

The Proposed Changes include a new rail bridge over Moolabin Creek, consistent with the 2011 EIS. The existing Moolabin Creek rail corridor bridges are affected by both Brisbane River and local Moolabin Creek flooding.

Construction

As identified in the 2011 EIS, the construction area at Clapham Yard stabling area is affected by flooding, therefore construction works will be designed and implemented to avoid inundation from stormwater due

to a 2-year (6hr) ARI rainfall event and flood waters due to a 5-year ARI rainfall event in accordance with the Project's Imposed Conditions.

The foundation construction works proposed for the design at Moolabin Creek include a temporary platform over the creek or from a stone fill working platform within the creek, subject to further construction planning and approvals. As identified in the 2011 EIS, construction work at Moolabin Creek has the potential to cause an increase in water level at adjacent commercial/industrial buildings in the order of 40mm and 90mm in the 1 in 20 AEP and 1 in 100 AEP flood respectively. Construction staging and other mitigation measures would be developed in consultation with stakeholders and approval agencies to comply with the Project Imposed Conditions including implementation to avoid afflux.

Operation

The Clapham Yard stabling area is affected by flooding from Brisbane River and overland flows.

The Proposed Change design aims to achieve cut/fill balance at Clapham Yard and minimise filling in the floodplain. The rail level would be no lower than the mainline rail level over Moolabin Creek (this is the lowest point on the adjacent mainline). This would mean that the stabling yard may not achieve the Queensland Rail stabling requirement of 1 in 100 AEP flood immunity, however would prevent reduction in Brisbane River floodplain capacity and significantly reduce the amount of fill required to be imported to Clapham Yard (compared to the 2011 EIS). Other infrastructure assets within the stabling yard, other than stabling roads, would be designed to meet the required flood immunity.

Further modelling is proposed in detailed design to confirm the required cut/fill balance and levels required for stabling roads and rail systems assets. It is proposed that all power and rail system assets would be at 1 in 200 AEP and all signalling assets and crew facility buildings would be at 1 in 100 AEP. Further design and modelling will also include consideration of mitigation required to manage the risks associated with more frequent inundation of the yard than would occur if the yard were designed to achieve 1 in 100 AEP flood immunity, and to confirm no offsite afflux associated with reprofiling the yard.

The immunity of the rail alignment across Moolabin Creek will remain largely unchanged compared with existing conditions. The rail alignment across the bridge will have an approximate flood immunity of 1 in 50 AEP Brisbane River flood event and 1 in 100 immunity for the local Moolabin Creek flood event which is generally consistent with existing conditions. The assessment of additional piers in Moolabin Creek conducted for the 2011 EIS identified negligible impacts of less than 10mm up to 1 in 100 AEP event which is expected to be consistent for the current proposed crossing.

Flood impacts resulting from the Clapham Yard stabling area and Moolabin Creek rail bridge are anticipated to be negligible, consistent with the findings during the 2011 EIS. This will be subject to further detailed modelling in the detailed design phase.

The existing drainage regime will be maintained, and the risk of local drainage impacts is negligible. Additional drainage modelling and assessment will be undertaken during the detailed design phase to demonstrate that the design does not result in unacceptable local flooding impacts.

7.2.6 General Construction Phase Impacts

Consistent with the Evaluated Project, during construction overland flow paths may convey water that is not part of a creek, river or waterway in and out of worksites. The majority of worksites are outside areas identified as having riverine, creek or storm surge flood risk, however some sites may be affected by overland flooding. Measures would be in place during construction to manage local flooding risks and impacts.

7.3 Mitigation Measures

The Proposed Changes involve modified design/locations of Project infrastructure, and areas previously identified during the 2011 EIS but subsequently excluded for the Evaluated Project.

Consistent with the Evaluated Project, worksites will be protected from overland flows during construction to ensure that equipment, materials and storage are above predicted flood levels. Consistent with the Evaluated Project, Project works and worksites will be designed and implemented to avoid inundation from stormwater due to a 2 year (6hr) ARI rainfall event and flood waters due to a 5 year ARI rainfall.

Project works will be designed to avoid afflux or cause the redirection of uncontrolled surface water flows, including stormwater flows outside of worksites.

Consistent with the Evaluated Project, Project works in Mayne Yard will be designed on the basis of detailed flood modelling.

Consistent with the Coordinator General's Environmental Design Requirements, the Project will be designed to be adaptable to conditions that may arise as a result of climate change, including accommodating the predicted 1.0m sea level rise scenario in 2100.

The following additional mitigation, modelling or design measures are anticipated compared to the Evaluated Project:

- Further detailed flood modelling and construction planning will be implemented for the proposed Breakfast Creek Bridge and Moolabin Creek Bridge to confirm and mitigate potential construction phase afflux impacts to upstream properties. Construction staging and other mitigation measures would be developed in consultation with stakeholders and approval agencies to comply with the Project Imposed Conditions including implementation to avoid afflux.
- For the Breakfast Creek crossing potential operational flood impacts will also be confirmed through further modelling to determine mitigation. This will be developed in consultation with stakeholders as part of subsequent State approvals required for works in a watercourse and tidal area under the *Planning Act 2016*.
- At Clapham Yard, further modelling is proposed in detailed design to confirm the required cut/fill balance and levels required for stabling roads and rail systems assets. This will also include consideration of mitigation required to manage the risks associated with more frequent inundation of the yard than would occur if the yard were designed to achieve 1 in 100 AEP flood immunity, and to confirm no offsite afflux associated with reprofiling the yard.
- At Albert Street Station, deployable flood protection against riverine flood for 1 in 10,000 AEP will be confirmed in detailed design.
- Deployable flood protection will be implemented at Roma Street station to protect against the regional 1 in 10,000 AEP flood plus sea level rise.
- Drainage design during delivery phase will provide sufficient detail to confirm the ability to meet the drainage design standards.

7.4 Conclusion

Proposed Changes to design and delivery of the Project have been reviewed to determine potential material changes to the predicted flooding and drainage impacts of the Evaluated Project.

Key changes in RfPC-4 that are relevant to the flood assessment include the new bridge crossing of Breakfast Creek, proposed reduced fill levels at Clapham Yard, and deployable flood protection at Roma and Albert Street Stations to achieve the 1 in 10,000 AEP with sea level rise.

Further detailed modelling and confirmation of mitigation measures will occur in the detailed design phase for the above key project changes to meet the project requirements.

Potential construction phase flood and drainage impacts are generally consistent with the Evaluated Project and will be managed through measures outlined in the Project OEMP to meet the Project requirements.

8. Technical Report: Air Quality

8.1 Introduction

This technical report has been prepared for the CRR Project to assess the impacts to air quality as a result of the Proposed Changes to the Evaluated Project. The Proposed Changes are described in Volume 1 of this RfPC-4.

In some cases, the Proposed Changes are generally in accordance with the design and impacts identified for the Evaluated Project. Where this is the case, further assessment of the Proposed Changes has not been undertaken.

8.2 Methodology

The methodology used for the assessment of air quality impacts associated with the Proposed Changes included an initial qualitative review to determine which changes would be likely to result in material air quality impacts, followed by further quantitative assessment (dispersion modelling) for relevant construction locations.

In addition to comparing the scale of works proposed for the Proposed Changes with that assessed for the Evaluated Project, changes to work locations have also been considered as these changes could result in works being closer to sensitive receptors.

Where the assessment has identified potential for changed impacts, mitigation measures have been reviewed and new mitigation or monitoring proposed where relevant.

No changes to air quality legislation or policy have been identified which need to be incorporated into this assessment.

8.2.1 Air dispersion modelling

Where dispersion modelling of air quality impacts was carried out for the Evaluated Project, this focussed on fugitive dust emissions from construction activities. This comprised applying emission factors for Total Suspended Particles (TSP), PM₁₀ (particulate matter 10 micrometers or less in diameter) and PM_{2.5} (particulate matter 2.5 micrometers or less in diameter) to dust generating construction activities, including drilling, blasting, excavating spoil, loading material in trucks, rock breaking, piling, wind erosion and wheel generated dust from machinery on-site. Selected emission factors take account of the level of mitigation, such as water spraying and hoardings, assumed to be implemented on-site during the construction phase.

The Evaluated Project included dispersion modelling at the Southern Portal and Boggo Road Station, Woolloongabba Station, Northern Portal and Mayne Yard. Following a review of the proposed design changes, it was determined that for RfPC-4, updated dispersion modelling was required to assess changes to construction phase air quality impacts at the following worksites:

- Mayne Yard
- Woolloongabba
- Roma Street Station (incorporating works for the Inner Northern Busway relocation and lowering)
- Southern Portal and Boggo Road station (as the worksites would be close together and works would occur at the same time, it was considered appropriate to assess these sites cumulatively).

Revised dispersion modelling at the above locations was conducted using the same method as the Evaluated Project using the CALPUFF dispersion model including the same meteorological data. A

qualitative review of potential air quality impacts was conducted for other project locations such as Exhibition Station and Fairfield to Salisbury Stations. This is due to the fact that these locations are not major worksites or spoil handling locations therefore have a reduced potential for offsite air quality impacts.

Figure 8.2 to Figure 8.5 show the wind roses predicted by CALMET² for the areas modelled. Prevailing winds are south-westerly with the exception of at Roma Street Station, where prevailing winds are from the east.

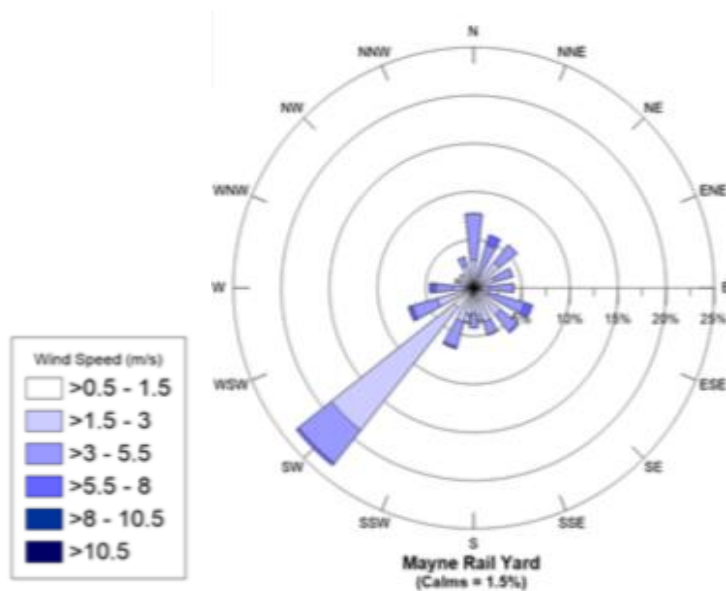


Figure 8.2: Wind Rose predicted by CALMET for Mayne Yard

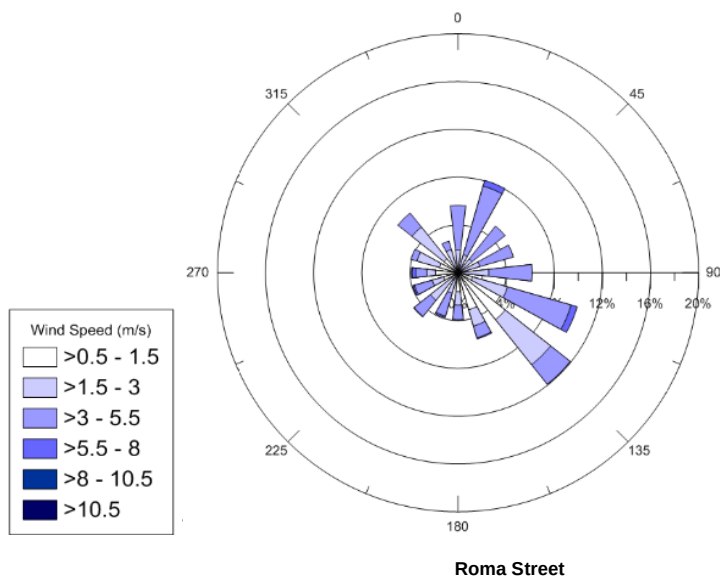


Figure 8.3: Wind Rose predicted by CALMET for Roma Street

² CALMET is the meteorological processor for the Calpuff model.

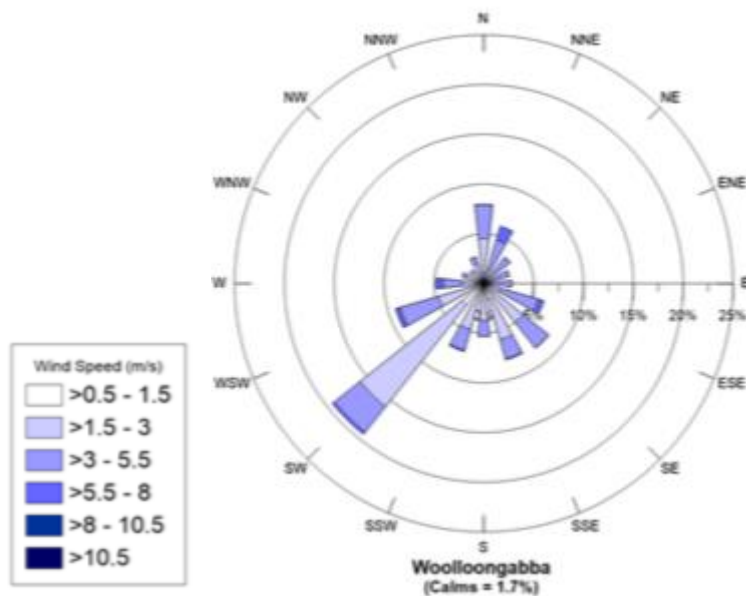


Figure 8.4: Wind Rose predicted by CALMET for Woolloongabba

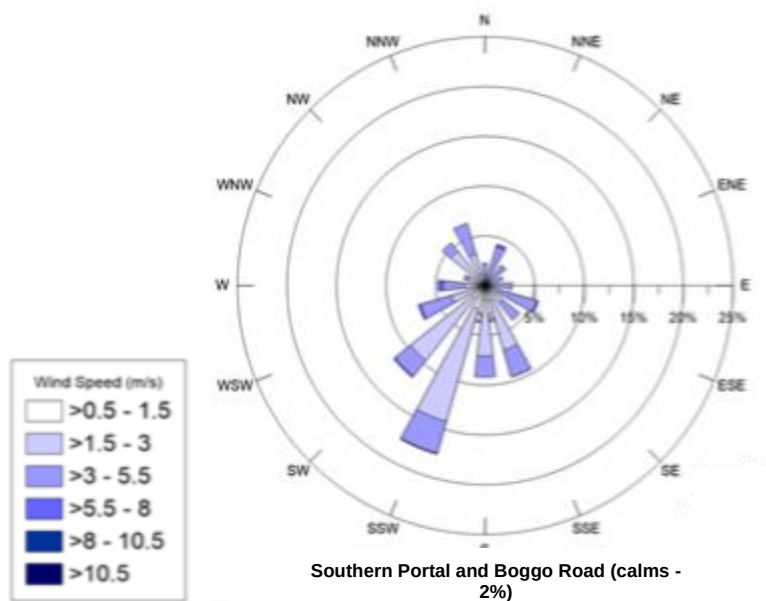


Figure 8.5: Wind Rose predicted by CALMET for Southern Portal/Boggo Road

8.2.2 Changes to emission estimation

Consistent with the Evaluated Project, particulate emission rates (TSP, PM₁₀ and PM_{2.5}) have been estimated for the key construction areas, based on published emission factors for the following dust-generating activities (as relevant to each site):

- Drilling and blasting
- Mobile machinery
- Loading trucks with spoil
- Wheel-generated dust from truck movements on unpaved areas

- Wind erosion of disturbed areas.

The emission factors used to estimate fugitive dust emissions for RfPC-4 are unchanged from those used in the Evaluated Project and have been used in the dispersion modelling to estimate the dust emission rates from each construction worksite.

Control factors have also been assumed for the mitigation measures proposed to minimise dust emissions, as shown in Table 8.1. There have been some changes to the mitigation measures proposed for the Evaluated Project, to reflect that the enclosure equipped with fabric filter is no longer proposed at Southern Portal/Boggo Road, and the percentage of sealed roads has been reduced to provide a more conservative estimate of likely emissions.

For the Southern Portal/Boggo Road worksites, an additional mitigation scenario has been tested to adequately mitigate potential air quality impacts. The control factors for this additional assessment are shown in Table 8.2. Additional mitigation includes level 2 water sprays to minimise wheel-generated dust and wind erosion and manual watering of visual dust generated by bulldozers/front end loaders, excavators, piling rigs. The percentage of sealed roads has also been increased to mitigate wheel-generated dust.

Table 8.1. Control factors used for the estimation of dust emissions from construction activities

Construction Worksite	Construction Activity	Control Method	Control Factor
Mayne Yard Southern Portal/Boggo Road Station	Drilling	Water Spray	70%
	Blasting	Hoardings around construction worksite	30%
	Excavators/Front-End Loaders	Hoardings and water spray	65%
	Bulldozers on spoil	Hoardings around construction worksite	30%
	Loading trucks	Hoardings around construction worksite	30%
	Wheel-generated dust	50% Sealed/hardstand roads and sprays	75%
	Rock breaker	Hoardings around construction worksite	30%
	Piling rig	Hoardings around construction worksite	30%
	Wind erosion	Water Spray	50%
Woolloongabba Station Roma Street Station	Drilling	Acoustic enclosure, water spray	91%
	Blasting	Acoustic enclosure, hoardings	70%
	Excavators/FELs	Acoustic enclosure, hoardings, sprays	85%
	Bulldozers on spoil	Acoustic enclosure, hoardings	79%*
	Loading trucks	Acoustic enclosure, hoardings	79%*
	Wheel-generated dust	Acoustic enclosure, 50% Sealed/hardstand roads and sprays	92.5%
	Rock breaker	Acoustic enclosure, hoardings	79%*
	Piling rig	Acoustic enclosure, hoardings	79%*
	Wind erosion	Acoustic enclosure, water spray	85%

* It should be noted that the control factors for these activities were incorrectly reported for Woolloongabba Station for the Evaluated Project. The Evaluated Project results were based on a 79% control factor in the modelling not a 70% control factor as reported.

Table 8.2. Additional control factors assessed for the Southern Portal/Boggo Road worksites.

Construction Worksite	Construction Activity	Control Method	Control Factor
Southern Portal/Boggo Road Station	Drilling	Water Spray	70%
	Blasting	Hoardings around construction worksite	30%
	Excavators/FELs	Hoardings and water spray or manual watering to ensure materials are moist	83%
	Bulldozers on spoil	Hoardings around construction worksite and water spray or manual watering to ensure materials are moist	65%
	Loading trucks	Hoardings around construction worksite	30%
	Wheel-generated dust	90% Sealed/hardstand roads and Level 2 water sprays	98%
	Rock breaker	Hoardings around construction worksite	30%
	Piling rig	Hoardings around construction worksite, manual watering on visual dust	90%
	Wind erosion	Level 2 water Spray	75%

The emission rates calculated for each of the construction worksites are presented in Table 8.3. to 8.5, along with the emission rates calculated for the Evaluated Project (where applicable). There are no emission limits set for construction worksites as part of the project however there are ambient air quality goals which apply off-site. Therefore, emission rates have been calculated in order to predict off-site concentrations using dispersion modelling.

As was the case for previous assessments, the model predictions are very conservative as they are based on peak activity levels occurring continuously for the entire year. It is unlikely that all activities assumed would occur at the same time.

Table 8.3. Estimated TSP emissions from construction activities for the Proposed Changes (kg/hour)

	Mayne Yard	Roma Street	Woolloongabba	Boggo Road and Southern Portal	Boggo Road and Southern Portal (additional control factors)
Drilling	<0.1	<0.1	<0.1	0.02	0.02
Blasting	<0.1	<0.1	0.2	<0.01	<0.01
Excavators/FELs	1.2	0.9	0.6	0.9	0.45
Bulldozers on spoil	1.0	1.0	<0.1	1.0	0.52
Loading trucks	<0.1	<0.1	<0.1	0.02	0.02
Wheel-generated dust	5.0	4.0	0.7	1.4	0.14
Rock breaker	1.0	<0.1	0.1	0.2	0.24
Piling rig	2.3	3.4	0.7	1.1	0.16
Wind erosion	1.6	<0.1	0.2	1.4	0.68
Total Site (RfPC-4)	12.1	9.3	2.5	6.1	2.24
Evaluated Project	4.3	-	3.7	0.16	

Table 8.4. Estimated PM₁₀ emissions from construction activities for RfPC-4 (kg/hour)

	Mayne Yard	Roma Street	Woolloongabba	Boggo Road and Southern Portal	Boggo Road and Southern Portal (additional control factors)
Drilling	<0.1	<0.1	<0.1	<0.01	<0.01
Blasting	<0.1	<0.1	0.1	<0.01	<0.01
Excavators/FELs	0.6	0.4	0.3	0.4	0.2
Bulldozers on spoil	0.2	0.2	<0.1	0.2	0.1
Loading trucks	<0.1	<0.1	<0.1	<0.01	<0.01
Wheel-generated dust	1.2	1.0	0.2	0.4	<0.01
Rock breaker	0.2	<0.1	<0.1	0.1	0.1
Piling rig	0.5	0.7	0.1	0.2	0.0
Wind erosion	0.8	<0.1	<0.1	0.7	0.3
Total Site (RfPC-4)	3.5	2.3	0.8	2.0	0.8
Evaluated Project	1.1	-	1.2	0.07	

Table 8.5. Estimated PM_{2.5} emissions from construction activities for RfPC-4 (kg/hour)

	Mayne Yard	Roma Street	Woolloongabba	Boggo Road and Southern Portal	Boggo Road and Southern Portal (additional control factors)
Drilling	<0.1	<0.1	<0.1	<0.01	<0.01
Blasting	<0.1	<0.1	<0.1	<0.01	<0.01
Excavators/FELs	<0.1	<0.1	<0.1	<0.01	<0.01
Bulldozers on spoil	<0.1	<0.1	<0.1	0.1	0.1
Loading trucks	<0.1	<0.1	<0.1	<0.01	<0.01
Wheel-generated dust	0.1	<0.1	<0.1	0.03	<0.01
Rock breaker	<0.1	<0.1	<0.1	0.02	0.02
Piling rig	0.2	0.4	<0.1	0.1	0.02
Wind erosion	<0.1	<0.1	<0.1	0.1	0.04
Total Site (RfPC-4)	0.7	0.6	0.1	0.4	0.15
Evaluated Project	0.4	-	0.3	0.014	0.014

It can be seen that the increase in the scale and intensity of works has increased emissions of TSP, PM₁₀ and PM_{2.5} at Mayne Yard. The changes to the Woolloongabba worksite lead to a reduction in emissions generated compared to those assessed for the Evaluated Project. This is due to a reduced number of peak spoil truck movements based on the construction methodology.

For the Southern Portal and Boggo Road station, emissions derived for the works proposed as part of RfPC-4 are higher than those assessed for the Evaluated Project. This is because the Evaluated Project includes an enclosure equipped with a fabric filter as a mitigation option for these sites, which is no longer proposed, and there would be an increase in spoil generation at this location compared to the Evaluated Project. Additional mitigation has been included to account for the removal of the enclosure equipped with fabric filter.

Predicted concentrations at sensitive receptors near the above locations as a result of these surface works are presented in the following sections.

8.2.3 Existing air quality and air quality goals

Background air quality information adopted in the Evaluated Project and summarised in Table 8.7 was established based on data from four monitoring stations (Cannon Hill, Brisbane CBD, South Brisbane, Rocklea). Table 8.7 also includes the air quality goals included in the CRR Project Imposed Conditions.

National and State-wide air quality legislation was updated in 2017 to include assessment criteria for PM_{2.5}. This was therefore incorporated into the air quality assessment carried out for the Evaluated Project. However, PM_{2.5} is more relevant to vehicle emissions than dust from construction, therefore is not included as an air quality goal for the project as specified in the CRR Project Imposed Conditions. Nevertheless, PM_{2.5} is included in this assessment of the Proposed Changes (and was also assessed for the Evaluated Project), and modelling results for PM_{2.5} have been compared to the objectives in the Environmental Protection Policy (Air) 2008 (Table 8.8).

There are no additional pollutants that need to be considered as part of RfPC-4 due to changes in legislation or requirements. These air quality goals apply at areas off site where members of the public are exposed for time periods comparable with the air quality goal averaging period.

A review of data from the four monitoring stations was used to determine the background concentrations for those pollutants which have project goals. Table 8.7 provides the background concentrations used in the assessment derived from monitoring data for 2017. At the time of writing, 2017 provides the latest complete year of validated data. Monitored annual average PM₁₀ concentrations for 2017 were found to be similar to those background concentrations in Table 8.7 and therefore the background pollutant concentrations used for the Evaluated Project remain valid for use in RfPC-4. The background concentration and Environmental Protection Policy objectives for PM_{2.5} are shown in Table 8.8

The data indicates that background concentrations are well below the respective air quality goals within the CRR Project Imposed Conditions (specified in Table 4 of the Coordinator General's Change Report, March 2019).

Table 8.7. Background concentrations of air quality indicators against CRR Project goals (as documented in the CRR Project Imposed Conditions from the Coordinator General)

Air quality indicator	Averaging period	Units	Background concentration	Air quality goal	Criterion
TSP	24 hours	µg/m ³	26	80	Human health
	Annual	µg/m ³	24	90	
PM ₁₀	24 hours	µg/m ³	17	50	
	Annual	µg/m ³	14.5	25	
Dust deposition	30 days	mg/m ² /day	60	120	Nuisance

Table 8.8. Background concentrations of PM_{2.5} against the objectives in the EPP(Air) 2008

Air quality indicator	Averaging period	Units	Background concentration	Air quality objective	Criterion
PM _{2.5}	24 hours	µg/m ³	8.3	25	Human health
	Annual	µg/m ³	6.5	8	

8.3 Changes to Potential Impacts

8.3.1 Alignment

Alignment changes for RfPC-4 include horizontal and vertical alignment changes at Mayne Yard in the northern extent of the Project, and changes to tunnel alignments from Roma Street to Albert Street Stations, Albert Street to Woolloongabba and Woolloongabba to Dutton Park. The Proposed Changes are as described in RfPC-4 Volume 1 and are not expected to have a significant impact to air quality. Air quality impacts arising from changes to the scale of works at Mayne Yard are described below.

8.3.2 Mayne Area

8.3.2.1 Mayne Yard

Mayne Yard is in a largely industrial/commercial area. There are sensitive receptors close to Mayne Yard in the form of commercial properties on Burrow Street and residential properties and community spaces approximately 200m to the west, in Windsor. The nearest residential properties are separated from Mayne Yard by existing industrial properties.

The Proposed Changes to construction activities in Mayne Yard East and new stabling facilities in Mayne Yard North result in increased area of works and duration, compared to the Evaluated Project. The trough structure in Mayne Yard which required the removal of 36,000m³ of spoil is no longer part of the proposed design.

The Evaluated Project has a worksite in Mayne Yard North and two smaller general site areas at the site access and Mayne East. Five worksites are proposed at Mayne Yard as part of the Proposed Changes. The main site compound will be located in the Mayne north worksite with additional compound areas to the north of Breakfast Creek to serve the construction of the bridge.

Potential air quality impacts associated with worksites include fugitive dust emissions associated with laydown areas and emissions associated with vehicle movements and site machinery and equipment. Air quality modelling for Mayne Yard for the Evaluated Project predicted exceedance of the nuisance-based criteria (as per the CRR Project Imposed Conditions) for 24-hour average TSP concentrations and annual average dust deposition at two commercial receptors near Mayne Yard.

The new stabling facility at Mayne Yard North has not been assessed previously. For RfPC-4, to enable the use of the site as a stabling facility, demolition of the existing facilities would be required, and surface works would then be carried out to install tracks and associated facilities to stable 14 six carriage trains. Works would be staged in Mayne Yard so that works in Mayne Yard East and North would not occur concurrently.

The assessment of the Mayne Yard worksite undertaken for the Evaluated Project has been updated to include the design changes discussed above and incorporates the mitigation identified in Table 8.18.1. Contour plots showing the distribution of impacts for particulate matter, TSP and dust deposition are provided in Appendix D. An assessment of predicted concentrations at the closest sensitive receptors was also undertaken. Sensitive receptor locations are shown in Figure 8.4.



Figure 8.4: Sensitive receptors assessed at Mayne Yard

Table 8.9. Table 8.9 shows predicted concentrations at each of the receptors assessed. Exceedances of the project air quality goals are highlighted as bold.

No exceedances of relevant short term (24-hour average) or long term (annual average) criteria are predicted at any of the sensitive receptors surrounding the site for all pollutants with the exception of 24 hour average TSP concentration at commercial receptor M5 and dust deposition at two commercial receptors located at Burrows Street (M4 and M5). This is generally consistent with the Evaluated Project. Considering the conservative approach adopted for this study, any exceedances at these receptors is unlikely during the construction phase.

Table 8.9. Predicted concentrations at receptors in the proximity of Mayne Yard

Receptor	Type	TSP 24hr	TSP Annual	PM ₁₀ 24hr	PM ₁₀ Annual	PM _{2.5} 24hr	PM _{2.5} Annual	Dust Deposition Daily Max
Unit		µg/m ³						mg/m ² /day
M1	Residential	38.9	26.9	21.7	15.6	8.9	6.7	70.7
M2	Commercial	43.4	28.6	23.4	16.3	9.2	6.8	81.5
M3	Commercial	54.3	32.9	26.2	17.6	9.7	6.9	100.4
M4	Commercial	77.8	44.9	32.9	21.5	10.7	7.4	145.0
M5	Commercial	85.9	43.3	34.5	20.6	11.0	7.3	137.2
M6	Residential	40.1	26.7	21.7	15.5	8.8	6.6	69.9
M7	Residential	38.9	26.4	21.3	15.4	8.8	6.6	69.9
M8	Residential	38.7	26.7	21.5	15.5	8.9	6.6	70.4
M9	Commercial	37.7	26.8	20.8	15.5	8.7	6.6	68.2
M10	Commercial	52.7	33.5	25.2	17.5	9.6	6.9	85.1
M11	Commercial	61.7	29.1	27.7	16.1	9.7	6.8	93.2
M12	Commercial	70.1	31.5	30.2	16.8	10.4	6.8	108.5
M13	Commercial	48.0	30.9	23.7	16.8	9.4	6.8	84.0
M14	Commercial	37.1	26.4	21.0	15.4	9.0	6.6	69.8
M15	Commercial	51.8	32.2	25.5	17.4	9.8	6.9	100.5
Air quality goal³		80	90	50	25	25	8	120

Effective dust suppression methods such as damping down, covering exposed areas and managing equipment and vehicle movement across site should be used to minimise the generation and spread of dust. These are already included in the approved Project OEMP.

The Evaluated Project assessment identified the potential for disturbance of contaminated land as part of surface works required for the Project. This would have local air quality and human health impacts if not managed. Impacts associated with the works proposed for RfPC-4 are similar to previously approved impacts however due to the additional areas of work at Mayne Yard North, it is likely that the area of contaminated land to be disturbed at Mayne Yard would be greater.

The Project OEMP includes mitigation measures to manage disturbance of contaminated land and these would need to be implemented at all works discussed as part of RfPC-4 where contamination has been identified.

8.3.2.2 Breakfast Creek Bridge

The crossing of Breakfast Creek is approximately 180m and as such the volume of the structure that would be required is likely to be less than 10,000m³. While the construction material would be dusty i.e.

³ There is no project air quality goal for PM_{2.5} therefore predicted concentrations have been compared to the objectives in the EPP(Air) for reference.

concrete/steel it is anticipated that the bridge would be installed in prefabricated segments minimising dust generation activity on-site during construction.

The closest residential properties are approximately 100m away from the proposed construction.

Therefore, it is considered that the potential for air quality impacts from this construction in isolation would be low and could be managed through the implementation of air quality management measures.

8.3.3 Northern Area

8.3.3.1 Exhibition Station

RfPC-4 works would not result in a substantial change to the worksite footprint for Exhibition Station as the construction works can be accommodated in the worksite area for the currently Evaluated Project.

It has been previously established that the station upgrade would have a low potential for air quality impacts as construction works are not considered to be significant. Best practice air quality management measures would be used to minimise dust generation during the construction phase. The proposed design changes are minor in terms of increasing dust generating activities, therefore the impacts are expected to be generally in accordance with the current Evaluated Project and no further air quality assessment is considered necessary.

8.3.3.2 Minor Civil Works

A number of civil structural works are required in the Northern Area as described in Volume 1. This includes protection/strengthening works on existing infrastructure and the replacement of the train wash subway. These civil works within the rail corridor are generally in accordance with the Evaluated Project.

Other minor demolition and construction works associated with the civil structural works in the Northern Area are unlikely to generate significant amounts of dust and further detailed assessment of air quality is not considered to be required for these activities. Any dust generated should be managed by the implementation of air quality management measures.

8.3.3.3 Site access to the Northern Portal

Air quality impacts in this area have been previously evaluated related to construction activities at the worksite for the Northern Portal. The Evaluated Project includes a secondary site access through Victoria Park off Gregory Terrace. Proposed Changes include a changed route through the park and demolition of a Department of Health building (Biomedical Technology Services). This has the potential to affect local air quality by changing the location of the haul routes and therefore emissions from trucks, and dust generation from the need to demolish a building.

This changed site access may result in sections of Gregory Terrace and adjacent residential properties experiencing an increase in construction traffic compared to the Evaluated Project.

The introduction of this site access would require the demolition of an existing building which is approximately 10,000m³ and is adjacent to the existing rail corridor. The closest properties to this building are commercial premises, with the closest residential receptor approximately 100m to the south. Demolition of this building would be temporary and dust generation could be managed through the implementation of air quality management measures on site.

The introduction of this site access is not expected to significantly affect local air quality.

8.3.4 Central Area

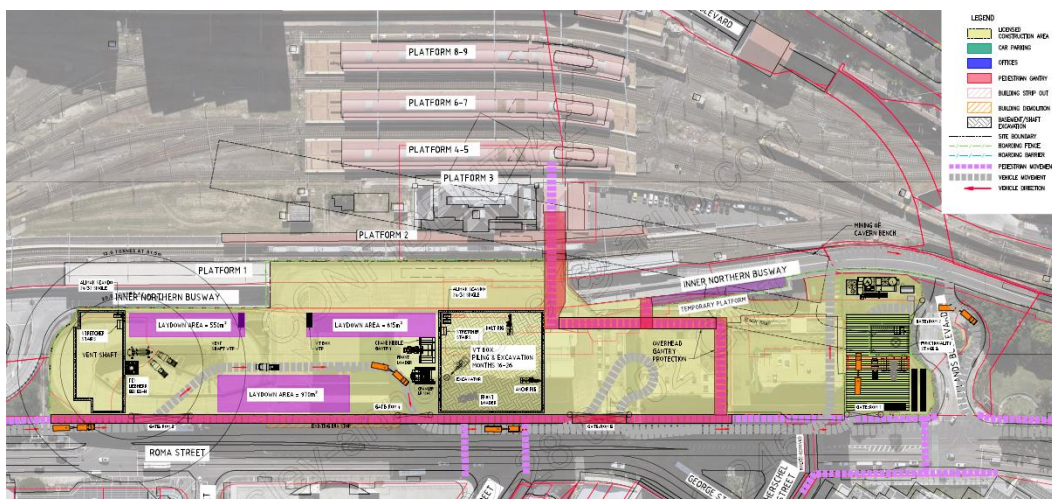
8.3.4.1 Roma Street and Inner Northern Busway

Roma Street Station

RfPC-4 includes a new alignment of the underground station and changes to the Inner Northern Busway (INB) which will be lowered underground to service both the existing surface rail station and the proposed underground cross river rail station.

The main surface works would be the vent shaft to the west, the 'vertical transport box' in the centre and a construction shaft located at Lot 60 in the east, which includes an acoustic shed. Those activities that have the potential to generate the most dust, such as removal of spoil from the mined cavern to develop the underground station would occur through the Lot 60 acoustic shed. The presence of the acoustic shed means that dust levels at the surface are likely to meet the air quality goals for the project.

For the Evaluated Project the construction methodology for Roma Street station includes a larger acoustic shed over the cut-and-cover shaft (located centrally in the worksite), supporting the mined cavern construction and station works. Dispersion modelling was not conducted for the Roma Street site for the Evaluated Project due to the acoustic shed.



Due to a proposed increase in the scale of works at Roma Street compared with the Evaluated Project, dispersion modelling has been carried out to determine the impacts in the surrounding area. This included expansion of the scale of works due to surface works associated with the relocation of the INB, as described further below. Contour plots showing the distribution of impacts for particulate matter, TSP and dust deposition are provided in Appendix D.

No exceedances of the air quality project goals are predicted off-site. Dust generation would occur through excavation and piling needed to deliver the vent shaft and the 'vertical transport box' however this would be managed by the contractor through proven dust management techniques.

Dust monitoring proposals for locations to the north of the existing Roma Street surface station and the Transcontinental Hotel to the south, have been included to manage previously evaluated impacts. These proposals remain valid and should be implemented to ensure the implementation of dust management measures outlined in the Project OEMP and the use of the acoustic shed is effective.

Inner Northern Busway

The lowering of the INB would occur through the Roma Street worksite which would extend further east through Emma Miller Place. Earthworks/spoil generation would occur as part of these works in conjunction with construction of the new underground Roma Street station.

There are existing surface roads which serve the INB which will be demolished as part of the project. Realigned surface roads would also need to be constructed to the west of Roma Street surface station. Dust generated through these works would be managed through the implementation of best practice air quality measures. The air quality modelling for Roma Street incorporated relevant construction assumptions and expanded work area for the INB works. As identified above, the modelling did not predict any exceedance of air quality goals at nearby sensitive receptors. Air quality mitigation measures in the Project OEMP would be implemented for these works.

Once operational, the lowering of the INB underground will remove bus movements on surface roads surrounding Roma Street Station. This has the potential to improve air quality (marginally) by removing bus movements and subsequent emissions throughout the day and in particular reducing the contribution of buses to congestion at peak times.

8.3.4.2 Albert Street Station

Key design changes at Albert Street station include realignment of the station to the north, demolition of 142 Albert Street and the construction of an additional northern pedestrian entry to the station. The main air quality impacts associated with the construction of Albert Street Station include the demolition of 142 Albert Street and the worksite used to construct the station. The construction methodology has changed to a mined cavern compared to cut and cover proposed the Evaluated Project, therefore the potential for air quality impacts has reduced. An acoustic shed is still proposed to be employed during construction.

Consistent with the Evaluated Project, quantitative modelling has not been conducted at Albert Street due to a low potential for adverse air quality impacts compared to other sites.

Demolition of 142 Albert Street (Lot 9/B118233) and excavation of shaft

Demolition of this building has not been assessed previously. The building to be demolished is two storey and sits between existing commercial properties on Albert Street. The Royal Albert apartments are located opposite and are the closest residential receptor. Sensitive receptors are likely to include staff and customers of the various commercial premises and residential receptors nearby may also be affected depending on wind direction.

While demolition of the building has the potential to result in dust, this would be managed through implementation of dust management measures in the Project OEMP. This would help minimise the generation and spread of dust to sensitive receptor locations.

Following demolition of this building a shaft would be excavated to allow construction of the northern pedestrian entry to the station. Dust generation during excavation of the shaft would also be managed through implementation of the dust management measures in the Project OEMP. Once the shaft is constructed, ongoing construction activities in the shaft are not expected to generate dust levels at the surface that would exceed the air quality goals for the project.

Albert Street worksite

The location of the Albert Street worksite has not changed from that assessed for the Evaluated Project. The construction methodology for Albert Street station is now a mined cavern approach rather than cut and cover which reduces the risk of air quality impacts. The majority of dust-generating activities would occur within a

shaft for the services building and within a purpose-built acoustic shed for the mined cavern/tunnelling works. Therefore, impacts would be no worse than the Evaluated Project.

8.3.4.3 Woolloongabba Station

The air quality impacts assessed for the Evaluated Project relate to the worksite at Woolloongabba during the construction phase associated with earthworks and tunnelling activities including spoil removal.

The Proposed Changes would result in Woolloongabba Station being realigned to the western side of Lot 63/SP184386 to improve the interchange and allow for a more successful integration with the proposed Brisbane Metro. While the station has moved the worksite remains to the east of Leopard Street between Vulture Street and the South East busway.

The assumptions related to spoil generation, vehicle and machinery movements, and blasting included in the dispersion modelling undertaken for the Evaluated Project have changed and therefore the assessment of air quality impacts from this site has been revised to account for these changes. An acoustic shed is proposed at the Woolloongabba worksite for tunnelling and spoil logistics which is consistent with the Evaluated Project and will also serve to mitigate air quality impacts.

Contour plots showing the distribution of impacts for particulate matter, TSP and dust deposition are provided in Appendix D.

No exceedances of relevant short term (24-hour average) or long term (annual average) criteria are predicted at any of the residential receptors surrounding the site for all pollutants with the exception of 24-hour average TSP concentration predicted at a commercial receptor on Main Street. Exceedances of dust deposition criterion are predicted at three receptors surrounding the site. Considering the conservative approach adopted for this study, any exceedances at these receptors is unlikely during the construction phase.

This revised assessment predicts that impacts would be less than previously evaluated as part of the Evaluated Project, for which exceedance of air quality goals was predicted for PM₁₀, PM_{2.5}, TSP and dust deposition. This is due to lower levels of peak spoil generation (and therefore vehicle movements) estimated for RfPC-4 compared to the Evaluated Project, although the total volume of spoil from Woolloongabba would be increased from the Evaluated Project. Spoil volumes at each worksite are described in Volume 1.

The Project OEMP includes for two dust monitoring locations and one particulate matter monitoring location in the proximity of the Woolloongabba Station worksite and these would still be proposed.

Table 8.10 shows predicted concentrations at each of the receptors assessed. Exceedances of the project air quality goals are highlighted as bold.

Table 8.10. Predicted concentrations at receptors in the proximity of Woolloongabba Station worksite

Receptor	TSP 24hr	TSP Annual	PM10 24hr	PM10 Annual	PM2.5 24hr	PM2.5 Annual	Dust Deposition Daily Max
Unit	µg/m ³						mg/m ² /day
W1	63.3	38.0	32.7	19.4	10.2	7.1	160
W2	53.9	33.2	27.0	17.9	9.4	6.9	113
W3	49.7	32.3	27.2	17.5	9.5	6.9	112
W4	61.5	37.3	32.9	19.3	10.1	7.1	156
W5	89.0	46.0	45.0	22.4	11.3	7.5	223
W6	55.8	29.5	27.3	16.5	9.7	6.7	128

Receptor	TSP 24hr	TSP Annual	PM10 24hr	PM10 Annual	PM2.5 24hr	PM2.5 Annual	Dust Deposition Daily Max
W7	42.2	28.0	22.7	15.9	8.9	6.7	79
Air quality goal⁴	80	90	50	25	25	8	120

8.3.5 Southern Area

8.3.5.1 Southern Portal and Boggo Road Station

Boggo Road Station and the Southern Portal are generally in the same location as the Evaluated Project with minor changes to the location of the commencement of the trough structure, to the south. Boggo Road Station and the Southern Portal would be constructed through a combination of cut and cover and mined cavern which would be likely to reduce the air quality impacts.

For the Evaluated Project, the modelling for Boggo Road Station and Southern Portal showed no health or nuisance-based exceedances. The works were proposed to be enclosed with a fabric filter to control dust emissions, this measure is no longer proposed in RfPC-4, as a result modelling has been updated for these sites.

As discussed, two scenarios have been assessed, one with the removal of the fabric filter enclosure and standard control measures (Scenario 1) and another with the removal of the fabric filter enclosure and additional control measures (Scenario 2). An assessment of predicted concentrations over a grid surrounding the site and at the closest sensitive receptors was undertaken. Sensitive receptor locations close to the Southern Portal and Boggo Road Station worksites are shown in Figure 8.5.

Scenario 1 results in exceedances of the project air quality goals with the exception of annual average TSP at nearby receptors. Some of these exceedances are significant, more than double the air quality project goals. As such, Scenario 2 was investigated to minimise impacts. The majority of exceedances are removed with the exception of the nuisance based dust deposition goal which remains at one nearby receptor. Concentrations are significantly reduced from Scenario 1. Additional watering measures and an increased percentage of sealed roads at the site are required to minimise impacts as far as practicable. Contour plots showing the distribution of impacts for particulate matter, TSP and dust deposition (Appendix D) and predicted concentrations at sensitive receptors are presented for Scenario 2.

⁴ There is no project air quality goal for PM_{2.5} therefore predicted concentrations have been compared to the objectives in the EPP(Air) for reference.

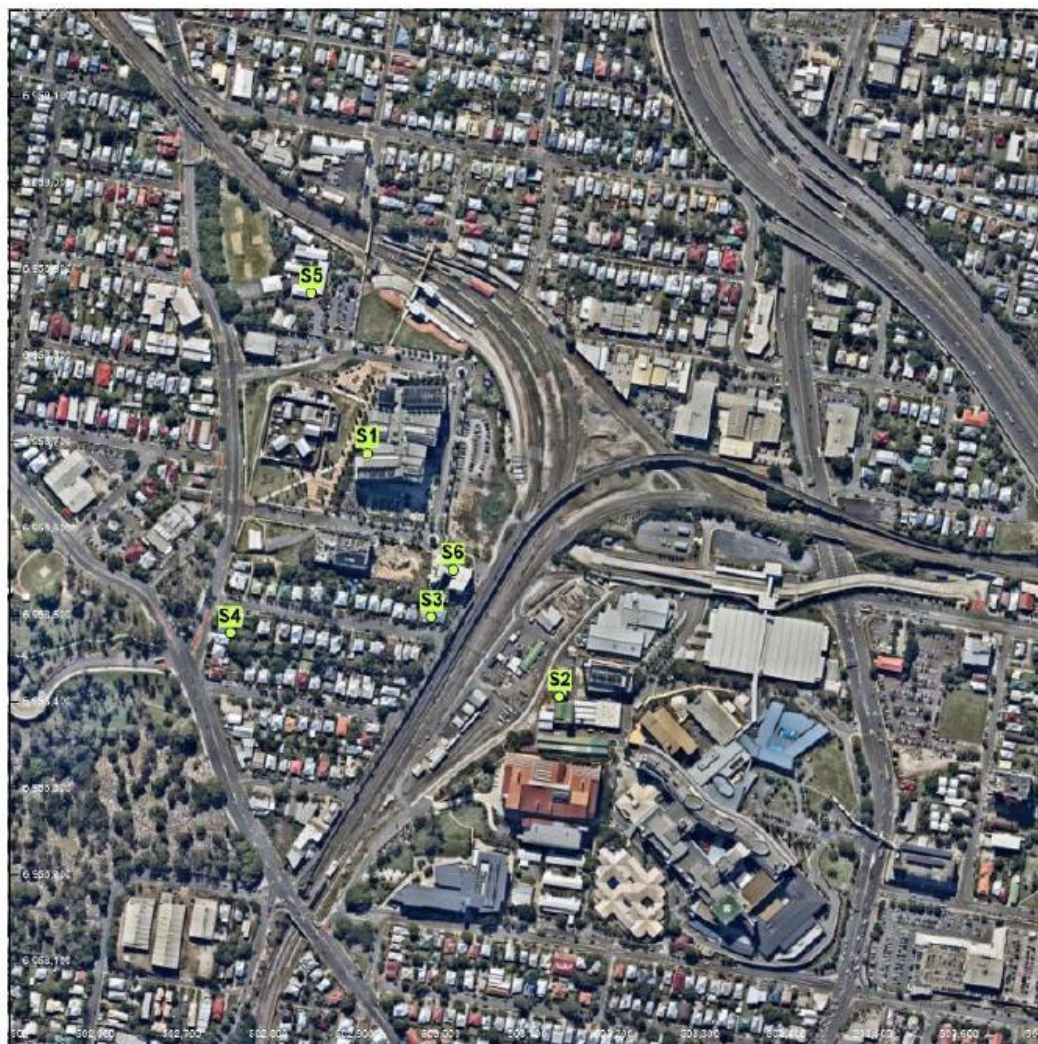


Figure 8.5: Sensitive receptors assessed at the Southern Portal and Boggo Road Station worksite

Table 8.11. Predicted concentrations at receptors in the proximity of Southern Portal and Boggo Road worksite (Scenario 2 – additional mitigation)

Receptor	Type	TSP 24hr	TSP Annual	PM ₁₀ 24hr	PM ₁₀ Annual	PM _{2.5} 24hr	PM _{2.5} Annual	Dust Deposition
Unit		µg/m ³						mg/m ² /day
S1	Commercial	35.4	26.6	21.0	15.7	9.1	6.7	80
S2	Hospital – support services	60.8	37.8	31.3	20.2	11.3	7.4	140
S3	Residential	57.0	33.1	32.8	18.5	10.0	7.1	112
S4	Residential	29.5	24.8	18.3	14.8	8.7	6.6	67
S5	School	30.3	25.0	18.6	15.0	8.7	6.6	66
S6	Residential	56.3	32.6	32.3	18.2	10.1	7.1	113

Air quality goal ⁵	80	90	50	25	25	8	120
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Dust and particulate matter monitoring for locations surrounding the Southern Portal and Boggo Road worksite were proposed for the Evaluated Project to manage previously identified impacts, including at Princess Alexandra Hospital, Dutton Park State School, the Ecosciences precinct and nearby residential properties. These monitoring locations remain valid and should be implemented to ensure the dust management measures outlined in the Project OEMP are effective. The OEMP and OAQMP will be amended to include the additional control factors that are required to minimise impacts as far as practicable for this site, as shown in Table 8.2.

Where monitoring indicates an exceedance, additional mitigation measures may be required consistent with the Outline Air Quality Management Plan (OAQMP). This may include:

- Additional site management measures (e.g. additional watering and other forms of dust suppression, sealing traffic areas within worksite, stabilising exposed work areas);
- Ceasing dust generating activities that are likely to exceed the goals during dry, windy conditions; and
- Re-evaluating the efficacy of the dust controls and supplementing them if required.

8.3.5.2 Dutton Park Station

Consistent with the Evaluated Project design, the Dutton Park Station platforms have been shifted to the south of Annerley Road and the station would be upgraded to provide for an integrated pathway for independent access. This would require the demolition of existing station buildings and construction of new buildings, ramps, station furniture, new canopies, balustrades and signage. There are residential properties on Cope Road immediately adjacent to the railway corridor south of Annerley Road.

This site would not be a major worksite or location for spoil haulage therefore the works would have a low potential for construction phase air quality impacts and any impacts would be temporary and minor and would be managed through the measures in the Project OEMP.

8.3.5.3 Fairfield to Salisbury Stations

The proposed station upgrades as part of the Proposed Changes are not considered to be significant with regards to potential air quality impacts during construction given they are largely minor (e.g. demolition of station buildings, ramps, station furniture, new canopies, raised platforms, balustrades, signage, toilets etc.). The station upgrades would have a low potential for construction phase air quality impacts and any impacts would be temporary and minor.

Although no further air quality assessment is considered necessary for the proposed station upgrades, there are sensitive receptors within close proximity to the majority of stations as shown in Table 8.12. Therefore, air quality management measures as identified in the Project OEMP are to be implemented during the construction period.

Table 8.12: Distance of sensitive receptors to each station

Station	Distance and direction
Fairfield	20m to the east and west
Yeronga	30m to the east

⁵ There is no project air quality goal for PM_{2.5} therefore predicted concentrations have been compared to the objectives in the EPP(Air) for reference.

Yeerongpilly	25m to the east
Moorooka	130m to the east
Rocklea	20m to the north
Salisbury	25m to the east

8.3.5.4 Clapham Yard Stabling

Clapham Yard stabling is not part of the Evaluated Project. The Proposed Changes include provision of stabling capacity for 27 trains, crew facilities, carparking and other civil works. The Proposed Changes are similar to that assessed in the 2011 EIS when this site was an element of the design. The Proposed Changes result in a significant reduction in the amount of fill proposed to be placed at the yard compared to the EIS. The EIS identified potential for air quality impacts at this location due to the large volumes of fill proposed to be received.

