Airport Link

Wooloowin Worksite Modification

Request for Project Change

June 2009

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EXECUTIVE SUMMARY

Airport Link Description

Airport Link comprises two parallel road tunnels and associated surface connections. The Project has a southern connection with the Inner City Bypass, North South Bypass Tunnel (under construction), the City between Bowen Hills and Windsor, and to Fortitude Valley via Campbell Street. The Project has a north-western connection at Kedron, allowing access to and from Gympie Road and Stafford Road in the north. The Project also has a north-eastern connection at Clayfield where access would be provided to and from Sandgate Road and the East-West Arterial.

A complete description of the Project is available in the Airport Link Request for Project Change Report[1] dated May 2008.

Previous Assessment Process

In May 2007, the Coordinator-General issued an evaluation report, in accordance with the *State Development and Public Works Organisation Act 1971* (SDPWO Act), for Airport Link[2]. The evaluation report contained a number of recommendations and conditions for the delivery and implementation of the Project.

Following its evaluation of proposals to finance, construct and operate Airport Link, the State of Queensland sought a further evaluation from the Coordinator-General in relation to a number of changes proposed to Airport Link. On 29 July 2008, the Coordinator-General issued a Change Report in which the findings of that evaluation were presented[3]. While the Changed Project was substantially similar to the Environmental Impact Statement (EIS) reference design for Airport Link, the changes addressed a number of the technical and community concerns arising from that early reference design.

Process for Evaluation of Change

The evaluation of both the Reference Project, subject of the EIS and the first Airport Link Changed Project by the Coordinator-General were carried out under Part 4 of the SDPWO Act. The SDPWO Act provides the process for the Coordinator-General to evaluate changes to a declared significant project, previously the subject of an evaluation report.

The Coordinator-General's evaluation reports for the EIS and the Change Report both have effect for the Project. However, the Change Report prevails to the extent of any inconsistency.

Similarly, the Coordinator-General's Change Report regarding the changes proposed in this request would also prevail over the EIS evaluation and the Change Report dated July 2008, to the extent of any inconsistency.

[1] Available at: http://www.airportlinkeis.com/OtherLinks/RfPC/INDEX.HTM
[2] Available at: http://www.dip.qld.gov.au/resources/project/aiport-link-tunnel/airport-link-c-g-report.pdf
[3] Available at: http://www.dip.qld.gov.au/resources/project/aiport-link-tunnel/airport-link-change-report1.pdf

Project Implementation and Changes

The Airport Link Project is now being delivered by BrisConnections Pty Ltd (BC), with construction commenced, and worksites established at Windsor, Lutwyche, Kedron, Clayfield and Toombul.

The project is currently on-time and on-budget overall. However, as detailed design and construction progresses, a constraint has emerged which was not apparent during the preparation of the tender process, and consequently, was not identified by BC and presented to the Coordinator-General for evaluation in the Request for Project Change 2008.

This constraint involves greater uncertainty and complexity arising from the ground conditions in the vicinity of the Kedron underground ramps which would result in potential delays to construction and delay of the construction program if not addressed.

This proposed change to the Airport Link Project is referred to in this document as the "Changed Project". This Request for Project Change document identifies the changes, the reasons for the changes, their effects and measures proposed to avoid, minimise, mitigate and/or offset any negative impacts arising from those changes.

Description of the Changed Project

As detailed design and construction progresses, difficult ground conditions in the vicinity of the Kedron underground ramps have become apparent. The original Project planning and program were based on ensuring the Kedron caverns were completed prior to the arrival of the Tunnel Boring Machines (TBMs) and to enable the critical tunnel fitout and electrical activities to be efficiently sequenced.

Owing to the adverse ground conditions, extra work is required to construct more complex tunnel supports. Slower excavation rates compared to those originally anticipated have increased the construction program for each part of the Kedron Ramps and Caverns (KR&C). The impact would be that the Kedron caverns providing for the ramp connections with the mainline tunnels beneath Wooloowin, in the vicinity of Rose Street, would not be constructed in time to receive the TBMs progressing westwards from Clayfield.

The ramp tunnels provide access to the caverns for cavern excavation prior to the TBM passage, primary power feed from the Kedron substation and access for the concrete lining operations to the caverns and associated ramps. Delays in the construction of the Kedron caverns and ramp tunnels would lead to a delay in the advance of the TBM's and subsequently an extension of the construction program.

With the extension of the construction program, the Kedron worksite and associated facilities would remain open and operating for an extended period. A delay in the construction program would also require the spoil-receiving and handling facilities, for each of the TBMs at Clayfield and Toombul to remain open longer.

Description of Change at Rose Street Worksite

The proposed change to the Airport Link Project is a change to part of the delivery methodology for the project.

The proposed change would include establishment and use of an additional worksite at Rose Street, Wooloowin, operational for 29 months, and the construction of a shaft and access passage from that worksite to access the mainline tunnels being constructed from Clayfield.

The proposed change is to provide access to the mainline tunnel alignment for construction of the caverns necessary to accommodate the Kedron ramps ahead of the TBMs advancing from the worksite in Kalinga Park, Clayfield.

The proposed worksite could also remain functional for the duration of the delivery (construction) phase to allow more efficient fitout of the tunnels once they have been constructed.

Reasons for Proposed Change

The tunnel excavation works associated with the KR&C are critical to both the completion of the overall Project works and individual components of the Project works.

Delays to the KR&C excavation works would adversely affect critical activities such as progress of the TBMs and their consequent completion on schedule, progress and finish the tunnel fitout, progress on pre-commissioning, the provision of electrical power routes, the commencement of final tunnel commissioning and consequently completion as well as the rehabilitation of Chalk Street and Kalinga Park worksites to their designated post-construction uses.

Delays in construction of KR&C also give rise to a number of adverse consequences of the Project delivery methodology.

Benefits of Proceeding with the Proposed Change

Benefits to the Community

In keeping with the practice across the Airport Link Project corridor, the community living near the proposed worksite would be consulted on future uses of the site post construction and rehabilitation and wider community benefit projects.

BC, through its contractor, Thiess John Holland (TJH), would fund a community benefits program and/or redevelopment of the proposed worksite.

The Wooloowin worksite would be fully remediated and restored to its current condition at the end of works by mid-2012. Any consultation on possible future uses of the site would begin 12 months prior to the end of works, but would be subject to the plans of the current owner (the Department of Transport and Main Roads).

While the Project remains on-time and on budget, the adverse ground conditions in the Kedron area would lead to delays. An approval of the proposed change would help to ensure:

- the Project is completed on time rather than being delayed with the associated community amenity and overall Project benefits delivered earlier than otherwise would be the case;
- progress of the TBMs is not delayed and the commencement of improvements and ultimately the return of the Chalk Street and Kalinga Park precincts to their normal operations earlier than would otherwise be the case; and

- the tunnel fitout, the provision of electrical power routes, pre-commissioning, final commissioning and consequent completion of tunnel and adjacent cut cover structures is achieved on schedule to allow associated roadworks to be completed earlier than would otherwise be the case.

Effect of Changes to the Project

The Changed Project would achieve the objectives of the Airport Link Project while delivering the Project on time rather than being delayed with the associated community amenity and overall Project benefits delivered earlier than otherwise would be the case.

Transport System and Haul Route

The proposed worksite would be situated on a State-controlled arterial route connecting the western suburbs of Brisbane to the Brisbane Airport precinct. The arterial route comprises Stafford Road, Gympie Road, Kedron Park Road, Park Road, Rose Street, Junction Road, Sandgate Road and the East West Arterial. In the vicinity of the proposed worksite, Rose Street conveys approximately 6,100 vehicles per day which is well within the capacity of the route.

The preferred haul route for construction vehicles accessing the proposed worksite would comprise, for out-bound traffic Rose Street, Junction Road and Sandgate Road and following approved currently approved haul routes. For in-bound or returning construction vehicles, the preferred haul route would comprise Sandgate Road, Rode Road, Gympie Road, Kedron Park Road, Park Road, Rose Street and Kent Road. Construction vehicles accessing the proposed worksite would also follow this anti-clockwise route.

The Project Change would have several effects on the transport system arising from the transport of plant, equipment and materials to establish the proposed worksite, removing excavated material from the project works, and supporting the fitout of the excavated tunnels.

Assessment of the existing traffic conditions near the worksite indicates that the impact to traffic operations and safety along the proposed haul route would be negligible in terms of impacts on daily traffic flows and would have minimal impact on the existing community facilities located along the route.

At its peak, the predicted impact of construction activities at the Rose Street worksite would lead to approximately 84 additional heavy construction vehicles per day using the construction haul route. The peak would occur during the 12 month tunnelling phase of works, with the movement of spoil haulage vehicles, concrete trucks and general deliveries. While this increase may be noticeable to the local community in terms of potential impacts on amenity, the increase would be well within the traffic capacity and function of the route.

Ingress to the worksite off Kent Road would be provided as a normal driveway access (left turn in only). Egress from the worksite would be also be a left-turn onto Park Road.

Pedestrian access around the site as well as access to the existing bus stop on Kent Street (adjacent to the site) would be maintained at all times, as would pedestrian access on Park Road, particularly near the Kedron State High School. A traffic controller would monitor and manage pedestrian movements at the site access / egress during school drop-off and pick-up times.

The proposed construction haul route and access arrangements to the Rose Street worksite would not affect public transport routes, the designated cycle route or local access to businesses, private residences or public facilities, including schools, churches and parks.

Car parking for the proposed Rose Street worksite workforce would be provided at the existing Kedron worksite. The workforce would be transported to and from the proposed worksite via a dedicated project shuttle bus. No private vehicle access or car parking on the site or in nearby local streets would be permitted.

Air Quality

The environmental objectives for the project are to maintain ambient air quality at properties adjacent to worksites and to ensure that community concerns are addressed quickly and effectively.

With implementation of effective mitigation measures, the proposed worksite at Rose Street would result in the satisfactory mitigation of dust being generated during earthmoving and excavation works for site preparation, as well as dust emissions from shaft excavation works and stockpiling, handling and transport of excavated material, including the loading of spoil into trucks.

The use of diesel-powered vehicles, plant and equipment at the proposed worksite would generate gaseous emissions. These emissions would be effectively managed through site environmental management, operating within a ventilated worksite shed and emission controls on equipment.

Construction activities which would generate dust or other airborne pollutants would be conducted within the acoustic lined shed or underground. A ventilation system would service both the underground works and the workshed. The ventilation system would be designed to capture engine emissions from plant and equipment. Ventilated air would be captured within the workshed and released to the ambient environment after having first passed through a dust-removal system and a high-level ventilation outlet. The height of the ventilation outlet would be at least 5 metres above the height of the shed (i.e. at least 22.5m high).

With the appropriate mitigation measures in place (i.e ventilation system and outlet) pollutant concentrations are predicted to comply with the relevant air quality goals approved for the project by the Coordinator-General. Pollutant concentrations associated with construction vehicles are also predicted to be well below these goals.

Compliance with the relevant air quality goals would be monitored throughout the construction phase.

Noise

The environmental objectives for noise are to maintain a reasonable acoustic environment for living (in particular sleeping) and to ensure consultation with concerned property owners and occupiers is effective and responsive.

Noise modelling was utilised to predict the impacts associated with noise emissions from the plant noise sources anticipated to operate during the proposed construction activities.

Provision of a 5 metre noise barrier at the site perimeter is planned, prior to the commencement of site establishment and construction works. Following site

establishment, the construction of an acoustic shed would also significantly reduce potential noise emissions associated with excavation and spoil handling.

Without mitigation, there would be a significant number of properties predicted to experience construction noise in excess of the noise goals. This predicted impact would be significantly reduced through the provision of control measures such as the noise barrier, screening for fixed plant and equipment and installation of the acoustic shed. Nonetheless, the noise assessment has predicted that during site establishment, construction of the acoustic shed and shaft excavation phases (12 weeks duration) there is the potential to exceed the daytime noise goals at two properties adjacent to the site. Consultation with the owners of these two properties would commence immediately about the potential provision of additional off-site mitigation measures.

Following construction of the acoustic shed, all excavation and spoil handling activities would be conducted within the shed to reduce environmental impacts from the worksite. Modelling for construction activities within the acoustically lined shed indicates that during the daytime, noise goals would be exceeded at one property and exceedances of the equivalent night-time continuous noise level goals is predicted to occur at several properties. The night-time loudest noise levels goal would be achieved for all sensitive receptors. Owners of these properties would be consulted directly regarding further mitigation of potential impacts.

For day-time construction work, with the acoustic barrier installed, there would be no predicted exceedances of the noise goals at commercial premises or educational establishments. For residential properties, with the acoustic barrier installed:

- noise from site establishment construction work is predicted to exceed noise goals (L_{A10}) at three residential properties by up to 9 decibels (dB);
- noise from excavation of the shaft ahead of the erection of the acoustic shed is predicted to exceed noise goals (L_{A10}) at two residential properties by 2dB;
- noise for construction works within the acoustic shed (doors open) is predicted to exceed noise goals (L_{A10}) at one residential property by 1dB.

For night-time construction, with the 5.0 metre acoustic barrier and the acoustic lined shed installed (doors closed):

- continuous noise from construction work is predicted to exceed the noise goal (L_{Aeq}) at 31 residential properties by up to 12 dB;
- peak noise from construction work is not predicted to exceed the noise goal (L_{Amax}) at any residential property.

Where exceedances of noise goals are predicted, early consultation with the owners and occupants of potentially-affected premises would be required, in accordance with the Coordinator-General's. Shotcrete deliveries between the hours of 18:30 and 22:30 are anticipated, with shotcrete being unloaded within the acoustic shed. These events are not predicted to exceed the night-time maximum noise goal.

The movement of construction traffic from the Rose Street worksite is not predicted to lead to significant changes in road traffic noise along the preferred construction haul route. This is due primarily to the low numbers of construction vehicles likely to be using the route on a daily basis.

Regenerated noise and vibration from construction of the main-line tunnels were assessed as part of the EIS and the Request for Project Change (dated July 2008). No change in either regenerated noise or vibration is anticipated above those levels because there is no change proposed to the construction of the mainline tunnels associated with the proposed worksite.

Compliance with the relevant noise goals would be monitored throughout the construction phase.

Vibration

The environmental objectives for vibration are to maintain a reasonable acoustic environment for living and in particular sleeping, to protect heritage buildings and other sensitive places from the effects of vibration such as cosmetic damage, to avoid structural damage to buildings, and to ensure consultation with concerned property owners and occupiers is effective and responsive.

Goals for vibration to guide the construction, planning and management were established in the Coordinator-General's conditions for Airport Link and remain relevant to the Change Project.

Vibration from Site Establishment

Vibration from site establishment is predicted to occur, at low levels, from the use of vibratory rollers, as a 'worst case' scenario. Where monitoring indicates that goals would be exceeded, other rollers with much lower vibration effects, would be used during site establishment.

The predicted vibration at the closest residential building based on non-continual use of a vibratory roller is approximately 5 millimetres per second (mm/sec) peak particle velocity (ppv), which is well below the Coordinator-General's goal (that may result in cosmetic damage) of 10 mm/sec ppv. As there would be no night-time work during site establishment, there would be no predicted impact on sleep disturbance.

Vibration from Shaft Construction

Vibration from the construction of the shaft could arise from piling, the use of rock hammers, and if required, from drilling and blasting if hard rock is encountered.

The level of vibration for a rock hammer, or hydraulic hammer, at the closest residential building is predicted to range from 0.5 to 1.0 mm/sec ppv, which would be well below the goal for cosmetic damage. To remain below the goal for avoiding sleep disturbance, either alternatives to rock hammers or a limitation on out of hours work would be required.

Vibration from Blasting

At the proposed Rose Street worksite, the upper 20 metres of ground material near the shaft collar is not expected to require blasting. This provides a minimum separation distance between the blasting area and the nearest property (Park Road) of approximately 25 m.

To achieve the environmental objectives, the relevant goals for blasting in such close proximity to residential property would be:

- to avoid sleep disturbance – 0.5mm/sec ppv; and

- to minimise cosmetic damage – 10mm/sec ppv.

The level of vibration from the construction activities due to unmitigated blasting is predicted to be 25mm/sec ppv, which would be perceptible at properties about the works area. Therefore, blasting, if absolutely required, would need to be significantly mitigated to achieve the goal set by the Coordinator-General. Alternatives to blasting during construction of the shaft would be employed where possible.

Compliance with the vibration goals would be monitored throughout the construction phase and a comprehensive condition survey of all properties predicted to exceed the 10mm/sec goal would be conducted.

Blasting Air Overpressure

Predicting the expected level of overpressure was undertaken through a review of other projects undertaking a similar scale of blasting in similar conditions. These show that for a worst-case scenario, overpressure levels at the worksite may range beyond 120 dB for residences located within a 50 metre radius around the shaft collar. Further than 50 metres, residences are expected to receive overpressure levels less than 120 dB, well below the condition of 130dB.

Compliance with an overpressure value of 130 dB at all monitoring locations can be achieved at residential and commercial buildings through modifications to blast design and as the shaft deepens, some reduction in the measured level of overpressure is expected.

Design of the acoustic shed would need to take into account the impacts of airblast overpressure. For residences within 50 metres, the acoustic shed would also provide a mitigation of airblast overpressure, which would combine with careful blast design to achieve the Coordinator-General's condition.

Road Header Driven Tunnelling

Predicted regenerated noise and vibration from the main-line tunnels were assessed as part of the EIS and the Request for Project Change (July 2008). As this Request for Project Change does not propose a change to the construction method of the mainline tunnels, no change is expected in either the predicted levels for regenerated noise and vibration.

Hydrology

There would be no impacts to surface hydrology or flood events as a result of the proposed change. Groundwater drawdown and inflow is expected to be managed effectively during construction.

Surface flows and groundwater entering the shaft and adit would be managed, removed and treated within the designed drainage management system to meet appropriate discharge standards prior to release.

A comprehensive groundwater monitoring system is proposed for the site to detect any hydrocarbon contamination from a former service station site opposite the worksite. Limited sampling has not detected any hydrocarbon contamination directly beneath the former service station site.

Social Environment

The existing social environment of the locality of the worksite is characterised by low density residential land uses, quiet neighbourhoods, and good connectivity to the city and community facilities. Changes to this environment would arise with construction and operation of the worksite, including changes to access and connectivity, as well as changes to local amenity.

Pedestrian movements in the local area typically are associated with local schools. Consequently, pedestrian safety is important around the proposed worksite and in the local streets serving these community facilities. With the proposal to use Kedron Park Road and Park Road as part of the construction haul route, local traffic management to achieve pedestrian safety around the Kedron State High School is proposed. Such traffic management would include a traffic controller operating at key locations during school drop-off (07.30 – 09.00hrs) and pick-up (14.30 – 16.00hrs) times.

Changes in amenity may also result through construction noise and vibration, dust, vehicle emissions, and changes to the visual environment. The recommendations contained in this report, in addition to the Coordinator-General's conditions, aim to largely preserve the social amenity of the areas impacted by this project change.

With regards potential visual impact, the location of the proposed worksite in combination with the proposed scale and height of the acoustic shed would result in it being highly visible to nearby stakeholders and the travelling public. To address concerns about visual impact, the shed would be designed to include appropriate materials and colours to minimise visual disturbance to the community, and the undue reflection of light and heat upon nearby properties.

Any likely changes to access or amenity would be communicated to affected parties well in advance of changes being made.

Visual Amenity

Visual amenity would be impacted to varying degrees during the construction and operation of the acoustic shed at the worksite. The location, design and size of the shed would make it highly visible, although the impact would be temporary in nature. Visual impacts would be mitigated through the use of appropriate materials and colours in design and construction.

Depending on shed materials, daylight glare may also impact on neighbouring residents, drivers, pedestrians and cyclists, while light spill also has the potential to impact on residents in close proximity to the site. Careful design and siting of external lighting would be undertaken to avoid adverse light spill onto adjoining or adjacent properties. Near neighbours, particularly those residing on the northern boundary of the proposed worksite would also be consulted about proposed mitigation measures for glare and reflected heat.

Impacts during the construction stage would be managed in accordance with the Construction Environmental Management Plan (EMP) and the Coordinator-General's conditions.

Conclusions

This Request for Project Change relates to a proposal to establish and operate an additional worksite at Rose Street Wooloowin for the construction of the Kedron caverns and ramps, and to support the fitout of the ramps and the mainline tunnels of Airport Link.

Without the change, Airport Link would not be delivered on time. The requested change would avoid the extension of the construction program for other worksites including the spoil receiving facilities at Clayfield (Kalinga Park) and Toombul, the main worksite at Kedron and the TBM receiving site at Lutwyche (Chalk Street).

The request arises from the discovery, during detailed design and field investigations, of more difficult ground conditions than anticipated during the preparation of the proposal to deliver and operate Airport Link. Such difficult ground conditions would result in:added complexity in the design and construction of the ground-supports for the KR&C and potential delays in completing the KR&C in time to receive the TBMs constructing the mainline tunnels.

The establishment and operation of a construction worksite at Rose Street, has the potential to cause a number of impacts on the amenity and environmental quality of the locality. With effective mitigation, such impacts might be managed within acceptable levels. Such mitigation measures might derive from implementation of the existing Coordinator-General's conditions in combination with the additional recommendations and conditions suggested in this report.

The benefits to the Airport Link construction program and construction safety, of the establishment and operation of a construction worksite at Rose Street, would cost out-weigh the potential impacts on the amenity and environmental quality of the locality.

With the development and implementation of effective mitigation measures, such impacts would be managed within acceptable levels. Such mitigation measures would derive from implementation of the existing Coordinator-General's conditions in combination with the additional recommendations and site-specific and change-specific conditions suggested in this report.

1 INTRODUCTION

1.1 Airport Link – Description

The Airport Link Project is described in the Coordinator-General's Change Report dated 29 July 2008[4].

Airport Link comprises two parallel road tunnels and associated surface connections as shown in **Figure 1-1**. The Project has a southern connection with the Inner City Bypass, CLEM 7 (under construction), the City between Bowen Hills and Windsor, and to Fortitude Valley via Campbell Street. The Project has a north-western connection at Kedron, allowing access to and from Gympie Road and Stafford Road in the north. The Project also has a north-eastern connection at Clayfield where access would be provided to and from Sandgate Road and the East-West Arterial.

The Airport Link alignment has a total length of approximately 6.7 km, of which approximately 5.3 km would be constructed in-tunnel. Between the southern and north-western connections, each tunnel would accommodate three traffic lanes. Between the north-western and north-eastern connections, each tunnel would accommodate two traffic lanes. Connections would be provided with the motorway and arterial road network in Windsor / Bowen Hills in the south, in Kedron / Lutwyche / Stafford in the north-west and in Clayfield / Toombul in the north-east.

Connections with the surface road network in Kedron / Lutwyche / Stafford involve extensive ramps to and from the mainline tunnels to be constructed at ground level, above ground level and underground.

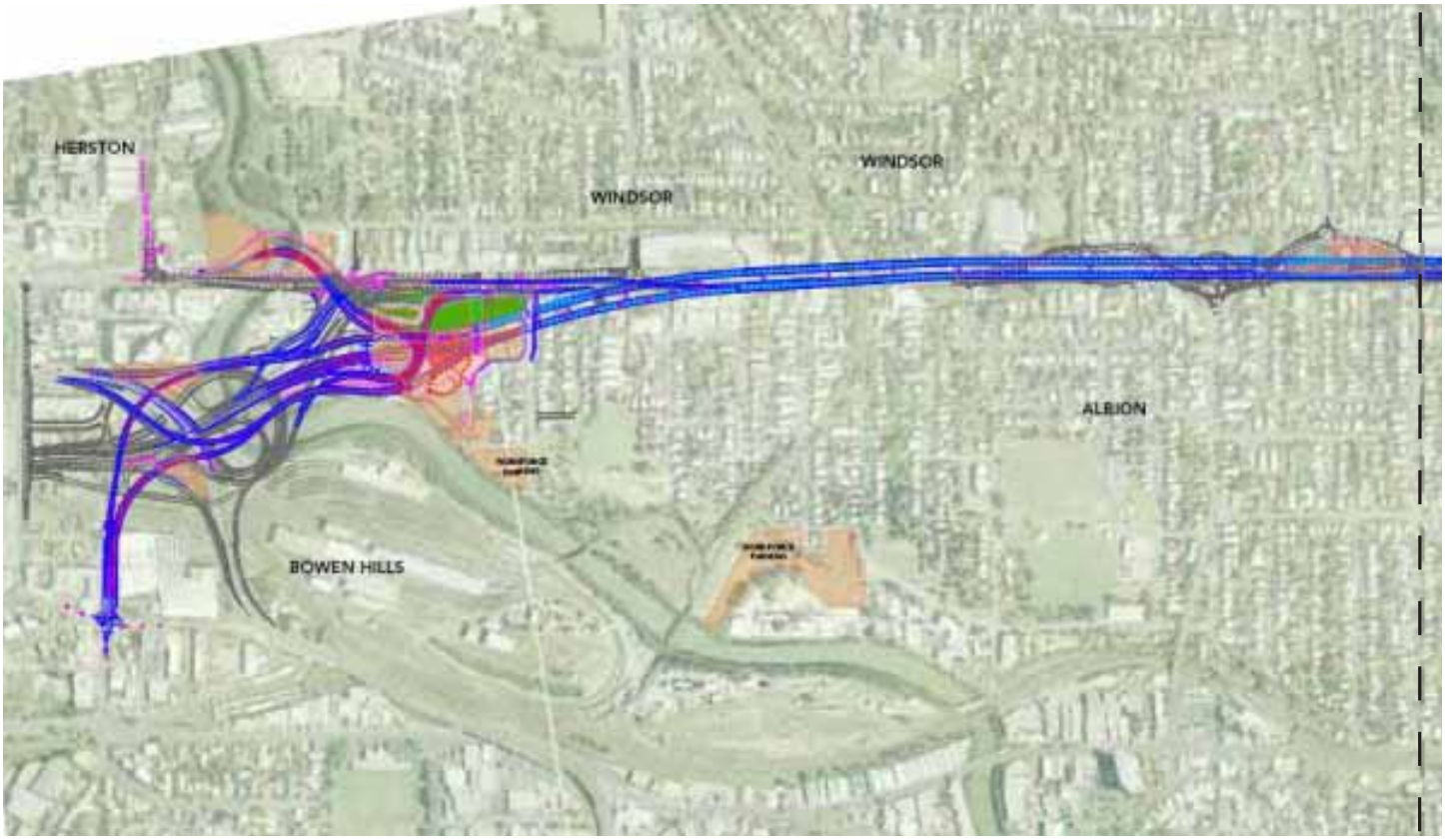
A complete description of the Project is available in the Airport Link Request for Project Change.

1.2 Airport Link

In May 2007, the Coordinator-General issued an evaluation report, in accordance with the *State Development and Public Works Organisation Act 1971* (SDPWO Act), for the Airport Link Project. The evaluation report contained a number of recommendations and conditions for the delivery and implementation of Airport Link.

Following its evaluation of proposals to finance, construct and operate Airport Link, City North Infrastructure (CNI) on behalf of the State of Queensland sought a further evaluation from the Coordinator-General in relation to a number of changes proposed to Airport Link. On 29 July 2008, the Coordinator-General issued a Change Report in which the findings of that evaluation were presented. While the Changed Project was substantially similar to the Environmental Impact Statement (EIS) reference design for Airport Link, the changes addressed a number of the technical and community concerns arising from that early reference design and presented the proposed designs, delivery mechanisms and impact mitigation measures of the Changed Project delivery.

[4] Airport Link EIS Evaluation Report (May 2007) and Airport Link Change Report (July 2008) are available at http://www.airportlinkeis.com or www.dip.qld.gov.au



LEGEND

- TRANSITION STRUCTURE
- CUT AND COVER TUNNEL
- DRIVEN TUNNEL - TBM
- DRIVEN TUNNEL - ROAD HEADER
- REINFORCED EARTH STRUCTURE OR FILL EMBANKMENT
- ELEVATED STRUCTURE
- CROSS PASSAGES
- PEDESTRIAN AND CYCLE PATHS
- SURFACE ROADS
- MEDIAN / ISLANDS
- NORTH-SOUTH BYPASS TUNNEL
- WORKSITES AND WORKFORCE PARKING
- VENTILATION FAN STATION
- BUSWAY PROJECT

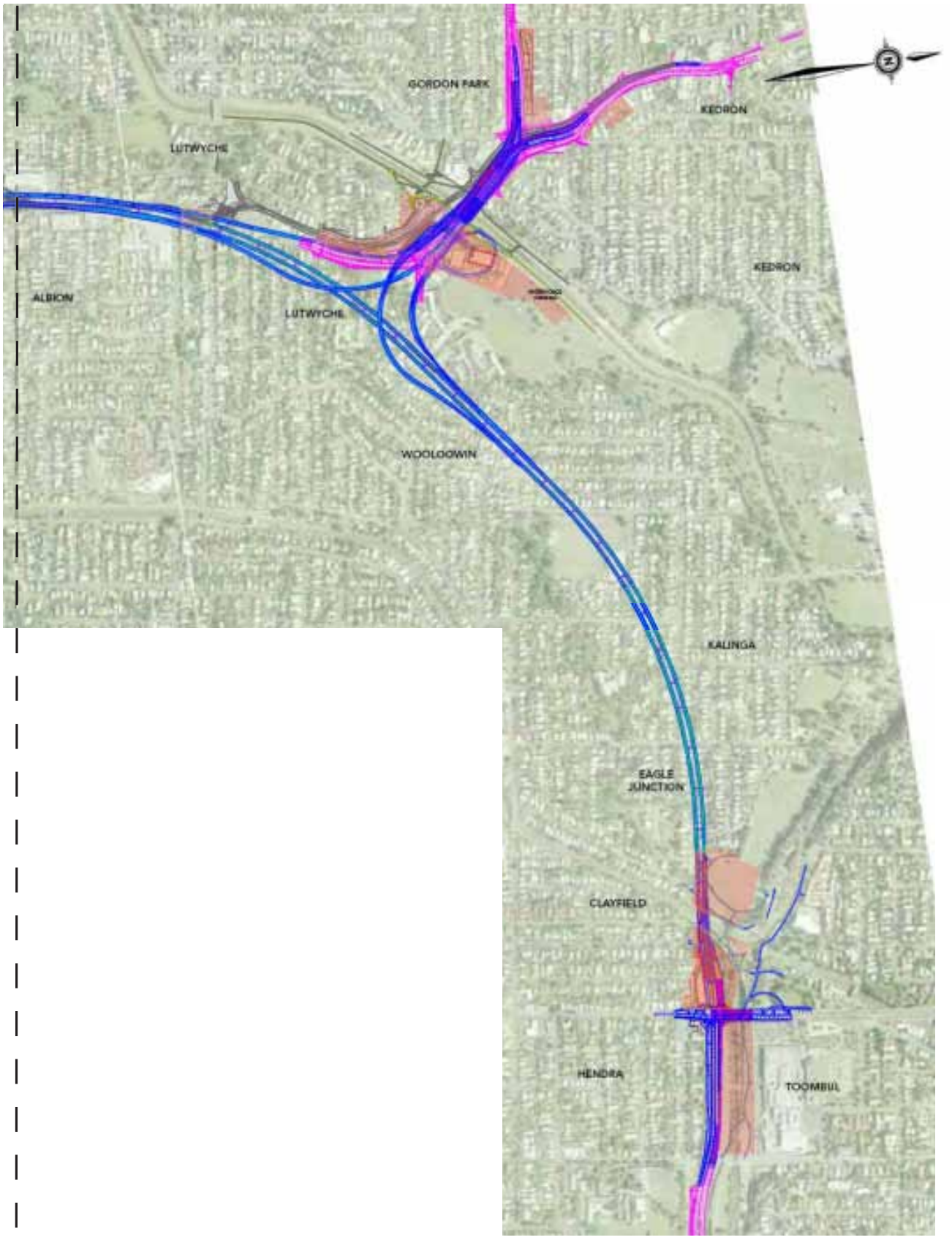


Figure 1-1

Airport Link Alignment

1.3 Project Implementation and Changes

The Changed Project, evaluated in the Coordinator-General's Change Report of July 2008, is now being delivered by BrisConnections Pty Ltd (BC), with construction commenced, and worksites established at Bowen Hills, Windsor, Lutwyche, Kedron, Clayfield and Toombul.

Following a competitive tender process, BrisConnections (sponsored by Macquarie Capital Group, Thiess and John Holland) was appointed by the State of finance, design, construct, commission, operate and maintain Airport Link for a period of 45 years. BrisConnections have contracted Thiess John Holland (TJH) to undertake the design and construction of the three projects.

As design and construction progresses, a constraint has emerged which was not apparent during the initial Project design.

This constraint involves the identification of unsuitable ground conditions in the vicinity of the Kedron underground ramps than those anticipated and inferred from available geotechnical during the initial design process. Different ground conditions have resulted in potential delays to construction and extension of the construction program.

In response to these issues, a new worksite is proposed to be established and used to enable the previously unforeseen adverse ground conditions to be addressed, so that flow-on adverse impacts on the Project's schedule and road users can be minimised.

1.3.1 Adverse Ground Conditions

These ground conditions have the potential to slow the rate of progress in excavating the tunnel which provides access to the 'Kedron Caverns'[5]. This tunnel access needs to be in place before the Tunnel Boring Machines (TBMs), being driven from Toombul, reach Kedron.

Consequently, the TBM's could be delayed and the Project's critical path impacted as a result of the late excavation of the Kedron Caverns. To overcome this issue TJH has proposed the construction of an alternative access shaft which would be located on vacant land, owned by Queensland Department of Transport and Main Roads (DTMR) at the intersection of Rose Street and Park Road. If the construction program was to be extended, the Kedron worksite and associated facilities would remain open and operating for an extended period.

The delay in the construction program would also require the spoil-receiving and handling facilities, for each of the TBMs at Clayfield and Toombul to remain open longer as progress in construction of the Kedron Caverns for the ramps is delayed.

1.4 Process for Evaluation of Project Change

The evaluation of both the Airport Link Reference Project and the Changed Project by the Coordinator-General were carried out under Part 4 of the SDPWO Act. The SDPWO Act provides the process for the Coordinator-General to evaluate changes to a significant project, previously the subject of an evaluation report.

[5] The caverns are the sections of tunnel where ramps meet the mainline tunnel drives.

The steps to be followed, as set out in Part 4 Division 3A of the SDPWO Act, in identifying, assessing and reporting on the proposed changes to the Reference Project are:

- The Proponent applies to the Coordinator-General to evaluate a proposed change to the Project. The application must include a description of the proposed change and its effect on the Project, the reasons for the proposed change and information to allow the Coordinator- General to make the evaluation. This report fulfils that obligation.
- The Coordinator-General may:
    - refer the details of the proposed change to anyone the Coordinator-General considers may be able to assist in making the evaluation;
    - ask the Proponent for further information about the proposed change, its effects on the Project or any other related matter; and
    - decide whether to require the Proponent to publicly notify the proposed change and its effect on the Project.
- The Coordinator-General must evaluate the proposed change, considering all properly made submissions, the nature of the change and its effects on the Project, the Project as evaluated under the Coordinator-General's report for the EIS for the Project, the environmental effects of the change and its effect on the Project.
- The Coordinator-General must prepare a 'Change Report' that evaluates the effects of the proposed change and may state such conditions as are necessary to address the impacts of the proposed changes. The Change Report must be given to the Proponent and must be publicly notified.

The Coordinator-General's Evaluation Report (ER) for the EIS and the Change Report both have effect for the Project. However, the Change Report prevails to the extent of any inconsistency. Similarly, the Coordinator-General's Change Report regarding the changes proposed in this request would also prevail over the EIS evaluation and the Change Report dated July 2008, to the extent of any inconsistency.

1.5 Consultation

Consultation in relation to Airport Link has been extensive since the conception of the Project with the EIS preliminary consultation, public notification of the EIS, and public notification of the Request for Project Change in June 2008. Since then, BC has maintained a consultative approach with regular meetings with Community Liaison Groups (CLGs), interested parties, stakeholder briefings, and responding to email, telephone inquires and maintaining an active complaints response system.

In support of this Request for Project Change for the Rose Street worksite, the proponent is facilitating a range of agency and community information processes.

Public consultation on the Rose Street worksite Change would include:

- consultation with property owners who would be directly affected by the Rose Street worksite;
- visits to directly-affected property owners and residents;
- stakeholder engagement; and

- community information sessions.

Additional material will be accessible from the CNI website (www.citynorthinfrastructure.com.au) and in the form of a newsletter to be distributed in the locality.

If the Coordinator-General requires public notification of the Request for Project Change, in accordance with the SDPWO Act, any person may make a submission to the Coordinator-General about the proposed changes to the approved Airport Link Project during the period of public notification.

Properly-made submissions to the Coordinator-General must:

- be made within the submission period;
- be in writing and signed by each person making the submission;
- state the name and address of each person making the submission; and
- state the grounds for the submission, and the facts and circumstances relied upon in support of those grounds.

The address for the making of the submission is:

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2 EXISTING ENVIRONMENT

2.1 Site Description

The site of the proposed new worksite, which constitutes the key aspect of the proposed change to Airport Link, is situated at Rose Street, Wooloowin, on the corners of Kent Road and Park Road (**Figure 2-1)**. **Figure 2-2** shows the location of the site in relation to the Airport Link Project while **Figure 2-3** indicates the location of the site within the local area.

The proposed worksite is situated within a low-density residential area characterised by single detached dwellings. Small-scale commercial activities are conducted on land fronting Kent Road to the south and east of the site and on Park Road south-west of the site. These include:

- a veterinary clinic located approximately 20m south of the site;
- an aviation school located approximately 20m east of the site;
- a commercial development (including a café, restaurant, homeware store, hairdresser, naturopath and acupuncturist) located approximately 45m south-east of the site; and
- a natural therapies clinic located approximately 25 m south-west of the site.

The proximity of these type of business to operating worksites and/or construction activities is similar to those on other areas of the Project such as the Truro Street tunnel portal, Kedron cut cover structure and the Lutwyche/Gympie/Stafford roadworks and structures.

Melrose Park is situated approximately 140 m to the east, along Rose Street. The Kedron State High School is situated approximately 190 m to the south-west of the proposed worksite along Park Road. To the east, the Eagle Junction shopping centre is located approximately 700 m from the site along Rose Street / Junction Road.