The EIS included dispersion modelling for Clapham Yard and identified that TSP concentrations (24 hour) were predicted to exceed the goal of 80 µg/m³ at parkland to the northwest of the worksite. PM₁₀ concentrations were expected to comply with the air quality objective.

The Proposed Changes would result in reduced air quality impacts due to a reduction in fill, earthworks timeframe and a reduced number of truck movements.

The potential for air quality impacts at Clapham Yard is expected to be consistent with or less than that identified in the 2011 EIS, and mitigation measures would be implemented in accordance with the Project OEMP.

8.3.6 Operational changes to train and traffic movements

The Project has the potential to impact local air quality during operation through changes to emissions generated by motor vehicles (through both modal shift and increased traffic in some areas with passengers travelling to new stations) and trains. The project would be used by both freight and passenger trains. Freight trains operating in the Brisbane area are currently powered by diesel engines, while the passenger trains are powered by electricity supplied through overhead wires.

The number of passenger train movements for the CRR project is increased compared to that assessed for the Evaluated Project. Passenger trains are electric, serviced by overhead lines, therefore this increase would not lead to significant additional local emissions to air not previously assessed. Increases in train movements has the potential for minor air quality impacts from increased brake pad wear and friction between the wheels and rails for electric trains. Freight services, which do generate emissions to air, are not anticipated to change from those levels predicted for the Evaluated Project.

The Proposed Changes are not anticipated to result in significant changes to emission generated by motor vehicles.

It is not expected that there will be any material changes to the key sources of operational-phase air emissions from the assessment outcomes of the Evaluated Project.

8.4 Changes to Mitigation Measures

The air quality management measures described in the Project OEMP are relevant and should be implemented across the changed Project. General dust suppressant measures should be implemented at all locations where works are to be carried out.

The additional control measures shown in Table 8.2 are required to be added to the Project OEMP and Outline Air Quality Management Plan (OAQMP) for the Southern Portal and Boggo Road worksite. It is also noted that the OAQMP requires additional mitigation measures to be implemented where monitoring to be undertaken during the construction phase indicates an exceedance.

8.5 Conclusion

Following a review of the works proposed for RfPC-4, it was determined that at most locations air quality impacts would be generally consistent with the Evaluated Project. Due to changes to the scale, method or location of construction works, updated quantitative air quality assessment (dispersion modelling) was undertaken for Mayne Yard, Roma Street Station, Woolloongabba Station, Southern Portal and Boggo Road Station.

For Southern Portal and Boggo Road Station worksites, modelling showed exceedance of health-based and nuisance-based air quality goals at nearby sensitive receptors therefore additional control measures have been modelled. This reduces the offsite impacts however some exceedances of the nuisance-based air quality goals at nearby receptors are still predicted. The additional control measures (shown in Table 8.2) will be added to the Project OEMP and OAQMP and implemented for these worksites. Otherwise the air quality management measures described in the Project OEMP remain valid and should be implemented across the Project. General dust suppressant measures should also be implemented at all locations where works are to be carried out.

No changes to the air quality CRR Project Imposed Conditions detailed in the Coordinator-General's change report have been identified as a result of design changes considered in RfPC-4.

9. Technical Report: Noise and Vibration

9.1 Introduction

This technical report has been prepared for the CRR project to assess the potential changes to noise and vibration impacts associated with the Proposed Changes, compared to the Evaluated Project impacts. Where new or changed impacts have been identified, mitigation measures have also been reviewed and new or modified measures proposed where relevant.

In some cases, the Proposed Changes are generally in accordance with the design and impacts identified for the Evaluated Project. Where this is the case, further detailed assessment has not been undertaken.

9.2 Methodology

In cases where the Proposed Changes would result in substantially similar noise and vibration impacts as the Evaluated Project or the 2011 EIS, or to the existing condition, no detailed noise modelling has been conducted and a subjective discussion of impacts is included.

For areas where the Proposed Changes have the potential for changes to the noise or vibration impacts compared to the Evaluated Project or 2011 EIS, an assessment of the changes has been conducted using the methodology in the following sections.

9.2.1 Operational Noise Modelling

9.2.1.1 Airborne Noise

Modelling was conducted in SoundPLAN 8.0 for areas where the alignment has changed significantly compared to the Evaluated Project or the 2011 EIS to predict noise levels at sensitive receivers. The model includes terrain contours, buildings, existing noise barriers, number of trains and noise emission levels, rail movements and relevant noise sources for the rail stabling yard and the location of noise sensitive receivers.

The Nordic Rail Traffic Noise Prediction Method (Kilde 130) has been used for all surface rail noise assessments and the CONCAWE industrial prediction model has been used to account for the additional noise emissions from stationary trains in the stabling yard. This is consistent with the method used for the Evaluated Project and is required by QR EMS Specification MD-15-316.

Source assumptions for passenger trains are as per Queensland Rail's standard database of noise emissions. Passenger train movements were modelled as SMU/IMU/NGR trains 144m in length (i.e. 6 car trains). Train speeds were modelled as 80 km/h in mainline sections, 50 km/h within entry to stabling yards and 30 km/h within Stabling yards.

Freight trains were modelled as having current-generation double-headed locomotives (36m long) and a 1500 m consist length, as per the 2011 EIS. Freight trains speeds were modelled as 60 km/h throughout the alignment.

Portal openings were modelled as a tunnel opening in SoundPLAN 8.0 with the following tunnel lining absorption coefficients as shown in Table 9.1.

Table 9.1. Tunnel Lining Absorption Coefficients

Frequency Range (Hz)	<160	160-400	500-1250	>=1600
Absorption Coefficient	0.1	0.2	0.3	0.3

Corrections for curves, bridges and turnouts have been modelled based on features identified in the proponent's designs, existing track alignments and aerial photography. Modelling corrections are as per QR MD-15-316, with a turnout correction of +6dB from Kilde 130.

Existing noise barriers have been included in the model except where the proposed revised design would require deletion of the noise barrier (e.g. extension of station platforms).

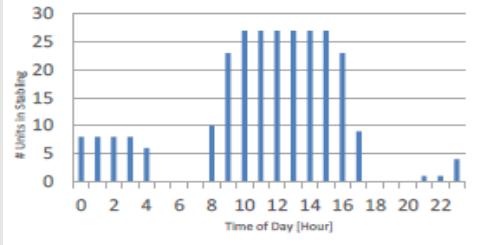
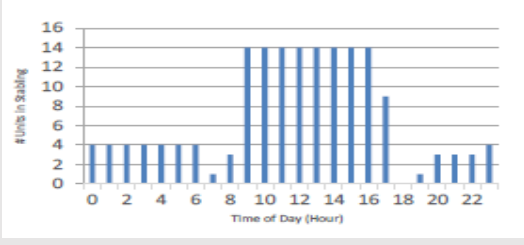
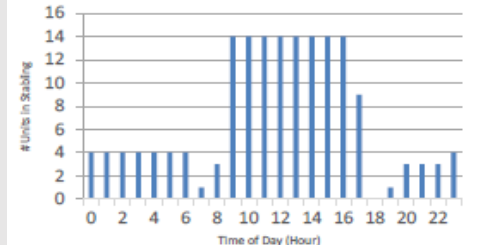
The predicted noise levels include contributions from the rail movements, stabling yards and tunnel portals and include shielding from any existing noise barriers. All predicted levels include a +2.5 dB(A) facade correction consistent with the Evaluated Project and Queensland Rail noise modelling Specification MD-15-316.

Traffic volumes used for modelling were provided by the CRR Delivery Authority and are provided in Table 9.2. below. Train movements to and from stabling yards were also assessed and are shown in Table 9.3.

Table 9.2. Train volumes for the CRR Project

Segment	Year 2026		Year 2036	
	Freight Train Movements	Passenger Train Movements	Freight Train Movements	Passenger Train Movements
Salisbury - Yeerongpilly	8	418	12	447
<i>Up</i>		209		213
<i>Down</i>		157		170
<i>Dual Gauge</i>	8	52	12	64
Yeerongpilly - Park Road	34	488	42	577
<i>Up</i>		244		278
<i>Down</i>		165		195
<i>Dual Gauge</i>	34	79	42	104
Roma Street - Bowen Hills	0	650	0	859
Roma Street to Northern Portal via Exhibition line	18	28	26	34
CRR Up and Down: Victoria Park – Bowen Hills (Exhibition Loop via Normanby) – From Northern Portal	0	488	0	418
Ferny Grove Flyover	0	182	0	182
North of Bowen Hills - Main	0	155	0	130
North of Bowen Hills - Suburban	0	99	0	133

Table 9.3. Train Movements to and from stabling yards per day

	Clapham Yard	Mayne North	Mayne East
Overnight Stabled	8	4	18
Interpeak Stabled	27	14	30
Capacity	36	18	28
Daily Histogram			

9.2.1.2 Groundborne Noise and Vibration

Groundborne noise levels are assessed only for areas where the track is below ground. This is because the airborne noise level is dominant over the groundborne noise level for surface track except in particularly unusual cases e.g. a receiver behind an unusually tall noise barrier.

Noise predictions for the revised alignment were conducted using a hybrid empirical/analytical modelling approach consistent with the requirements of ISO 14837-1:2005⁶.

The rail source levels were based on measurements of Sydney rollingstock from previous tunnelling projects, consistent with the previous EIS assessment.

Lithology corrections were modelled by using the vibration loss rates presented in the EIS (which were also adopted for the Evaluated Project) which presented a comparison of the propagation loss for Brisbane tuff (considered representative of the lithology for the entire project alignment) and Sydney sandstone (considered representative of the lithology of the source measurements).

Train speeds within the tunnel were assumed as follows (based on posted line speeds and the predicted operational rail modelling):

- | | |
|--|---------|
| • Southern portal to Boggo Road | 50 km/h |
| • Boggo Road to Woolloongabba station | 70 km/h |
| • Woolloongabba Station to Roma Street station | 80 km/h |
| • Roma Street station to Northern portal | 70 km/h |

The predicted ground vibration levels were converted to in-building vibration levels (and consequently radiated groundborne noise levels) using published data for typical building foundation losses, slab amplification and propagation losses within the building (for locations on upper floors).

The default track fixing used for modelling was Standard Attenuation (SA) fixing (Type 1), with the basis of design a Sonneville LVT track fixing with stiffness 30 kN/mm per fastener.

Higher-performance Type 2 High Attenuation (HA) (basis of design Sonneville LVTHA with stiffness 10 kN/mm/fastener) and Type 3 Very High Attenuation (VHA) (basis of design a floating track slab system with Delkor Alt 1 fasteners with 27 kN/mm/fastener stiffness) have also been used as mitigation options for track sections where the Type 1 track does not provide sufficient groundborne noise reduction.

9.2.2 Construction Noise Modelling

Construction noise levels from construction worksites have been predicted using source noise levels from BS5228.1 and the CONCAWE noise model, which allows prediction of noise levels under different meteorological conditions.

A range of noise levels is presented for each prediction location, based on the closest and furthest points of approach of the construction activity and assuming worst case downwind propagation at the closest point of approach, and best case upwind propagation at the furthest point of approach. This gives the full expected range of noise levels at receivers.

⁶ International Standard ISO 14837-1 (2005) *Mechanical vibration – Ground borne noise and vibration resulting from Rail Systems. Part 1: General Guidance.*

Noise levels are predicted at the worst-affected location at a building or for a group of similar receivers.

No corrections for screening have been included in predictions except for cases where an intermediate building blocks the line-of-sight between the construction site and a receiver (e.g. construction noise impacts for residential receivers on the “second row” behind commercial or industrial buildings e.g. receivers to the east side of Moorooka Station). Reflections from surrounding buildings have been included where significant.

9.3 Changes to Potential Impacts

9.3.1 Alignment

9.3.1.1 Northern Portal to Roma Street

Construction

The alignment north of Roma Street to the Northern Portal is consistent with the Evaluated Project. The construction methodology for the section between Roma Street and the Northern Portal remains as Tunnel Boring Machine (TBM) construction, which is as per the Evaluated Project.

Construction noise and vibration impacts for the Proposed Changes would be substantially as per the Evaluated Project for the section between Roma Street and the Northern Portal.

Operation

The alignment north of Roma Street to the Northern Portal is consistent with the Evaluated Project. A section of high attenuation track is used in the vicinity of Petrie Terrace.

No exceedances of the Project’s operational noise criteria are predicted for the revised alignment with the designed trackform.

9.3.1.2 Roma Street to Albert Street

Construction

The changes to the project alignment mean that there will be changes to the construction noise and vibration impacts from underground works.

Noise and vibration modelling has been conducted for the revised tunnel alignment to predict the construction noise and vibration levels resulting from the tunnelling works.

Noise and vibration from the Tunnel Boring Machine operation has been predicted from Roma Street Station to Albert Street Station. The tunnel boring machine is assessed as a “continuous” noise source since the source is slow-moving and would stay in essentially the same location over the 1-hour assessment period. Noise levels are predicted for the unmitigated scenario since there are no practicable technical mitigation measures to reduce construction vibration from TBM operation. Tunnelling vibration is predominantly a function of the hardness of the ground being excavated, with the excavation methodology resulting in little change between different methods.

No exceedances of the groundborne noise criteria are predicted between the Roma Street station and Albert Street Station.

No exceedances of the human comfort vibration criteria for residences are predicted between Roma Street Station and Albert Street Station.

One exceedance of the human comfort vibration criterion for office buildings is predicted for 123 Albert Street, Brisbane. However, since vibration predictions are calculated for the lowest floor of the building and there will be losses associated with vibration propagation up the building, this predicted exceedance may not be significant in practice for receivers located above the lowest floors.

Operation

The tunnel alignment ties into Albert Street Station which has moved north west along the alignment. From Albert Street to Roma Street, a single 1200m radius curve replaces reverse 300m curves to diverge at City Hall and head under Emma Miller Place, following under the QR rail lines. This increases the distance of the tunnel from sensitive receptors, such as the law courts. Groundborne noise levels at the law courts are predicted to be below 20 dB(A).

A high attenuation track fixing is used between Albert Street and Roma Street station to address groundborne noise impacts to receivers within the Brisbane CBD.

No exceedances of the Project's operational noise and vibration criteria are predicted for the revised alignment with the designed trackform.

9.3.1.3 Albert Street to Woolloongabba

Construction

The changes to the project alignment mean that there will be changes to the construction noise and vibration impacts from underground works.

Noise and vibration modelling has been conducted for the revised tunnel alignment to predict the construction noise and vibration levels resulting from the tunnelling works.

Noise and vibration from the TBM operation has been predicted from Albert Street Station to Woolloongabba Station. The TBM is assessed as a “continuous” noise source since the source is slow-moving and would stay in essentially the same location over the 1-hour assessment period. Noise levels are predicted for the unmitigated scenario since there are no practicable technical mitigation measures to reduce construction

vibration from TBM operation. Tunnelling vibration is predominantly a function of the hardness of the ground being excavated, with the excavation methodology resulting in little change between different methods.

No exceedances of the groundborne noise or human comfort vibration criteria are predicted between the Albert Street Station and Woolloongabba Station.

Operation

From Woolloongabba Station to Albert Street section a curve is proposed to be removed resulting in the alignment under Botanic Gardens being slightly to the east of the current CRR alignment. This shortens the length by 70m, in addition the vertical alignment has been deepened to increase cover to rock under the Brisbane River. The deeper tunnel depth and the revised alignment reduces impacts to residential receivers in Kangaroo Point. A high attenuation trackform is used between Woolloongabba Station and the Brisbane River crossing.

A high attenuation track fixing is used between Alice Street and Albert Street station to address groundborne noise impacts to receivers within the Brisbane CBD.

No exceedances of the Project's operational noise and vibration criteria are predicted for the revised alignment with the designed trackform.

9.3.1.4 Woolloongabba to Boggo Road / Southern Portal

Construction

The changes to the project alignment mean that there will be changes to the construction noise and vibration impacts from underground works.

Noise and vibration modelling has been conducted for the revised tunnel alignment to predict the construction noise and vibration levels resulting from the tunnelling works.

Noise and vibration from the roadheader tunnelling operation has been predicted from Woolloongabba Station to the Southern Portal. Tunnelling is assessed as a "continuous" noise source since the source is slow-moving and would stay in essentially the same location over the 1-hour assessment period. Noise levels are predicted for the unmitigated scenario since there are no practicable technical mitigation measures to reduce construction vibration from roadheader operation. Tunnelling vibration is predominantly a function of the hardness of the ground being excavated, with the excavation methodology resulting in little change between different methods.

Groundborne noise and vibration impacts increase as the tunnel progresses south because the tunnel depth generally decreases as the tunnel approaches the Southern Portal.

Groundborne noise levels are predicted to exceed the 35 dB(A) criterion for residential receivers at night for receivers located to the south/west of the Pacific Motorway within approximately 30 m of the tunnel alignment. The 40 dB(A) criterion for residential receivers at day would be exceeded for receivers within approximately 20 m of the tunnel alignment.

The maximum predicted noise level is 50 dB(A) which would occur for receivers on Quarry Street, Woolloongabba.

No groundborne noise impacts to the EcoSciences Precinct, TRI Building or PA Hospital are predicted.

Groundborne vibration levels would exceed the daytime human comfort vibration goals for receivers within approximately 30 m of the alignment between Longwood Street, Woolloongabba and Quarry Street, Woolloongabba. Vibration levels would exceed the human comfort night-time vibration levels within approximately 25 m of the alignment between Longwood Street, Woolloongabba and Quarry Street, Woolloongabba.

The maximum vibration level at residential receivers is predicted to be 1 mm/s at properties on Quarry Street, Woolloongabba. Maximum vibration levels at the EcoSciences building are predicted to be 0.13 mm/s which exceeds the threshold value for vibration-sensitive equipment.

The EcoSciences building has a Transmission Electron Microscope (TEM) which was discussed in the EIS as having a sensitivity to floor vibration based on the manufacturer's data ranging from 0.019 mm/s to 0.3 mm/s depending on the frequency of vibration. Floor vibration levels will differ to the ground vibration level exterior to the building due to foundation losses as vibration enters the building and amplification from the building slab; these factors are frequency dependent and can mean that internal levels may be lower or higher than the external vibration level.

The location of the TEM within the EcoSciences building is not known and therefore the maximum predicted vibration level has been assumed to occur at the TEM location.

At this stage of assessment, the dominant frequency of the construction vibration is unknown; however, guidance can be sought from use of the vibration criterion (VC) curves which are commonly used for specifying vibration limits for vibration-sensitive facilities.

A TEM would normally be considered to be able to operate satisfactorily at a vibration level of VC-D. The vibration predictions for the EcoSciences building indicate that vibration levels exceeding VC-D would occur for between 0-21% of the time depending on the location within the complex.

Operation

Noise and vibration impacts between the Southern Portal and Boggo Road station are controlled via use of a high attenuation trackform.

Key changes to the horizontal and vertical alignment from Boggo Road Station to Woolloongabba Station include the flattening of reverse curves to improve maintenance and increase speeds. This alignment changes results in the Woolloongabba Station moving 70m west achieving a better public space and precinct. The change to alignment reduces vibration levels from curving that would result in increased groundborne noise levels for residential receivers above the tunnels. As a result, impacts would be reduced compared to the Evaluated Project.

A floated track slab trackform is required between Boggo Road Station and the Pacific Motorway to control groundborne noise and vibration impacts to the EcoSciences building and to residential receivers in Woolloongabba.

No exceedances of the Project's operational noise and vibration criteria are predicted for the revised alignment with the designed trackform.

9.3.2 Mayne Area

9.3.2.1 Mayne Yard

Construction

Track Works to facilitate the changed alignment, new bridge and stabling alterations to the existing rail tracks and infrastructure in Mayne Yard are required.

Rail construction works include demolition/removal of existing rail lines, earthworks to remove ballast, earthworks and drainage works for the realigned rail lines and fencing works.

The Evaluated Project includes altering or relocating existing rail infrastructure and road, pedestrian and public utility infrastructure within the surface rail corridor.

Surface track works required in Mayne Yard are generally in accordance with the Evaluated Project.

Construction noise impacts from surface rail works within Mayne Yard will be generally as per the Evaluated Project.

The proposed works include demolition and relocation of existing diesel loco facilities located in Mayne East to allow the reconfiguration of Mayne East entry. The future location, if required, will be selected and built by others however demolition impacts are included as part of this assessment.

Demolition of the existing facilities has been assessed based on a typical activity sound power level of 120 dB(A) for unmitigated demolition works.

Predicted unmitigated noise levels at the nearest residential receivers to the western side of Breakfast Creek are in the range 48-62 dB(A).

Construction noise goals for the works would be 57 dB(A) day / 49 dB(A) night for residential receivers (based on a typical façade reduction of 7 dB(A) for a Queenslander-type house).

This would result in exceedances of up to 5 dB(A) during the day and 13 dB(A) at night for unmitigated demolition works.

Potential mitigation measures for demolition activities depend on the detailed planning of the activity as to which measures are feasible, but could include substitution of alternate demolition methods, use of silencers on major items of equipment, conducting works behind barriers/hoardings where possible as well as materials handling measures including the use of damped receptacles and avoiding the dropping of material from heights. The likely demolition methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Operation

The Evaluated Project alignment at Mayne Yard, includes two new tracks, one situated at-grade and traversing between Mayne Yard West and Mayne Yard East and one traversing the eastern side of Mayne Yard, with this track partly contained within a trough (underpass). The Proposed Changes are within the existing rail corridor.

The proposed alignment of the Up CRR and Down Main lines running to the west of the Mayne North yards shifts these lines and associated rail movements approximately 120 m closer toward residential receivers on the opposite side of Breakfast Creek compared to the Evaluated Project. The new alignment is approximately 350 m away from a residential receiver at the closest point of approach. This results in an increase in the total rail noise levels at these receivers compared to the Evaluated Project, however the airborne noise levels are still below the Project's operational noise criteria.

The alignment change will decrease airborne noise levels to the east of the rail corridor compared to the Evaluated Project however the land usage in this area is predominantly industrial and does not include sensitive receivers.

9.3.2.2 Breakfast Creek Bridge

Construction

The New Breakfast Creek Bridge is proposed to take the CRR Up and CRR Down lines and the Main Down line across Breakfast creek approximately 50 m west of the existing crossing via a new bridge arranged as a six-span crossing over Breakfast Creek.

The new bridge will be constructed in a greenfield environment away from the operating main and suburban lines.

The construction of the new Breakfast Creek rail bridge results in a new construction worksite to the west of the existing bridge which results in shorter offset distances between the worksite and surrounding noise and vibration sensitive receivers, including residential receivers to the west of Breakfast Creek. This will increase the noise and vibration exposure of these sites.

Noise levels for piling and installation of the new bridge have been predicted based on a typical unmitigated adjusted activity sound power level for bored piling of 117 dB(A).

Predicted unmitigated noise levels at the nearest residential receivers on Grafton Street are in the range 56-67 dB(A).

Construction noise goals for the works would be 57 dB(A) day / 49 dB(A) night for residential receivers (based on a typical façade reduction of 7 dB(A) for a Queenslander-type house).

This would result in exceedances of up to 10 dB(A) during the day and 18 dB(A) at night for bridge works.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods (e.g. use of CFA piling or hydraulically jacked piles), use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible.

At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

To minimise impacts to flooding in the area from the new bridge dredging of approximately 3,000 m³ to enlarge the creek is required at the bridge location as well as a minor bund just downstream of the Ferny Grove rail bridge, located on the west bank, adjacent to the shared path.

Noise and vibration impacts to surrounding residences have been predicted based on a typical sound power level of 118 dB(A) for a barge-mounted backhoe dredger.

Predicted noise levels at the nearest residential receivers on Grafton Street are in the range 54-62 dB(A).

This would result in exceedances of up to 5 dB(A) during the day and 13 dB(A) at night for dredging works.

Potential mitigation measures for the backhoe dredging could consist of selecting quieter items of plant and/or using residential-grade silencers on the backhoe. A noise reduction of approximately 5 dB(A) would typically be achievable however this depends on the particular items of plant used for construction.

Operation

A new Breakfast Creek Bridge for the Main lines is proposed to cross Breakfast creek 50 m west of the existing crossing. A new concrete bridge arranged as a six-span crossing over Breakfast Creek will carry the two CRR tracks and the Down main track. As a worst-case assumption, the bridge was modelled as having no side parapets which would act as noise barriers for the wheel/rail interface source.

The new Breakfast Creek rail bridge will result in an increase in noise levels at the residential receivers to the west of the rail alignment compared to existing condition and compared to the Evaluated Project. This is due to the closer source-receiver distance for the realigned tracks and also due to the structure-radiated noise levels from the bridge structure itself.

Noise levels at the closest receivers on Grafton Street and Bowen Street will increase as a result of the new bridge, however the airborne noise levels are still below the Project's operational noise criteria.

9.3.2.3 Mayne North Stabling Yard

Construction

A new stabling facility is proposed in Mayne Yard north, which has not previously considered under the Evaluated Project. The area is currently used for below rail infrastructure maintenance including sidings for works trains and one track that can be used to stable electric trains.

The stabling facility will be provided 14 x 6 NGR or non-NGR trains, a graffiti removal track and non-electrified track of 115m.

Demolition of signal construction depot, rail construction depot, surveyors' depot, track maintenance depot, Mayne north shunters facilities is required to construct stabling in this area.

The demolition works have been assessed based on a typical activity sound power level of 120 dB(A) for unmitigated demolition works.

Predicted unmitigated noise levels at the nearest residential receivers to the western side of Breakfast Creek are in the range 50-65 dB(A).

Construction noise goals for the works would be 57 dB(A) day / 49 dB(A) night for residential receivers (based on a typical façade reduction of 7 dB(A) for a Queenslander-type house).

This would result in exceedances of up to 8 dB(A) during the day and 16 dB(A) at night for demolition works.

Potential mitigation measures for demolition depends on the detailed planning of the demolition activity as to which measures are feasible, but could include substitution of alternate demolition methods, use of silencers on major items of equipment, conducting works behind barriers/hoardings where possible as well as materials handling measures including the use of damped receptacles and avoiding the dropping of material from heights. At this early stage of assessment, the likely demolition methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

The Evaluated Project has assessed altering or relocating existing rail infrastructure and road, pedestrian and public utility infrastructure within the Mayne Yard area.

Construction noise impacts from surface rail works within the Mayne North area will be generally as per the Evaluated Project.

Operation

A new stabling facility is proposed in Mayne Yard north, not previously considered under the Evaluated Project. The area is currently used for rail infrastructure maintenance including sidings for works trains and one track that can be used to stable electric trains.

The proposed Mayne North stabling yard will result in an increase in airborne rail noise levels at residential receivers located to the west of Breakfast Creek due to the increased rail movements within the area. Noise sources include noise from air-conditioning equipment on stabled trains as well as noise from rail movements within the yard and noise from train maintenance and cleaning operations.

Total rail noise levels at the closest receivers on Albany Street and Gennon Street will increase compared to the Evaluated Project due to the additional noise sources at Mayne North, however the noise levels are still below the Project's operational noise criteria.

9.3.3 Northern Area

9.3.3.1 Northern Portal

Construction

There is no significant change to the Northern Portal design compared to the Evaluated Project. The construction noise and vibration impacts from Northern Portal construction would be as per the Evaluated Project.

Operation

The proposed Northern Portal design includes repurposing of existing tracks within the Normandy Yard for the Up Exhibition track which shifts the track to the south towards Brisbane Girls Grammar School. This means that Up trains on the Exhibition track will move to be approximately 25 m away from the Sports Centre of BGGG (the closest building at BGGG) compared to the existing ~65 m distance. Although the Sports Centre is not considered to be noise-sensitive, the Learning Centre at BGGG is also located adjacent to the rail corridor and the repurposing of existing track for the Up Exhibition track will move the line significantly closer to the Learning Centre. This is shown in Figure 9.6 below.



Figure 9.6: Existing alignment (grey) and proposed alignment (purple).

The cumulative level from all rail sources at the Sports Centre is L_{Amax} 92 dB / $L_{Aeq,24hr}$ 64 dB which exceeds the Project's operational noise criteria, however the Learning Centre is predicted to be below the noise criteria. As discussed above, the cause of this exceedance is the loco movements on the proposed realigned Up Exhibition track. The contribution from CRR tracks is more than 10 dB below the contribution from Exhibition Line tracks at this receiver.

The predicted noise level from the existing tracks (with the same rail traffic volumes) is L_{Amax} 86 dB / $L_{Aeq,24hr}$ 64 dB which would meet the Project's operational noise criteria.

A preliminary noise barrier investigation indicates that a 6 m noise barrier placed at the boundary of the rail corridor would result in a predicted noise barrier attenuation of only 1 dB for the Sports Centre. A 6 m noise barrier is not effective at providing noise reduction for the Sports Centre because this receiver is elevated above the rail corridor and therefore the barrier is not blocking the line of sight to the building.

BGGG will experience an increase in noise levels of up to 6 dB as a result of the Proposed Changes. However, the only building predicted to experience an exceedance of the Project's operational noise criteria is the northern façade of the Sports Centre. A sports building would not be considered to be a noise-sensitive usage and any classrooms within the Sports Centre appear to be not located on the northern façade (or if

they are, they do not have external windows). As such, no noise mitigation is considered necessary for BGGS.

9.3.3.2 Exhibition Station

Construction

For the Evaluated Project, the Exhibition station location is just south of midway between Bowen Bridge Road and O'Connell Terrace and consists of a dual platform connected by vertical transport and overpass, with pedestrian access to the RNA showgrounds and the above-mentioned roads from the underpass, ramps and elevated walkways. The development involved constructing a new track on structure (at existing track level to the north of the existing tracks, and the lengthening of the existing passenger platforms.

The proposed changes to the Exhibition Station are a reduction in work in that the existing Exhibition Station will be upgraded to QR Premium Station, the works proposed are:

- Extension of Platforms 2 and 3.
- Removal of existing Platform 1.

The impacts for the proposed upgrade of Exhibition Station would be reduced compared to the noise impacts from a full redevelopment of the station assessed as part of the Evaluated Project. No significant additional noise impacts would be anticipated.

Operation

Operational noise from Exhibition Station will be as per the Evaluated Project.

9.3.3.3 Minor Civil Works

A number of civil structural works are required in the Northern Area as described in Volume 1. This includes protection works on existing infrastructure and replacement of the train wash subway. These civil works within the rail corridor are generally in accordance with the Evaluated Project and therefore detailed assessment has not been undertaken.

9.3.4 Central / Tunnel Area

9.3.4.1 Roma Street Station

Construction– Underground Station

Due to the changed tunnel alignment, the location of the proposed underground CRR Roma Street Station has changed. The station is to be realigned to the east under Roma Street rail yards, as shown in Volume 1.

The station will be 280m long and 21.5m wide constructed in a mined cavern, there will be a single plaza entry located on the former Brisbane Transit Centre (BTC) West Tower with a service building, plus egress shaft entry points located to the east and west of the station. The eastern egress shaft will be located in Lot 60 with the western egress shaft located at the western end of the former Brisbane Transit Centre. The changed site plan is provided in Volume 1.

The CRR 2017 Roma Street Station was to be a large central cut-and-cover construction with mined caverns extending to the south-east and north-west along the alignment. A change in construction methodology is proposed, with the station now to be constructed mostly as a mined cavern supported from two deep shafts constructed at the eastern and western ends of the site. The eastern access shaft needs to support essential 24/7 tunnelling and cavern construction and will therefore have an acoustic shed incorporated into the temporary site facilities.

Construction for the surface building for the Roma Street underground station and the western egress shaft is located on the site of the Evaluated Project Roma Street underground station. Noise and vibration impacts from the proposed station building and western egress shaft would be substantially as per the Evaluated Project.

The eastern egress shaft in Lot 60 is located further to the east than assessed in RfPC-1, and is located within an area that was assessed as part of the demolition and construction works for RfPC-3.

A station shaft was proposed as part of the 2011 EIS within Emma Miller Place on the opposite side of Parklands Boulevard to the proposed egress shaft.

However, at the time of writing of the 2011 EIS, the Supreme Court and Magistrates Court buildings on Roma Street had not been constructed and therefore no assessment of impacts to the court buildings was conducted for the EIS's eastern shaft. Additionally, the nearest residential receiver to the south/west of the EIS's proposed eastern egress shaft was the Hotel Jen (previously the Holiday Inn), which is to be demolished as assessed in RfPC-3. This means that the EIS did not assess noise impacts to residential receivers on Roma Street e.g. Abbey Apartments, which, although not the closest receivers at the time of writing the EIS, will now be the closest residential receivers to the eastern egress shaft works.

The construction noise impacts from the new eastern egress shaft have been predicted based on a typical unmitigated construction activity sound power level of 110 dB(A) for site establishment works and 120 dB(A) for shaft excavation works. Shaft excavation works would occur within an acoustic enclosure. The EIS discussed the acoustic performance of an acoustic enclosure and calculated a typical noise reduction for diesel-powered items of plant of 12 dB(A) for a medium-performance enclosure and 24 dB(A) for a high-performance enclosure. These noise reductions have been assumed to be representative to the construction activity as a whole, although it is noted that the reduction would differ for construction activities that have a particularly different noise spectrum.

Construction noise goals for Abbey Apartments are 70 dB(A) (day) / 65 dB(A) (evening) / 57 dB(A) (night) based on the internal noise goals and a façade reduction of 15-20 dB for a modern apartment building with operable single glazing. (The lower bound of the façade reduction has been applied based to account for degradation of acoustic seals on operable glazing for an older building such as the Abbey Apartments).

External noise levels at the Abbey Apartments from the eastern shaft works are predicted to be 56-63 dB(A) from site establishment, 59-63 dB(A) from shaft excavation with a medium-performance enclosure and 49-52 dB(A) from shaft excavation with a high-performance enclosure.

This results in predicted exceedances of the construction noise goals at the Abbey Apartments at night of up to 6 dB for site establishment, and up to 6 dB for shaft excavation with a medium-performance enclosure. No exceedance is predicted for shaft excavation with a high-performance enclosure. No exceedances of construction noise criteria during the day or evening are predicted.

The construction noise goal for courts is 45-50 dB(A) depending on the space usage, with courtrooms having the most stringent goal. Using a façade loss of approximately 20 dB(A) for the Supreme Court and Magistrates Court, this results in external criteria of 65-70 dB(A) for court buildings.

External noise levels at the Supreme Court are predicted to be 66-68 dB(A) from site establishment, 67-69 dB(A) from shaft excavation with a medium-performance enclosure and 56-58 dB(A) from shaft excavation with a high-performance enclosure.

This results in predicted exceedances of the construction noise goals at the Supreme Court of up to 3 dB for site establishment, and up to 4 dB for shaft excavation with a medium-performance enclosure. No exceedance is predicted for shaft excavation with a high-performance enclosure.

External noise levels at the Magistrates Court are predicted to be 54-63 dB(A) from site establishment, 59-63 dB(A) from shaft excavation with a medium-performance enclosure and 48-52 dB(A) from shaft excavation with a high-performance enclosure. No exceedances are predicted at the Magistrates Court.

Construction - Relocation of Inner Northern Busway

The Roma Street works also include relocation and lowering of the Inner Northern Busway (INB). The proposed busway alignment ties in to the existing busway intersection underneath the eastern end of Emma Miller Place and would consist of an underground cut and cover tunnel generally parallel with Roma Street, located along the southern end of the current Brisbane Transit Centre site. The relocated busway would then tie in to the existing Inner Northern Busway via a reconfigured intersection adjacent to Countess Street.

Construction works associated with the busway relocation would involve works on the Brisbane Transit Centre site, and therefore would extend over the same geographical area as the RfPC-1 works for demolition of the BTC West Tower and the RfPC-3 demolition works for demolition of the BTC East Tower and Hotel Jen.

The construction methodology for the CRR Roma Street underground station in RfPC-1 was also a cut and cover structure. Therefore, the proposed busway construction would involve similar impacts to the Evaluated Project construction works, albeit extending over an extended length of Roma Street.

The changed impacts associated with the busway relocation would be from the section of cut-and-cover structure located between the BTC West Tower and Emma Miller Place. The noise emission characteristics for the cut-and-cover structure have been assumed the same as for the Evaluated Project. An assessment of the change in noise levels associated with the changed source position has been conducted.

Noise levels at the most-affected residential receiver (Abbey Apartments, 160 Roma Street) would not increase compared to the levels predicted for the RfPC 1 works because the closest point of approach of the construction site is located within the footprint of the former BTC West Tower.

Airborne noise emission from the excavation of the cut-and-cover structure are expected to be substantially the same as for the RfPC-1 assessment, with levels of up to 84 dB(A) predicted at Abbey Apartments. Construction noise goals for Abbey Apartments are 70 dB(A) (day) / 65 dB(A) (evening) / 57 dB(A) (night) based on the internal noise goals and a façade reduction of 15-20 dB for a modern apartment building with operable single glazing. (The lower bound of the façade reduction has been applied based to account for degradation of acoustic seals on operable glazing for an older building such as the Abbey Apartments).

This would result in a 14 dB exceedance of the construction noise goals during the day, 19 dB during the evening and a 27 dB exceedance at night.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should an exceedance of more than 20 dB be confirmed by more-detailed modelling, respite periods are likely to be required for the construction works.

Noise levels at the Supreme Court would be approximately the same as the predicted levels at Abbey Apartments (because the offset distance between the closest point of the new INB worksite to the Supreme Court is approximately the same as the offset distance from the closest point of the worksite to Abbey Apartments). This means an external level of up to approximately 84 dB(A) at the façade of the Supreme Court. This is higher than the worst-case level at the Courts predicted for the RfPC-1 construction works because the RfPC-1 works did not involve any construction on the BTC East tower or Hotel Jen sites.

The construction noise goals for courts is 45-50 dB(A) depending on the space usage, with courtrooms having the most stringent goal. Using a façade loss of approximately 20 dB(A) for the Supreme Court and

Magistrates Court, this results in external criteria of 65-70 dB(A) for court buildings i.e. an exceedance of up to 19 dB at the Supreme Court.

Noise levels at the Magistrates Court would be 1-2 dB lower than at the Supreme Court due to the slightly increased separation distance between the closest point of approach of the works and the Magistrates Court.

These noise levels are presented for construction with a 3 m site hoarding as per the RfPC-1 predictions. As per the EIS, a reduction of approximately 12 dB would occur for works occurring within an acoustic shed with medium-performance construction, and a reduction of approximately 24 dB for works within an acoustic shed with high performance construction.

Operation – Station

The relocated Roma Street station will result in a change to the source location for mechanical ventilation noise sources. These noise sources will be designed to comply with environmental noise criteria as part of the detailed design of the project.

Operation – Relocation of Inner Northern Busway

The relocated Inner Northern Busway will be located underground and therefore operational noise impacts will be negligible.

9.3.4.2 Albert Street Station

Construction

The proposed CRR Albert Street Station was to be beneath Albert Street between Margaret Street and Elizabeth Street. A changed location north-west along the alignment towards Roma Street is proposed to optimize the station catchment, as shown in Volume 1.

Additional demolition works are required at 142 Albert Street to allow construction of the northern entrance. This is an off-street entrance where the Evaluated Project entrance north of Charlotte St was within the existing road reserve. The station construction methodology has changed from a central shaft cut and cover with mined cavern extensions to now be a fully mined cavern construction, see Volume 1. The changed construction method eliminates the cut and cover box, reducing volume of excavation, surface construction area, impacts and avoids interface with utilities.

The demolition and construction works for the station cavern north of Mary Street was assessed as part of the Evaluated Project.

The additional demolition of 142 Albert Street to allow the northern station cavern of the station to be constructed has been assessed based on a typical activity sound power level of 120 dB(A) for unmitigated demolition works.

Predicted unmitigated noise levels at the nearest residential receivers (Royal Albert Hotel) are 80-85 dB(A). Predicted unmitigated noise levels at the nearest commercial receivers (138 Albert Street and 160 Albert Street, the buildings immediately adjacent) are 88-102 dB(A).

The noise goals for intermittent construction noise at Albert Street Station are 70 dB(A) day / 57 dB(A) night for residential receivers, and 75 dB(A) for commercial (when in use), based on a façade loss of 15 dB(A) for the Royal Albert Hotel for a masonry building with single glazing and a façade loss of 20 dB(A) for a typical commercial building.

The demolition works are predicted to result in exceedances of 15 dB (day) and 28 dB (night) for residential receivers, and exceedances of up to 27 dB for commercial receivers. This is an increase compared to the Evaluated Project and is due to the close proximity of the 142 Albert Street site to nearby receivers.

Potential mitigation measures for demolition activities depend on the detailed planning of the activity as to which measures are feasible, but could include substitution of alternate demolition methods, use of silencers on major items of equipment, conducting works behind barriers/hoardings where possible as well as materials handling measures including the use of damped receptacles and avoiding the dropping of material from heights. At this early stage of assessment, the likely demolition methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

The construction noise impacts from the new northern cavern have been predicted based on a typical construction activity sound power level of 110 dB(A) for site establishment works and 120 dB(A) for shaft excavation works. Shaft excavation works would occur within an acoustic enclosure. The EIS discussed the acoustic performance of an acoustic enclosure and provided a typical noise reduction for diesel-powered items of plant of 12 dB(A) for a medium-performance enclosure and 24 dB(A) for a high-performance enclosure. These noise reductions have been assumed to be representative to the construction activity as a whole, although it is noted that the reduction would differ for construction activities that have a particularly different noise spectrum.

Site establishment works would result in exceedances of up to 5 dB (day) and 18 dB (night) at residential receivers, and exceedances of up to 17 dB for commercial receivers.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods, use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible (although this would be unlikely to be effective for locations where the receiver is elevated above the works and the hoarding would not block the line of sight). At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Shaft excavation works would result in exceedances of up to 3 dB (day) and 16 dB (night) at residential receivers and exceedances of up to 15 dB for commercial receivers for works conducted within a medium-performance acoustic shed. Works conducted within a high-performance acoustic shed would result in no exceedances during the day for residential receivers and exceedances of 4 dB at night for residential receivers, and exceedances of up to 3 dB for commercial receivers.

Groundborne noise and vibration impacts from the Albert Street station excavation works have been predicted based on an excavator with hydraulic hammer.

Groundborne vibration levels from station excavation on the northern 142 Albert Street cavern are predicted to reach a maximum vibration level of 0.77 mm at nearby receivers which exceeds the impact criteria for commercial receivers and for residential receivers during the day. However, vibration levels are only predicted to exceed the commercial/ residential daytime vibration criterion for approximately 5% of construction works, and to exceed the residential night-time vibration criterion for 30% of construction works.

The groundborne noise level would reach a maximum level of 49 dB(A) which would comply with daytime impact criteria for both residential and commercial receivers but would exceed night-time criteria for residential receivers. Noise levels are predicted to exceed the night-time residential criteria for approximately 10% of the construction works.

Groundborne noise levels from the station excavation at the southern (Mary Street) cavern would be as per the Evaluated Project.

Operation

The relocated Albert Street station will result in a change to the source location for mechanical ventilation noise sources. These noise sources will be designed to comply with environmental noise criteria as part of the detailed design of the project.

9.3.4.3 Woolloongabba Station

Construction – Underground Station

The location of the CRR Woolloongabba Station is proposed to shift approximately 70m west to allow for future integration with Brisbane Metro. The surface station building is also located further to the south on the former GoPrint site. The new location features tracks running to the east of Reid Street, as opposed to just west of Hubert Street for the Evaluated Project and west of Reid Street for the 2011 EIS. As such, the proposed station location is intermediate between the EIS and the Evaluated Project.

There is no material change in construction methodology of the station itself, with a central cut-and-cover station box and mined station tunnels; however, the change in station location will result in a change in noise exposure for surrounding properties compared to the Evaluated Project. The construction method would still include acoustic shed(s) which would assist in mitigation of noise and dust impacts at the site. One shed will be used to cover tunnel access shaft and used to facilitate underground construction logistics. The second shed will be used in the management of spoil removal.

The changes in noise levels at a selection of representative receivers is outlined below in Table 9.4 based on the closest distance of the receiver from the cut-and-cover worksite. The EIS identified the cut-and-cover component of station construction (shaft excavation) as causing the greatest construction impacts. RfPC-1 commented that the airborne noise impacts from Woolloongabba Station construction would be consistent with the impacts as assessed in the EIS.

Table 9.4. Change in Sound Level to Sensitive Receivers at Woolloongabba Station Construction Site

Location	EIS Distance (m)	RfPC-1 Distance (m)	RfPC-4 Distance (m)	Change in Sound Level	
				(RfPC-4 vs EIS)	(RfPC-4 vs RfPC-1)
Gabba Central Apartments	200	110	190	+0.4 dB	-4.7 dB
St Nicholas Russian Orthodox Cathedral	100	60	95	+0.4 dB	-4.0 dB
Kangaroo Point Holiday Apartments	120	65	125	-0.4 dB	-5.7 dB
Leopard Street Residential	90	155	120	-2.5 dB	+2.2 dB
Trinity Lane Residential	170	270	190	-1.0 dB	+3.1 dB

The proposed station location would generally result in lower construction noise levels at the worst-affected receivers (i.e. receivers across Vulture Street E.g. Kangaroo Point Holiday Apartments and St Nicholas Russian Orthodox Cathedral) compared to the Evaluated Project, although noise levels at other receivers to the west (which are less-affected by the Evaluated Project) would increase. The highest predicted noise level at any receiver resulting from the Proposed Changes construction is lower than the highest predicted noise level at any receiver from the Evaluated Project.

Noise levels from the Proposed Changes are similar or lower than the 2011 EIS predicted noise levels. The minor increase in noise level compared to the EIS of less than 1 dB at the Gabba Central apartments and at St Nicholas Russian Orthodox Cathedral is imperceptible and not considered significant.

Construction - Busway Plaza Bridge

A new pedestrian access bridge (the “plaza bridge”) between Woolloongabba Station and Stanley Street over the busway is proposed. The pedestrian bridge is 8m wide and 41m long and consists of concrete headstock and columns, to avoid altering the existing retaining walls on the busway a new reinforced earth wall will be installed 5m behind the retaining walls.

Noise levels from construction of the busway plaza bridge have been predicted based on typical construction equipment sound power levels, with an activity sound power of 110 dB(A) assumed for lifting and concreting works.

This would result in the following noise level ranges at sensitive receivers (depending on source location and meteorological conditions):

• Gabba Central Apartments	48-58 dB(A)
• St Nicholas Russian Orthodox Cathedral	46-59 dB(A)
• Kangaroo Point Holiday Apartments	46-57 dB(A)
• Leopard Street Residential	45-57 dB(A)
• Trinity Lane Residential	47-57 dB(A)

The noise goals for intermittent construction noise at Woolloongabba Station are 70 dB(A) day / 57 dB(A) night for residential receivers, based on a 15 dB(A) façade loss for masonry buildings with operable single glazing. Noise criteria for St Nicholas Russian Orthodox Cathedral (when in use) would be 65 dB(A), based on a 15 dB(A) façade loss for a heavy masonry building with older operable windows.

The busway bridge is predicted to result in no construction noise exceedances during the day and exceedances of up to 1 dB at night at surrounding residential receivers, and no exceedances at St Nicholas Russian Orthodox Cathedral.

Construction - Spoil Handling

The Evaluated Project includes spoil handling via the Woolloongabba Station worksite as the launch point for the TBM and mining operations.

No significant change to the spoil handling procedures are proposed as part of the current project and therefore no significant change to the noise and vibration impacts from spoil handling (including construction traffic) would occur compared to the Evaluated Project.

Operation

The relocated Woolloongabba station will result in a change to the source location for mechanical ventilation noise sources. These noise sources will be designed to comply with environmental noise criteria as part of the detailed design of the project.

9.3.4.4 Boggo Road Station

Construction – Station

The CRR Boggo Road Station has had minor changes including being lowered by approximately 2m and the tunnel extended to avoid interface with existing bus, rail and the freight flyover. These changes are within the

previously evaluated CRR alignment and considered to be generally in accordance with the Evaluated Project design drawings.

The construction methodology remains as being predominantly cut and cover with a long cut and cover box below the future development site to the south. Due to the lowering of the vertical alignment, a mined cavern method is now proposed for the northern end of the station instead of cut-and-cover. This would minimise impacts to rail and busway operations which pass above the cavern.

The reduced extent of cut-and-cover station construction will reduce the duration of airborne noise impacts compared to the Evaluated Project due to the shorter duration of open-air works – i.e. a greater proportion of station construction works will occur underground. The loudest noise impacts to residential receivers at Quarry Street will also decrease by approximately 5 dB due to the decreased extent of cut-and-cover construction which increases the distance between these receivers and the nearest cut-and-cover section of the worksite.

However, the construction noise levels at the EcoSciences Building, PA Hospital, TRI building or residential receivers to the south of the station will not change significantly because the closest point of approach of construction works to these buildings is located within a section that is to be constructed using cut-and-cover.

Groundborne noise and vibration impacts from Boggo Road station construction are predicted to be below the groundborne noise criteria at all receivers. Vibration impacts are below the human comfort criteria at all receivers, however maximum vibration levels at the EcoSciences building are predicted to be 0.13 mm/s which exceeds the threshold value for vibration-sensitive equipment.

The EcoSciences building has a Transmission Electron Microscope (TEM) which was discussed in the EIS as having a sensitivity to floor vibration based on the manufacturer's data ranging from 0.019 mm/s to 0.3 mm/s depending on the frequency of vibration. Floor vibration levels will differ to the ground vibration level exterior to the building due to foundation losses as vibration enters the building and amplification from the building slab; these factors are frequency dependent and can mean that internal levels may be lower or higher than the external vibration level.

The location of the TEM within the EcoSciences building is not known and therefore the maximum predicted vibration level has been assumed to occur at the TEM location.

At this stage of assessment, the dominant frequency of the construction vibration is unknown; however, guidance can be sought from use of the vibration criterion (VC) curves which are commonly used for specifying vibration limits for vibration-sensitive facilities.

A TEM would normally be considered to be able to operate satisfactorily at a vibration level of VC-D. The vibration predictions for the EcoSciences building indicate that vibration levels exceeding VC-D would occur for between 0-21% of the time depending on the location within the complex (i.e. for some areas of the building VC-D is not exceeded, whereas for other locations VC-D is exceeded for up to 21% of the construction works).

Construction - Pedestrian and Cycle Bridge

The proposed pedestrian underpass in the Evaluated Project is to be deleted, with a new elevated surface connection pedestrian and cycle link from Princess Alexandra Hospital to Boggo Road Urban Village proposed. The bridge spans from Joe Barker Street over the QR and freight tracks providing a 5.4m clearance and connects with the existing cycleway adjacent to the Boggo Road Busway.

Noise levels from construction of the pedestrian/cyclist bridge have been predicted based on typical construction equipment sound power levels, with an unmitigated activity sound power of 110 dB(A) assumed for lifting and concreting works.

This would result in the following noise level ranges at sensitive receivers (depending on source location and meteorological conditions):

- | | |
|-------------------------------|-------------|
| • ESA Leukemia Village | 59-73 dB(A) |
| • Ecosciences Building | 48-63 dB(A) |
| • PA Hospital (Main Building) | 43-56 dB(A) |
| • TRI Building | 45-57 dB(A) |
| • Railway Terrace Residential | 55-63 dB(A) |
| • Elliott Street Residential | 42-54 dB(A) |

The noise goals (equivalent external noise level) for intermittent construction noise at Boggo Road Station are:

- 57 dB(A) day / 49 dB(A) night for residential, based on a typical façade loss of 7 dB(A) for Queenslander-type houses.
- 70 dB(A) day / 62 dB(A) night for ESA Leukemia Village and PA Hospital (based on residential/ward sensitivity and assuming a 20 dB(A) façade loss for both buildings, based on the recent construction of the ESA Leukemia Village adjacent to the rail line, which would have been subject to the provisions of MP4.4 of the Queensland Development Code, and a sealed façade for PA Hospital)
- 75 dB(A) (when in use) for Ecosciences Building and TRI Building, based on a 20 dB(A) façade loss.

The pedestrian/cyclist bridge works are predicted to result in exceedances of up to 6 dB during the day and of up to 14 dB at night at surrounding residential receivers; and exceedances of up to 3 dB (day) and 11 dB (night) at the ESA Leukemia Village. No exceedances of construction noise criteria are predicted at the PA Hospital, Ecosciences Building or TRI Building.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods, use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible.