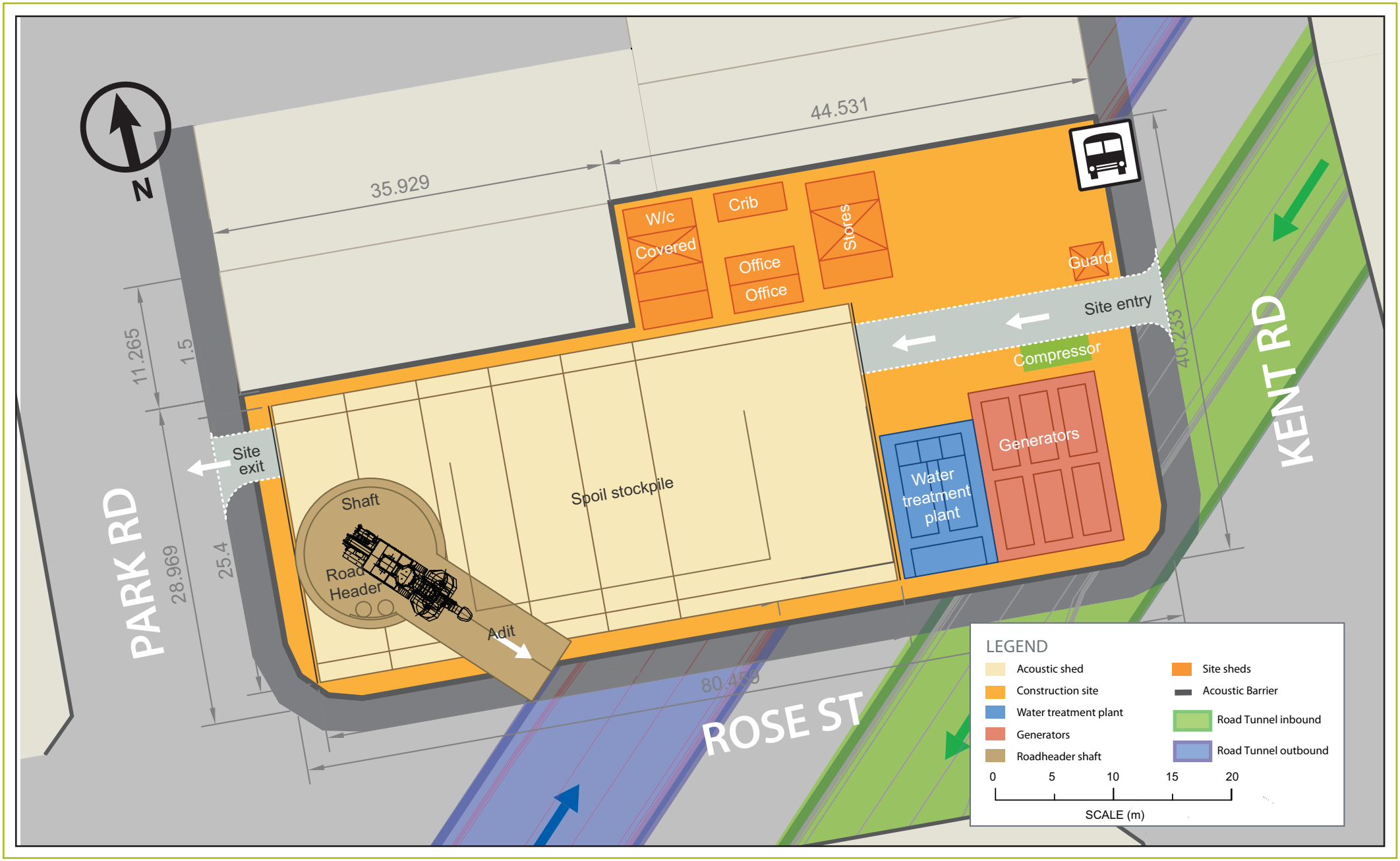


Figure 2-1

Proposed Site Plan

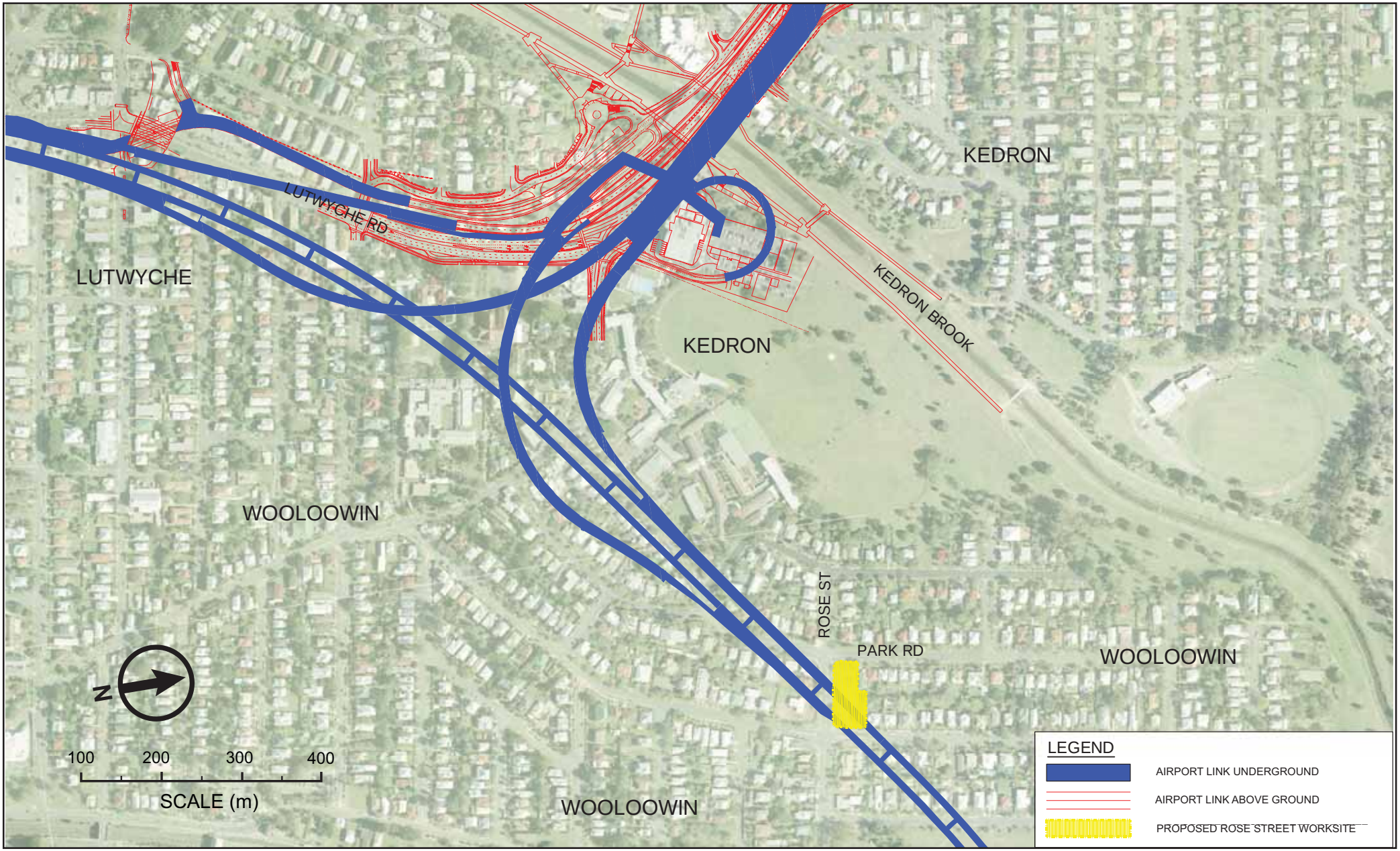
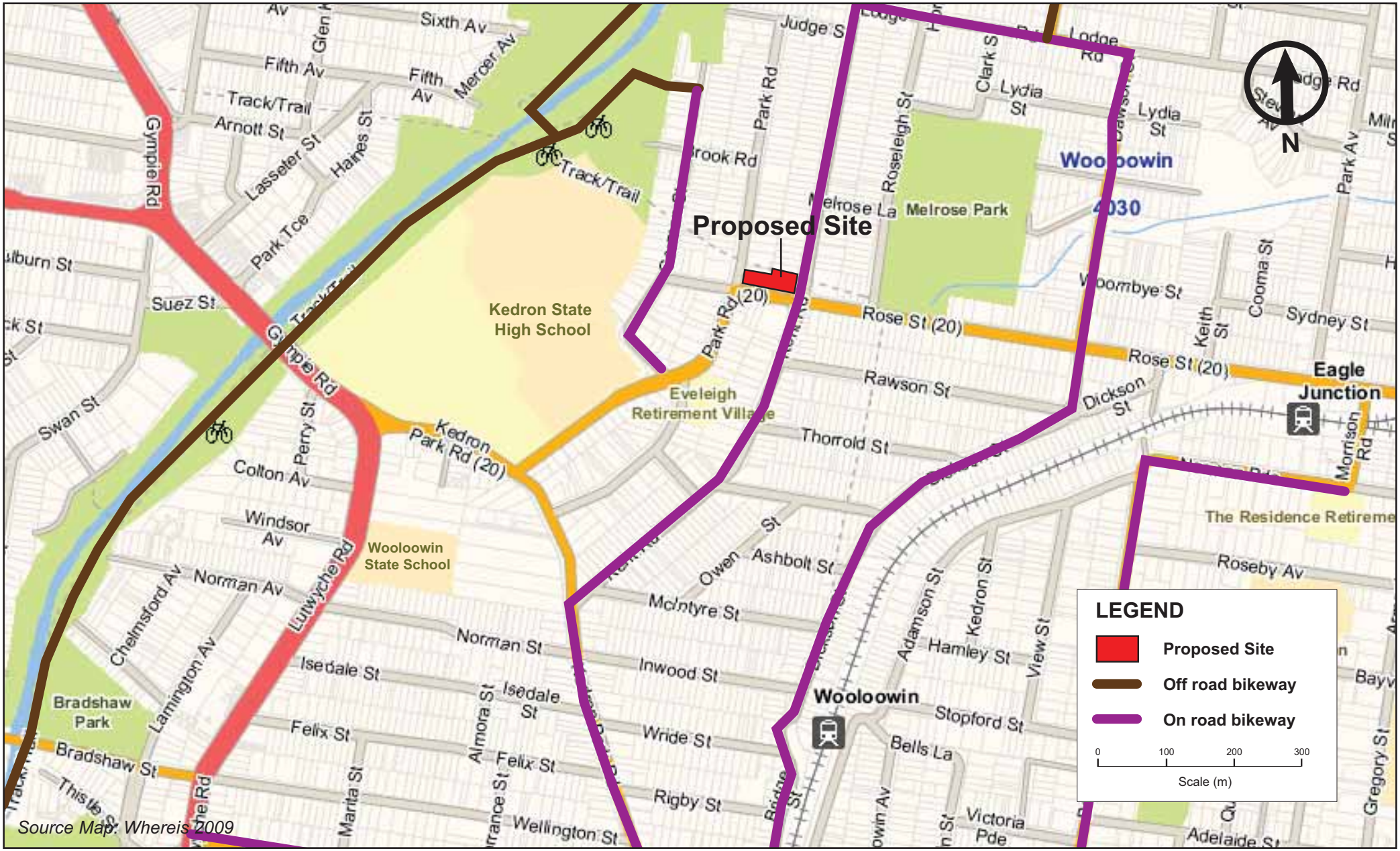


Figure 2-2

Locality Map



Source Map: Whereis 2009

Figure 2-3

Local Area

2.2 Property Description

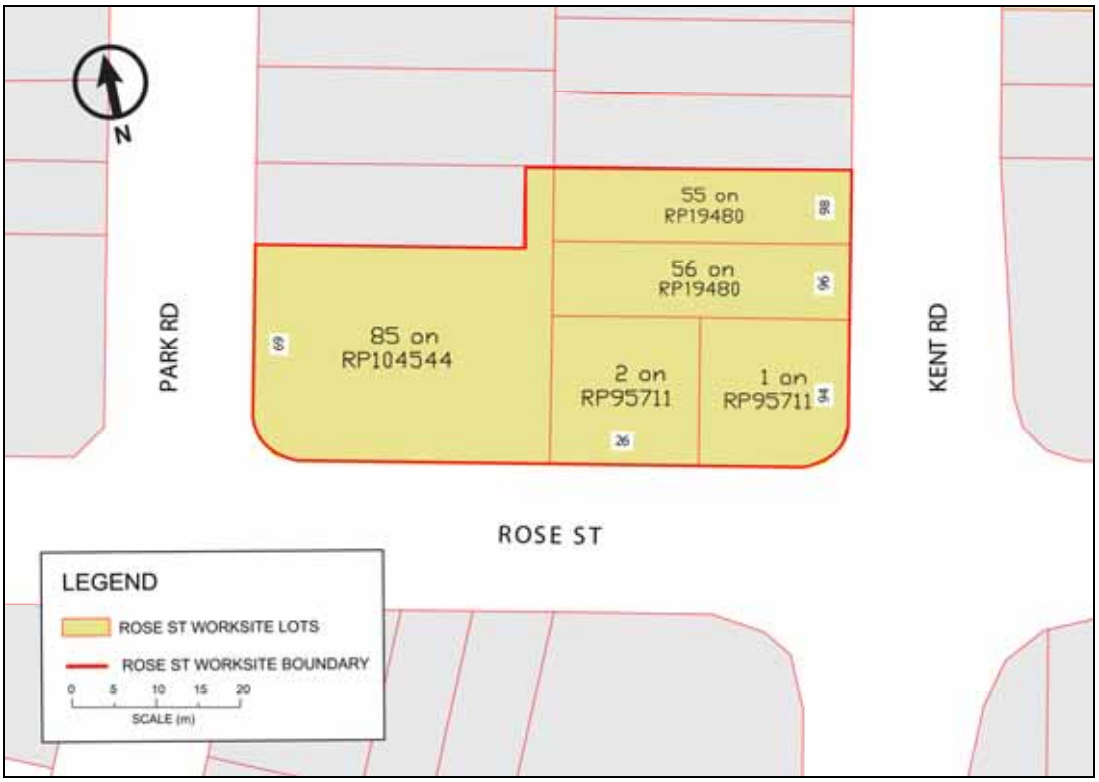
The proposed worksite is bounded by Rose Street to the south (80 m frontage), Kent Road to the east (40 m frontage) and Park Road to the west (29 m frontage) (**Figure 2-4**). The area of the land is approximately 2,819m^2 and comprises of the lots shown in **Table 2-1**.

Table 2-1: Property Description

Plan	Lot	Area (m^2)	Frontage (m)
RP 104 544	85	1,204	60
RP 19480	55	405	10
RP 19480	56	405	10
RP 95711	1	400	37
RP 95711	2	405	20
Total		2,819	137

The lots comprising the proposed worksite are owned by the State of Queensland, represented by DTMR. Native Title interests in the land are considered to be extinguished as the land is freehold.

Figure 2-4: Property Lots



2.2.1 Character of Local Roads

The road network in the vicinity of the Changed Project is shown in **Figure 2-5**.

Rose Street and Kent Road form a section of Metroad 5, which is a State-controlled QTMR road linking the western suburbs with the inner northern suburbs and the Brisbane Airport precinct. This cross-city link consists of Wardell Street, Stafford Road and Gympie Road. The cross-city function is extended from Gympie Road to the east and the Brisbane Airport precinct via other State-controlled roads including Kedron Park Road, Park Road, Rose Street, Junction Road, Sandgate Road and the East-West Arterial.

The Kedron Park Road, Park Road, Rose Street and Junction Road section of this cross-city link is a two lane undivided route comprising of one traffic lane and a parking lane in each direction. The route provides access to the northern suburbs around Wooloowin.

A large number of residential properties are located along this route.

Rose Street

Rose Street is a two lane road, and as an extension of Junction Road, forms part of the east-west connection from Sandgate Road to Gympie Road.

According to the DTMR's Road Planning and Design Manual, Rose Street functions as an arterial road, or Regional Road. Queensland's Regional Road Network "*provides important links for commercial, freight and commuter traffic within regions*"[6], and Rose Street (as an extension of Junction Road) serves as a link between the Lutwyche Road and Sandgate Road corridors. It also serves as a signposted route to service Brisbane Airport, and facilitates cross-regional travel in a network that has minimal east-west routes available, other than the local street system.

Although it is classified as an arterial route and carries approximately 6,100 vehicles per day (Annual Average Daily Traffic - AADT), Rose Street does not present as a major thoroughfare within the context of the area. This is due to the road not having the appearance of typical arterial roads, which tend to have four lanes or larger widths and/or a lower density of housing along their lengths. Rose Street is predominately a low density residential area, characterised by 'tin and timber' housing and small-scale commercial activities adjacent to the intersection with Kent Road.

[6] Queensland Department of Transport and Main Roads, Road Planning and Design Manual, August 2004

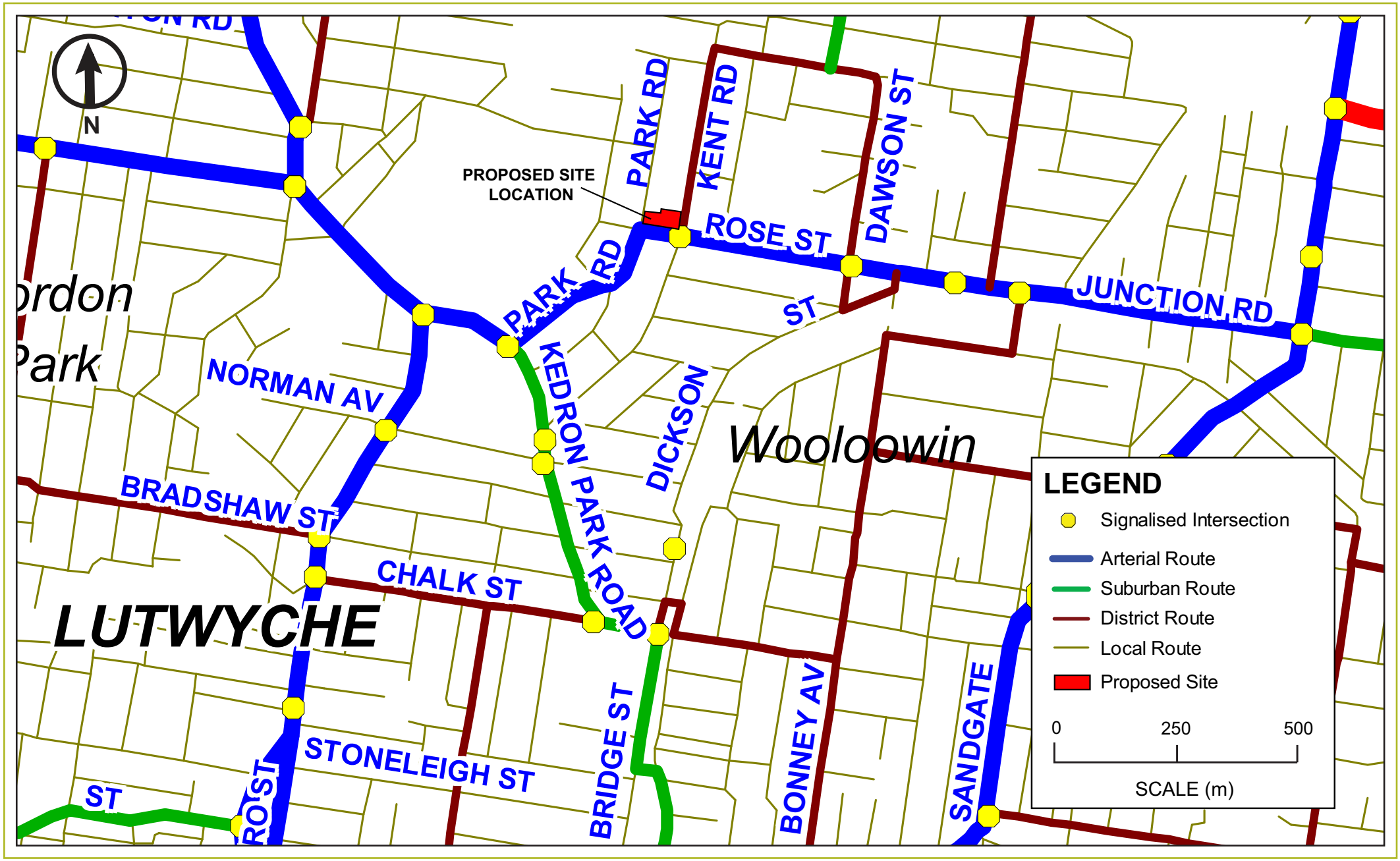


Figure 2-5

Road Network

Photo 2-1: View Down Rose Street, Looking east through Kent Road Intersection.

Kent Road

Kent Road is a two lane district route (north of Rose Street) providing north-south connectivity in Wooloowin and a local road (south of Rose Street).

In the vicinity of the proposed worksite, the road is characterised by low density residential uses and low traffic flows. Small-scale commercial facilities are located on the eastern side of Kent Road where it intersects with Rose Street.

There are designated on-street cycle lanes and bus stops for the 320 and 321 services on both sides of the road.

Photo 2-2: Residential Dwellings, Kent Road

Photo 2-3: Shops Located at Corner of Kent Road and Rose Street

Park Road

The section of Park Road between Kedron Park Road and Rose Street forms part of the State-controlled East-West Arterial route. North of Rose Street, Park Road is classified as a local road characterised by low traffic flows and low density residential uses.

Photo 2-4: View of Park Road south of Rose Street

Photo 2-5: View of Park Road north of Rose Street

2.2.2 Local Land Use

Existing land use in the vicinity of the site of the proposed change is shown in **Figure 2-6**. Land around the Rose Street worksite is predominantly low density residential, while a significant proportion of land is also within the Community Use (CU) area. Education premises include Kedron State High School and Wooloowin State School.

Consistent with City Plan[7] area classifications, the predominant existing land uses in the area are residential dwellings, most of which are included in the Demolition Control Precinct. Low-medium residential uses also exist in the form of multiple dwellings.

Adjacent to the study area, Melrose Park and Kalinga Park are used for passive and active recreation. Melrose Park contains general recreation space and the Kalinga Bowls Club Inc. Kalinga Park contains sporting fields and general recreation space.

A total of 13 residential properties and one commercial property in the locality are owned by the DTMR. The commercial property, located at 36 Rose Street, is currently leased by the Queensland Aerospace College. Three other commercial properties are located in the study area namely:

- a veterinary clinic at 86 Kent Road;
- a natural therapies clinic at 64 Park Road; and
- a commercial development at 85 Kent Road, including a café, restaurant, homeware store, hairdresser, naturopath and acupuncturist.

[7] Brisbane City Council, *City Plan 2000* as amended

Figure 2-6

Existing Land Uses

2.2.3 Visual Character

In the Airport Link EIS, the Wooloowin area is described as having the most intact and consistent visual character of suburban low density housing and domestic landscaping within the overall Airport Link study corridor. The area is characteristic of Brisbane's older residential suburbs, comprised predominantly of light weight 'tin and timber' Queenslander-style houses, of both 'low set' and 'high set' forms. Typically, a 'high set' Queenslander house on level ground would not exceed 8 m in height from ground level to the peak of its roof.

The built form in the study area is typical of this low density, low rise suburban character.

Highly suburban in character, Wooloowin is defined by good quality residential built form and a recognisable tree-lined street form. The residential street pattern provides an efficient framework for pedestrian and cyclist movement, and shaded footpaths are a valuable landscape form. The street pattern also facilitates access to the Kedron Brook open space system as well as the Wooloowin and Eagle Junction train stations.

2.3 Existing Transport Operations

The proposed worksite is situated on Rose Street, Wooloowin, which is part of the State-controlled road network serving the transport needs of the inner northern suburbs of Brisbane.

The transport corridors of Gympie Road, Lutwyche Road, Sandgate Road, Kedron Park Road, Rose Street and Junction Road are controlled by DTMR and are linked via STREAMS[8] to provide optimal travel times. The arterial roads under Brisbane City Council (BCC) control are coordinated with the DTMR corridors.

The local road system is subservient to the through arterial road system.

2.3.1 Traffic Flows

The intersections along both Junction Road and Rose Street operate within a coordinated traffic corridor. The current AADT Daily Traffic Volumes (Austraffic, August 2008), AM and PM peak vehicle movements are shown in **Table 2-2**. Where possible, the proportion (%) of Commercial Vehicles (CVs) is provided to illustrate the character of traffic flows along the corridor.

Table 2-2: Existing Traffic Flows

Intersection	Flow Direction	AM Peak Veh / hr	CV	PM Peak Veh / hr	CV	AADT
Rose Street / Kent Road	Eastbound	531	Note 1	442	Note 1	6,162
Dawson Street / Rose Street	Eastbound	507	Note 1	370	Note 1	6,092
Sandgate Road / Junction Road	East to North	255	26	268	13	2,555[2]
Kedron Park Road / Lutwyche Road	South to East	1,219	49	599	6	9,961

[1] STREAMS data does not provide classification data

[8] STREAMS is a synchronised system developed by DTMR for managing the operation of signalised intersections on selected routes in Brisbane's road network.

[2] AADT estimated from Manual Count Data

2.3.2 Public Transport

Bus services on Routes 320 and 321 operate through the intersection of Kent Road and Rose Street. These bus services operate at greater frequencies in the peak direction. TransLink timetables show that bus services operate every 20 minutes in the peak direction and every 30 minutes outside of peak periods.

Eagle Junction railway station is located on the southern side of Junction Road between Bonney Avenue and Morrison Road, with a commuter parking area provided off Junction Road. A signalised pedestrian crossing across Junction Road is located at the entrance to the station.

2.3.3 Bicycle Movements and Facilities

A dedicated on-road cycle route is provided along Kent Road from Shaw Road and the off-road Kedron Brook path south via Kedron Park Road to Chalk Street. This route ultimately connects with the central city via the path system following Enoggera Creek to Victoria Park.

Another nominated on-road cycle route is via Gorman Street.

2.3.4 Pedestrian Movements and Facilities.

Pedestrian footpaths are located on all sections of Junction Road with signalised crossings located at all signalised intersections along Junction Road, Rose Street and Kedron Park Road. Pedestrian-operated signals are also located at the entry to the Eagle Junction railway station.

Pedestrian facilities in the form of pedestrian refuge islands are located along the section of Park Road between Kedron Park Road and Rose Street. The major proportion of pedestrian movements in this area are associated with Kedron State High School located on Kedron Park Road / Park Road. The main school access / egress for pedestrians is off Park Road near the intersection of Gorman Street. On-site observations show that the busiest period for pedestrian and vehicular activity occurs at the end of the school day.

During designated arrival and departure times at Kedron State High School (07:30 - 09:00 and 14:30 – 16:00), a 40 kph restricted zone is effective on Park Road.

2.3.5 Emergency services vehicle movements

The Department of Emergency Services (DES) located on Kedron Park Road, currently operates a left-in/left-out onto Kedron Park Road and emergency services vehicles use the existing road network.

3 REASON FOR PROPOSED CHANGE

The proposed change to the Airport Link Project is a change to part of the delivery methodology for Airport Link. The change would include establishment and use during the construction period of an additional worksite at Rose Street, Wooloowin, and the construction of a shaft and adit (horizontal passage) from that worksite to access the mainline tunnels being constructed from Clayfield.

The proposed change is to provide access to the mainline tunnel alignment for construction of the caverns necessary to accommodate the Kedron ramps ahead of the TBMs advancing from the worksite in Kalinga Park, Clayfield. The proposed worksite would remain functional for the duration of the delivery of the Airport Link Project, or construction phase, to allow more efficient fitout of the tunnels once they have been constructed.

Reasons for the change are provided below. Detail of the actual change description is provided in **Section 4**.

3.1 Rationale for Change

3.1.1 Overview

The tunnel excavation works associated with the Kedron Ramps and Caverns (KR&C) are critical to both the completion of the overall Project works and individual components of the Project works. The ramp tunnels provide the following:

- access to the caverns for cavern excavation prior to the TBM passage;
- primary power feed from the Kedron substation; and
- access for the concrete lining operations to the caverns and associated ramps.

Delays to the KR&C excavation works would adversely affect the timing of following critical activities:

- progress of the TBMs and their consequent completion on schedule;
- ability to progress and finish tunnel fitout;
- ability to progress pre-commissioning, the provision of electrical power routes, the commencement of final commissioning ;and
- rehabilitation of the Chalk Street and Kalinga Park worksites to their designated post-construction uses.

3.1.2 Geological Conditions

The construction program for these critical activities was based on analysis of the existing geotechnical information available at the time of initial design and the structural support required in the anticipated geological conditions.

After commencement of the Project works, further geotechnical fieldwork, assessment and analysis has identified significantly poorer ground conditions than anticipated at initial design. The analysis now indicates extended construction time and delays for the individual ramps and caverns. These predicted delays would

impact significantly on the delivery program, and would adversely affect the completion of Project works.

The differences between the geology anticipated at the time of initial design and those currently assessed are summarised in **Table 3-1**, while **Figure 3-1** includes a geotechnical long section and geology as currently assessed.

Table 3-1: Comparison of Anticipated and Actual Ground Conditions

Anticipated	Currently Found and Assessed
The crown of the tunnel in Brisbane Tuff varying from low strength to high strength	The crown of the tunnel in siltstone/mudstone varying from extremely low strength to high strength
Material above tunnel crown in Tingalpa formation of low strength Overlain by highly weathered material and residual soils	Material above tunnel crown inherently variable in behaviour due to deposition and weathering profiles plus relatively thin layers of clay seams Overlain by highly weathered material and residual soils
Tunnel cross-section intersecting through Inter Tuff sediments and Brisbane Tuff	Tunnel cross section intersecting through Inter Tuff sediments
Invert of the tunnel in high strength Brisbane Tuff	Invert of the tunnel in high strength Brisbane Tuff

Tunnel Support Types

As a direct consequence of these significant differences, the more substantive tunnel excavation support types have been significantly increased in extent and complexity. The primary differences between the current support regime and that anticipated at the time of initial design stage are:

- excavation advance rate reduced from 1.2 m to 1.0 m per day or less (16% reduction in advance rate);
- overall ramp progress reduced by between 25% and 45%. This is a critical delay component as it determines the commencement of the cavern excavation and the subsequent progress of the TBM and the completion works schedule[9];
- exchange of fibrecrete for two layers of steel mesh reinforced shotcrete with starter bar connections, increasing complexity in construction;
- significant amounts of face support introduced; and
- poor ground conditions requiring the invert to be fully closed (structural support required to the floor of the tunnel) on each advance.

These differences in complexity are further described in the Work Method Statement - Rose Street Worksite, TJH, May 2009 (**Appendix A.2** – Work Method Statement - Rose Street Worksite.

[9] The actual increased duration percentages are not directly transferable to the overall project delay but the aggregated impacts of each ramp's commencement and duration determines the completion of the respective programs

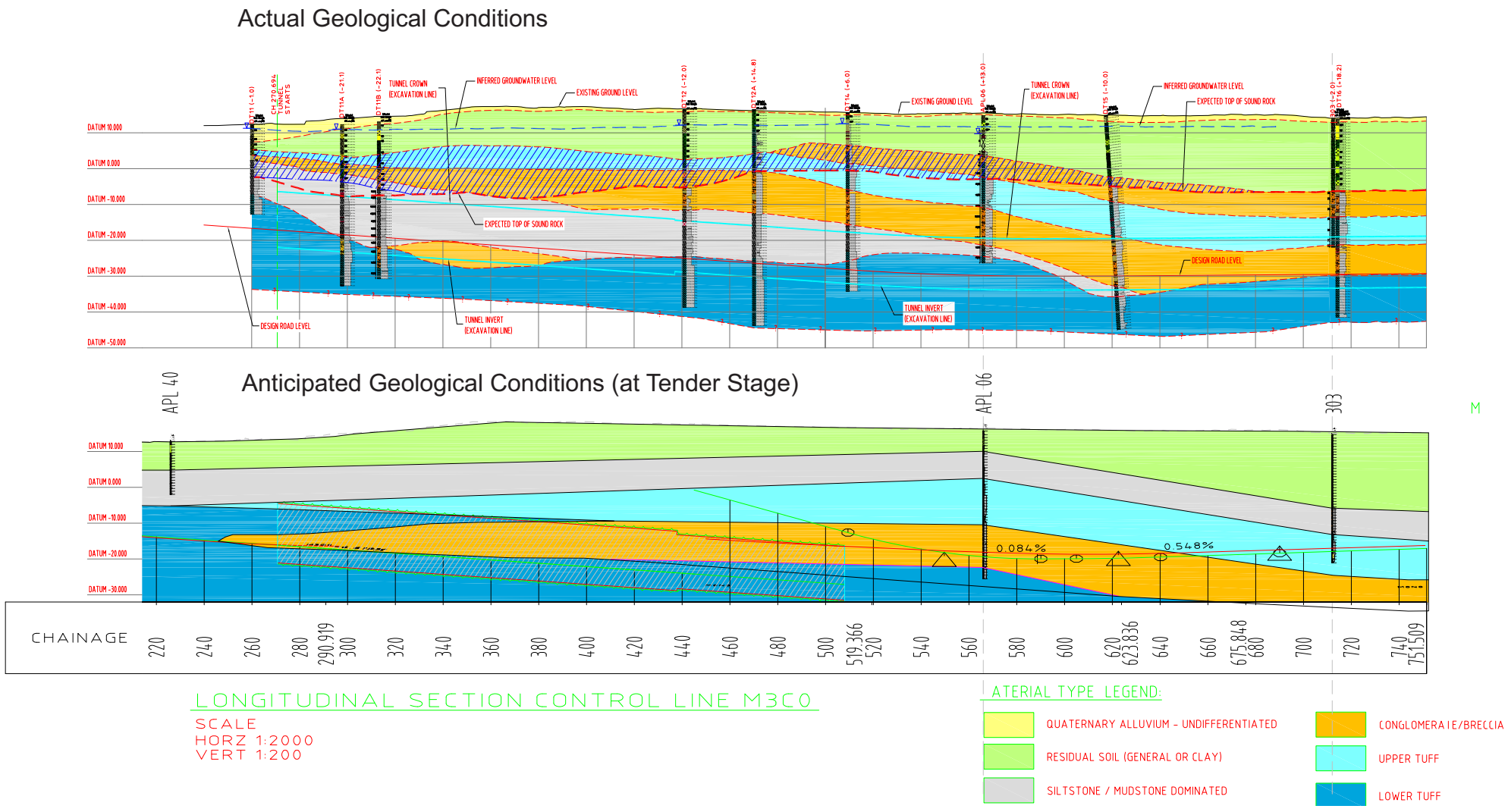


Figure 3-1

Actual Geological and Anticipated Geological Conditions

Implications for Project Delivery Methodology

These differences in ground conditions, and consequential delays in construction of KR&C give rise directly to a number of adverse consequences of the Project delivery methodology. If not addressed, these adverse consequences include:

- delays in the advance of the TBMs beneath Wooloowin, and subsequently in their arrival and removal from the Chalk Street worksite;
- extension in the time required to keep open and operating the spoil handling facilities in Kalinga Park and Toombul, as well as the spoil conveyor east of Toombul;
- extension in the time required to keep open the Kedron worksite and delay to the rehabilitation of that worksite for community use;
- extended but lower-intensity spoil transport activities from the Kedron worksite;
- increases in Project construction costs.

3.2 Justification of Proposed Change

3.2.1 Impacts of Adverse Geotechnical Conditions on Progress

The extra work required to construct the more complex tunnel supports due to the adverse geological conditions would result in slower excavation production rates compared to those originally anticipated. The excavation rates reflect the combination of all activities required to be completed to progress the tunnelling operation, including installation of supports, detailed excavation, temporary lining and invert preparation. These rates are compared in **Table 3-2**.

In **Table 3-2** the term 'Type' refers to the tunnel excavation support type which details the scope of work necessary to excavate the tunnel in varying conditions. The various support types have been diagrammatically detailed in **Appendix A.1**.

Table 3-2: Comparison of Construction (Production Rates)

	Initial Estimated Production Rates	Anticipated Production Rates
Heading excavation	Type 2 – 4 => 1,500m^3/wk Type 5 – 6 => 1,300m^3/wk	Type 4 => 1,050-1,200m^3/wk Type 5 – 6 => 300- 750m^3/wk
Bench excavation	Type 2 – 4 => 2,200 m^3/wk Type 5 – 6 => 1,800 m^3/wk	Type 4 => 1,800- 2,500 m^3/wk Type 5 – 6 => 750-1,800 m^3/wk

Note: The above ranges in the anticipated excavation rates are likely to vary depending on cross sectional width.

The combination of the increased lengths, the heavier support types and the reduced excavation rates associated with these types has increased the construction program for each part of the KR&C (**Table 3-3**).

Table 3-3: Implications for Construction Program

Area	Original (Planned) Duration (Days)	Current (Predicted) Duration (Days)	Delay (Days) (%)
Ramp B	492	718	226 (45.9%)
Ramp C	268	335	67 (25.0%)
Ramp D	445	643	198 (44.5%)
Westbound Cavern	208	202	-6 (-2.9%)[1]
Eastbound Cavern	374	370	-4 (-1.1%)[1]
Total	1,787	2,268	481 (26.9%)

[1] Cavern durations are the result of minor volumetric reductions developed through geometric means such as refinement of alignments.

The durations presented in **Table 3-3** have been derived by applying the anticipated production rates for the various tunnel excavation support types against the physical scope (i.e. volume) of the respective ramp and cavern structures.

A range of mitigation measures, acceptable under the Project performance specifications, have been considered in identifying the likely program delay. Such measures include:

- reducing lengths of ramps and caverns by modifying vertical and horizontal alignments; and
- reducing the cross sectional area by refining space-proofing, fire and life safety requirements.

In addition, other initiatives such as alternative excavation support methodologies using steel sets, specialist equipment and reduced cross-sections would also be investigated further. These initiatives would reduce the overall construction period and various sub-components, but do not result in the Project being completed by the required date. The reduction in cross-section of the tunnels would need to maintain road safety requirements set through the road design specifications.

3.2.2 Impacts of Construction Delays

The original Project planning and program was based on ensuring the Kedron caverns were completed prior to the arrival of the TBMs and to enable the critical tunnel fitout and electrical activities to be efficiently sequenced.

This program sequencing is shown on the attached “GP08 (Original GP08 Workfronts)” program and corresponding diagrammatic representation “Original GP08 Workfronts” in **Appendix A.1** – Change to Program / Alternatives.

The overall impact on the construction program is dependent on a number of planning factors including the actual ground conditions, sequencing, the number of work areas that can be effectively opened up, and the level of resourcing.

3.3 Alternative Construction Methodologies

3.3.1 Alternative Tunnel Alignments

This section considers alternative tunnel alignments that could minimise the current and predicted delays being experienced in the Kedron area due to poor ground conditions.

Change the Vertical Alignments

A significant change in grade, and vertical alignment, would be required to achieve a material improvement on the length of the ramp due to the unsuitable geological condition of the area. There are a number of intersecting ramps in the tunnel design. Changing the vertical alignment by taking the mainline tunnels deeper would require the lengthening of other ramps in order to maintain all the road design criteria (e.g. sight lines and merge lengths).

The studies undertaken to date conclude that changing the vertical alignment would not be a feasible alternative to resolving the delays caused by soil conditions at Kedron.

Change to the Ramp Design Speed

The ramp design speed dictates sight distances and merge lengths, which in turn govern tunnel width. Reductions in tunnel widths reduce the required ground support with a corresponding benefit to rate of excavation.

Reducing the ramp speed would reduce ramp functionality with respect to traffic flows and would potentially create merge issues, and resultant decrease in safety, for drivers moving from the ramp into the faster-moving main stream of tunnel traffic. Due to the associated functionality and safety issues this option is not considered to be feasible.

Separating Ramps and Tunnels

The current configuration has two distinct traffic flows merging within the eastbound ramp from Kedron with a longitudinal tunnel egress appended to one side.

The options considered were to separate the two traffic flows into separate tunnels and join them further down the ramp where the geology improved. Due to the requirement to have two lanes of traffic merged into one before the cavern and the necessary merge distances, either the joining of the two tunnels occurs very close to the current portal site or the ramps and caverns are extended significantly to the east, which in turn delays the commencement of cavern excavation. For the reasons described this option is not considered to be feasible.

3.3.2 Alternative Construction Sequence

An alternative construction sequence would allow the TBMs to traverse the caverns prior to completion of cavern excavation. This would allow the TBMs to cut through a partially-excavated cavern.

While this technique is relatively simple with the appropriate TBMs, the adverse ground conditions encountered between Kedron and Clayfield for Airport Link require a different type of TBM (i.e. Earth Pressure Balance – EPB - style single shielded segment machines). The use of this type of TBM to cut through a partially-

excavated cavern would introduce additional safety risks for the tunnelling crews. The measures required to mitigate the safety risks in turn would delay progress of the TBMs through the caverns.

Once a TBM had traversed an incomplete cavern, the supply systems for the TBM (conveyor, services, etc) would essentially quarantine the cavern from the works necessary to complete the cavern excavation until the TBM work was complete.

In summary, this option does not assist in mitigating delays to the completion of the Project.

3.3.3 Alternative Planning / Sequencing / Resources

Progress on the Project has, and is currently being delayed by the poorer than anticipated ground conditions in the Kedron ramp area, and the overall completion date would be delayed unless an alterative option to improve progress is implemented.

A number of alternative options were developed to mitigate this impact on the overall Project completion. The options developed and their corresponding program milestones are tabulated below. The sequencing and resource levels associated with these options are detailed in the respective program and corresponding diagrammatic representations attached in **Appendix A.1** – Change to Program / Alternatives.

Table 3-4: Alternative Options Analysis

Program[1] (Status / Version)	Start of Ramp C	Complete W/B Cavern (Excavation Only)	Complete E/B Cavern (Excavation Only)	Complete Balance of Mined Tunnels (Excavation, Pavement & Lining)	Resource Implications
Start and durations of Tender Programme IP06	18/03/2009	11/06/2010	10/08/2010	26/10/2011	
Original GP08 (original tender document) Workfronts	07/07/2009	10/07/2010	20/08/2010	30/08/2011	Original 4 No workfronts anticipated
GP08 Alternative 1 (impact of actual geology)	07/07/2009	22/06/2011	18/08/2011	22/08/2012	One extra workfront and roadheader on Ramp B.
GP08 Alternative 2 (impact of actual geology)	07/07/2009	22/06/2011	20/05/2011	22/05/2012	Two extra workfronts and roadheaders on Ramp B and Eastbound cavern.
Rose Street Access shaft	07/07/2009	04/09/2010	08/10/2010	27/10/2011	Extra workfront and roadheaders on Ramp B, eastbound

					and westbound caverns.
DES Access shaft option	07/07/2009	26/5/2011	17/3/2011	8/3/2012	Extra workfront and roadheaders on Ramp B, eastbound and westbound caverns.
Melrose Park Access shaft option	07/07/2009	6/5/2011	12/2/2011	17/2/2012	Extra workfront and roadheaders on Ramp B, eastbound and westbound caverns.

[1]Refer to Appendix A.1 for description of programs details and diagrammatic representations

The alternative GP08 options, which incorporate additional roadheader resources, improve the overall Project duration marginally but still do not allow for progression of the TBM leading to program delays. The option that best achieves the original GP08 program dates is the Rose Street Access Shaft and is therefore the preferred option.

3.3.4 Alternative Shaft Locations

For tunnelling projects a conventional solution when delays to tunnelling occur involves sinking an access shaft to gain access to the area which is being delayed to allow additional excavation machines to be utilised to increase the rate of production.

Several options have been considered for possible alternative shaft locations in developing the proposed change to the delivery methodology for Airport Link. They include a shaft located adjacent to the DES building in the Kedron worksite, and a shaft located in Melrose Park, as well as the proposed location on the corner of Rose Street, Kent Road and Park Road.

Department of Emergency Services and Melrose Park

While the planning and sequencing for these options would be identical to the Rose Street proposal, the commencement of cavern excavations would be delayed due to the time required to construct the access tunnel from the shaft to the cavern locations.

The alternative access shaft locations for the Melrose Park and DES options are detailed in **Figure 3-2** and **Figure 3-3**.

Rose Street (Proposed)

The planning for the Rose Street shaft would follow a similar sequence to the Airport Link Project while permitting additional excavation machines to be applied to the westbound and eastbound caverns at the eastern end. The application of additional roadheaders directly to the westbound and eastbound caverns via the Rose Street access shaft, without the travel distances associated with both the DES and Melrose Park sites, provides the most effective strategy to complete the caverns and avoid the impacts of delay described above.

Commencing construction works at this location facilitates the critical TBM construction milestones and achieves the overall Project program.

Figure 3-2: Melrose Park Alternative Shaft Location

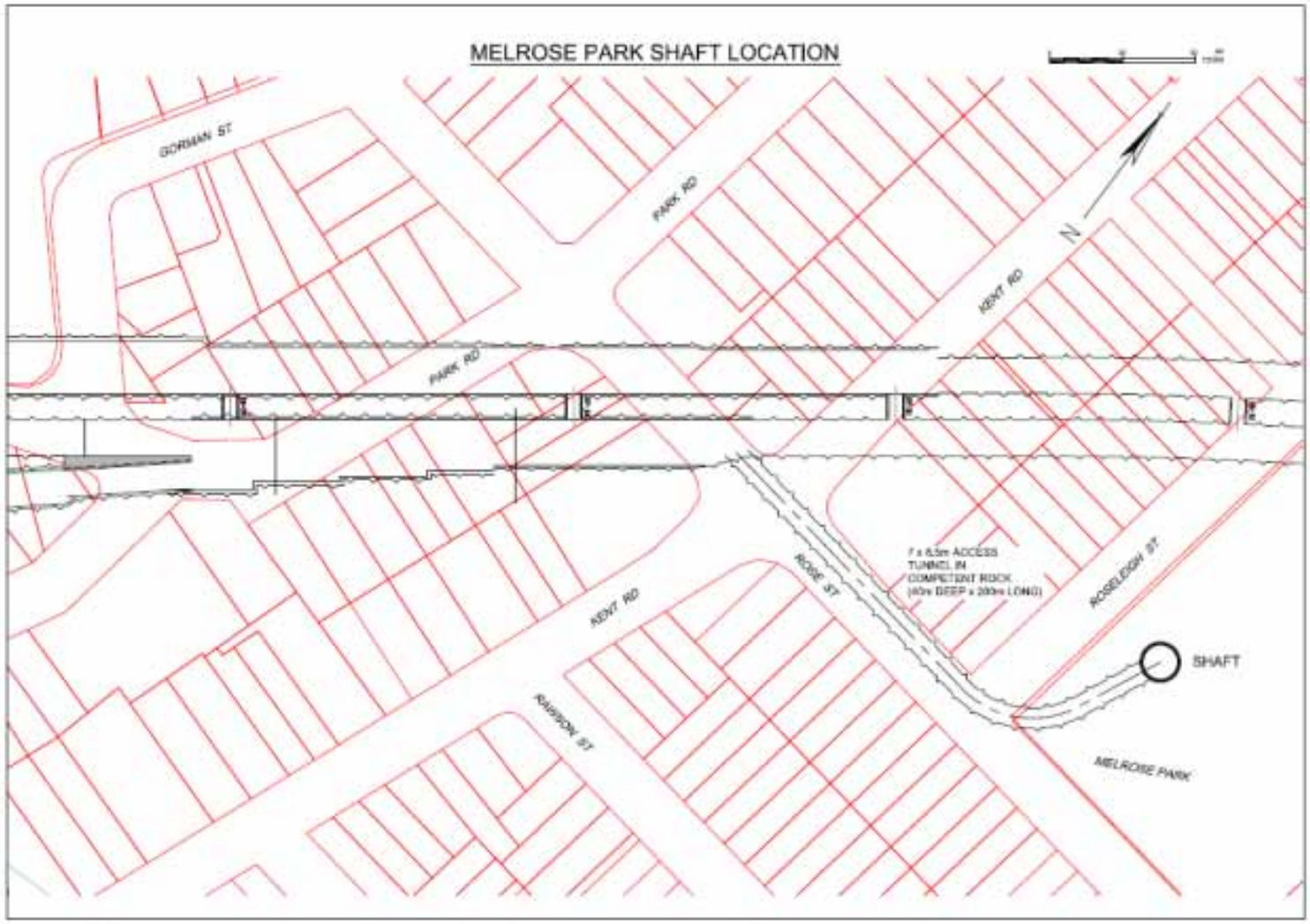
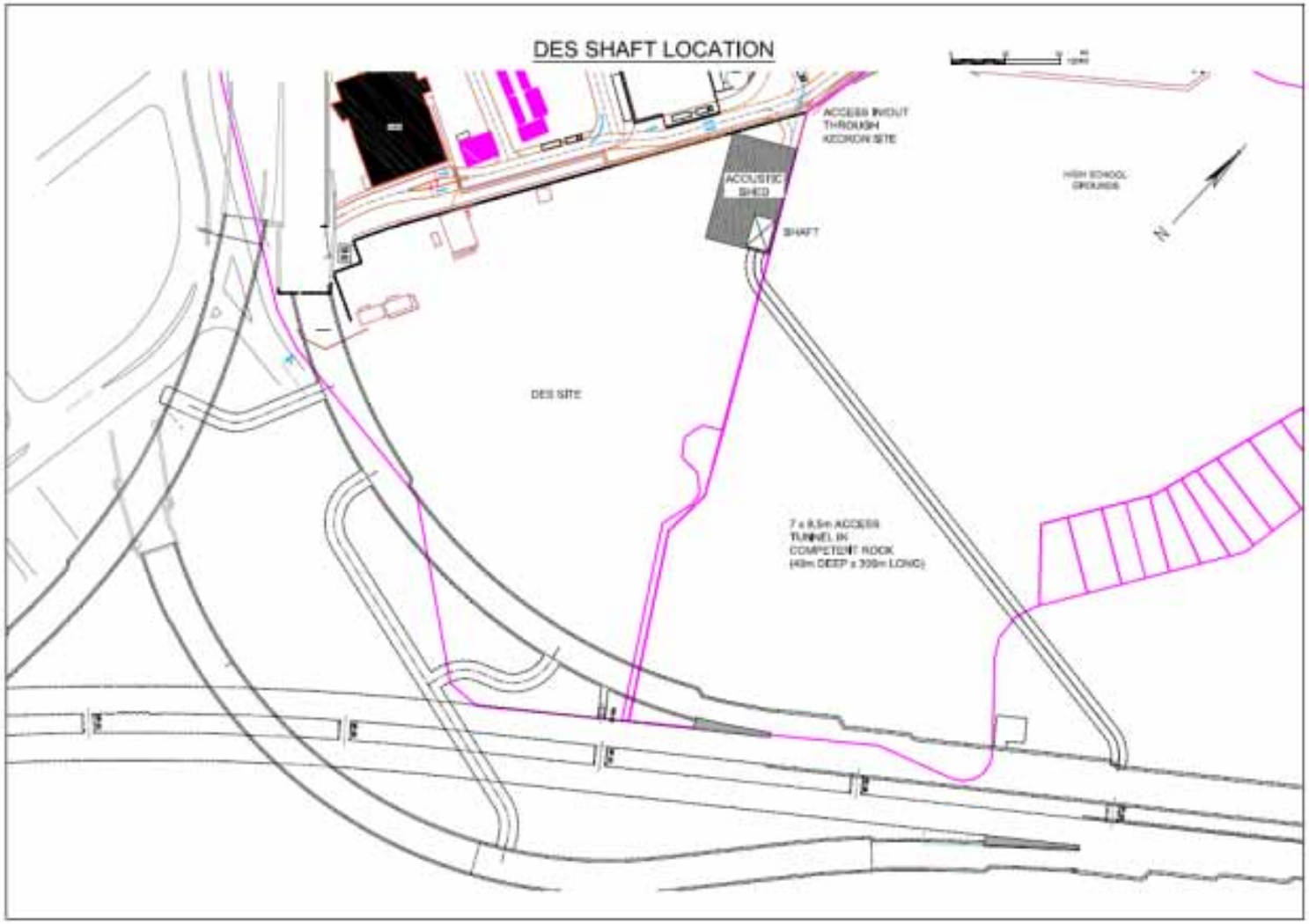


Figure 3-3: Department of Emergency Services Alternative Shaft Location



3.4 Consequences of Not Proceeding with Proposed Change

A delay in the Project completion as a result of delays with the construction of the KR&C would lead to impacts at the metropolitan and local level.

The impacts at the metropolitan level would include delays in realising the predicted Project benefits such as:

- reduced congestion and improved traffic flows on key routes in the inner northern suburbs;
- greater access to public transport for the northern suburbs;
- a safer road network;
- improvements in the general amenity of the road corridor; and
- flow-on economic savings through reductions in congestion, travel time and motor vehicle operating costs, as well as environmental benefits.

The impacts at the local level would include:

- the necessary use of the cut and cover structures for access to the mainline tunnels such that the junction of Lutwyche Road and Kedron Park Road adjacent to the Kedron Park Hotel would remain in a partially-completed form longer with the associated impact on traffic flows;
- the extension of operations of the spoil handling facilities in Kalinga Park and Toombul, with potential impacts on amenity in Kalinga Park and the Schulz Canal open space corridor;
- the consequential extension of the period in which spoil handling impacts would be experienced by people living, working or moving through these areas;
- the consequential delay in the decommissioning of the spoil handling facilities in Kalinga Park and along the Schulz Canal open space corridor, and a delay then in the rehabilitation of these open spaces for return to community use;
- the consequential delay in use of the Chalk Street worksite for receiving, disassembling and removing the TBMs.

3.5 Benefits of Proceeding with the Proposed Change

3.5.1 Benefits to the Community

Benefits to the community of the proposed change proceeding would include:

- the creation of 220 additional jobs;
- additional employment to local sub-contractors, security, traffic control, piling contractors, steel fabricators, fencing and so on;
- additional workforce for construction engineering and supervision at the Rose Street worksite.

The additional resources required for the Rose Street worksite would also have flow on effects to the wider community workforce, including:

- additional major equipment being purchased or hired (i.e. road headers, cranes, underground trucks, ventilation equipment, power supply ($5m);
- additional materials being supplied (i.e. concrete, steel reinforcing, structural steel, timber ($3m); and
- consumables from small local business.

In keeping with the practice across the Airport Link Project corridor, the community living near the proposed worksite would be consulted on future uses of the site and wider community benefit projects.

BC through its contractor, Thiess John Holland (TJH), would fund a community benefits program and/or redevelopment of the proposed worksite.

The Wooloowin worksite would be fully remediated and restored to its current condition at the end of works by mid-2012. Any consultation on possible future uses of the site would begin 12 months prior to the end of works but would be subject to the plans of the current owner who has the right to have the land returned to them.

3.5.2 Benefits to the Project

An approval of the proposed change would help to ensure:

- The Project is completed on time rather than being delayed with the associated community amenity and overall Project benefits delivered earlier than otherwise would be the case;
- progress of the TBMs is not delayed and the commencement of improvements and ultimately the return of the Chalk Street and Kalinga Park precincts to their normal operations earlier than would otherwise be the case; and
- the tunnel fitout, the provision of electrical power routes, pre-commissioning, final commissioning and consequent completion of tunnel and adjacent cut and cover structures is achieved on schedule to allow associated roadworks to be completed earlier than would otherwise be the case.

4 DESCRIPTION OF PROPOSED CHANGE

4.1 Overview

The requested change would be a change to only part of the delivery methodology for Airport Link. The requested change would involve:

- the establishment of a new and additional worksite on land at Rose Street, Wooloowin;
- the construction of an access shaft and access tunnel from the worksite to the caverns to be constructed on the mainline tunnel alignments to accommodate the ramps to and from the Kedron surface connections;
- the construction of these mainline caverns from the new worksite rather than from the Kedron worksite;
- the delivery of construction materials for the construction and fitout of the caverns and the mainline tunnels from the Rose Street worksite in addition to such works from the Kedron worksite;
- introduction of new truck haulage routes moving spoil from the Rose Street worksite with Ingress to the worksite off Kent Road (left turn in only) and egress from the worksite onto Park Road (left turn only);
- the haulage of shaft and cavern spoil from the Rose Street worksite, with empty spoil trucks (and other materials delivery trucks) approaching via Gympie Road and Park Road and full trucks (or other departing trucks) leaving the site down Rose Street and Junction Road; and
- the decommissioning and rehabilitation of the Rose Street worksite.

While the caverns beneath Wooloowin would remain unchanged in their location, design and general construction from the approved delivery methodology and accessing them for their construction from the Rose Street worksite would represent a change in the delivery methodology.

The Rose Street worksite would provide access for personnel, plant and equipment in the construction of the east and westbound galleries and ramp drives. Two roadheaders would operate from the Rose Street worksite to excavate the caverns between approximately Chainage Locations 5100 and 5300.

Access to the mainline tunnels from the Rose Street worksite would be via a shaft 12 m wide located on the western end of the site, adjacent to Park Road. The shaft would be approximately 42 m deep and would have a short drive, approximately 15 m in length, at its base to access the mainline tunnels. The shaft and access tunnel are temporary works and would be backfilled on completion of the works occurring from the Rose Street worksite.

4.1.1 Construction Phases

The construction activities proposed at the Rose Street worksite would consist of several discrete phases, including (**Table 4-1**):

- site establishment;
- tunnelling;
- fitout; and
- demobilisation and site rehabilitation.

Table 4-1: Construction Phases

Rose Street Access Shaft	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11
Establishment																													
Surface Works & Services																													
Piling and Shed Foundations																													
Acoustic shed construction																													
Shaft Excavation																													
Tunnel Works																													
Tunnel Excavation & Support																													
TBM travel through caverns																													
Tunnel Civil Fitout																													
Mechanical & Electrical Fitout																													
Decommission and Rehabilitate																													
Backfill																													
Landscape																													

4.1.2 Workforce

An indication of the personnel numbers expected during the various phases of the works, as well as the type of personnel, is provided in the table below:

Table 4-2: Workforce Requirements

Phase	Typical	Peak	Type of Personnel
Site establishment	10	20	Subcontractors, labourers, site management
Tunnelling	30	50	Shift tunnellers, trades, site management
Civil fitout	30	50	Direct labour, subcontract labour, site management
Mech/Elec fitout	50	80	Electrical / mechanical trades, site management
Demobilisation	10	20	Subcontractors, labourers, site management

4.2 Site Description and Design

This section outlines the construction activities and the work methods to be implemented in the worksite establishment and worksite operations taking place from the Rose Street worksite as part of the tunnelling and fitout works for the Airport Link Project.

The proposed worksite is currently vacant land bounded on three sides by Park Road, Rose Street and Kent Road. The northern boundary of the site abuts residential properties. The Rose Street worksite plan and elevation is shown in **Figure 4-1**.

During site establishment, a number of temporary buildings would be erected on the site including lunch rooms, offices and amenities buildings. These buildings would be located in the centre north of the site adjacent to the nearest residences as they are generally low noise emitters and would offer some acoustic screening from the other site establishment activities. In addition to these temporary buildings, other temporary structures that would be erected on the proposed worksite include an acoustic shed, water treatment plant and site electrical facilities.

Shaft excavation would commence prior to the completion of the acoustic shed to allow for the operation of piling equipment. Other activities that would take place within the acoustic shed would include shaft access, spoil storage, handling and loading into haulage vehicles, and repair and maintenance activities. Other facilities that would be installed on the site include storerooms and material lay-down areas.

The processes involved in site establishment and ongoing operations are described below.

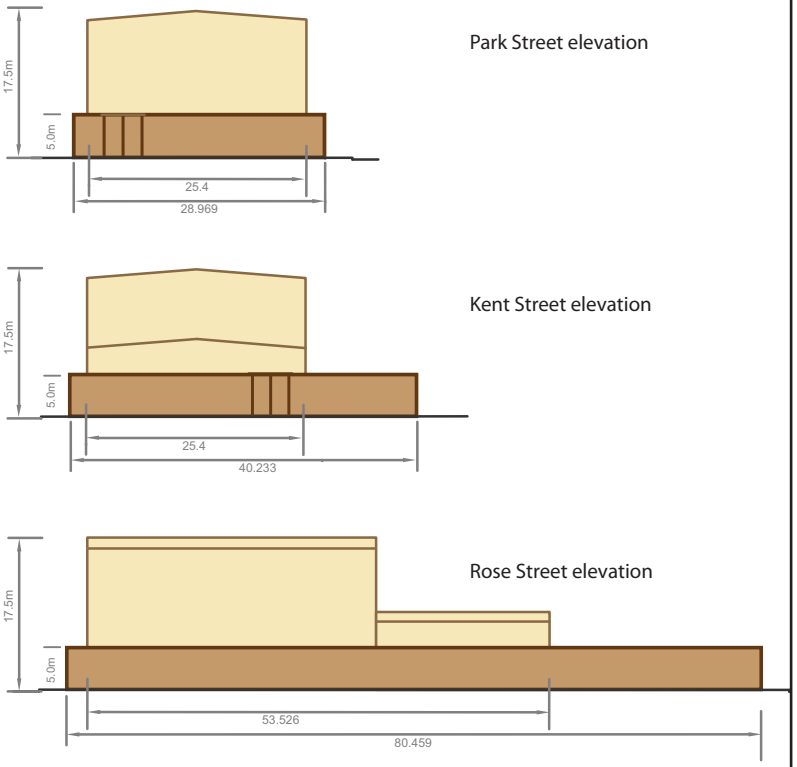


Figure 4-1

Proposed Site Plan and Elevation

4.2.1 Storage and Set-Down Areas

Given the limited area of the site, storage would be kept to a minimum, with regular deliveries of supplies and equipment from the Kedron site to service the requirements of the tunnelling operation at Rose Street.

A storage and lay-down area is proposed for the north-eastern area of the site. Typical materials and equipment that would be stored on the site would include ground support equipment, plant consumables, steel for maintenance and repair activities, personal safety consumables and other general construction tools and consumables (refer to **Table 4-3** for hazardous materials).

The storage and lay-down area would be a hardstand suitable for the type of material and equipment stored and the vehicles that would access the area. Storage would involve appropriate signage, locked enclosures and containment vessels, including perimeter bunding to mitigate against accidental releases. Appropriate personal protective equipment and processes would be utilised.

4.2.2 Acoustic Screens or Barriers

A 5 m high acoustic barrier would be erected about the perimeter of the site. The barrier serves to prevent trespassers entering the site as well as to reduce noise generated within the site compound. The barrier would extend about the perimeter of the site similar to that shown in **Figure 4-2** (dependant on final design of entry/exit points)

The barrier would be constructed of material with a minimum mass density of 10 kg/m^2.

4.2.3 Proposed Building Structures

The proposed buildings layout would be as shown in **Figure 4-1** above. All buildings and facilities would be situated within the site. The site boundary is approximately 3.3 m from the kerb line on Park Road, Kent Road and Rose Streets. The footprint of each of the proposed buildings to be located on the site is follows:

- acoustic shed – 25 m x 53 m (height 17.5 m);
- site accommodations (six offices) – 2.5 m x 6.5 m plus walkways and covered outdoor areas;
- electrical compound – 11.5 m x 16 m;
- water treatment plant – 8 m x 14 m;
- guard house – 3 m x 3 m; and
- air compressor – 2.5 m x 5 m.

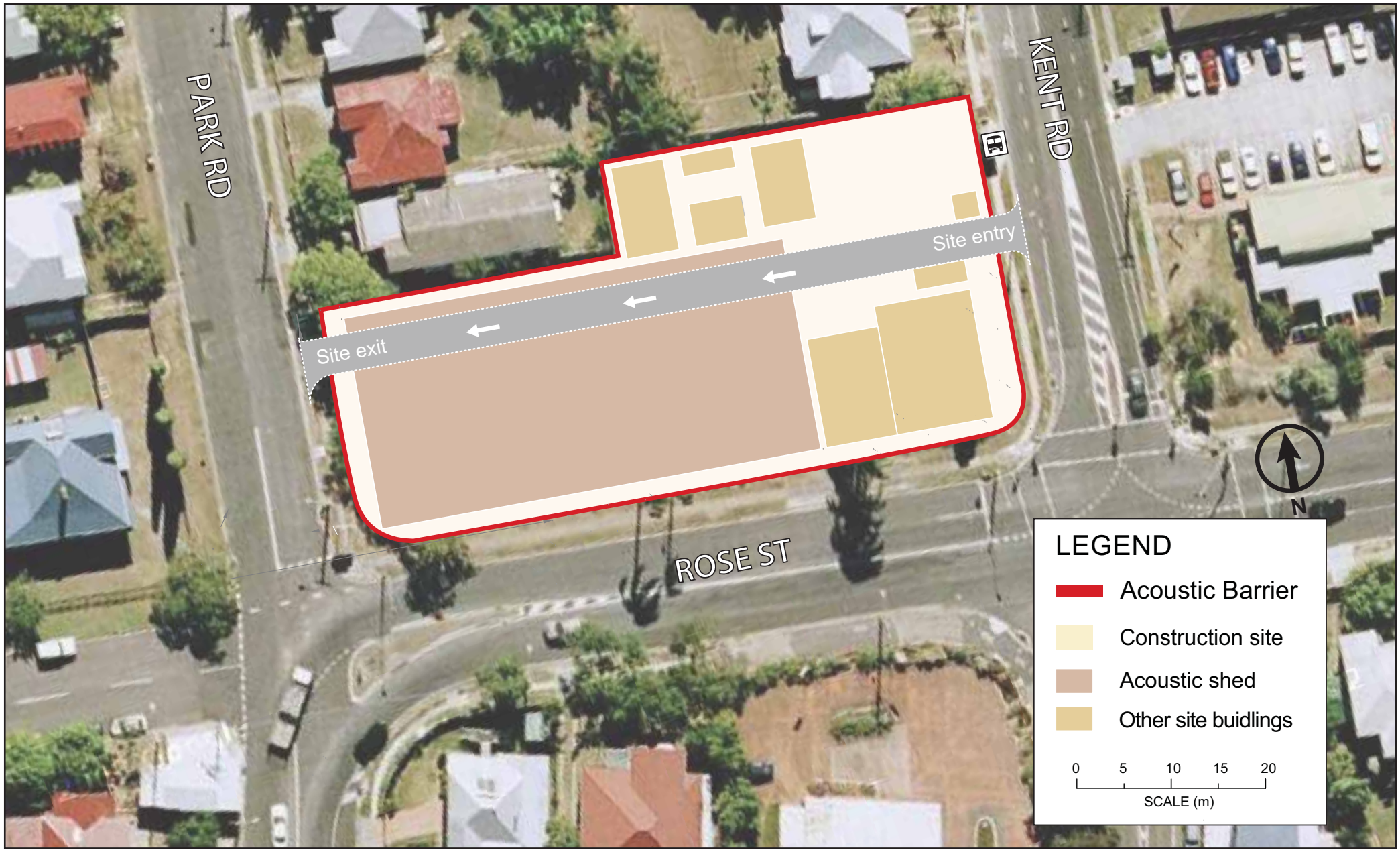


Figure 4-2

Location of Acoustic Barrier

Setbacks to the installed buildings from Rose Street would be approximately 5 m. The boundary clearances to the north would be 1.5 m. The boundary clearances for the site accommodations would be 1 m from each adjacent boundary as shown in the site layout drawing.

Acoustic Shed

The proposed acoustic shed would accommodate most of the site works, including:

- shaft access for personnel and tunnelling equipment;
- maintenance and repair of plant and equipment;
- spoil storage, handling, loading and haulage from tunnel;
- ventilation fans; and
- gantry crane.

The acoustic shed would be approximately 25 m x 53 m and would have a stepped roof profile that is 17.5 m at its highest, and 7.5 m at the lower section. The acoustic shed would have steel portal frames onto which high-performance acoustic panels and colourbond steel sheeting are attached to provide noise attenuation.

Other fixed equipment external to the acoustic shed may also need to have an enclosure or barrier to mitigate the break-out of noise.

Other Site Buildings

Site accommodations would consist of several pre-fabricated buildings including change rooms, lunch rooms, ablutions, offices and store rooms.

Pre-fabricated buildings would be placed on temporary piers by mobile crane and then connected to electrical and plumbing services. In some instances a covered walkway or covered outdoor area would be provided between buildings.

The fitout of the ancillary buildings on-site would include:

- site sheds – office equipment including, air conditioners, photocopiers, workstations, kitchens, ablutions;
- site accommodations – ablutions / showers, kitchen, change facilities, lockers etc.;
- storerooms – shelving, lockable cupboards, lighting; and
- covered areas – outdoor furniture.

Water Treatment Plant

A temporary treatment facility will be set up on site during the establishment stage to deal with water collected on the site during the initial works and shaft sinking. The temporary facility will consist of storage and holding tanks that will be manually dosed, tested and pumped when suitable water quality is achieved.

The permanent site treatment plant will take some time to install and commission, it is expected that the temporary facility will be in place for the duration of site establishment and shaft sinking and the permanent site treatment plant will be commissioned towards the end of the year.

An identical situation is taking place at the main Kedron compound currently.

The water treatment plant would consist of tanks and containers plumbed together with facilities for automated dosing of chemicals required to treat the water to a satisfactory level prior to discharge.

Additionally, a facility for the removal of deposited sediment would be required as part of the plant, as would storage for the chemicals used in the treatment process.

The storage of chemicals on the proposed worksite would be required to comply with the *Dangerous Goods Safety Management Act 2001*. The chemicals used in the water treatment process would vary depending on the content of the water to be treated, but could include:

- acid;
- caustic;
- coagulant; and
- flocculant.

The installation of a water treatment plant generally involves the use of mobile cranes, as well as the connection of various services and pipes.

Electrical Equipment

The available power in nearby streets may not be sufficient to meet requirements. A likely solution for power at the Rose Street worksite is to place a series of portable generators, or gensets, on the site.

Four gensets have been accommodated on the site layout outside the acoustic shed along with 2 m x 6 m containers of associated electrical equipment. Each genset is approximately the size of a 6 m shipping container. Additional acoustic screening would be required to achieve the noise goals for worksite operation. The gensets would be installed into position by mobile crane.

The gensets would be required throughout the period of tunnel excavation. However, the electricity supply requirement for the period prior to and at the conclusion of excavation would be significantly lower than during tunnelling works.

Night Lighting

Lighting would be placed around the site to illuminate pedestrian walkways and work areas for safety and security purposes. Lighting would be directed towards the ground as much as possible and directed away from areas where the spill of light has the potential to present a nuisance to nearby residents. Where predictive modelling indicates potential night light levels above 8 Lux, mitigation measures would be implemented.

Site lighting would generally consist of a combination of fluorescent lighting and directed spot lighting. The 5 m acoustic barrier is expected to eliminate any spill lighting that may potentially be a nuisance to nearby residents.

Off-Site Services

The relocation of existing amenities would be minimised in the proposed site layout. The existing bus stop on Kent Road would remain in place, with the proposed

access to site being closer to Rose Street toward the south. The worksite operation would not impact on the provision of bus services.

The proposal would require the installation of a driveway on Park Road north of Rose Street and on Kent Road north of Rose Street. The footpaths on both these roads would be maintained and available for use during the establishment and operation of the proposed worksite. Several short term pedestrian relocations would likely be required during site establishment and occasionally during worksite operations. In these circumstances, local traffic management measures would address and maintain pedestrian and cyclist safety.

4.3 Worksite Establishment

4.3.1 Construction for Worksite Establishment

Plant, Equipment and Machinery

The plant and equipment expected to be used throughout the establishment and use of the Rose Street worksite would typically include the following:

- backhoe/excavator
- roller/compactor
- mobile cranes – various sizes
- scissor lifts/boom lifts
- air compressors
- piling rigs/drilling rigs
- hand held drills and tools
- concrete pumps/trucks
- hand tools/Power tools
- spoil haulage trucks
- semi trailers
- electrical generators
- concrete finishing tools

Vehicles accessing the site regularly would include concrete delivery trucks, spoil haulage trucks (truck and trailer configuration) and other delivery vehicles.

A loader and telehandler would be used on the site surface for moving equipment and for the handling and loading of spoil.

Installation of Barrier

An acoustic barrier 5 m in height would be erected around the perimeter of the Rose Street worksite prior to any other site establishment work occurring on the site. The barrier would serve as an effective acoustic screen as well as a security fence, and would consist of steel posts concreted into place, onto which would be fixed timber rails and a plywood facade. The facade would be painted prior to or on completion of installation.

Clearing / Grubbing

Due to the current site conditions, clearing and grubbing would entail the removal of grass, trees and shrubs from the site. In order to minimise the chance of environmental incident, this task would be conducted together with the placement of hardstand around the site.

Sediment laden water collected on site would be discharged after treatment through the water treatment plant.

Construct Hardstand

Hardstand areas, including concrete pavements, roadbase and gravelled areas would be constructed about the site. Roadbase or gravel areas would be sealed or asphalted to manage dust and sediment risks. The hardstand areas may be required for lay-down areas, pads for various equipment and pathways, etc.

Concrete roadways would be placed about the site for through traffic and would serve spoil trucks and delivery trucks through the operational period of the site.

Concrete pavements would be typically placed from the agitator or from a concrete pump generally located within the site boundaries. Other hardstand areas would typically be placed by a loader or excavator, and rolled and compacted to the desired grade and level. Water carts would be used to control dust as work is undertaken.

Construct Spoil Bin and Gantry Crane

Foundations for the above-mentioned structures would typically involve reinforced concrete piles. Pile depths and sizes would vary for the structure and load, but essentially would be similar.

Piled foundations would be constructed with a piling rig. This work would be sequenced such that a piling rig (or rigs) are mobilised to site and drill holes for all the structures concurrently. Reinforcement cages would be installed either by mobile crane or by the piling rig, and concrete is typically placed with a concrete pump.

The spoil bin would be situated within the acoustic shed. The volume of the spoil bin is generally as large as the space on the site allows. In this instance the volume of spoil bin would be the approximate equivalent of one days' production when both roadheaders are in excavation phase.

The gantry crane would be assembled *in situ* and would require mobile cranes for pre-assembly and final assembly. It is desirable, but not essential, to have the gantry crane assembled and commissioned prior to the excavation of the shaft. The gantry crane is expected to be utilised for the full duration of operations at the Rose Street worksite. Any post-excavation activities utilising the Rose Street worksite would most likely require the use of the gantry crane.

Construct Acoustic Shed

The assembly and installation of the acoustic shed would involve several mobile cranes as well as boom lifts and scissor lifts. An indicative duration for installation is shown on the site program (**Table 4-1**). It is expected that a 100 t mobile crane would be required on site for four weeks in the erection of the portal frames and installation of the acoustic cladding. Along with the mobile crane, 20 m boom lifts and scissor lifts would be required for personnel access during this time, as well as during the installation of colourbond cladding after the installation of acoustic panelling.

For works that take place outside of general construction hours, the doors of the acoustic shed would be closed. A silenced louvre would be installed on the acoustic shed to permit the circulation of air through the shed and the tunnels. The louvre would be situated on the south side of the shed in order to minimise the potential for disturbance to nearby residents.

Ventilation Details

The ventilation system used to commence tunnelling would be situated temporarily within the shed. This system includes one fan to blow fresh air into the tunnel and one fan and dust scrubber unit to extract dust-laden air from the tunnel excavation face, filter out the dust particles and exhaust clean air out. The ventilation fans typically have silencers on the inlet and outlet side of the fan. As the tunnel excavation advances and enough space is created, both the blower fan and the fan / scrubber would be relocated into the tunnel. The duration that the ventilation fans would be housed within the shed on the surface is approximately four to six weeks.

4.3.2 Shaft Development and Excavation

Shaft Piling and Capping Beam

The geotechnical information indicates that the piles required about the shaft would be approximately 25 m deep. The type of pile to be used may include secant piles or may be constructed by Cutter Soil Mix (CSM) walls. Both methods would have similar environmental and noise impacts. The preferred method would be selected on the basis of design considerations, rig availability, economy and speed of installation.

At the conclusion of piling, it is expected that an *in-situ* concrete capping beam would be placed about the collar of the shaft to cap off the piles. The capping beam is a cast *in-situ* concrete beam with steel reinforcement.

Shaft Excavation

The shaft is expected to be approximately 42 m deep. The geotechnical information indicates that the first 20 m are in conditions that would most likely permit excavation by free digging (i.e. no drilling, blasting, rock hammers). An excavator would be positioned within the shaft and would excavate this material between the piles. A kibble would hoist spoil to the surface by mobile crane or by gantry crane.

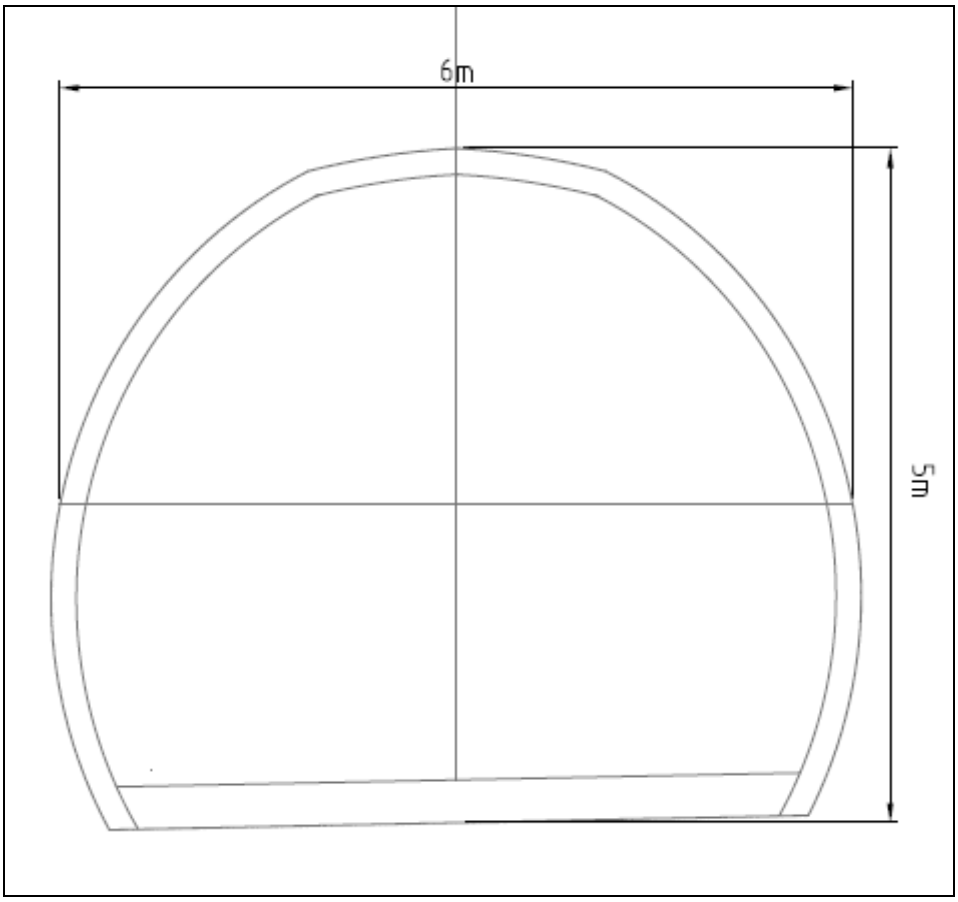
Beyond the point where geological conditions prevent an excavator from digging freely, material would be excavated using a hydraulic rock hammer, or if the conditions dictate, by drill and blast techniques. This would only be undertaken after completing the construction of the acoustic shed. It is anticipated that excavation by hydraulic hammer is feasible, such that drilling and blasting would be unlikely apart from exceptional circumstances.

Excavation of the shaft would commence as soon as it were possible to do so. Out of hours works on the shaft excavation would commence only upon the completion of the acoustic shed enclosing the shaft and equipment operating within the shaft.

Construction of Access Adit

An adit would be excavated to enable access from the shaft into the mainline driven tunnel, eastbound cavern. The adit would, as shown in **Figure 4-3**, have nominal dimensions of 6.0 m wide x 5.0 m high. The length of this adit between the shaft and the mainline tunnel is 15m.

Figure 4-3: Cross-section of Adit



The adit would be excavated in medium to high strength Tuff and as such, anticipated rock support for this area would be rockbolts of expected 2 m – 3 m length installed in the crown with a sprayed concrete lining of anticipated thickness 250 mm.

The rock support would be installed by a specialised drill jumbo, and it is expected that the spacing between rows of bolts would be 1 - 1.5 m. Shotcrete is applied by either a robotic shotcrete rig, or by hand utilising a concrete pump and air compressor. Excavation and support are distinct activities that would be governed by the same protocols that apply to the permanent works tunnels, that being the permit to tunnel system where excavation is only permitted to advance based on inspections of the 'as found' conditions, the installation of the required support and the observation of surface and in-tunnel monitoring data.

4.4 Hours of Work

During the site establishment phase, works would be confined to the approved Project construction hours of 06:30 – 18:30 Monday to Saturday[10], with there being no work on Sundays or public holidays. These hours of work are consistent with the allowable construction hours for the Project. However, they represent a significant

[10] Work below ground or within the acoustic shed can continue without limitation on hours, providing the environmental requirements of the Coordinator-General's conditions are being satisfied.

decrease for the haulage of spoil. The existing haulage conditions for the Project allow haulage to occur between 06:30 Monday to 18:30 Saturday.

When the acoustic shed is completed and able to provide noise screening to achieve the environmental objectives and goals stated in the Coordinator-General's conditions, the hours of work for activities conducted within the acoustic shed would be extended to meet program requirements.

Tunnelling, as with other sections of the Project, would be conducted within the acoustic shed and acoustic enclosures, on both day and night shifts.

Spoil haulage would not be undertaken outside of normal construction hours and spoil haulage trucks would not be allowed at the proposed worksite out of hours. Some construction materials may have to be delivered to the proposed worksite outside normal work hours. In such circumstances, the loading or unloading of delivery vehicles would only be undertaken within the acoustic shed. For example, several deliveries of shotcrete would likely be required outside of normal construction hours. The expectation is that a maximum of four concrete truck deliveries may be required between the hours of 18:30 and 06:30. Shotcrete deliveries beyond 22:30 are not proposed. However, if required all shotcrete unloading would occur within the acoustic shed with the roller doors closed.

4.5 Rose Street Worksite Operation

4.5.1 Proposed Construction Activities

Access for Tunneling

Initially, the primary function of the shaft and of the proposed worksite is to provide access for tunnelling activities in the Kedron Ramps and Caverns. The roadheaders, trucks and other equipment such as drilling rigs and shotcrete machines would be lowered by the gantry from a position within the acoustic shed to commence tunnel excavation.

If the roadheader component weights exceed the capacity of the gantry crane, a large mobile crane in the order of 400 t would be required. This crane would require a systematic plan for delivery, mobilisation and demobilisation, and would involve out of hours work, potential temporary road closures and localised traffic management. Additionally supplementary cranage may also be required.

The shaft would also provide the pathway for excavated tunnel spoil from both the access tunnel and the Kedron Ramps and Caverns to be removed to the surface. Construction spoil, including muck, would be brought to the surface for storage, handling, loading and transportation, all from within the acoustic shed.

4.5.2 Spoil Handling, Haulage and Placement

Spoil Handling

kibble attached to the gantry would be used to hoist the excavated material out. A loader on the surface would manage the spoil stockpile and also load the spoil trucks. Spoil trucks would enter the acoustic shed and would be loaded at the spoil stockpile. All of these works would occur within the acoustic shed.