At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Construction - Busway Modifications

Discussions with Translink and Brisbane City Council (BCC) are ongoing regarding the possibility of using the existing busway outside of bus service hours to haul spoil from the worksite. If use of the busway is approved, then additional civil road works are proposed, including:

- Construction of a right-hand turn lane from Annerley Road into Peter Doherty Street; and
- Construction of heavy vehicle access from the Busway for haulage of spoil from the worksite (on the eastern side of rail corridor).

Noise levels from busway modification roadworks have been predicted based on typical construction equipment sound power levels, with an unmitigated activity sound power of 115 dB(A) assumed for roadworks.

This would result in the following noise level ranges at sensitive receivers (depending on source location and meteorological conditions). Note that noise levels are predicted for the closer of the two worksites (i.e. busway or Annerley Road) for each receiver:

Busway Works:

• ESA Leukemia Village	51-64 dB(A)
• Ecosciences Building	52-62 dB(A)
• PA Hospital (Main Building)	51-61 dB(A)
• TRI Building	50-60 dB(A)
• Railway Terrace Residential	53-59 dB(A)
• Elliott Street Residential	49-59 dB(A)

Annerley Road Works:

• Boggo Road Gaol	64-68 dB(A)
• ESA Leukemia Village	48-58 dB(A)
• Annerley Road Residential	69-73 dB(A)
• Rawnsley Street Residential	66-72 dB(A)

The noise goals (equivalent external noise level) for intermittent construction noise at Boggo Road Station are:

- 57 dB(A) day / 49 dB(A) night for residential
- 70 dB(A) day / 62 dB(A) night for ESA Leukemia Village and PA Hospital
- 75 dB(A) (when in use) for Ecosciences Building and TRI Building
- 70 dB(A) for Boggo Road Gaol / Police Station, assuming a 15 dB(A) façade loss for a heavy masonry building with single glazing.

The busway works are predicted to result exceedances of up to 2 dB (day) and up to 10 dB (night) at surrounding residential receivers (Railway Terrace and Elliott Street). No exceedances of construction noise criteria are predicted at ESA Leukemia Village, the PA Hospital, the Ecosciences Building or the TRI Building.

The Annerley Road / Peter Doherty Street intersection works are predicted to result in exceedances of up to 16 dB during the day and of up to 24 dB at night at surrounding residential receivers (Annerley Road and Rawnsley Street). No exceedances of construction noise criteria are predicted at the ESA Leukemia Village, the Ecosciences Building or Boggo Road gaol/ police station.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the works.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods, use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible.

At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Operation

There will be no significant changes in operational noise emission compared to the previously evaluated Boggo Road station.

9.3.4.5 Southern Portal

Construction

The Southern Portal is generally in the same location as the Evaluated Project, however, there are minor changes proposed to commence the trough structure approximately 40 to 50m south along the alignment and the cut and cover approximately 80m to the south with the CRR Up and Down lines not parallel but diverging to avoid existing foundations of the freight line. This results in the portal for the CRR Down line being in largely the same location as the Evaluated Project, but the portal for the CRR Up line shifts towards the east.

There are some slight changes to the surface tracks in the area of the Southern Portal however the surface track works required in the southern area of the Project are generally in accordance with the Evaluated Project.

Construction noise impacts from surface rail works within the Southern Area will be generally as per the Evaluated Project.

Maximum construction noise impacts from the Southern Portal construction works will be largely as per the Evaluated Project although the extent of construction will increase (and hence the duration of construction works). This is because the closest point of construction for most of the identified receivers is common to both the Evaluated Project and the proposed Southern Portal.

Noise and vibration impacts to Ecosciences, ESA Leukemia Village and PA Hospital will be as per or lower than the Evaluated Project.

Noise impacts for the TRI building and residential receivers on Railway Terrace will increase due to the greater extent of cut-and-cover construction. The following changes in noise level are predicted:

- Railway Terrace receivers: increases of up to 8.4 dB(A)
- TRI Building increase of 3 dB(A)

The Evaluated Project predicted noise levels of up to 76 dB(A) at residential receivers at Railway Terrace, and up to 81 dB(A) at the PA Hospital precinct (including TRI building).

Under the Evaluated Project, the closest receiver to the cut-and-cover structure was 49 Rawnsley Street; for the proposed project the closest receiver is 38 Railway Terrace. RfPC-1 presented noise levels for a receiver catchment of receivers with similar noise exposure and presented results at the worst-affected receiver within this catchment. Assuming that the predicted noise level of 76 dB(A) in RfPC-1 was predicted at 49 Rawnsley Street, this would result in a noise level from the Evaluated Project of 68 dB(A) at 38 Railway Terrace (due to its greater distance from the previously evaluated Southern Portal).

The increase in noise level at 38 Railway Terrace predicted from the Proposed Change Southern Portal location is +8.4 dB compared to the Evaluated Project Southern Portal location – i.e. resulting in a noise level of 76 dB(A) at 38 Railway Terrace, which would result in exceedances of up to 19 dB (day) and 27 dB (night).

The net effect of the changed Southern Portal is an increase in less than 1 dB in the construction noise levels at the worst-affected receiver on Railway Terrace; in addition, the location of the worst-affected receiver has shifted to the south.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the construction works.

In RfPC-1, the TRI building was assessed as being part of the PA Hospital precinct, with results being presented for the worst-affected of several buildings considered as part of the PA Hospital precinct. It is assumed that the noise level predicted was actually at the TRI Building, which is the closest building to the rail corridor.

Following this assumption, and based on the relative distance of the buildings to the previously evaluated Southern Portal location, the predicted noise levels from the Evaluated Project would be 84 dB(A) at the TRI building.

The increase in noise levels from the proposed Southern Portal would therefore result in a 9 dB exceedance at the TRI Building. This is an increase of 3 dB compared to the Evaluated Project and is because the revised portal location has moved towards the east (i.e. towards the TRI and PA Hospital).

Groundborne noise and vibration impacts from the revised Southern Portal excavation works have been predicted based on an excavator with hydraulic hammer. Groundborne noise levels are predicted to be below the construction noise goals at all receivers.

Groundborne vibration levels are predicted to be below the general construction vibration criteria at all surrounding receivers. However, the TRI building and PA Hospital may contain vibration-sensitive equipment and further investigation into the location and sensitivity of this equipment should be conducted as part of detailed construction management.

Operation

The Southern Portal is generally in the same location as the Evaluated Project, however, there are minor changes proposed to commence the trough structure approximately 40 to 50m south along the alignment and the cut and cover approximately 80m to the south with the CRR Up and Down lines not parallel but diverging to avoid existing foundations of the freight line. This results in the portal for the CRR Down line being in largely the same location as the Evaluated Project, but the portal for the CRR Up line shifting towards the east.

The Proposed Changes' Southern Portal locations will result in a minor increase in noise level at receivers to the east of the rail corridor due to the changed portal locations, which have shifted to the east. There is an increase in airborne noise levels at the PA Hospital, TRI Building and PACE Building however noise levels at these locations are below the Project's operational noise criteria.

There is also a concurrent decrease in the noise level contribution from the CRR portals for receivers on the western side of the rail corridor, however noise levels at receivers on the western side are dominated by noise from the freight overpass and therefore the change in overall noise level is negligible.

Cumulative noise levels from all QR tracks exceed the Project's operational noise criteria at seven (7) receivers within the Southern Area, based on the existing noise barrier design. These exceedances are due to trains on surface tracks with the contribution from Cross River Rail resulting in no increase in noise levels compared to the "do nothing" case.

Noise impacts in the Southern Portal area from the modified project would be slightly reduced compared to the Evaluated Project. The changed alignment results in a negligible change in noise levels for all receivers except receivers on the eastern side of the rail corridor (i.e. PA Hospital, TRI Building and PACE building), which are predicted to experience an increase in noise levels; however noise levels would comply with the Project's operational noise criteria at these receivers.

9.3.5 Southern Area

9.3.5.1 Dutton Park Station

Construction

The upgrade works to the existing surface station at Dutton Park have increased compared to the Evaluated Project. Proposed Changes include:

- The station location has moved south to avoid placing the new CRR turnouts within the platform extents;
- A new island platform and one side platform;
- A new covered pedestrian bridge is proposed next to and north of Annerley Road Bridge, which will provide access to the upgraded station from catchments via Cornwall Street and Annerley Road and the PA Hospital via stairs and lifts; and
- Works to the existing Annerley Road Bridge.

Four retaining walls are required in and around Dutton Park Station to provide access to the new northern pedestrian access bridge. These will be a combination of reinforced cantilever walls, reinforced soil structures and cut reinforced slopes.

The station relocation requires demolition of the existing access ramp, station building, the northern extent of the existing island platform and the side platform off Cornwall Street. The shelters, including the Queensland Rail heritage listed shelter, will be relocated or demolished.

Construction activities will include construction of the new platform and station buildings, as well as piling and installation of the new pedestrian overpass.

Noise levels for station construction have been predicted based on a typical unmitigated activity sound power level for general construction of 110 dB(A).

Noise levels for piling for the retaining walls have been predicted based on a typical unmitigated adjusted activity sound power level for bored piling of 117 dB(A).

Noise levels for demolition of the existing Dutton Park station platforms and buildings have been based on a typical activity sound power level of 120 dB(A) for unmitigated demolition works.

The noise goals (equivalent external noise level) for intermittent construction noise at Dutton Park station are:

- 57 dB(A) day / 49 dB(A) night for residential based on a 7 dB(A) façade reduction for a typical Queenslander type house.
- 65 dB(A) for places of worship on Railway Terrace (based on a 15 dB(A) façade loss for a masonry façade with closed operable windows)
- 75 dB(A) for the PACE building (based on a 20 dB(A) façade reduction through a typical sealed commercial façade)

Station Construction

Predicted unmitigated noise levels at the closest residences from station construction works as follows:

- Annerley Road / Cope Street residential 64-70 dB(A)
- Noble Street residential 63-69 dB(A)

Station construction works are predicted to result in exceedances of up to 13 dB (day) and 21 dB (night) at surrounding residential receivers.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the construction works.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods, use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible.

At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Piling Works

Predicted unmitigated noise levels at the closest residences from piling works for retaining walls are as follows:

- Annerley Road / Cope Street residential 72-78 dB(A)
- Noble Street residential 71-76 dB(A)

Piling works are predicted to result in exceedances of up to 21 dB (day) and 29 dB (night) at surrounding residential receivers.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the construction works.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods (e.g. use of CFA piling or hydraulically jacked piles), use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible.

At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Demolition of Existing Dutton Park Station

Predicted unmitigated noise levels at the closest residences from demolition of the existing Dutton Park station and platforms are as follows:

- Rusk Street / Cornwall Street residential 66-72 dB(A)
- PACE Building 71-75 dB(A)
- Railway Terrace places of worship 76-82 dB(A)
- Railway Terrace residential 59-70 dB(A)

Demolition works are predicted to result in exceedances of up to 15 dB (day) and 23 dB (night) at surrounding residential receivers and exceedances of up to 17 dB at places of worship on Railway Terrace. No exceedances at the PACE building are predicted to occur.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the construction works.

Potential mitigation measures for demolition activities depend on the detailed planning of the activity as to which measures are feasible, but could include substitution of alternate demolition methods, use of silencers on major items of equipment, conducting works behind barriers/hoardings where possible as well as materials handling measures including the use of damped receptacles and avoiding the dropping of material from heights. At this early stage of assessment, the likely demolition methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Operation

The extension of Dutton Park Station to the south is expected to have negligible effect on operational noise levels in terms of noise emission. Noise impacts in the vicinity of the station include noise from any new station mechanical plant (which can be mitigated via selection of noise mitigation measures as design progresses) and changes in the locations of noise sources from trains accelerating/decelerating at the station. However, the L_{max} and $L_{Aeq,24hr}$ noise levels are not strongly affected by the station relocation because the increase in noise from acceleration and deceleration sources is offset by a reduction in train speed at the station and the overall noise level is similar.

However, as per MD-15-317 the existing noise barrier on the eastern side of the rail corridor south of Annerley Road (starting at Cope Street) would be required to be deleted as part of the station extension, because MD-15-317 requires “for safety reasons, noise barriers shall not be built behind station platforms or any connecting pedestrian pathways”.

This would result in an increase in rail noise levels for receivers on Cope Street, Tamar Street and Sampson Street. Noise levels would exceed the Project’s operational noise criteria at 9 receivers with noise levels of up to 94 dB L_{Amax} and 72 dB $L_{Aeq,24hr}$ at the worst affected receivers.

9.3.5.2 Fairfield to Salisbury Stations

The proposed design does not construct the additional narrow-gauge track on the eastern side of the rail corridor that was proposed in the 2011 EIS. This means that a greater number of train movements will occur on the existing tracks compared to the EIS assessment and means, on average, that train movements occur further to the west under the proposed design compared to the EIS. This will generally decrease the $L_{Aeq,24hr}$ noise impacts compared to the EIS due to the greater source-receiver distance to trains. However, maximum noise levels are dominated by freight train movements on the dual gauge line, which is generally in the same location as per the 2011 EIS project (with the exception of specific areas where the proposed design includes

track realignments e.g. Yeerongpilly Station and Moorooka Station / Clapham Yard). Therefore, no significant reduction in overall noise impacts is expected compared to the 2011 EIS.

Fairfield Station

Construction

The station upgrade works to Fairfield Station were not assessed in the Evaluated Project or the 2011 EIS.

Construction works consist of construction of a new platform face on the dual gauge line and works to raise the platform height on the existing platforms.

Construction of the additional platform at Fairfield Station will result in construction noise and vibration impacts to surrounding receivers including receivers on Midmay Street immediately opposite the station.

Major construction activities including construction of the new platform and station buildings, as well as piling and installation of the new pedestrian overpass.

Noise levels for station construction have been predicted based on a typical unmitigated activity sound power level for general construction of 110 dB(A). Noise levels for piling and installation have been predicted based on a typical unmitigated adjusted activity sound power level for bored piling of 117 dB(A).

Predicted noise levels at the closest residences from station construction are as follows:

- Midmay Street residential 58-73 dB(A)
- Equity Street residential 59-70 dB(A)

Construction noise goals for the works would be 57 dB(A) day / 49 dB(A) night for residential receivers (based on a typical façade reduction of 7 dB(A) for a Queenslander-type house).

Station construction works are predicted to result in exceedances of up to 16 dB (day) and 24 dB (night) at surrounding residential receivers.

Predicted noise levels at the closest residences from piling works are as follows:

- Midmay Street residential 73-80 dB(A)
- Equity Street residential 74-82 dB(A)

Piling works are predicted to result in exceedances of up to 25 dB (day) and 33 dB (night) at surrounding residential receivers.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the construction works.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods (e.g. use of CFA piling or hydraulically jacked piles), use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible. At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Operation

The station upgrade works to Fairfield Station were not assessed in the Evaluated Project or 2011 EIS.

The additional platform at Fairfield Station would result in negligible change to existing operational noise levels. Noise impacts in the vicinity of the station include noise from new station mechanical plant (which can be mitigated via selection of noise mitigation measures as design progresses).

Yeronga Station

Construction

The station upgrade works to Yeronga Station were not assessed in the Evaluated Project or 2011 EIS. Construction works consist of construction of a new platform face on the dual gauge line and works to raise the platform height on the existing platforms.

Construction of the additional platform at Yeronga Station will result in construction noise and vibration impacts to surrounding receivers including receivers on Lake Street and Fairfield Road adjacent to the station.

Construction noise sources for the station construction and the piling works for the overpass would be as per the other F2S stations.

Predicted noise levels at the closest residences from station construction are as follows:

- Cowper Street / Shottery Street residential 55-65 dB(A)
- Lake Street residential 59-69 dB(A)

Construction noise goals for the works would be 57 dB(A) day / 49 dB(A) night for residential receivers (based on a typical façade reduction of 7 dB(A) for a Queenslander-type house).

Station construction works are predicted to result in exceedances of up to 12 dB (day) and 20 dB (night) at surrounding residential receivers.

Predicted noise levels at the closest residences from piling works are as follows:

- Cowper Street / Shottery Street residential 70-73 dB(A)
- Lake Street residential 74-81 dB(A)

Piling works are predicted to result in exceedances of up to 24 dB (day) and 32 dB (night) at surrounding residential receivers.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the construction works.

Surface track works for the adjustment of the track layout at Yeronga would generally be in accordance with the Evaluated Project.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods (e.g. use of CFA piling or hydraulically jacked piles), use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible. At this early

stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Operation

The station upgrade works to Yeronga Station were not assessed in the Evaluated Project or the 2011 EIS.

The additional platform at Yeronga Station would result in negligible change to on operational noise levels. Noise impacts in the vicinity of the station include noise from new station mechanical plant (which can be mitigated via selection of noise mitigation measures as design progresses).

Noise impacts from the new crossover at Yeronga Station will result in a localised increase of noise levels with noise levels exceeding the Project's operational noise criteria at two receivers. However, the dominant noise source is freight movements on the existing dual gauge track and the increase in noise levels is less than 3 dB and therefore would not trigger the need for additional mitigation in accordance with QR guidelines.

South of Yeronga Station there have been changes to the receiver building heights due to a new triple storey apartment development at 1 Cook Street, which would exceed criteria by 2 dB(A) with the existing noise barriers. These receivers would not be considered noise sensitive in 2026 since it is less than 10 years since construction of the development, however in 2036 this receiver would be considered noise sensitive. There is also a residual exceedance of 1 dB(A) over criteria at the existing receiver at 601 Fairfield Road, however the project is not causing an increase of more than 3 dB at this receiver and therefore does not trigger additional mitigation in accordance with QR Guidelines.

Yeerongpilly Station

Construction

Upgrade of Yeerongpilly Station is not part of the Evaluated Project or 2011 EIS.

The proposed Yeerongpilly Station upgrade is for construction of a third platform face for the relocated Up Suburban track and raising the platform height for the existing platforms.

Yeerongpilly Station already has an existing station overpass and therefore no overpass works are proposed for Yeerongpilly Station.

Construction of the additional platform at Yeerongpilly Station will result in construction noise and vibration impacts to surrounding receivers including receivers on Wilkie Street adjacent to the station and receivers on the opposite side of Fairfield Road including the Yeerongpilly Green residential development (in construction) and the Brisbane City Council South Regional Business Centre.

Construction noise sources for the station construction would be as per the other F2S stations.

Predicted noise levels at the closest sensitive receivers from station construction are as follows:

- | | |
|--------------------------------------|-------------|
| • Wilkie Street residential | 55-75 dB(A) |
| • Yeerongpilly Green residential | 46-59 dB(A) |
| • BCC South Regional Business Centre | 56-63 dB(A) |

Construction noise goals for the works would be 57 dB(A) day / 49 dB(A) night for residential receivers (based on a typical façade reduction of 7 dB(A) for a Queenslander-type house), and 75 dB(A) for commercial receivers (based on a 20 dB(A) reduction for a typical sealed commercial façade).

Station construction works are predicted to result in exceedances of up to 18 dB (day) and 26 dB (night) at surrounding residential receivers. No exceedances at commercial receivers are predicted.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the construction works.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods (e.g. use of CFA piling or hydraulically jacked piles), use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible. At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Surface track works for the adjustment of the track layout at Yeerongpilly would generally be in accordance with the assessment in the 2011 EIS, which concluded that noise levels exceeding the construction noise goals would occur for receivers in the vicinity of trackworks and that “all reasonable and feasible” noise mitigation should be applied, and noted that the duration of trackworks is typically short due to the operational requirement to conduct works during rail shut-down periods.

Operation

The trackworks at Yeerongpilly Station modify the alignment of the Up Suburban and Down Suburban tracks to be further to the east so that the Up Suburban line serves the new platform face at Yeerongpilly Station and the Down Suburban serves the old Up Suburban platform at the existing station.

A new Auxiliary line allows trains from the Dual Gauge to access the former Down Suburban platform face.

These track changes mean that train movements at Yeerongpilly Station are generally running one track further east than for the existing track layout. This reduces the distance to the nearest receivers on Wilkie Street.

Total rail noise levels at the closest receivers on Wilkie Street will increase, however the noise levels are still below the Project’s operational noise criteria. Further, compared to the 2011 EIS project noise levels at the “second row” of houses are significantly reduced because the 2011 project would have resumed the “first row” of houses and relocated the rail corridor and Yeerongpilly Station to the east.

North of Yeerongpilly Station a new crossover connecting the existing Dual Gauge line to the new Auxiliary line which will cause a localised increase in noise levels. One exceedance of the Project’s operational noise criteria is predicted to occur at 3 Ortive Street however the increase in noise level is less than 1 dB which therefore does not trigger additional mitigation in accordance with QR Guidelines.

Moorooka Station

Construction

Construction of the additional platform at Moorooka Station was not assessed in the Evaluated Project or 2011 EIS.

Accessibility works including the overpass and raising the platform height at the existing station were assessed as part of the EIS. However, the overpass extent proposed for Moorooka Station has increased significantly due to the relocation of the dual gauge line and the third platform to the west of Clapham Yard.

For receivers to the east of Moorooka Station, which are the closest receivers to the works, there would be no change in the worst-case construction noise levels from overpass works at these receivers compared to the 2011 EIS works. This is because the closest works location to these receivers is the same in both the assessed 2011 EIS and the Proposed Changes.

The nearest residential receivers to the west of Moorooka Station are more than 500 m away and therefore the extension of the overpass to the west would not result in significant noise impacts at these receivers.

Noise and vibration impacts from the overpass construction were assessed in the EIS, which indicated noise levels of up to 63 dB(A) at residential receivers

Construction noise goals for the works would be 57 dB(A) day / 49 dB(A) night for residential receivers (based on a typical façade reduction of 7 dB(A) for a Queenslander-type house).

Overpass construction works are predicted to result in exceedances of up to 6 dB (day) and 14 dB (night) at surrounding residential receivers.

Construction noise sources for the addition of the third platform face would be as per the other F2S stations.

Predicted noise levels at the closest residences from station new platform construction are as follows:

- Blackburn Street residential 40-52 dB(A)
- Chaucer Street residential 45-52 dB(A)

Station construction works for the new platform are predicted to result in no exceedances during the day, and exceedances of up to 3 dB (night) at surrounding residential receivers.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods (e.g. use of CFA piling or hydraulically jacked piles), use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible. At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Operation

The new platform at Moorooka Station and the realignment of the Dual Gauge track to pass on the western side of Clapham Yard will result in a decrease in noise levels compared to the existing scenario. This is because the rail movements are moving further away from the closest sensitive receivers on the eastern side of the rail corridor, particularly freight movements on the dual gauge line which are dominating the L_{max} noise levels. This will result in a noise reduction for receivers on the eastern side of the corridor.

The closest receivers on the western side of the rail corridor are more than 500 m away from the rail corridor, at which point noise levels would be comfortably below the Project's operational noise criteria.

Rocklea Station

Construction

Construction of the additional platform at Rocklea Station was not assessed in the Evaluated Project or 2011 EIS.

Accessibility works including the overpass and raising the platform height at the existing station were assessed as part of the 2011 EIS, which predicted noise levels of up to 73 dB(A) at residential receivers.

Construction noise goals for the works would be 57 dB(A) day / 49 dB(A) night for residential receivers (based on a typical façade reduction of 7 dB(A) for a Queenslander-type house).

Overpass construction works are predicted to result in exceedances of up to 16 dB (day) and 24 dB (night) at surrounding residential receivers.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the construction works.

Construction noise sources for the addition of the third platform face would be as per the other F2S stations.

Predicted noise levels at the closest residences from station new platform construction are as follows:

- Brooke Street residential 57-69 dB(A)
- John Bright Street residential 45-57 dB(A)

Station new platform construction works are predicted to result in exceedances of up to 12 dB (day) and 20 dB (night) at surrounding residential receivers.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the construction works.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods (e.g. use of CFA piling or hydraulically jacked piles), use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible. At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Operation

The Proposed Changes do not result in any significant change to the operational noise or vibration levels compared to the project as assessed in the 2011 EIS.

Salisbury Station

Construction

Upgrade works at Salisbury Station are not part of the Evaluated Project or the 2011 EIS, with the exception of the footbridge extensions over the widened rail corridor which was included in the 2011 EIS.

Construction noise sources for the station construction and the piling works for the overpass would be as per the other F2S stations.

Predicted noise levels at the closest residences from station construction are as follows:

- Fairlie Terrace residential 50-65 dB(A)
- Olivia Avenue residential 52-72 dB(A)

Construction noise goals for the works would be 57 dB(A) day / 49 dB(A) night for residential receivers (based on a typical façade reduction of 7 dB(A) for a Queenslander-type house).

Station construction works are predicted to result in exceedances of up to 15 dB (day) and 23 dB (night) at surrounding residential receivers.

Predicted noise levels at the closest residences from piling works are as follows:

- Fairlie Terrace residential 68-69 dB(A)
- Olivia Avenue residential 71-80 dB(A)

Piling works are predicted to result in exceedances of up to 23 dB (day) and 31 dB (night) at surrounding residential receivers.

Exceedances of greater than 20 dB over the noise criteria would trigger a requirement for consultation with the affected property and a requirement to conduct works only during the daytime with respite periods. During the detailed construction planning for the works, investigation of mitigation measures should be conducted. Should the 20 dB exceedance be confirmed by more-detailed modelling, respite periods are likely to be required for the works.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods (e.g. use of CFA piling or hydraulically jacked piles), use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible. At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Operation

The Proposed Changes do not result in any significant change to the operational noise or vibration levels compared to the existing scenario.

9.3.5.3 Clapham Yard

The Clapham Yard stabling facility and track works were assessed as part of the 2011 EIS, however, this component was subsequently excluded in the Evaluated Project.

Construction

The Proposed Changes at Clapham Yard are similar to that assessed in the 2011 EIS. The stabling facility design includes capacity for a total of 23 stabling roads and one stabling road for graffiti removal road, cleaning, maintenance and inspection facilities and northern (and limited southern) access for rollingstock.

Other surface works are also similar in nature to those assessed in the 2011 EIS, including removal and installation of utilities, new crew facility and civil works (including rail pedestrian and vehicle access, car parking, signs and line marking, road and footpath lighting, security and fencing perimeters, security gates, surface drainage, demolition works and relocation of existing buildings).

Changes since the EIS include no requirement for a viaduct and embankment, no new bridge structure over Sherwood Road/Muriel Avenue, reduced footprint of civil works and reduced fill volumes.

Construction noise impacts of the Proposed Changes would therefore be expected to be consistent with or less than identified in the 2011 EIS. The EIS found that the worst-case construction activity was trackworks for which noise levels of up to 62 dB(A) were predicted at surrounding residential receivers.

Construction noise goals for the works would be 57 dB(A) day / 49 dB(A) night for residential receivers (based on a typical façade reduction of 7 dB(A) for a Queenslander-type house).

Clapham Yard construction works are predicted to result in exceedances of up to 5 dB (day) and 13 dB (night) at surrounding residential receivers.

Potential mitigation measures for construction activities depend on the detailed planning of the activity as to which measures are feasible, but could include selection of the quietest items of plant available, substitution of alternate quieter construction methods, use of silencers on major items of equipment and conducting works behind barriers/hoardings where possible.

At this early stage of assessment, the likely construction methodology is not sufficiently developed to allow a prediction of the potential reduction in noise levels from mitigation measures. As an indicative range, a reduction of 5-10 dB from mitigation measures would typically be feasible.

Operation

The proposed Clapham Yard stabling facility will result in an increase in airborne rail noise levels at residential receivers located to the east of Ipswich Road from rail movements within the yard compared to the existing scenario, in which the yard is infrequently used. Noise sources include noise from air-conditioning equipment on stabled trains as well as noise from rail movements within the yard and noise from train maintenance and cleaning operations.

The increased noise and vibration from the stabling yard operation would be offset by the realignment of the Dual Gauge line which will route rail movements on this line to the west of the stabling yard, resulting in greater source-receiver distances which will reduce the overall noise level from the running tracks.

Operational rail noise levels for Clapham Yard were predicted based on rail movements to/from the yard based on the stabling yard usage and air-conditioning noise levels from stabled trains.

Total rail noise levels at the closest receivers east of Ipswich Road from the cumulative effect of the realignment of the Dual Gauge and the addition of Clapham Yard will decrease compared to the existing scenario, chiefly due to the realignment of the Dual Gauge which offsets the new noise sources from the yard itself. Noise levels at surrounding receivers will be below the Project's operational noise criteria.

9.4 Changes to Mitigation Measures

9.4.1 Mayne Yard

The noise contribution from stabling yard operations to the overall rail noise emissions is negligible compared to the noise levels emitted rail traffic noise levels.

9.4.2 Northern Area

The proposed realignment of the Up Exhibition track is predicted to cause an increase of 6 dB at the worst-affected building at Brisbane Girls Grammar School (BGGs), the Sports Centre. Under QR's environmental policy, this would trigger further noise management controls if the BGGs Sports Centre receiver is in fact deemed to be noise-sensitive.

A preliminary noise barrier investigation indicates that a 6 m noise barrier placed at the boundary of the rail corridor would result in a predicted noise barrier attenuation of only 1 dB for the Sports Centre. A 6 m noise barrier would not be effective as this receiver is elevated above the rail corridor and therefore the barrier is not effective at blocking the line of sight to the building.

Further, the northern façade of Sports Centre would not be considered noise-sensitive, since there are no windows on the northern façade and the sports activities are considered less noise-sensitive than teaching activities.

Accordingly, although the Proposed Change would include realignment of the Up Exhibition line causing an increase of 6 dB at the BGGGS Sports Centre, no noise mitigation is considered necessary.

9.4.3 Central / Tunnel Area

A summary of the required extent of Type 1, 2 and 3 trackform is provided in the tables below:

Table 9.5. Extent of Type 1, 2 and 3 trackform required

Down Track			
Approximate Chainage		Distance (m)	Track Type
Start (m)	End (m)		
980	1270	290	Type 1 – SA
1270	1700	430	Type 2 – HA
1700	2305	605	Type 3 – VHA
2305	2655	350	Type 2 – HA
2655	2800	145	Type 1 – SA
2800	3555	755	Type 2 – HA
3555	4320	765	Type 1 – SA
4320	5700	1380	Type 2 – HA
5700	6200	500	Type 1 – SA
6200	6505	305	Type 2 – HA
6505	7750	1245	Type 1 – SA
Total Type 1 – SA		2945	43.5%
Total Type 2 – HA		3220	47.5%
Total Type 3 – VHA		605	9%
Up Track			
Approximate Chainage		Distance (m)	Track Type
Start (m)	End (m)		
980	1270	290	Type 1 – SA
1270	1700	430	Type 2 – HA
1700	2305	605	Type 3 – VHA
2305	2655	350	Type 2 – HA
2655	2800	145	Type 1 – SA
2800	3555	755	Type 2 – HA
3555	4320	765	Type 1 – SA
4320	5700	1380	Type 2 – HA
5700	6200	500	Type 1 – SA

Down Track			
Approximate Chainage		Distance (m)	Track Type
Start (m)	End (m)		
6200	6505	305	Type 2 – HA
6505	7750	1245	Type 1 – SA
Total Type 1 – SA		2945	43.5%
Total Type 2 – HA		3220	47.5%
Total Type 3 – VHA		605	9%

9.4.3.1 Southern Portal

RfPC-1 discussed the predicted noise levels in the Southern Area and the requirement for noise mitigation:

During operation, twelve noise sensitive receptors in the vicinity of the Southern portal are predicted to exceed QR's 65 dBA LAeq(24hour) and 87 dBA Single Event Maximum planning levels. Eleven (11) of the predicted exceedances occur along Railway Terrace and Rawnsley Street and the final exceedance predicted for the ESA Village – Leukaemia Foundation;

There is an existing noise barrier along Railway Terrace, adjacent to the existing rail corridor which varies in height between 4.25m and 5.5m. Increasing the height of this existing noise barrier to 6m (the typically accepted maximum noise barrier height in Queensland) along the full length eliminates four of these predicted exceedances at the southern end of Railway Terrace, by reducing noise levels by up to 8 dBA.

Although the increase in height does reduce rail noise levels at some of the other residences by up to 3 dBA, it is not able to reduce the noise levels to below the planning levels, leaving seven residences along Railway Terrace and Rawnsley Street predicted to exceed the planning levels with the designed noise barrier upgrade. This is due to the elevated track structure near Railway Terrace carrying freight traffic and the topography of the area.

In order to achieve the planning noise levels at all Railway Terrace and Rawnsley Street residences, a 5m noise barrier would be required on the edge of the elevated track structure. This would not be a feasible solution particularly from a civil engineering standpoint due to wind loading design constraints. Further investigation and consultation with affected parties will be required to manage operational rail noise at this location during detailed design.

An exceedance is predicted at the Leukaemia Foundation Building (41 Peter Doherty Street). Due to the size of the building, a noise barrier is not a practical solution for mitigating rail noise as it is not possible to break line-of-sight to the tracks with a noise barrier of no more than 6 m in height. Given the recent construction of the building, it is highly likely that the building has been designed and constructed with noise attenuation measures in the building facade. Determining whether or not this is the case would be the first step in further investigating how to manage operation rail noise at this location.

The acoustic report that formed part of the Development Application for the ESA Village, stated that the façade was to be designed and constructed with an increased building facade performance in order to account for rail noise. Therefore, noise mitigation has been included in the design of this receiver and additional mitigation has not been designed for this receiver.

The effectiveness of the barriers designed for RfPC-1 were modelled for the Proposed Changes. The RfPC-1 noise barriers (which would be an increase in height and length of the existing barriers) are predicted to reduce noise levels at all Railway Terrace receivers to be compliant with Project's operational noise criteria

(with the exception of the ESA village as discussed above). This is an improvement compared to the RfPC-1 modelling under which a residual exceedance was predicted at seven properties.

The reasons for this difference could be related to slightly different noise modelling input assumptions e.g. changes to the predicted future train volumes, train speeds, or fleet mix; as well as the decrease in noise levels associated with the changed portal locations for the Proposed Changes.

9.4.4 Southern Area

9.4.4.1 Dutton Park Station

The existing noise barrier on the eastern side (Tamar, Cope and Samson Streets) will need to be increased to a minimum height of 6m in the majority of the barrier to 4.5m towards the proposed extended platform. The barrier would have a total length of 345m. The existing barrier on the western side also will need to be increased in height. The height would range from 5m to 6m, with a combined total length of 340m. This is shown in Figure 9.7 below.

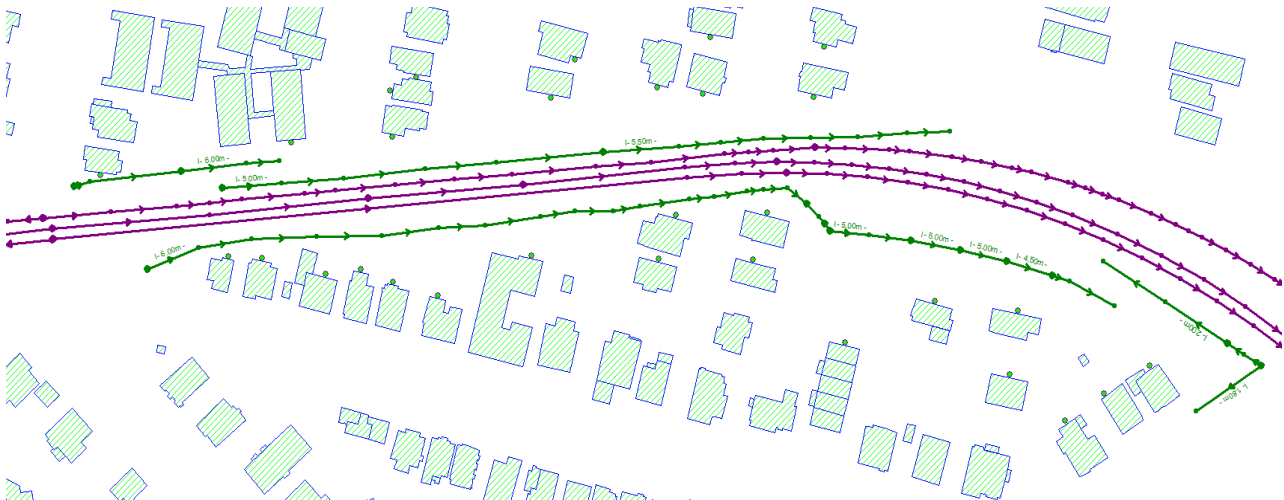


Figure 9.7: Dutton Park Station Noise Barrier

QR's Noise Management Procedure MD-15-317 states that noise barriers shall not be built behind station platforms for safety reasons. A barrier has been provisionally included at the property boundary, including 25m setback from the platform. However, three properties would still have residual exceedances of up to 4 dB of the Project's operational noise criteria even with 6 m height noise barriers. These are:

- 51 Tamar Street
- 53 Tamar Street
- 47 Wilkins Street West

If the barrier described above is deemed to not comply with MD-15-317, a barrier with a section removed near the new platform has also been investigated. This is shown in Figure 9.8 below:

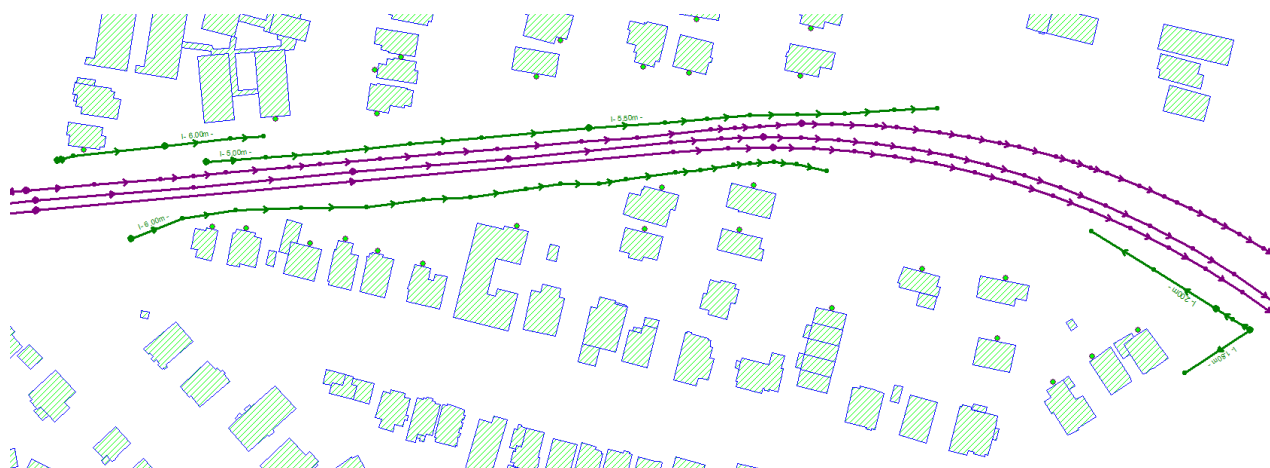


Figure 9.8: Dutton Park Station Barrier - alternative

By removing the section of barrier behind the proposed extended platform, there would be five properties that would still have residual exceedances of up to 4 dB over the Project's operational noise criteria even with 6 m height noise barriers. These are:

- 51 Tamar Street
- 53 Tamar Street
- 8 Cope Street
- 10 Cope Street
- 47 Wilkins Street West

9.4.4.2 Fairfield to Salisbury

The 2011 EIS recommended four noise barriers at Salisbury (Bellvue/Olivia Avenue east), Rocklea (Fairlie Terrace east), Yeerongpilly (Station street east) and Yeronga (Fairfield Road west):

Table 34 Designed Operational Noise Barriers

Noise Barrier	Location	Length (m)	Height (m)	Area (m ²)
1 ¹	South of Salisbury Station	375	6 to 7	2,345
	North of Salisbury Station	214	5	1,070
2	South of Rocklea Station	88	4.5	395
	North of Rocklea Station	43	5	217
3	Yeronga	165	4.5	735
4	Yeerongpilly Station	155	4	625

Note 1: The section of Noise Barrier 1 south of the Salisbury Station (approximately 375 m) replaces an existing noise barrier of 1.5 to 4.5 m in height.

These noise barriers are predicted to no longer be required due to the deletion of the new narrow-gauge line that was proposed in the 2011 EIS, the different design in the vicinity of Yeerongpilly Station (including the retention of Yeerongpilly Station at its existing location) and changes to the predicted future traffic volumes.

Although one exceedance of the Project's operational noise criteria does occur in the vicinity of 2011 EIS Noise Barrier 3 (western side of the rail corridor between the Corinda Line and Cardross Street), the increase in noise levels is less than 1 dB and is not considered a Significant Change and therefore would not justify provision of a noise barrier.

To address the predicted exceedances at receivers on Cook Street and Fairfield Road south of Yeronga Station, the 165m long existing noise barrier on the western side of the rail corridor south of Yeronga Station

(from Nelson Street to Cook Street) would need to be extended to 200m, with a maximum height of 4.5m towards the south. With the extended barrier there would be no exceedances of criteria at this location. This is shown below in Figure 9.9.

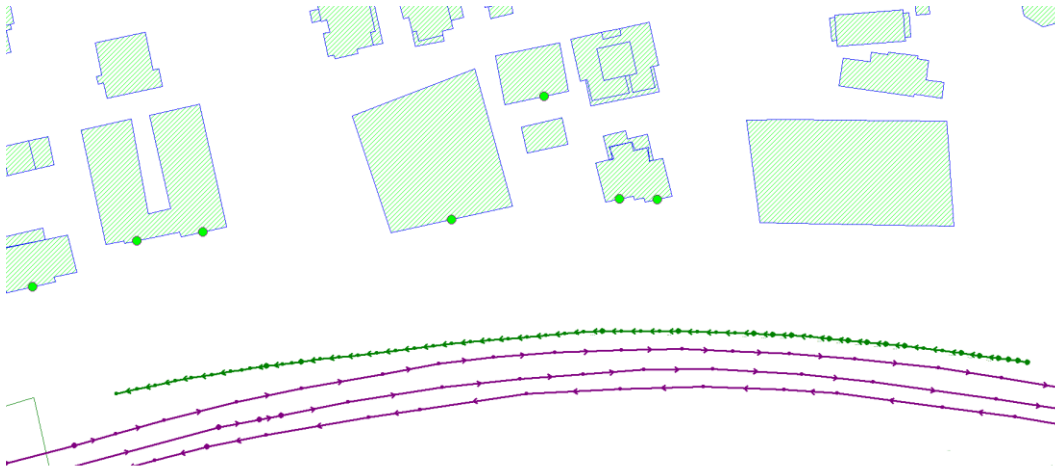


Figure 9.9: Required extent of noise barrier south of Yeronga Station

However, since this exceedance is due to receiver height changes and not due to an increase of more than 3 dB caused by the Proposed Changes (which would trigger additional mitigation in accordance with QR Guidelines), this barrier may not be considered necessary.

9.5 Conclusion

The Proposed Changes will result in changes to the noise and vibration impacts of the project during both construction and operation.

Application of the Coordinator-General's requirements in practice on the project as design changes developed revealed some ambiguities or inconsistencies in the wording of the Coordinator-General's requirements. To address these, proposed revisions to the requirements as relevant to noise and vibration have been drafted and are described in Volume 1.

9.5.1 Mayne Area

The Proposed Changes result in no significant increase in operational noise and vibration impacts during the Mayne Yard area. The realignment of tracks through Mayne Yard and the new Mayne North stabling yard increase noise levels at surrounding receivers compared to the Evaluated Project, but noise levels are underneath the Project's operational noise criteria. Construction noise impacts from Mayne Yard works would result in unmitigated exceedances of up to 10 dB for day works and 18 dB for night works.

9.5.2 Northern Area

Within the Northern Area, the Proposed Changes would result in a negligible change in operational noise levels from Exhibition Station.

Construction noise impacts at Exhibition Station would be as per the Evaluated Project.

An increase in operational noise impacts to Brisbane Girls Grammar School would occur due to the realignment of the Up Exhibition line which decreases the distance between this receiver and the rail noise source. Noise impacts are dominated by freight movements on the realigned Exhibition line rather than noise from the CRR tracks. Construction noise impacts for the Northern Area would be as per the Evaluated Project for trackworks.

9.5.3 Central/Tunnel Area

Operational noise impacts within the Central/Tunnel Area are predicted to comply with the Project's operational noise criteria at all receivers via selection of appropriate low-vibration trackforms.

Construction noise impacts within the Central/Tunnel area will be similar to the Evaluated Project, however there will be changes to the locations of maximum impact due to the changed alignment and relocation of stations.

Unmitigated construction works at Roma Street (including proposed realignment works for the Inner Northern Busway) would result in noise exceedances of up to 14 dB during the day and 27 dB exceedance at night at residential receivers, and exceedances of up to 19 dB at the Supreme Court. This is an increase in impacts compared to the Evaluated Project.

Unmitigated construction works at Albert Street station are predicted to result in exceedances of 15 dB (day) and 28 dB (night) for residential receivers, and exceedances of up to 27 dB for commercial receivers. This is an increase in impacts compared to the Evaluated Project.

Construction noise impacts from the proposed Woolloongabba Station would be substantially similar to the Evaluated Project. An exceedance of up to 1 dB at night is predicted for new bridgeworks associated with Woolloongabba Station.

Construction noise impacts from Boggo Road station would decrease compared to the Evaluated Project due to the reduced extent of cut-and-cover works. The new pedestrian/cyclist bridge works at Boggo Road are predicted to result in exceedances of up to 6 dB during the day and of up to 14 dB at night at surrounding residential receivers; and exceedances of up to 3 dB (day) and 11 dB (night) at the ESA Leukemia Village. The Annerley Road / Peter Doherty Street intersection works are predicted to result in exceedances of up to 16 dB during the day and of up to 24 dB at night at surrounding residential receivers.

Noise and vibration impacts from tunnelling works would result in exceedances of groundborne noise criteria of up to 10 dB for day works and 15 dB for night works. Exceedances of the human comfort vibration criteria are predicted for both day and night works for receivers located between the Pacific Motorway and the Southern Portal, with levels of up to 1 mm/s predicted.

Groundborne vibration exceedances at the Ecosciences Building may occur for construction of the Boggo Road station and tunnel, depending on the location of the sensitive equipment within the Ecosciences building.

Noise levels at the PA Hospital, TRI Building and PACE Building will experience a minor increase due to the realignment of the Southern Portal however noise levels at these receivers are under the Project's operational noise criteria. Construction noise from the revised Southern Portal location would result in exceedances of up to 19 dB (day) and 27 dB (night) at residential receivers, and exceedances of up to 9 dB at the TRI Building.

9.5.4 Southern Area

Within the Southern area, noise impacts are predicted to be substantially as per the Evaluated Project with the exception of Dutton Park Station for which the extent of works has increased. Exceedances of the Project's operational noise criteria occur at nearby receivers however these exceedances are due to existing surface tracks and the contribution from CRR is not significant. The Proposed Changes result in decreases in the contribution of noise from CRR at the worst-affected receivers however no significant reduction in noise impacts would occur because noise levels are dominated by existing surface tracks.

At Dutton Park Station construction noise impacts are predicted to result in exceedances of up to 21 dB (day) and 29 dB (night) at surrounding residential receivers.

9.5.5 Fairfield to Salisbury

The Evaluated Project did not include works in the Fairfield to Salisbury area. Operational noise impacts are generally as per the existing scenario for Salisbury Station and Rocklea Station. Construction noise impacts will increase compared to the EIS because the EIS did not assess the construction of an additional platform face at Rocklea station and did not assess construction noise at Salisbury Station at all.

The Proposed Changes would result in a negligible change in the operational noise level from Fairfield Station. Station construction works are predicted to result in exceedances of up to 25 dB (day) and 33 dB (night) at surrounding residential receivers.

Operational noise levels at Yeronga Station will experience a localised increase at receivers in the vicinity of the new crossover. Marginal exceedances of the Project's operational noise criteria are predicted at two receivers in the absence of noise mitigation. Station construction works are predicted to result in exceedances of up to 24 dB (day) and 32 dB (night) at surrounding residential receivers.

Operational noise levels at Yeerongpilly Station will increase due to the track realignments which decrease the distance between running lines and residential receivers immediately to the east of the station. However no exceedances of the Project's operational noise criteria due to the Proposed Changes are predicted. Residual exceedances at one residence are predicted from existing tracks in the absence of noise mitigation. Station construction works are predicted to result in exceedances of up to 18 dB (day) and 26 dB (night) at surrounding residential receivers. However operational and construction impacts for receivers east of Wilkie Street are decreased compared to the assessment in the 2011 EIS due to the deletion of the proposed new Yeerongpilly Station and southern tunnel portal that were included in the EIS.

Operational noise impacts at Moorooka Station will decrease compared to the existing scenario due to the realignment of the Dual Gauge track which shifts rail movements on this track further away from residential receivers. Construction noise impacts from the construction of the overpass and an additional platform at Moorooka Station are predicted to result in exceedances of up to 6 dB (day) and 14 dB (night) at surrounding residential receivers.

Construction noise impacts at Rocklea Station are predicted to result in exceedances of up to 16 dB (day) and 24 dB (night) at surrounding residential receivers.

Construction noise impacts at Salisbury Station are predicted to result in exceedances of up to 23 dB (day) and 31 dB (night) at surrounding residential receivers.

Operational noise levels from the Clapham Yard stabling facility would be compliant with the Project's operational noise criteria. Clapham Yard construction works are predicted to result in exceedances of up to 5 dB (day) and 13 dB (night) at surrounding residential receivers.

10. Technical Report: Cultural Heritage

10.1 Overview

This technical report has been prepared for the CRR Project to assess the potential changes to impacts to both non-Indigenous heritage and indigenous heritage potentially impacted by the Project and compares the current Evaluated Project. Volume 1 describes the Proposed Changes to the design and delivery of the CRR Project.

10.2 Assessment Methodology

This technical report is informed by searches and targeted field assessment.

Non-Indigenous Heritage

Desktop searches were undertaken using the following heritage listings:

- The National Heritage List and Commonwealth Heritage List (NHL) - places of National and Commonwealth significance;
- Queensland Heritage Register (QHR) - places of State significance;
- BCC Heritage Register (BHR) - places of Local significance; and
- QR Heritage Register (QRHR) – QR heritage places.

Targeted preliminary field assessments of the Evaluated Project and Proposed Changes footprint were completed by a Heritage Consultant to identify any change impact on non-indigenous heritage values. A physical inspection of the four new railway station areas (Boggo Road, Woolloongabba, Albert Street and Roma Street) and existing Exhibition Station was undertaken to verify values and understand current site conditions. The inspection included photography of each key feature within the assessment scope.

A preliminary settlement assessment of the proposed RfPC alignment was undertaken to identify predicted settlement and associated impacts of the works upon existing infrastructure. Details of potential settlement risks and related mitigation measures is provided in Technical Report 2 (Land). Details of vibration assessment conducted on the proposed changed alignment is provided in Technical Report 8 (Noise and Vibration).

Indigenous Cultural Heritage

A Cultural Heritage Management Plan (CHMP) is mandatory under Part 7 of the *Aboriginal Cultural Heritage Act 2003* (ACH Act) whenever an EIS is required. A formal CHMP under Part 7 of the ACH Act establishes a statutory process for addressing cultural heritage with certainty. A CHMP is a State-approved agreement between the land user and the Aboriginal party(ies) of the area and identifies how project activities must be managed to avoid harm to Indigenous cultural heritage or to minimise harm where avoidance is not reasonably practicable.

CHMPs are being prepared, in consultation with the two nominated Aboriginal Parties, for the Project's EIS study corridor including a plan area that cover the currently Evaluated Project footprint and Proposed Changes subject of RfPC-4. The CHMPs, once agreed by the Aboriginal Parties, will be issued to the Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP) for approval.

10.3 Changes to Potential Impacts

10.3.1 General Impacts

As identified in the Evaluated Project assessment, the potential adverse heritage impacts may result from one or both of the following:

- A potential impact on the visual setting of a known heritage place due to the introduction of unsympathetic built form in its proximity; and/or
- A potential adverse impact on the physical fabric of a known heritage place as a result of disturbance of groundcover, increased vibration and/or settlement caused by the construction works.

Heritage places identified as having potential for adverse heritage impacts from the current Evaluated Project that are still within the zone of influence for the RfPC-4 project alignment are listed in Table 10.1.