The loading and haulage of the spoil off the site would be controlled to minimise impact on both the travelling public and local residents. Some of the measures to be adopted include:

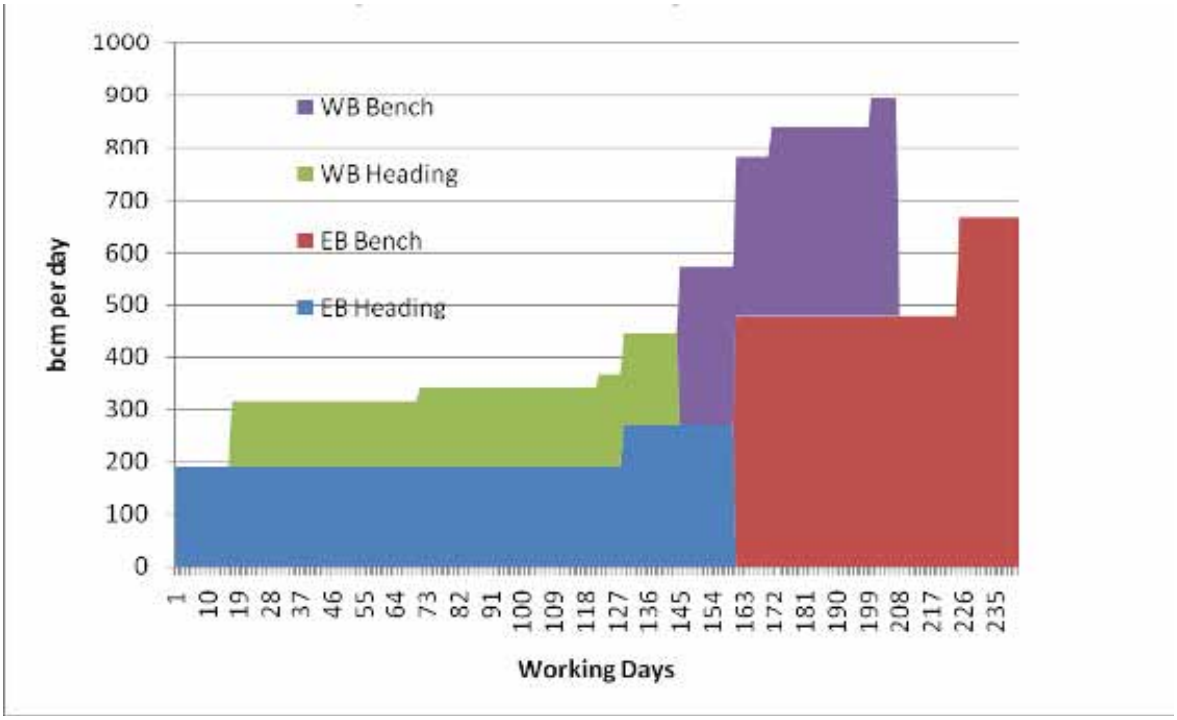
- spoil trucks would enter and exit the site in a left-in / left-out configuration to limit the space taken on the road;
- all trucks would be fitted with radios to facilitate the staging of trucks, such that trucks would be called onto the proposed worksite as the loaded truck is leaving to ensure queuing beyond the site boundary does not occur. The proposed worksite has capacity to store a maximum of three trucks onsite at any time;
- the entry point would have a full time traffic controller whilst truck haulage is underway to ensure pedestrian, cyclist and bus stop patrons are not impacted by truck movements (this is in addition to the two traffic controllers proposed adjacent to Kedron State High School during drop-off and pick-up times);
- the trucks would be loaded on a concrete loading bay and would at no time be required to travel on unsealed ground, thus eliminating the risk of dirt being transported onto the local roads; and
- trucks would be required to pass over devices within the worksite designed to remove loose material from the vehicle, to prevent transfer of spoil off site.

Estimates of Spoil Volume

The estimate of spoil that would be produced by the establishment of the Rose Street worksite would be approximately 5,000 m^3 for site establishment, while the daily expected excavation rates are shown in **Figure 4-4**. It is estimated that the tunnel excavation activities would produce approximately 120,000 bank cubic metres (bcm)[11] of spoil. Based on 14 bcm[12] per truck load, approximately 9,000 truckloads would be required to remove the spoil and muck from the worksite.

[11] A bank cubic meter represents the contents of a cubic meter of rock in-situ. An approximate conversion, depending on the nature of the rock, would allow 1.5m^3 loose material per 1 bcm. One bcm would weigh approximately 2.3 tonnes, again depending on the nature of the rock or in-situ material.
[12] 14bcm load equates to approximately 32 tonnes.

Figure 4-4: Daily Excavation Rates



As shown above the peak daily spoil production is in the order of 900 bcm which equates to 4,500 bcm per week. This peak production is equivalent to 325 truck movements spread over a five day week, i.e. 65 trucks per day carrying approximately 32 t per load.

For the initial five months of excavation works, the average daily spoil production would be less than 350 bcm. After this time, production rates would vary but would average approximately 700 bcm/day for the remaining four months.

Spoil Placement

Proposed spoil placement sites for the Rose Street worksite would include those currently being utilised for the main Project.

4.5.3 Other Construction Activities

The shaft access at the proposed Rose Street worksite would also be a delivery point for the supply of tunnelling materials and consumables. Deliveries would typically consist of items such as ground support, temporary services pipes, concrete and shotcrete, etc. Other common materials to be delivered routinely include lubricants for the roadheaders, fuel for plant and equipment, steel and steel cutting gasses for boiler-making activities

The total of all vehicle movements to site is expected to be in the order of 100 per day at peak times, 35 of which would consist of deliveries via truck or other commercial vehicle.

Beyond the tunnelling phase of the works, the proposed worksite would be used as an access for civil and mechanical fitout of the mainline tunnels and ramps.

The limited area on the site constrains the storage of materials, such that regular deliveries of supplies and equipment from the Kedron site would be necessary to service the requirements of the tunnelling works at the Rose Street worksite

Some of the materials and equipment stored on site would be categorised as hazardous or dangerous. These goods would be stored in accordance with legislative requirements and manufacturer's guidelines. The storage provisions contained within legislative and manufacturer's guidelines typically include the following:

- bunding for chemicals;
- bunding for oils and greases;
- spill kits and spill containment devices;
- fire extinguishers and other fire fighting equipment;
- barriers or fencing as may be required for materials and equipment; and
- procedural controls for elements such as refuelling.

The types and quantities of hazardous substances likely to be stored on site include but are not limited to those materials identified in **Table 4-3**.

Table 4-3: Hazardous Materials Storage

Materials	Quantities
Fuel	10,000L
Solvents	< 200L
Additives	5,000L
Cleaning agents	< 500L
Oils and grease	5,000L
Paints	< 100L
Pesticides	< 20L
Other hazardous materials (welding rods, cement, other)	

4.6 Community Relations

BC and its contractor TJH will develop a thorough Community Communication Plan to ensure all impacted stakeholders understand:

- the necessity of the Rose Street worksite;
- construction phasing including establishment, operation, decommissioning and rehabilitation of the site;
- construction impacts and mitigation measures and processes; and
- community legacy options for the site's reinstatement.

4.6.1 Education and Information

Communication and community relations activities would be delivered in two phases in line with the Coordinator General's Change Report, the Project Deed,

Community Consultation Management Plan (CCMP) and subsequent strategy documents to educate and inform stakeholders of activities and impacts associated with design and construction.

These activities would include use of:

- the Project web site www.brisconnections.com.au;
- Visitor information centre located at Centro Lutwyche;
- mobile public displays;
- fact sheets;
- community notifications;
- doorknocks;
- newsletters;
- CLG meetings;
- advertisements;
- one-on-one meetings with community members / interest groups;
- information sessions;
- fortnightly construction updates – emailed to key stakeholders including elected representatives;
- weekly reports to organisational stakeholders;
- media – regular provision of story ideas and interviews through media releases etc;
- signage – both site signage and electronic messaging where required;
- community presentations – e.g.: schools, aged care homes etc;
- site tours; and
- sponsorships.

4.6.2 Community Issues Management

Throughout the establishment and operation of the site, BC would endeavour to maintain public confidence through:

- implementation of its communications and consultation plans;
- provision of transparent and easily accessible information;
- timely explanation of new construction activities;
- responsiveness to community concerns and complaints;
- development of strategies to solve new and arising issues;
- timely correction of misinformation in the public domain;
- training of all Project members in communication and authorisation protocols in the management of issues; and

- management of any media and community issues and enquiries in accordance with agreed Project protocols.

4.6.3 Complaints Management

A complaint is defined as any communication received from a stakeholder expressing dissatisfaction. This is a purposely broad definition and is used to ensure that matters of concern to stakeholders are addressed promptly.

The community would be notified of the Project contact details on the website, in construction notifications, on-site signage and Project publications such as newsletters. Information on how to make a complaint would be provided on the website and at the Visitor Information Centre.

Complaints can be made via the 24 hour Community Hotline, project email, in writing, face-to-face on site, or via third parties such as BCC.

The initial contact point for complaints would be the area Community Liaison Coordinators (CLCs) who would activate the Project response to the complaint, manage the ongoing communication with the complainant and inform the community member of the status of the complaint until they are satisfied with the actions taken to resolve the complaint. Management of the complaint is escalated if the complainant remains unsatisfied as outlined in the following sections.

The CLC would contact the relevant manager to initiate an immediate investigation of the complaint and determine what action would be taken to reasonably address the complaint.

Complaints relating to environmental matters made by members of the public to the Queensland Department of Environment and Resources Management (DERM) would be treated as environmental incidents and managed in accordance with the Projects' 'Incident Notification, Reporting and Investigation' process.

4.6.4 Complaints Database and Reporting

All public enquiries and complaints would be captured in the Project's Consultation Management System. Complaints would be flagged as a type of contact and the following information would be captured in the complaint record:

- name, address and contact details of the complainant (private details would be stored in accordance with the Privacy Policy);
- date and time complaint received;
- how the complaint was received (hotline, email, etc);
- staff member who received the complaint;
- physical address of the event;
- a description of the main and any supplementary issues raised by the complainant (e.g. air quality, noise);
- whether it is an environmental issue – if it is, record notification of environment manager or the activation of the relevant environmental complaint management process e.g. noise and vibration, dust (see Design and Construction - D&C - Environmental Management Plan – EMP – for details);

- any supporting material provided such as photographs (which can be attached to the record);
- actions required and deadlines;
- action taken and history, including recording time and details of the response information provided to the complainant; and
- status of the complaint (open, closed).

Statistics from this database would be presented by BC in the 'Weekly Stakeholder / Community Relations and Communications Report' to the State and in the monthly report. Where possible, additional information that graphically identifies clusters of complainants would be included.

The monthly report of complaints would form part of an overall performance and compliance report which would be posted on the Project website in accordance with Coordinator-General requirements. Information which could identify any complainant would not be included in the report.

4.7 Approvals

4.7.1 Approvals

The proposed change would be a change to development which is exempt development under the provisions of *City Plan 2000*, as amended. Development approval would be required for the proposed building works, with such development being assessable under the *Building Code of Australia.* The Building Code assessment is to ensure the design and construction of the building is to an acceptable safety standard and confirms to Fire Safety Requirements.

There are no other aspects of the proposed request for Project Change which would be likely to require development approval.

4.7.2 Site EMP

The existing EMP for the Project would be the overarching document for the proposed Rose Street worksite. The EMP contains the following information:

- overview;
- objectives and performance criteria;
- environmental policy;
- responsibilities;
- risk management;
- management review;
- obligations;
- organisation charts;
- Coordinator-General mapping document;
- subordinate documentation registers;
- non-conformance reporting / incident management;
- reporting;

- training;
- communication;
- document control;
- subcontractor management;
- contract / legislative requirements; and
- licenses and Approvals Register.

The site establishment, construction and operational works for the proposed worksite would be undertaken in accordance with the D&C EMP including subordinate documentation such as Area Environmental Plans (AEPs) and procedures.

The Site Environmental Plans (SEPs) would form the updated and specific documentation for environmental management at the site. Two SEPs are envisaged for the site, being the site establishment and construction phase and then the operational phase of the proposed worksite. Both SEPs would include site-specific mitigation measures, based on predictive modelling, to be applied to the site during both phases. These SEPs would not be fixed documents and would evolve to meet changes for the site and subsequent mitigation for those changes. Contents of the SEP would include but not be limited to the following management requirements where applicable:

- noise;
- vibration;
- air quality;
- erosion and sediment;
- light spill;
- Construction Traffic EMP Sub-Plan, including car parking, pedestrian and cyclist activities;
- waste management;
- Acid Sulphate Soils (ASS) / contaminated land; and
- cultural heritage (Indigenous).

The AEP and the SEPs would be required to be developed and produced for the Coordinator-General prior to the commencement of works on the proposed worksite. The commencement of works would include the erection of the acoustic barrier and site establishment works.

5 EFFECTS OF PROJECT CHANGES

The changes proposed to the construction methodology change the relative environment and community effects of the Changed Project.

The anticipated effects of the change for the Rose Street worksite are:

- exposure of different properties to construction and property impacts associated with tunnel works (shaft sinking, construction site establishment) due to changes in the construction operations of the tunnel in response to poor ground conditions in Kedron;
- introduction of new truck haulage routes moving spoil from the Rose Street worksite;
- potential impact of spoil haul traffic and construction traffic accessing the Rose Street worksite for the local community in Wooloowin;
- increased noise levels from construction activities for local community;
- potential air / dust impacts from construction and operation of the Rose Street worksite;
- potential visual amenity impacts for local residents from the construction of the acoustic shed;
- potential vibration impacts on residents and commercial premises located near the Rose Street worksite due to drilling and rock hammering during the construction and operation phase; and
- impacts on the community due to changes in access arrangements and requirements for parking in the vicinity of the Rose Street worksite.

5.1 Effects on Properties

The request for Project Change would introduce a construction worksite into part of Wooloowin which is not presently affected by Project works associated with the delivery methodology of Airport Link.

There would be five (5) properties directly affected by the proposed change. These properties are bounded by Rose Street, Kent Road and Park Road, and have been owned by the State of Queensland (QTMR) for some decades as part of the formed corridor for the Northern Freeway proposal conceived as part of the 'Wilbur Smith plan' for Brisbane's road transport network.

The proposed change has the potential to indirectly affect adjacent properties by way of the environmental effects of establishing, operating and decommissioning the proposed worksite. The potential environmental effects of the proposed change are described later in this chapter.

5.2 Effects of the Transport System

The proposed change would have several effects on the transport system as a consequence of transport plant, equipment and materials to establish the proposed worksite and to support the fitout of the excavated tunnels; as well as the removal of excavated material from the construction of the access shaft, access tunnel and the Kedron Ramps and Caverns.

5.2.1 Construction Vehicle Route

The Rose Street worksite would operate as a left turn in / out onto the local road system, minimising conflict movements. This effectively reduces the options for construction haulage routes. All construction vehicles of a gross mass greater than 2 t or length greater than 6 m would approach and leave the proposed worksite via the approved construction haul route.

Based on an assessment of available route options the preferred construction haulage route selected to service the Rose Street worksite is described below and is shown on **Figure 5-1**.

The construction haulage route is a one-way circuit east along Rose Street and Junction Road to Sandgate Road, returning via Rode Road, Gympie Road, Kedron Park Road, Park Road, Rose Street to Kent Road.

The construction haulage route uses State-controlled roads and arterial roads only. Land uses along this route vary from residential to commercial, including the Eagle Junction railway station and shopping centre. The route would allow access to both north and south spoil placement sites.

The intersection of Sandgate Road and Junction Road is oversaturated during the AM peak. To minimise the impact on the intersection operation, construction vehicles during that peak period would be directed north, allowing the use of the existing left-turn slip lane onto Sandgate Road. Vehicles returning to site would be directed to access from the intersection of Kedron Park Road / Lutwyche Road, via the approved route of Sandgate Road, Rode Road and Gympie Road.

To minimise impacts along the identified route, it is proposed to operate construction vehicles in a circuit, allowing only the eastbound movement on Junction Road between Kent Road and Sandgate Road, thus minimising the impact of the haulage operation on Junction Road residents and businesses. It would also minimise impacts on the Eagle Junction shopping centre parking area and Eagle Junction railway station commuter parking area – both being located on the southern side of Junction Road.

Construction vehicles during the AM peak period would be directed to turn left onto Sandgate Road. The return route would be via Rode Road, Gympie Road, Kedron Park Road and Rose Street to turn left into Kent Road and left into site.

By adopting this haul route circuit, the potential impact on the oversaturated right turn from Sandgate Road north approach is avoided.

The haul route would require a modification of the traffic island located at the intersection of Park Road and Rose Street to accommodate the swept path of construction vehicles leaving the proposed worksite. The reconfigured island would be in compliance with Road Planning and Design Manual requirements for use as a pedestrian refuge island.

5.2.2 Potential Construction Traffic Impacts

The construction traffic anticipated to be generated by the Rose Street worksite is shown in **Table 5-1**, including the durations of each activity.

Table 5-1: Daily Construction Traffic

Trips Generated	Light Vehicles	Commercial Vehicles
Site Establishment		**42**
Deliveries	12	6
Concrete works	-	21[1]
Spoil Haulage	-	15
Tunnelling		**84**
Deliveries	12	3
Concrete works	-	16
Spoil Haulage	-	65
Civil Fit Out		**30**
Deliveries	12	10
Concrete works	-	20
Mechanical and Electric		**10**
Deliveries	12	10
Demobilisation		**40**
Deliveries	20	10
Spoil Haulage	-	30

[1] Only during concrete pours, expect 10 pours during establishment

The intersections along both Junction Road and Rose Street have been assessed with respect to additional vehicles generated by construction activities at the Rose Street worksite.

During the AM and PM peak periods, additional construction vehicles, including spoil haulage vehicles, represent between a 1% and 3% increase to existing AADT (daily traffic) volumes. This increase is less than the normal variation in traffic flows and therefore the impact to traffic operations along Junction Road and Rose Street is considered negligible in terms of daily traffic flows.

The impact of additional commercial vehicles would peak at 84 commercial vehicles during the tunnelling phase of works, with the movement of spoil haulage vehicles, concrete trucks and general deliveries. While this increase may be noticeable to some stakeholders in terms of potential amenity impacts, the increase would be well within the capacity and the function of the route.

CNI

Construction Haul Route

Public Transport

The existing bus stop located on the western side of Kent Road, north of the Rose Street intersection, would not be relocated during the operation of the Rose Street worksite as illustrated in **Figure 2-1**.

The one-way flow outbound (eastbound) on Junction Road would not directly impact on the Eagle Junction railway station car park. Pedestrian access via the signalised crossing at the entry to the location would not be impacted.

Bicycle Movements and Facilities

No changes are proposed to the designated cycle route along Kent Road, north of the intersection of Rose Street.

Pedestrian Movements and Facilities.

The site access on Kent Road would operate as a normal driveway access (left turn in only). Pedestrian access to the bus stop would be maintained at all times, as would pedestrian access on Park Road. One traffic controllers would monitor and manage pedestrian movements at the site access / egress.

Similarly, it is recommended that an additional two traffic controllers be provided at designated locations to manage traffic flows and pedestrian movements on Park Road between Kedron Park Road and Rose Street during peak arrival and departure times for Kedron State High School.

Local Access

The proposed construction haul route and access arrangements to the proposed worksite would not affect access to businesses, private residences or public facilities, including schools, churches and parks.

Parking and access to the Eagle Junction shops and rail station would be maintained by adopting the one-way flow for construction vehicles east-bound along Rose Street and Junction Road. These facilities and services are located on the southern side of Junction Road and are affected by westbound traffic on Junction Road. The proposed construction haul route avoids this direction of travel.

Access to Kedron State High School, the Queensland Aerospace College facility on the eastern side of Kent Road, north of Rose Street, the shops located on the eastern side of Kent Road and the veterinary clinic on the western side of Kent Road, both south of the intersection of Rose Street also would not be impacted.

Construction Workforce Parking

The workforce for the Rose Street worksite would be transported to site via a shuttle bus[13].

Car parking for the proposed Rose Street workforce would be provided at the Kedron worksite. The workforce would be transported to and from the proposed worksite via a dedicated Project shuttle bus only. Drop-offs and pick-ups would occur within the boundaries of the worksite. No private vehicle access or car parking on the site or in nearby local streets would be permitted by the contractor.

[13] Troop carrier or similar sized vehicle. Shuttle vehicles do not include private vehicles operating on a car-pooling basis.

Pavement Impacts

The preferred route for construction traffic on the arterial road system would have minimal impact on the existing pavement conditions. It is possible that some pavement damage may occur at the site entry / exit points; therefore, BC would monitor the pavement at these locations and take remedial action where required, in consultation with the Queensland Government, and where relevant, BCC.

Traffic Safety

The preferred route for construction traffic on the arterial road system would have minimal impact on the existing facilities / community receptors located along the routes. Specific measures as outlined above would be introduced to assist in maintaining the current level of safety for road users.

To ensure that Airport Link construction vehicles not accessing the Rose Street worksite are prevented from the use of Junction Road, specifically from the Kedron worksite, the Kedron egress would be designed and constructed to ensure that large vehicles over 6 m in length, or in excess of 2 t gross mass, are not able to turn left onto Kedron Park Road. This does not apply to other non-Project traffic travelling along Gympie Road and onto Kedron Park Road.

5.2.3 Mitigation Measures

While the anticipated traffic impacts from the establishment, operation and decommissioning of the proposed Rose Street worksite are not expected to be adverse or create or worsen existing traffic hazards, a range of mitigation measures are proposed to ensure the function, safety and amenity of the construction haul route is maintained. Measures to manage construction haulage routes and construction site access include:

- Option 1 described above is the construction haul route for the proposed worksite and may be used only by construction vehicles accessing or departing the worksite, as opposed to other Airport Link Project construction traffic.
- Traffic monitoring on Rose Street adjacent to the worksite is to be implemented to manage and avoid the use of Rose Street, Kent Road and Junction Road by other construction traffic associated with Airport Link works. The use of these streets by other Airport Link construction traffic would be avoided.
- A comprehensive Construction Traffic EMP Sub-Plan would be prepared prior to the commencement of site establishment works, and implemented to control truck movements to avoid, or mitigate and manage the impacts of construction vehicle traffic on the road network. The relevant road authority would be consulted, and the local community informed, in exceptional circumstances when no suitable alternative routes are available for specific construction tasks (e.g. removal of over-sized tunnelling machinery, delivery of over-sized construction components).

Measures to manage the operation of construction vehicles include:

- Real-time monitoring would be implemented to manage truck position, speed, route and performance in relation of traffic conditions and schedule requirements.

- Truck speed and position would be managed to avoid queuing on the approaches to the proposed worksite, and to avoid queueing of construction vehicles in local streets.
- Where traffic flows to the proposed worksite would lead to queueing or congestion in local streets, construction vehicles would be directed first to a staging area situated in a designated and accepted commercial or industrial area identified in the Construction Traffic EMP Sub-Plan.
- All vehicles leaving the proposed worksite would pass over or through devices designed and maintained to remove soil (e.g. rumble bars) and other materials which could contaminate or pollute receiving waters, roads, ambient air or diminish environmental conditions.

Measures to maintain traffic flows on the road network include:

- The community, including potentially affected businesses and the administrations of community facilities and emergency services, would be notified in advance about proposed traffic diversions and clear signage would be provided of changed traffic conditions arising from construction activities and take other measures to ensure safe traffic movement (e.g. traffic controllers, traffic signal operational).
- Measures to avoid construction traffic of a gross mass greater than 2 t or a length greater than 6 m associated with the proposed worksite using local streets in the vicinity of the worksite.
- Access to properties adjoining the proposed worksite would be maintained at all times.
- An employee parking scheme for the construction worksites would be prepared and implemented prior to the commencement of site establishment works, and maintained for the duration of the Rose Street worksite operations, including decommissioning, to manage the impacts on car parking in the vicinity of the worksite. Such a scheme would require all workers' car parking to be accommodated at the Kedron worksite, and such workers being transported by a Project shuttle vehicle to the Rose Street worksite and back.
- No workers' car parking is to be permitted in local streets surrounding the Rose Street worksite. Traffic monitors would be engaged to monitor this.
- Traffic flows would be monitored and the traffic management measures reviewed to address specific local traffic issues.

Measures to maintain public transport services include:

- Traffic management measures near construction works would be designed to avoid disruption to bus route and timing.

Measures to maintain pedestrian and cyclist movements include:

- Safe pedestrian and cycle access would be maintained near construction works, including to community facilities, such as Kedron State High School, Wooloowin State School, child care facilities, churches, aged care accommodation, open space, health care and shopping facilities.

- The local community, and in particular Kedron State High School, would be notified about changes to pedestrian and cycle access during construction near the proposed worksite.
- Traffic controls designed for the safe movement of pedestrians and cyclists near the worksites would be prepared and implemented prior to the commencement of any site works and maintained for the duration of activities at the proposed worksite.

5.2.4 Performance Criteria

Spoil haulage routes would be nominated in the Construction Traffic EMP Sub-Plan as required by the Coordinator-General's condition 5(i) in Appendix 1 Schedule 3 with minor roads only being used where they are required for the most direct access to motorway and arterial routes.

5.3 Noise

5.3.1 Overview

The noise assessment is based on an investigation and analysis of the existing acoustic environment and the likely impacts of the construction and operation of the Rose Street worksite, as presented in **Appendix A.3** – Air and Noise Quality Assessment - Rose Street Worksite.

5.3.2 Existing Environment

The land use in the locality of the proposed worksite site is predominantly residential. Some small-scale commercial businesses are located to the east on Kent Road and to the south at the corner of Rose Street and Kent Road. Most housing is either raised or two-storey. The nearest sensitive receptors are located adjacent to the northern boundary of the proposed worksite. A monitoring site was identified having regard for the most noise-sensitive uses in close proximity to the proposed Rose Street worksite.

Figure 5-2 identifies the sensitive receptors considered in the predictive noise modelling. A total of 98 residential houses have been modelled to determine potential impacts.

Figure 5-2: Sensitive Receptor Locations

Data from which the existing noise environment is determined have been obtained from:

- site inspections during peak traffic periods and proposed haul hours – Monday to Saturday 06:30 to 18:30; and
- unattended continuous measurement of sound pressure levels over a seven day period (May 2009).

The noise environment at the Rose Street worksite area is typical of many inner urban areas, in that it is largely determined by road traffic noise. At this location there are no other significant sources of noise such as mechanical plant noise or rail noise.

Through reference to AS1055.2, the BCC Noise Impact Assessment Planning Scheme Policy (NIAPSP) provides guidance to average background noise levels for residential areas in Brisbane. These values represent an indication of the typical background noise levels expected in an area given its proximity to major and minor roads and commercial or industrial uses.

Table 5-2 presents a summary of the average background noise levels for each category of residential use within Australia. This information is used to identify the most appropriate noise goals for residential receptors near to the Rose Street worksite based on pre-commencement noise monitoring.

Table 5-2: Estimated Average Background A-Weighted Sound Pressure for Different Areas Containing Residences in Australia

Noise Area Category	Description Of Neighbourhood	Average Background A-Weighted Sound Pressure Level (LA90, T)					
		Monday to Saturday			Sunday and Public Holidays		
		07:00-18:00	18:00-22:00	22:00-07:00	09:00-18:00	18:00-22:00	22:00-09:00
R1	Areas with negligible transportation	40	35	30	40	35	30
R2	Areas with low density transportation	45	40	35	45	40	35
R3	Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
R41	Areas with dense transportation or with some commerce or industry	55	50	45	55	50	45

[1] Categories R5 and R6 from NIAPSP would be expected to have background noise levels equal to or greater than these

Based on the noise monitoring completed at the proposed Rose Street worksite, the area is defined as an R3 Noise Category.

The day and evening average L_{A90} noise levels were measured at 52 dB(A) and 46 dB(A) respectively. This corresponds to the designated day and evening R3 background noise levels of 50 dB(A) and 45 dB(A), respectively. The results exclude noise monitoring results obtained during periods of heavy rain (greater than 0.5 mm per 15 minute interval) as recommended in AS 1055.1.

5.3.3 Construction Noise Criteria

Goals for noise to guide the construction planning and management were established in the Coordinator-General's conditions for Airport Link in July 2008. The Coordinator-General's conditions also provide that where the goals are predicted to be exceeded, the Proponent is required to implement mitigation

measures and undertake consultation to manage the impact on potentially affected residents. These goals and triggers for additional mitigation measures and consultation remain relevant and necessary for the Changed Project.

Table 5-3 presents a summary of the internal noise goals provided in the Draft EMP for the Project and in the Coordinator-General's conditions for construction activities associated with the Project.

Table 5-3: Summary of Noise Goals

Criteria	Day (Area Near Major Road)		Night (R1-R3 Noise Area)	
	Steady-state ($L_{Aeq,adj,15\text{-}min}$)	**Non-steady state ($L_{A10,adj,15\text{-}min}$)**	**Steady-state ($L_{Aeq,adj,15\text{-}min}$)**	**Non-steady state (L_{Amax})**
Residential Receptors				
Internal	45	55	30	45
External[1]	55	65	40	55
Teaching Areas (Queensland Aerospace College)				
Internal	45	55	45	55
External[2]	65	75	65	75
Commercial Receptors				
Internal	45	55	-	-
External[2]	65	75	-	-

[1] 10 dB attenuation assumed for building façade construction
[2] 20 dB attenuation assumed for facade construction and the use of air-conditioners

It is assumed that the noise level difference between the level outside a residential dwelling, and inside a habitable room is a nominal 10 dB(A) for older type dwellings that rely predominantly on natural ventilation through open windows.

Table 5-4: Internal Noise Goals to Avoid Sleep Disturbance

Criterion	Hours	Goal For residences within R1 – R3 categories as described in NIAPSP
For intermittent construction noise	18:30 – 06.30	45dBA $L_{A\ max}$
For steady construction noise	18:30 – 06.30	35dBA $L_{Aeq\ adj\ (15mins)}$ for temporary noise 30dBA $L_{Aeq\ adj\ (15mins)}$ for long term noise

5.3.4 Potential Noise Sources at Rose Street Worksite

The noise levels at nearby receptors would vary depending on the location and elevation of the noise sources, the intervening topography, noise barriers and the distance between the source and receiver.

The sources of potential noise from construction and operation of the proposed Rose Street worksite would include:

- concrete trucks;
- haul trucks;
- excavator;
- concrete pump;
- concrete vibrator;
- gantry crane;
- piling rig;
- reversing beepers;
- front end loader;
- crane;
- ventilation fans;
- generators; and
- compressors / pumps

During operation of the acoustic shed, it is assumed that the majority of noise from within the shed would be emitted by the front-end loader, gantry crane and workshop tool noise at surface level. Contribution from noise associated with equipment within the tunnel has been assumed to be minimal owing to the mitigating effects of depth and ground cover.

For the purpose of assessing potential impacts, the following stages have been considered for the proposed Rose Street worksite activities:

- **Stage 1** – site establishment, construction of shed foundations (including construction of concrete foundations and pilings);
- **Stage 2** – shaft excavation beyond depth of 20 m with hydraulic hammer (prior to construction of the acoustic shed); and
- **Stage 3** – site operation with acoustic shed constructed (commencement of roadheader excavation).

Stages 1 and 2 would occur during the daytime work hours only (06:30 – 18:30) from Monday to Saturday. Stage 3 is planned to occur both during the day and night-time periods following completion of the acoustic shed. **Table 5-5** lists the noise sources considered in the modelling for Stages 1 to 3.

During Stage 1 the potential for noise generation is greatest, particularly for establishing shed foundations. This requires a piling rig and, as shown in **Table 5-5,** this activity has the potential to generate high noise levels. However, use of the piling rig would occur intermittently over an eight week period during Stage 1 as shown previously in **Table 4-1.**

Experience from numerous similar construction worksites is that the daytime noise emissions would likely be non-steady. The L_{A10} (daytime) parameter has therefore been used in the assessment of the construction noise for Stages 1 to 3.

For the night-time period, steady state (such as ventilation, generators and compressors) and non-steady state (such as gantry crane, excavator, concrete trucks and general tool noise) operational noise with the shed constructed have

been assessed. The L_{Aeq} parameter has been used for steady noise sources and the L_{Amax} parameter for non-steady noise sources.

Table 5-5: Noise Source Sound Power Levels

Activity	Noise Source	Number Required	Sound Power Level (dBA)	Acoustical Usage Factor[1] (%)
Stage 1 Shed Construction	Concrete Truck	1 per hour	111	1 @ 40%
	Concrete Pump	1	107	50
	Concrete Vibrator	1	108	20
	Piling Rig	1	118	20
	General Tool Noise	1	109	50
	Crane	1	105	17
	Haul Truck	1	103	40
	Warning Horn/Reversing Beeper	All vehicles	115	5
Stage 2 Shaft Excavation (during shed construction)	Excavator with Hydraulic Hammer[2]	1	115	20
	Crane	2	105	17
	General Tool Noise	1	109	50
	Boom/Scissor Lifts	2	107	17
Stage 3 Site Operation (shed constructed)	Haul Truck (daytime)	6 per hour	103	40
	Pump[2]	1	76	100
	Excavator	1	114	40
	Concrete Truck	1	107	40
	Gantry Crane	1	105	17
	Generators (external to shed)[3]	4	81	100
	Compressors (external to shed)[3]f the construction suite	1	83	100
	Warning Horn/Reversing Beeper	All vehicles	115	5
	General Tool Noise	1	109	50
	Front end Loader	1	111	40

[1] Acoustical usage factors based on information provided by the United States Department of Transport Federal Highway Administration (http://fnwa.dot.gov/environment/noise/handbook/09.htm)
[2] Excavator with hydraulic hammer has been assumed to be located 20 m down in the shaft giving 5 dBA noise reduction for the noise emission at the surface.
[3] Fixed plant external to the shed has been assumed to be fitted with acoustic enclosure achieving R_w 20 dB.

5.3.5 Predicted Noise Modelling

Noise modelling was utilised to predict the impacts associated with airborne noise emissions from the plant noise sources anticipated to operate during the proposed construction activities on sensitive receptors.

Modelling scenarios for the various stages of construction and operation of the construction site have been considered in the following sections. Modelling considered a 'no noise mitigation' scenario and 'noise mitigated' scenarios for comparison for each of the stages of construction works. The adopted sound power level of plant and equipment are considered based on available data for the equipment proposed to be utilised.

Prior to commencing Stage 1 site works, an acoustic barrier would be erected around the perimeter of the site. The barrier, as well as serving to secure site access, would provide a reduction in offsite noise impacts. The acoustic barrier would be installed on the perimeter of the Rose Street worksite, as shown in **Figure 4-2** and discussed in **Section 4.2.4**.

The following scenarios have been considered for modelling the construction of the shed:

- no mitigation;
- 2.4 m perimeter barrier; and
- 5.0 m perimeter barrier.

In addition to the above mitigation scenarios, acoustic enclosures achieving 20 dB Rw have been assumed for all fix plant items located externally to the shed (pump, generators and compressors).

Stage 1 Modelling Results – Shed Construction

The results of the acoustic modelling for Stages 1 and 2 are provided as:

- maximum predicted daytime L_{A10} noise levels for all sensitive buildings; and
- tabulated results of the number of sensitive buildings / properties predicted to exceed the noise goals for each scenario.

Table 5-6 presents predicted external noise levels during Stage 1 construction of the shed. Stage 1 construction noise would only occur during daytime work hours. **Table 5-7** presents the total number of properties predicted to exceed the relevant noise goals.

Table 5-6: Shed Construction – Predicted External Noise Levels

Receptor Group	Maximum Predicted External L_{A10} Noise Levels			Daytime L_{A10} Noise Goals
	No Mitigation	2.4 m Barrier	5.0 m Barrier	
Residential	78	78	74	65
Educational[1]	68	67	62	75
Commercial	73	70	61	75

It should be noted that he Aerospace College (educational receptor group) is located further from the noise sources, such as, the hydraulic hammer and therefore the noise levels are generally lower than the other receptor groups. However, it is less effectively shielded when it comes to the 5m barrier scenario than the commercial receivers and therefore does not shown an improvement in noise levels with increasing barrier height.

Table 5-7: Shed Construction – Total Properties Exceeding Noise Levels

Receptor Group	Total No. Of Receptors	No. of Properties Exceeding Daytime L_{A10} Noise Goal		
		No Mitigation	2.4 m Barrier	5.0 m Barrier
Residential	98	23	23	3
Educational	1	0	0	0
Commercial	3	0	0	0

Significant exceedances are predicted without any noise barrier. The L_{A10} noise goals are predicted to be exceeded by up to 13 dBA under this scenario.

Provision of noise barriers at the site perimeter are predicted to reduce potential noise levels significantly and the total number of properties predicted to exceed the noise goals.

With a 5.0 m acoustic barrier, an exceedance of the L_{A10} noise goals of up to 9 dBA is predicted. The total number of properties predicted to exceed the noise goals is significantly reduced to only 3 properties through the provision of 5.0 m acoustic barriers.

Figure 5-3 presents predicted external L_{A10} noise levels for ground floor and first floor levels.

For two of the properties exceeding the noise goal, closed doors for the perimeter noise barrier (i.e. 5 m noise barrier around all perimeters) would achieve the noise goal, leaving only 71 Park Road experiencing predicted exceedances of the noise goal by up to 3 dBA.

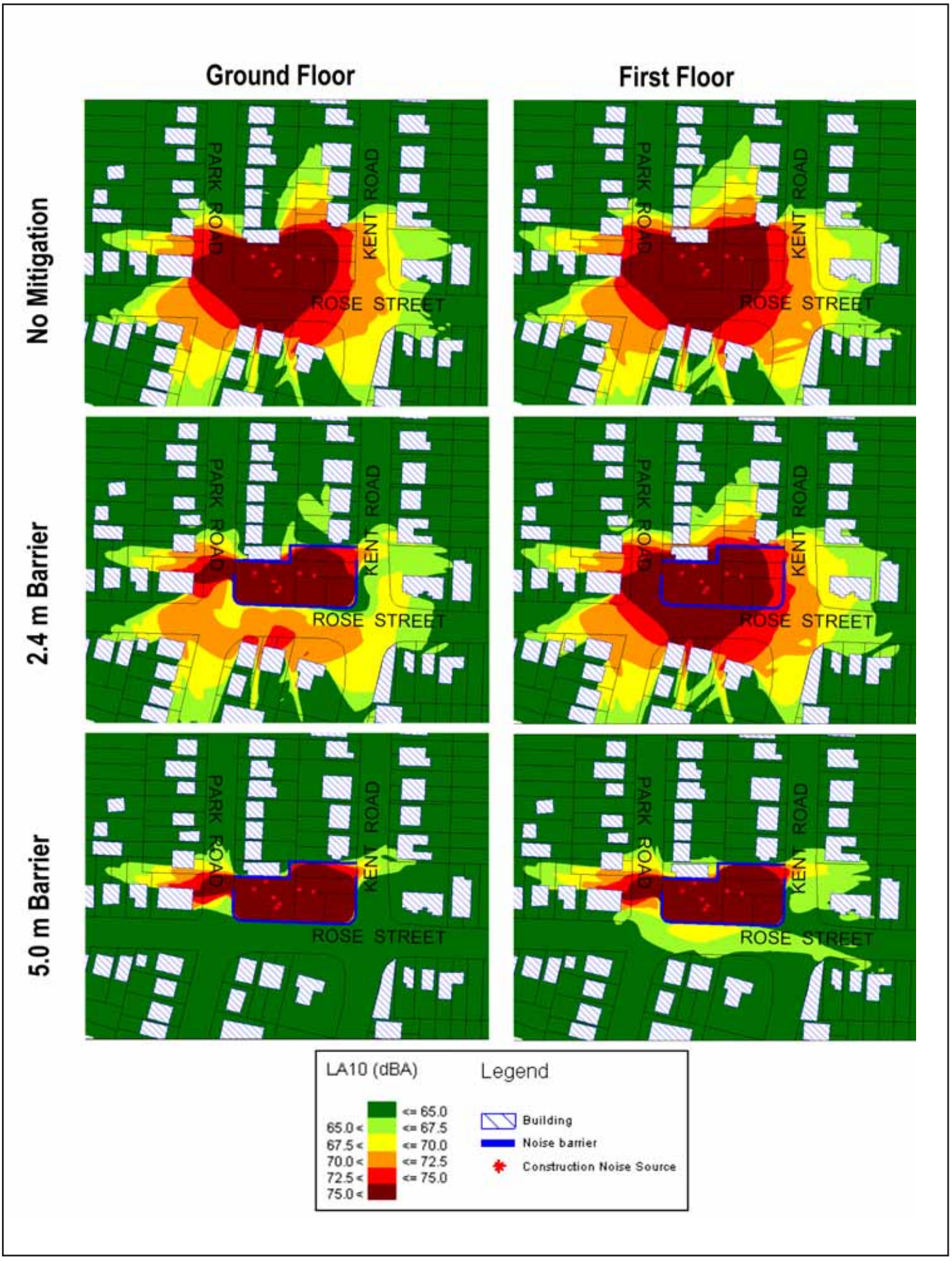


Figure 5-3

Stage 1 Shed Construction - Predicted External LA_{10} Noise Levels

Stage 2 Modelling Results – Shaft Excavation

The results of the acoustic modelling for Stage 2 are provided as:

- maximum predicted daytime L_{A10} noise levels for all sensitive buildings; and
- tabulated results of the number of sensitive buildings/properties predicted to exceed the noise goals for each scenario.

Table 5-8 presents predicted external noise levels during Stage 2 shaft excavation during shed construction noise. Construction noise would only occur during daytime work hours. **Table 5-9** presents the total number of properties predicted to exceed the relevant noise goals.

Table 5-8: Shaft Excavation – Predicted External Noise Levels

Receptor Group	Maximum Predicted External L_{A10} Noise Levels			Daytime Noise Goals
	No Mitigation	2.4 m Barrier	5.0 m Barrier	
Residential	74	74	67	65
Educational	63	62	60	75
Commercial	69	66	56	75

Table 5-9: Shaft Excavation – Total Properties Exceeding Noise Goals

Receptor Group	Total No. Of Receptors	No. of Properties Exceeding Daytime L_{A10} Noise Goal		
		No Mitigation	2.4 m Barrier	5.0 m Barrier
Residential	98	9	8	2
Educational	1	0	0	0
Commercial	3	0	0	0

During the construction phase, significant exceedances are predicted without any form of noise barrier. The L_{A10} noise goals are predicted to be exceeded by up to 9 dBA.

Provision of noise barriers at the site perimeter are predicted to reduce potential noise levels significantly and the total number of properties with potential to exceed the noise goals. With a 5.0 m noise barrier, an exceedance of the L_{A10} noise goals of up to 2 dBA is predicted.

The total number of properties predicted to exceed the noise goals would be significantly reduced to only two properties through the provision of 5.0 m noise barriers.

Figure 5-4 presents predicted external L_{A10} noise levels for ground and first floor levels during Stage 2.