Table 10.1. Heritage places previously identified within or adjacent to the Evaluated Project

Place	Address	Heritage Register Listing
Heritage structures of RNA Showgrounds	600 Gregory Terrace	QHR, BHR
Victoria Park	454 Gregory Terrace	QHR, BHR
Brisbane Girls Grammar School	70 Gregory Terrace	BHR
Brisbane Grammar School	24 Gregory Terrace	QHR, BHR
Kelvin Grove Road - fig trees and air raid shelter (landscape precinct)	140A Kelvin Grove Road	QHR, BHR
The Normanby Hotel	1 Musgrave Road	QHR, BHR
Hardgrave Park	155 Petrie Terrace	BHR
'Shawn' Apartments	172 Petrie Terrace	BHR
Paslewydd	176 Petrie Terrace	BHR
Princes Row	190-198 Petrie Terrace	BHR
'O'Keeffe's Buildings	226, 228 and 230 Petrie Terrace	BHR
Illawarra Mansions	242-246 Petrie Terrace	BHR
Florence House	256 Petrie Terrace	BHR
Petrie Terrace Police Barracks (Paddington Barracks) (former)	Petrie Terrace	QHR
Victoria Barracks	Petrie Terrace	NHL, BHR
Countess Street Rail Bridge abutments	Countess Street	BHR
Countess Street Rail Bridge	Countess Street	BHR, QRHR
Roma Street Railway Station	Brisbane City	QHR, BHR, QRHR

Place	Address	Heritage Register Listing
Roma Street Platform Shelter	Brisbane City	QHR, BHR, QRHR
Transcontinental Hotel	462-468 George Street	QHR, BHR
The former baby clinic	51 Herschel Street	BHR
Former Bank of Queensland	458-460 George Street	BHR
Brisbane Fruit and Produce Market	71-97 Turbot Street	BHR
Early Streets of Brisbane	Charlotte Street and Albert Street intersection	QHR, BHR, Brisbane CBD Archaeological Plan
Albert Street Uniting Church	319 Albert Street	QHR, BHR
Former Queensland Deposit Bank	245 Albert Street	BHR
King George Square	Brisbane City	BHR
Brisbane City Hall	64 Adelaide Street	QHR, BHR
William Cairncross Building	188-196 Albert Street	BHR
Perry House/Royal Albert Apartments/Hotel	167 Albert Street (corner Elizabeth Street)	QHR, BHR
Brisbane Botanic Gardens	Brisbane City	QHR, BHR
Residence - 'Rineston'	56 Llewellyn Street	BHR
Residence - 'Doonholm'	23 Walmsley Street	BHR
St Joseph's complex, Leopard Street (church, school and presbytery)	36 Leopard Street 44 Leopard Street 88 Lockerbie Street	BHR
Semi Detached Residences	38 Mark Lane	BHR
St Nicholas Russian Orthodox Cathedral	330-334B Vulture Street	QHR, BHR
The former Woolloongabba Police Station	842-848 Main Street	QHR, BHR
The former Woolloongabba Post and Telegraph Office	765 Stanley Street	QHR, BHR
The former RAOB Hall	1 Hubert Street	BHR
The Chalk Hotel	735 Stanley Street	BHR
Boggo Road Gaol	150 Annerley Road	QHR, BHR
Dutton Park Platform Shelter	Dutton Park Station	QRHR

There are several State and Local heritage listed places surrounding the additional construction work area that were not identified during previous assessments. Table 10.2 lists out 40 additional heritage places within

and adjacent to the proposed alignment. Based on the settlement and vibration risks identified during preliminary settlement and vibration assessment along the proposed RfPC-4 alignment, a buffer of 50m was applied to identify adjacent heritage places to determine potentially impacted properties.

Table 10.2. Additional heritage places

Place	Address	Lot on Plan	Heritage Register Listing	Evaluated Project	Change in Impact
Mayne Area (including North of Breakfast Creek)					
Breakfast Creek Rail Bridge (Warren Truss Bridge)	Breakfast Creek – North of Mayne Yard	Lot 105 on SP261952 Lot 51 on SP122218	QRHR	No impacts identified	Within the project footprint. This bridge is no longer used and will be demolished as part of the Project. Detailed heritage assessment and archival recording required prior to demolition of Warren Truss Bridge.
Northern Area					
Tufton House	8 Tufton Street	Lot 8 on RP94274	BHR	No impacts identified	Immediately adjacent to the project footprint. Temporary air quality impacts from construction work. No direct impact likely.
Old Museum Building	480 Gregory Terrace	Lot 661 on SP238193	QHR BHR	No impacts identified	Immediately adjacent to the project footprint. Temporary air quality impacts from construction work. Vibration levels are likely to be below the heritage threshold of 2 mm/s. No vibration or settlement impact predicted from Exhibition Station works.
Bowen Bridge and approach walls	At Bowen Bridge Road (between Gregory Terrace and Herston Road)	Road Reserve	BHR	No impacts identified	Adjacent to the project footprint, likely reduced direct impacts with less construction works and duration.
New Zealand Loan and Mercantile Agency Company Woolstore (former)	10, 10A and 14 Bowen Bridge Road	Lot 32 on SP232285 Lots 496 and 691 on SL12309	BHR	Feeder Station proposed at this location	Partially within the project footprint. Queensland Rail storage shed will be demolished for construction of Feeder Station, consistent with the current Evaluated Project impact. Biomedical Technology Services (BTS) building will be demolished for construction access and laydown area. Detailed heritage assessment and archival recording required prior to demolition of these buildings.
Central Area					
Albert Street Station to Roma Street Station					
Brisbane Dental	168 Turbot Street	Lot 86 on SP169883	QHR		Adjacent to the project footprint. The estimated surface vibration is less than

Hospital and College			BHR	No impacts identified	0.5mm/sec. Less than 5mm ground settlement is predicted at these sites. No vibration or settlement impact predicted from station and tunnelling works.
Ann Street Presbyterian Church	141 Ann Street	Lot 101 on SP253299	QHR BHR		
Wheat Creek Culvert (underground)	Adelaide and Albert Streets	Road reserve	BHR		
Early Streets of Brisbane	Adelaide Street and Albert Street intersection	Road reserve	QHR BHR		
Early Streets of Brisbane	Burnett Lane	Road reserve	QHR BHR		
OK Building (former)	117 Queen Street	Lot 1 on SP140690	BHR		
Gaujard and Elson Building (former)	125 Queen Street	Lot 5 on RP516	BHR		
Beak House (former)	127-127A Queen Street	Lots 1 and 2 on RP517	BHR		
Federal Deposit Bank (former)	115 Queen Street	Lot 1 on RP218420	BHR		
Allan and Stark (former) (Miss Brisbane)	110 Queen Street	Lot 1 on RP886307	QHR BHR		
Place	Address	Lot on Plan	Heritage Register Listing	Evaluated Project	Change in Impact
Rutter and Sons (former)	114 Queen Street	Lot 21 on B3153	QHR BHR	No impacts identified	Adjacent to the project footprint. The estimated surface vibration is less than 0.5mm/sec. Less than 5mm ground settlement is predicted at these sites. No vibration or settlement impact predicted from station and tunnelling works.
Love's Auction Mart (former)	116 Queen Street	Lot 12 on B3149	QHR BHR		
Regent Building	167 Queen Street	Lot 2 on RP49018	QHR BHR		
Brisbane Arcade	160 Queen Street	Lots 3 and 4 on RP671	QHR BHR		
Barry and Roberts Building/York	91 Queen Street	Lot 41 on RP218420	BHR		

Hotel/Hotel Carlton/Telegraph Building					
Edwards and Chapman (former)/Sportsgirl	120 Queen Street	Lots 13-14 and 23 on B3153	QHR BHR		
George Weston and Son's Workshop (former)	42 Charlotte Street	Lot 4 on RP613	BHR		
Albert Street Station					
Mooney's Building	130 Mary Street	Lot 504 on B118215	QHR BHR	No impacts identified	Adjacent to the project footprint. The estimated surface vibration is less than 0.5mm/sec. Less than 5mm ground settlement is predicted at this site. No vibration or settlement impact predicted from station works.
Woolloongabba Station to Albert Street Station					
Watson Brothers Building	129 Margaret Street	Lot 12 on B118229	QHR BHR	No impacts identified	Adjacent to the project footprint. The estimated surface vibration is less than 0.5mm/sec. Less than 5mm ground settlement is predicted at this site. No vibration or settlement impact predicted from tunnelling works.
Kangaroo Point Cliffs	Kangaroo Point	Lot 223 on SL5130 Lot 236 on SL1009	QHR BHR	No impacts identified	Adjacent to the project footprint. The estimated surface vibration is less than 0.5mm/sec. Less than 10mm ground settlement is predicted at this site.
Place	Address	Lot on Plan	Heritage Register Listing	Evaluated Project	Change in Impact
Boggo Road Station to Woolloongabba Station					
Masonry Flats	52 Hawthorne Street	Lot 9 on RP12214	BHR	No impacts identified	Adjacent to the project footprint. The estimated surface vibration is less than 0.5mm/sec. Less than 5mm ground settlement is predicted at this site. No vibration or settlement impact predicted from tunnelling works.
Dutton Park Station					

Hefferan Park air raid shelter and bus shelter	260 Annerley Road	Lot 1 on RP806368	QHR BHR	No impacts identified	Adjacent to the project footprint. The estimated surface vibration is less than 0.5mm/sec. No vibration or settlement impact predicted from station works.
Southern Area					
Fairfield Passenger Station	Fairfield Station	Lot 440 on SP117129	QRHR	No works proposed	Within the project footprint. Existing station building will be demolished and replaced with new station building.
Fairfield Platform Shelter	Fairfield Station	Lot 440 on SP117129	QRHR		Within the project footprint. Existing platform will be raised to the new platform height and shelter will be reinstated and retained onsite.
Fairfield Footbridge	Fairfield Station	Lot 440 on SP117129	QRHR		Within the project footprint. Footbridge will be removed to allow for an integrated pathway for independent access.
Residential - 19 th Century Residence	25 Belfast Street	Lot 2 on RP70935	BHR	No works proposed (no impacts identified from tunnel works in 2011 EIS)	Adjacent to the project footprint. No vibration or settlement impact predicted from track works.
Residential - 19 th Century Residence	6 Dublin Street	Lot 3 on RP62831	BHR		
Residential - 19 th Century Residence	5 Dublin Street	Lot 6 on RP75334	BHR	No works proposed (no impacts identified from tunnel works in 2011 EIS)	Adjacent to the project footprint. No vibration or settlement impact predicted from station works.
Residential - 19 th Century Residence	10 Killarney Street	Lot 1 on RP72498 Lots 15 and 10 on RP37757	BHR		
Place	Address	Lot on Plan	Heritage Register Listing	Evaluated Project	Change in Impact
Yeronga overpass (footbridge)	Yeronga Station	Lot 550 on SP117131	BHR QRHR	No works proposed	Within the project footprint. Footbridge will be removed to allow for an integrated pathway for independent access.
Yeerongpilly Passenger Station	Yeerongpilly Station	Lot 550 on SP117131	QRHR	No works proposed (minor construction impacts identified in 2011 EIS)	Within the project footprint. Existing station building will be demolished and replaced with new station building as a result of raising the existing platform height.

Rocklea Platform Shelter	Rocklea Station	Lot 10 on SP122190	BHR QRHR	No works proposed (no major impacts to the existing station fabric as assessed in 2011 EIS)	Within the project footprint. Existing platform will be raised to the new platform height and shelter will be reinstated and retained onsite.
Rocklea Footbridge	Rocklea Station	Lot 10 on SP122190	BHR QRHR		Within the project footprint. Footbridge will be removed to allow for an integrated pathway for independent access.
Salisbury Passenger Station	Salisbury Station	Lot 12 on SP122191	BHR QRHR	No works proposed (no major impacts to the existing station fabric as assessed in 2011 EIS)	Within the project footprint. Existing station building will be demolished and replaced with new station building as a result of raising the existing platform height.
Salisbury Footbridge (Timber)	Salisbury Station	Lot 12 on SP122191	BHR QRHR		Within the project footprint. Footbridge will be removed to allow for an integrated pathway for independent access.

10.3.2 Mayne Area

There is one additional heritage listed site within Mayne area that has not been previously assessed and is shown in Figure 10.1.

A new bridge will be constructed over Breakfast Creek approximately 50m west of the existing bridges. This bridge work will be within QR corridor. The existing heritage listed Breakfast Creek Rail Bridge (Warren Truss Bridge) is no longer used and will be demolished as part of the CRR Project. As part of the previous Queensland Rail Breakfast Creek Suburban Bridge Replacement Project, a multi-criteria analysis (MCA) was conducted by WSP in conjunction with Queensland Rail and other key stakeholders to determine a preferred option for upgrade of the structure. This assessment determined that there was no prudent or feasible alternative to the demolition of the structure and an Exemption Certificate was issued by the Queensland Rail Heritage Committee in relation to its removal. Demolition of this bridge will now form part of the Cross River Rail Project, with a new rail bridge now proposed to the west of existing bridges over the creek.

Additional works within rail corridor to the north of Albion Road overpass will also include overhead line equipment (OHLE) and signalling modification works. All OHLE works will generate negligible ground-borne vibration and therefore minimal risk of impacting on heritage structures.

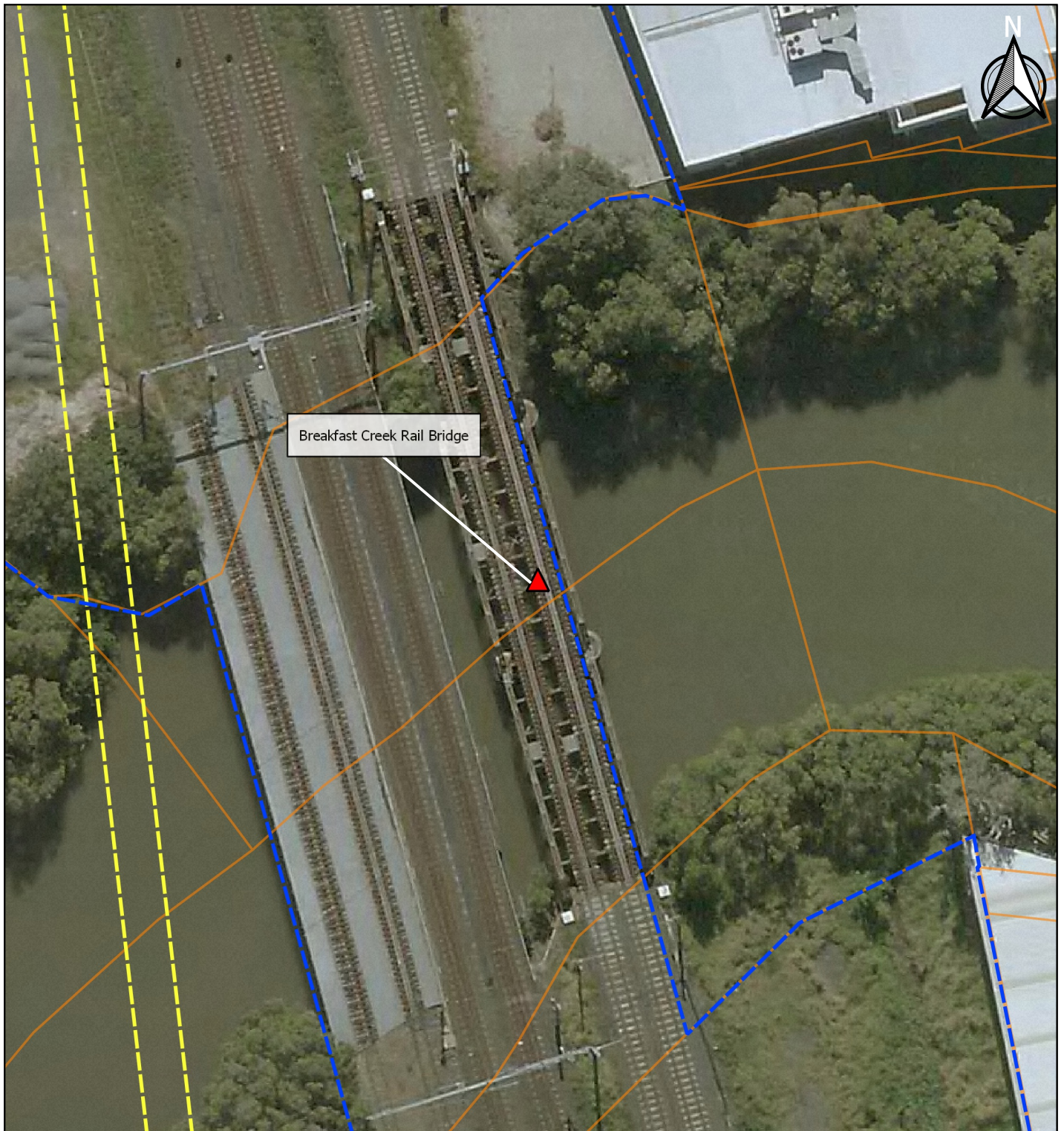


Figure 10.1

Mayne Area

Legend

 QR Heritage Register	 Rail Corridor Boundary	 Cut And Cover Structure	 Cross Passage
 BCC Heritage Register	 Existing Road	 Trough Structure	 Temporary Adit/Cavern
 Queensland Heritage Register	 New Surface Platform	 TBM Tunnel	 Existing Standard Lot
 CRR Track	 Existing Surface Platform	 Mined Tunnel	
		 Station Cavern	

10.3.3 Northern Area

The proposed RfPC-4 alignment north of Northern Portal is mostly along the current Evaluated Project alignment. There are four additional heritage listed sites within this area that have not been previously assessed. Additional heritage sites in the vicinity of Northern Area are shown in Figure 10.2.

The previous Evaluated Project considered vibration impacts to the heritage buildings at the RNA Showgrounds and concluded that no exceedances of the 2 mm/s heritage vibration criteria would occur. The offset distance between the updated Exhibition Station and the Old Museum is greater than the distance between the base case Exhibition Station and the RNA showgrounds buildings. Accordingly, vibration levels at the Old Museum are likely to be below the heritage threshold of 2 mm/s. There will be a reduction in construction impacts to surrounding heritage places to the Exhibition Station with the reduced intensity of works from having a station upgrade rather than a new station constructed. These places included:

- The various RNA showground heritage elements (nine in total);
- Old Museum; and
- Reduced impact on the heritage underpass.

However, any vibration-intensive works occurring within 10 m of a heritage building (including RNA and the Old Museum) should be accompanied by pre-construction condition surveys and monitoring during construction.

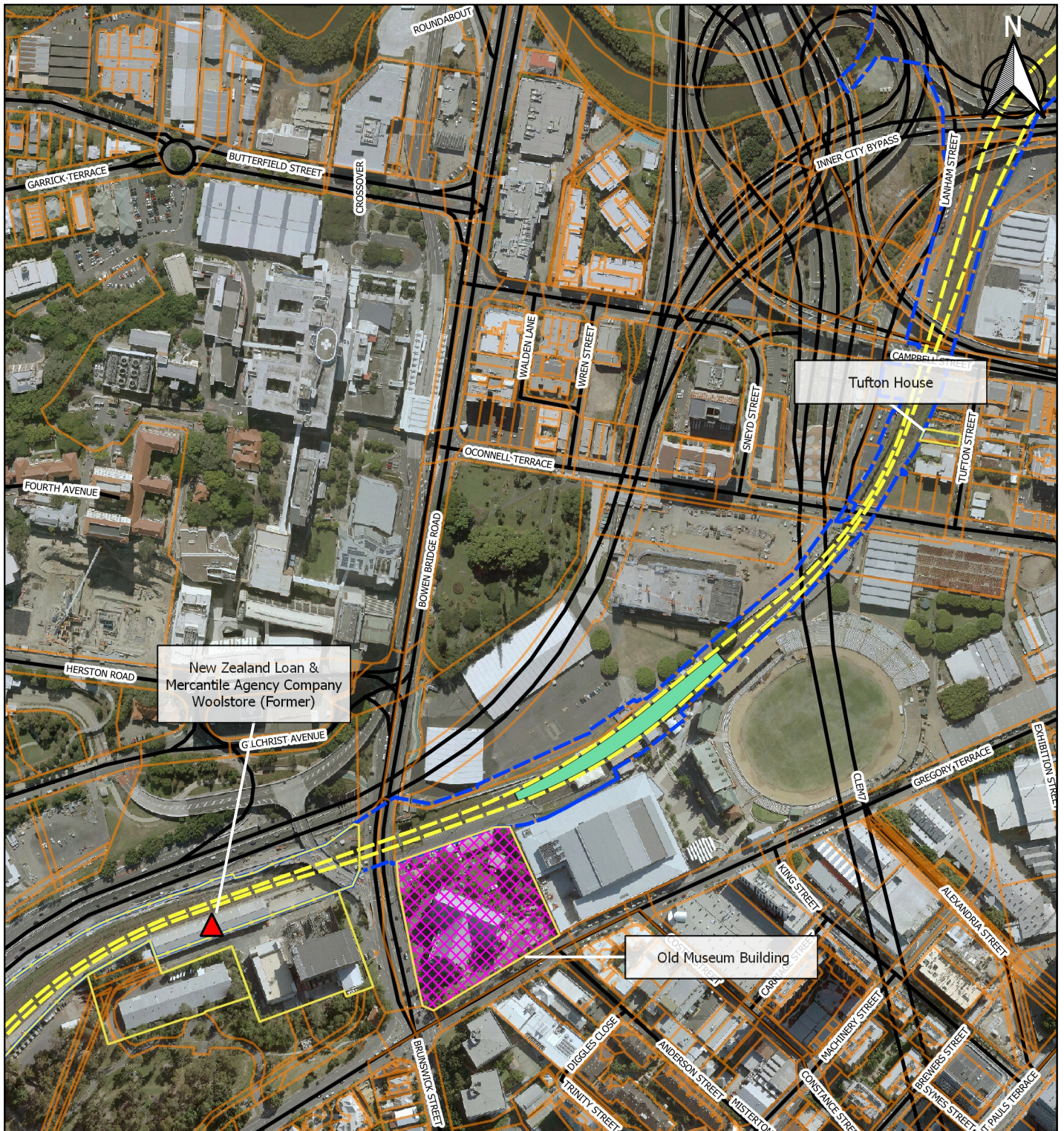


Figure 10.2

Northern Area

Legend

	QR Heritage Register		Rail Corridor Boundary		Cut And Cover Structure		Cross Passage
	BCC Heritage Register		Existing Road		Trough Structure		Temporary Adit/Cavern
	Queensland Heritage Register		New Surface Platform		TBM Tunnel		Existing Standard Lot
	CRR Track		Existing Surface Platform		Mined Tunnel		
			Station Cavern				

Victoria Park

The Proposed Changes to the construction access will directly impact the local heritage listed site, the former New Zealand Loan and Mercantile Agency Company Woolstore, which is now used as the Queensland Health's Biomedical Technology Services (BTS) building. This building is contained on the Brisbane City Council local heritage register. The New Zealand Loan & Mercantile Agency Ltd provided investment and loan of monies, it was heavily involved in the wool industry and established this woolshed circa 1909, adjacent to other woolsheds in Victoria Park. These woolsheds were located on the Exhibition branch railway and during World War I (WWI) wool was stockpiled by the Commonwealth Government in the Victoria Park sheds, for use in the war effort. In World War II (WWII), the RAAF took over the stores as part of its Transportation and Movements Office.

Demolition of the former Woolstore building is an additional impact to heritage values not previously assessed. Detailed heritage assessment and archival recording will be completed prior to demolition of these buildings.

The Queensland Rail storage shed, a QR heritage listed site, will be demolished for construction of Feeder Station, consistent with the Evaluated Project impact.

There will also be a slight increase in impacts to the State listed Victoria Park heritage values with the changed construction access and increased traffic volumes predicted. These impacts will be temporary during the construction period.

There is no significant change to the Northern Portal structure design compared to the reference project and as such the vibration impacts from Northern Portal construction would be as per the Evaluated Project.

10.3.4 Central Area

There are 22 additional heritage listed sites within Central area that have not been previously assessed and suitable mitigation measures not proposed. Additional heritage sites in the vicinity of Central Area are shown in Figures 10.3 - 10.5.



Figure 10.3

Central Area (Brisbane CBD)

Legend

QR Heritage Register	Rail Corridor Boundary	Cut And Cover Structure	Cross Passage
BCC Heritage Register	Existing Road	Trough Structure	Temporary Adit/Cavern
Queensland Heritage Register	New Surface Platform	TBM Tunnel	Existing Standard Lot
CRR Track	Existing Surface Platform	Mined Tunnel	
	Station Cavern		

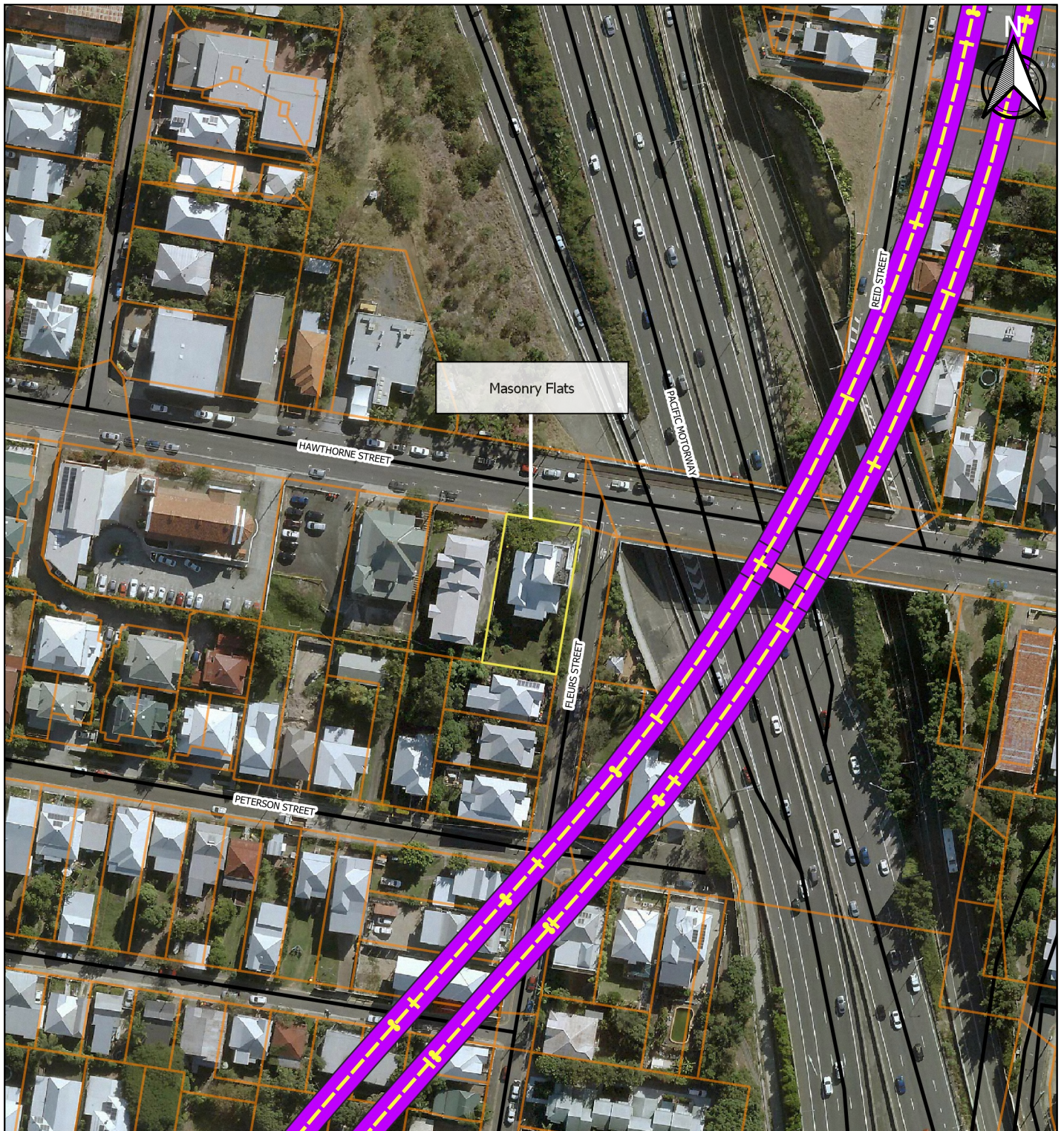


Figure 10.4

Central Area (Boggo Road Station to Woolloongabba Station)

Legend

QR Heritage Register	Rail Corridor Boundary	Cut And Cover Structure	Cross Passage
BCC Heritage Register	Existing Road	Trough Structure	Temporary Adit/Cavern
Queensland Heritage Register	New Surface Platform	TBM Tunnel	Existing Standard Lot
CRR Track	Existing Surface Platform	Mined Tunnel	
	Station Cavern		

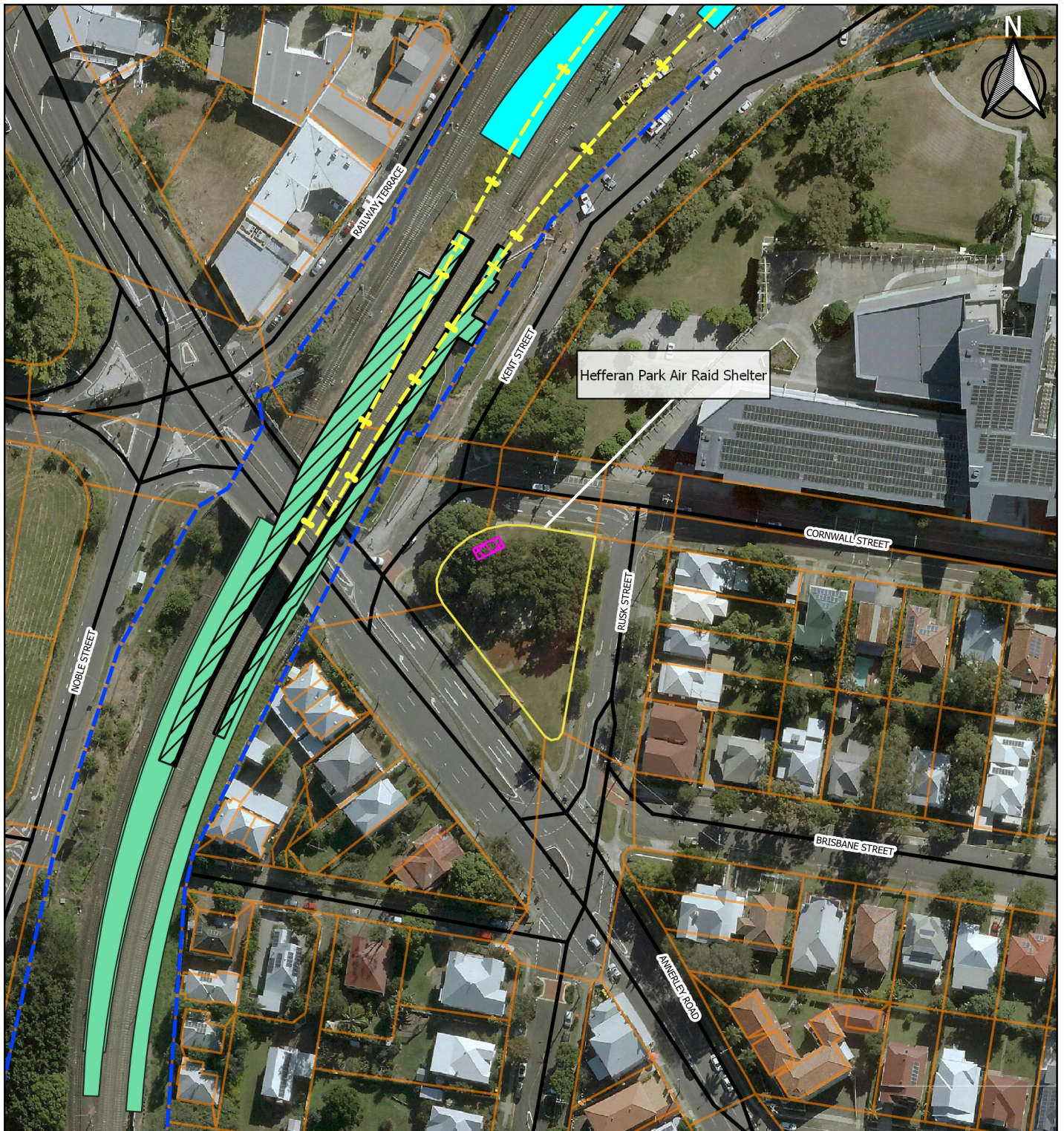


Figure 10.5

Central Area (Dutton Park Station)

Legend

- | | | | |
|------------------------------|---------------------------|-------------------------|-----------------------|
| QR Heritage Register | Rail Corridor Boundary | Cut And Cover Structure | Cross Passage |
| BCC Heritage Register | Existing Road | Trough Structure | Temporary Adit/Cavern |
| Queensland Heritage Register | New Surface Platform | TBM Tunnel | Existing Standard Lot |
| CRR Track | Existing Surface Platform | Mined Tunnel | |
| | Station Cavern | | |

Potential Settlement Impacts

Preliminary settlement analysis indicates settlement to be less than 10 mm above mined tunnels and up to 30 mm above the station caverns. This is less than the 0-50 mm of settlement estimated in the previous Evaluated Project due to improved Tunnel Boring Machine (TBM) technology. However, settlement above the Boggo Road Cavern has been predicted to be up to 60mm.

A preliminary surface settlement impact assessment of the project alignment identified only one heritage listed building, Roma Street Station, or structure within the zone of influence resulting in a slight risk of settlement-induced damage. This is significantly less than the number identified within the previous Evaluated Project designs.

Other indirect impacts are from traffic and dust generation from construction activities in the central area, however, compared to the Evaluated Project the mined cavern construction method will reduce these impacts from the current box cut excavation station methodology proposed.

Roma Street Station

The proposed Roma Street Station is now moved under the existing heritage listed station. The maximum surface settlement at Roma Street station is expected to be in the range of 0-50 mm, which is higher than 20-25 mm estimated for the Evaluated Project. Existing Roma Street Station building is identified with a 'Slight Risk' of damage which will require settlement monitoring.

The opening of the visual line of sight through the station plaza design increases views and amenity opportunities of the heritage value providing beneficial value.

Roma Street Section of the Inner Northern Busway (INB) Relocation

The proposed Roma Street section of the INB relocation will be an underground cut and cover tunnel generally parallel with Roma Street, at the southern edge of the Brisbane Transit Centre (BTC) site. The heritage impact will be no worse than the current Evaluated Project as the alignment runs between heritage listed Transcontinental Hotel and Roma Street Railway Station.

Albert Street Station to Roma Street Station

The new tunnel alignment in this section now follows Queensland Rail alignment at the corner of Roma Street and Albert Street, thus resulting in reduced impact on the heritage listed sites along George Street, Turbot Street and Hershel Street. The alignment is now closer to Albert Street Uniting Church, Brisbane Dental Hospital and College, Brisbane School of Arts, Ann Street Presbyterian Church and the Old Wind Mill on Wickham Terrace.

There is a reduced settlement impact in this section from TBM running tunnels with estimated settlement of 0-10 mm as compared to 0-25 mm for the Evaluated Project.

The indicative ground-borne vibration from TBM excavation in this section is under 0.5 mm/s for the Changed Project, as compared to 0.3 to 0.7 mm/s for the previous Evaluated Project.

Albert Street

An additional location 54m north-west along the alignment towards Roma Street is proposed in addition to Albert Street Station. This will require additional demolition works at 142 Albert Street to allow construction of a new northern entrance. The station construction methodology has changed from a central shaft cut and cover with mined cavern extensions to a fully mined cavern construction. The changed construction method

eliminates the cut and cover box, reducing volume of excavation, surface construction area, impacts and avoids interface with utilities.

The predicted settlement of 0-50 mm from Albert street station works is consistent with the current Evaluated Project.

Groundborne vibration levels from station excavation on the northern 142 Albert Street cavern are predicted to reach a maximum vibration level of 0.77 mm at nearby receivers.

Woolloongabba Station to Albert Street Station

Alignment changes in this section has eliminated a number of heritage-listed sites compared to the Evaluated Project alignment by avoiding tunnelling under St Nicholas Russian Orthodox Cathedral, three semi-detached houses at 38 Mark Lane, and the residence 'Doonholm' at 23 Walmsley Street. The proposed alignment now runs under the heritage listed residential site 'Rineston' at 56 Llewellyn Street and is closer to the St Joseph's complex (School, Church and Presbytery).

The predicted settlement in this section from TBM running tunnels is consistent with the current Evaluated Project.

The estimated ground-borne vibration from TBM excavation in this section is under 0.5 mm/s along the changed project, well below the established heritage threshold of 2 mm/s.

Woolloongabba Station

The location of the CRR Woolloongabba Station is proposed to shift approximately 70m west to allow for future integration with Brisbane Metro. The surface station building is also located further to the west on the former GoPrint site. There is no material change in construction methodology of the station itself, with a central cut-and-cover station box and mined station tunnels. The change in station location will reduce any potential vibration and settlement impacts to the former Woolloongabba Police Station, as compared to the current Evaluated Project.

The predicted settlement from mined station tunnel at this site is increased from 10-25 mm in 2016 Project to 10-50 mm, resulting in reduced overall impact on heritage sites surrounding the station area.

Boggo Road Station to Woolloongabba Station

With the change in location of Woolloongabba Station towards west of the Evaluated Project location, the proposed tunnel alignment near Woolloongabba Station is now moved towards 70m west of existing alignment. This has resulted in reduced vibration levels from curving and hence reduced impact on non-indigenous cultural heritage by avoiding tunnelling under heritage listed Former Woolloongabba Post Office, Brisbane Associated Friendly Society (BAFS) Dispensary and Royal Antediluvian Order of Buffaloes Lodge Hall. However, the alignment now runs under the local heritage listed site (Former Chalk Hotel), resulting in reduced overall impact in this section compared to the authorised impacts.

The predicted settlement in this section from mined tunnel is between 0-20 mm, with reduced impact compared to 15-30 mm for the current Evaluated Project.

The estimated ground-borne vibration from TBM excavation in this section is under 0.5 mm/s along the changed project, compared to 0.1 to 0.2 mm/s for the Evaluated Project resulting from a mined tunnel construction method.

10.3.5 Southern Area

The alignment to the south of Dutton Park Station is within rail corridor previously assessed as part of the 2011 EIS. There are 13 additional heritage listed sites within Southern area that has not been previously assessed and suitable mitigation measures were not proposed. Additional heritage sites in the vicinity of Southern Area are shown in Figures 10.6 - 10.9.



Figure 10.6

Southern Area (Fairfield Station)

Legend

	QR Heritage Register		Rail Corridor Boundary		Cut And Cover Structure		Cross Passage
	BCC Heritage Register		Existing Road		Trough Structure		Temporary Adit/Cavern
	Queensland Heritage Register		New Surface Platform		TBM Tunnel		Existing Standard Lot
	CRR Track		Existing Surface Platform		Mined Tunnel		
					Station Cavern		



Figure 10.7

Southern Area (Yeronga and Yeerongpilly Stations)

Legend

- | | | | |
|------------------------------|---------------------------|-------------------------|-----------------------|
| QR Heritage Register | Rail Corridor Boundary | Cut And Cover Structure | Cross Passage |
| BCC Heritage Register | Existing Road | Trough Structure | Temporary Adit/Cavern |
| Queensland Heritage Register | New Surface Platform | TBM Tunnel | Existing Standard Lot |
| CRR Track | Existing Surface Platform | Mined Tunnel | |
| | Station Cavern | | |



Figure 10.8

Southern Area (Rocklea Station)

Legend

 QR Heritage Register	 Rail Corridor Boundary	 Cut And Cover Structure	 Cross Passage
 BCC Heritage Register	 Existing Road	 Trough Structure	 Temporary Adit/Cavern
 Queensland Heritage Register	 New Surface Platform	 TBM Tunnel	 Existing Standard Lot
 CRR Track	 Existing Surface Platform	 Mined Tunnel	
	 Station Cavern		



Figure 10.9

Southern Area (Salisbury Station)

Legend

	QR Heritage Register		Rail Corridor Boundary		Cut And Cover Structure		Cross Passage
	BCC Heritage Register		Existing Road		Trough Structure		Temporary Adit/Cavern
	Queensland Heritage Register		New Surface Platform		TBM Tunnel		Existing Standard Lot
	CRR Track		Existing Surface Platform		Mined Tunnel		
			Station Cavern				

Boggo Road Station

The construction methodology for this station remains a predominantly cut and cover. However, due to the lowering of the Boggo Station vertical alignment, a mined cavern method is now proposed for the northern end of the station instead of cut and cover. The ground-borne vibration in this section is predicted to be less than the previous Evaluated Project.

There is no settlement impact predicted at the Boggo Road Gaol considering there is only 0-20mm settlement predicted at the Eco-Sciences building which is closer to the construction site compared to the Gaol.

Ground-borne vibration level at heritage listed Boggo Road Gaol is predicted to be well below the established heritage threshold of 2 mm/s. The maximum vibration level at the EcoSciences building which is very close to the proposed Station is predicted to be 0.13 mm/s.

Dutton Park Station to Salisbury Station

The alignment to the south of Dutton Park Station is within rail corridor previously assessed as part of the 2011 EIS.

There is no vibration impact predicted at the heritage sites from track works along this section of the project. Structural changes proposed for stations in this section of the corridor include raised platforms, new third platforms, new station buildings at all stations and new footbridges. These works are expected to result in minor impacts to the existing station fabric.

10.3.6 Mitigation Measures

Mitigation measures for indigenous cultural heritage have been identified in the Project's CHMP. Non-indigenous heritage management is identified in the Outline Non-Indigenous Cultural Heritage Management Plan.

Mitigation Measures which are currently being implemented, include:

- Ongoing consultation with the Queensland Heritage Council, Department of Environment and Science (DES), RNA and Heritage Consultant to address heritage impacts within various State listed sites;
- Arborist assessments have been completed for RNA fig trees;
- Preliminary operational groundborne noise and vibration modelling has been undertaken for CRR operations with a 'no exceedance' of Heritage building vibration criteria identified;
- Preliminary settlement analysis has been undertaken for Tunnel construction and monitoring proposed for six (6) heritage-listed places where predictive modelling indicates settlement may be likely; and
- Development of a Project Archaeological Management Plan (AMP), which has been prepared in consultation with the DES Heritage and Archaeological Unit, to manage potentially archaeological artefacts that are uncovered during the construction phase of the Project.

Mitigation Measures which are consistent with the Evaluated Project:

- Comprehensive geotechnical and groundwater investigations to be undertaken to confirm subsurface conditions and verify locations of potential settlement impacts;

- Where predictive modelling indicates settlement risk classification is slight (10-50mm) or greater, further detailed assessment is required and detailed design and construction planning is to incorporate measures to limit settlement;
- Ensure that any impacts to the heritage properties are avoided or minimised where possible through design solutions during detailed design;
- Manage unavoidable heritage impacts through Heritage Management Plans to preserve history;
- Undertake archival (photographic) or 3D photogrammetry recording before any accepted impacts occur;
- Where required, temporary fencing or other barricading during construction works to minimise risk of inadvertent heritage impacts;
- An Archaeological Management Plan will be developed and endorsed by the Department of Environment and Science (DES) for identification and management of potential subsurface archaeological features and deposits across the Project area; and
- Where there is development on a Queensland heritage place as part of the Project, this will be managed through the assessment processes identified in section 69 of the *Cross River Rail Delivery Authority Act 2016* and section 71 of the *Queensland Heritage Act 1992*.
- For settlement, a summary of mitigation measures is further detailed in Section 3: Technical Report – Soils, Geology and Geomorphology.

Table 10.3. Mitigation measures for RfPC-4

Place	Address	Heritage Register Listing	Mitigation measures for RfPC-4
Breakfast Creek Rail Bridge (Warren Truss Bridge)	Breakfast Creek – North of Mayne Yard	QRHR	Detailed heritage assessment and archival recording required prior to demolition of Warren Truss Bridge.
Heritage structures of RNA Showgrounds	600 Gregory Terrace	QHR BHR	Consult with the RNA and suitably qualified heritage consultant regarding detailed impact assessment and mitigation measures. Address heritage impacts during detailed design. Consult an arborist in relation to fig tree relocation. (measures are consistent with the Evaluated Project)
Old Museum Building	480 Gregory Terrace	QHR BHR	This site is located immediately adjacent to the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
New Zealand Loan and Mercantile Agency Company Woolstore (former)	10, 10A and 14 Bowen Bridge Road	BHR	Detailed heritage assessment and archival recording required prior to demolition of Queensland Rail storage shed and Biomedical Technology Services (BTS) building.
Victoria Park	454 Gregory Terrace	QHR BHR	Avoid damage to mature trees with temporary realignment of bicycle path and construction site access.
Brisbane Girls Grammar School	70 Gregory Terrace	BHR	This site is located immediately adjacent to the proposed alignment. If during detailed design further

Place	Address	Heritage Register Listing	Mitigation measures for RfPC-4
			modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Brisbane Grammar School	24 Gregory Terrace	QHR BHR	This site is located immediately adjacent to the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken. Further assessment during detailed design of potential vibration impacts during construction and relocation of the pedestrian bridge.
Kelvin Grove Road - fig trees and air raid shelter (landscape precinct)	140A Kelvin Grove Road	QHR BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
The Normanby Hotel	1 Musgrave Road	QHR BHR	
Hardgrave Park	155 Petrie Terrace	BHR	Settlement monitoring (consistent with the Evaluated Project)
'Shawn' Apartments	172 Petrie Terrace	BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Paslewydd	176 Petrie Terrace	BHR	
Princes Row	190-198 Petrie Terrace	BHR	
'O'Keeffe's Buildings	226, 228 and 230 Petrie Terrace	BHR	
Illawarra Mansions	242-246 Petrie Terrace	BHR	
Florence House	256 Petrie Terrace	BHR	
Petrie Terrace Police Barracks (Paddington Barracks) (former)	Petrie Terrace	QHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Victoria Barracks	Petrie Terrace	NHL BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Countess Street Rail Bridge abutments	Countess Street	BHR	
Countess Street Rail Bridge	Countess Street	BHR QRHR	
Roma Street Railway Station	Brisbane City	QHR	Settlement monitoring

Place	Address	Heritage Register Listing	Mitigation measures for RfPC-4
		BHR	Vibration monitoring will be required at the Roma Street Station Heritage Building during tunnel mining.
Transcontinental Hotel	462-468 George Street	QHR BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
The former baby clinic	51 Herschel Street	BHR	
Former Bank of Queensland	458-460 George Street	BHR	
Brisbane Fruit and Produce Market	71-97 Turbot Street	BHR	
Brisbane Dental Hospital and College	168 Turbot Street	QHR BHR	
Ann Street Presbyterian Church	141 Ann Street	QHR BHR	
Wheat Creek Culvert (underground)	Adelaide and Albert Streets	BHR	This site is located within the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Early Streets of Brisbane	Adelaide Street and Albert Street intersection Burnett Lane	QHR BHR Brisbane CBD Archaeological Plan	This site is located partially within the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Early Streets of Brisbane	Elizabeth Street and Albert Street intersection Charlotte Street and Albert Street intersection	QHR BHR Brisbane CBD Archaeological Plan	Settlement monitoring Surface ground disturbance to involve archaeologist.
Albert Street Uniting Church	319 Albert Street	QHR BHR	This site is located immediately adjacent to the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Former Queensland Deposit Bank	245 Albert Street	BHR	
King George Square	Brisbane City	BHR	This site is located within proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Brisbane City Hall	64 Adelaide Street	QHR BHR	This site is located immediately adjacent to the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.

Place	Address	Heritage Register Listing	Mitigation measures for RfPC-4
OK Building (former)	117 Queen Street	BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Gaujard and Elson Building (former)	125 Queen Street	BHR	
Beak House (former)	127-127A Queen Street	BHR	This site is located partially within the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Federal Deposit Bank (former)	115 Queen Street	BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Allan and Stark (former) (Miss Brisbane)	110 Queen Street	QHR BHR	
Rutter and Sons (former)	114 Queen Street	QHR BHR	
Love's Auction Mart (former)	116 Queen Street	QHR BHR	
Regent Building	167 Queen Street	QHR BHR	
Brisbane Arcade	160 Queen Street	QHR BHR	
Barry and Roberts Building/York Hotel/Hotel Carlton/Telegraph Building	91 Queen Street	BHR	
Edwards and Chapman (former)/Sportsgirl)	120 Queen Street	QHR BHR	
William Cairncross Building	188-196 Albert Street	BHR	
Perry House/Royal Albert Apartments/Hotel	167 Albert Street	QHR BHR	Partially within project alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
George Weston and Son's Workshop (former)	42 Charlotte Street	BHR	Settlement monitoring Surface ground disturbance to involve archaeologist. (measures are consistent with the Evaluated Project)
Mooney's Building	130 Mary Street	QHR BHR	
			This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.

Place	Address	Heritage Register Listing	Mitigation measures for RfPC-4
Watson Brothers Building	129 Margaret Street	QHR BHR	
Brisbane Botanic Gardens	Brisbane City	QHR BHR	This site is located within proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Kangaroo Point Cliffs	Kangaroo Point	QHR BHR	Settlement monitoring
Residence - 'Rineston'	56 Llewellyn Street	BHR	This site is located within proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Residence - 'Doonholm'	23 Walmsley Street	BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
St Joseph's complex, Leopard Street (church, school and presbytery)	36 Leopard Street 44 Leopard Street 88 Lockerie Street	BHR	
Semi Detached Residences	38 Mark Lane	BHR	
St Nicholas Russian Orthodox Cathedral	330-334B Vulture Street	QHR BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken. Detailed design of the station entrances be responsive to heritage places in the vicinity.
The former Woolloongabba Police Station	842-848 Main Street	QHR BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
The former Woolloongabba Post and Telegraph Office	765 Stanley Street	QHR BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken. Detailed design of the station entrances be responsive to heritage places in the vicinity.
The former RAOB Hall	1 Hubert Street	BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
The Chalk Hotel	735 Stanley Street	BHR	Settlement monitoring Detailed design of the station entrances be responsive to heritage places in the vicinity.

Place	Address	Heritage Register Listing	Mitigation measures for RfPC-4
Masonry Flats	52 Hawthorne Street	BHR	This site is located within 50m of the proposed alignment. If during detailed design further modelling indicates that these sites require settlement monitoring, then it will be undertaken.
Boggo Road Gaol	150 Annerley Road	QHR BHR	This site is located more than 100m away from the proposed alignment. No settlement monitoring required. Design Boggo Road Station sympathetically to visual setting of gaol complex.
Dutton Park Platform Shelter	Dutton Park Station	QRHR	Consult with the Queensland Rail Heritage Committee (QRHC) and suitably qualified heritage consultant regarding detailed impact assessment and mitigation measures. Address heritage impacts during detailed design.
Fairfield Passenger Station	Fairfield Station	QRHR	Consult with the Queensland Rail Heritage Committee (QRHC) and suitably qualified heritage consultant regarding detailed impact assessment and mitigation measures. Address heritage impacts during detailed design.
Fairfield Platform Shelter	Fairfield Station	QRHR	
Fairfield Footbridge	Fairfield Station	QRHR	
Yeronga overpass (footbridge)	Yeronga Station	BHR QRHR	
Yeerongpilly Passenger Station	Yeerongpilly Station	QRHR	
Rocklea Platform Shelter	Rocklea Station	BHR QRHR	
Rocklea Footbridge	Rocklea Station	BHR QRHR	
Salisbury Passenger Station	Salisbury Station	BHR QRHR	
Salisbury Footbridge (Timber)	Salisbury Station	BHR QRHR	

10.4 Conclusion

The Proposed Changes will result in changes to the heritage impacts of the project during both construction and operation. However, general heritage management will be achieved through the application of the Coordinator-General's requirements and implementation of the approved Project OEMP.

Mayne

No State heritage places are affected by the Proposed Changes. However, the Queensland Rail listed Breakfast Creek Rail Bridge (Warren Truss Bridge) within the project footprint will be removed as part of the CRR Project.

Northern Area

While the impact to heritage items within the RNA showgrounds State heritage listing (#601709) remain the same, additional impacts will be recorded through the State heritage listed Victoria Park. These impacts will be minimised through the implementation of the Project OEMP and through consultation with the Queensland Heritage Council and the Department of Environment and Science's Heritage Unit.

Central Area

This preliminary surface settlement impact assessment of the project alignment within the zone of influence identified only two heritage listed buildings or structures with a slight risk of settlement-induced damage. This is significantly less than the number identified within the previous 2011 EIS and the Evaluated Project. The estimated ground-borne vibration from TBM excavation is under 0.5 mm/s along the mined tunnel sections, well below the established heritage threshold of 2 mm/s. An improvement to the Roma Street heritage will occur through the opening of the visual line of sight through the station plaza, increasing views and amenity opportunities of the heritage value.

The Proposed Changes in Albert Street result in a reduced risk to heritage buildings from settlement and groundborne vibration with the reduced vertical alignment of the tunnel and the mined cavern method instead of a large cut-and-cover station structure. The predicted settlement of 0-50 mm from Albert Street Station works is consistent with the current Evaluated Project.

Southern Area

There are a number of Queensland Rail listed heritage values in the F2S Area that will be impacted along the alignment through structural changes with new station buildings and new footbridges. These works are expected to result in minor impacts to the existing station fabric. These works will be completed in consultation with the QR Heritage Council.

11. Technical Report: Social Impact

11.1 Overview

This technical report has been prepared for the CRR Project to assess the potential changes to impacts to social values and characteristics of communities arising from the Proposed Changes in comparison to the Evaluated Project. Volume 1 describes the Proposed Changes to the design and delivery of the CRR Project.

In some cases, the Proposed Changes are generally in accordance with the design and impacts identified for the Evaluated Project. Where this is the case, further assessment of the Proposed Changes has not been undertaken.

11.2 Assessment Methodology

Social Impact Assessment (SIA) is “a process for the identification, analysis, assessment, management and monitoring of the potential social impacts of a project, both positive and negative. The social impacts are the direct and indirect impacts that affect people and their communities during all stages of the project lifecycle” (Queensland Department of State Development, Manufacturing, Infrastructure and Planning, 2018).

A detailed SIA was undertaken as part of the 2011 EIS. This was reviewed and updated to reflect the changes for RfPC-1 in 2017, with a technical note summarising the changes to social impacts for property impacts, equity, social infrastructure, community values, local area impacts and project workforce.

In order to assess the change in social impacts from the Evaluated Project as a result of the Proposed Changes, this report includes assessment of:

- Changed property impacts with regard to number of properties that need acquisition.
- Impacts on social infrastructure.
- Changes to project workforce.
- Local area impacts as a result of the Proposed Changes from both a construction and operational perspective.
- Changes to mitigation measures required, if any.

11.3 Changes to Potential Impacts

11.3.1 General Impacts

11.3.1.1 Equity

As for the Evaluated Project, the Proposed Changes provide the opportunity for equitable transport access for local and regional communities and commuters and improves connections to where people live, work and play. The reintroduction of the route from Fairfield to Salisbury, and further enhancements in this area will ensure that communities along this section of the railway will also benefit from transport access improvements. In addition to improving transport access, the Proposed Changes enhance pedestrian accessibility and connectivity in the precincts surrounding the stations.

11.3.1.2 Social Infrastructure

Consistent with the Evaluated Project, the Proposed Changes will help improve access to a range of important district and regional level social infrastructure assets for communities in the study corridor as well as the wider South East Queensland (SEQ) region. These include:

- Major medical and health care facilities such as the Royal Brisbane and Women's Hospital (RBWH), Princess Alexandra (PA) and Mater Hospital.
- Sport and entertainment facilities such as the Gabba Stadium, Suncorp Stadium and the RNA Showgrounds.
- Education facilities such as Queensland University of Technology (QUT) and the University of Queensland (UQ).
- Major open spaces such as the City Botanic Gardens, Roma Street Parkland and Victoria Park
- Delivery of the Brisbane City Council (BCC) Albert Street vision for Albert Street within the project area.
- Improved accessibility to a wide range of community service organisations (such as community and traditional services clubs, pensioner or senior citizen associations).

Any change in impacts upon specific social infrastructure facilities are covered in the relevant sub-sections of this chapter.

11.3.1.3 Property Impacts

The Proposed Changes will require the acquisition of additional properties for surface works compared to the Evaluated Project. Changes to tunnel alignments have reduced the number of properties affected by volumetric acquisition. Surface and volumetric property acquisition is provided in Table 11.1. The main area of additional surface acquisition would be at Clapham Yard where 11 additional industrial properties would be acquired. There would also be two (2) additional residential site acquisitions at Dutton Park Station.

Table 11.1. Change in property acquisition required

Property Acquisition – Land Use Types	Evaluated Project	Proposed Changes
Surface acquisition		
Residential	0	2
Commercial / Industrial	17 (Includes two sites added as part of RfPC-3)	31 (includes 3 temporary sites)
Other (e.g. park, showground, facilities)	14	17 (includes 10 temporary sites)
Total surface acquisition	31	50 (includes 13 temporary)
Volumetric acquisition		
Residential	141	104
Commercial / Industrial	38	33
Other (e.g. park, showground, facilities)	16	15
Total volumetric acquisition	195	152
Property sites - Total	226	202

11.3.1.4 Project Workforce

Consistent with the Evaluated Project, the Proposed Changes will generate a large demand for skilled workers as well as general civil construction labour during the construction phase. During its five-year construction period, the Project will support an estimated 1500 jobs each year, and up to 3000 jobs during the peak of the construction phase. This is consistent with the Evaluated Project.

In addition, the Project will generate a range of indirect jobs, such as in the construction, financial and business services, Government services and road transport sectors. As for the Evaluated Project, parking for workers and visitors will be provided at each major construction worksite. Impacts on parking and access are addressed in the Traffic and Transport technical chapter.

When operational, in addition to the workers to operate train services and staff stations, maintenance workers will be required to maintain project infrastructure.

11.3.2 Tunnel Alignment Changes

The key changes to social impacts associated with changes to the tunnel alignments would be modified noise and vibration impacts during construction and volumetric acquisition. Between Roma Street and Albert Street the realignment moves the tunnel to be under the existing QR rail corridor and Emma Miller Place, further from sensitive receptors on Roma Street. No exceedances of the Project's operational noise and vibration criteria are predicted in this section (with track mitigation), with predicted noise exceedance at one location during construction. Volumetric acquisition would be reduced in this area.

From Albert Street to Woolloongabba, the deeper tunnel and the revised alignment reduces noise impacts to residential receivers in Kangaroo Point and will reduce the number of properties subject to volumetric acquisition.

During construction, the changed alignment between Woolloongabba Station and Boggo Road station would result in some exceedances of the Project's groundborne noise goals at residential receivers in proximity to the tunnel. As for the Evaluated Project, the alignment would still pass close to the Ecosciences Precinct and PA hospital therefore impacts of vibration on sensitive equipment at the Ecosciences Precinct and PA hospital would need to be managed and mitigated, consistent with the Evaluated Project. Operational noise impacts in this section would be reduced compared to the Evaluated Project, with no exceedances of the Project's operational noise and vibration criteria. See the **Technical Report: Noise and Vibration** for further details. The proposed realignment change will involve a change in properties impacted by volumetric acquisition. The properties volumetrically affected between Southern Portal and Northern Portal is expected to be reduced from 195 to 152 sites.

11.3.3 Mayne Area

11.3.3.1 Mayne Yard

The scale of works in Mayne Yard North is increased from the Evaluated Project and the rail alignment would be closer to sensitive receptors to the west.

Construction

Construction in Mayne Yard has the potential to result in changed amenity impacts to nearby receptors. The majority of adjacent properties are industrial however there are residential properties to the west across Breakfast Creek. The noise and vibration report identifies a potential exceedance of noise criteria during demolition works in Mayne Yard East. Air quality modelling for Mayne Yard indicates minor exceedance of dust deposition goals at a nearby commercial receiver. Visual impacts would be generally consistent with the Evaluated Project. As the works are contained within an existing rail environment this minimises the potential

for other social impacts arising during construction and would not significantly affect access or connectivity. Construction impacts would be managed in accordance with the measures in the Project OEMP.

Operation

Operational noise at sensitive receivers would increase during operation however would still be below the Project's operational noise criteria. New pedestrian accesses will enhance connectivity and provide additional sustainable transport options for staff accessing the site by foot.

Overall, social impacts at Mayne Yard in relation to horizontal and vertical alignment and proposed stabling in Maybe Yard North are considered to be consistent with the Evaluated Project.

11.3.3.2 Breakfast Creek Rail Bridge

To accommodate the proposed new rail alignment, a new bridge is proposed over Breakfast Creek, to the west of the existing bridge.

Construction

Construction of the new Breakfast Creek Bridge may result in temporary dust, noise, and water quality impacts. The bridge was not previously part of the Evaluated Project and would represent an additional impact. There are residential receptors to the west and industrial receptors to the east. Construction noise levels are predicted to exceed the Project's construction noise goals at nearest sensitive receptors in the absence of additional mitigation. Potential air and water quality impacts would be managed through implementation of dust control, air quality, and erosion and sediment control measures in the Project OEMP.

Operation

It is anticipated that there may be an increased visual impact as a result of the new bridge, although this will be minor due to the surrounding land uses and existing bridge crossing (refer to visual and lighting technical report). There will also be an increased noise impact during operation to properties in proximity to the bridge, however this is not predicted to exceed the Project's operational noise criteria and no additional mitigation measures are required. Refer to the noise and vibration technical report.

There will be no property acquisition required for the new bridge.

11.3.4 Northern Area

11.3.4.1 Track and Civil Works

Proposed changes to the alignment in the Northern Area involve the shifting of tracks to the south, closer towards the Brisbane Girls Grammar School. Modelling shows this would cause an increase in noise levels and exceedance of the Project's operational noise criteria at the Sports Centre, which is the closest building at the Brisbane Girls Grammar School. However, the Sports Centre has no windows on its northern façade and the sports activities are considered less noise-sensitive than teaching activities. A six metre noise barrier would not be effective at providing noise reduction as the building is elevated above the rail corridor. Therefore, no noise mitigation is proposed for this location. Noise impacts and mitigation measures are further discussed in the noise and vibration technical report. As the works are within the rail corridor no other changed social impacts are expected compared to the Evaluated Project.

11.3.4.2 Minor Civil Structures

A number of civil structural works are required in the Northern Area as described in Volume 1. This includes protection works on existing infrastructure and replacement of the train wash subway. These civil works within the rail corridor are generally in accordance with the Evaluated Project and would not result in any significant changes to the construction or operational social impacts reported for the Evaluated Project.

The Exhibition Station Subway Underbridge is a State Heritage Place as part of the RNA. The existing walls will be retained, and the replacement underbridge will match the form and heritage features of the existing subway underpass, and as such this will not impact on the heritage value of the RNA. Further information on the heritage impacts is provided in the Technical Report: Heritage.

11.3.4.3 Exhibition Station

Exhibition Station would be generally in the same location as the Evaluated Project and would maximise the use of existing station infrastructure.

Potential changed construction and operational social impacts compared to the Evaluated Project are outlined below.

Construction

Consistent with the Evaluated Project, noise, dust and traffic associated with construction of Exhibition Station would cause potential disruption to local residents. The construction of a new entrance at Bowen Bridge Road may result in a minor increase to construction impacts at this location.

During construction, there is an increased social benefit from the Proposed Changes compared to the Evaluated Project. The reduced scale of works and proposed construction staging over two stages ensures the availability of the station to patrons during annual Ekka events. This allows events at the showgrounds to be continued to be accessed by rail transport thus improving social inclusion of event attendees by continuing to provide affordable public transport options.

The proposal also requires the removal of heritage fig trees consistent with the Evaluated Project. Consistent with the Evaluated Project, this may have an impact on the local community who value the heritage, environmental, and visual values of these trees. The proposal has considered and sought to avoid/minimise impacts on nearby heritage items through geometry and design speeds. These include the Queensland Rail heritage listed building to the west of Bowen Bridge Road overbridge and the heritage listed infrastructure (including existing toilet facility) located within the RNA precinct. Further information on the heritage impacts is provided in the Technical Report: Heritage.

Overall, social construction impacts at Exhibition Station are considered to be consistent with the Evaluated Project.

Operation

The proposal requires additional permanent land requirements from RNA to accommodate the vertical transport connection from the RNA to access the station and the unpaid pedestrian connections. This is considered to have a negligible social impact.

As for the Evaluated Project, the changes at Exhibition Station will result in a number of improvements to the operational social impacts in this area:

- The connections to the RNA Plaza will strengthen connectivity to Bowen Bridge Road, O'Connell Terrace, the Herston Health Precinct, King Street Convention Centre and the Old Museum.
- The station overpass has been located centrally along the platforms to allow better distribution of patrons.
- The Proposed Changes would result in impacts to heritage buildings at the RNA Showgrounds consistent with the Evaluated Project.

Exhibition Station upgrade will improve public transport access for communities in Bowen Hills to key growth areas and major employment centres in South East Queensland, support future developments at Bowen Hills, and improve access to the RNA, consistent with the Evaluated Project.

11.3.4.4 Victoria Park site access

The Evaluated Project included an access road through Victoria Park which was an upgrade of an existing track and entered the rail corridor via the Brisbane City Council Depot. The Coordinator-General's conditions for the project require project works and worksites in Victoria Park 'minimise the loss or trees and ornamental plantings and must minimise the area of the park directly impacted during such works'.

An alternative access to the railway corridor and Northern Portal is proposed through Victoria Park. This would be a primary rather than secondary access to the corridor and would be consistent with the condition above.

The revised route would still access from Gregory Terrace, entering the rail corridor north of the BCC depot through the Department of Health (Biomedical Technology Services) property. This option has a smaller footprint through Victoria Park than the Evaluated Project, resulting in slightly decreased impacts on the social and recreational values of the park although minor tree removal will still be required. This option would require the acquisition and demolition of the Department of Health building which is local heritage. As the route would be a primary haulage route, this would increase the number of vehicles through the park compared to the Evaluated Project and may increase the amenity impacts to residential receptors south of Gregory Terrace.

11.3.5 Central / Tunnel Area

11.3.5.1 Roma Street Station and Inner Northern Busway

Roma Street station is to be realigned further east under Roma Street rail yards than the Evaluated Project. The Inner Northern Busway is proposed to be relocated and lowered which is a change from the Evaluated Project and requires works to the east of Roma Street Station through Emma Miller Place, including cut and cover tunnel works and demolition of existing structures in the vicinity of Roma Street Station.

Construction

Consistent with the Evaluated Project there will be temporary amenity impacts during construction at Roma Street including noise, air quality and traffic impacts which would cause potential disruption to station and busway users and the local community. The location of the eastern egress shaft would be a change from the Evaluated Project with predicted exceedances of the Project's construction noise goals at nearby sensitive receptors as detailed in the noise and vibration report.

There will be changes to pedestrian movements and access at stages during the construction period, and the addition of the Inner Northern Busway works would increase the level of disturbance in this area including the diversion of buses onto Roma Street.

The works will require cut and cover construction through Emma Miller place and Parkland Boulevard. This would have an adverse social impact for users of the public space at Emma Miller place. As the lowering of the busway was not part of the Evaluated Project, this would be an additional social impact, due to the incremental increase in the scale of works and associated noise, dust and traffic in this precinct. Construction noise levels at the Supreme Court would be increased compared to the Evaluated Project, as the works are further east. Modelling (without mitigation) shows that the works would result in exceedance of the Project's construction noise goals for this receiver. Noise mitigation will be developed through detailed construction planning and would result in a reduction in predicted noise levels.

Construction impacts will vary depending on the construction stage and will be managed to minimise disruption to local residents, users of the Inner Northern Busway and Roma Street Train Station, and to minimise noise impacts and air quality impacts to sensitive receivers. Impacts to access during construction

can be mitigated through wayfinding signposting and communications. Traffic and transport impacts will be managed through a Construction Traffic Management Plan.

A minor beneficial change from the Evaluated Project is the removal of the College Close satellite site logistics area from the project area as it will not be required during construction. This will avoid the amenity impacts and potential disruption associated with a construction logistics area in this location.

Operation

Once operational, the new Roma Street station plaza will provide improved public space and pedestrian capacity and provides for two direct pedestrian crossing points over Roma Street and modification of the George and Roma Street intersection aims to provide better connection to the CBD.

The minimised and realigned station footprint releases more area for public realm and over station development compared to the Evaluated Project.

Locating Roma Street Station under the surface rail is considered to have a positive social impact as it will reduce the operation noise impact to sensitive receptors on Roma Street and will provide better integration with other transport modes.

During operation the new busway station will provide improved integration and wayfinding between Brisbane Metro, coach station, rail station and bus services.

Emma Miller Place and Parkland Boulevard are proposed to be reinstated into comparable existing forms on the completion of the works in this area, therefore the social impact to these public areas would be temporary.

11.3.5.2 Albert Street Station

The Proposed Changes would result in Albert Street Station being north of the position proposed in the Evaluated Project with two access points to the station provided through a building or station plaza, rather than street entrance points. The construction methodology has changed to include mined cavern rather than cut and cover.

Construction

Amenity impacts (noise, vibration, dust) would still arise during construction and would be generally consistent with the Evaluated Project, however the revised station location and construction methodology, including mined cavern approach, would be expected to reduce disruption to existing business particularly retail. Pedestrian access and shopfront access will be maintained along Albert Street. However, demolition works at 142 Albert Street would result in noise levels which are predicted to exceed the Project's construction noise goals (without mitigation) for residential and commercial properties which is an increase compared the Evaluated Project. Consistent with the Evaluated Project an acoustic shed would be used to minimise dust and noise from the cavern/tunnelling site.

Operation

The consolidated station entries results in reduced structures on Albert Street which frees up public space and creates greater opportunity to deliver the proposed Brisbane City Council Albert Street vision in this area.

The proposed upgrade will provide a more central station and a closer connection to key CBD destinations and activity areas while reducing the overall public domain footprint.

As opposed to the Evaluated Project, the relocated station will avoid any impact on the Myer Centre car park ramp. This reduces the social impact and disruption that would have resulted.

The Proposed Project requires the demolition of 142 Albert Street which is an additional property impact from the Evaluated Project. This property currently provides for retail/restaurant facilities which would be removed. There are a number of other similar retail tenancies in the CBD therefore the impact of this would be minimal.

The secondary entrance provided at 142 Albert Street would improve interchange to Myer centre and Queen Street bus station compared to the Evaluated Project. This would have an improved social impact compared to the Evaluated Project by improving pedestrian connectivity to multiple modes of public transport. The northern and southern entries would be connected by an underground mezzanine that would encourage diversity of walkable route options for users.

11.3.5.3 Woolloongabba Station

Woolloongabba Station is proposed to be located approximately 70m west of the location proposed for the Evaluated Project. This would accommodate the future Brisbane Metro station and increase the area for event crowd management.

Construction

The impacts associated with construction of the station are generally consistent with those of the Evaluated Project and would include temporary dust, noise and traffic impacts associated with construction and spoil removal. The construction method would still include acoustic sheds which would assist in mitigation of noise and dust impacts at the site. One shed will be used to cover the tunnel access shaft and facilitate underground construction logistics. The second shed will be used in the management of spoil removal.

The proposed station location would generally result in lower construction noise levels at the worst-affected receivers compared to the Evaluated Project, which found that noise levels would be consistent with the EIS (exceedance of the construction noise goals by up to 15 dB during the day at nearest sensitive receptors in the absence of mitigation). The busway bridge is predicted to result in no exceedance of the construction noise goals during the day and exceedances of up to 1 dB at night at surrounding residential receivers.

Operation

The movement of the station to the west allows for future accommodation of Brisbane Metro and increases the distance to Gabba Stadium which provides more space for crowds during events. Other operational social benefits of this station would be consistent with the Evaluated Project such as improved access and economic opportunities around the station and integration with future development.

11.3.5.4 Southern Portal

The Southern Portal is generally in the same location as proposed for the Evaluated Project and within the rail corridor. The proposal however seeks to commence the trough structure approximately 40-50m south along the existing alignment, and the cut and cover approximately 80m to the south. The proposal also includes minor changes to the surface tracks in this area and proposes a mined tunnel instead of cut and cover into Boggo Road Station.

Construction

Consistent with the Evaluated Project, temporary construction impacts are expected, including noise, air quality, visual, and traffic impacts which would cause potential disruption to residents, visitors, students, employees and/or patients at the different sensitive receptors located in the area including PA Hospital, ESA Village Leukaemia Foundation, and Dutton Park State School. The mined cavern approach reduces potential

disruption to Princess Alexandra (PA) and the Ecosciences Precinct to that expected with the cut and cover method proposed for the Evaluated Project.

Operation

The social impacts associated with the operation of the Southern Portal are consistent with that assessed for the Evaluated Project.

11.3.6 Southern Area

11.3.6.1 Boggo Road Station

Boggo Road Station would be largely consistent with the Evaluated Project, however is proposed to be located approximately 25m to the north. It would also be lowered vertically by 2m to avoid interface with the existing bus, rail, and freight flyover. A key change to this station precinct is the provision of a new elevated surface connection which provides a pedestrian and cycle link from the PA Hospital to Boggo Road Urban Village. This removes the need for a pedestrian underpass which was part of the Evaluated Project. This proposed change also removes the provision of a new bridge from Boggo Road plaza to Boggo Road busway platforms and Park Road railway platforms as proposed in the Evaluated Project. The proposal also seeks to consolidate all services for the station in a single building located centrally to the platform.

Construction

As with the Evaluated Project, temporary construction impacts are expected, including noise, visual amenity, air quality and traffic impacts which would cause potential disruption to residents, visitors, employees, students, and/or patients, at the different sensitive receptors located in the area including PA Hospital, ESA Village Leukaemia Foundation, Dutton Park State School, and residential properties along Railway Terrace and Merton Road (to Elliott Street). Construction noise impacts from Boggo Road station would decrease compared to the Evaluated Project due to the reduced extent of cut-and-cover works. The new pedestrian/cyclist bridge works at Boggo Road are predicted to result in exceedances of Project noise goals of up to 6 dB during the day and of up to 14 dB at night at surrounding residential receivers; and exceedances of up to 3 dB (day) and 11 dB (night) at the ESA Leukemia Village (without mitigation).

The Proposed Changes would require increased haulage at this location compared to the Evaluated Project and this would be managed through construction site access and haulage management to minimise potential impacts to Dutton Park Primary School and the road network.

The revised station location is expected to have a reduced impact on the existing rail and bus infrastructure in the area during construction. This is considered to have a reduced social impact compared to the Evaluated Project.

The Proposed Changes would require the use of an area of road reserve on Boggo Road as a construction worksite. As the area is road reserve, the social impact of this is negligible.

Operation

Outlook Park (near the Boggo Road/Joe Baker Street roundabout), a small local park containing play equipment. This park will be required as part of the permanent impact as part of the Boggo Road Station development. This is consistent with the Evaluated Project which impacted this park.

Overall and consistent with the Evaluated Project, the Proposed Changes have a positive impact on accessibility for residents, employees, and visitors to the area, and benefits to social equity through the provision of a new station and pedestrian link in the area.

11.3.6.2 Dutton Park Station

The Proposed Changes would extend the Dutton Park Station platforms south of Annerley Road and reposition station buildings. The Proposed Changes provide a new covered rail overpass to the PA Hospital and stairs and lifts at street level to improve access from Cornwall Street and Annerley Road.

Construction

Temporary construction impacts are expected, including noise, air quality, visual and traffic impacts which would cause potential disruption to residents, visitors, employees and/or patients at the sensitive receptors located in the area including PA Hospital and Dutton Park State School. These are discussed in the relevant technical chapters and would be generally consistent with the Evaluated Project.

A temporary platform extension would be required to support the station upgrade work and this would result in additional acquisition of two residential properties at 15 and 16 Cope Street. This would have a negative social impact due to the necessary acquisition of land and relocation of residents/owners.

Operation

The upgrade to Dutton Park Station would improve pathways for independent access, pedestrian access, and pedestrian comfort through a covered rail overpass. This would have a beneficial social impact compared to the Evaluated Project. Increased noise levels associated with operations would be expected in the area, due to required removal of an existing noise barrier. Noise impacts and mitigation measures are further discussed in the noise and vibration technical report.

11.3.7 Fairfield to Salisbury Area

11.3.7.1 Fairfield to Salisbury Stations

The Proposed Changes include station upgrades for Fairfield, Yeronga, Yeerongpilly, Moorooka, Rocklea and Salisbury Stations, which were not part of the Evaluated Project. The station upgrades will provide a new platform at each station, improved station facilities and integrated pathways for independent access.

Construction

In general, temporary construction impacts are expected at all stations, including noise, air quality and traffic impacts which would cause potential disruption to station users and the local community, however these would be localised and can be managed through implementation of mitigation measures in the Project OEMP.

A number of the stations have heritage values and are listed as Brisbane City Council and/or the Queensland Rail heritage items. This includes station buildings at Fairfield and Yeerongpilly Stations, ticket office at Salisbury Station and footbridges at Yeronga, Rocklea and Salisbury Stations. Removal of these heritage structures may have heritage impacts which may be felt by the community; however social impacts associated with this are considered to be minimal, particularly if the proposed management approach is agreed in consultation with QR and where relevant BCC or the State Government.

Temporary road (including footpaths and road reserves) occupation and/or closures may also be required to complete construction works and disruption to road users, pedestrians and the general public would be managed through a Construction Traffic Management Plan.

Operation

The station upgrades will have a beneficial social outcome compared to the Evaluated Project due to the improved accessibility provided by the changes to platforms, carparks and pedestrian connectivity. This improves traveller amenity and social equity and access for the local community. The new station buildings will enhance visual amenity and sense of place for users.

No permanent property acquisition is required for the Fairfield to Salisbury Stations.

11.3.7.2 Clapham Yard stabling

The Clapham Yard stabling facility and track works were assessed as part of the 2011 EIS, however, this component was subsequently removed from the Evaluated Project.

The Proposed Changes at Clapham Yard are similar to that assessed in the 2011 EIS, including new stabling facilities, track realignment, cleaning, maintenance and inspection facilities and northern (and limited southern) access for rollingstock. Other surface works are also similar in nature to those assessed in the 2011 EIS, including removal and installation of utilities, new crew facility and civil works. The works at Clapham Yard are shown in Volume 2 of this RfPC.

Proposed Changes at the site include new staff car park, train storage area and supporting utilities, embankment along Fairfield Road, new bridges, elevated pedestrian crossing that ties in with Moorooka Station and resumption of a number industrial lots to the west of the yard.

These changes are considered to result in the following changes to the construction and operational social impacts reported for the Evaluated Project.

Construction

Works at Clapham yard may result in temporary noise, air quality and traffic impacts however as the works would be within an area of generally industrial character within or adjacent to the rail corridor, construction impacts are not considered likely to be significant from a social perspective and would be managed through the measures in the Project OEMP.

The Proposed Changes include additional resumption of approximately 10 industrial properties to the west of the yard which is an additional social impact compared to the Evaluated Project and would affect property owners and businesses. This would be managed through engagement with affected property owners.

The construction of the new proposed bridge over Moolabin Creek may result in temporary afflux during construction however further modelling and detailed construction planning will identify management measures to avoid afflux, consistent with the Project's Imposed Conditions.

Operational

Post-construction, the yard will form part of the operational rail environment and will provide fundamental stabling capacity for the operation of the rail network. The **Technical Report: Noise and Vibration** identifies that total rail noise levels at the closest receivers east of Ipswich Road from the cumulative effect of the track realignment and stabling facility will decrease compared to the existing scenario, chiefly due to the realignment of the track which offsets the new noise sources from the yard itself. Noise levels at surrounding receivers will be below the Project's operational noise criteria.

11.4 Mitigation Measures

The social impact mitigation measures proposed as part of the Evaluated Project continue to be applicable to the Proposed Changes, including the following which are consistent with the Project OEMP:

- Maintain safe and efficient pedestrian and vehicle access, including delivery vehicle access, to businesses near to the construction worksites and other construction works, including providing alternative access, where required.
- Undertake early and on-going notification in accordance with the community and stakeholder engagement plan with business owners near to construction worksites or other construction works. Undertake on-going consultation with the RNA to ensure suitable access is maintained to the RNA Showgrounds for livestock and delivery vehicles during the Ekka and other major scheduled events at

the RNA Showgrounds. General road access is also to be maintained to the RNA Showgrounds during the course of the Project works.

- Develop and implement a Charter for Local Content for the Project in accordance with the Queensland Government Local Industry Policy.
- Develop and distribute information packages to affected businesses providing information on available assistance services.
- Undertake early and on-going consultation with managers of community facilities above the tunnel alignment or near to construction worksites or other construction works. Undertake consultation with managers of the Gabba Stadium to ensure planning of major construction works or haulage activities considers the timing of and effects on major events.
- Maintain safe access for pedestrians and cyclists near to construction worksites and other construction works.
- Reinstate open space areas disturbed by construction activities (i.e. Victoria Park – temporarily diverted bicycle path) progressively and as soon as practicable following construction.
- Involve the Traditional Owners, local communities and other relevant stakeholders, in rehabilitation of open space areas affected by construction activities.

Refer to other technical reports for details of proposed mitigation for air quality, traffic and transport, noise and vibration, heritage and landscape and visual.

11.5 Conclusion

The Proposed Changes would continue to provide long term benefits to communities in the study area, Brisbane and South East Queensland through improved transport access to major centres and employment areas. The Proposed Changes would also support important growth areas in inner Brisbane, helping to achieve the objectives set out in *ShapingSEQ* related to economic growth and cohesive communities. Long-term beneficial social and community effects would be realised through increased accessibility and connectivity to a range of district and regional level social infrastructure.

Generally, the changes to social impacts as a result of the Proposed Changes are not considered to be significantly different to the social impacts for the Evaluated Project, however additional areas will be affected. The inclusion of the station upgrades south of Dutton Park is a change from the Evaluated Project and will result in minor localised amenity impacts during construction but will result in beneficial impacts to access, connectivity and equity during operation. There will also be additional construction impacts associated with works at the Inner Northern Busway that will increase the scale of construction in this area and potential for amenity impacts to surrounding residents and the public.

A number of the other changes proposed at Clapham Yard, Mayne Yard and Exhibition Station would result in some small-scale changes to social impacts from the project, in particular in relation to construction worksite access, property impacts and accessibility.

Changed social impacts compared to the Evaluated Project include:

- Total surface property acquisition has increased as a result of the Proposed Changes and volumetric acquisition has decreased. The increase in surface acquisition includes residential and commercial/industrial properties with associated social impacts such as relocation experienced by residents/owners.
- Improved accessibility and social equity through improved access to stations and between platforms, and providing integrated pathways for independent access.
- Beneficial amenity impacts at stations due to improved access and updated architectural features

- Changes to noise and vibration, air quality and traffic impacts during construction and operation that would be managed through design and construction management measures.

No required changes to the Project Imposed Conditions have been identified with respect to the social impacts identified for the Proposed Changes.

Appendix A: Traffic and Transport

A1 Updated Traffic Impact Analysis – Albert Street

The purpose of this technical note is to assess the changes to impact as a result of the modifications proposed in the RfPC-4 to Albert Street. A previous analysis was carried out for RfPC-1 and documented in *Appendix A Traffic impact analysis of Albert Street Closure* (CRR Environmental Impact Statement Technical Reports Vol. 4 February 2017).

This analysis was prepared to document the changes to impact on traffic, including new future year traffic growth rates around the CBD and new passenger demands on the proposed Albert Street station. The Proposed Change also requires reclaiming the lot on 142 Albert Street for a second entrance of the new Albert Street station while retaining vehicle traffic on Albert Street between Charlotte and Elizabeth Streets. The Myer car park exit on Albert Street will remain at the same location but will now require exiting vehicles to turn right into Charlotte Street, as opposed to exiting southbound on Albert Street as per the current manoeuvre.

This technical note summarises the new results considering the modifications provided.

A1.1 Overview of updates

The intersection survey used in the Evaluated Project was utilised for this analysis. Intersection turning counts have been undertaken at 7:30-9:30 am and 4:00-6:30 pm on 27th April 2016. The counts differentiate vehicle types in light vehicles, heavy vehicles and buses. Pedestrian volumes at each intersection were also recorded for SIDRA modelling inputs. Based on the overall traffic counts, it indicates the AM peak hour is between 8:00 and 9:00 am and the PM peak hour is between 5:00 and 6:00 pm. The peak hour volumes have been input into SIDRA for the 2016 existing year model.

The following subsections describe the modified scope for the current analysis.

A1.2 Future year traffic growth rates

The updated growth rates were obtained from the CRR Strategic Transport Model to estimate the updated future year traffic growth in the CBD. Table A1 summarises the traffic growth rates for the modified analysis. These new traffic growth rates reflect future developments within the CBD that have an impact on CRR.

Table A1. Future year traffic growth rates for RfPC-4 and RfPC-1

Period	RfPC-4 compounding growth rate p.a.	RfPC-1 compounding growth rate p.a.
2016 to 2023	0.02%	0.60%
2016 to 2033 (Overall)	0.43%	0.38%

Source: CRR Strategic Transport Model

A1.3 Passenger demands on Albert Street Station

Passenger demands and distribution utilising CRR are presented in Table A2. Pedestrian traffic was added to the background pedestrian traffic of the assessed intersections using the assumed distribution in the table.

Table A2. Passenger demand and distribution on Albert Street station (2036)

2036 With CRR				
Trip Distribution To/From Albert Street				
Station name	AM Peak		PM Peak	
	Board	Alight	Board	Alight
Albert Street CRR	2,188	25,790	23,488	2,320

Location	AM Peak		PM Peak	
	From	To	From	To
Albert Street (North West)	544	9,906	8,903	796
Charlotte St (North East)	39	1,113	834	62
Charlotte St (South West)	77	690	1,022	41
Albert Street (South East)	446	10,325	4,095	821
Mary St (North East)	707	249	6,364	40
Mary St (South West)	348	3,507	2,264	534

Scenario: 2036M0Q2m_S00SP6100cBM04_PRJ_501AP01
Source: CRR_PT_board alight_2026_36 -190301.xlsm | SUMMARY1

Source: CRR Strategic Transport Model 2019

A1.4 Intersection phasing changes

The signal phasings on Albert Street / Charlotte Street and Albert Street / Mary Street were updated for the future years to include the pedestrian scramble phasings recently introduced in these intersections. Both the future year (2036) with project and without project featured the pedestrian scramble phasings.

A1.5 Traffic circulation changes

The closure of Albert Street between Mary and Charlotte (with CRR) will result in a redistribution of traffic to other parts of the CBD network. Robust and straightforward assumptions were made in the Evaluated Project to understand the current routes of the impacted traffic and the proposed detour routes with the project for this assessment.

The same assumptions were made for this analysis with the exception that Albert Street between Elizabeth and Charlotte Streets will remain open and vehicles from the Myer car park on Albert Street will make a right turn into Charlotte Street. The right turn movement into Albert Street coming from Charlotte Street north will also remain. The changes to traffic circulation routes for the southbound and northbound traffic are illustrated in Figure A1 and Figure A2 respectively.

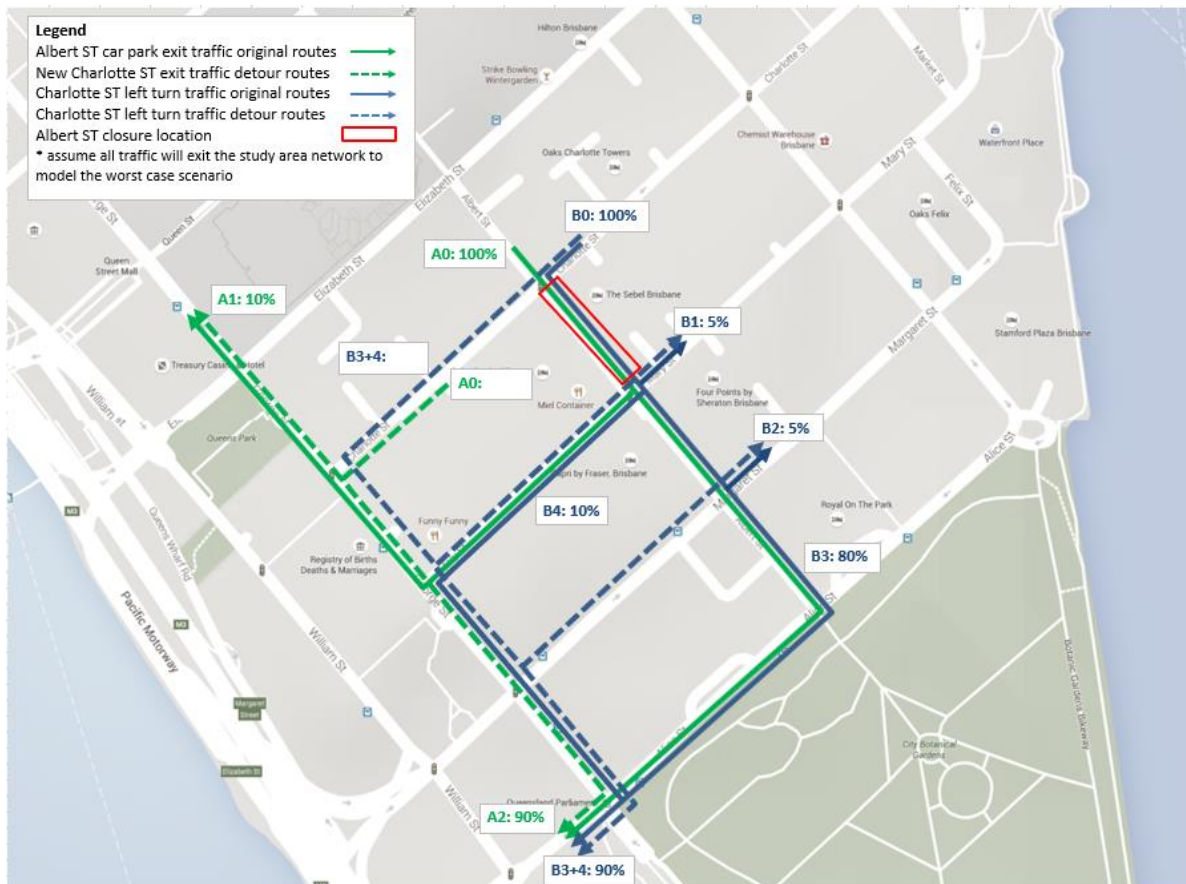


Figure A1: Changes in traffic circulation routes for southbound traffic on Albert Street

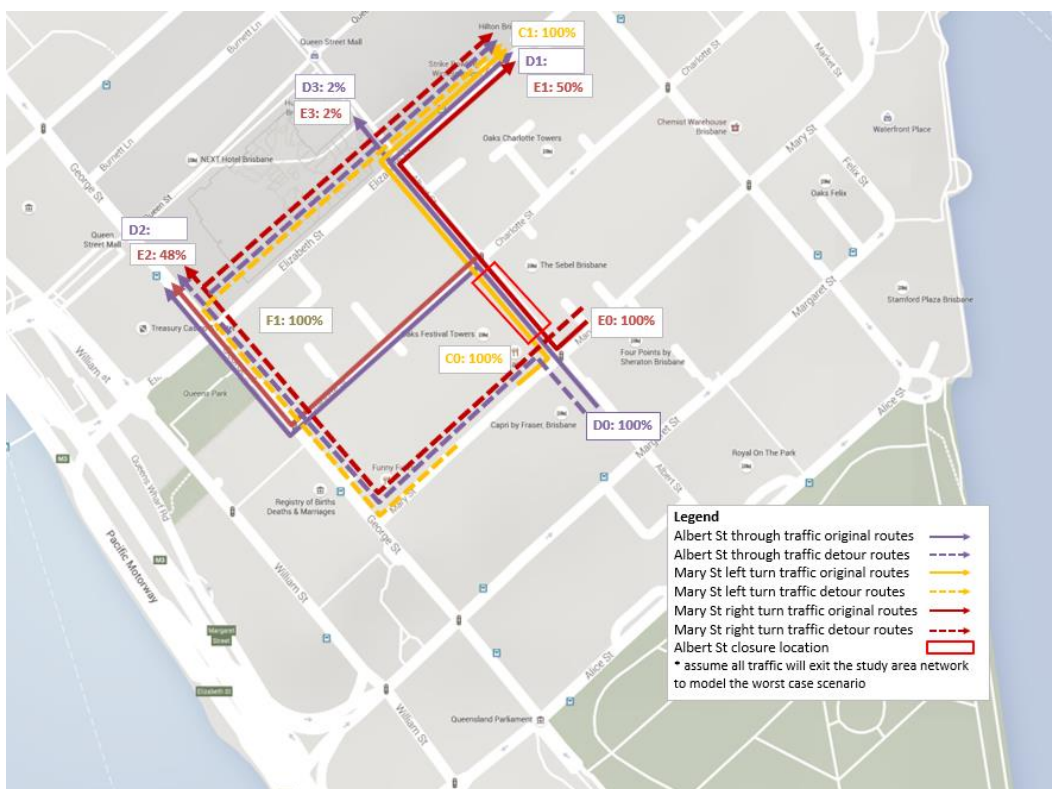


Figure A2: Changes in traffic circulation routes for northbound traffic on Albert Street

A1.6 SIDRA model and results

Intersection analysis has been undertaken using SIDRA 8.0 to assess the traffic impacts of the project on Albert Street. The intersections near the road closure section which are anticipated to have direct traffic impact have been evaluated. The 2036 SIDRA intersection model results that include the project are assessed and compared with 2036 results without the project.

Degree of Saturation (DOS) and Level of Service (LOS) criteria

The level of service criteria (LOS) used for determining the performance of the intersections is based on the degree of saturation (DOS) and uses the SIDRA method. For this analysis, a LOS D is deemed acceptable.

Level of Service	Degree of Saturation (x) – Signals
A	$x \leq 0.60$
B	$0.60 < x \leq 0.70$
C	$0.70 < x \leq 0.90$
D	$0.90 < x \leq 0.95$
E	$0.95 < x \leq 1.00$
F	$x > 1.00$

Source: SIDRA Intersection 8 user Guide

Models with the project

The intersection layouts of Albert St / Charlotte St and Albert St / Mary St will be changed due to the road closure as a result of the project. Pedestrian scramble phasings were implemented for these two intersections for the future year (2036). The comparison of intersection layouts for with and without project scenarios is shown in Figures A3 and A4. Layouts of all the other tested intersections were assumed to be kept as per the existing layout.

For this analysis, the same assumptions on signal cycle times and phasings were used for the intersections assessed.

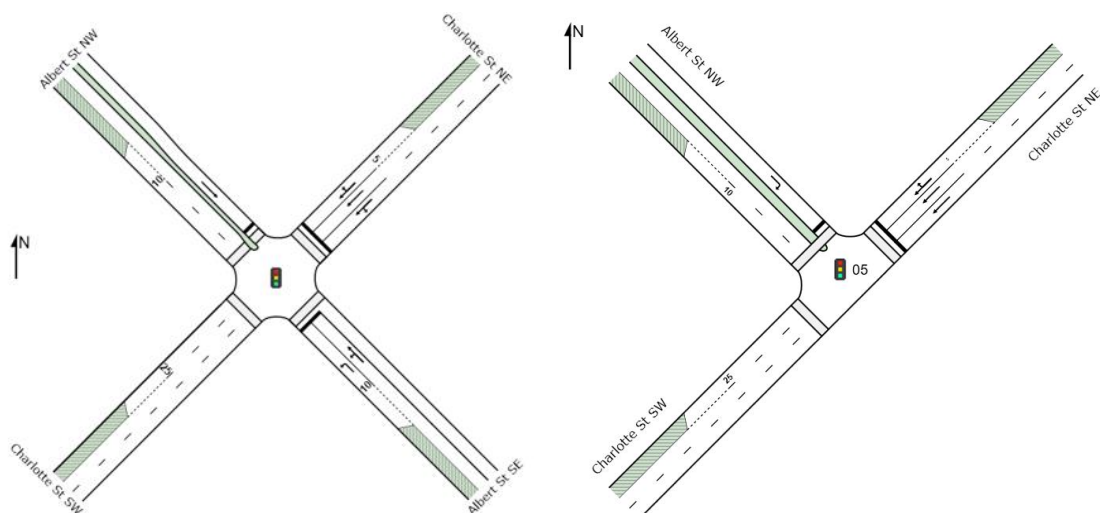


Figure A3: Intersection layout comparison of Albert and Charlotte Streets with & without the project

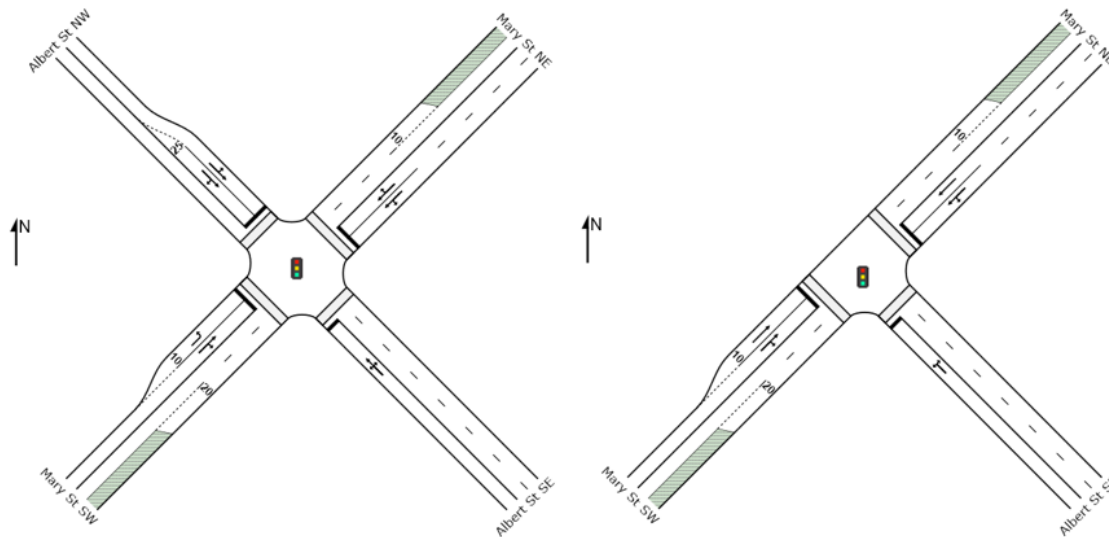


Figure A4: Intersection layout comparison of Albert and Mary Streets with & without the project

Results

The SIDRA model results for the modified analysis are summarised in Table A3 and Table A4 for the AM and PM peak respectively. With the project, none of the intersections assessed exceeded capacity in both AM and PM peak periods for 2036. In the AM peak, the intersection with the highest DOS is George St / Mary St which is 0.90 (LOS D). In the PM peak, the intersection of George St / Alice St is estimated to reach a DOS of 0.94 (LOS D).

In comparison with the previous analysis results (RfPC 2033 with project, with mitigation), the DOS generally slightly increased due to increased traffic demands. An improvement is observed on George Street / Elizabeth Street due to the reduced traffic diversion. The intersections within the immediate vicinity of the Albert Street station exhibited higher DOS due to the additional phase from the pedestrian scramble.

Table A3. AM peak intersection performance with the project

Site name	2016 Existing		2033 With Project* (RfPC)		2036 With Project	
	DOS	LOS	DOS	LOS	DOS	LOS
George St-Elizabeth St	0.71	C	0.87	C	0.85	C
George St-Charlotte St	0.38	A	0.52	A	0.59	A
George St-Mary St	0.48	A	0.75	C	0.90	D
George St-Margaret St	0.52	A	0.57	A	0.54	A
George St-Alice St	0.65	B	0.73	C	0.74	C
Albert St-Elizabeth St	0.48	A	0.62	B	0.79	C
Albert St-Charlotte St	0.59	A	0.37	A	0.49	A
Albert St-Mary St	0.53	A	0.56	A	0.83	C
Albert St-Margaret St	0.45	A	0.50	A	0.57	A
Albert St-Alice St	0.29	A	0.28	A	0.46	A

Note: * Result with mitigation measures at George Street / Elizabeth Street intersection

LOS is based on DOS (SIDRA Method)

Table A4. PM peak intersection performance with the project

Site name	2016 Existing		2033 With Project* (RfPC)		2036 With Project	
	DOS	LOS	DOS	LOS	DOS	LOS

George St-Elizabeth St	0.57	A	0.79	C	0.59	A
George St-Charlotte St	0.39	A	0.86	C	0.88	C
George St-Mary St	0.49	A	0.69	B	0.85	C
George St-Margaret St	0.45	A	0.59	A	0.62	B
George St-Alice St	0.77	C	0.88	C	0.94	D
Albert St-Elizabeth St	0.56	A	0.70	B	0.78	C
Albert St-Charlotte St	0.53	A	0.44	A	0.74	C
Albert St-Mary St	0.39	A	0.43	A	0.77	C
Albert St-Margaret St	0.33	A	0.23	A	0.57	A
Albert St-Alice St	0.67	B	0.50	A	0.64	B

Note: * Result with mitigation measures at George Street / Elizabeth Street intersection
LOS is based on DOS (SIDRA Method)

A1.7 Summary

Results from the SIDRA intersection assessments for the Proposed Changes indicate that there is a minor impact on intersection operation throughout the CBD with all intersections operating within acceptable levels of service in the morning and afternoon peak periods in 2036.

However, in comparison with the previous analysis results (RfPC-1 2033 with project, with mitigation), a slight increase in DOS is observed due to the increased volume as a result of analysing the 2036 demand, as opposed to 2033. Conversely, an improvement is observed on George Street / Elizabeth Street because of the reduced traffic diversion (having Albert Street between Elizabeth Street and Charlotte Street open).

The intersections within the immediate vicinity of the Albert Street station exhibited higher DOS due to the additional phase from the pedestrian scramble and increased pedestrian crossing demands.

It should be noted that the CRR Strategic Transport Model also takes into consideration the increase of passenger volumes added by the Brisbane Metro Project. Hence, this technical note should be considered as an indicative scenario when assessing the traffic impacts from other developments within the CBD that have not been considered in this analysis (i.e. Albert Street Vision, Queens Warf and final Brisbane Metro design), as they are expected to influence significantly on these results.

The CRR Transport Integration Group will continue to liaise with the Brisbane City Council and Transport and Main Roads to incorporate any recommendations resulting from the cumulative impact analysis.

A2 Updated Traffic Impact Analysis – Roma Street

The purpose of this technical note is to document the analysis of the potential impacts to the Roma Street / Herschel Street intersection based on the road geometry modifications proposed.

The extent of works proposed is primarily focused around the Roma Street / Herschel Street intersection and Roma Street / Parkland Boulevard intersection. The proposed design introduces a new approach to the Roma Street / Herschel Street intersection and closes the Parkland Boulevard intersection. The changes proposed is provided in Figure A5: below.