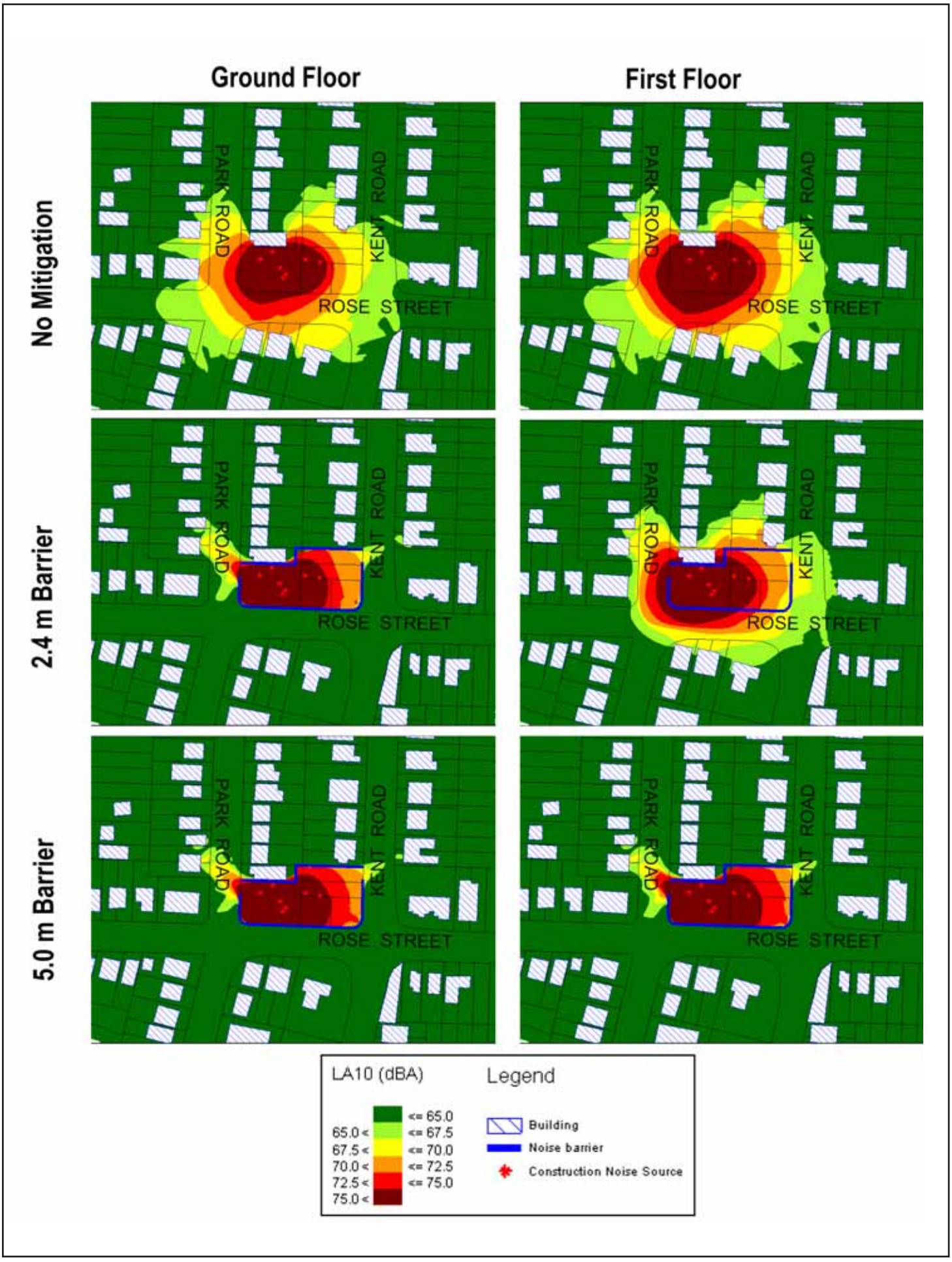


Figure 5-4

Stage 2 Shaft Excavation During Construction of Shed
Predicted External LA_{10} Noise Levels

Exceedances of the adopted noise goals are predicted even with the above noise control measures. However, if closed doors for the perimeter noise barrier (i.e. 5 m noise barrier around all perimeters) is enforced all properties would achieve the noise goals.

Stage 3 Modelling Results – Site Operation

For construction works within the acoustic shed the noise modelling has considered the following modelling scenarios:

- daytime operation - open roller doors – predicted L_{A10} noise levels;
- night-time operation - closed roller doors – predicted L_{Aeq} noise levels; and
- night-time operation - closed roller doors – predicted L_{Amax} noise levels.

The proposed shed construction material comprises of an external 50 mm Ortech Easiboard, internal 0.6 mm steel and cavity filled with 50 mm thick fibre glass insulation (14-18 kg/m^3). The transmission loss for the proposed shed construction is shown in **Table 5-10**. In addition, the internal walls and ceiling of the acoustic shed would need to be lined with acoustic absorbent material to increase the noise reduction of the shed. The acoustic absorption specification of the acoustic lining is also shown in **Table 5-10**.

The roller doors would be located on the western wall (4.5 m x 5.0 m) and eastern wall (7.5 m x 5.0 m). The transmission loss for the roller doors is also shown in **Table 5-10**.

Table 5-10 presents the construction material specifications adopted for the noise modelling.

Table 5-10: Acoustic Specifications of Construction Materials

Construction Material	Octave Band Frequencies (Hz)								Rw
	63	125	250	500	1000	2000	4000	8000	
Sound Transmission Loss									
Proposed Ortech Wall/Ceiling System	16	24	40	50	56	61	71	-	50
Roller Doors	3	8	14	20	23	26	27	35	23
Sound Absorption									
Proposed 50mm mineral wool lining (25-50 kg/m^3) with 0.05 mm PE-foil.	0.10	0.20	0.63	0.99	0.95	0.83	0.66	0.65	-

In addition to the above, acoustic enclosures around external fixed plant (with an Rw of 20dB) have been assumed.

Table 5-11 presents predicted external noise levels for construction works within the acoustic shed and in the lay down area outside the shed. Roadheader excavation is expected to occur during the day-time and night-time. It is assumed

that the roller doors to the acoustic shed remain closed during the night time period only.

Table 5-12 presents the total number of properties predicted to exceed the relevant noise goals.

Table 5-11: Stage 3 Operational – Predicted External Noise Levels

Construction Scenario	Receptor Group	Maximum Predicted Noise Levels dB(A)			External Noise Goals
		No Mitigation	2.4 m Barrier	5.0 m Barrier	
Daytime Operation (L_{A10})	Residential	76	76	66	65 (Daytime L_{A10})
	Educational	68	65	63	75 (Daytime L_{A10})
	Commercial	65	65	60	75 (Daytime L_{A10})
Night-Time Operation (L_{Aeq})	Residential	57	58	52	40 (Night-time L_{Aeq})
Night-Time Operation (L_{Amax})	Residential	59	59	55	55 (Night-time L_{Amax})

Table 5-12: Phase 3 Operational – Total Properties Exceeding Noise Goals

Construction Scenario	Receptor Group	No. of Properties Exceeding Daytime L_{A10} Noise Goal		
		No Mitigation	2.4 m Barrier	5.0 m Barrier
Daytime Operation (L_{A10})	Residential	6	6	1
	Educational	0	0	0
	Commercial	0	0	0
Night-Time Operation (L_{Aeq})	Residential	42	42	31
Night-Time Operation (L_{Amax})	Residential	2	2	0

During daytime operations of the worksite with a 5 m perimeter noise barrier only 103 Kent Road is predicted to exceed the noise goal. With closed doors on the perimeter barrier (i.e. 5 m noise barrier around all perimeters) 103 Kent Road is predicted to achieve the daytime noise goal (refer to **Figure 5-5**).

The night-time L_{Amax} noise goal is achieved for all sensitive receptors with the 5 m perimeter noise barrier.

Exceedances of L_{Aeq} night-time noise goals is predicted at 31 properties by up to 12 dBA with 5 m high perimeter noise barrier (refer **Figure 5-6** and **Figure 5-7**).

Further mitigation reducing the noise emission of the two ventilation fans[14] and the external fix plant equipment (generators and compressors) would be required.

Predictions show that the night-time L_{Aeq} noise goal would be achieved if:

[14] Ventilation fan noise modelled on two Korfman 160kW fans

- silencers achieving 12 dBA noise reduction are fitted to the ventilation fans, and

- the acoustic enclosure(s) for the generators and compressors are increased by 10 dB (eg Rw 30 dB instead of 20 dB).

Overall, significant reductions in noise levels are predicted for the worksite using the proposed shed construction materials and internal acoustic lining. It is also noted that there is potential for a maximum of four shotcrete trucks to make deliveries between the hours of 18:30 and 06:30. The night-time maximum noise level goal would be exceeded during such events.

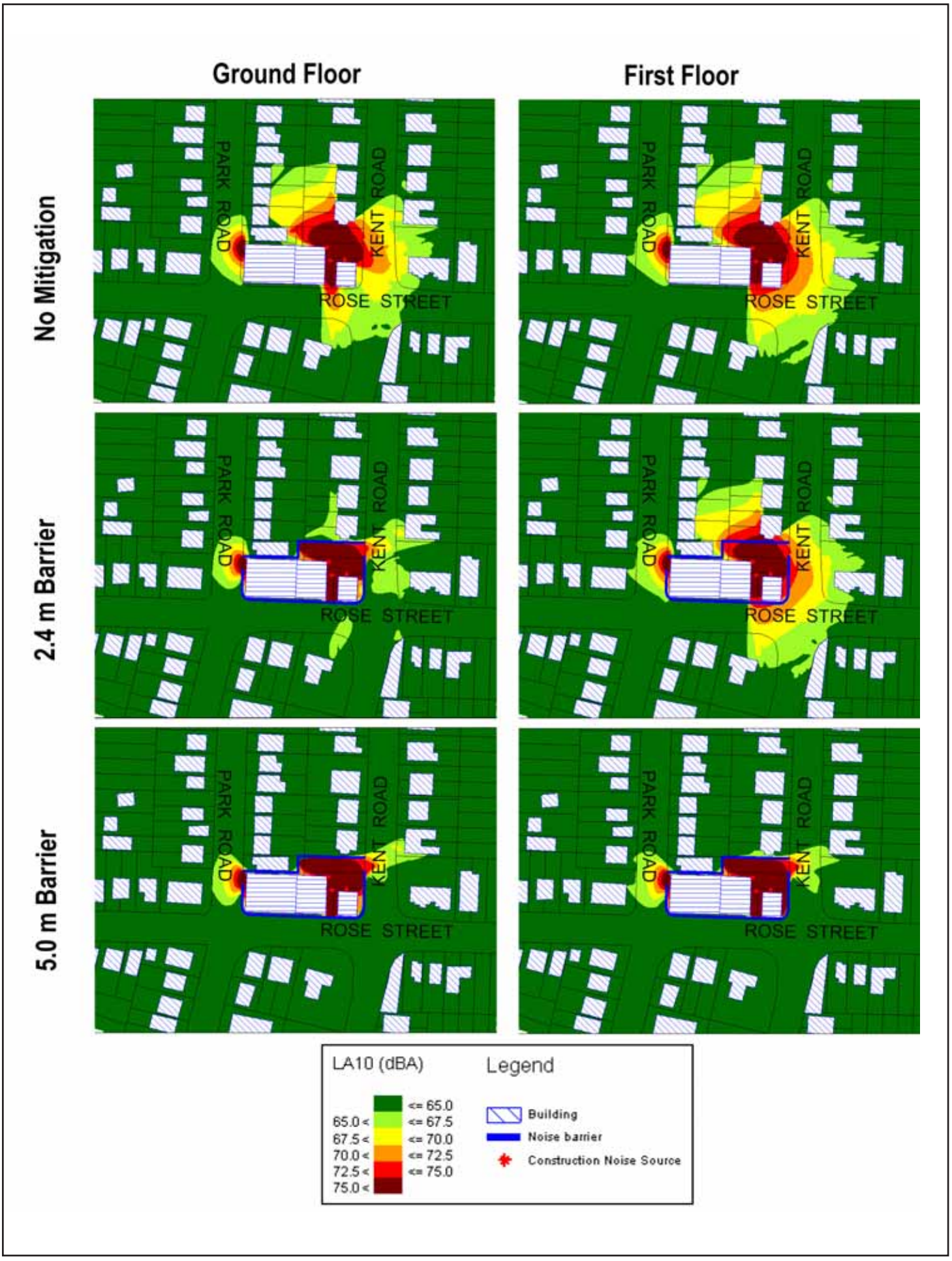


Figure 5-5

Stage 3 Daytime Shed Operation – Predicted External LA_{10} Noise Level

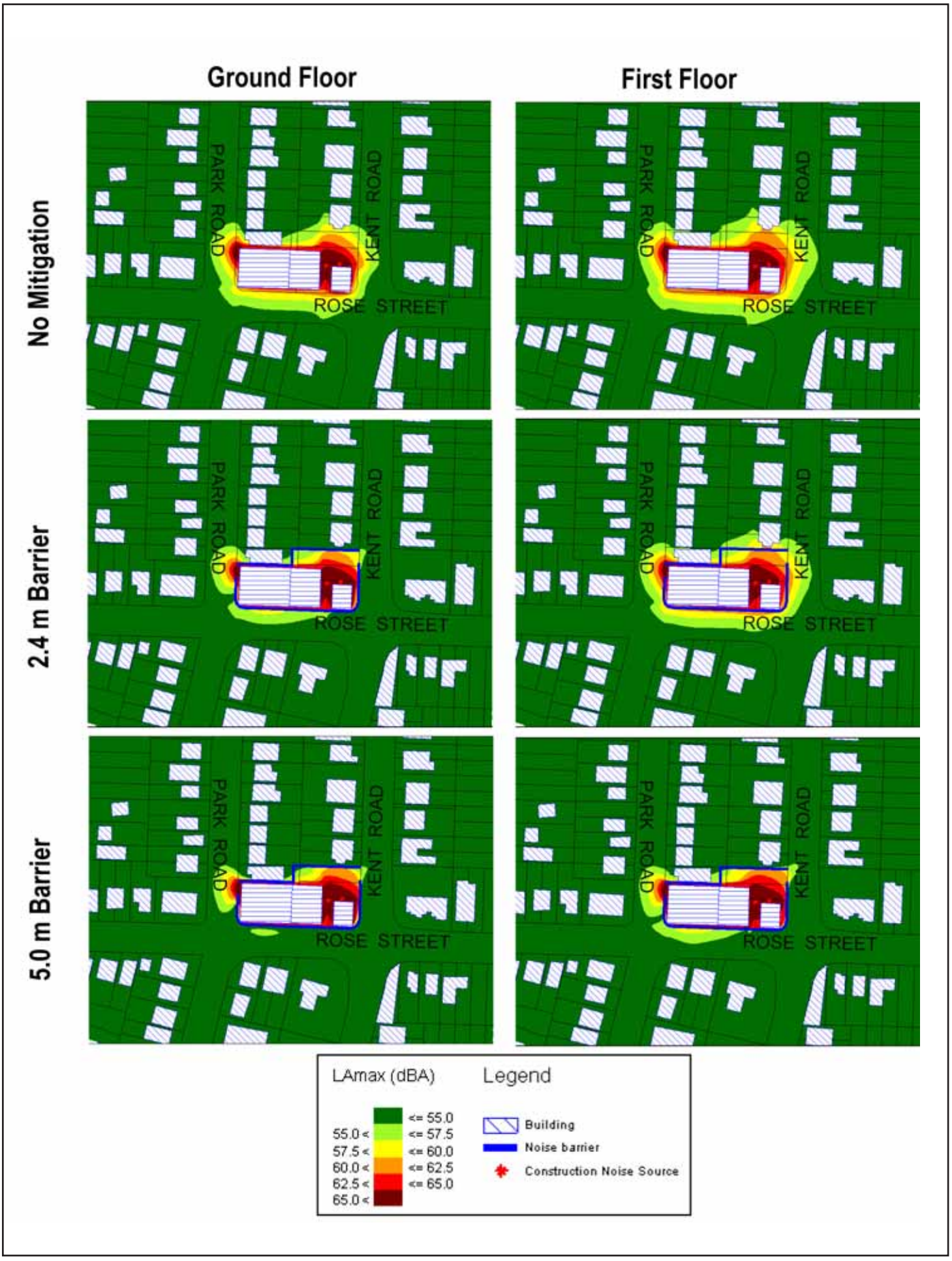


Figure 5-6

Stage 3 Nightime Shed Operation – Predicted External LA_{MAX} Noise Level

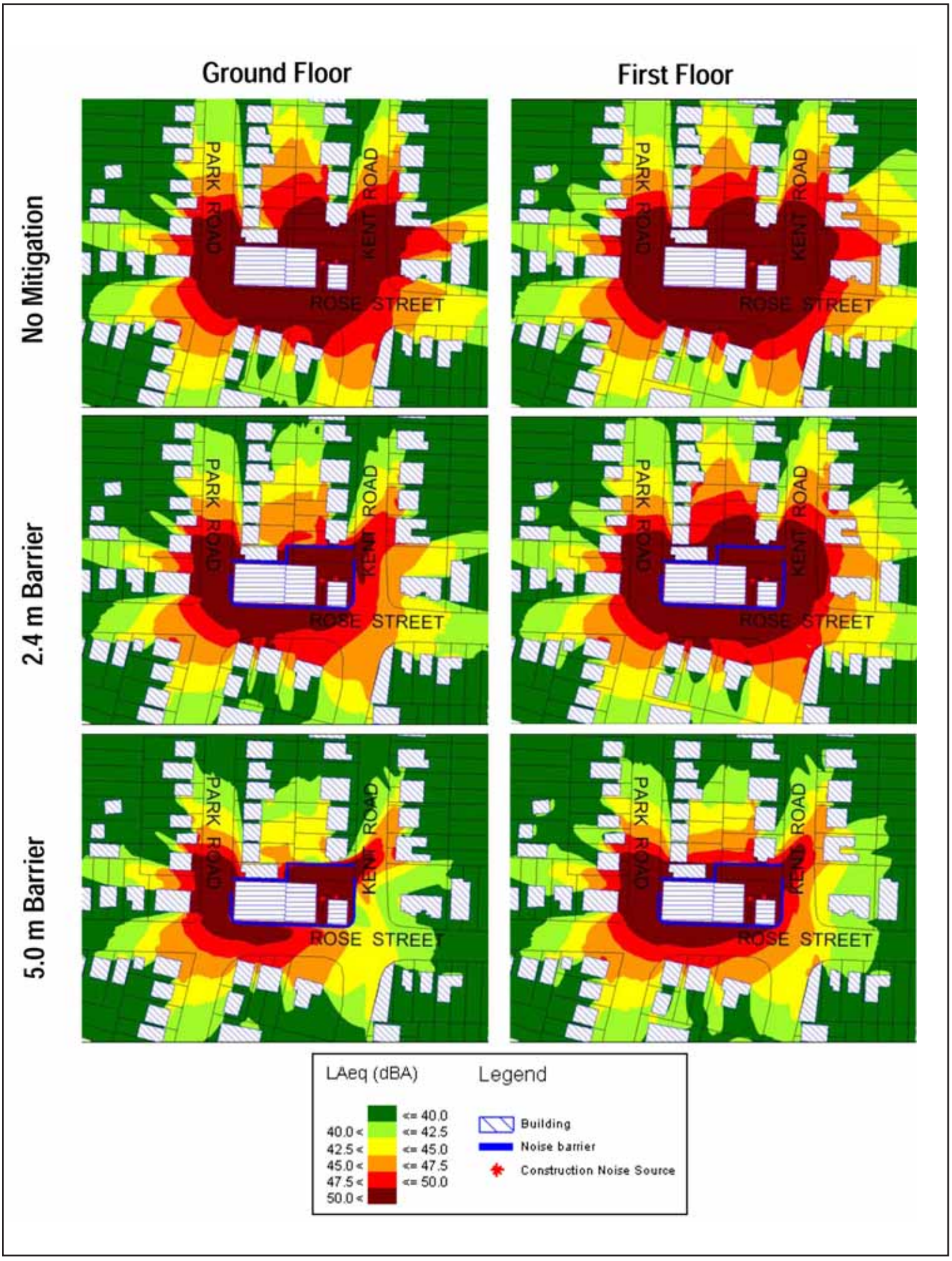


Figure 5-7

Stage 3 Nighttime Shed Operation – Predicted External LA_{eq} Noise Level

5.3.6 Summary of Noise Assessment

Exceedances of the adopted noise goals are predicted even with the implementation of planned mitigation and control measures. However, it should be noted that the frequency of exceedances would depend on the intensity of the use of noisy equipment during construction. The modelling represents a conservative approach and takes into account noisy equipment operating during the busiest construction periods.

5.3.7 Road Traffic Noise Monitoring

Increases in noise emissions from roadways as a result of the addition of construction traffic have been assessed by predicting how the additional truck traffic would alter the $L_{A10(1\text{-hour})}$ level of noise emission from roadways.

As a 'worst case scenario' assessment, the minimum one hour traffic was attained for each section of road during the proposed haulage hours, Monday to Saturday, 06:30 to 18:30. For the assessment of the worst case, the peak hourly spoil truck frequency of ten trucks per hour has also been adopted.

Calculations have been made to attain the potential increase in relative noise levels from each travelled road section. The addition of haul vehicles would increase both traffic volumes and the percentage of heavy vehicles, as described in **Table 5-13**.

Table 5-13 presents the traffic flows along each section of road considered based on 2006 and 2008 traffic counts performed by the DMR. The minimum traffic occurring during any one hour period from 06:30 – 18:30 Monday to Saturday has been extracted from the DMR data. **Table 5-13** also presents the relative percentage increase in commercial vehicles (% CV) predicted as a result of the expected maximum hourly increase of 10 haul vehicle movements per hour.

Table 5-13: DMR Traffic Counts 2008

Road Section	Minimum 1 Hour Count (06:30 – 18:30)	%CV	Count CV	Additional Haulage Vehicles	%CV with Haulage
Option 1					
Gympie Road (Rode – Kitchener) (2006 data)	3,526	5.6	199	10	5.9
Gympie Road (Kitchener – Stafford)	3,400	6.4	219	10	6.7
Gympie/Lutwyche Road	3,942	6.5	256	10	6.7
Kedron Park Road	985	4.6	45	10	5.5
Park Road	625	6.3	39	10	7.8
Rose Street	810	5.3	43	10	6.5
Junction Road	1,011	2.8	28	10	3.8
Sandgate Road (Junction – East West Arterial)	2,480	6.9	172	10	7.3
Sandgate Road (East West Arterial – Nundah Tunnel)	1,086	7.5	81	10	8.3
Rode Road (2006 data)	1,077	4.4	47	10	5.3

Road Section	Minimum 1 Hour Count (06:30 – 18:30)	%CV	Count CV	Additional Haulage Vehicles	%CV with Haulage
Option 1 Alternative					
Gympie Road (Rode – Kitchener) (2006 data)	3,526	5.6	199	20	6.2
Gympie Road (Kitchener – Stafford)	3,400	6.4	219	20	7.0
Gympie/Lutwyche Road	3,942	6.5	256	20	7.0
Kedron Park Road	985	4.6	45	10	5.5
Park Road	625	6.3	39	10	7.8
Kent Road (Weekdays)	99	2.0	2	10	11
Kent Road (Saturdays)	55	2.0	1	10	17.1
Kedron Park Road (South)	985	4.6	45	10	5.5
Chalk Street	Counts not avl.	-	-	-	-
Lutwyche Road (Chalk – Kedron Park)	2,583	3.2	83	10	3.6

The change in traffic volumes and %CV is most significant where existing volumes of traffic are low. This is due to the addition of a small number of commercial vehicles, which greatly increases the number of commercial vehicles and proportionately increases the %CV for this section of road. Kent Street is the most prominent, going from an assumed 2% existing heavy vehicle content to a significant 17.1% (Saturdays) or 11.0% (Monday through Friday).

5.3.8 Traffic Noise Predictions

Table 5-14 presents a summary of the predicted increase in one hour L_{A10} traffic noise levels for each section of road considered.

Table 5-14: Predicted Change to 1-hour L_{A10} Noise Levels

Roadway	Road Section	Change to 1-Hour L_{A10} Predictions (dB(A))
Haul Route Option 1		
Gympie Road	Rode Road – Kitchener Street	+ 0.1
Gympie Road	Kitchener Street – Stafford Road	+ 0.1
Gympie/Lutwyche Roads	Stafford Road – Kedron Park Road	+ 0.1
Kedron Park Road	Lutwyche Road – Park Road	+ 0.3
Park Road	Kedron Park Road – Rose Street	+ 0.4
Rose Street	Park Road – Dawson Street	+ 0.3
Junction Road	Dawson Street – Sandgate Road	+ 0.3
Sandgate Road	Junction Road – East West Arterial	+ 0.1
Sandgate Road	East West Arterial – Nundah Tunnel	+ 0.2
Rode Road	Shaw Road – Gympie Road	+ 0.3

Roadway	Road Section	Change to 1-Hour L_{A10} Predictions (dB(A))
Haul Route Option 2		
Gympie Road	Rode Road – Kitchener Street	+ 0.1
Gympie Road	Kitchener Street – Stafford Road	+ 0.2
Gympie/Lutwyche Roads	Stafford Road – Kedron Park Road	+ 0.1
Kedron Park Road	Lutwyche Road – Park Road	+ 0.3
Park Road	Kedron Park Road – Rose Street	+ 0.4
Kent Road (Weekdays)	Rose Street – Kedron Park Road	+ 2.8
Kent Road (Saturdays)	Rose Street – Kedron Park Road	+ 3.6
Kedron Park Road	Kent Street – Chalk Street	+ 0.3
Chalk Street	Kedron Park Road – Lutwyche Road	Data unavailable
Lutwyche Road	Chalk Street – Kedron Park Road	+ 0.1

Changes in noise levels of 2 dB(A) or less are usually considered undetectable to the human ear and such changes are therefore usually considered to represent negligible additional impact. The results presented in **Table 5-14** predict that increases in road traffic noise as a consequence of spoil haulage traffic generally would not be significant for haul route Option 1.

The modelling predicts significant impacts on predicted noise from traffic along Kent Road for haul route Option 1 Alternative.

Review of the results for Kent Road indicates that for Saturday traffic, having lower volumes than weekday traffic, the increase in both traffic volume and the relative percentage of heavy vehicles is significant.

Therefore, it is recommended that haul route Option 1 be adopted for use during operation of this proposed worksite.

5.3.9 Mitigation Measures

The following noise mitigation measures would be implemented to maintain a reasonable noise environment at noise sensitive receiver locations:

- Best practice management over engine noise emissions by procurement and maintenance of a fleet that conforms to Australian Design Rule 28/01 for engine noise emissions, tested in accordance with the National Road Transport Commission document on Stationary Exhaust Noise Test Procedures for In-Service Motor Vehicles.
- Adoption of airbag suspension throughout the fleet to minimise noise associated with empty trucks travelling over road surface irregularities.
- Real time tracking and management of the position of the truck fleet to ensure that waiting queues are appropriate to space constraints, minimising noise from idling trucks.
- Keeping road sections well maintained would reduce noise impacts (trailers banging). This would be achieved through notifying authorities to ensure proper maintenance of road sections.

- Informing residents along haul route sections located in residential areas of predicted traffic flows and the haulage program and duration.
- A 5.0 m high noise barrier would be constructed of a material with a minimum mass density of 10 kg/m^2 and be continuous with no air gaps;
- The Project would be constructed in accordance with the Construction EMP and the Construction Noise and Vibration EMP Sub-Plan.
- Where the predictive modelling predicts that noise goals for daytime construction works are likely to be exceeded, then reasonable and practicable noise mitigation measures available such as property treatments (e.g. window and/or door upgrades and ventilation/air conditioning) would be implemented in conjunction with the initial acoustic barrier works, i.e. prior to significant work commencing. These measures would be developed in consultation with owners and occupants of potentially-affected premises.
- Where the predictive modelling predicts that noise goals for sleep disturbance are likely to be exceeded by operational works, then reasonable and practicable noise mitigation measures available such as property treatments (e.g. window and/or door upgrades and ventilation/air conditioning) would be implemented prior to the commencement of night operations. These measures would be developed in consultation with owners and occupants of potentially-affected premises.
- Construction of an acoustic shed, using the proposed wall / ceiling system, covering the shaft excavation and stockpile area constructed to the following specifications:
    - external 50 mm attenuation cladding;
    - internal 0.6 mm steel an cavity filled with 50 mm thick fibre glass insulation (14 - 18 kg/m^3);
    - proposed 50mm mineral wool lining (25-50 kg/m3) with 0.05 mm PE-foil lining the inside of the shed;
    - roller doors located on the western wall (4.5 m x 5.0 m) and eastern wall (7.5 m x 5.0 m); and
    - installation of acoustic curtains at the vehicle entry and exit points.
- Night-time works would occur only within the acoustic shed, and then only with the roller doors closed, except for the arrival and departure of shotcrete delivery vehicles. Shotcrete delivery vehicles arriving or departing after 22:30 would unload within the acoustic shed. Vehicles would not be reversed within the worksite after 18:30.
- Ensure that the design of continuously operating shed ventilation and any other plant that operates at night meets night-time noise objectives and goals. This is likely to include (subject to detailed design):
    - silencers achieving 12 dBA noise reduction fitted to the 2 ventilation fans located within the shed, and
    - the acoustic enclosure(s) for the generators and compressors achieve an Rw of 30 dB.

- Minimising the noise generated by the operation of plant and equipment through the use of acoustic enclosures around external fixed plant (with an Rw of 20 dB).
- Minimising reversing to alleviate the noise from reversing beepers (or utilise less tonal 'broadband' or 'quacker' type alarms).
- Ensuring that all plant / equipment / vehicles are well maintained and fitted with suitable mufflers to their exhaust.
- Aligning the plant such that the body of a machine is shielding noisy activities from residential receptors.
- Providing, if and where necessary, acoustic treatments to windows and facades of adjacent residences, or providing relocation services during any short duration of high noise activity which could not practicably be shielded at the source.

5.3.10 Performance Criteria

- Demonstrate through predictive modelling of the proposed construction techniques and monitoring ambient noise readings prior to construction to establish pre-disturbance levels.
- Maintain the goals for noise and vibration during construction to achieve an acceptable noise environment as defined by the Coordinator-General's goals for construction noise, having regard to the scale and duration of construction works, and the character of land use activities in the construction area.
- Monitor and report monthly on the performance of construction works with regards to environmental guidelines for noise.

5.3.11 Monitoring

- To manage construction noise effectively, continuous monitoring would be commenced with occupants of affected premises in the area of construction influence prior to the commencement of construction works likely to cause exceedances of the noise goals.
- Noise monitoring would be undertaken at sensitive receptors on a weekly basis where access for attended monitoring can be obtained. Selection of location for monitoring would be based on those locations predicted to be most exposed to noise and where access is granted. External monitoring would be undertaken where internal access cannot be gained.
- Noise mitigation, modelling and monitoring results would be reported as part of the overall Project Monthly Environmental Report and monitoring results would be included into the Monthly Environmental Monitoring Report (Appendix of the Monthly Environmental Report).
- Monitoring of construction noise would be undertaken in accordance with accredited procedures and would be included in the required reporting.
- Reporting on exceedances of noise goals, complaints, responses to complaints and corrective actions would be included as part of the Monthly Environmental Monitoring Report.
- The Monthly Environmental Monitoring Report would be tabled at the Community Liaison Groups (CLG) and noise issues discussed at the relevant CLGs.

5.4 Vibration

5.4.1 Overview

The studies and assessments undertaken for the Project EIS indicate that compliance with the vibration guidelines can be achieved in most instances, and where predicted modelling indicates the goals are likely to be exceeded, measures would be implemented to minimise any adverse impact on the community or infrastructure.

The goal values, as provided in the EIS and later produced in the Coordinator General's conditions are shown in **Table 5-15**. It is considered that with careful management, early engagement and ongoing consultation the development of the Rose Street shaft and tunnel access can be completed in accordance with these requirements.

Table 5-15: Vibration Guide Values – Minimal Risk of Cosmetic Damage

Vibration Type	Equipment	Peak Particle Velocity (mm/sec)		
		Heritage Listed	Residential	Sensitive Commercial
Transient Vibration	Blasting	2	10	10
Continuous Vibration	TBM / Roadheader/ Hydraulic Hammer	2	5	5

The Coordinator-General's conditions further specify that transient airblast overpressure must not exceed 130 dB (linear) peak at a sensitive place.

The planned finished depth of the shaft is approximately 42 m below the current ground level and is shown on **Figure 4-1**. The initial 20 m is expected to be excavated without any requirement for removing harder competent rock. The lower 20 m would be excavated using hydraulic hammer. Drilling and blasting at the worksite is not planned; however, whether this technique would be required would depend on rock type encountered.

The shaft diameter is approximately 15 m and would restrict the size of the hammering equipment that can be successfully mobilised and operated, as well as the scale of the drilling and blasting equipment.

5.4.2 Potential Construction Impacts

The sources of potential vibration from construction activities at the Rose Street worksite include:

- surface works – operation of earth-moving equipment, compaction equipment, elevated equipment including piling rigs, drilling equipment and other associated plant and equipment;
- general construction works – including use of hydraulic hammers, drilling and blasting; and
- tunnelling – operation of tunnelling machinery such as roadheaders, TBMs, earth-moving equipment and other associated plant and equipment.

Preparation of the Worksite

Preparation of the worksite would include the use of rollers to achieve the required level of compaction and for footing preparation such as preparation of the area about the shaft collar, including the hardstand, roadway and foundations for site buildings.

Static rollers would result in minimal or no vibration at the nearest properties. Vibration monitoring would be undertaken at the nearest sensitive receptors to confirm vibration goals are not being exceeded during the preparation period.

Boring of Secant Piles

The boring of the secant piles in the upper section of the shaft would induce very low levels of vibration. Data from other project sites suggest that vibration values would be less than 0.5 mm/s at a distance of 6 m from the cutter head. At the nearest property in Park Road, the vibration levels are predicted to be around 0.25 mm/s, and would not likely be detected by or disturb residents of that property.

Vibration monitoring would also be undertaken during this activity to ensure that vibration goals are being achieved.

Shaft Excavation Works

The proposed location of the shaft is adjacent to several residential properties along Park Road and Kent Street, commercial properties along Rose Street, and services, in particular a high pressure gas line, along Park Road.

Recent investigation indicates that the rock type within the shaft is of relatively low strength with occasional harder bands. With this information the adoption of blasting as a primary part of the excavation process is not anticipated; however, local variations in geology may require a small and controlled amount of blasting to progress the works.

For planned construction activities the equipment potentially capable of inducing measurable and perceptible levels of vibration at surrounding properties may be used during the construction of the shaft, in particular in the following construction areas:

- Piling – the geotechnical analyses indicate that piling would be required about the shaft to a depth exceeding 25 m. Piling would, however, be restricted to bored secant piles or a soil mix wall, either of which are expected to generate very low levels of vibration and perceptible only within a few metres of the shaft collar.
- Hydraulic hammers and drill and blast – where the proposed excavation works for the shaft would be undertaken in rock, it is proposed that these are completed using hydraulic hammers primarily with small-scale controlled drilling and blasting methods as a backup strategy for extremely hard rock.

The predicted modelling for the expected level of vibration from both hydraulic hammering and drill and blast activities is based on vibration / distance relationships derived from the analyses of data collected from the Project. Information of vibratory rollers has been gathered from other projects in Brisbane and has been used in the estimation of vibration levels for the Rose Street worksite.

Vibratory Rollers

Levels of ground vibration caused by vibratory rollers can range up to 1.5 mm/s at distances of around 25 m. The highest levels of vibration usually occur as the roller is brought to rest and the frequency of the centrifugal forces passes through resonance with the natural frequency of the roller/ground/structure.

The nearest homes are located at distances of (approximately) 10m or greater from the shaft between. The predicted vibration levels are less than 5mm/s at this distance and therefore compliance with the Coordinator-General's conditions is predicted.

Shaft Construction with Hydraulic Hammers

At the proposed Rose Street worksite, the upper 20 m of material near the shaft collar is a soft decomposed rock which is not expected to require the use of hydraulic hammers for excavation. Once below this level, harder rock is likely to be encountered. In those circumstances, the primary form of excavation of the shaft would be by hydraulic hammers.

The level of vibration measured at the adjacent properties would be dependent upon hammer energy and the distance between the hammering location and the point of measurement. Measurements from other similar Project areas indicate that the level of vibration would be at a maximum at the rock interface (estimated to be 20 m below the collar) in the range of 0.5 m to 1 mm/s.

Vibration levels of this magnitude would be perceptible to persons within the nearest properties, although levels are expected to be within the compliance values specified in the Coordinator-General's conditions.

Vibration from Blasting

At the proposed Rose Street worksite, the upper 20 m of material near the shaft collar is not expected to require blasting. This provides a minimum separation distance between the blasting area and the nearest property (Park Road) of approximately 25 m. Blasting activities at other areas in similar rock types have identified a relationship between distance, explosive type and vibration levels. An approximation of the ground vibration variation with distance from the blast is provided in the following equation:

$$PPV = k\left(\frac{D}{\sqrt{m}}\right)^{e}$$

Where:

PPV = peak particle velocity (mm/s)
m = charge mass per hole (kg)
D = distance from blast (m)
e = site exponent – a value of -1.49 is appropriate for this Project
k = site constant value – 4185

Based on the above equation the explosive quantities would be restricted to comply with a 10 mm/s vibration maximum at the nearest property and then quantities would increase as the shaft deepens.

Predictive modelling for the excavation of the shaft indicates that there would be exceedances of the 10mm/s on occasion during initial excavation of the shaft, however in order to achieve compliance with the vibration guidelines listed in the Coordinator-General's conditions the scale of blasting would be significantly restricted and would greatly reduce the effectiveness of this method of excavation.

The use of hydraulic rock breakers (as stated above) or alternative low energy products such as Nonex, Cardox or PCF as a primary means of excavation are available and, as they produce inherently lower vibration levels, are more likely to comply with the Coordinator-General's conditions. However, while these methods induce lower levels of vibrations, the vibration would necessarily persist for longer periods of time (several days for the rock breakers as opposed to the short duration of the blast event of not more than several seconds) which may be considered more intrusive to adjacent residents.

The greater amplitude of vibration from blasting, although for a shorter duration, may be preferable by some residents and local authorities, providing the induced vibration is not sufficiently high to be capable of causing cosmetic or structural damage to the building or harm to residents. Adherence to all local and internationally accepted guidelines or standards would prohibit damage of these types of buildings.

Experience from other projects indicates that vibration levels in excess of the 10mm/s recommended in the Coordinator-General's conditions pose no greater threat to building integrity and may only be marginally more perceptible to building occupants.

Where monitoring and modelling indicate that the goals and triggers are predicted to be exceeded additional mitigation measures would be implemented and consultation undertaken to manage the impact on potentially affected residents.

The following mitigation measures are considered mandatory:

- vibration monitoring of all blasts at the nearest property in each direction (from the shaft);
- comprehensive condition surveys of all properties predicted to exceed the Coordinator-General's 10mm/s goal; and
- extensive community liaison consultation would be completed, in accordance with the Draft EMP.

Assessment of businesses with equipment that would be sensitive during operation due to excessive vibration includes the following establishments:

- Wooloowin Veterinary Surgery, 86 Kent Road, Wooloowin; and
- Queensland Aerospace Training Centre, 30 Rose Street, Wooloowin.

It is not known at present whether any equipment sensitive to vibration is located at these premises. Advance consultation with the occupants and owners of these premises would be required to identify equipment that may be sensitive and affected by construction activities at the proposed worksite. Consultation would occur at an early stage to ensure that aspects of the construction methodology can be changed to mitigate impacts on those receptors.

Air Overpressure

As described above, the Coordinator-General's conditions apply an air overpressure limit of 130 dBL to all sensitive receivers in public areas. Unlike ground vibration, air overpressure is significantly less affected by rock mass, but controlled to a far greater extent by the type of blasting. Blast design factors such as uncharged collar length, blasthole diameter, burden and initiation sequence, meteorological and topographical effects would be taken into account if blasting is required at the site.

Predicting overpressure levels using standard equations, such as those proposed by the United States Bureau of Mines, generally produce erroneous results when applied in a constrained environment like shafts or tunnels. Predicting the expected level of overpressure is therefore best undertaken through a review of other projects undertaking a similar scale of blasting in similar conditions. These show that for a worst-case scenario, overpressure levels may range beyond 120 dBL for residences located within a 50 m radius around the shaft collar. Further than 50 m, residences are expected to receive overpressure levels less than 120 dBL.

Compliance with an overpressure value of 130 dBL at all monitoring locations can be achieved at residential and commercial buildings through modifications to blast design.

As the shaft deepens, some reduction in the measured level of overpressure is expected.

An acoustic shed would be erected on site over the shaft. The vibration impacts from any blasting occurring after the acoustic shed has been constructed would be significantly reduced. The acoustic shed would be designed to achieve the best attenuation of overpressure levels through appropriate selection of materials and construction methods. A preliminary assessment suggests that a selection of building materials with different impedances (density and compressional velocity) best serve to reduce overpressure levels. The acoustic shed would necessarily offer significant attenuation of noise impacts linked with any surface delay elements used in the design.

The combined measures, including best procedures with blast design and covering of the blast are predicted to reduce overpressure levels to acceptable values, that is in compliance with the maximum 130 dBL limit at the nearest receivers.

Road Header Driven Tunnelling

The slant distances (the distance from the tunnel crown to the foundation of a building) for the short section of tunnel required to get from the shaft to the main-line tunnels are no less than those associated with the main-line tunnel.

As predicted regenerated noise and vibration from the main-line tunnels was assessed as part of the original Change Report, and no increase is anticipated above those levels due to the proposed new construction site, no further assessment is warranted for this report.

5.4.3 Potential Construction Impacts - Summary

In summary, whilst the level of vibration from the construction activities would be perceptible at properties about the works area, they can be designed to maintain vibration levels at less than those values given in the Coordinator-General's

conditions if no blasting occurs during construction of the shaft. Should the need for blasting arise and it be considered acceptable for the blast design to exceed the Coordinator-General's condition of 10mm/s but remain below the Environmental Protection Act's (1998) 25 mm/s limit, then the following mitigation measures are considered mandatory:

- vibration monitoring of all blasts at the nearest property in each direction (from the shaft)
- comprehensive condition surveys of all properties predicted to exceed the Coordinator-General's 10mm/s goal, and
- extensive community consultation in accordance with the Draft EMP.

Overall, reductions in vibration levels are predicted for the proposed Rose Street worksite using the proposed shed construction materials with internal acoustic lining and through the implementation of control and mitigation measures as outlined below.

5.4.4 Mitigation Measures

The following mitigation and control measures for overpressure levels would be implemented in order to comply with the Coordinator-General's conditions:

- The Project would be constructed in accordance with the Construction EMP and the Construction Noise and Vibration EMP Sub-Plan.
- Mitigation measures would be designed and implemented to minimise impacts on human comfort, building damage or disturbance from construction vibration.
- For sensitive areas such as residential areas, construction techniques would be adopted that avoid or minimise impacts of vibration or regenerated noise.
- Where predictive modelling indicates that vibration goals are likely to be exceeded during construction the Contractor would undertake notification of construction to alert property owners and occupants of the likely implications, duration of construction techniques, possible effects and predicted levels of vibration, as well as what measures would be taken to maintain human comfort, normal daily business activities and to minimise structural damage to buildings.
- Adequate advance notification, including on the day of blasting, of all blasting activities would be made to persons that may be adversely affected.
- Blasting would only occur between the hours of 07:30 and 16:30 Monday to Saturday, and only once the acoustic shed is completed and in full use.
- The blast would be designed to achieve the Coordinator-General's conditions, including minimum distances between explosive column and the rock surface, maximising the stemming length and minimising the amount of explosive used to the extent practicable. If this is not possible then alternative low energy products such as Nonex, Cardox or PCF or a hydraulic rock breaker should be used.
- Coverage of the shaft blast area with appropriate overburden material and/or matting would be implemented, where required, to minimise the generation of overpressure.
- Comprehensive condition surveys of all properties predicted to exceed the Coordinator-General's vibration goals

- Where necessary, off-site mitigation measures would be implemented to minimise, mitigate or otherwise offset the impacts of construction vibration on buildings and human comfort. This may include measures such as temporary modifications to premises or equipment sensitive to the predicted range of vibration, or offer of temporary alternative accommodations.

5.4.5 Performance Criteria

- Adopt suitable construction techniques to achieve the vibration goals approved in the Coordinator-General's conditions, having regard to the scale and duration of construction works, the nature of the terrain through which the construction works are to pass and the character of land use activities.
- Where required, identify and implement other reasonable and practicable mitigation measures to achieve acceptable vibration objectives for construction works.
- Undertake continual monitoring to ensure vibration goals are not being exceeded, and environmental conditions are being maintained within the area of construction influence.
- Report regularly on the performance of construction works with regard to environmental goals for vibration.

5.4.6 Monitoring

- Continuous monitoring of vibration (including over-pressure) would be commenced with occupants of affected premises prior to the commencement of construction works predicted to cause exceedances of vibration goals.
- Monitoring would be undertaken in accordance with accredited procedures at representative locations where predictive modelling for vibration indicates the potential for impacts on sensitive building contents.

5.5 Air Quality

This section presents an assessment of potential air quality impacts associated with the proposed construction activities on sensitive receivers near the Rose Street worksite. For the purposes of assessing compliance of the proposed works with the air quality goals, air dispersion modelling has been undertaken as has a review of air quality monitoring data from the region of relevance to the proposed Rose Street worksite.

5.5.1 Description of the Existing Environment

In order to predict cumulative ground level concentrations, consideration has been given to existing background levels based on monitoring completed by the then Queensland EPA.

The Department of Environment and Resource Management (DERM) operate a number of monitoring stations within the Brisbane area. **Table 5-16** presents a summary of the nearest monitoring stations to the proposed site measuring each of the considered contaminants along with the measured averaging period. The CO and PM_{10} background levels have been based on monitoring completed by Air Noise Environment in 2006 at Pinkenba.

Table 5-16: Background Air Quality Monitoring

Contaminant	CO	NO_2	Benzene	PM_{10}	TSP
Background Concentration (µg/m³)	375	41	5.4	25	84
Averaging Period	1 hour	1 hour	1 hour	24 hour	24 hour
Monitoring Site	Pinkenba	Rocklea	Springwood	Pinkenba	Brisbane CBD

5.5.2 Construction Air Quality Goals

The air quality objectives for construction of the proposed Rose Street worksite are based on the Queensland Environment Protection Policy (EPP (Air)) 2008 goals and Coordinator-General's conditions. The current goals for the assessment of air quality impacts during construction of the Airport Link Project are detailed in the Airport Link EIS Draft EMP (2006) and referenced in the Coordinator-General's Change Report (2008).

The construction ambient air quality goals are as follows:

- PM_{10} Maximum 24hourly average – 150 µg/m^3;
- PM_{10} Annual average – 50 µg/m^3; and
- Total Suspended Particulate (TSP) annual average – 90 µg/m^3.

Deposited dust, if present at sufficiently high levels, can reduce the amenity of an area. No formal criteria for dust deposition exist within Queensland, although an informal draft guideline of 120 mg/m^2/day was introduced some years ago by the then Department of Environment and Heritage (now DERM) applicable at nearby sensitive residential places. A dust deposition guideline of 120 mg/m^2/day is therefore considered appropriate for construction at the Rose Street worksite.

Table 5-17 and **Table 5-18** present a summary of the air quality goals considered for the purposes of the assessment. It is noted that the Coordinator General's report provides air qualities for dust fallout and PM_{10} levels only. Where air quality goals associated with other pollutants are required, reference would be made to air qualities provided by the National Environmental Protection (Ambient Air Quality) Measure 2003 in the *Environmental Protection (Air) Policy 2008*.

Table 5-17: Summary of Air Quality Goals

Existing Dust Fallout Level (g/m^2/month)	Maximum Acceptable Increase over Existing Background Fallout Levels (g/m^2/month)	
	Residential Area	Commercial Area
2	2	2
3	1	2
4	0	0
5	0	0
Health-based Goal for Ambient Air (PM_{10})		
24 hour average (exceedances no more than 5 times/year)		50 $\mu g/m^3$

Table 5-18: Summary of NEPM Air Quality Goals

Pollutant	Goal	Averaging Period	Source
Carbon Monoxide	11,000	8 hour	NEPM/EPP (Air)
Nitrogen Dioxide	246 62	1 hour Annual	NEPM
TSP	90	Annual	NEPM
Benzene	10	Annual	NEPM

5.5.3 Existing Air Quality Monitoring Data

Particle Concentration

Air quality monitoring was undertaken at Kedron for the Airport Link EIS over a period of approximately 13 months concluding in 2006. The monitoring station was established in the DES complex to the north of Gympie Road. The data collected would provide a basis for comparison with the Rose Street site, although the traffic flows on Gympie Road were significantly higher than those presently experienced on or predicted for Rose Street.

Data from the Kedron air quality monitoring also provides most complete set of representative data for CO, NO_2, PM_{10} and $PM_{2.5}$. **Table 5-19** summarises each of the air pollutants and compares these data with the relevant air quality goal and data recorded at Kedron.

Table 5-19: Kedron Air Quality Monitoring Data 2006

Pollutant	Averaging Period	Background (monitored)	Goal (Coordinator-General Conditions)
Carbon monoxide (CO)	8 hrs	2.2mg/m^3	8 mg/m^3
Nitrogen dioxide (NO_2)	1 hr	95 µg/m^3	246 µg/m^3
	Annual	21.9 µg/m^3	62 µg/m^3
Paticulates (PM_{10})	24 hrs	33.8 µg/m^3	50 µg/m^3
	Annual	13.5 µg/m^3	50 µg/m^3
Paticulates ($PM_{2.5}$)	24 hrs	16.6 µg/m^3	25 µg/m^3
	Annual	6.3 µg/m^3	8 µg/m^3

[1] The PM2.5 goals are referred to as Advisory Reporting Standards and are set for the purpose of gathering data to facilitate a review of these standards as part of the development of the PM2.5 NEPM. The goals are not applied on a project-specific basis.

It can be seen from **Table 5-19** that air quality monitoring data collected at Kedron is well below the ambient air quality goals for all parameters.

Dustfall

Dust deposition data is currently collected during construction activities at the Kedron worksite from the Project air quality monitoring station located at the rear of Kedron State High School. This data provides an indication of the level of dust fallout from similar construction activities occurring nearby to the proposed Rose Street worksite, and is considered representative of dust levels that may be expected around the proposed Rose Street worksite.

Table 5-20: Dust Deposition Data from Kedron State High School Project Monitoring Site

Location	Monitoring Period	Dust Fallout g/m^2/mth
Kedron DES	5/12/08 – 5/1/09	0.8
	11/2/09 – 11/3/09	1.6
	11/3/09 – 10/4/09	1.8
	14/3/09 – 14/5/09	1.8

5.5.4 Potential Construction Impacts

The main community concerns in relation to Project construction works typically relate to dust generation from excavation and material handling, potential odour emissions from excavated material and exhaust emissions from diesel powered equipment.

Considering the proximity of sensitive receptors (residential) and the likely duration of construction activities at the proposed Rose Street worksite, the management of dust emissions would most likely be important for the community. The sources of dust generation associated with construction activities are likely to include:

- earth-moving and excavation works for site preparation; and
- stockpiling, handling and transport of excavated material including the loading of spoil into trucks.

Other potential impacts on air quality during construction at the proposed worksite include:

- the operation of diesel-powered plant and equipment; and
- potential odour generation from the excavation of contaminated material.

Site Establishment

The greatest potential for dust arising from site establishment activities is likely to include:

- graders working on unpaved areas and dozers moving materials;
- pavement and curb ripping;
- wind erosion from exposed surfaces;
- wheel-generated dust from vehicles travelling along unpaved or dirty paved surfaces; and
- the handling and transport of spoil.

With the implementation of appropriate dust management practices during site establishment, the extent of dust nuisance should be within the dust deposition goals provided in the Coordinator-General's conditions.

Measures for the management and control of potentially odorous or harmful substances (particulate and gaseous) are outlined in **Section 5.5.11**.

Diesel Powered Vehicles and Plant

The main sources of exhaust emissions from diesel-powered equipment are likely to include:

- vehicles working at the surface construction site, such as excavators, front-end loaders, scrapers, rollers, backhoes, concrete trucks, delivery trucks, truck mounted cranes, rock hammers, etc.;
- trucks queuing, contrary to management requirements, adjacent to sensitive receivers located near the proposed worksite;
- fully-laden trucks exiting the acoustic shed and commencing their journey to spoil placements areas;
- stationary plant emissions (mobile generators, dewatering pumps, concrete pumps, etc.); and
- vehicles and equipment operating within the shaft excavation area or within the enclosed acoustic shed, including front-end loaders, trucks and mobile diesel generators.

The main potential for impacts from diesel emissions is likely to result from trucks queuing adjacent to residents located near to the Rose Street worksite and operation of diesel equipment within the underground excavation area. The

exhaust emissions would contribute to volumes of particulates, carbon monoxide, carbon dioxide, hydrocarbons and nitrogen oxides in the atmosphere.

Air quality impacts from gaseous emissions as listed above are expected to be minimal given the relatively low number of trucks per day (maximum of 85 vehicles) compared to existing traffic movements on Rose Street.

Underground Works

The main emissions with potential to impact on ambient air quality associated with underground works are the shaft excavation works, stockpiling of spoil material, loading of spoil into trucks and the off-site transport of spoil. The main risk in terms of external emissions is expected to be particulate matter arising from the roadheader excavation.

To control external dust emissions from the shaft construction and truck loading works, a shed would be constructed as part of the initial site establishment works. All stockpiling and truck loading activities would be undertaken entirely within the shed. Truck operators would cover their loads prior to leaving the shed.

A tunnel ventilation system would be installed and operated from within the shed. The shed would also need to be ventilated through this system to manage the risk of dust nuisance from spoil handling and loading within the shed. The ventilation system would be fitted with dust extraction and filtration equipment to ensure the Coordinator-General's conditions for managing dust nuisance are satisfied. Air from the extraction system would be released to the ambient environment via a high level ventilation outlet attached to the shed. The height of the outlet would be approximately 2 m above the peak of the shed roof[15].

Dust impacts from shaft excavation, spoil stockpiling and truck loading operations at off-site sensitive receivers are required to satisfy the dustfall criteria presented in **Table 5-18** above, and to meet the environmental values set out in *Environmental Protection Policy (Air) 2008*..

5.5.5 Air Quality Monitoring

Predictive modelling has been completed using the Ausplume dispersion model to assess the potential air quality impacts associated with PM_{10} emissions from excavation activities. Emission rates have been based on monitoring results completed at a similar roadheader excavation sites in Australia. **Figure 5-8** presents predicted cumulative ground level concentrations associated with the proposed set up.

The modelling results take into consideration a 20 $\mu g/m^3$ existing background concentration, as measured at the Rocklea EPA Monitoring station (2007). For the purposes of the modelling, it is assumed that all tunnel air emissions are released via a high level ventilation outlet from the shed. A flowrate of 10 m^3/sec for air leaving the ventilation outlet has been considered, based on the design of the proposed ventilation system.

[15] With the shed roof reaching to 17.5 m at its highest point, the height of the high level ventilation outlet would need to be at least 22.5 m above ground to achieve adequate dispersion of air from the ventilation system.

5.5.6 Air Quality Modelling Results

Shed Construction

During construction of the acoustic shed, various diesel-powered equipment and machinery are expected to be used. Likely sources of emissions associated with construction of the shed include haul trucks, cranes, piling rig and concrete equipment (concrete pump/vibrator). Construction activity outside of the acoustic shed is planned to occur between the hours of 06:30 and 18:30 Monday to Saturday only.

Table 5-21 presents the modelled source and emission data considered for modelling of shed construction emissions. Emission factors have been sourced from the US EPA Exhaust and Crankcase Emission Factors for Non-Road Engine Modelling – Compression Ignition. The modelling has taken into consideration that construction and associated air emissions would occur during the daytime only.

Table 5-21: Shed Construction – Emission Data

Equipment	Power kW	Load Factor	Operating Time	Emission Rate (g/s)			
				CO	NO	PM_{10}	Benzene
Concrete Truck	350	0.1	50%	0.00549	0.01628	0.00098	0.00005
Haul Truck	350	0.1	50%	0.00549	0.01628	0.00098	0.00005
Piling Rig	200	0.5	50%	0.01402	0.04688	0.00281	0.00017
Crane	270	0.5	50%	0.02118	0.06285	0.00377	0.00021
Concrete Pump	45	0.75	50%	0.00958	0.02955	0.00125	0.00009
Concrete Vibrator	5	0.75	50%	0.00287	0.00300	0.00020	0.00002

5.5.7 Predicted Air Quality Modelling Results

Predicted dispersion ground level concentrations for carbon monoxide, nitrogen dioxide, PM_{10} and Benzene are presented in **Figure 5-8** through to **Figure 5-11**.

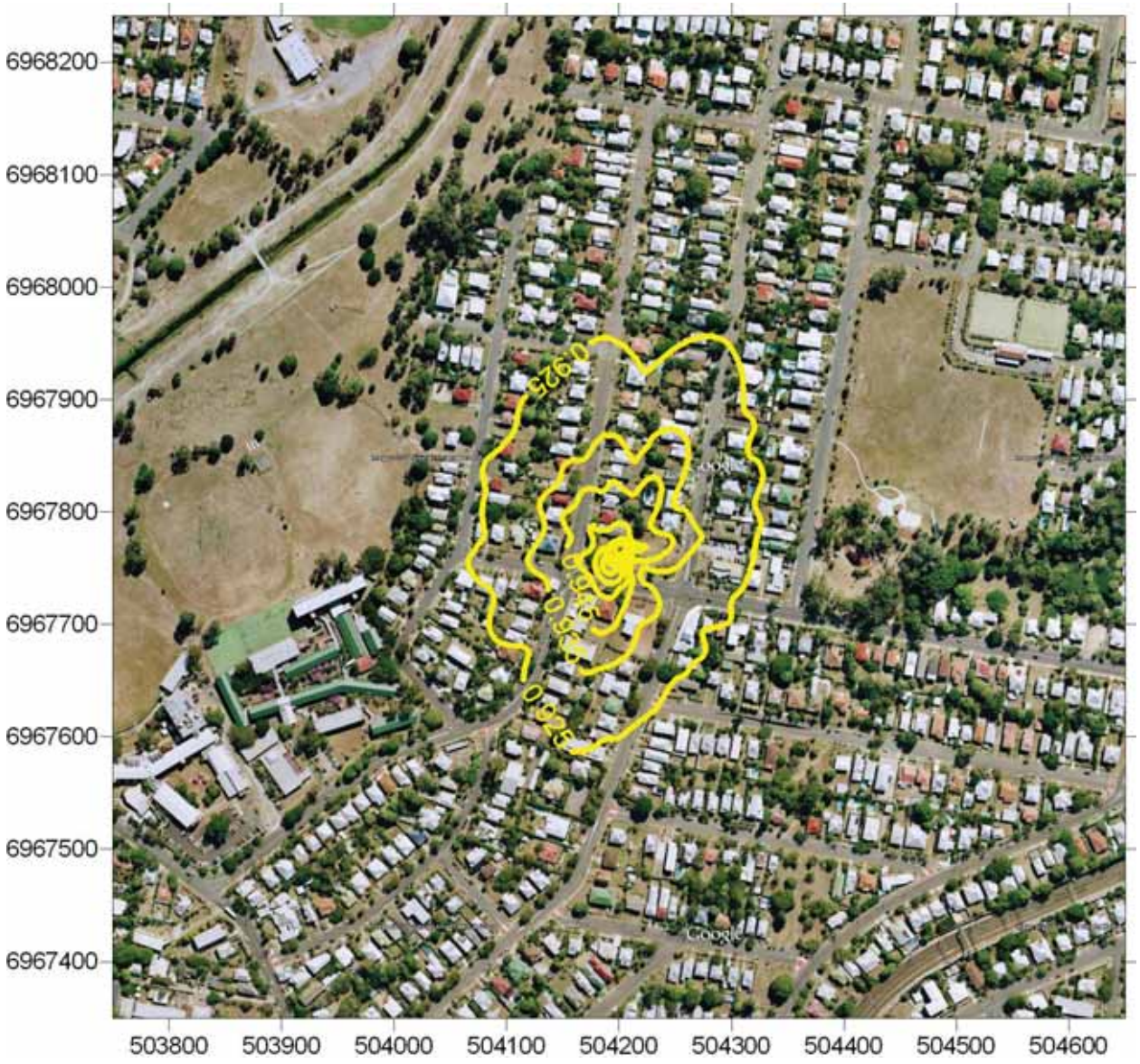


Figure 5-8

Predicted Cumulative Ground Level CO Concentrations (8-hour Average)(µg/m^3), Air Quality Goal – 11 000 µg/m^3

Figure 5-9

Predicted Cumulative Ground Level NO_2 Concentrations (1-hour average)(µg/m^3), Air Quality Goal – 246 µg/m^3

Figure 5-10

Predicted Cumulative Ground Level PM_{10} Concentrations (24 –hour average) (µg/m^3), Air Quality Goal – 50 µg/m^3

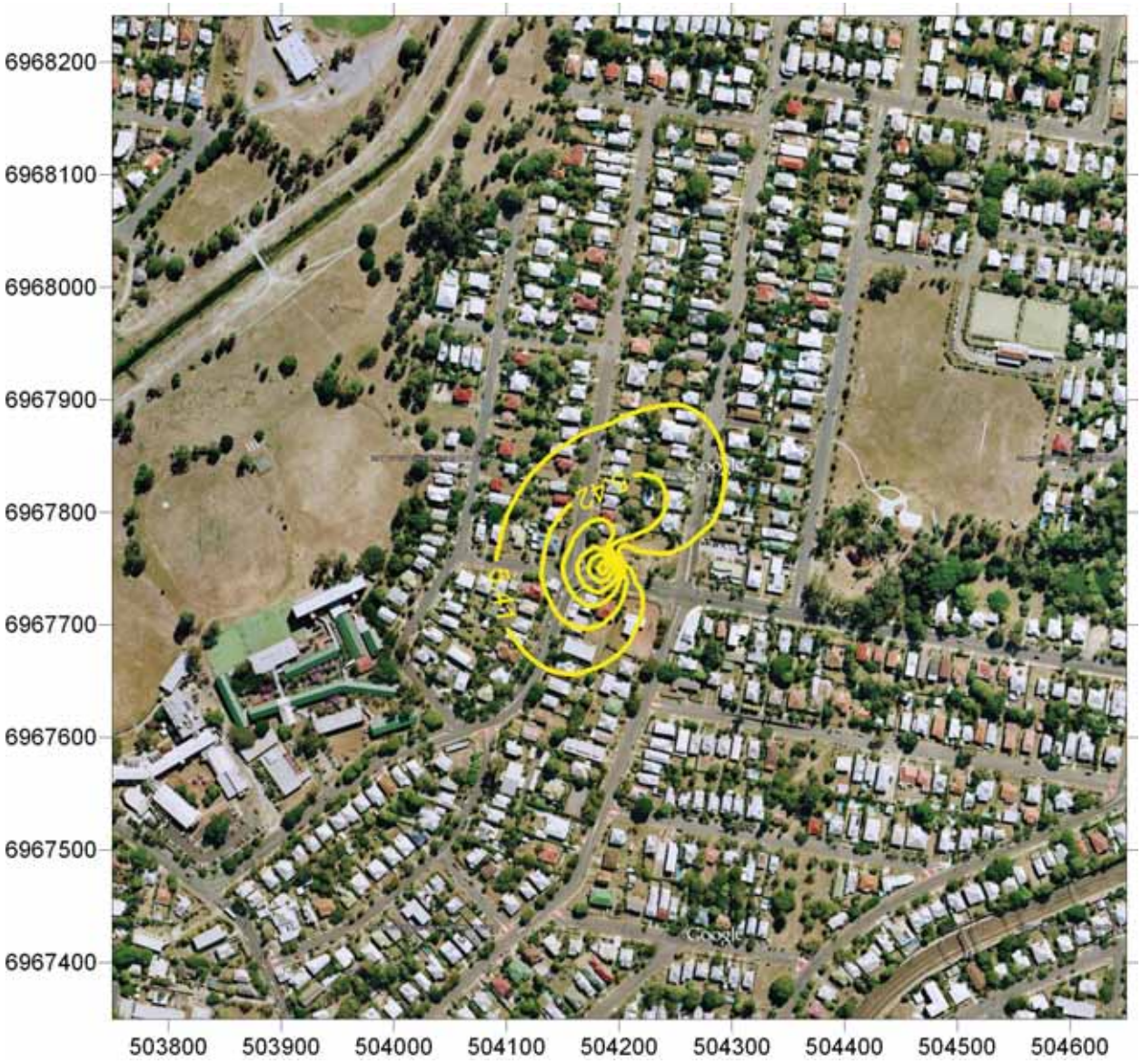


Figure 5-11

Predicted Cumulative Ground Level Benzene Concentrations (Annual average) (µg/m^3), Air Quality Goal – 10 µg/m^3

Site Operation

Once the construction of the shed has been completed, the main sources of air emissions would be shaft excavation and tunnel access construction (e.g. using the roadheader machinery) and four proposed diesel generators. While the use of diesel generators on-site has yet to be confirmed to determine a 'worst-case' scenario, generator emissions have been included in the assessment.

The following emission sources have been considered during operation of the shed:

- shaft excavations and tunnel access construction; and
- the proposed diesel generators (total of four).

Emission rates for the proposed shaft excavation and tunnel access work have been based on monitoring data provided by TJH associated with previous tunnel works in Australia. Emission rates for the proposed generators have been based on information provided by equipment supplier (Aggreko).

Two scenarios have been considered for the purpose of assessing potential impacts:

- No mitigation – shaft excavation and tunnel access construction emissions vented via shed louvres along the southern wall, no particulate or catalytic converters provided for the generators.
- Mitigation –
    - all shaft excavation and tunnel access construction emissions vented via a high level ventilation outlet (no louvres) with a vertical dispersion;
    - particulate filters (> 90% PM_{10} reduction) and catalytic converter (>90% NO_x reduction) on generators; and
    - where predictive modelling or monitoring of work practices shows an exceedance of daytime air quality goals mitigation measures would be undertaken including closing of all barrier gates, shed roller doors, etc.

Table 5-22 presents the estimated emission rates for the proposed operational works, as well as maximum predicted sensitive receptor concentrations with and without mitigation for each pollutant. Predicted dispersion ground level concentrations for pollutants are presented in figures which follow (**Figure 5-12** to **Figure 5-16**).

Table 5-22: Worksite Operation – Emission Data

Equipment/Activity	Emission Rate (g/s)				
	CO	NO_x	PM_{10}	TSP	Benzene
No Mitigation -					
Shaft Excavation & Tunnel Access Construction	1.26	0.19(NO_2)	0.047	0.094[a]	0.0003
Generators	0.833	4.962	0.069[b]	0.069	0.0024
With Mitigation -					
Shaft Excavation & Tunnel Access Construction	1.26	0.19 (NO_2)	0.0047	0.0094[a]	0.0003
Generators	0.833	0.4962	0.0069[b]	0.0069	0.0024

[a] Assumed to be two times the amount of PM_{10} (based on NPI emission factors)
[b] All particulate matter emitted from the generators are assumed to be PM_{10}

Figure 5-12

Predicted Cumulative Ground Level CO Concentrations (8-hour Average) (µg/m^3), Air Quality Goal – 11 000 µg/m^3

Figure 5-13

Predicted Cumulative Ground Level NO_2 Concentrations (1-hour average) (µg/m^3), Air Quality Goal – 246 µg/m^3

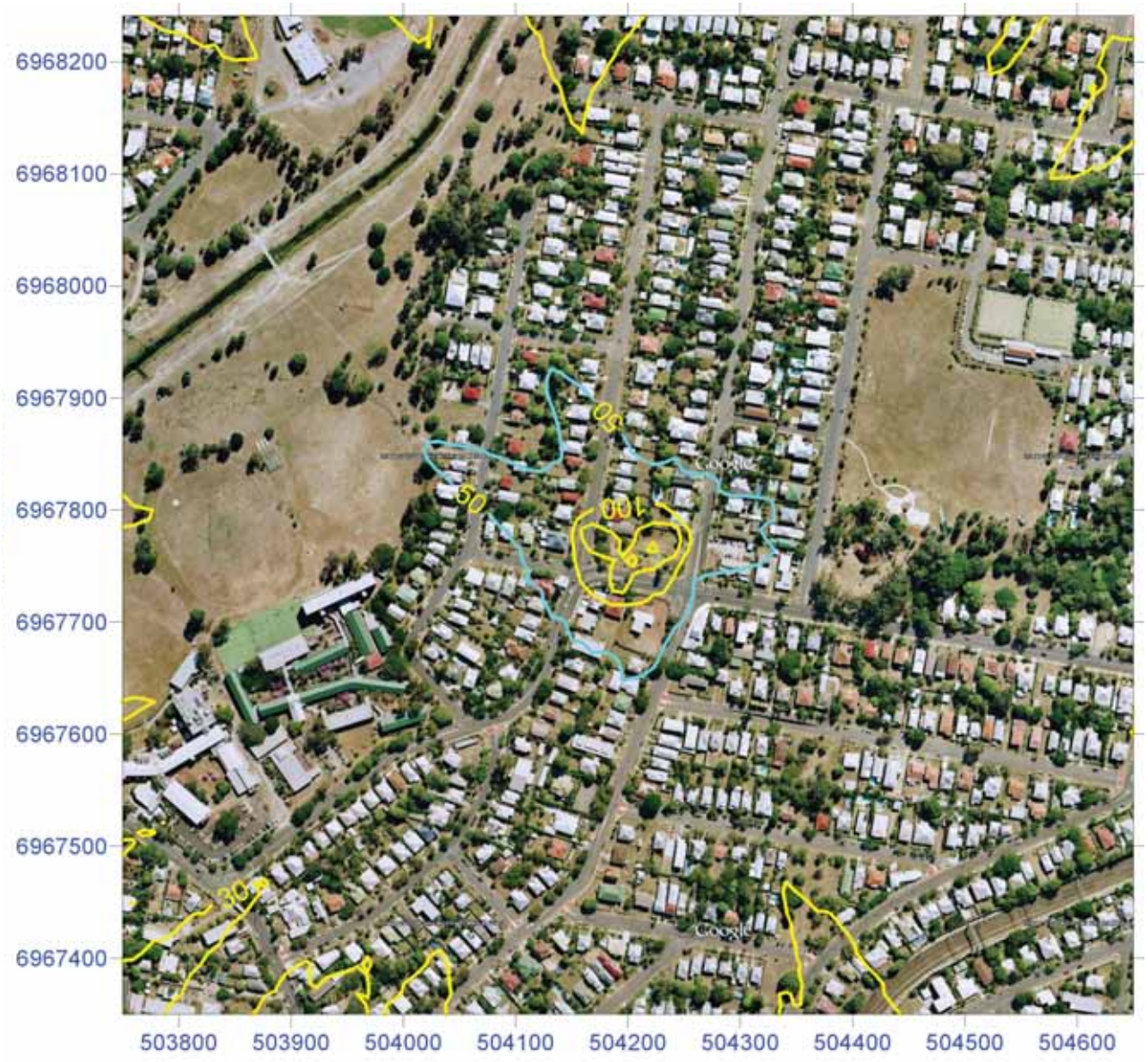


Figure 5-14

Predicted Cumulative Ground Level PM_{10} Concentrations (24 –hour average) (µg/m^3), Air Quality Goal – 50 µg/m^3

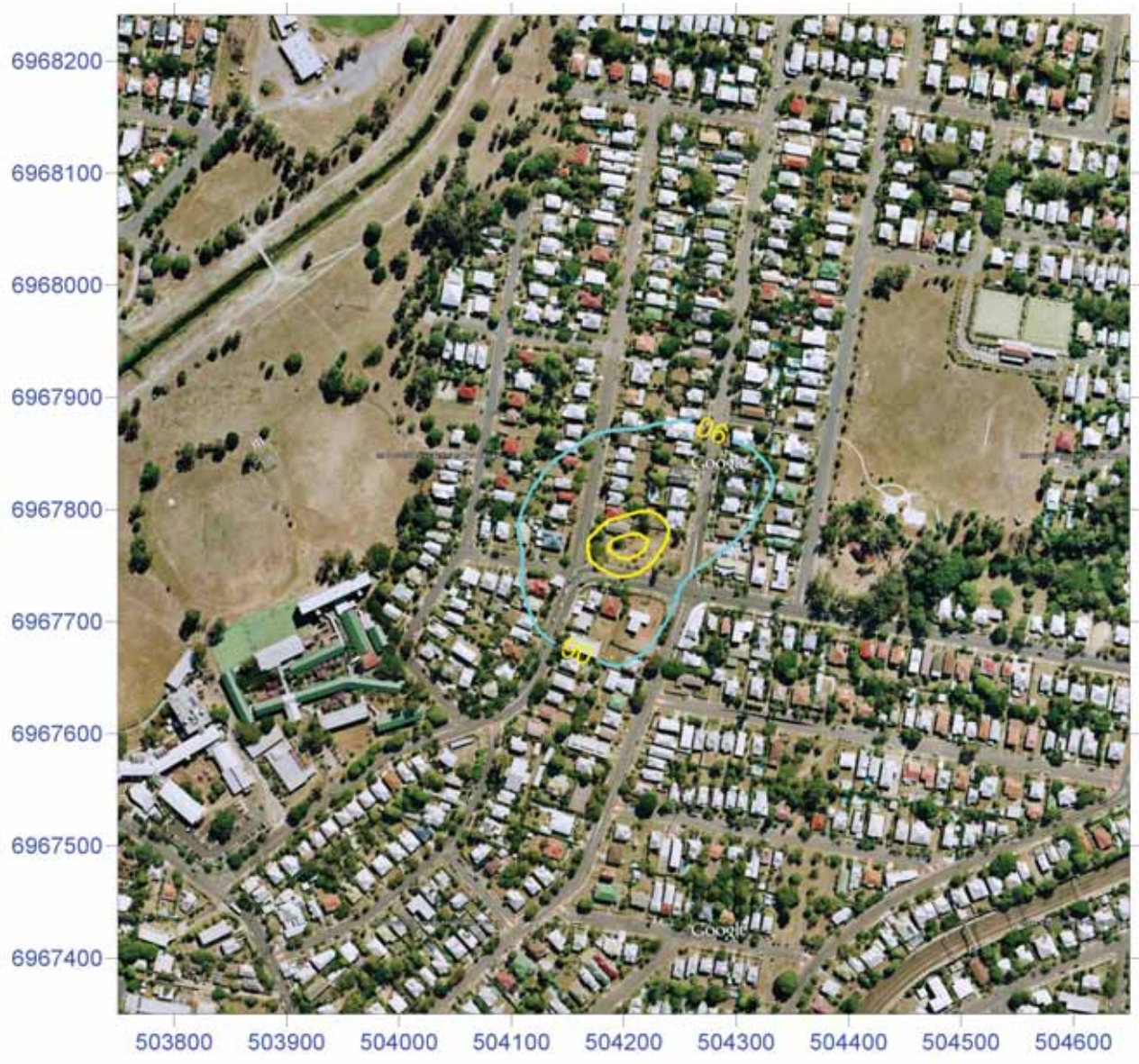


Figure 5-15

Predicted Cumulative Ground Level TSP Concentrations (Annual Average) (µg/m^3), Air Quality Goal – 90 µg/m^3

Figure 5-16

Predicted Cumulative Ground Level Benzene Concentrations (Annual average) (µg/m^3), Air Quality Goal – 10 µg/m^3

According to the modelling results for the ‘no mitigation’ scenario, non-compliance with the relevant air quality goals is predicted for PM_{10}, TSP and Nitrogen dioxide (NO_2) concentrations. Nitrogen dioxide is predicted to exceed the air quality goal by a significant margin (with generators contributing significantly to the overall concentrations from the site).

Figure 5-17 to **Figure 5-19** present predicted concentrations for the ‘with mitigation’ scenario. According to predicted results, provided that the appropriate mitigation measures are installed, pollutant concentrations are predicted to comply with the relevant air quality goals.

Figure 5-17

Mitigation - Predicted Cumulative Ground Level NO_2 Concentrations (1-hour Average) ($\mu g/m^3$) Air Quality Goal – 246 $\mu g/m^3$

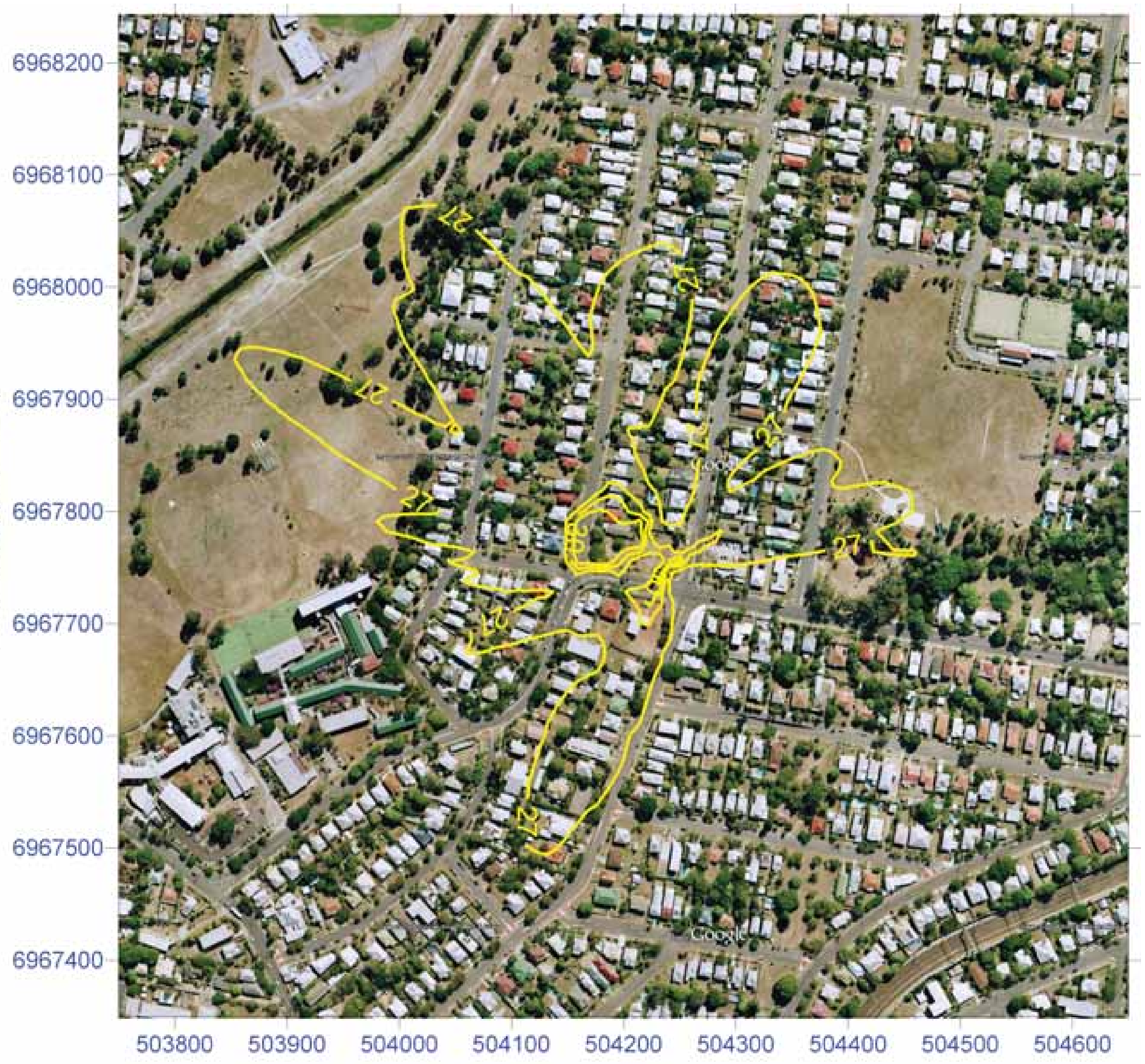


Figure 5-18

Mitigation - Predicted Cumulative Ground Level PM_{10} Concentrations (24 – hour average) ($\mu g/m^3$), Air Quality Goal – 50 $\mu g/m^3$

Figure 5-19

Mitigation - Predicted Cumulative Ground Level TSP Concentrations (Annual average) (µg/m^3), Air Quality Goal – 90 µg/m^3

5.5.8 Air Quality Emissions – Spoil Haulage

During roadheader excavation, up to 10 spoil haulage truck movements are proposed per hour. Haul trucks are to be directed along Gympie Road, Park Road, Rose Street, Junction Road, Rode Road and Sandgate Road.

Dispersion modelling was completed for maximum hourly traffic movements on the proposed haul route. For the purpose of assessing potential impacts, haul truck emissions along Park Road, Rose Street and Junction Road have been considered.

In order to model existing traffic emissions, vehicle fleet emission rates were provided by BCC in the form of an emissions-factoring spreadsheet for the Brisbane vehicle fleet of 2,000. **Table 5-23** and **Table 5-24** present the modelled emission factors.

Table 5-23: Traffic Data

Pollutant	Existing Traffic		Proposed Construction Traffic
	Park Road Traffic (g/km/vehicle)	Rose Street Traffic (g/km/vehicle)	Articulated Vehicle (g/km/vehicle)
Max Hourly Count	1083	922	10
HV%	6.3	5.3	100

Table 5-24: Emission Factors

Pollutant	Park Road Traffic (g/km/vehicle)	Rose Street Traffic (g/km/vehicle)	Articulated Vehicle (g/km/vehicle)
Nox	2.705	2.843	34.314
CO	12.947	12.852	6.940
TOC	0.759	0.758	0.664
Benzene1	0.038	0.038	0.033
PM_{10}	0.106	0.115	1.001

[1] Estimated as 5% of total organic compounds (TOC)

Figure 5-20 to **Figure 5-23** present predicted contour plots for various vehicular emission compounds. Contour plots for both existing traffic and the contribution from haul vehicles are presented. As indicated in these figures, 10 haul vehicles are not predicted to contribute significantly to the surrounding air quality.