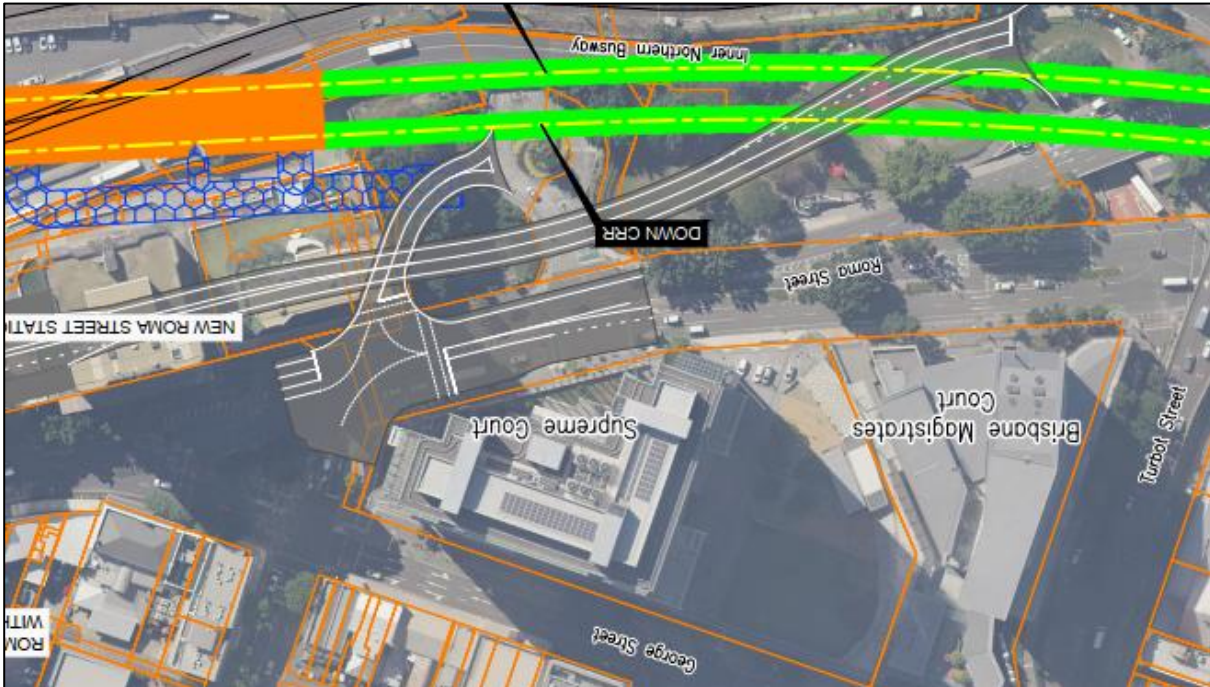


Figure A5: Proposed works to Roma Street / Herschel Street

A2.1 Intersection Geometry

In the proposed design, the Hotel Jen Car Park access will be removed and will be converted into an access which ties into the existing roundabout along Parkland Boulevard. In addition to this, the existing median will be replaced with an additional turning lane to facilitate the turning movement from Roma Street into the new access. In addition to these changes, a pedestrian crossing will be introduced at the northern and eastern approach of this intersection. This is to facilitate pedestrian movements across Roma Street as the existing pedestrian overpass and the pedestrian crossings at the Parkland Boulevard intersection will be removed. As a result of this, the access to the Parkland Boulevard intersection will be closed off. An indicative SIDRA figure of the existing intersection and that in the proposed design is provided in Figure A6:.

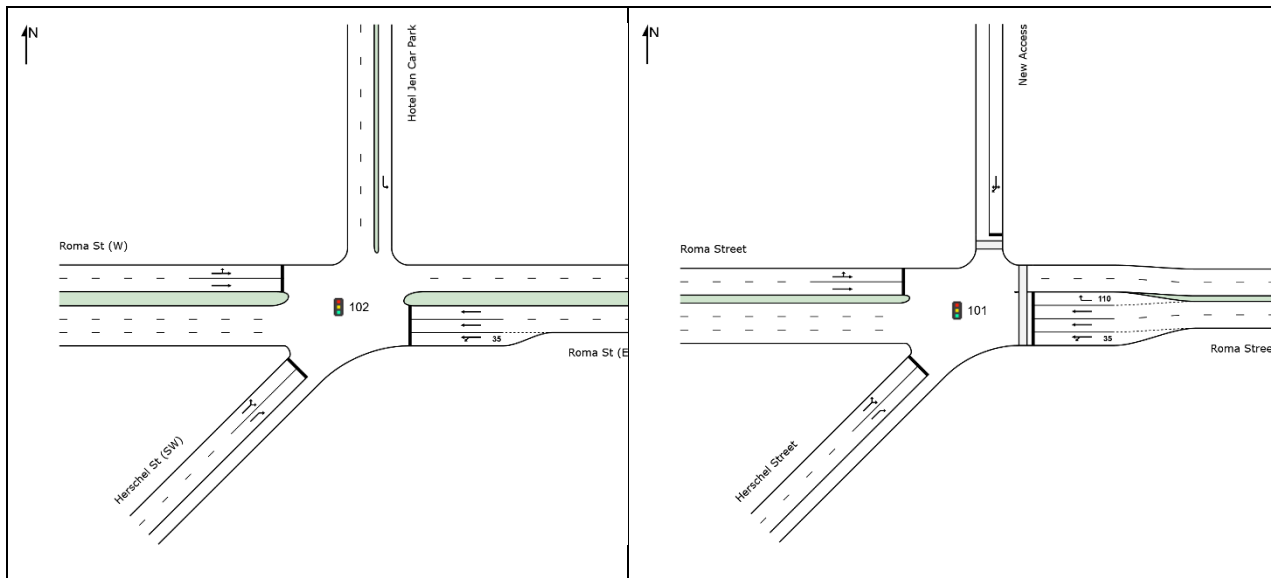


Figure A6: Roma Street / Herschel Street (Existing vs. Proposed)

A2.2 Traffic Volumes

Traffic volumes for this new intersection were obtained from a traffic survey undertaken on the 15th of March 2018 for the following intersections:

- Roma Street / Parkland Boulevard;
- Roma Street / Herschel Street;
- Roma Street / George Street; and
- Roma Street and Makerston Street.

Whilst there were no changes proposed for the George Street and Makerston Street intersection, due to the proximity of the sites to the Herschel Street intersection these sites have been analysed in a network to account for potential upstream/downstream queuing. The peak period for the four intersections was determined to be between 7:45 – 8:45 AM and the volumes presented in the figures below.

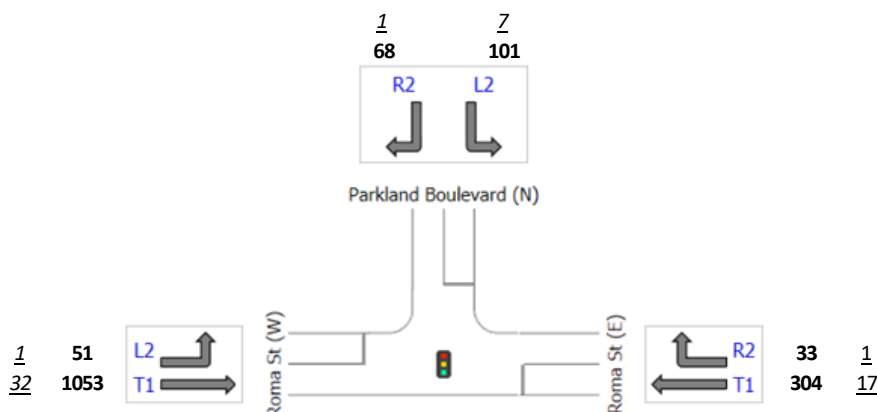


Figure A7: Roma Street / Parkland Boulevard (2018 AM Peak survey volumes)

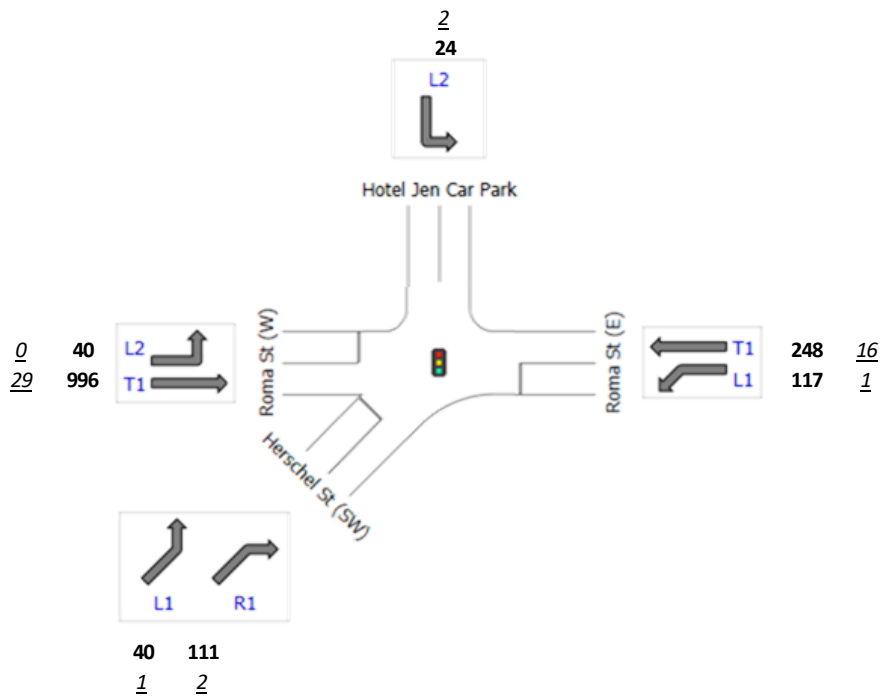


Figure A8: Roma Street / Herschel Street (2018 AM Peak survey volumes)

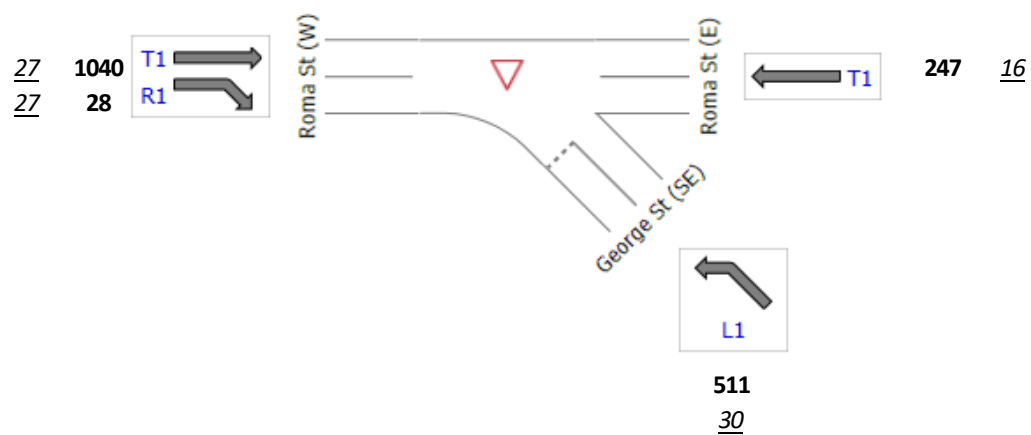


Figure A9: Roma Street / George Street (2018 AM peak survey volumes)

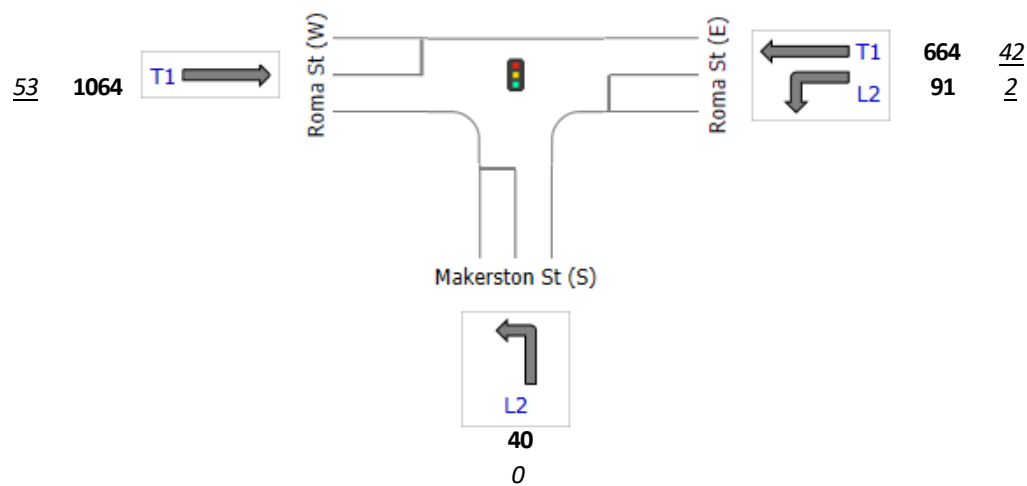


Figure A10: Roma Street / Makerston Street (2018 AM peak survey volumes)

The proposed changes to the intersection effectively combines the Parkland Boulevard and Herschel Street intersections together, and as such it is assumed that all traffic volumes that previously access the Parkland Boulevard approach would now be redirected to the new northern approach on the Roma Street / Herschel Street intersection. The assumed 2018 volumes based on the Proposed Changes is therefore as below.

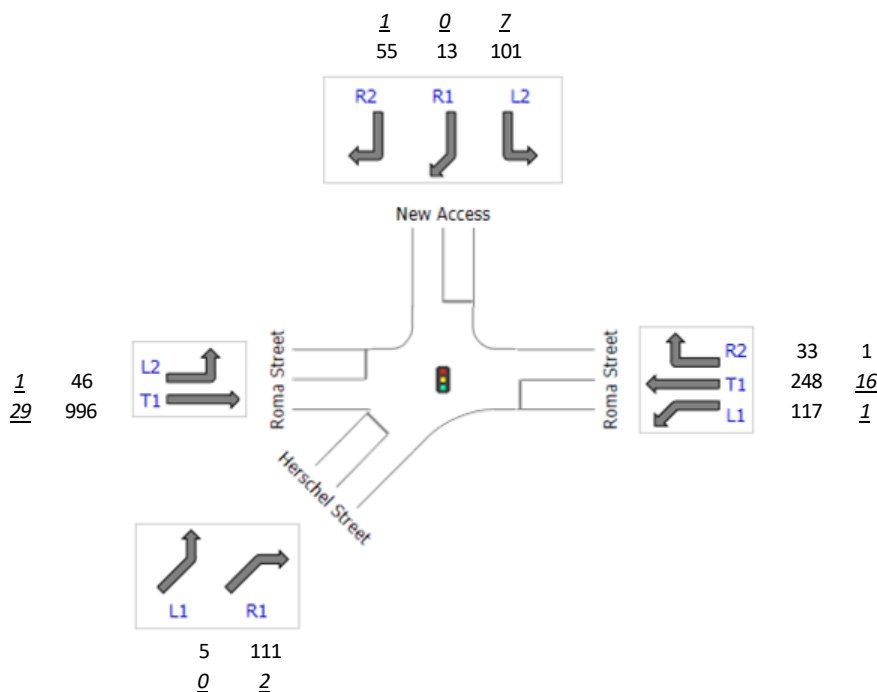


Figure A11: 2018 traffic volumes (proposed design)

To determine the volumes in the design year, growth rates supplied from the CRR Strategic Transport Model was utilised. It was informed that the CBD traffic growth rate between 2018 to 2026 is 0.02% per annum (p.a) and from 2026 to 2036 the growth rate is 0.43% p.a. The 2036 design year traffic volume based on these growth rates are provided below for the following intersections:

- Roma Street / Herschel Street (proposed layout)

- Roma Street / George Street; and
- Roma Street / Makerston Street

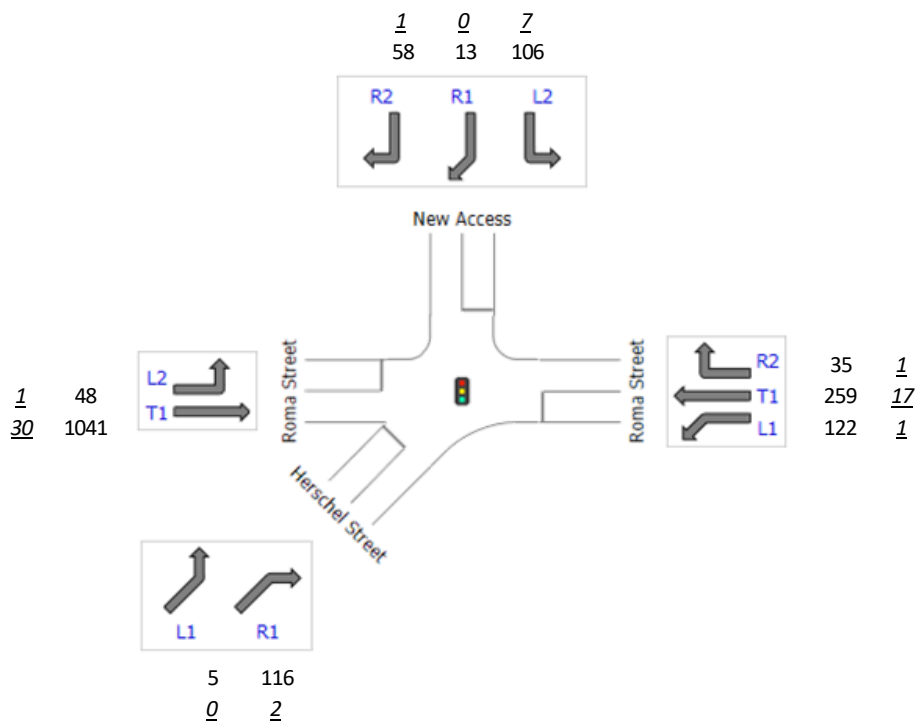


Figure A12: Roma Street / Herschel Street (proposed layout) 2036 volumes

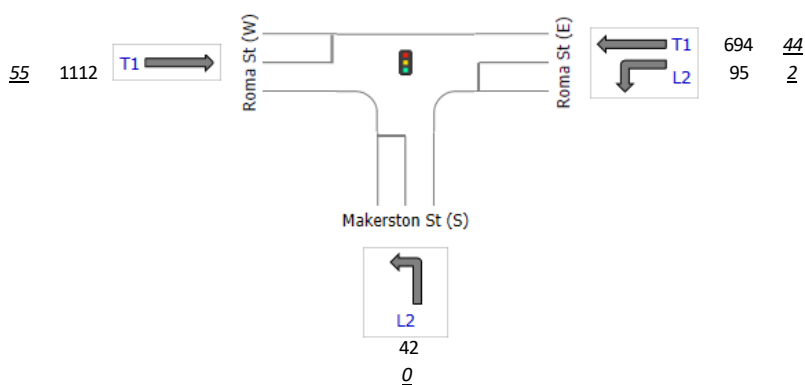


Figure 10: 2036 Roma Street / Makerston Street volumes

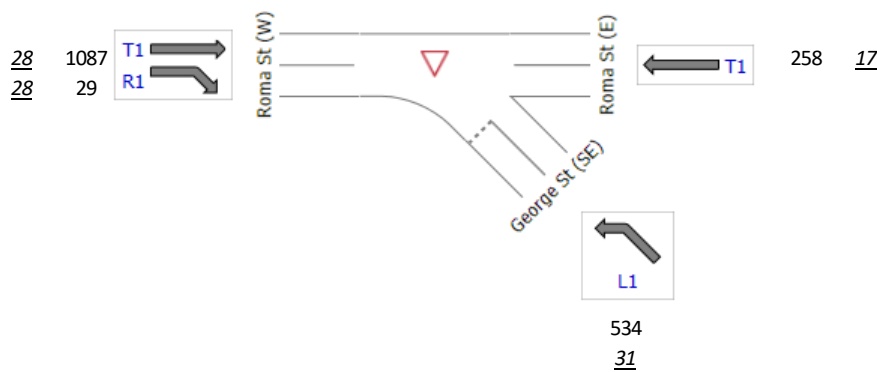


Figure A14: 2036 Roma Street / George Street volumes

A2.3 Pedestrian Volumes

Pedestrian movement information was provided through pedestrian crossing surveys at locations along Roma Street (dated 15 March 2018) including:

- Roma Street / Makerston Street;
- Roma Street / Parkland Boulevard; and
- Pedestrian Overpass (George Street landing).

Because of the proposed change to the Herschel Street and Parkland Boulevard intersection, pedestrians utilising the overpass and crossing at Parkland Boulevard will be redirected to the new crossings provided at Roma Street / Herschel Street. The assumed pedestrian volume at the proposed intersection during the 7:45 – 8:45 AM peak period is provided below.

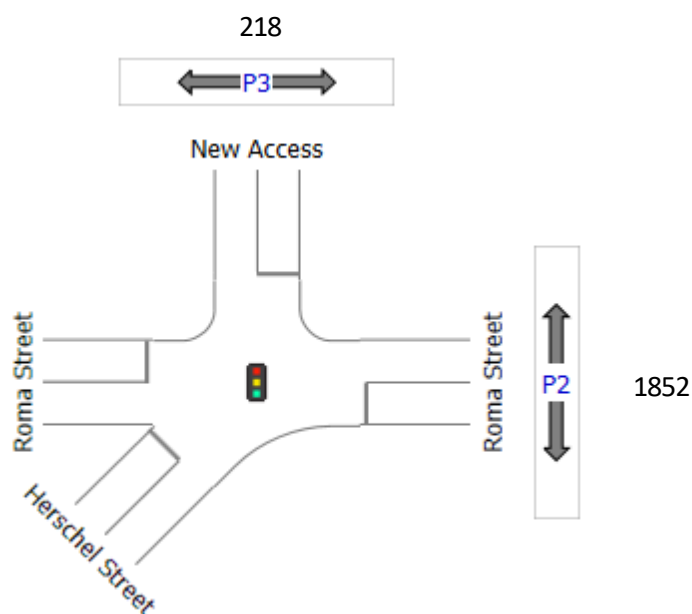


Figure A15: Proposed intersection pedestrian volumes

The pedestrian volumes for the Roma Street / Makerston Street intersection is provided in Figure A16 below.

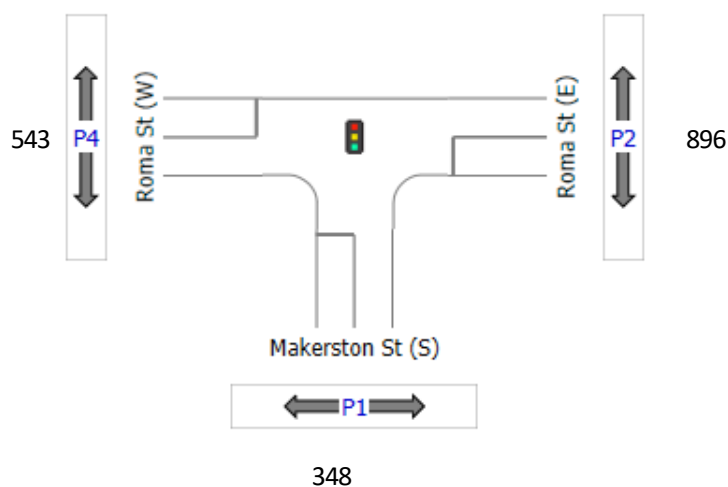


Figure A16: Makerston Street pedestrian volumes

A2.4 Signal Phasing

The phasing for Makerston Street is based on the existing signal plans provided by BCC and is provided in the Figure A17 below.

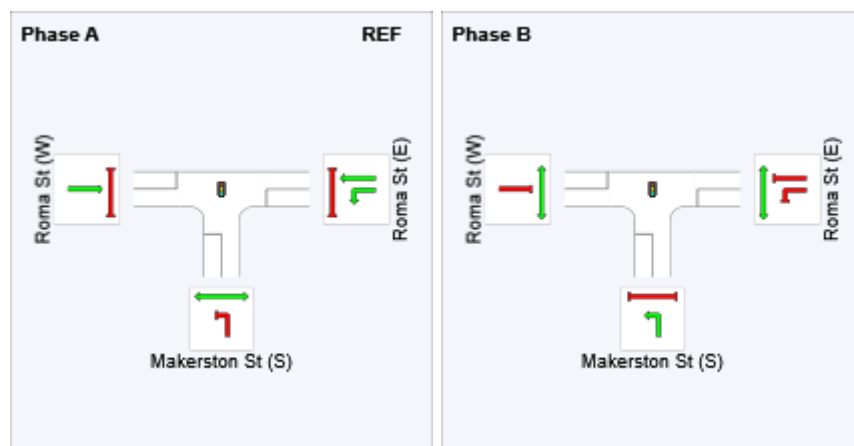


Figure A17: Roma Street / Makerston Street phasing

No phase sequences have been proposed for the modified intersection. The following signal phases is assumed for this analysis. It is noted that no dedicated right turn movement have been provided for the Roma Street (eastern approach) as the existing right turn into Parkland Boulevard is also a filtered movement. The indicative phasing is provided below.



Figure A18: Modified Roma Street / Herschel Street phasing

Due to the significant changes to the intersection layouts and phasing sequence, the existing phase timings were not utilised and instead determined based on SIDRA's optimised timings.

A2.5 Intersection Performance

The intersection analysis was undertaken using the SIDRA Intersection 8.0 package. To quantify the intersection performance, the following performance measures have been reported:

- Degree of Saturation (DOS (%)) – this is the ratio of demand flow to capacity. For a signalised intersection, the DOS should remain below 90%;
- Average delay (sec) – The average delay per vehicle in second incurred by vehicles over the modelled time period;
- Level of Service (LOS) – An index of the operational performance of traffic on a given approach based on average delays; and
- 95th percentile queue (m) – A queue length measured in metres of which only 5% of queues are equal to or greater than.

The overview of the network performance in terms of DOS and LOS is provided below.

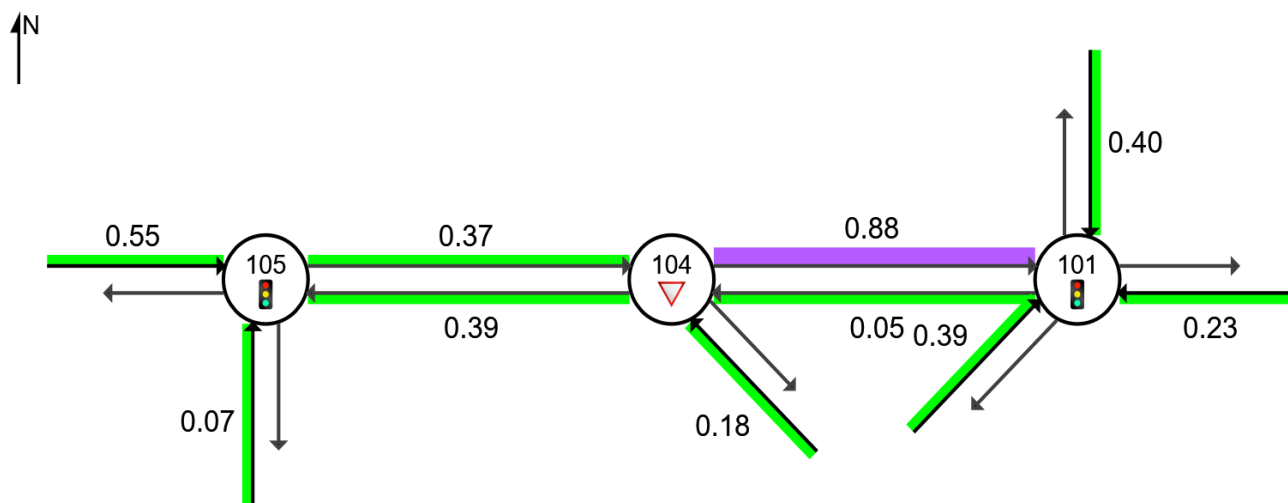


Figure A19: Network performance summary (DOS)

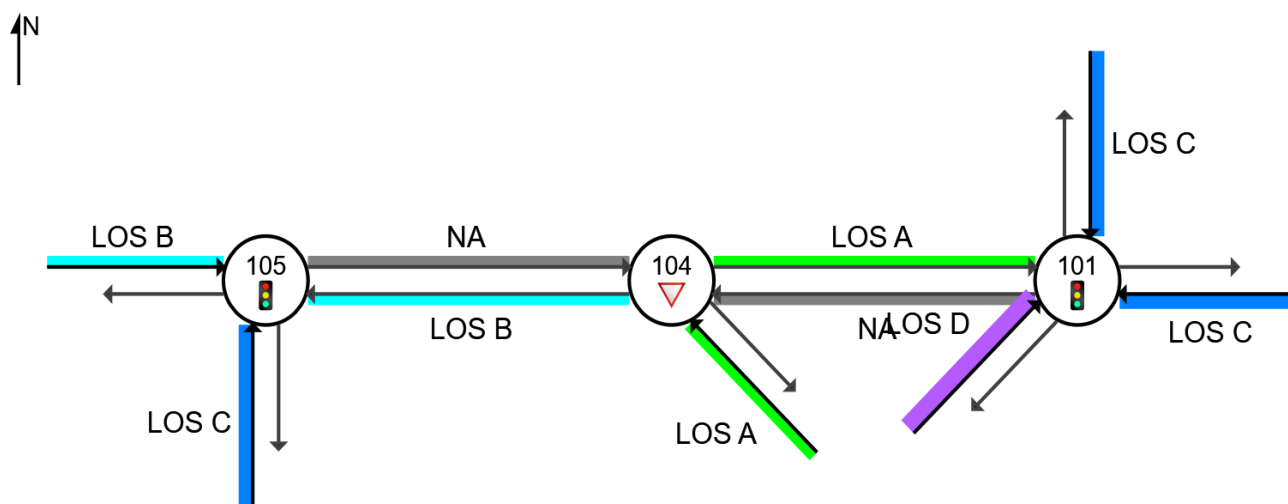


Figure A20: Network performance summary (LOS)

A detailed summary of the intersection performance in the 2036 design year is provided in Table A5 below.

Table A5. 2036 Design year intersection performance summary

Intersection / Approach	DOS (v/c)	Delay (s)	Level of Service	95 th Queue (m)
Roma St / Parkland Boulevard				
Roma Street (E)	23%	20.5	LOS C	14.9
New Access (N)	40%	28.5	LOS C	23.8
Roma Street (W)	88%	5.9	LOS A	43.4
Herschel Street (SW)	39%	37	LOS D	9.7
All Vehicles	88%	13.6	LOS B	43.4
Roma St / George St				
George St (SE)	18%	2.7	LOS A	2.5
Roma St (E)	5%	0	NA	0
Roma St (W)	37%	0.1	NA	0.9

All Vehicles	37%	0.8	NA	2.5
Roma St / Makerston St				
Makerston St (S)	7%	20.1	LOS C	4.4
Roma St (E)	39%	15.6	LOS B	31.6
Roma St (W)	55%	17	LOS B	46
All Vehicles	55%	16.5	LOS B	46

Based on the analysis above, it is determined that the proposed layout will operate within capacity for the AM peak period based on the traffic growth rates and pedestrian volumes provided. It is acknowledged that there will be a need to coordinate signal timings with nearby intersection which may potentially reduce the intersection performance. However, for the purpose of this technical note, the intersection performance in 2036 for the proposed design is still adequate.

A3 SIDRA analysis of critical intersections with construction traffic

A3.1 Intersections assessed

Consistent with the Evaluated Project, construction traffic has the potential to impact on existing traffic conditions through additional construction vehicles using the road network. Construction traffic would be generated from spoil haulage from excavation sites and tunnels, and from the delivery of construction materials including oversized loads.

An assessment of the impact has been done at precincts where there has been an increase in construction traffic and a potential impact has been identified. The following is an analysis of the most critical intersections around each site where construction traffic is likely to increase significant delays.

The intersections assessed are:

Area	Specific location
Northern Portal	<i>Bowen Bridge Road, Gregory Terrace and Brunswick Street (Proposed) Gregory Terrace and Victoria Park access</i>
Albert Street	Albert Street and Alice Street Albert Street and Charlotte Street Albert Street and Elizabeth Street Albert Street and Margaret Street Albert Street and Mary Street George Street and Alice Street George Street and Charlotte Street George Street and Elizabeth Street George Street and Margaret Street George Street and Mary Street
Woolloongabba Station	Vulture Street and Main Street Leopard Street and Stanley Street Main Street and Stanley Street
Boggo Road Station	Annerley Road and Peter Doherty Street Annerley Road and Boggo Road
Southern Portal	Ipswich Road and O'Keefe Street
Clapham Yard	Fairfield Rd, Sherwood Rd and Muriel Ave

A3.2 Methodology

The Guide to Traffic Impact Assessment (GTIA) states that an assessment must be completed for a new development, the intersection delay impacts for all intersections where the "development traffic exceeds 5% of the base traffic for any movement in the design peak periods in the year of opening of each stage".

The 5% excess has been calculated for each intersection by comparing to the overall flow of each movement where CRR construction traffic is expected to travel through. For the analysis, heavy vehicles movement have been converted to Passenger Car Equivalents as per the Austroads Guide to Traffic Management Part 3, which states that:

- Vehicle classes 2 to 5: 2 passenger car equivalents
- Vehicle classes 6 to 9: 3 passenger car equivalents

- Vehicle classes 10 to 11: 4 passenger car equivalents
- Vehicle class 12: 5 passenger car equivalents.

In this analysis, the heavy vehicle from the traffic surveys were assumed to be between vehicle classes 2 to 5 (2 pcu). The heavy vehicles added by the project are assumed to be between Class 6 to 9 which the equivalent of 3 pcu.

A SIDRA analysis has been completed for those intersections where construction traffic has exceeded 5%. All the analysis has been done for the opening year (2025).

A3.3 Construction traffic volumes

Peak construction traffic generated by each site is detailed below in Table A6.

Table A6. Peak construction traffic volumes

Station	RfPC-1	Changed project	PCU rate
Mayne Yard	8	11	33
Northern Portal	5	10	30
Exhibition Station	4	11	33
Roma Street	6	15	45
Albert Street	5	13	39
Woolloongabba	11	23	69
Boggo Road	6	24	72
Southern Portal	3	9	27
Clapham Yard	n/a	17	51

A3.4 Intersections below 5% impact

A preliminary analysis shows that the following intersections will not be affected by the Changed Project as the additional traffic does not increase the overall volume of the intersection by more than 5%.

Clapham Yard Station

Fairfield Road / Sherwood Road / Muriel Avenue

For this intersection, it has been assumed that 50% of the traffic will arrive from the north and 50% from the south as vehicles are likely to use any of the spoil locations. A 2% traffic growth rate has been considered.

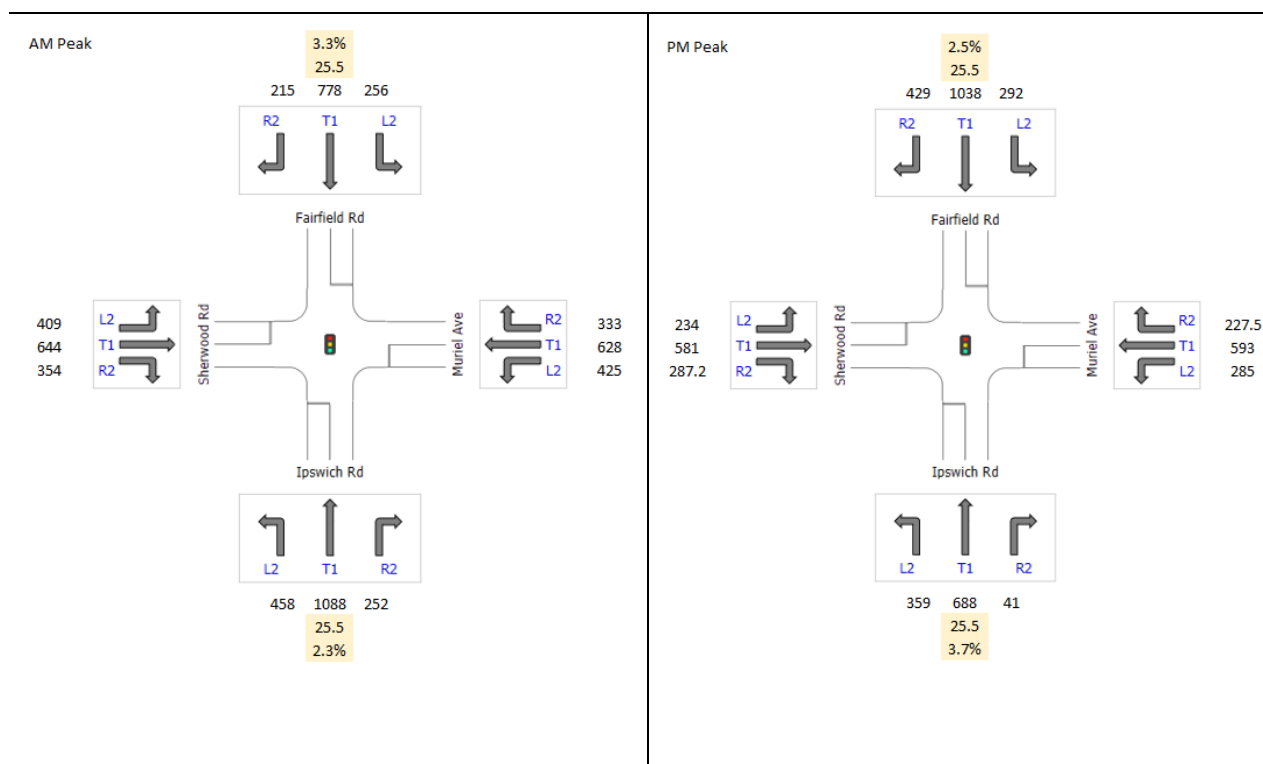


Figure A21: Fairfield Road / Sherwood Road / Muriel Avenue volumes

A3.5 Detailed intersection analysis

The intersections with additional construction volumes in the excess of 5% have been analysed for both AM and PM peak periods for the 2025 design year. The performance summaries for these intersections is provided in Table A7 below.

Table A7. Intersection performance summary

Precinct	Site name	Peak	2025 Without Construction		2025 With Construction	
			DOS	LOS	DOS	LOS
Albert Street	George Street and Elizabeth Street	AM	75%	C	87%	C
		PM	58%	A	81%	C
	Albert Street and Elizabeth Street	AM	46%	A	80%	C
		PM	79%	C	85%	C
	Albert Street and Charlotte Street	AM	59%	A	54%	A
		PM	79%	C	88%	C
	George Street and Charlotte Street	AM	42%	A	54%	A
		PM	55%	A	82%	C
	George Street and Mary Street	AM	52%	A	81%	C
		PM	59%	A	78%	C
	Albert Street and Mary Street	AM	67%	B	84%	C
		PM	63%	B	74%	C
	Albert Street and Margaret Street	AM	49%	A	52%	A
		PM	41%	A	51%	A

	George Street and Margaret Street	AM	53%	A	57%	A
		PM	55%	A	58%	A
	George Street and Alice Street	AM	67%	B	71%	C
		PM	84%	C	91%	D
	Albert Street and Alice Street	AM	31%	A	44%	A
		PM	74%	C	60%	B
Woolloongabba	Main St-Vulture St	AM	94%	D	96%	E
		PM	141%	F	144%	F
	Main St-Stanley St	AM	125%	F	126%	F
		PM	109%	D	117%	E
	Leopard St-Stanley St	AM	83%	C	85%	C
		PM	-	-	-	-
Boggo Road	Annerley Rd-Peter Doherty Dr	AM	50%	A	50%	A
		PM	51%	A	57%	B
	Annerley Rd-Boggo Rd	AM	65%	B	65%	B
		PM	62%	B	65%	B
Southern Portal	Ipswich Rd-O'Keefe St (access from the east)	AM	99%	E	99%	E
		PM	128%	F	128%	F
	Ipswich Rd-O'Keefe St (access from the south)	AM	99%	E	99%	E
		PM	128%	F	131%	F
Exhibition Station and Northern Portal	Gregory Tce - Bowen Bridge Rd - Brunswick St	AM	129%	F	139%	F
		PM	118%	F	127%	F
	(Proposed) Gregory Tce - Victoria Park access	AM	-	-	78%	A
		PM	-	-	67%	A
Clapham Yard	Fairfield Rd - Palomar Road - Chale St	AM	80%	C	81%	C
		PM	84%	C	85%	D

All ten assessed intersections in the CBD (Albert Street Station) were observed to operate within acceptable limits (LOS D or better) with the addition of construction vehicles. It is not anticipated that the additional construction vehicles will adversely impact the operation of these intersections.

The following intersections were observed to operate within acceptable limits (LOS D or better) with the addition of construction vehicles and therefore significant adverse impacts to the network are not anticipated:

- Leopard St - Stanley St
- Annerley Rd - Peter Doherty Dr
- Annerley Rd – Boggo Rd
- (Proposed) Gregory Tce - Victoria Park access
- Fairfield Rd – Palomar Rd – Chale St

The PM peak of Leopard St – Stanley St was not assessed as the construction volume for PM peak was less than 5% of total through movement from Leopard St to Pacific Mwy SB on-ramp.

As part of construction of the Exhibition Station a construction access point has been proposed off Gregory Terrace (approximately 130m west of Gregory Tce - Brunswick St). This involves the introduction of a signalised intersection alongside the removal of on-street parking at this location to accommodate a new turning lane for construction vehicles. As the intersection does not currently exist there were no intersection results for the 'without construction' scenario.

The SCATS data provided for the Fairfield Rd – Palomar Rd – Chale St intersection does not include counts for the left turn slip lane (onto Chale Street) from the northern approach. It is assumed in the analysis that the number of vehicles utilising the sip lane will be the same as the vehicles exiting Chale St during the respective peak periods.

The following intersections were observed to operate at LOS E or F, both with and without construction vehicles:

- Main St-Vulture St
- Main St-Stanley St
- Ipswich Rd-O'Keefe St (access from the east)
- Ipswich Rd-O'Keefe St (access from the south)
- Gregory Tce - Bowen Bridge Rd- Brunswick St.

However, it was observed that the addition of the construction traffic only has a minor impact on the intersections, thus the impacts are deemed to be within acceptable limits. Therefore, the construction traffic impact generated by Changed Project CRR is not anticipated to have a significant adverse impact on the operations of these intersections.

Nevertheless, mitigation will be further assessed during development of the CTMP.

Appendix B: Settlement Contours



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DRAWN		03.10.18
DRG CHK		03.10.18
DESIGN APPROVAL / CERTIFICATION		03.10.18
PROFESSIONAL	DATE	

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DELIVERY AUTHORITY

Network - Civil Engineering

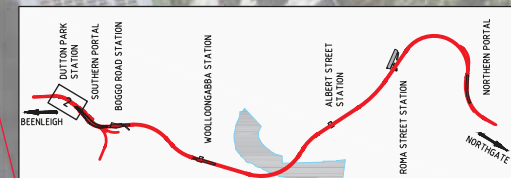
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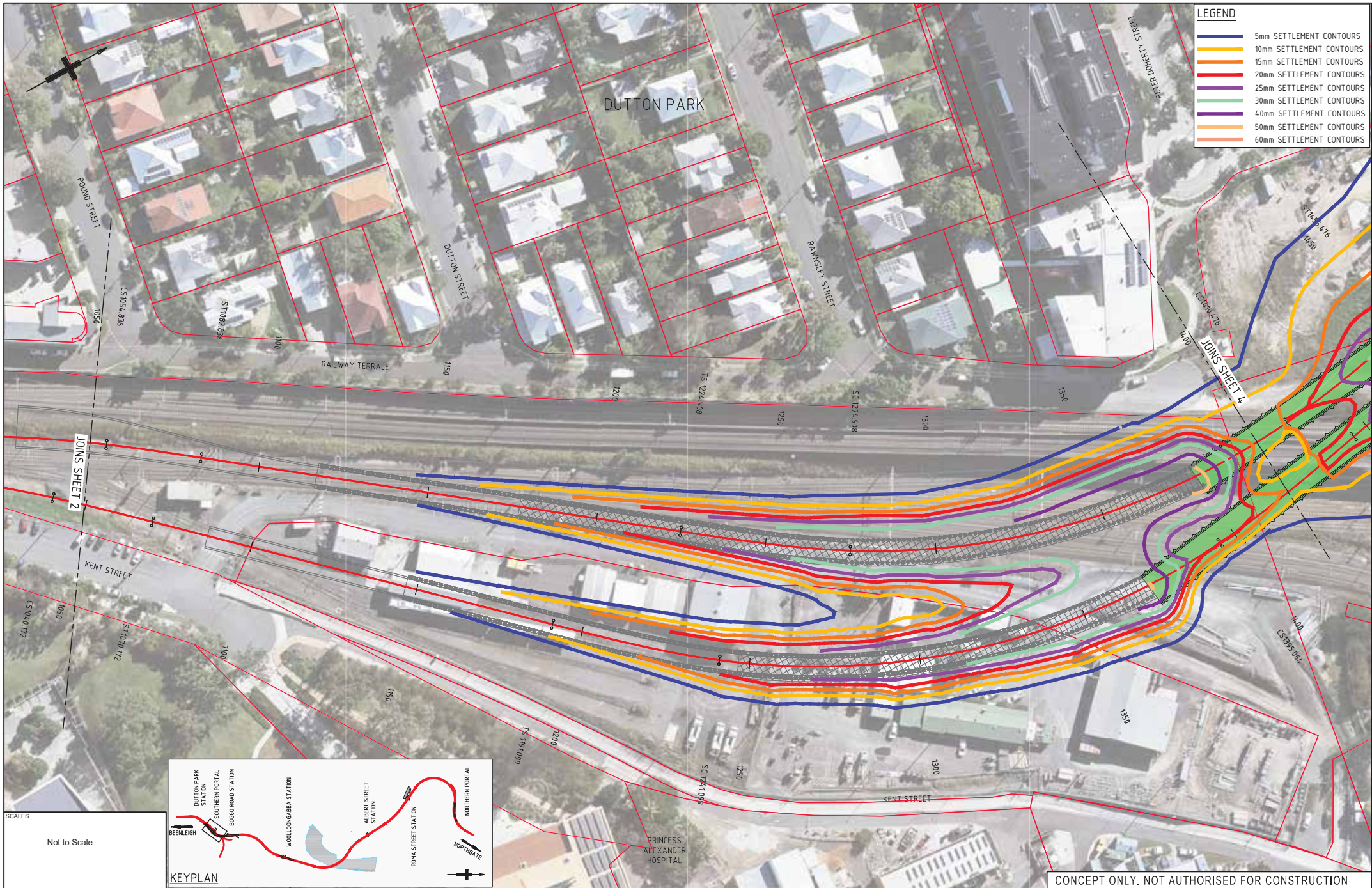
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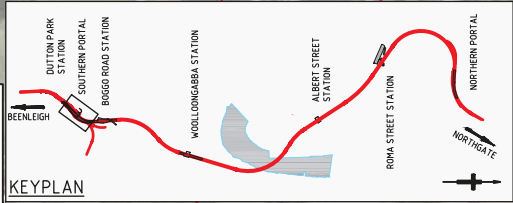
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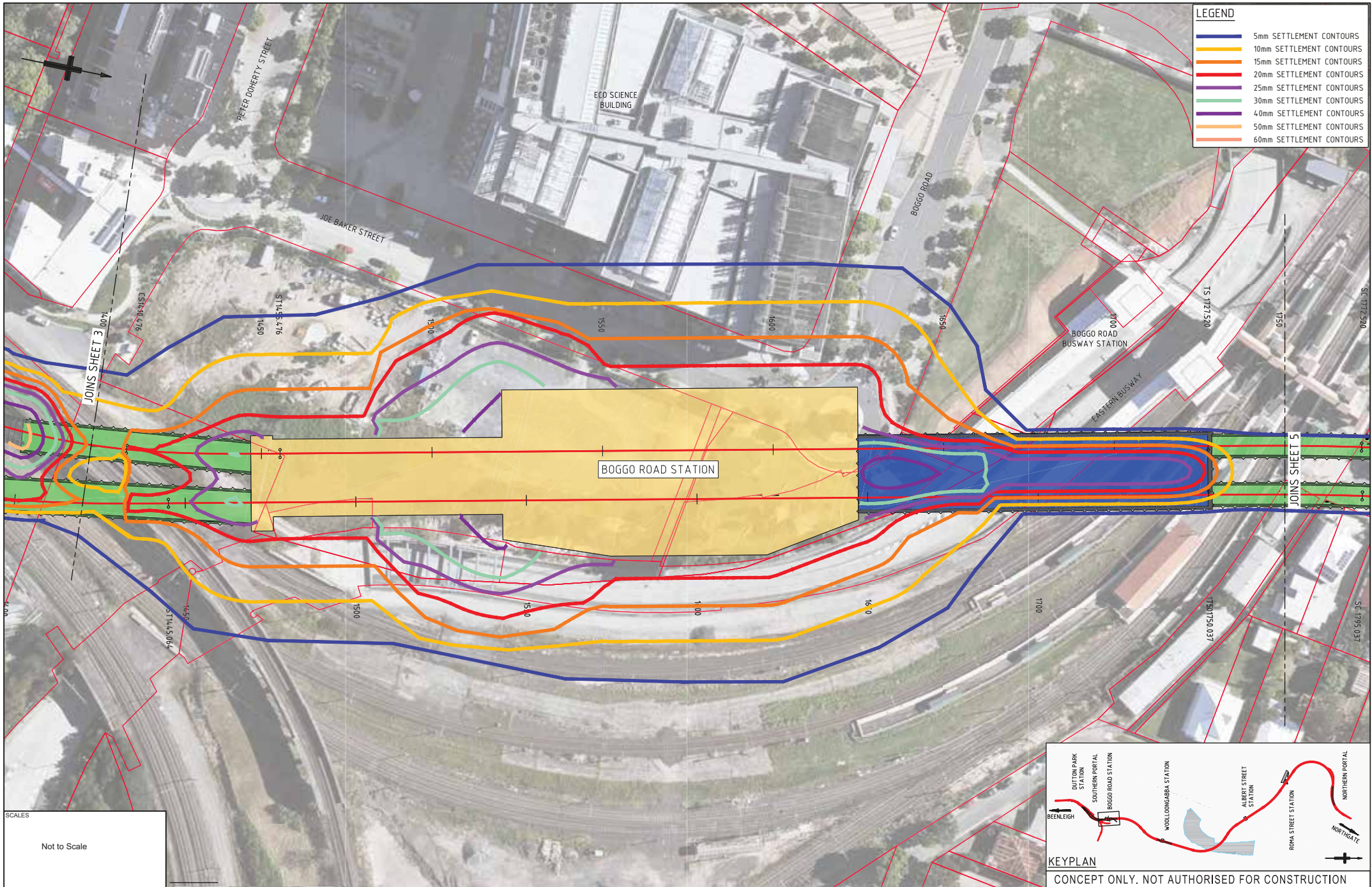
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Network - Civil Engineering

PROJECTWIDE
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PROFESSIONAL QUALIFICATION	DATE

CROSS RIVER RAIL
DELIVERY AUTHORITY

Network - Civil Engineering

PROJECTWIDE
CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
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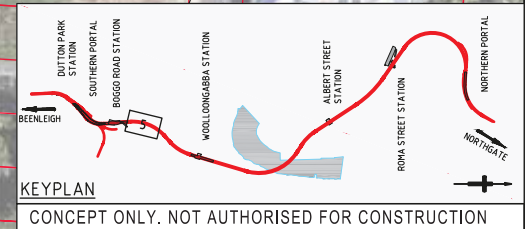


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PROJECTWIDE
CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 4

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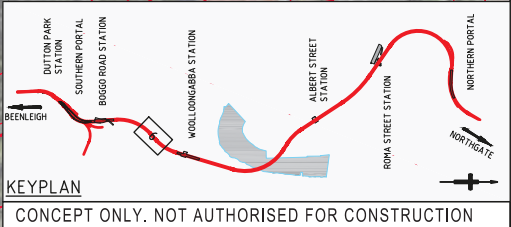
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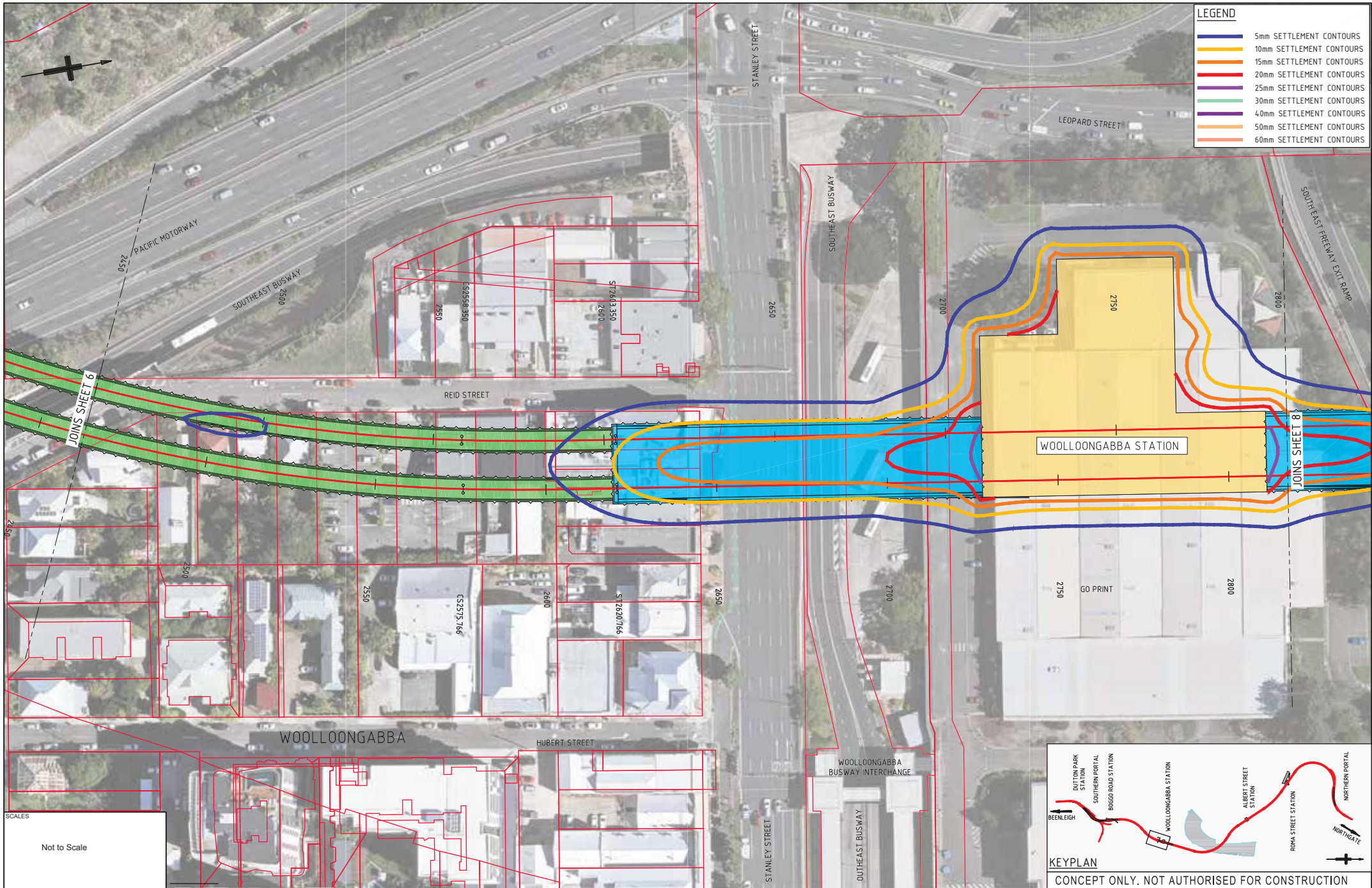


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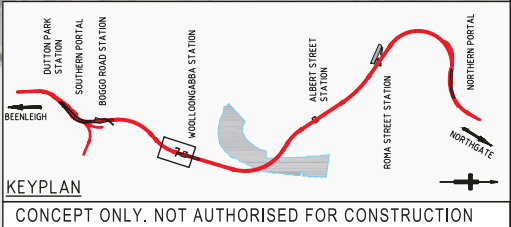
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SCALES

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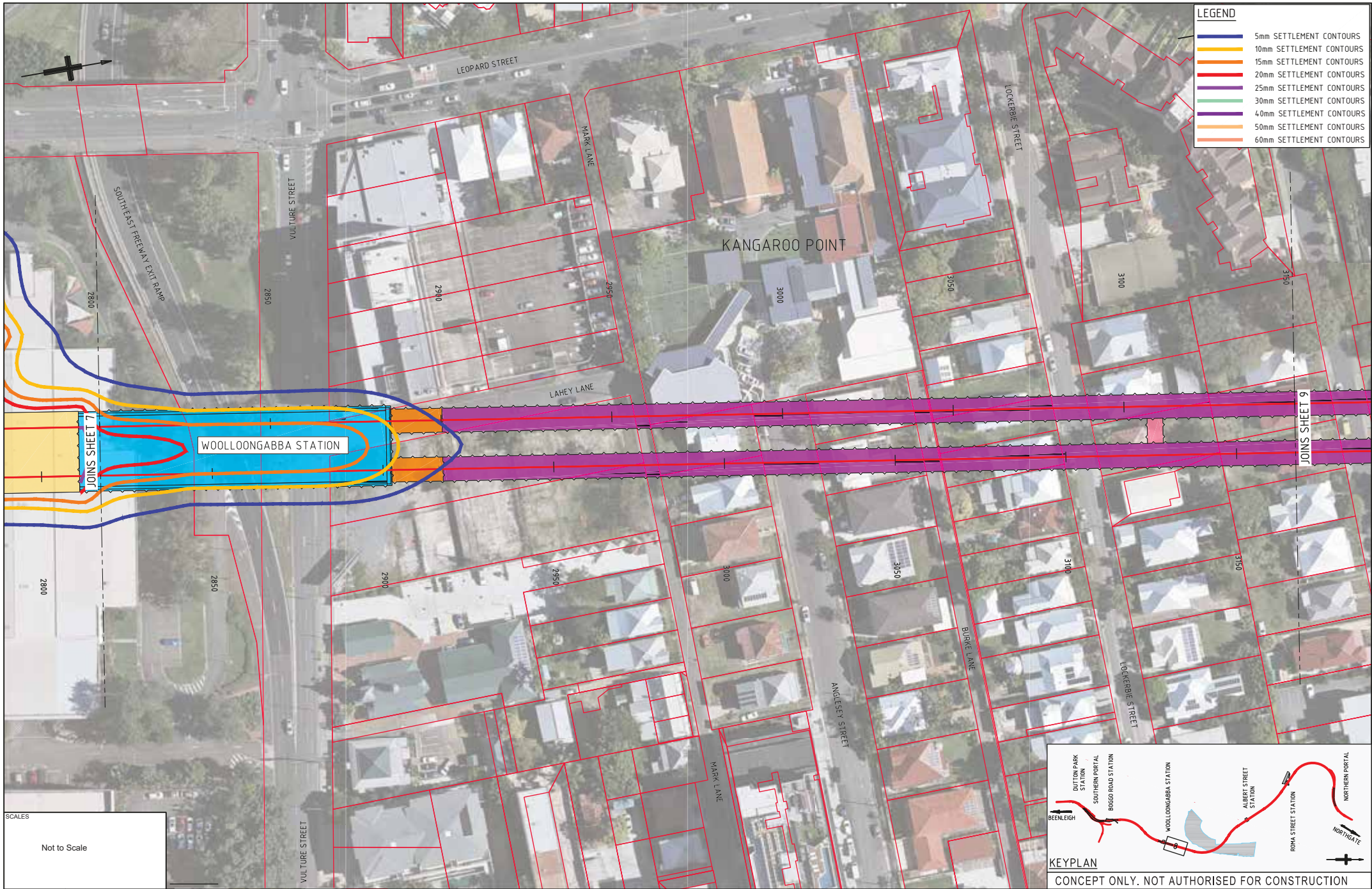
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PROFESSIONAL QUALIFICATION	DATE

**CROSS RIVER RAIL
DELIVERY AUTHORITY**

Network - Civil Engineering

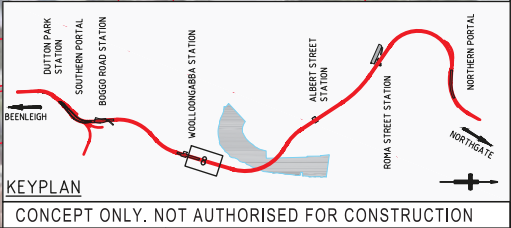
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CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 6

DRAWING NUMBER	ISSUE
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CROSS RIVER RAIL
DELIVERY AUTHORITY

Network - Civil Engineering

PROJECTWIDE
CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 7

DRAWING NUMBER

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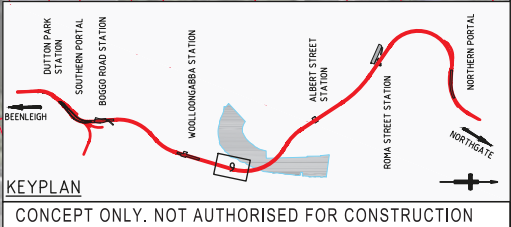
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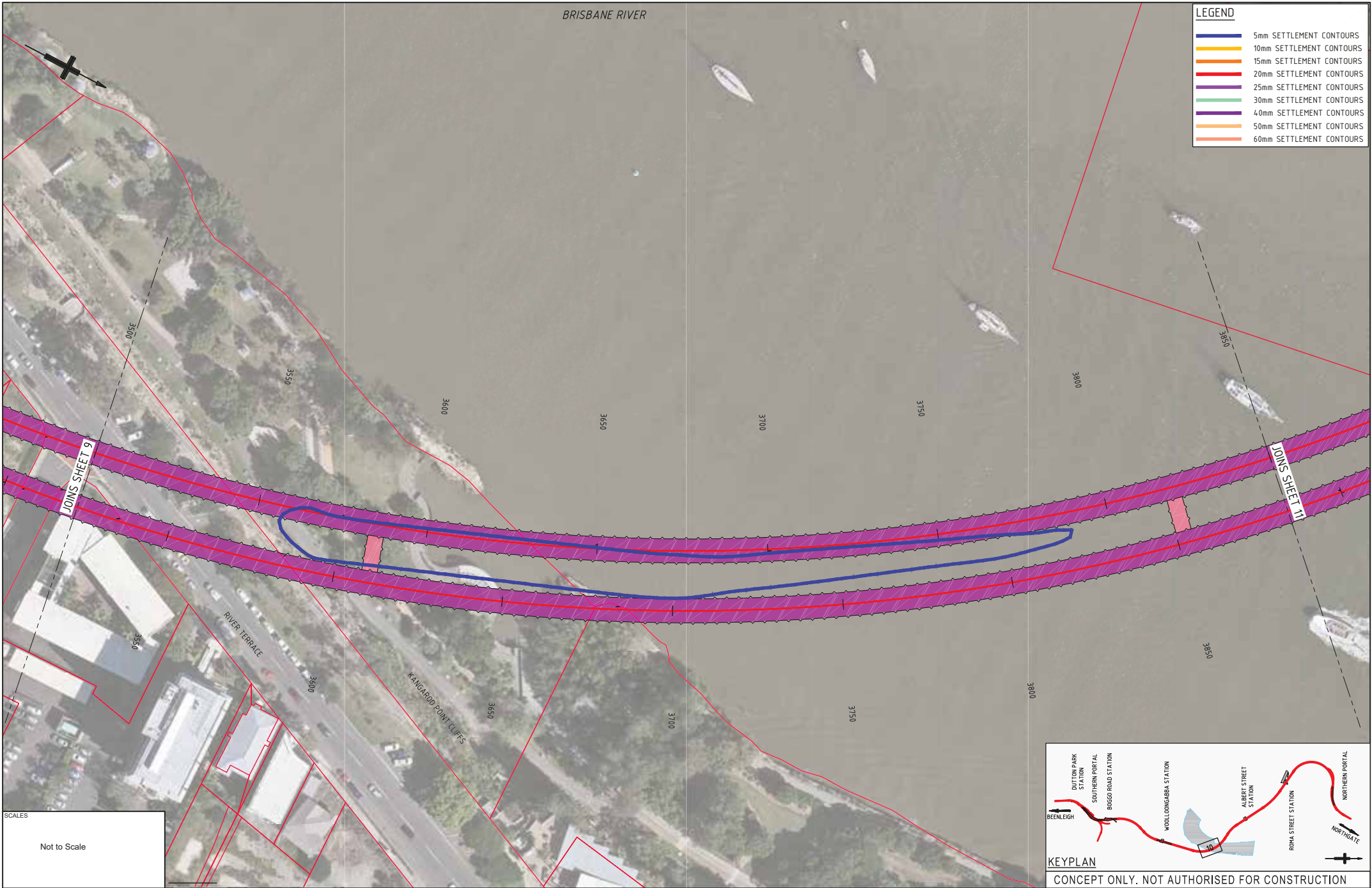
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CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 8

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CROSS RIVER RAIL
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GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 9

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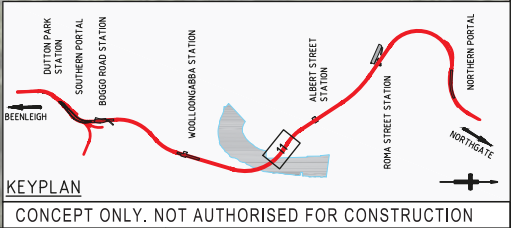
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CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 10**

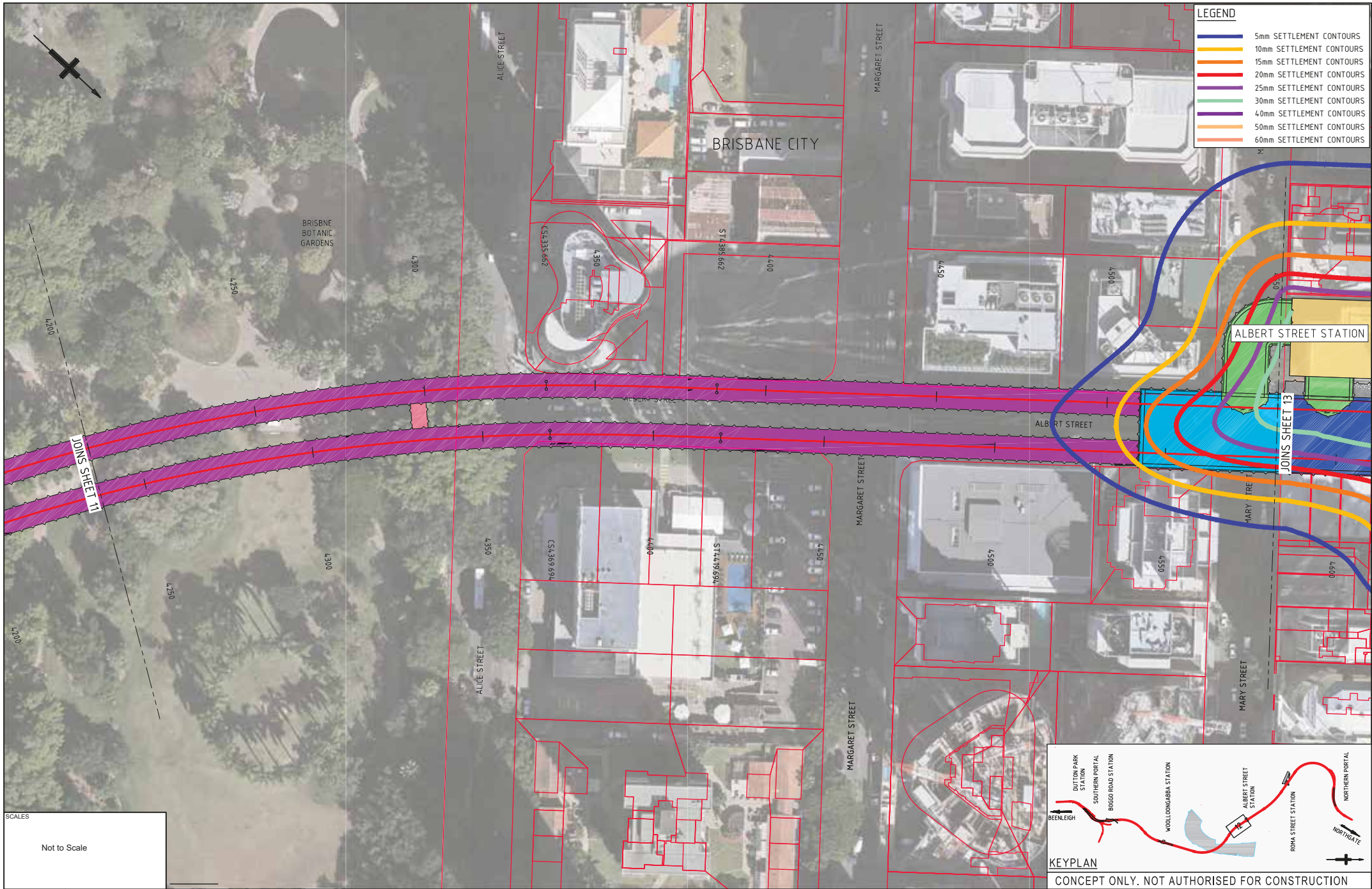
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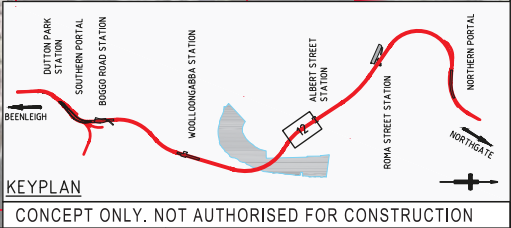
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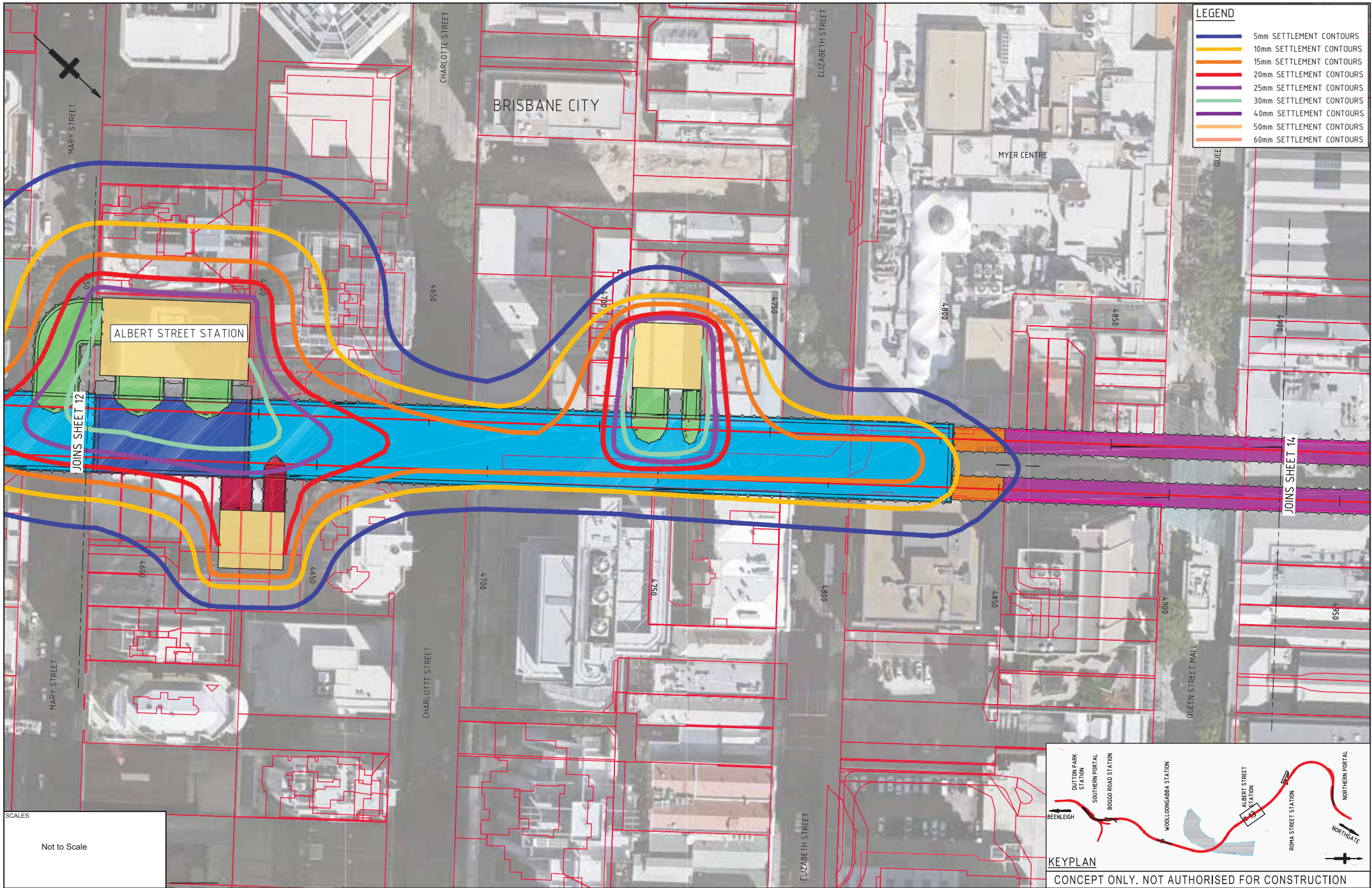
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CROSS RIVER RAIL DELIVERY AUTHORITY

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PROJECTWIDE
CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 11

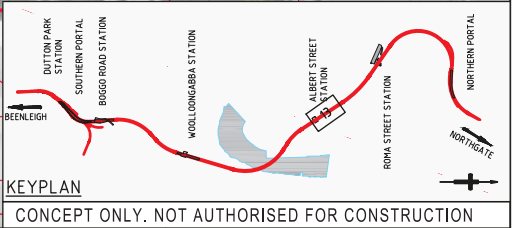
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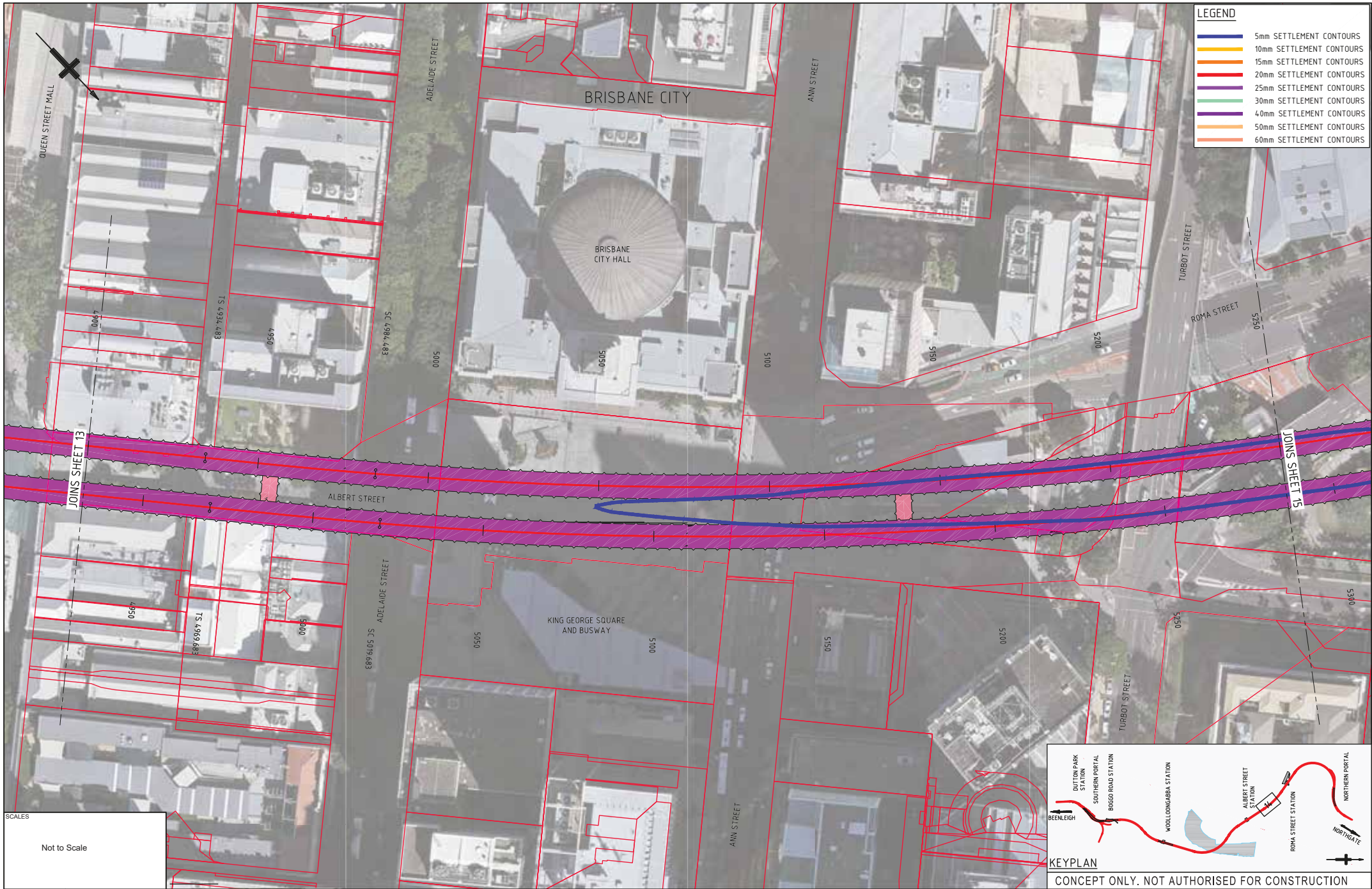
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CROSS RIVER RAIL DELIVERY AUTHORITY

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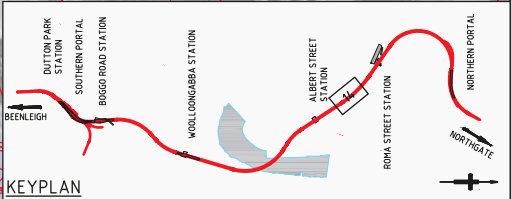
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CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 12

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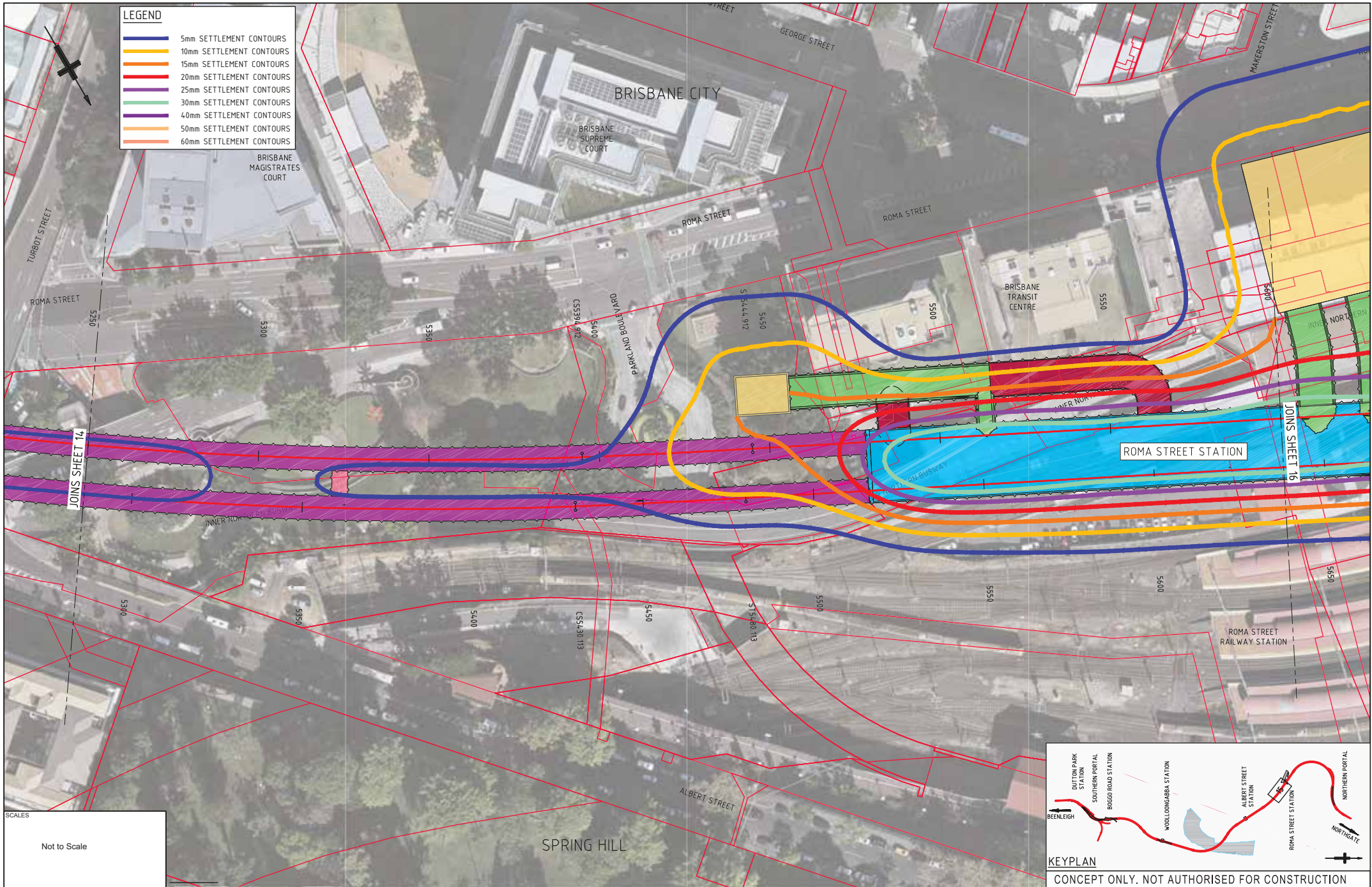


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CROSS RIVER RAIL
DELIVERY AUTHORITY

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PROJECTWIDE
CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 13

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CROSS RIVER RAIL
DELIVERY AUTHORITY

Network - Civil Engineering

PROJECTWIDE
CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 14

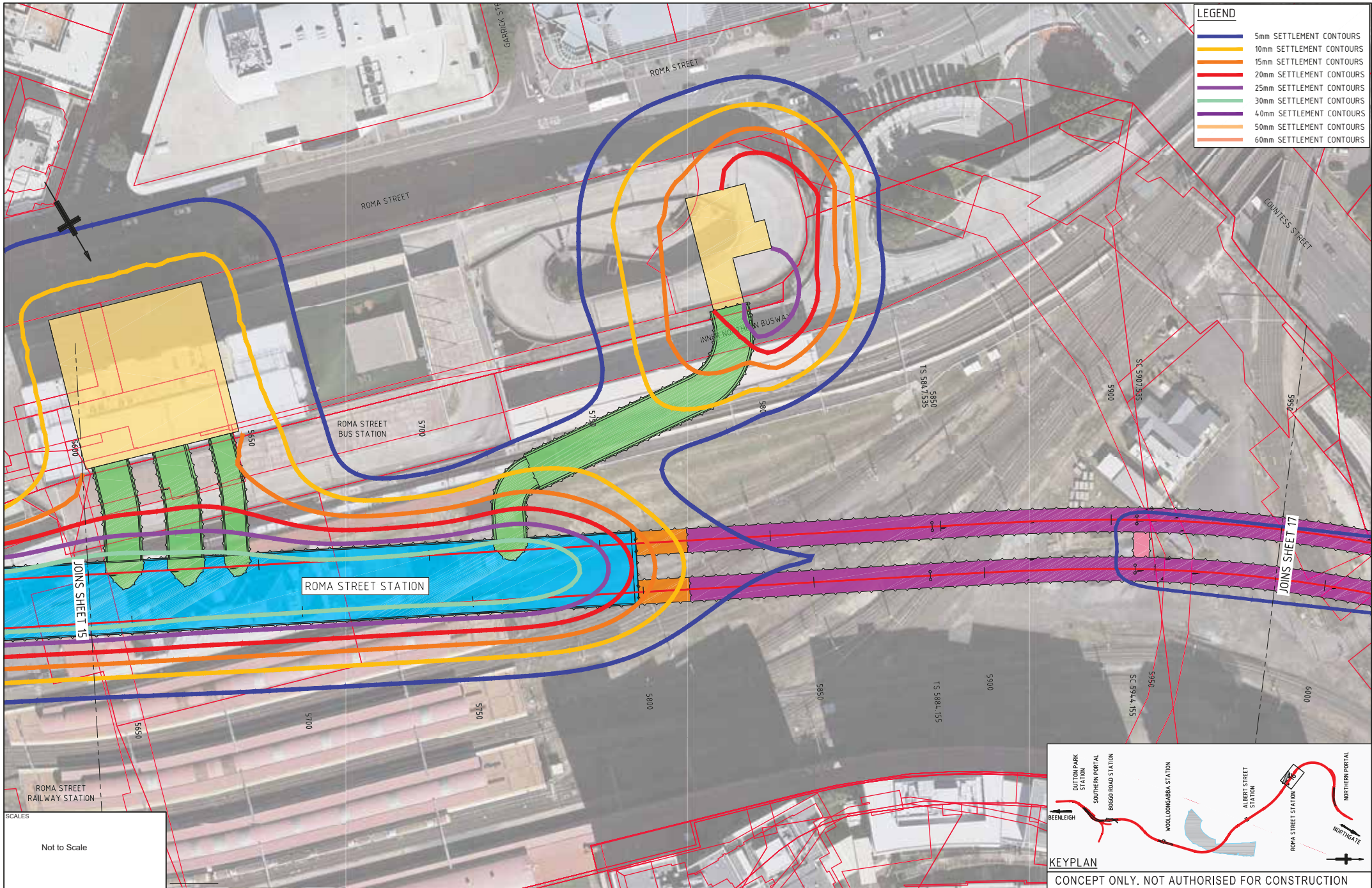
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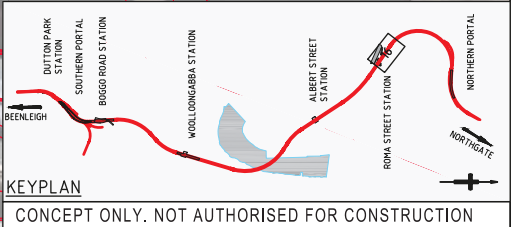


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ROMA STREET RAILWAY STATION

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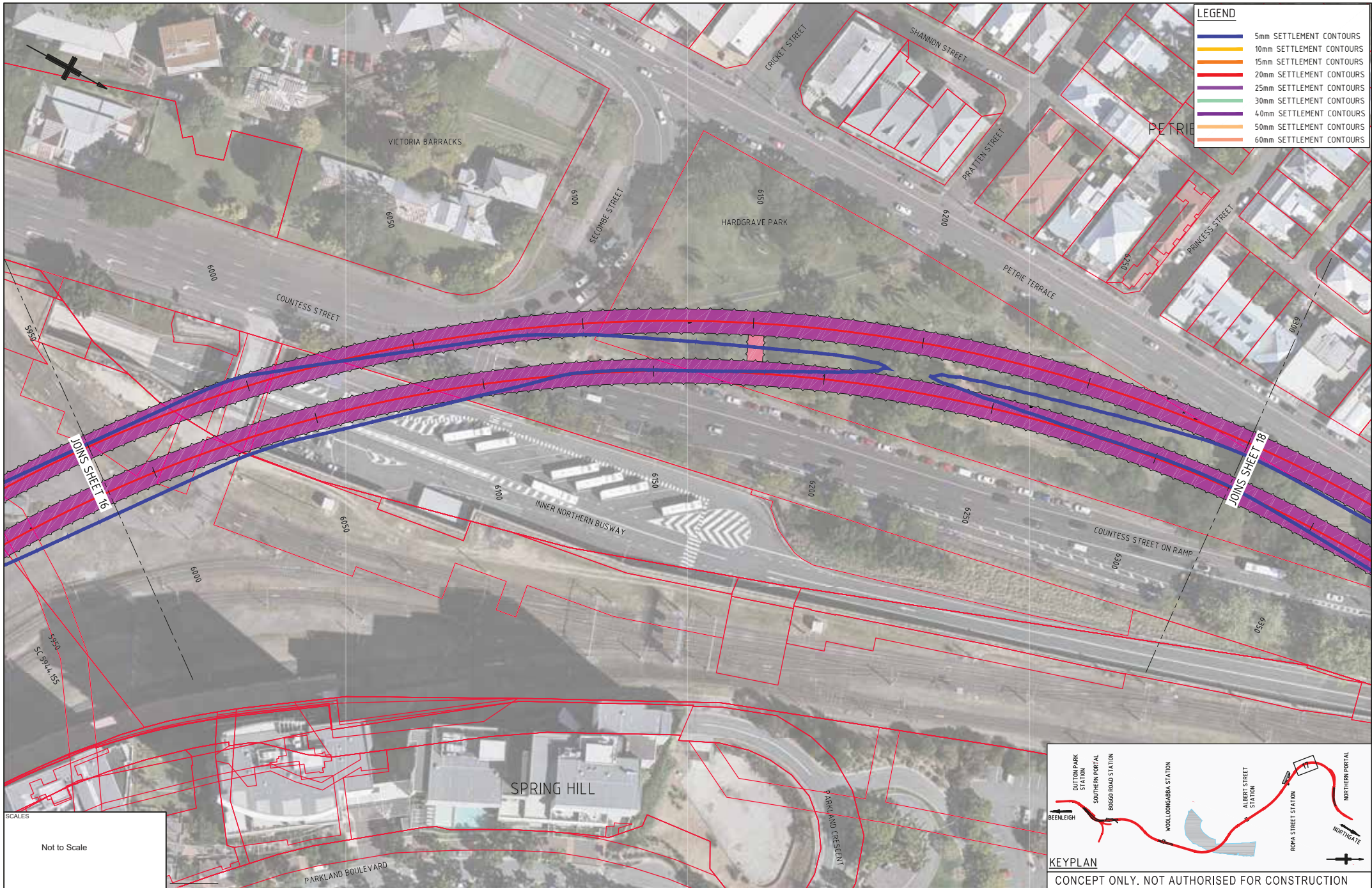
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**CROSS RIVER RAIL
DELIVERY AUTHORITY**

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PROJECTWIDE
CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 15

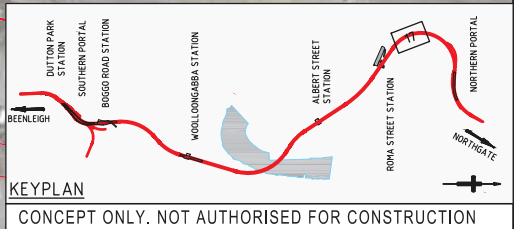
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SCALES

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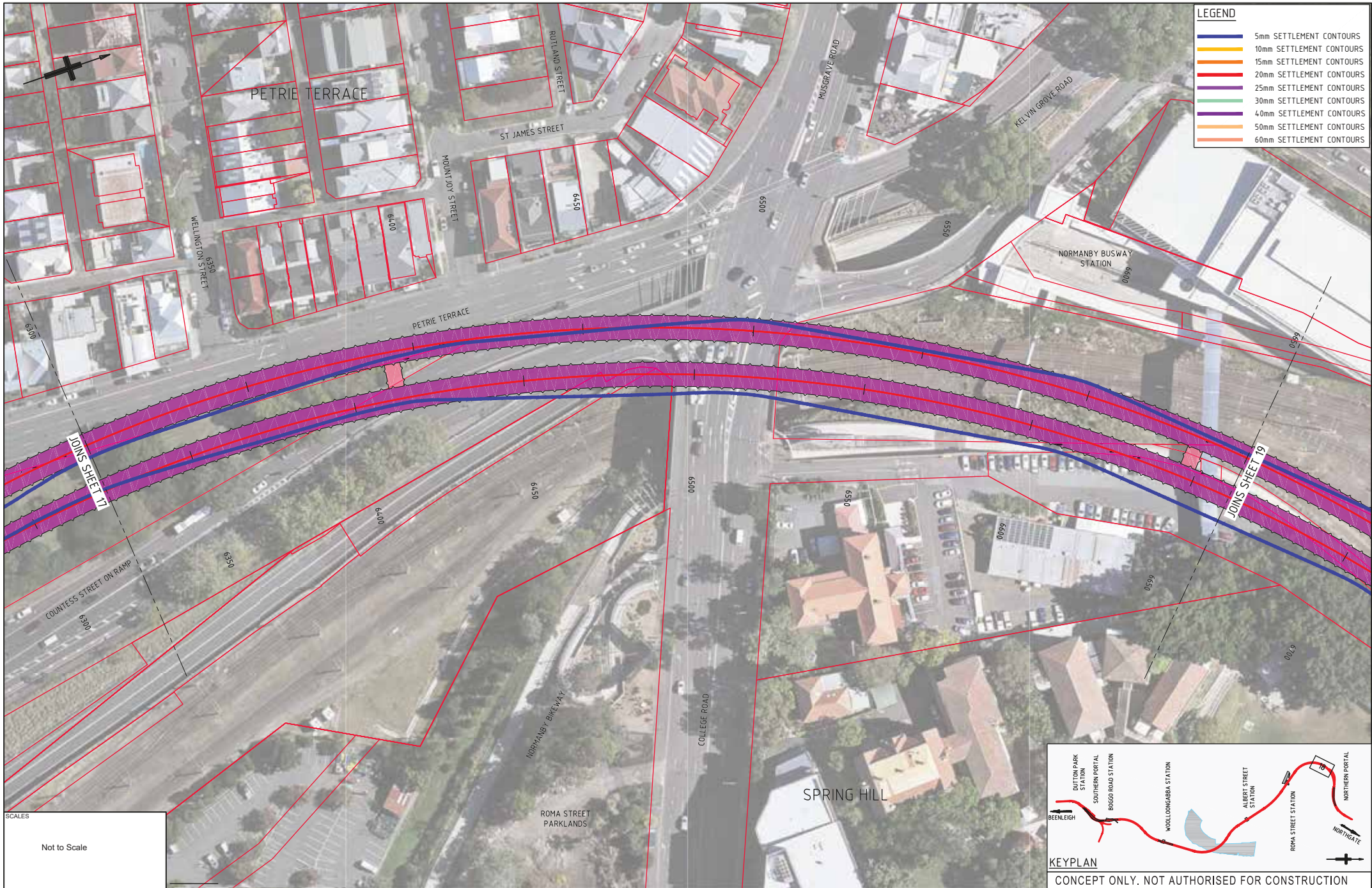
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CROSS RIVER RAIL DELIVERY AUTHORITY

Network - Civil Engineering

PROJECTWIDE
CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 16

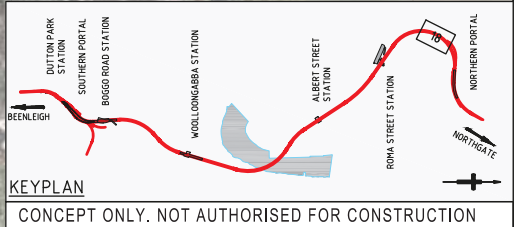
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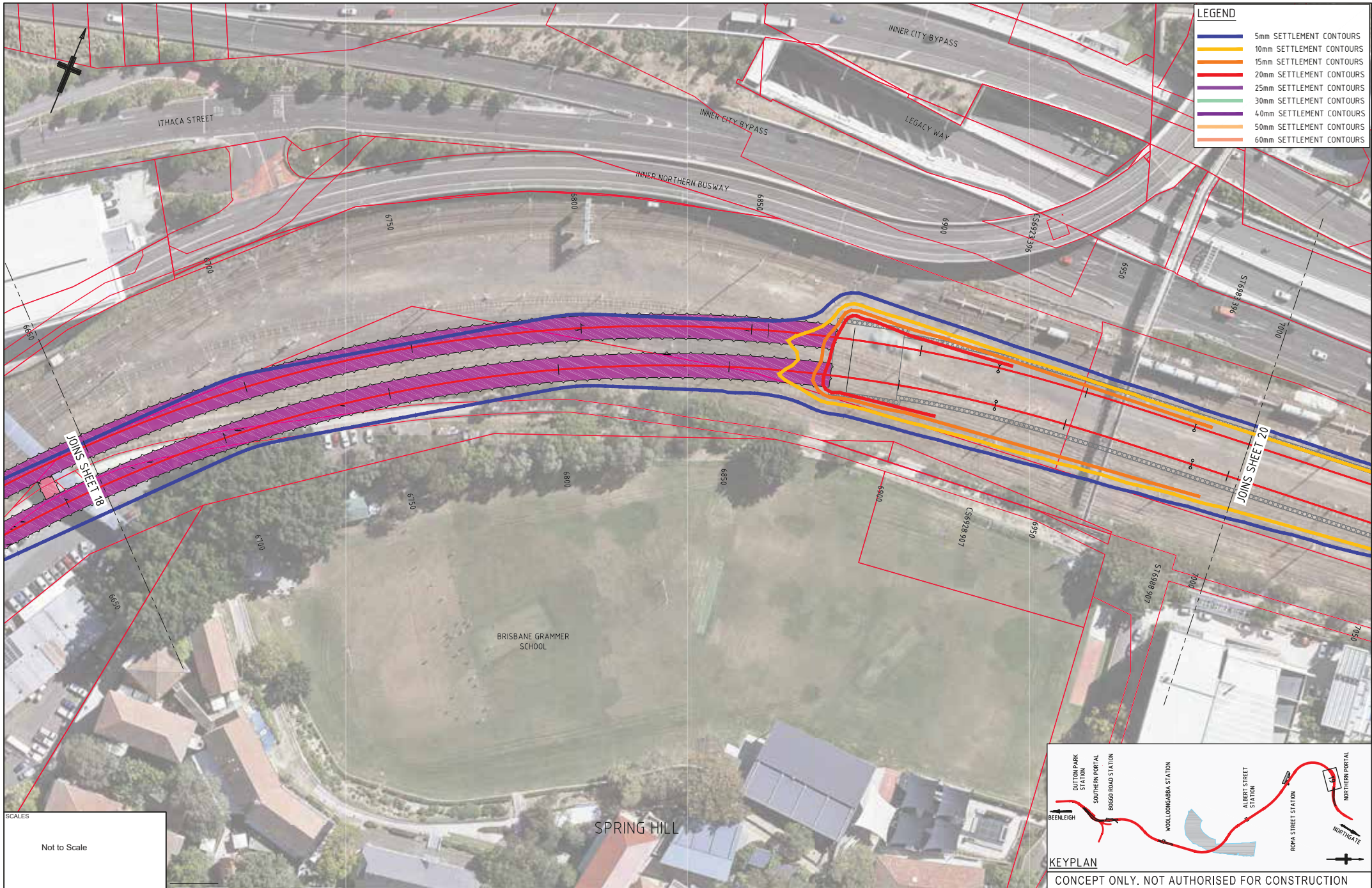
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**CROSS RIVER RAIL
DELIVERY AUTHORITY**

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CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 17

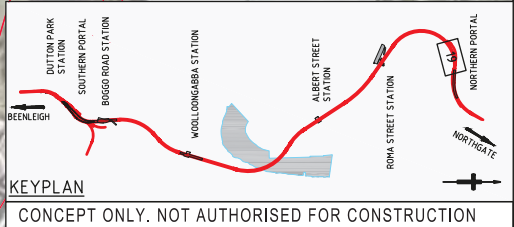
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SCALES

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CROSS RIVER RAIL
DELIVERY AUTHORITY

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CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 18

DRAWING NUMBER

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CROSS RIVER RAIL DELIVERY AUTHORITY

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CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 19

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CROSS RIVER RAIL - TSD
GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 20

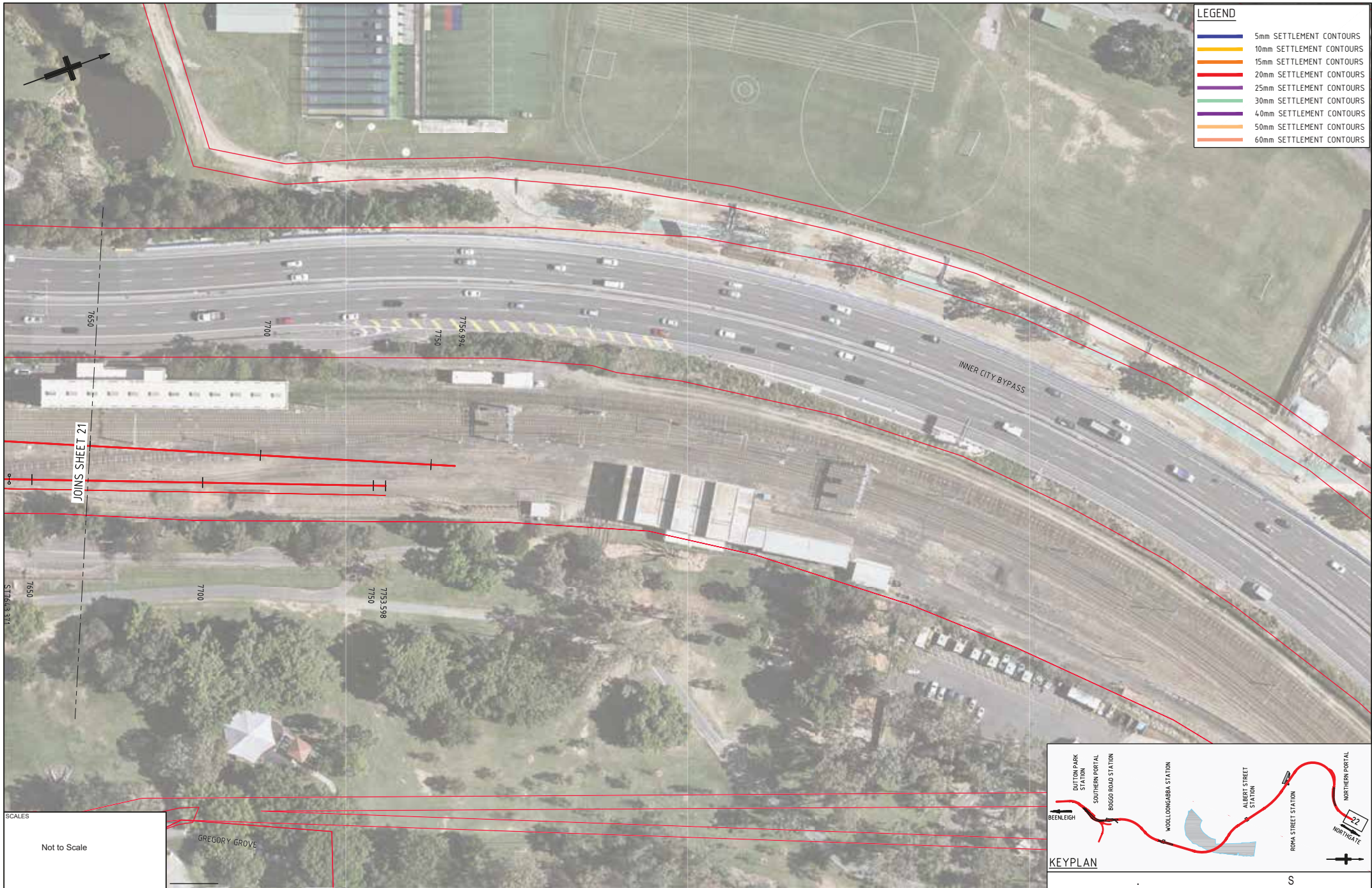
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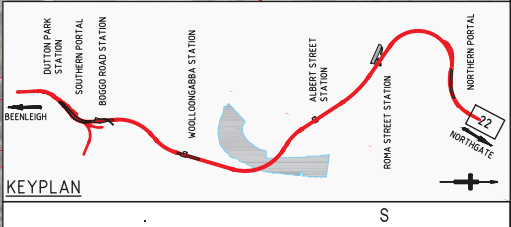
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DELIVERY AUTHORITY**

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**PROJECTWIDE
CROSS RIVER RAIL - TSD**

GENERAL ARRANGEMENT
SETTLEMENT PLAN - SHEET 21

DRAWING NUMBER	ISSUE
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Appendix C: Visual Amenity Assessment Tables

An assessment was conducted to analyse the landscape and visual impacts through the selection of representative viewpoints. Assessments have been evaluated against two main criteria including; the sensitivity of the surrounding environment and the modification expected for the study area.

Assessment Tables

Landscape sensitivity

Landscape Sensitivity	Attributes of landscape sensitivity categories
High	A landscape protected by national designation and/ or widely acknowledged for its quality and value; a landscape with distinctive character and low capacity to accommodate the type of change envisaged.
Moderate	A moderately valued landscape, perhaps a regionally important landscape and / or protected by regional/state designation, or where its character, land use, pattern and the scale may have some capacity to accommodate a degree of the type of change envisaged.
Low	A landscape valued to a limited extent, perhaps a locally important landscape or where its character, land use, pattern and scale are likely to have the capacity to accommodate the type of change envisaged.
Negligible	A landscape which is not valued for its scenic quality or where its character, existing land use, pattern and scale are tolerant of the type of change envisaged, and the landscape has the capacity to accommodate change.