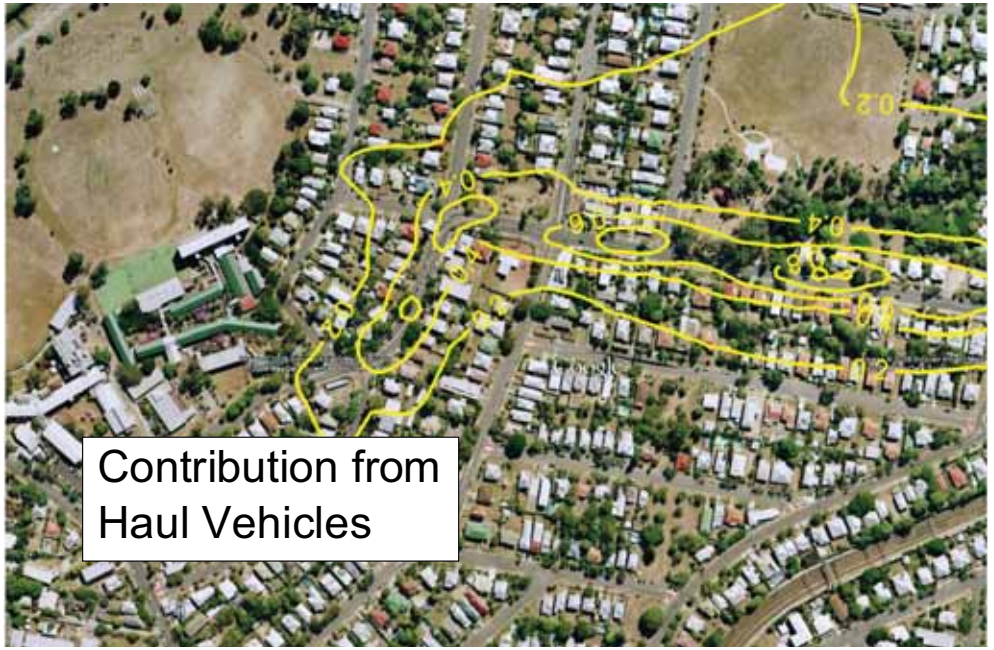


Figure 5-20

Predicted Ground level PM_{10} Concentrations (24 hour Average) ($\mu g/m^3$)

Figure 5-21

Predicted Ground level NO_2 Concentrations (1 hour Average) ($\mu g/m^3$)

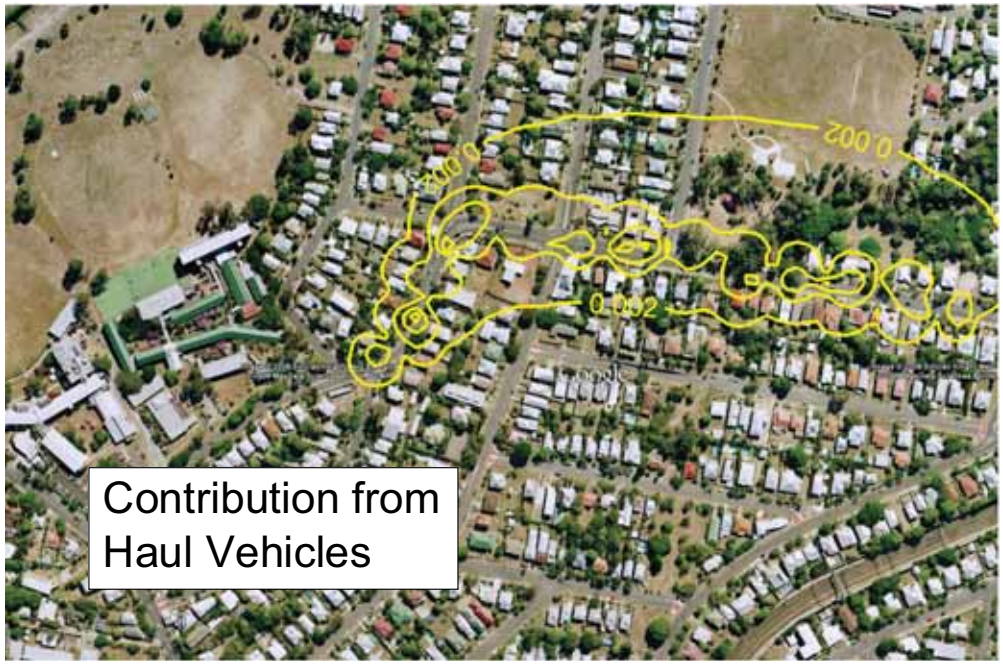


Figure 5-22

Predicted Ground level Benzene Concentrations (Annual Average) (µg/m^3)

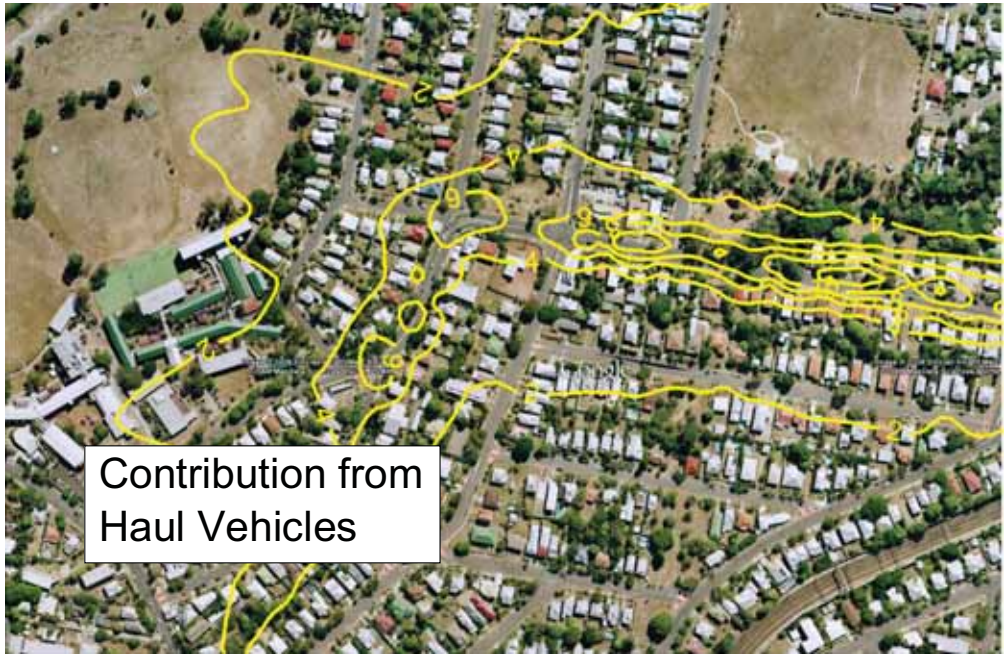


Figure 5-23

Predicted Ground level CO Concentrations (8 hour Average) ((µg/m^3)

5.5.9 Summary of Air Quality Assessment

The findings of air dispersion modelling for the proposed Rose Street worksite can be summarised as follows:

- compliance with air quality goals for site establishment and construction of the site can be achieved with the implementation of site environmental management and mitigation measures;
- compliance with the air quality goals for emissions associated with shaft excavation and site diesel generators can be achieved with implementation of effective mitigation measures; and
- pollutant concentrations associated with additional haul route vehicles are predicted to be well-below the goals established in the Coordinator-General's conditions as well as the environmental values established in EPP (Air) 2008.

Based on predictive air dispersion modelling, dust fallout and PM_{10} monitoring would be carried out at the nearest sensitive receptors. Permanent dust fallout gauges would be installed at the nearest sensitive receptors and monitoring would be conducted for the duration of worksite operations to ensure and demonstrate compliance with the Coordinator-General's air quality goals.

5.5.10 Mitigation Measures for Construction Impacts

Proposed mitigation measures required to be implemented to avoid the potential for nuisance dust impacts during the site construction works include:

- construction activities at the site would be in accordance with the Construction EMP and the Construction Air Quality EMP Sub-Plan;
- prior to commencement of construction a Construction Air Quality EMP Sub-Plan would be prepared and implemented, which would incorporate measures to avoid, or mitigate and manage the potential adverse environmental impacts of diminished air quality arising from construction activities;
- the release of dust from construction works would not exceed the dustfall criteria set out in **Table 5-17**; and
- all shed emissions would be directed externally via a high level ventilation outlet standing at a height of at least 22.5m above ground level or at least 5 m higher than the highest point of the acoustic shed roof, with a vehicle entry door closed with a curtain to create negative pressure forcing all emissions up the ventilation outlet.

Management Measures for Diesel Exhaust Emissions

The effects of diesel exhaust emissions can be minimised by the following measures:

- avoiding queuing of the construction traffic vehicle fleet in the streets adjacent to the Rose Street worksite to avoid or mitigate and manage the potential for vehicle emissions impacting on adjacent properties;
- ensuring that construction vehicles are not idling for excessive periods (e.g. more than 3 minutes) if required to queue on the construction site;
- where required, exhaust emissions from mobile and stationary plants would be directed away from the ground and sensitive receivers; and

- provision of emission reduction technology (i.e. particulate filters and catalytic converters) on the proposed generators.

These combustion products are expected to be low and would not result in an exceedance of ambient air quality goals. These emissions have not been estimated or modelled as part of this assessment

Management Measures for Odour Impacts

During the first disturbances of potentially odorous soils, work management measures would include:

- proceeding slowly during excavation of potentially odorous sites to determine whether odour impacts at off-site sensitive receivers would be likely;
- in the event that odour impacts would be likely, disturbances would only take place if the wind direction is not incident on sensitive receivers; and
- if excavated soil is potentially odorous and stockpiled on site, it would be covered with a tarpaulin to prevent odour release prior to treatment or transport off-site.

Management Measures for Nuisance Dust Mitigation

Components of the dust and odour management and mitigation strategy would include:

- Surface excavation works would incorporate consideration of prevailing meteorological conditions (wind speed and direction), if high winds are blowing in the direction of sensitive receivers.
- Site preparation and construction activities would be carefully managed so dust does not become a safety hazard or nuisance.
- Watering on unsealed surfaces and roads would be used to minimise wheel-generated or wind-generated dust.
- Rumble bars would be installed to ensure dust-creating material is not transported off site.
- All trucks carrying spoil or other loose earth would be covered, and if necessary treated (e.g. mist sprays) prior to leaving site.
- All loose earth and similar material spilled or otherwise deposited within the construction site would be removed from trafficked areas as soon as practicable.
- An enclosed shed would be erected and equipped with ventilation and dust filtration equipment.
- The ventilation and dust filtration equipment for the enclosed sheds would be maintained to achieve air quality goals.
- All storage and handling of spoil from the shaft and tunnel would be performed within an enclosed shed.
- The shed would be large enough to allow for the stockpiling of excavated tunnel material, access and egress of trucks and truck loading operations.
- The shed would be ventilated during excavation works. Ventilation air would be treated by passing through a particulate filter prior to exit from the shed. The

particle filter would be regularly maintained and the dust collected from the filtration system would be disposed of appropriately.

- The loading of construction spoil into haulage vehicles would be undertaken within the enclosed shed, with the shed doors being closed.
- The sealed access roads to the shed would be kept dust free through regular sweeping and washing.
- Meteorological conditions would be monitored, particularly wind speed and direction and where necessary measures would be taken to avoid or mitigate and manage impacts of dust and odours on adjacent properties. Such measures may include:
    - modification of construction methods;
    - increase in dust suppression measures; and
    - cessation of work when no other reasonable or practical measure is available.
- Upon disturbance of potentially odorous soils, reasonable and practicable measures would be implemented to avoid or mitigate and manage impacts of odours on adjacent properties. Such measures may include:
    - proceeding slowly to monitor and determine the potential for odour impacts as sensitive receptors;
    - conducting works with odorous soils when wind directions are unlikely to affect sensitive receptors; and
    - covering odorous, excavated soil stockpiles to reduce odour impacts.
- Regular monitoring of TSP, PM_{10} and dust deposition levels would be undertaken at nearest sensitive places adjacent to the Rose Street worksite.
- Exit point controls would be affected to manage materials being deposited onto surrounding roads.
- Doors to the shed would be closed as much as possible to limit dust escape.

5.5.11 Performance Criteria

- Establish targeted baseline data prior to construction for pre-disturbance air quality levels.
- Avoid, or mitigate and manage potential air quality impacts including dust, odour and vehicle emissions from construction, spoil haulage and spoil placement.
- Take reasonable and practicable measures to manage the potential for diminished air quality (dust, odour, plant and vehicle emissions) at properties adjacent to the worksite due to construction activities.
- Take corrective action in response to diminished air quality for properties adjacent to construction sites as a consequence of construction works or operation of construction vehicles.
- Report on the effectiveness of any corrective action taken.

5.5.12 Monitoring

- Regular monitoring of air quality for dust, TSP and particles (PM_{10}) would be conducted to determine whether environmental requirements of the

Construction EMP are being met. The monitoring program, including the frequency of monitoring and the locations of monitoring stations, are to be established in the Construction EMP.

- Monitoring for construction impacts on ambient air quality would include representative sampling of baseline air quality.
- Monitoring of construction air quality impacts would be reported in the Construction Compliance Report in accordance with Condition 4 of Schedule 3 of Coordinator-General's Change Report. Records of monitoring results would be maintained at all times during the construction program and would be available for inspection by the relevant agency at any time.

5.6 Surface Water

5.6.1 Overview

Surface water would be impacted to varying degrees during the establishment and operational phase of the Rose Street worksite.

5.6.2 Potential Impacts on Surface Water

Potential impacts on receiving waterways may be either direct or indirect. Direct impacts may result from excavation works in or near drainage lines, and indirect impacts include water contamination due to sedimentation, erosion, changes to quality of road runoff during construction and potential pollutants from leaks and spills.

Potential impacts due to water runoff contamination may include:

- degradation of the quality (with sediment or pollutants) or water quality in the receiving water;
- contamination of underlying soils and groundwater; and
- effects on vegetation and fauna inhabiting surface water environments.

It is anticipated that the greatest potential for impacts on surface water from site activities may be from indirect impacts during the clearing and site establishment phase. There would be no direct impacts on nearby waterways and their catchments from the proposed site activities.

Site establishment works would require the removal of both sparse tree cover and grass / groundcover from the proposed location. The potential for soil erosion and sedimentation is the main construction related impact.

Potential sources of water contamination, which would require mitigation measures to avoid or minimise water quality impacts are:

- disturbance of ASS;
- sediment from disturbed areas;
- hydrocarbon or chemical leaks and small scale spills from vehicles;
- hydrocarbon or chemical spills from storage areas;
- discharge from temporary sewerage and site facilities; and
- storage and disposal of waste material including spoil placement.

Potential impacts to surface water quality would be reduced as construction progresses with erosion and sediment issues being greatly reduced following construction of the shed, the laying of concrete pavement and the placement of clean gravel on external surfaces.

5.6.3 Mitigation Measures for Construction Impacts

The following section outlines construction mitigation measures which may be implemented to minimise the potential for surface water quality impacts during the site construction works.

Site drainage would be created during the site establishment phase and would carry all potentially sediment-laden water collected on site through a combination of surface drainage, spoon drains and sumps. Sediment laden water collected on site would be discharged after treatment through the water treatment plant. All clean water would be directed into the stormwater system.

Fuels and chemicals stored on site would be contained within bunds designed in accordance with Australian Standards.

During site establishment and construction activities, a range of erosion and sediment control devices would be installed in accordance with the "Best Practice Erosion and Sediment Control Manual". The following controls would be installed as a minimum during site establishment:

- sediment fences to the boundary;
- sand bagging / silt socks and other gutter protection devices as required;
- drainage control (clean and dirty water management);
- temporary stabilisation techniques (soil stabilisers);
- entry and exit devices to limit material being tracked onto the surrounding road network;
- regular road sweeping to maintain traffic safety, public amenity and the protection of stormwater quality; and
- implement management measures to ensure that spills and leaks are cleaned up and remediated to minimise impacts on surface water.

A Soil and Water Management Plan (SWMP) would be developed and implemented to manage erosion and sediment issues. The SWMP is a subordinate document to the EMP and AEP. The SWMP would be transferred into the Project's existing environmental management documentation. In terms of controls to be installed, the SWMP provides general details and the SEPs would provide full details.

A sediment pond / basin would not be installed on site due to space constraints. All construction waste water would be managed and treated through the water treatment plant that would be installed on site.

Hazardous substances would be stored within a bunded containment area constructed and operated in accordance with Australian Standards. The bunds would be designed to ensure they are protected from the elements in addition to being separated from the normal stormwater flow paths. Spillage management would be through spill training of relevant personnel and the provision of containment tools such as spill clean-up materials. Material spilt within a bunded area would be pumped out and disposed of at an approved location.

Following construction of the work shed, all roof runoff would be collected in tanks installed onsite for reuse in the tunnelling process. Excess clean water would be plumbed into the existing stormwater drainage system.

5.6.4 Performance Criteria

- Contaminants, including sediments, that could cause adverse environmental impact to surface waters are not released as a consequence of construction, construction vehicle movements or spoil placement.
- Drainage from construction surface work site and spoil placement site is managed to avoid a loss in water quality in local receiving waters.

5.6.5 Monitoring

- As part of the overall Project the quality of receiving waters would be monitored against baseline data as detailed in the EMP.

5.7 Groundwater

5.7.1 Overview

The EIS prepared for the Airport Link Project provided a detailed assessment of the hydrogeology and groundwater quality along the study corridor, which included sampling and modelling of groundwater at three bores in the vicinity of the Rose Street worksite (**Figure 5-24**).

Figure 5-24: Location of Groundwater Bores on Rose Street Worksite.

Bores DT17 and 17A are located within close proximity to the site. Bore DT17 is situated toward the east of the site and bore 17A is located midway along the western site boundary in the approximate location of the shaft. Overburden material comprises predominantly clay with some sand and gravel lenses to a depth of approximately 20 – 25 m below ground level (BGL). Underlying the overburden is the Aspley-Tingalpa formation which consists of siltstone, sandstone and a 5 m thick bed of breccia / conglomerate. At a depth of approximately 30 – 35 m BGL the Brisbane Tuff is encountered.

The standing water level at DT17 is around 8.79 m BGL, which corresponds to the top of a sand layer in the bore log and is potentially an example of a perched water table within the clay. It is also anticipated that a bedrock aquifer would be encountered within the porous matrix of the sandstone and conglomerate units of the Aspley-Tingalpa formation, or within fractured zones of these units.

The groundwater surface generated from standing water levels of bores intersecting the Brisbane Tuff indicates that groundwater would be expected to be encountered at 9 m Australian Height Datum (AHD) and is flowing to the north and north-east. A groundwater dependent ecosystem was identified at two sites, i.e.: Melrose Park 140 m east of the site, and at Kedron Brook 500 m west of the (PBAJV 2009). However, the groundwater-dependent ecosystem at Melrose Park was identified in the PBAJV (2009) report as likely to be more dependent on surface water inflows than groundwater.

The Queensland Natural Resources and Water groundwater bore database indicates that there are no bores reported within 500 m of DT17, and 15 registered bores between 500 m to 1,000 m of DT17.

5.7.2 Groundwater Quality

Groundwater quality samples from monitoring bores associated with the Airport Link Project were collected and analysed in December 2008, and the results reported on 26 May 2009. Borehole DT19 is the closest borehole which was sampled, located approximately 150 m east of the Rose Street worksite.

Of the properties and analytes tested, suspended solids were reported at a concentration of 19 mg/L which is above the Water Quality Objectives (WQO) for Kedron Brook / Schultz Canal. However, it is noted that the Kedron Brook surface water sample collected reported a suspended solids concentration of 168 mg/L. Total Nitrogen for DT19 was reported at 1.1 mg/L which was also in exceedance of the WQO for Kedron Brook / Schultz Canal. All other analytes reported concentrations within guidelines.

5.7.3 Potential Construction Impacts

Potential impacts of the Project and construction of the tunnel on groundwater resources in this area have been discussed in detail in the EIS report, and impacts specific to the Rose Street worksite are discussed below.

The shaft would be excavated to a depth of 42 m through overburden and bedrock. The excavation would create a zone of negative pressure inducing groundwater flow towards the void, and causing groundwater to interact with oxygen. This may have the following effects on groundwater:

- drawdown / dewatering of perched aquifers in the overburden material;

- drawdown of deeper bedrock aquifer as water flows into the excavation;
- exposure to oxygen may have an effect on water quality (e.g. ASS issues, groundwater contamination from construction from leaks and spills); and
- interaction of groundwater with concrete / bentonite slurry mix as the piles are being constructed may have an adverse effect on groundwater quality.

The consequences of aquifer drawdown include:

- potential for compaction and subsidence of soils;
- loss of groundwater resource to groundwater users (if any) in the area; and
- loss of water to groundwater-dependent ecosystems identified at Melrose Park and at Kedron Brook.

No bores were identified within a 500 m radius of DT17 on the Queensland Natural Resources and Water groundwater database; therefore, it is not anticipated that the excavation would impact on other groundwater users.

In addition to the potential effects of the tunnelling works as described above, there is also potential for groundwater to impact on the sequence and methods of shaft construction. These potential effects include:

- geotechnical instability of excavation due to presence of water in soils, and water inflows to the excavation;
- potential for mobilisation of contaminated groundwater;
- groundwater inflow to rock excavation impeding construction; and
- dewatering of the shaft excavation may be required. Where water quality does not meet local licensing requirements for disposal treatment would be required.

A former service station site (now Wooloowin Vet) is located opposite the proposed worksite and is listed on the Queensland DERM's (formerly EPA) Environmental Management Register (EMR) due to its past use. Two groundwater wells are installed in Rose Street adjacent to the vet and one groundwater sampling event has been completed since installation. The results of this sampling are attached in **Appendix A.4** – and hydrocarbon contamination in the groundwater was not detected.

5.7.4 Mitigation Measures for Construction Impacts

The mitigation measures to minimise potential groundwater impacts would include:

- the Change Project would be constructed in accordance with the Construction EMP and the Construction Groundwater and Surface Water EMP Sub-Plan;
- monitoring of groundwater resources would be undertaken in accordance with the Construction EMP and generally and specifically in locations where predictive modelling suggests there is a potential for groundwater drawdown;
- measures would be implemented to avoid, mitigate and manage impacts on groundwater entering the construction site;
- measures would be implemented for the interception, treatment (if required), and disposal of contaminated groundwater entering the construction sites;

- where there is an identified potential risk of groundwater movement to the construction works, reasonable and practicable measures would be taken in Project design and construction to monitor and manage groundwater entering the tunnel or other construction works;
- the design and construction of the Change Project would provide suitable measures to intercept, treat if required and dispose of groundwater and liquid wastes, such as fire retardants, wash-down water, and contaminated stormwater, to avoid contamination of surface waters;
- management measures would be identified and implemented to ensure that accident spills are cleaned up and remediated to avoid potential contamination through seepage to groundwater; and
- mitigation measures would be developed and implemented based on results of the groundwater monitoring program from the bore that is located on the site.

Cut-off / Support Walls

In order to manage the effects of construction on groundwater, and the groundwater interactions during construction, it is proposed that cut-off / support walls be installed to prevent groundwater drawdown and inflow into excavation, and prevent groundwater exposure to excess oxygen.

Two options for cut-off / support walls are available:

- Secant pile wall – this style of wall is constructed as a series of interlocking bored piles which may be reinforced. A 'weak' set of piles is drilled using an auger bit and then the grout / slurry mix is injected as the auger is removed. The second set of piles is then drilled in between the first set and may hold steel reinforcement. This is a commonly used technique and one which is recognised for preventing water penetration.
- CSM wall – a new form of technology, CSM wall injects the grout into the soil as the wall is bored. This technique mixes the soil and grout as it is injected. The excavation is elongated rather than round like the secant piles and the walls are cut into the soil as a series. CSM walls are considered easier to construct in variable subsurface conditions and have fewer problems with borehole collapse.

Both installation methods involve excavating a series of interconnecting boreholes and filling them with a bentonite / concrete mixture, which may or may not be reinforced depending on structural requirements.

The piles (or CSM) would be excavated (keyed in or socketed) into competent rock to provide protection for both soil and weathered rock areas where perched groundwater may be encountered. The excavation within bedrock may also require a concrete / bentonite lining to prevent groundwater ingress, which may be especially significant if groundwater quality is of concern. The concrete / bentonite slurry mix used for the piled walls and excavation lining has the potential to effect groundwater geochemistry, therefore the composition selected must be appropriate.

The installation of cut-offs / support walls and sealing would significantly reduce the risk of impacts due to the construction of a shaft at Rose Street.

Groundwater Treatment

It is expected that groundwater treatment would be required onsite once the shaft excavation commences due to the collection of groundwater inflows. A water treatment plant would be designed and installed prior to encountering groundwater on the site.

Testing of groundwater prior to commencement of works would be undertaken to identify design requirements for the plant and discharge criteria. The water treatment plant would treat sediment laden water from surface operations in addition to managing any groundwater; however, it is not expected that surface water would require treatment following site stabilisation.

Following treatment at the water treatment plant, groundwater can be managed through a number of discharge options. All of these would be dependent upon the quantity and quality of the water experienced during construction. These options include the following:

- storage onsite via tanks for reuse in the tunnel process;
- discharged to sewer following testing and BCC approval;
- tankered from site for reuse in dust mitigation at other location on the Project or discharge at approved facilities; and
- discharged to stormwater following testing and BCC approval.

5.7.5 Performance Criteria

- Collect targeted baseline data prior to construction to establish pre-disturbance groundwater levels.
- Take all reasonable and practicable measures in construction activities to minimise the impacts on groundwater quality from the release of contaminants.
- Monitor and manage the extent of groundwater level drawdown.
- Monitor all groundwater usage in the study corridor and minimise any impacts from construction activities.

5.7.6 Monitoring

- Monitoring of groundwater conditions in the immediate area of excavation through converting DT17 into a monitoring borehole with data logger and observing any changes to groundwater levels. This borehole would be included in the water quality sampling program.
- Monitoring of the groundwater dependent ecosystem at Melrose Park through visual and photographic monitoring of the ecosystem and monitoring physical parameters (pH, temperature, DO, EC and redox) of the flow to assist in assessing the impacts from the excavation.
- Investigation of the potential impacts from the former service station to groundwater through conducting additional assessments.
- Monitoring of groundwater resources would be undertaken in accordance with the Construction EMP and specifically in locations where predictive modelling suggests there is potential for groundwater drawdown.
- Sampling and monitoring of any captured site water prior to discharge off-site.

5.8 Contaminated Land and Acid Sulphate Soils

5.8.1 Overview

The site currently consists of a generally flat, grass covered area with several trees and shrubs growing within the site boundary. The site establishment at the Rose Street worksite would require the removal of trees, other vegetation and topsoil from the site.

Contaminated Land

Surrounding Land Use

The site is surrounded primarily by residential land use and bordered on three sides by roadways including Rose Street. A former service station was located adjacent to the shaft site and currently operates as a veterinary clinic. The site is listed on the Queensland DERM's EMR due to its past use as a service station. As a result of this historical land use, two groundwater wells were installed in Rose Street adjacent to the Wooloowin Vet. One groundwater sampling event has been completed since installation and did not detect any hydrocarbon associated impacts in the groundwater.

Melrose Park is located approximately 140 m to the east of the site and is also listed on the EMR due to possible historical filling. Three groundwater wells have been installed at the site and have been sampled once and have not returned evidence of groundwater impacts.

Environmental Management Register

A search of the EMR maintained by the Queensland DERM of the nominated lots has been carried out, the results of which are summarised in **Table 5-25** below.

Table 5-25: Environmental Management Register Lot Search

Lot	Plan	EMR	CLR
85	RP 104 544	Not listed	Not listed
55	RP 19480	Not listed	Not listed
56	RP 19480	Not listed	Not listed
1	RP 95711	Not listed	Not listed
2	RP 95711	Not listed	Not listed

Historical Aerial Photographs

A number of historical aerial photographs have been reviewed to determine historical land use at the site. General observations are outlined below:

- August 1955 – 2 x large buildings present on the site, use is unclear;
- August 1964 – 2 x large buildings present on the site, use is unclear;
- June 1982 – Land use is unclear, large red roofed buildings;
- November 1994 – Land use is unclear, 2 x large red roofed buildings;
- March 2002 – Site is vacant and buildings demolished; and
- October 2008 – Vacant site.

5.8.2 Potential Construction Impacts and Mitigation Measures

Potential impacts associated with the disturbance of contaminated land are discussed below.

Acid Sulphate Soils – Potential Impacts

The potential impacts associated with disturbance of ASS material include:

- changes to water chemistry which could lead to degradation of aquatic ecosystems in receiving water bodies;
- sedimentation and erosion due to loss of aquatic vegetation;
- increased potential for mobilisation of contaminants (i.e. metals) within the groundwater and surface water systems due to acidified leachate / runoff contacting sub-surface materials in the area;
- increased risk of soil degradation, erosion and instability due to the deterioration of the structure of vulnerable soils;
- increased damage to infrastructure and reduced life expectancy of concrete and steel structures due to acidified runoff / leachate or direct contact with ASS material;
- extrusion or displacement of ASS affected material above the groundwater table resulting in the accelerated oxidation of ASS; and
- accelerated oxidation of ASS and uncontrolled release of acidified runoff / leachate resulting from exposure / disturbance of ASS during excavation, filling or groundwater drawdown / dewatering activities.

Due to the location of the site it is possible that ASS may be present at various depths; however, based on mapping within the study corridor conducted as part of the EIS the probability of ASS generating conditions at the Rose Street worksite is considered low. The proposed works would involve significant excavations works and management or treatment of the excavated soil (e.g. lime stabilisation, off-site treatment) may be required.

Acid Sulphate Soils – Mitigation Measures

The key mitigation measure for ASS disturbance is the quantification and delineation of ASS affected material that would potentially be disturbed as a result of the construction and operation of the Project through a detailed ASS investigation completed in accordance with the State Planning Policy 2/02 *Planning and Managing Development Involving Acid Sulfate Soils* and the *Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils in Queensland 1998* (Ahern *et al* 1998).

Mitigation measures for ASS disturbance would be developed and implemented during the design phase and would extend through to the construction and operational phases to ensure that the potential for disturbance of ASS is minimised and/or controlled in both the short and long terms.

Specific ASS management measures would be developed in consultation with the Queensland DERM and would incorporate the principle of ASS management as

outlined in the *Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines* (Dear *et al* 2002), which would include:

- avoidance;
- minimisation of disturbance;
- neutralisation;
- hydraulic separation; and
- strategic reburial (least preferred management measure).

Soil and Groundwater Contamination – Potential Impacts

The Change Project through excavation and earthworks has the potential to impact on contaminated land through excavation of contaminated soils and drawdown of groundwater, which may result in migration of contaminants.

There is potential for contaminated soil to be encountered on the Rose Street worksite which would be excavated during site preparation and shaft excavation. As described in **Section 5.8.1** there is a very low probability that contamination exists on the proposed Rose Street worksite and would therefore be released to the environment due to site disturbance and construction activities.

An assessment may be required of the potential impacts from the former service station to groundwater through a physical assessment of soil and groundwater contamination at the site. Subsequent remediation may be required prior to the commencement of excavation, depending on site conditions encountered in the assessment. Remediation options may include:

- removal and disposal of contaminant soil;
- removal, treatment and reuse of contaminated soil;
- removal of free phase hydrocarbons and contaminated groundwater (multi-phase extraction event);
- chemical or physical treatment of contaminated groundwater (biosparging or use of chemox compounds to speed up the oxidation process); and
- numerical modelling of the groundwater drawdown effects on the former service station site to assist in assessing the risk of potential contaminant transport.

All steps would be taken to avoid land contamination from Project activities, such as through the prevention of spillage of chemicals or oil at the Rose Street worksite and necessary remediation would be undertaken as required.

Soil Contamination Mitigation Measures

- Any contamination identified at the site would be assessed and either remediated onsite or removed and disposed of off-site in accordance with the Construction EMP requirements prior to any site disturbance.
- All materials with the potential to cause contamination would be listed in a Hazardous Materials Register and would be stored and handled in accordance with AS1940 and AS3780.

5.8.3 Assessment Criteria

The following actions would be carried out to assess the potential risks associated with contaminated land and ASS at the proposed shaft site:

- Complete additional rounds of groundwater sampling in the vicinity of the site, with particular reference to the former service station site adjacent to the shaft site.
- Complete a detailed historical review to determine the historical use of the site.
- Although the site(s) is not listed on the EMR, the historical activities are unclear at present and may warrant preliminary assessment of the shallow soil profile. It may be required to complete a series of shallow test pits (six in total) in the areas of the large historical buildings located on the site to assess the potential for potentially shallow contaminated soils.

5.9 Flora

5.9.1 Overview

The site establishment works at Rose Street worksite would require the removal of trees, other vegetation and topsoil from the site.

The ongoing (short term) use of the site by TJH would be for the purpose of tunnel access during construction of the tunnel drives east and westbound, generally from the north heading toward the south. Additionally, at the completion of tunnel excavation, the access through Rose Street would be used for deliveries for concrete lining, access for tunnel fitout, ventilation and underground substation works.

Existing Flora

There are no vegetation communities mapped by the EPA as Regional Ecosystems on the site or any vegetation communities listed as being of Commonwealth conservation significance under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The vegetation present on the site is not mapped or protected under BCC Natural Assets Local Law (NALL).

Vegetation on the site consists of a grassed groundcover with a mix of common urban landscape trees, planted native landscape trees and low shrubs (refer to **Photo 5-1**).

A planting of a cluster of native trees and shrubs is located in the south-east corner of the site (**Photo 5-2**). These include young Red Cedars (*Toona Australis*) and Crows Ash (*Flindersia austrlais*) trees up to 3 m in height, and low shrubs including Banksia species. Planted areas of *Lomandra longifolia* are present in the south-east and north-east corners of the site.

Photo 5-1: View of Northern End of the Site.

Other tree species that are located randomly around the site include Jacarandas (*Jacaranda mimosifolia*), a large Poinciana (*Delonix regia*), Orchid tree (*Bauhinia variegata*), Loquat (*Eriobotrya japonica*), Bottlebrush, (*Callistemon viminalis*), Paperbark (*Melaleuca linariifolia*), Cocos Palm (*Syagrus romanzoffiana*) and other common garden shrubs and low trees.

Photo 5-2 Planting of Native Trees and Shrubs in the south-east Corner of Site

Photo 5-3: Large Poinciana (*Delonix regia*) Located south-western Corner of the Site

5.9.2 Potential Impacts to Flora

All vegetation on the Rose Street worksite is required to be removed as part of the site establishment for the construction of infrastructure.

The vegetation currently provides some minor landscape and street amenity to the local area. However, there are no specimens of particular ecological significance or of unique or rare landscape character. Large Poincianas, such as the one on the site, are not unique or uncommon in the local area.

5.9.3 Mitigation Measures for Construction Impacts

As all vegetation is required to be removed, no mitigation strategies are suggested.

Rehabilitation of the site would be required when the construction works on the site have been completed.

5.10 Fauna

Existing Fauna

No fauna were observed to be present on the site. None of the trees have any significant habitat value such as hollows or uncommon foraging values.

Due to the urban nature of the location and minimal habitat, it is very unlikely that any fauna species of conservation significance would utilise the site. Fauna that are common to urban areas such as possums and birds may potentially utilise the site.

5.10.1 Potential Impacts to Fauna

There is a very low risk of the works having any direct impacts on fauna. No trees or habitat with high potential to provide nests or refuge to fauna are present on the site.

5.10.2 Mitigation Measures for Construction Impacts

Management strategies would be outlined in an EMP to ensure no fauna impacts result from the works including:

- engaging a fauna spotter prior to removal of tree species;
- checking trees for the presence of fauna prior to clearing; and
- relocation of fauna, if retrieved, to a suitable habitat and in accordance with permit requirements.

5.11 Social Environment

5.11.1 Overview

The existing social environment surrounding the Rose Street worksite is characterised by low density residential land uses, quiet neighbourhoods, and good connectivity to the city and community facilities. Changes to this environment may be associated with construction and operation of the Rose Street worksite, including:

- changes to access and connectivity, due to surface work activities and the increased movement of trucks and other vehicles through the area; and
- changes to local amenity, due to air quality, noise, vibration and visual impacts.

5.11.2 Existing Environment

The locality of proposed Rose Street worksite has a quiet character, with a number of large, older Queenslander style homes and leafy streetscapes. The locality is also traversed by busy through traffic routes accessing the Brisbane Airport, Australia Trade Coast, and Toombul and Lutwyche shopping centres.

Consultation undertaken for the Airport Link Project has identified the following local characteristics that people value in the suburb:

- access to quiet neighbourhoods within easy reach of the city's services and amenity;
- connectivity as derived from Kedron Brook, the park network, bike paths and access to public transport;
- the contribution of heritage places, street trees and open space to visual amenity and local identity;
- access to both local and regional community facilities; and
- housing choice, both detached housing suitable for families, and increasing options for smaller medium density housing.

Community safety is an important community value in the study area, and safe pedestrian access for school children is a priority. In particular, Wooloowin State School, located to the south-west of the worksite, has a strongly local catchment but is difficult to access by vehicle. Kedron State High School, located on Park Road, is also located close to the Rose Street worksite. Students commuting to school by train use Rose Street and Park Road to walk between Eagle Junction Train Station and Kedron State High School. As such, maintaining safe pedestrian access is extremely important.

Other social infrastructure in Wooloowin includes:

- community centres;
- religious facilities;
- childcare and education facilities;
- aged care centres;
- shopping centres;

- public transport (bus and train); and
- recreation facilities.

5.11.3 Potential Impacts and Mitigation Measures

Impacts on Motorists

Vehicle access to residential, business and community uses in the local area is unlikely to be significantly affected by the construction and operation of the Rose Street worksite.

The preferred construction haulage route is along Rose Street, Junction Road and Sandgate Road. To minimise impacts for residents and motorists along this route, construction vehicles would run in a circuit, allowing only eastbound movement on Junction Road between Kent Road and Sandgate Road. This would also minimise impacts on vehicles in the Eagle Junction shopping centre parking area. It is therefore expected that convenience of access for vehicles along these routes would be maintained.

During construction of the worksite, existing daily traffic volumes would increase by between 1% and 3% during the morning and afternoon peak traffic periods. These changes are considered minor, and would not impact on residents' daily journey to work or access to other neighbourhoods or nearby facilities and services.

To mitigate parking issues that may arise for local residents along the haulage route, it is proposed that parking monitors be engaged to ensure workers do not park in local streets adjacent to the proposed Rose Street worksite. Workforce pick-up and drop-off would occur from within the boundaries of the worksite.

Specific traffic management measures, as described in **Section 5.2** of this report, would be introduced to assist in maintaining the current level of safety for motorists and other road users. Access to properties adjoining the worksite would be maintained at all times.

No impact on emergency services access or routes is likely to be experienced.

Impacts on Public Transport Users

The Route 320 and 321 bus services operate through the intersection of Kent Road and Rose Street (**Photo 5-4**). Bus stops for these services would not need to be relocated for the Project, and entry to the worksite would be located south of the Kent Road bus stop to maintain good access for public transport users.

The operation of an eastbound-only construction haulage route would also ensure that the Eagle Junction railway station car park would not be directly impacted. Pedestrian access to the station's car park as well as to the bus stop would also be maintained at all times.

Photo 5-4: Bus Stop and Bus Service on Kent Road

Impacts on Pedestrians / Cyclists

The proposed Rose Street worksite is located within the walking catchment of the Eagle Junction convenience centre at Wooloowin. Pedestrian movements in this area are therefore typically associated with this centre, and also with Kedron State High School located in Park Road and Wooloowin State School to the south in Norman Street. Pedestrian activity peaks at the beginning and end of the school day (an example of morning peak activity is shown in **Photo 5-5**).

No changes to designated cycle routes in the vicinity of the worksite are proposed.

Any proposed changes to access for motorists, public transport users or pedestrians/cyclists would be communicated to affected parties in advance of changes being made. Any changes to the pedestrian or motorist environments would be appropriately sign posted so as to maintain community safety and legibility of the environment.

Community consultation mechanisms would be established in advance of construction so that any access and connectivity issues are dealt with in a timely and appropriate manner.

Photo 5-5: Pedestrian Activity on Rose Street – AM Peak

Local Amenity

The proposed worksite would be located in an area likely to be sensitive to changes in local amenity. Specifically, changes in amenity changes may result through increased noise and vibration, dust, vehicle emissions, and through changes to the visual environment.

During worksite construction, exceedances of noise and air quality goals are predicted without the application of mitigation measures. Exceedances of noise and air goals would impact adversely on the residential amenity of neighbouring properties, particularly properties located on the north boundary of the site. Of particular concern to the residential amenity of the area are the predicted exceedances of night-times goals for construction noise.

While Rose Street is a designated arterial route, the local community may be sensitive to changes in its character, potentially impacting on their sense of place if appropriate mitigation measures are not applied.

Changes to local amenity occurring as a consequence of the proposed change would be unlikely to impact on nearby public areas such as Melrose Park.