Landscape modification

Landscape Magnitude	Attributes of landscape magnitude categories
High	Dominant change: A clearly evident and frequent/continuous change in landscape characteristics affecting an extensive area, which is likely to fundamentally change the character of the landscape.
Moderate	Considerable change: A considerable change in landscape characteristics, frequent or continuous and over a wide area or a clearly evident change, but over a restricted area.
Low	Noticeable change: A noticeable change in landscape characteristics over a wide area or a considerable change over a restricted area but will not fundamentally change the character of the landscape.

Visual sensitivity

The sensitivity of a user or receptor refers to the context of the view and the appreciation associated with it. This may include the value placed on the viewpoint by viewers, including its contribution to the sense of place or local character of the area. The amount/frequency of viewers experiencing or visiting the views contributes to the sensitivity.

Visual Sensitivity	Attributes of visual sensitivity categories
High	Large numbers of viewers or those with proprietary interest and prolonged viewing opportunities such as residents and users of attractive and/or well-used recreational facilities. Views from a regionally important location whose interest is specifically focussed on the landscape, e.g. national park.
Moderate	Medium numbers of residents (e.g. rural communities and townships) and moderate numbers of visitors with an interest in their environment e.g. visitors to state forests, including bushwalkers, horse riders, trail bikers. Larger numbers of travellers with an interest in their surroundings, e.g. local designated scenic routes.
Low	Small numbers of visitors with a passing interest in their surroundings or transient views, e.g. those travelling along principal roads. Viewers whose interest is not specifically focussed on the landscape, e.g. workers, commuters, truck drivers. Isolated or small clusters of rural residential properties.
Negligible	Very occasional numbers of viewers with a passing interest in their surroundings, e.g. those travelling along minor roads and views from the air.

Visual magnitude of change

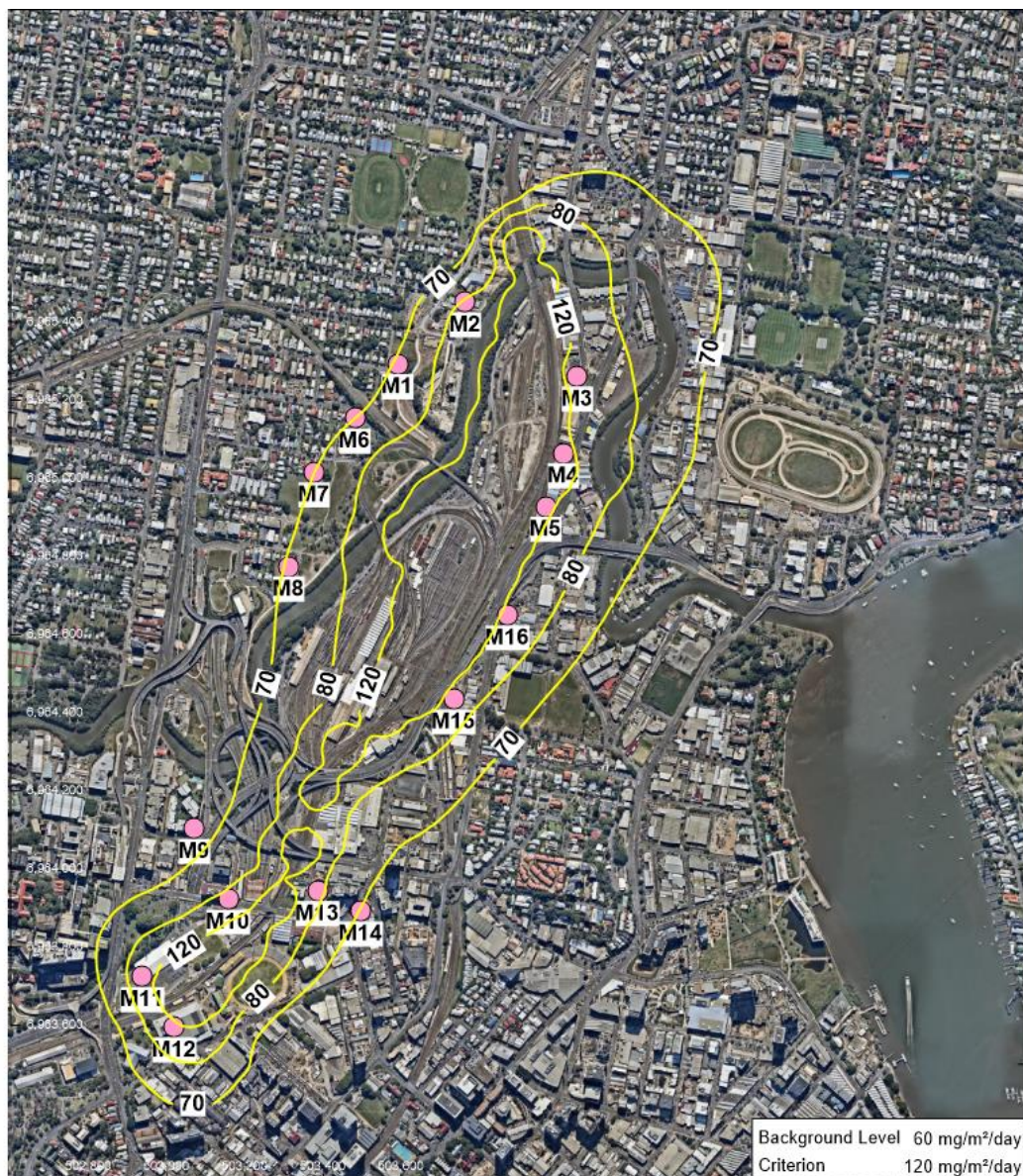
Visual magnitude of change refers to the extent of change expected to occur within the existing viewpoint. This includes the proposed project design outcomes and construction management plans. Modification is evaluated by firstly, the magnitude of the proposed visual changes and secondly, the contrast (or integration) of elements of the design with the surrounding environment of the representative viewpoint.

Visual Magnitude	Attributes of visual magnitude categories
High	Dominant change: Major changes in view at close distances, affecting a substantial part of the view, continuously visible for a long duration, or obstructing a substantial part or important elements of view. Generally, short distances (typically < 1 km) to the nearest project infrastructure element
Moderate	Considerable change: Clearly perceptible changes in views at intermediate distances, resulting in either a distinct new element in a significant part of the view or a more wide-ranging, less concentrated change across a wider area. Generally, short to medium views (typically 1 km – 2.5 km) to the nearest project infrastructure
Low	Noticeable change: Minor changes in views at long distances or visible for a short duration, and/or are expected to blend in with the existing view to a moderate extent. Generally, medium to long distance views (typically 2.5 km – 5 km) to the nearest project infrastructure
Negligible	Barely perceptible change: Change which is barely visible at a very long distance or visible for a very short duration, and/or is expected to blend with the existing view. Distant views (generally, >5 km) to the nearest project infrastructure.

Appendix D: Air Quality Contour Plots

D1: Mayne Yard Contour Plots

D1.1: Dust Deposition – Mayne Yard



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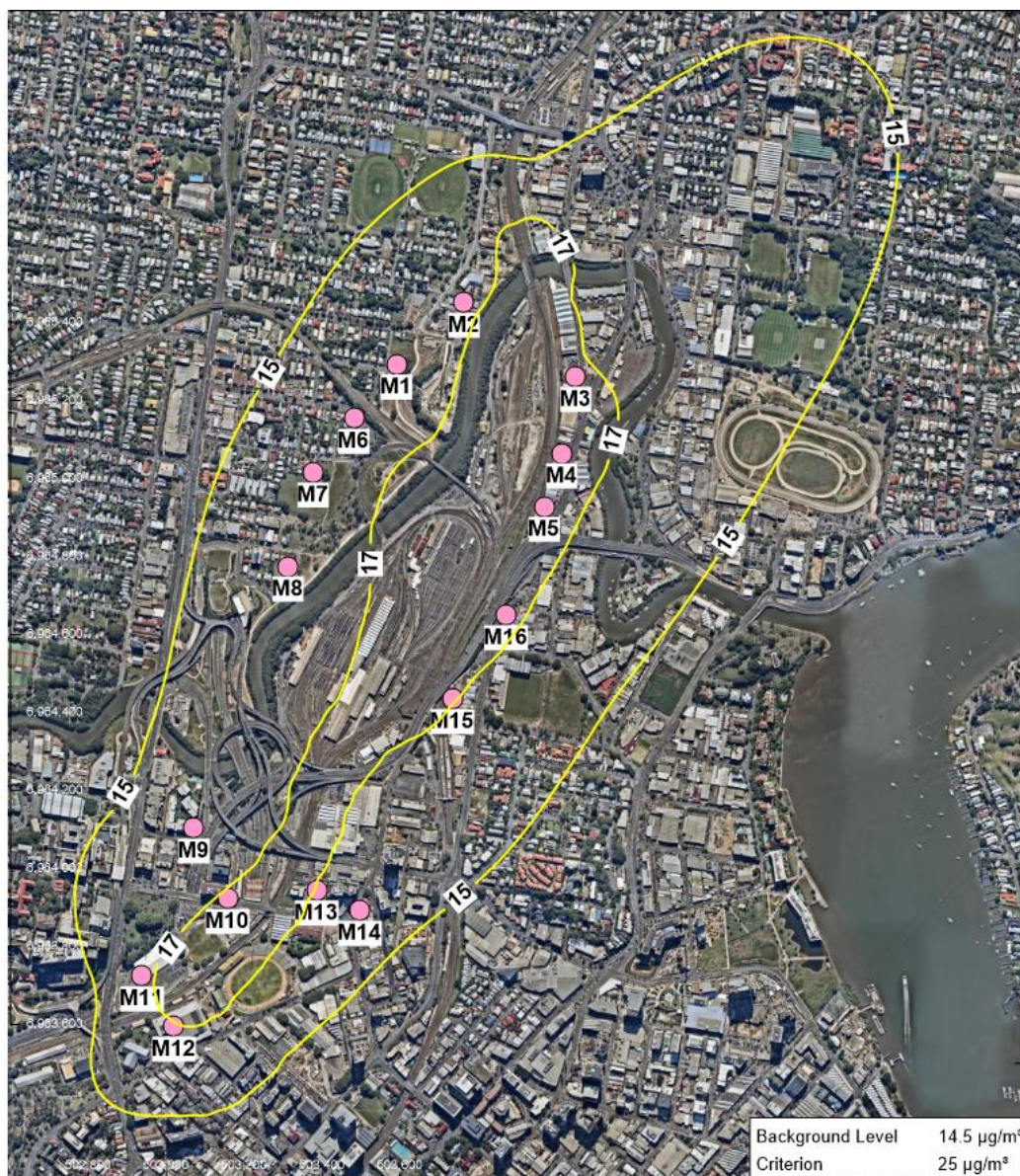
Project Number: 620.13054
Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 17/04/2019



Arup
**Cross River Rail 2018
Air Quality Impact Assessment**
Cumulative Impact - Construction

Pollutant	Dust Deposition	Averaging Period	1-Month	Unit	mg/m²/day
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D1.2: Annual and 24-hour average PM₁₀ – Mayne Yard



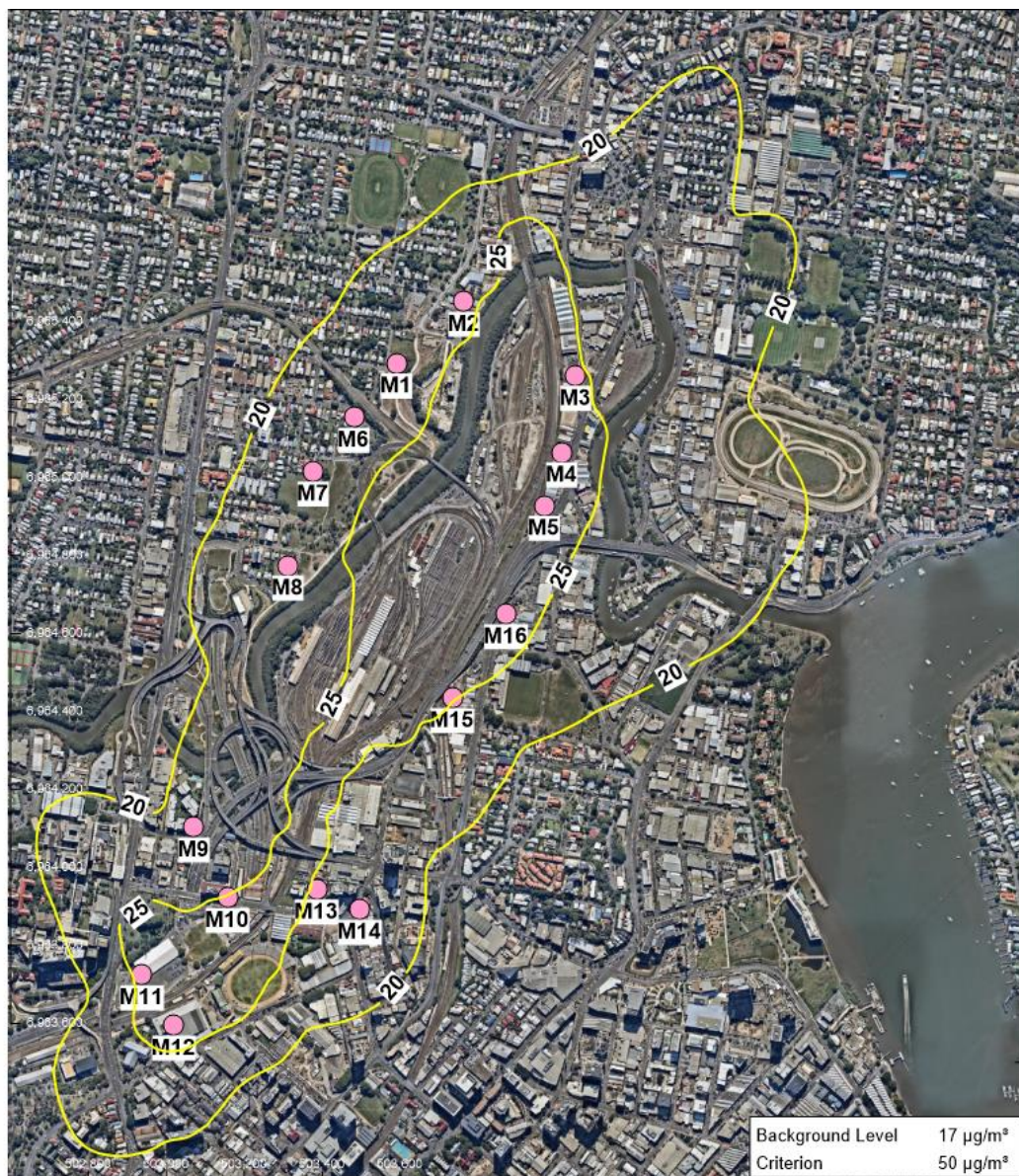
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Date: 17/04/2019



Arup				
Cross River Rail 2018				
Air Quality Impact Assessment				
Cumulative Impact - Construction				
Pollutant	PM ₁₀	Averaging Period	Annual	Unit
				µg/m³



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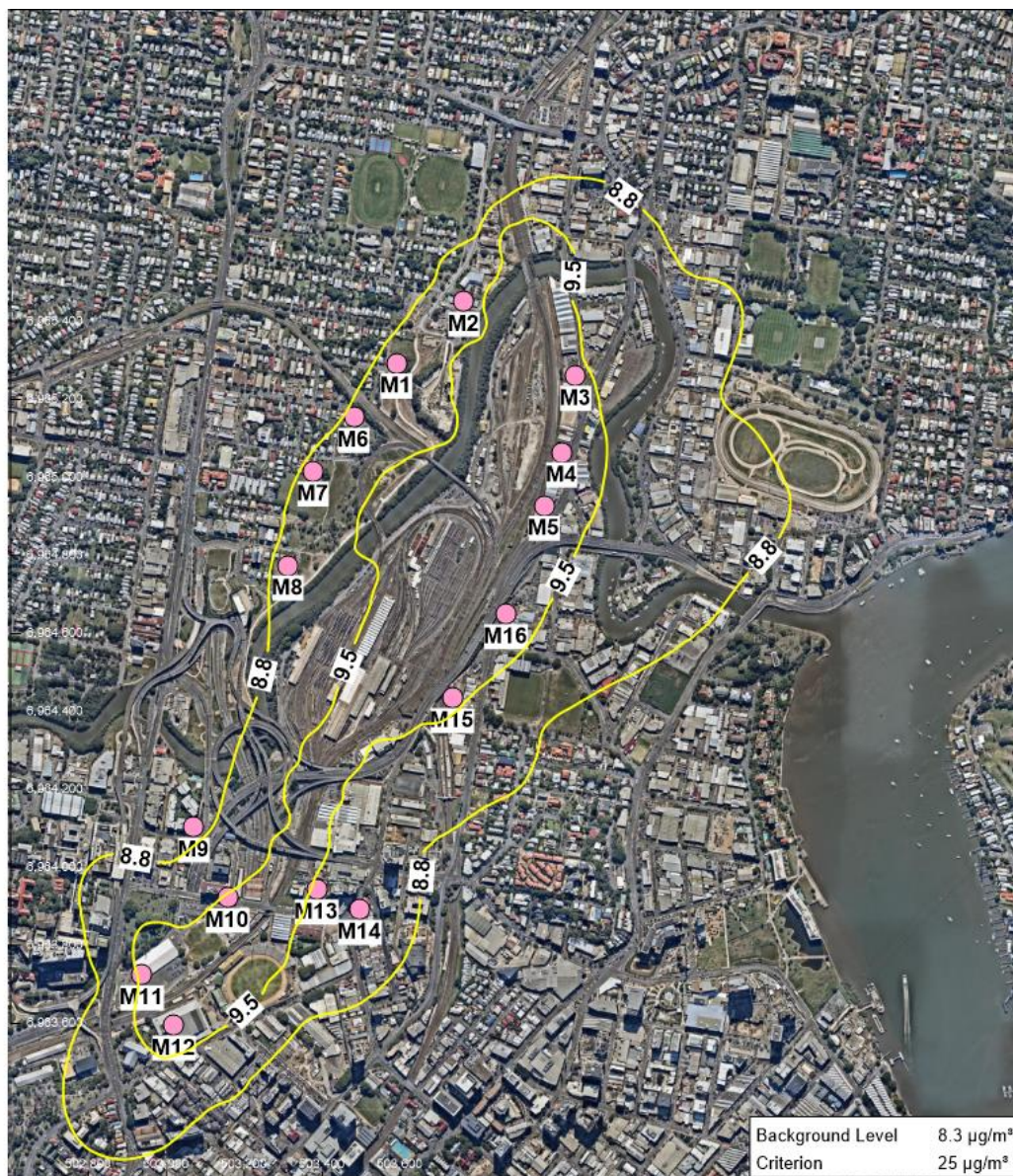
Project Number: 620.13054
Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 17/04/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM ₁₀	Averaging Period	Unit
		24-Hour	$\mu\text{g}/\text{m}^3$

D1.3: Annual and 24-hour average PM_{2.5} – Mayne Yard





Background Level	8.3 $\mu\text{g}/\text{m}^3$
Criterion	25 $\mu\text{g}/\text{m}^3$

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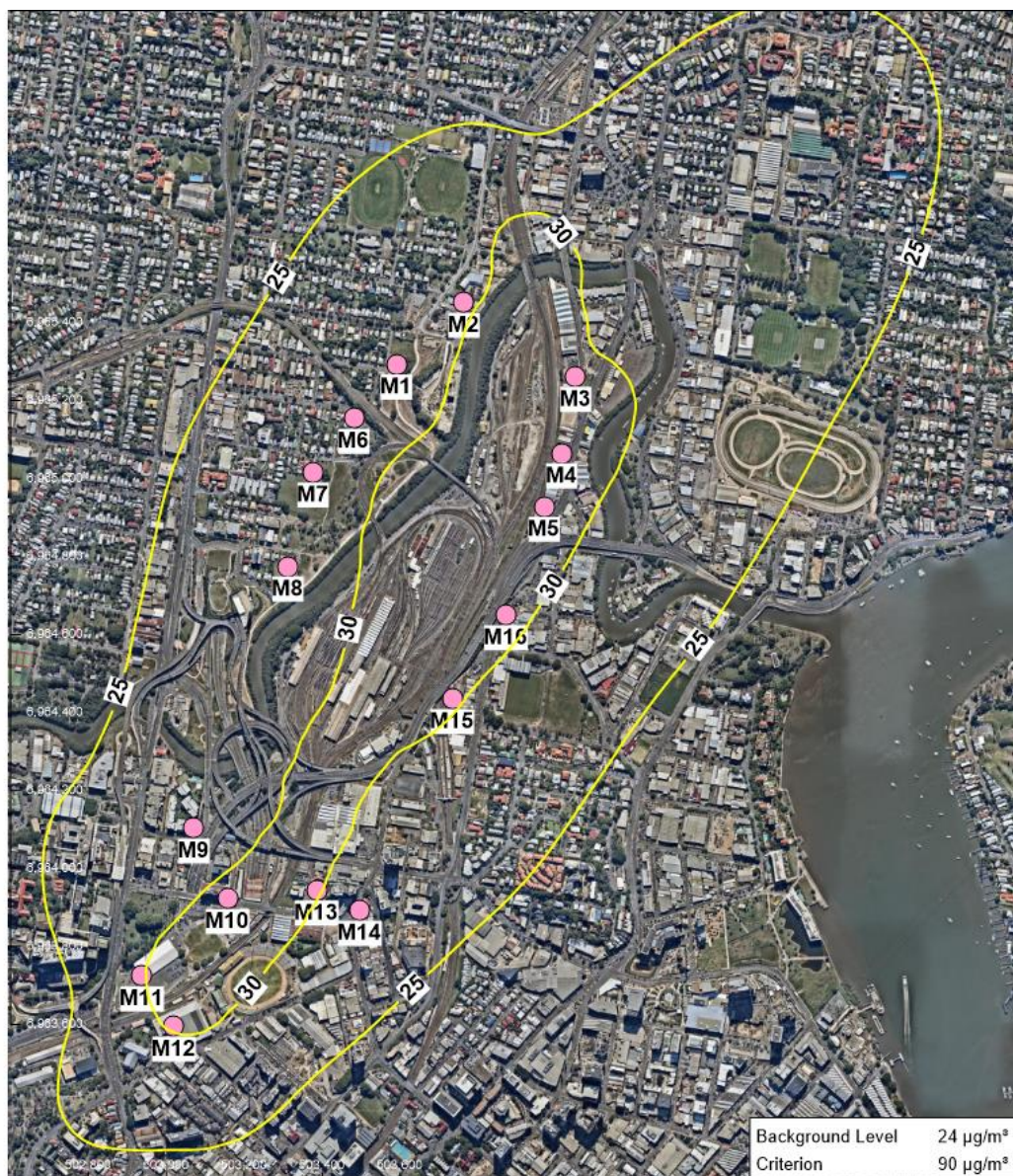
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Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 17/04/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM ₁₀	Averaging Period	Unit
		24-Hour	$\mu\text{g}/\text{m}^3$

D1.4: Annual and 24-hour average TSP – Mayne Yard



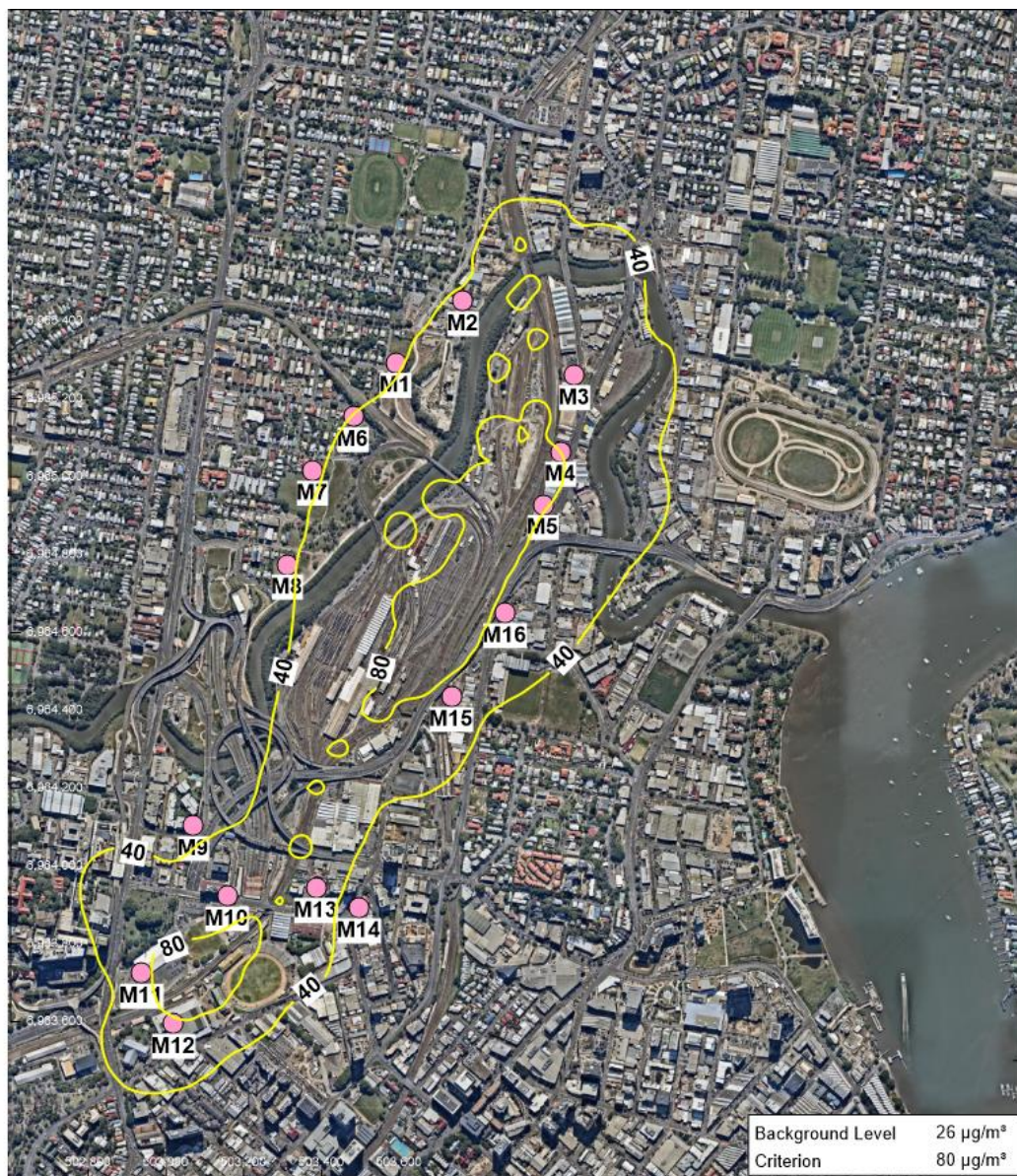
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Arup				
Cross River Rail 2018				
Air Quality Impact Assessment				
Cumulative Impact - Construction				
Pollutant	TSP	Averaging Period	Annual	Unit
				$\mu\text{g}/\text{m}^3$



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Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 17/04/2019



Arup				
Cross River Rail 2018				
Air Quality Impact Assessment				
Cumulative Impact - Construction				
Pollutant	TSP	Averaging Period	24-Hour	Unit $\mu\text{g}/\text{m}^3$

D2: Roma Street Contour Plots

D2.1: Dust Deposition – Roma Street



D2.2: Annual and 24-hour average PM₁₀ – Roma Street



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Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 17/04/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM ₁₀	Averaging Period	Annual
Unit			µg/m³



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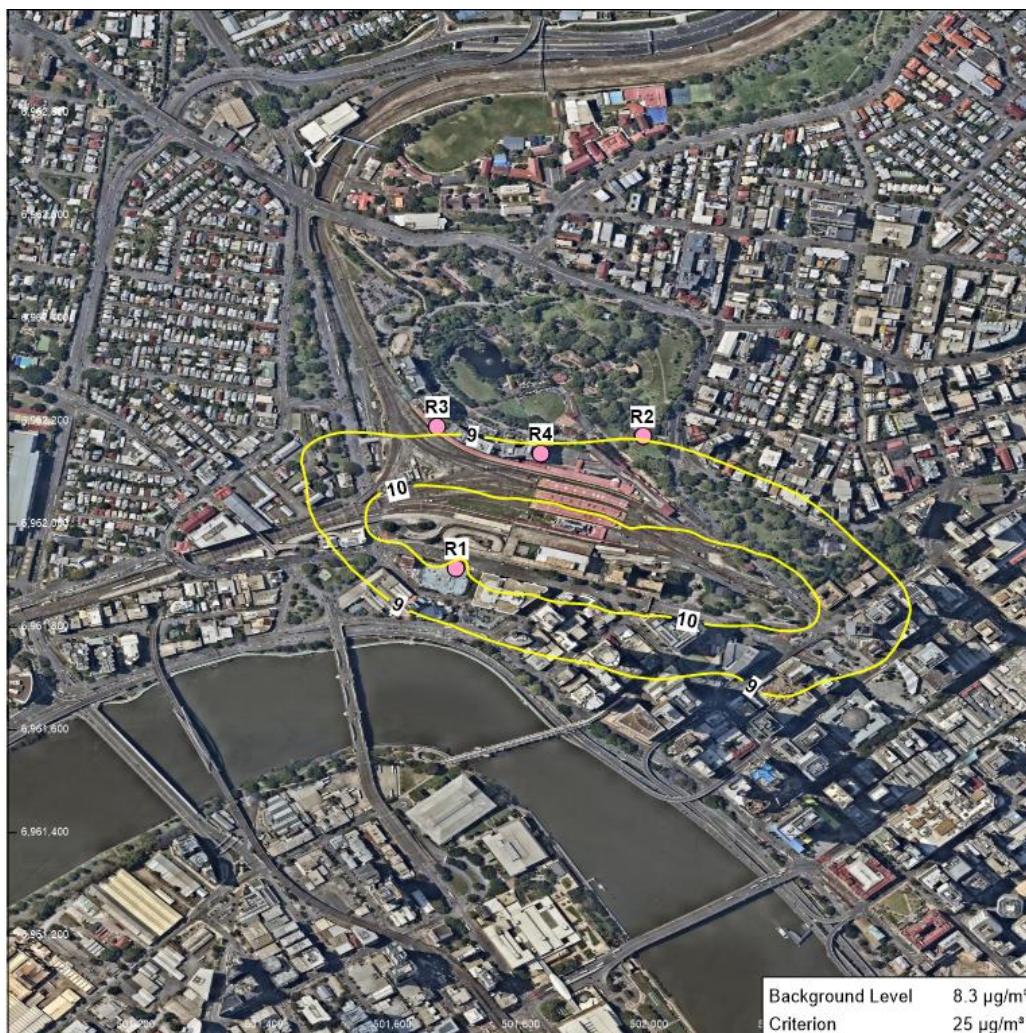
Project Number: 620.13054
Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 17/04/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM ₁₀	Averaging Period	Unit
		24-Hour	µg/m³

D2.3: Annual and 24-hour average PM_{2.5} – Roma Street





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Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 17/04/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM _{2.5}	Averaging Period	24-Hour
Unit	$\mu\text{g}/\text{m}^3$		

D2.4: Annual and 24-hour average TSP – Roma Street Station



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Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 17/04/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	TSP	Averaging Period	Annual
Unit	µg/m³		



Background Level 60 mg/m²/day
Criterion 120 mg/m²/day

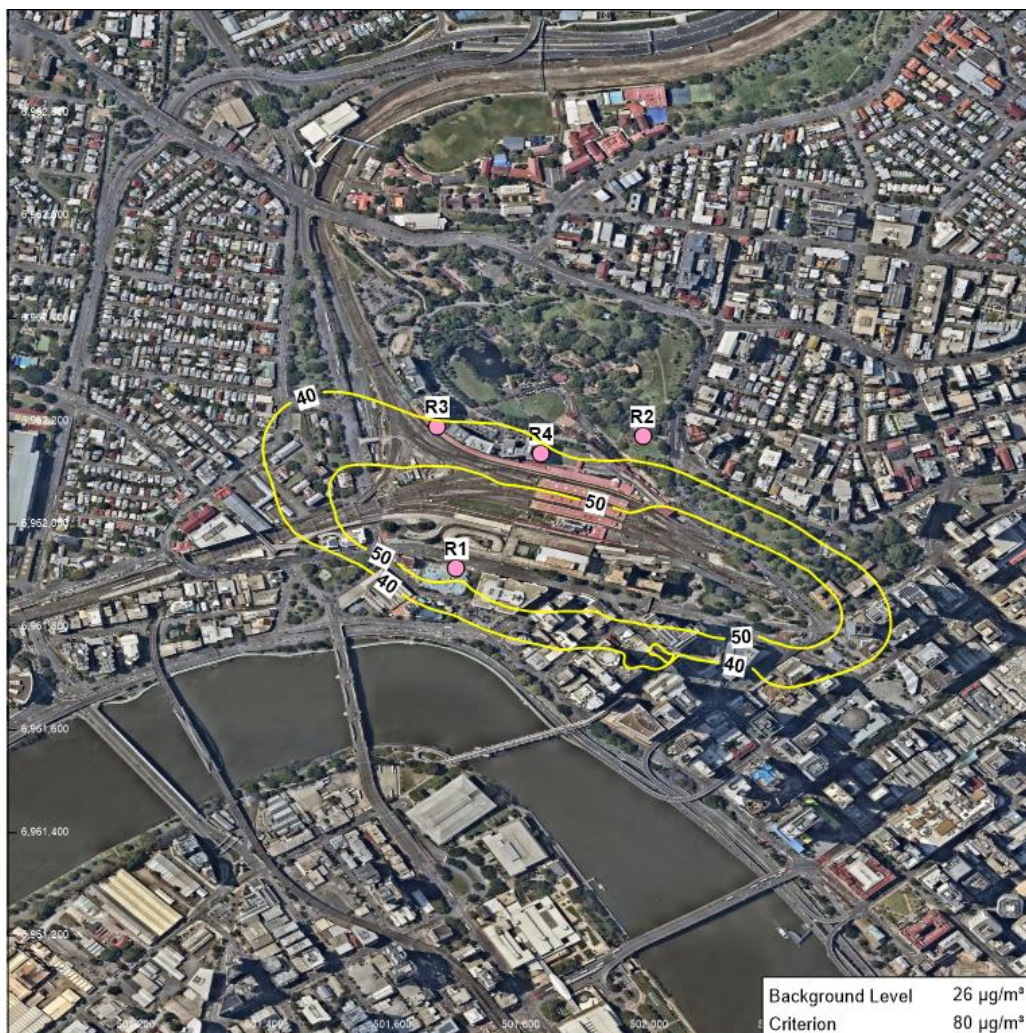
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Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 01/03/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	Dust Deposition	Averaging Period	Annual Unit mg/m ² /day



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Projection: GDA 1994 MGA Zone 56
Date: 17/04/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	TSP	Averaging Period	Unit
		24-Hour	µg/m³

D3: Woolloongabba Contour Plots

D3.1: Dust Deposition – Woolloongabba Station



D3.2: Annual and 24-hour average PM₁₀ – Woolloongabba Station



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Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 01/03/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM ₁₀	Averaging Period	Annual
Unit	µg/m³		



Background Level 17 $\mu\text{g}/\text{m}^3$
Criterion 50 $\mu\text{g}/\text{m}^3$

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Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 01/03/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM ₁₀	Averaging Period	24-Hour
Unit	$\mu\text{g}/\text{m}^3$		

D3.3: Annual and 24-hour average PM_{2.5} – Woolloongabba



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Projection: GDA 1994 MGA Zone 56
Date: 01/03/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM _{2.5}	Averaging Period	Annual
Unit	µg/m³		



Background Level 8.3 $\mu\text{g}/\text{m}^3$
Criterion 25 $\mu\text{g}/\text{m}^3$

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Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 01/03/2019



Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM _{2.5}	Averaging Period	24-Hour
		Unit	$\mu\text{g}/\text{m}^3$

D3.4: Annual and 24-hour average TSP – Woolloongabba





Background Level 26 $\mu\text{g}/\text{m}^3$
Criterion 80 $\mu\text{g}/\text{m}^3$

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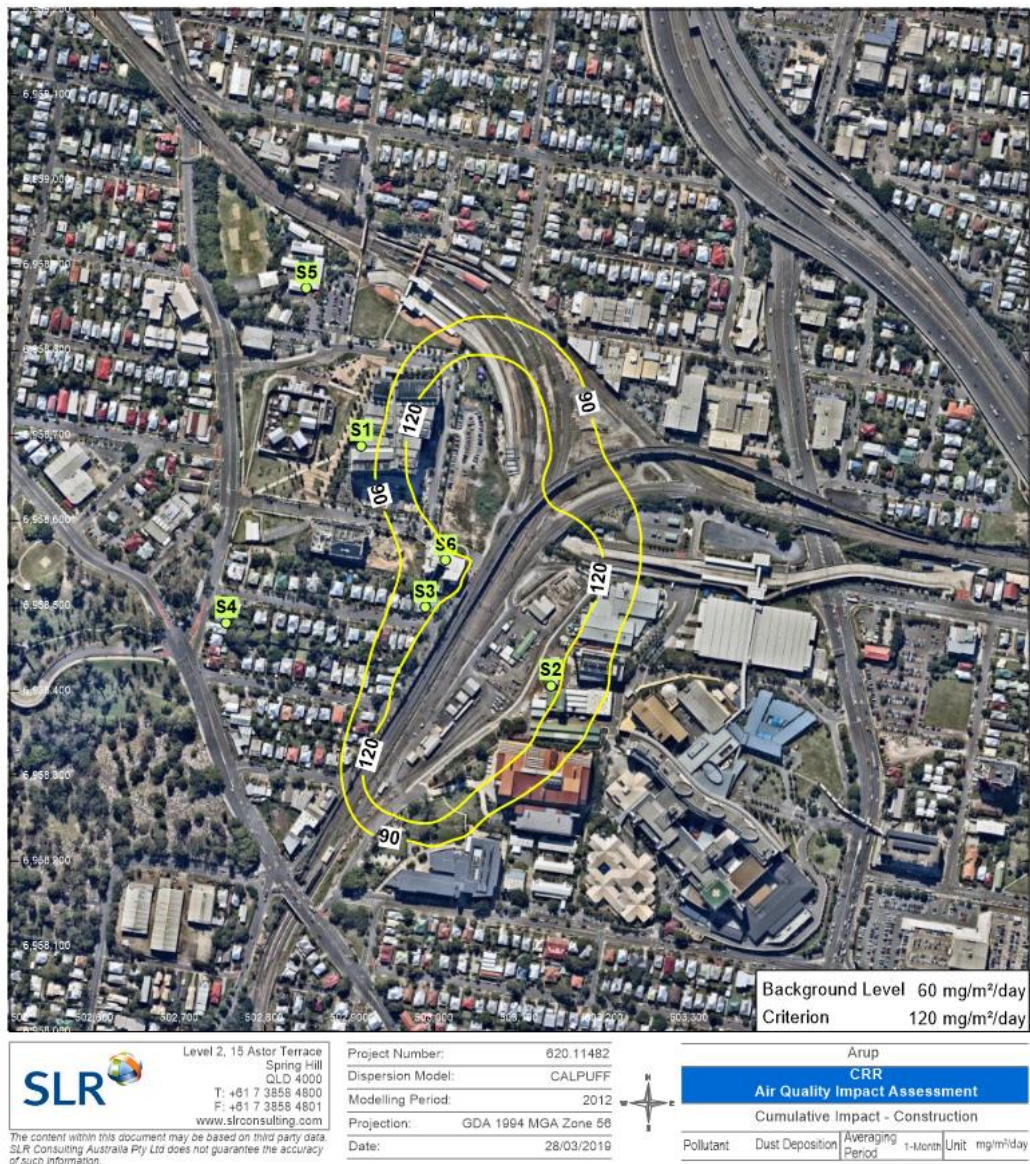
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Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 58
Date: 01/03/2019



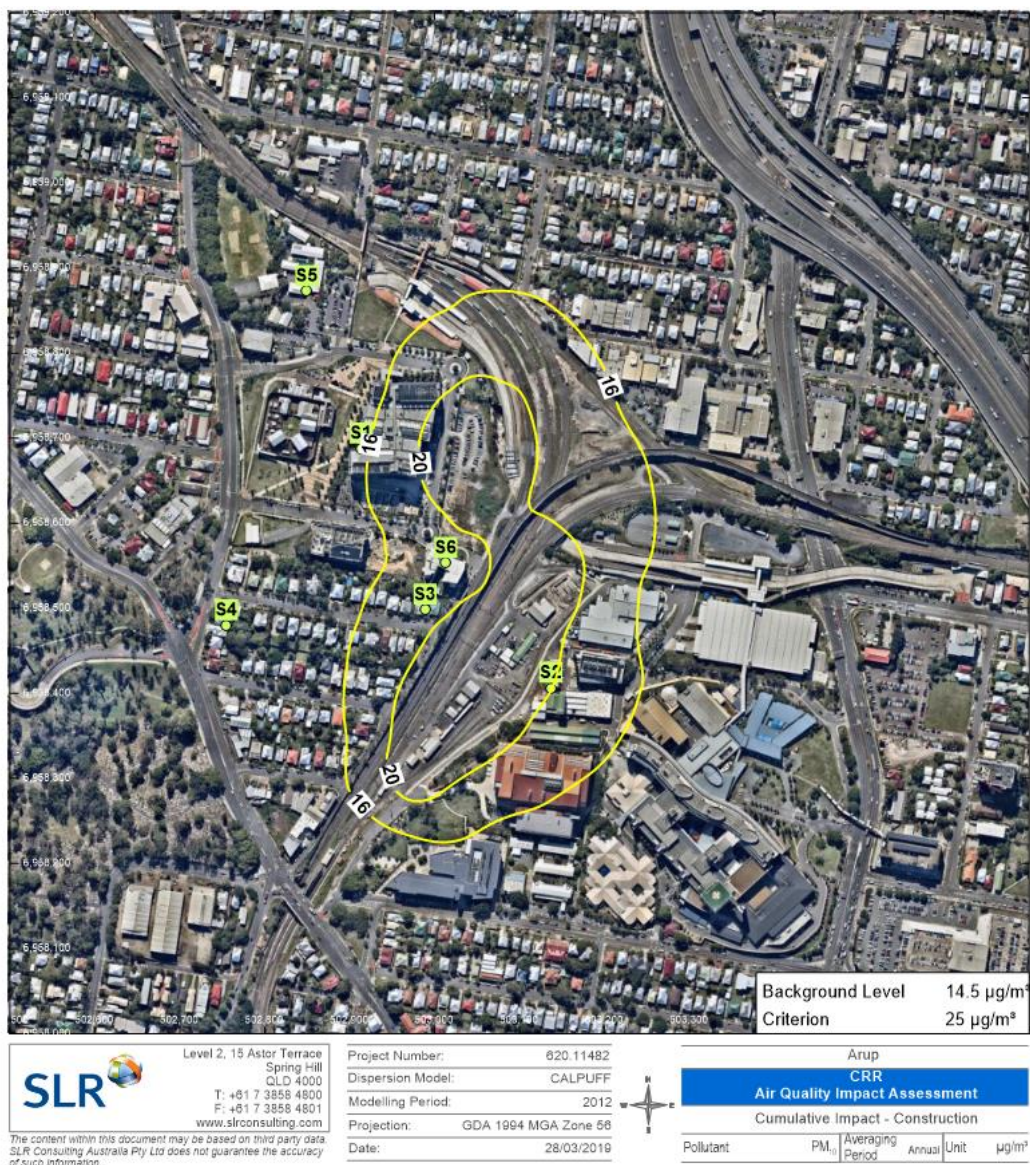
Arup			
Cross River Rail 2018			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	TSP	Averaging Period	24-Hour
Unit			$\mu\text{g}/\text{m}^3$

D4: Southern Portal and Boggo Road Contour Plots

D4.1: Dust Deposition – Southern Portal and Boggo Road Station



D4.2: Annual and 24-hour average PM₁₀ –Southern Portal and Boggo Road Station





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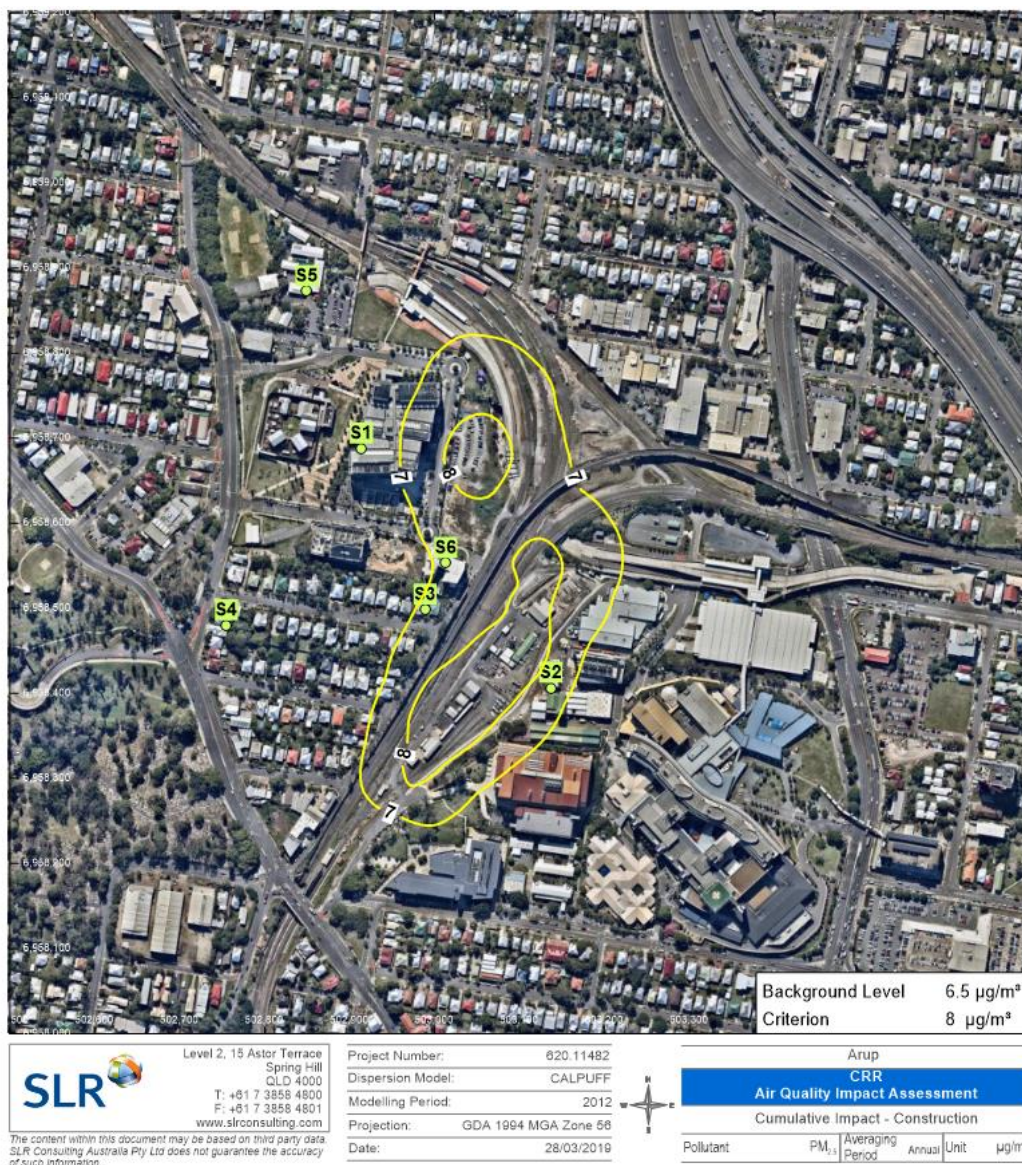
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Project Number: 620.11482
Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 28/03/2019



Arup			
CRR			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM ₁₀	Averaging Period	24-Hour
		Unit	$\mu\text{g}/\text{m}^3$

D4.3: Annual and 24-hour average PM_{2.5} – Southern Portal and Boggo Road Station





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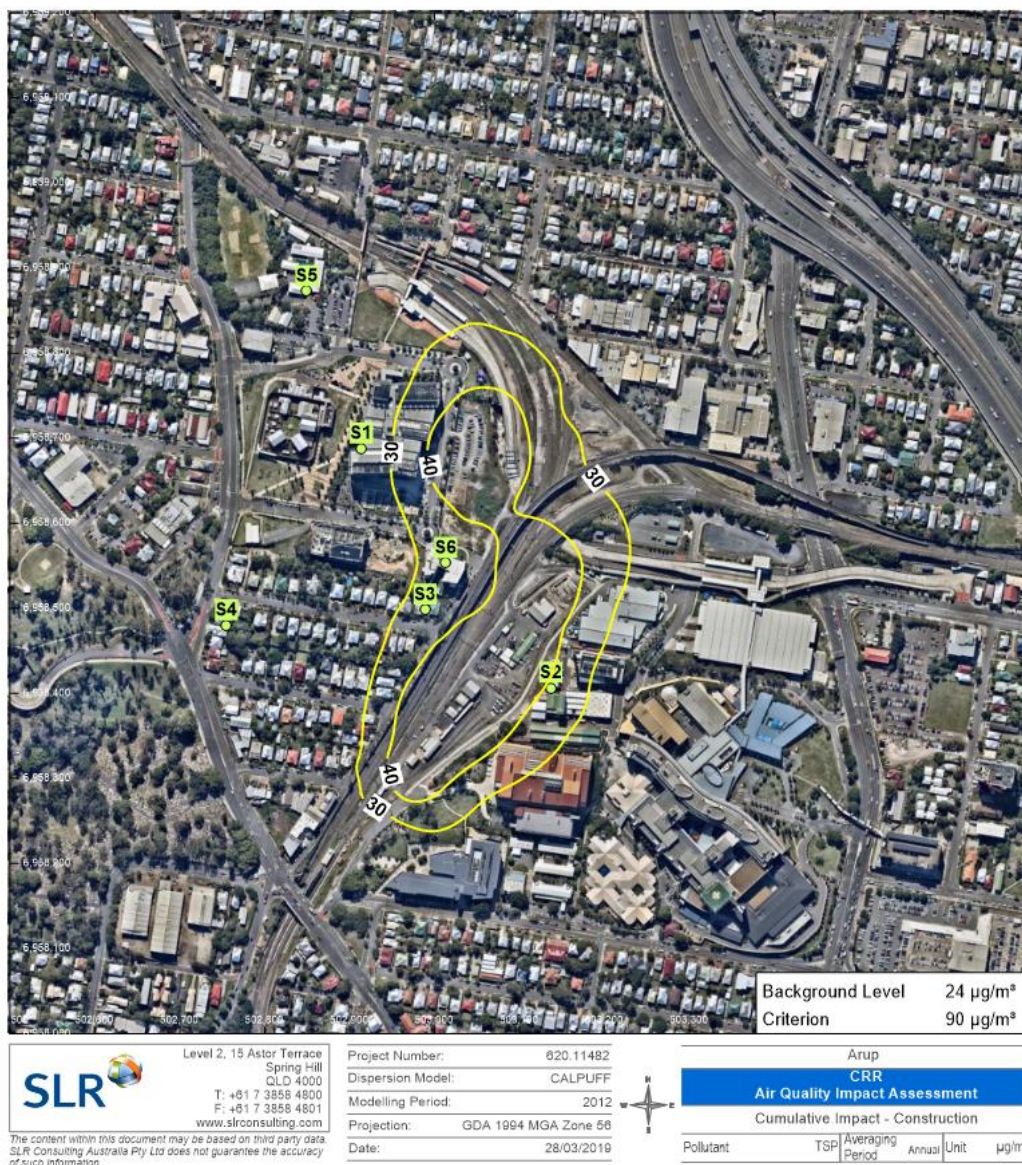
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Project Number: 620.11482
Dispersion Model: CALPUFF
Modelling Period: 2012
Projection: GDA 1994 MGA Zone 56
Date: 28/03/2019



Arup			
CRR			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	PM ₁₀	Averaging Period	24-Hour
		Unit	$\mu\text{g}/\text{m}^3$

D4.4: Annual and 24-hour average TSP –Southern Portal and Boggo Road Station





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Arup			
CRR			
Air Quality Impact Assessment			
Cumulative Impact - Construction			
Pollutant	TSP	Averaging Period	24-Hour
		Unit	$\mu\text{g}/\text{m}^3$