Sensitive places in the vicinity of the proposed Rose Street worksite area susceptible to noise, dust and vibration impacts, include the Wooloowin veterinary surgery on Kent Road, and the Queensland Aerospace Training Centre on Rose Street. These establishments would be consulted in advance of construction to identify equipment that may be affected by activities at the site. Consultation would occur at an early stage to ensure that aspects of the construction methodology can be changed to mitigate impacts on those receptors.

Visual amenity would also be impacted to varying degrees during the construction and operation of the acoustic shed at the Rose Street worksite. The size and dimensions of the shed would make it highly visible to nearby residents, businesses, pedestrians, cyclists, motorists and community land uses.

Residential character and local sense of place in Rose Street and surrounds would therefore be altered for the duration of construction and operation of the worksite. Daylight glare from the shed could also impact on community safety if appropriate mitigation measures are not adopted. As such, the shed would be designed to include the use of appropriate materials and colours to minimise visual disturbance to the community. It is also recommended that Crime Prevention through Environmental Design (CPTED) principles be employed for the design of the shed, to facilitate community safety around the site, and ensure that it does not become a vandalised or misused space.

A comprehensive suite of mitigation measures to deal with amenity impacts would be developed in close consultation with owners and occupants of potentially-affected premises. The likely nature, duration and extent of impacts would be communicated to these parties in advance of construction so that appropriate strategies are developed.

5.11.4 Performance Criteria

The performance criteria outlined in the Draft EMP for the management of noise, vibration, air quality, visual amenity and spoil haulage are applicable.

5.11.5 Monitoring

The monitoring strategies outlined in the Draft EMP for the management of noise, vibration, air quality, visual amenity and spoil haulage would be implemented to mitigate effects on the local social environment.

5.12 Visual Amenity

5.12.1 Overview

Visual amenity would be impacted to varying degrees during the construction and operation of the acoustic shed at the Rose Street worksite.

The EIS for the Reference Project noted that the Rose Street worksite location is in a portion of the corridor within the walking catchment of the Eagle Junction convenience centre at Wooloowin.

The predominantly low-density residential character creates a predictable and highly legible character within this key location. Residential built form and street patterns edged by open space are dominant characteristics of this key location.

Due to its position between the Lutwyche Road ridge line and Sandgate Road this key location is the most highly visible within the study corridor. This key location also provides the most intact and consistent visual character of suburban low density housing and domestic landscaping within the study corridor.

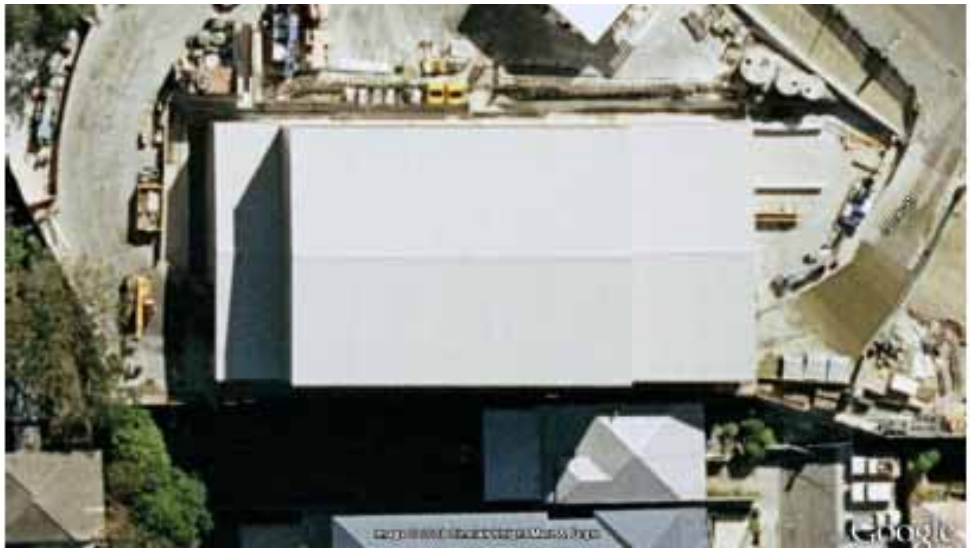
Acoustic Shed Description

The acoustic shed is approximately 25 m x 53 m and has a stepped roof profile that is 17.5 m at its highest.

The proposed acoustic shed for this site is a portal framed structure that is clad with colourbond sheeting. Indicative pictures of the acoustic shed used at the CLEM 7 Shaftson Avenue worksite are provided below.

Photo 5-6: Acoustic Shed located at Shaftson Avenue Worksite (CLEM 7)

Photo 5-7: Aerial View of Acoustic Shed Located at Shaftson Avenue (CLEM7)



5.12.2 Potential Construction Impacts

The location, design and size of the acoustic shed would make it visible to nearby residents, shop owners, pedestrians, cyclists, commuters and motorists travelling along Rose Street and Park Road.

The visibility of the shed and the urban context would contribute to a moderate to high visual impact in the local setting. This impact would be short term[16], due to the temporary nature of the facility and could be mitigated through the use of appropriate materials and colours in design and construction.

Depending on shed materials, daylight glare could impact on neighbouring residents, drivers, pedestrians and cyclists.

Analysis indicates that shadows would not affect the adjoining residences to the north of the worksite on 22 June, being the critical time for adverse shadow effects.

Light spill from the proposed worksite has the potential to impact on residents in proximity to the Rose Street worksite. Careful design and siting of external lighting is required to avoid adverse light spill onto adjoining or adjacent properties.

5.12.3 Mitigation Measures for Construction Impacts

Using the principles of camouflage the shape and size of the structure could be mitigated somewhat by camouflaging the visual mass as much as possible. A possible mitigation strategy to reduce mass size could include the break up of colour across the structure for example the use of grey green for the wall to 8 m, grade sheet colours into the blue from 8 to 15 m then perhaps a cream from 15 to 17 m . If the colours were to move across the wall surface in a diagonal fashion rather than straight horizontal it would prove useful in breaking up the building mass

Design measures proposed to mitigate the scale, bulk and visual impact of the acoustic shed should be developed and discussed with stakeholders prior to implementation. In this instance, stakeholders would include near neighbours and businesses, the BCC and the Queensland Government.

[16] 'Short term" in this context means two (2) years or less.

Light spillage can be avoided by implementing the use of luminaries that have designed cut off angles and lateral throw patterns rather than forward direct patterns (e.g. lighting used at sensitive public installations and tennis courts).

It is proposed that post top lights with matching wall mounts be installed as shown in **Appendix A.5**. These lights have controlled distribution and cut off, and are adjustable for additional control of light spill. The lights are preferable to flood lighting as mounting heights (4 m) can be kept to a minimum. Light spill from the structure would avoid intensities exceeding 8 Lux at the common property boundary. The lighting design for the Rose Street worksite is outlined in **Appendix A.5**.

Daylight glare or reflection from building cladding would be mitigated. Near neighbours, particularly those residing on the northern boundary of the proposed worksite would need to be consulted about proposed mitigation measures for glare and reflected heat.

Additional mitigation strategies could include the creation of shopfront images, gallery style boxes filled by artists with paintings and mural painting on the building or boundary fence involving the local schools, artists and community.

5.12.4 Performance Criteria

Impacts during the construction stage would be managed in accordance with the Construction EMP and the Coordinator-General's conditions. The interface between worksites and residential communities would be established and managed to avoid the distribution of impacts beyond the worksite boundaries to the extent reasonable and practicable.

For nearby or adjoining residents the interface should preserve a low-impact but effective edge to worksites. The use of materials, colours and the positioning of buildings, night-lighting, ventilation and other plant and equipment with continuous motor noise, workers' car parking and site offices would be sensitive to the nature and scale of adjoining and adjacent land uses, and where necessary, would include mitigation measures to ensure the utility of such premises is maintained.

6 HAZARD AND RISK MANAGEMENT

6.1 Overview

The environmental and social values for the local area around the Rose Street worksite have been identified in the relevant sections of the Changed Project. The 'environmental values' that are subject to potentially hazardous events include:

- residential communities and other sensitive land uses adjacent to the work site;
- motorists, pedestrians and cyclists who would use the road network identified for spoil haulage routes; and
- motorists, pedestrians and cyclists who would use the road network and footpaths near the worksite.

6.2 Potential Hazards

Potential hazards that have been identified in the construction and operation of the worksite include.

- operation of vehicles and construction equipment and storage of dangerous goods in the compound areas;
- fire or leakage or spillage of oils, fuels or other dangerous goods;
- transport of dangerous goods to the compound areas – spillage and accidents;
- transport of spoil to spoil placement areas – accidents leading to spillage;
- shaft / tunnel collapse or subsidence; and
- flooding and inundation during construction.

6.3 Hazardous substances stored on site

The types of hazardous substances likely to be stored on site include, but are not limited to:

- fuel (10,000l);
- solvents (<200l);
- additives (5,000l);
- cleaning agents (<500l);
- oils and grease (5,000l);
- paints (<100l);
- pesticides (<20l); and
- other hazardous chemicals (welding rods, cement, other).

6.4 Risk Assessment

Risk analysis addresses two issues:

- likelihood of an event to take place (frequency); and
- consequence which would arise if the event occurs.

These are then combined (as the product of frequency and consequence) to yield a risk rating which provides a guide to areas of risk that require attention, as described in Risk Assessment Methodology **(Table 6-1)**.

The likely outcomes for the main hazards providing a medium or higher level of risk associated with the construction are shown in the Risk Assessment Matrix (**Table 6-2)**.

The identified hazards have been assessed for risk and the associated mitigation strategies to be adopted are detailed in the following risk assessment worksheet.

The mitigation measures indicated in the table are explained in detail in **Section 6.5** below.

6.5 Hazard Mitigation

Safety management measures to be put in place during construction comprise:

- Containment and Hazardous Goods Management Plan in the event of spillage of fuels and other dangerous goods within either the tunnel or the surface construction sites during transport or storage.
- The Site EMP to be developed would contain the Hazardous Goods Management Plan as well as the Incident Management Plans and these would include provision for access and egress of emergency vehicles, particularly inside the shaft and tunnel access.
- Containment and clean-up procedures dealing with prevention of and management of spillage of spoil during transport to spoil placement areas. These would be included in sedimentation and erosion control plans developed as part of the Construction EMP.
- Installation of an appropriate pumping system as part of management strategy to deal with groundwater inflow.

Table 6-1: Risk Assessment Methodology

RISK ASSESSMENT WORKSHEET

LIKELIHOOD

A	Almost certain	Expected to occur in most circumstances
B	Likely	Would probably occur in most circumstances
C	Possible	Might occur at some time
D	Unlikely	Could occur, but would not be expected
E	Rare	Rare that this would occur. No previous occurrence in similar circumstances. Practically impossible

CONSEQUENCE

	People	Environment	Plant/Materials Damage
1	Fatal or Permanent Disability	Permanent Ecological damage	Extensive repairs or other corrective action required >$ 500k damage
2	Serious Lost time injury or illness	Major but recoverable ecological damage	Major repairs or other corrective action required $100k-$ 500k damage
3	Minor Injuries (MTI's) or illness	Limited but medium term environmental effects	Damage resulting in repairs to value $50k-$100k
4	Slight Injury (FAI) or illness	Minor short term environmental effects	Damage resulting in repairs to value $5k-$50k
5	No injury, illness	No measurable environmental effects	Minor rework or Use As Is. Damage resulting in repairs to value <$5k-$50k

Likelihood

Consequence

1	**2**	**4**	**7**	**11**
3	**5**	**8**	**12**	**16**
6	**9**	**13**	**17**	**20**
10	**14**	**18**	**21**	**23**
15	**19**	**22**	**24**	**25**

RISK RATING – SUMMARY

1-5 = High (H)

6-16 = Medium (M)

17-25 = Low (L)

Table 6-2: Risk Assessment Matrix

Task / Process / Work:		Rose Street Worksite							Date: 11/05/09	
Identification		**CURRENT Risk Rating**			**Action Required**	**NEW Risk Rating**			**Responsibility**	
Risks/Issues	**Potential Hazards**	**Likelihood**	**Consequences**	**Risk Rating**	**Controls / Treatment**	**Likelihood**	**Consequences**	**Risk Rating**	**Responsibility**	**Date Actioned**
Community impacts	Regenerative noise	B	4	14	Community consultation in advance of excavation works taking place. Ongoing monitoring and community involvement	C	4	18	Community team. Site management	

Task / Process / Work:		Rose Street Worksite							Date: 11/05/09	
Identification		**CURRENT Risk Rating**			**Action Required**	**NEW Risk Rating**			**Responsibility**	
	Construction noise causing complaints	B	3	9	Implement appropriate noise control measures and create a positive relationship with local community. Acoustic shed to be in place for tunnelling activities. Majority of works and all night time works take place within the acoustic shed. Restricted out of hours deliveries and works. Ongoing environmental monitoring for noise. Structure site and site activities to cause minimum possible disruption to nearby residents.	C	4	18	Community team. Environmental team. Site management	
	Construction site dust causing community complaints	A	3	6	Implementation of dust control measures. Tunnelling spoil to be contained within acoustic shed. Ongoing environmental monitoring Maintenance of surface hardstand areas and haul roads. Consideration given to site layout to minimise potential for dust generation by providing concrete or other maintained hardstands.	D	5	24	Community team. Environmental team. Site management	
	Property damage – settlement	C	3	13	Detailed design to minimise groundwater ingress into shaft. Monitoring of ground water levels and tunnel/shaft inflows.	D	3	17	Site management	

Task / Process / Work:		Rose Street Worksite							Date: 11/05/09	
Identification		**CURRENT Risk Rating**			**Action Required**	**NEW Risk Rating**			**Responsibility**	
					Surface monitoring for settlements. Action plan at various trigger levels of movement.					
	Large/Heavy lifts near residential properties – causing incident	C	3	13	Significant lift studies where required – surface bearing capacity to be established by geotech investigation. Selection of suitable cranes for each application. JSEA's for crane lifts.	D	3	17	Site management	
	Utilities and services – disruptions caused by site connections or other site works	B	4	14	Excavation permits for all excavations to identify nearby services and identify method of excavation. Connections to services to be planned to keep excavations to a minimum. Controlled excavations using qualified personnel and suitable excavation methods. Emergency response plan to consider an incident with underground or overhead services.	D	4	21	Site management	
	Fire	C	3	13	Correct storage and segregation of materials Fire extinguishing equipment to be provided about the site. No naked flame zones. Signage/barriers. Training of site personnel. Good housekeeping. Emergency response plan to consider a fire	D	3	17	Site management	

Task / Process / Work:		Rose Street Worksite							Date: 11/05/09	
Identification		**CURRENT Risk Rating**			**Action Required**	**NEW Risk Rating**			**Responsibility**	
					incident.					
	Construction vehicle movements on site – nuisance to local residents	B	5	19	Site traffic management plans. Designated vehicle travel routes. Dedicated site entrance and exit. Minimisation of reversing on site. Smart reverse alarms on all site vehicles..	D	5	24	Site management	
	Personnel parking – cause disruption or nuisance to community	B	5	19	Inductions to deliver relevant information to site personnel. Regular toolbox talks and monitoring	D	5	24	Site management	
	Building security on worksite – intruders/vandals	C	4	18	Access to site and to site buildings by authorised personnel only. All buildings, gates and stores locked after hours.	D	4	21	Site management	
	Storage of hazardous materials/chemicals	C	3	13	Materials stored as per specific requirements. Bunding and or barriers where required. Lockable storage containers. Restrictions on materials stored. Suitable quantities of spill control to be provided. Emergency response plan to consider type of materials stored and also location and quantity. Training of site personnel.	D	4	21	Site management	

Task / Process / Work:		Rose Street Worksite							Date: 11/05/09	
Identification		**CURRENT Risk Rating**			**Action Required**	**NEW Risk Rating**			**Responsibility**	
Traffic impacts	Traffic accident associated with site access/egress	C	2	8	Traffic management plan in place. Left turn entry into site, left turn exit out of site. Other assistance and controls such as mirrors, gates, speed humps etc as may be required. Limited parking on site.	D	2	12	Site management	
	Foreign object on public roadways	C	4	18	Implement appropriate control measures for vehicles delivering to and removing material from the site. All loads to be covered or secured prior to leaving site.	D	4	21	Site management	
	Public traffic distracted by worksite	C	5	22	Site perimeter fencing/barrier to prevent onlookers.	D	5	24	Site management	
	Uncontrolled visitors to site – unfamiliar with site requirements	C	3	13	All visitors required to advise site management of intent to visit the site. Restrict visitor access to the worksite. Designated walkways/barriers set up to segregate pedestrian visitors from the construction worksite.	D	3	17	Site management	
	Large wide loads – cause disruption to traffic	C	5	22	Specific large deliveries may have a separate risk assessment. Planned deliveries with community notification in advance of large or special	D	5	24	Site management	

Task / Process / Work:		Rose Street Worksite							Date: 11/05/09	
Identification		**CURRENT Risk Rating**			**Action Required**	**NEW Risk Rating**			**Responsibility**	
					deliveries.					
	Dirty roads around worksite	A	4	10	Controls implemented on site to segregate dirty areas from clean areas. Maintain clean haul roads through site. Wheel wash or rumble grid as required. Road sweeper to clean roads if required.	D	5	24	Site management	

7 DECOMMISSIONING / REHABILITATION

7.1 Decommissioning

7.1.1 Works and Timeframes Involved with Removal of Shaft and Surface Structures

At the completion of works taking place from the Rose Street worksite, the site would be demobilised. Demobilisation would involve the removal of all installations, filling the shaft and reinstatement of the site. The overall duration of demobilisation would be relatively short. The site is of modest size, with demobilisation likely to require approximately 8 weeks.

Installed equipment such as electrical and water treatment facilities, acoustic shed and other site buildings would be removed from the site by mobile crane and loaded onto trucks for transport off site. For the larger buildings, some dismantling would need to take place prior.

Concrete roadways and hardstands would be removed by hydraulic excavator and the concrete broken up and sent to recyclers.

7.1.2 Filling of Shaft and Rehabilitation of Surface

The backfilling of the shaft would occur simultaneously with the demobilisation of the acoustic shed to minimise potential dust generation. Dust generation would be further controlled with water sprays as required.

Backfilling of the shaft would proceed as follows -

1. Create cut-off wall to tunnel - A concrete or blockwork plug or wall would be constructed within the access drive to block the tunnel off from the shaft backfilling activities.

2. Backfill shaft - A backfill material would be placed and compacted within the shaft. The backfilling of the shaft would be subject to detailed design. Backfill material would consist predominately of engineered fill compacted to a road embankment standard. The material would be lowered to the base of the shaft for placement and compaction by mechanical equipment. The mechanical equipment at the shaft base would include a small excavator and a roller compactor. Approximately 4,500 m^3 of backfill material would be required and would be delivered by trucks.

Removal of piled foundations and hardstands would proceed as follows:

1. The piled foundations and shaft walls would be removed to a minimum depth of 2 m below ground level by hydraulic excavator with rockbreaker.

2. Hardstand areas about the site would be removed by hydraulic excavator. Concrete would be recycled and the site reinstated and landscaped.

Environmental impacts associated with decommissioning the Rose Street worksite would be predominantly dust, noise and vibration. These would be controlled by keeping

operations most likely to generate noise within normal construction work hours and by employing water sprays on rockbreaking activities to minimise dust generation.

Measures required to mitigate the impacts of decommissioning would be required to ensure the environmental objectives and the relevant goals for air quality, noise and vibration are achieved. The environmental management regime, including controls and mitigation measures would need to be maintained for the duration of the decommissioning and rehabilitation of the proposed worksite. Several additional measures would be required to address the particular environmental impacts of decommissioning. Such measures would include:

- staging of the decommissioning so that the 5.0m acoustic barrier erected around the perimeter of the proposed worksite is removed last of the structural elements and hardstand areas;
- removal of the piles around the shaft from within the acoustic shed prior to its dismantling and removal;
- construction vehicles transporting engineered fill to the shaft for back-filling are managed to avoid the need for stock-piling of fill material in the open prior to its use in the shaft;
- management of the removal of structures, services, hardstands, plant and equipment must ensure dust nuisance and noise nuisance does not occur for nearby sensitive places.

7.2 Rehabilitation and Landscaping

The proposed Rose Street worksite would be rehabilitated following completion of its use for construction works and decommissioning. The site would be rehabilitated to a state suitable for the agreed future land use. Sedimentation and erosion control devices developed during construction would be decommissioned and appropriate drainage reinstated.

Depending on the agreed final land use for the site, extensive landscaping would be carried out at the Rose Street worksite as necessary. The landscaping would be undertaken in accordance with landscape plans developed during the detailed design as described in the Airport Link EIS.

8 RECOMMENDATIONS AND CONDITIONS

The Coordinator-General issued his Evaluation Report on the environmental impact statement (EIS) for Airport Link in May 2007. Following an evaluation of a Request for Project Change relating to changes to the EIS reference project arising from identification of the preferred proposal for the delivery of Airport Link, the Coordinator-General issued a Change Report in July 2008.

The delivery of Airport Link is progressing with construction worksites established at Toombul and Clayfield, Kedron, Lutwyche and Windsor. Detailed design and detailed site investigations progressing ahead of construction works have identified a geotechnical constraint to construction and to the construction program in the uncertain ground conditions in the vicinity of the Kedron ramps where they would connect with the mainline tunnels.

This Request for Project Change is made in response to these uncertain ground conditions as a means for addressing the constraint and maintaining the construction program. If the Coordinator-General's evaluation allows the Request for Project Change, implementation of the proposed change would avoid the additional impacts on the wider community arising from an extension of the construction program and would avoid the cost impacts of such construction delays. It may also allow for the benefits of the Airport Link project to be realised earlier for the travelling public.

The proposed change to the delivery mode of Airport Link would impact adversely on the amenity and environmental quality in the locality of the Rose Street worksite, if no mitigation measures were to be implemented for most construction activities, such as site establishment, construction of the acoustic shed, excavation of the shaft and the adit, storage handling and loading of construction spoil, operation of plant and equipment, and the decommissioning and rehabilitation of the site.

8.1 Recommendations

Following detailed design, construction and geotechnical testing, this Request for Project Change provides a number of recommendations about the requested change to the Airport Link Project. The recommendations are that:

(a) The change to the Airport Link Project should proceed, subject to the conditions of the Coordinator-General's Evaluation Report dated May 2007, the Coordinator-General's Change Report dated July 2008 and specific conditions which seek to avoid, or mitigate and manage the potential impacts of the proposed change to the delivery mode of the Project. The following condition is recommended to address this issue:

All conditions from the EIS and Change Report apply equally to the Rose Street worksite ("General conditions"). Where specific conditions are imposed in relation to Rose Street, where practicable they are in addition to and not in substitution of any exising conditions imposed on the Project. Where any inconsistency arises between the specific conditions imposed in relation to Rose Street worksite and the the General conditions for the Project, the specific conditions are paramount.

(b) The Coordinator-General's conditions in response to the requested change should address the issues and the measures set out below:

(i) construction workforce car parking;

(ii) construction traffic management;

(iii) construction vehicle queuing;

(iv) construction spoil handling and management;

(v) noise;

(vi) blasting

(vii) construction air quality;

(viii) lighting; and

(ix) decommissioning.

8.2 Construction workforce car parking

The proposed Rose Street worksite would generate employment and the movement of a construction workforce in a locality not presently directly affected by such activity as a consequence of the Airport Link Project.

If not controlled and managed, workforce car parking could become a source of annoyance for residents and businesses in local streets due mostly to noise and a lack of parking capacity.

The scale of the workforce would vary according to the phase of the Rose Street worksite's operation. The workforce engaged in the site establishment phase would peak at approximately 20 people. The workforce for the tunnel construction phase would peak at approximately 50 people, whereas approximately 80 people would be engaged in the tunnel fit-out phase, following tunnel construction.

To avoid the potential impact of workforce parking in local streets, it is recommended that the following conditions be included in the Coordinator-General's Change Report.

All workforce car parking for the Rose Street worksite must occur at the Airport Link Kedron workside. The workforce must be transported between the Kedron worksite and the Rose Street worksite by a dedicated shuttle bus service with workforce drop-off and pick-up occurring within the Rose Street worksite.

8.3 Construction Traffic Management

With additional construction traffic movements on the roads there will be increased traffic on the surrounding road network. Although there is likely to be a low volume of construction vehicles moving to the Rose Street work site, we recommend a condition be adopted that assists in avoiding, or minimising and mitigating, disruption to local traffic movements generally - particularly during peak traffic periods including school drop-off and pick-up times.

The preferred construction haul route for the proposed Rose Street worksite would introduce Airport Link construction traffic to part of the arterial road network presently not influenced by such traffic. As an arterial route however, general purpose heavy vehicles are free to use this route in travelling between the Australia Trade Coast and Brisbane's western and north-western suburbs.

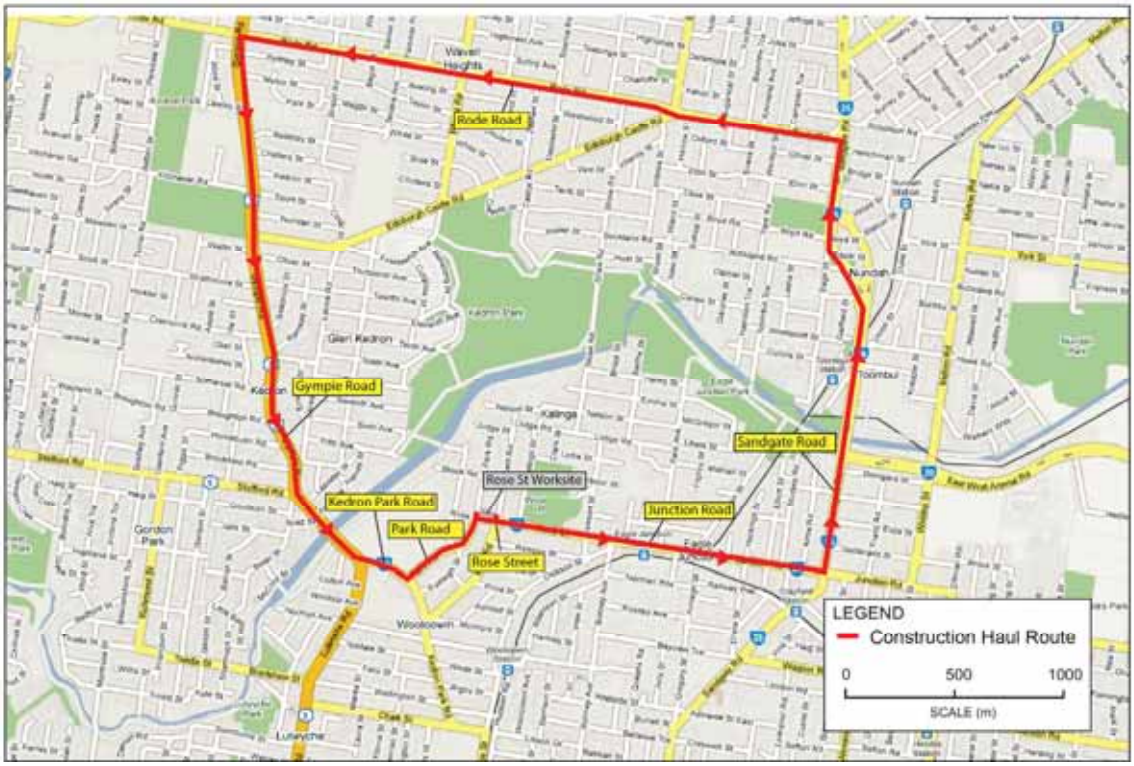
The preferred route forms a circuit and has the capacity to accommodate the low numbers of construction vehicles moving to and from the proposed worksite in a single direction of flow (ie anti-clockwise).

In order to manage the construction traffic risk, it is recommended that the following conditions be included in the Coordinator-General's Change Report:

(a) *All construction traffic movements including the haulage of spoil, materials, plant and equipment, to and from the Rose Street worksite must occur:*

(i) *only on the designated construction traffic route, being east-bound along Rose Street, Junction Road and Sandgate Road, with the return route being via Rode Road, Gympie Road, Kedron Park Road, Park Road, Rose Street and Kent Road as shown on* **Figure 8-1***;*

Figure 8-1: Construction Haul Route for Rose Street Worksite



(ii) *only between the hours of 06.30hrs to 18.30hrs Monday to Saturday, and at no time on Sundays or public holidays;*

(iii) *during school drop-off and pick-up times (being 7:30am to 9.00am and 2.30pm to 4:00pm, Monday to Friday on school days) only where traffic control measures, including without limitation appropriately qualified*

pedestrian controllers and traffic controllers, are in place to manage pedestrians and traffic flows in and around Kedron State High School.

(iv) *despite clause (ii), shotcrete may be delivered to the Rose Street worksite at any time, with a maximum of 4 deliveries of shotcrete between 6:30pm to 6:30am.*

(b) *Traffic controls designed for the safe movement of pedestrians and cyclists near the Rose Street worksite must be prepared and implemented prior to the commencement of any site works and maintained for the duration of activities at the Rose Street Worksite.*

(c) *Real-time monitoring must be implemented to ensure the construction route for the Rose Street worksite is used only by construction vehicles directly engaged on that site. Such monitoring must monitor the flow of construction vehicles on Park Road, Rose Street and Junction Road for comparison with predicted traffic flows for the worksite, and must also manage truck position, speed, route and performance in relation of traffic conditions and schedule requirements. Exceedances of construction traffic forecasts on these roads must be reported to the Coordinator-General immediately together with a corrective action report.*

(d) *The community, including potentially affected businesses, community facilities and emergency services, must be notified in advance about proposed local traffic management measures.*

(e) *Clear signage of changed traffic conditions arising from construction activities must be provided and other measures implemented as necessary to ensure safe traffic movement (e.g. traffic controllers, traffic signal operational).*

(f) *Measures must be implemented to avoid construction traffic of a gross mass greater than 2 t or a length greater than 6 m associated with the Rose Street Worksite using local streets in the vicinity of the worksite.*

(g) *Access to properties adjoining the Rose Street Worksite must be maintained at all times.*

8.4 Construction Vehicle Queuing

There is potential for local residents in adjacent properties to the proposed Rose Street work site to be affected adversely if construction vehicles were to queue to enter the worksite, particularly in morning with the proposed gate opening time of 06.30hrs. The potential for such negative affect would arise from vehicle noise, engine emissions and potentially constrained traffic conditions including constrained access due to kerbside parking.

In order to maintain a reasonable level of amenity and environmental quality for the locality of the proposed Rose Street worksite, the hours of work should be limited, by imposition of a suitable condition, to 06.30 – 18.30hrs Monday to Saturday, with no work on Sundays or public holidays. It is recommended that two exceptions are allowed to the limited work hours for this site -

- work below ground or within the acoustic shed can continue without limitation on hours, providing the environmental requirements of the Coordinator-General's conditions are being satisfied; and

- that up to four deliveries of shotcrete are permitted to the proposed worksite after 18.30hrs until the site reopens at 06:30hrs the next day.

It is recommended that the following conditions be included in the Coordinator-General's Change Report:

(a) *The construction vehicle fleet for the Rose Street worksite must be managed so that there is no queuing in proximity to Sensitive Places; and*

(b) *Where construction vehicle queuing is required for the Rose Street worksite, this must occur only in commercial or industrial areas identified in the Construction Traffic Management Sub-plan or within other Construction Sites.*

8.5 Construction Spoil Handling and Management

The handling, storage and loading of spoil during the site establishment, shaft excavation, adit excavation and decommissioning phases of the proposed worksite require careful management to avoid nuisance to nearby properties and along the preferred construction haul route.

It is recommended that the following conditions be included in the Coordinator-General's Change Report with regards to construction spoil handling and management:

(a) *No spoil, including surface material removed during site establishment, is to be stockpiled on site, handled or loaded within the Rose Street worksite prior to the installation of the acoustic screen around the perimeter in accordance with clause 1.6 below;*

(b) *Spoil, including surface material disturbed during site establishment, to be handled, stockpiled or loaded into haulage trucks on site must be:*

  (i) *prior to the installation of the acoustic-lined shed, managed to prevent dust nuisance*[17] *for nearby properties; otherwise*

  (ii) *fully contained within the acoustic-lined shed or the underground construction area prior to loading;*

(c) *No spoil is to be removed from the Rose Street worksite outside the hours of 06.30hrs to 18.30hrs Monday to Saturday and must not be removed at any time on Sundays or public holidays;*

(d) *No spoil is to be removed from the Rose Street worksite unless within a haulage vehicle equipped in accordance with the Coordinator-General's conditions, with a fully-covered load and travelling only in the approved direction on a designated haul route for the Rose Street worksite. The approved direction must be shown on an approved Construction Traffic Management Plan in accordance with clause 1.3 above.*

8.6 Noise and Vibration

As with other construction activities to be conducted during the establishment, operation and decommissioning of the proposed Rose Street worksite, there is potential for nearby properties to be negatively affected by noise and vibration.

[17] Dust nuisance would occur where the dustfall criteria are exceeded for any day.

The findings of predictive modelling conducted for this Request for Project Change indicate that, without effective mitigation, there would be significant exceedances of the environmental objectives and performance criteria and the goals for construction noise and vibration set by the Coordinator-General's Evaluation Reports of May 2007 and July 2008. For this reason, the installation of an acoustic screen, at least 5.0m in height and of sufficient density to achieve effective noise attenuation, must be undertaken prior to the commencement of any other construction activities.

There is also a need for early, effective and on-going consultation with the owners and occupants of nearby and potentially-affected properties. Mitigation measures proposed for some people may not be effective for others. An effective and committed approach to community engagement, consultation and impact mitigation would help achieve the environmental objectives, established in the Coordinator-General's evaluation reports, of:

- avoiding sleep disturbance;
- minimising if not avoiding the risk of cosmetic damage to buildings;
- minimising the risk of adversely affecting the operation of sensitive equipment in nearby commercial buildings; and
- avoiding the risk of structural damage to buildings.

Appendix 1, Schedule 3, Condition 9 of the Coordinator-General's evaluation report establishes noise and vibration goals that apply for the construction phase of the Project. These conditions will apply to the changes proposed to the Project.

In order to manage the risks outlined above, it is recommended that the following conditions be included in the Coordinator-General's Change Report in relation to the Rose Street worksite:

(a) *An acoustic barrier must be designed to achieve the environmental objectives, and constructed around the perimeter of the Rose Street worksite prior to site establishment;*

(b) *The acoustic barrier for the Rose Street worksite must:*

  (i) *be at least 5 metres in height;*

  (ii) *be constructed around the whole perimeter of the site with gate openings only for access points, with the gates to have the same acoustic performance as the acoustic barrier;*

  (iii) *be constructed of materials with a minimum mass density of 10 kg/m2 and be continuous with no gaps.*

(c) *To manage construction noise, vibration and air quality at the Rose Street worksite effectively, an acoustic shed must be completed prior to the commencement of roadheader excavation for the adit and tunnels.*

(d) *The acoustic shed must:*

  (i) *be designed to achieve the environmental objectives and performance criteria, and constructed (including by use of appropriate materials) to achieve compliance with the Coordinator-General's conditions, including in particular Appendix 1, Schedule 3, Conditions 8 and 9;*

(ii) *remain entirely enclosed between the hours of 18:30hrs to 06:30hrs and on Sundays and Public Holidays, other than to allow access and egress to the shed.*

(e) *All generators, filtration equipment and non-mobile plant within the Rose Street worksite must be contained within enclosures that are acoustically lined, to achieve the environmental objectives for noise and stated goals continuous noise sources*

(f) *Consultation must be undertaken with owners and occupants of potentially-affected premises where predictive modelling predicts that the construction noise goals as set out in Appendix 1, Schedule 3, Condition 9 of the Coordinator-General's evaluation report are likely to be exceeded by the construction or operation of the Rose Street worksite.*

(g) *Consultation must inform the development and implementation of effective mitigation measures to address the predicted exceedance of the noise goals. Possible mitigation measures include treatments to residential dwellings and sensitive commercial buildings (e.g. window treatments, door treatments, air conditioning) in order to mitigate predicted noise impacts.*

8.7 Blasting

Owing to the proximity of occupied premises to the proposed worksite, and the program intention to commence excavation prior to completion of the acoustic shed, the risk of fly-rock and other potential impacts from blasting in the shaft, must be comprehensively investigated and addressed, prior to the commencement of any blasting.

The Coordinator-General's evaluation report for both the EIS (report dated May 2007) and for the Request for Project Change (report dated July 2008) provided conditions for blasting in terms of vibration goals and airblast over-pressure goals. These goals are provided in the Coordinator-General's evaluation report at Appendix 1, Schedule 3, Condition 9(m) and Table 5. Exceedances of these goals is contemplated but are not anticipated as the norm. Where predictive modelling conducted prior to blasting indicates a risk of an exceedance of the goals, such modelling would trigger the requirement for more detailed consultation with potentially affected property owners and occupants, to determine the most effective mitigation and management measures to respond to the potential risk.

The existing conditions imposed by the Coordinator-General appear to be adequate for the management of blasting and related vibration and airblast over-pressure impacts and do not require any change.

It is recommended that the following condition be included in relation to the Rose Street worksite:

(a) *All construction blasting at the Rose Street worksite must be undertaken in accordance with the Construction Hazard and Risk EMP Sub-Plan, which must include procedures for the use of blasting mats to prevent any fly rock external to the construction areas.*

8.8 Construction air quality

The establishment, operation and decommissioning of a construction worksite in Rose Street has the potential to impact on ambient air quality through the release of dust and emissions from motor vehicles and stationary, diesel-powered plant and equipment.

The Coordinator-General's conditions for construction air quality address the risk of excessive dustfall by providing dustfall criteria and a goal for the release of particulate matter with an equivalent aerodynamic diameter less than 10µm (ie PM_{10}). The relevant conditions are set out in Appendix 1, Schedule 3, Condition 8 and would apply to the proposed worksite at Rose Street..

The proposed worksite is intended to be equipped with a high-level ventilation outlet for the removal of dust and engine emissions from stationary plant and equipment. While not finally determined by detailed design, the empirical evidence derived from the EIS investigations indicates the ventilation outlet must be at least 5 metres above the highest point of the acoustic shed, and must have an airflow velocity no less than 10m/sec to achieve adequate dispersion of the released air.

For the Rose Street worksite, it is recommended that the following condition be included:

(a) *Dust suppression measures to achieve the Coordinator-General's conditions must be devised and implemented to ensure dust nuisance does not occur during site establishment, operation or decommissioning of the Rose Street worksite;*

(b) *The shaft at the Rose Street worksite must be ventilated during tunnel excavation works, and ventilated air must be treated for the removal of dust prior to the release from the acoustic shed. Ventilated air must be released to the ambient environment via a high-level ventilation outlet attached to the acoustic shed.*

(c) *Particle filters must be maintained at the acoustic shed at the Rose Street worksite regularly to ensure the performance of the particulate removal technology meets the goals for ambient air quality in Appendix 1, Schedule 3, Condition 8, Table 2 of the Coordinator-General's evaluation report.*

(d) *The ventilation outlet for the Rose Street worksite acoustic shed must:*

(i) *be designed and operated to achieve the goals for ambient air quality provided in* **Table 8-1***; and*

Table 8-1: Ambient Air Quality Goals for Rose Street Worksite – Ventilation Outlet

Pollutant	Goal	Unit	Measuring Period
Carbon monoxide (CO)	10	mg/m^3	8 hour maximum
Nitrogen dioxide (NO_2)	246	$\mu g/m^3$	1 hour maximum
	62	$\mu g/m^3$	Annual mean
Particulate matter less than 10µm in diameter (PM_{10})	50	$\mu g/m^3$	24 hour maximum
	50	$\mu g/m^3$	Annual mean
Particulate matter less than 2.5µm in diameter ($PM_{2.5}$)	25	$\mu g/m^3$	24 hour maximum
	8	$\mu g/m^3$	Annual mean
Total suspended particulate matter (TSP)	90	$\mu g/m^3$	Annual mean

(ii) *be at least 22.5m above ground level in height; or*

(iii) *at least 5m higher than the highest point of the acoustic shed.*

(e) *The ventilation outlet for the Rose Street worksite must be designed and operated so that vitiated air is dispersed at a minimum velocity of 10 metres per second.*

(f) *The exhaust emissions from stationary, diesel-powered plant and equipment must be captured and released to the ambient environment via the high-level ventilation outlet attached to the acoustic shed.*

(g) *Construction vehicles required to queue or stand stationary on entering the worksite must not have their engines at idle for periods exceeding 3 minutes, unless standing within the acoustic shed.*

(h) *In addition to any requirement of a Construction Traffic Management Sub-Plan or Construction Vehicle Management Sub-Plan, for management of air quality impacts, construction vehicles leaving the Rose Street worksite must:*

(i) *pass over devices within the worksite designed to remove loose material from the vehicle;*

(ii) *have secured and covered loads, if carrying loose material to avoid spillage on leaving the worksite.*

8.9 Lighting

If not controlled through detailed design and siting controls, there would be a risk of light spill from the operational and security lighting for the proposed worksite impacting adversely on nearby properties, including residential properties. Investigations for this Request for Project Change indicate that adequate light spill for operational (safety) requirements and security requirements would be achieved from light standards at a height of 4.0metres. Such lighting installations would be directional in design, which when combined with the location of the 5.0metres acoustic screen on the boundary of the proposed worksite, would avoid the risk for light spill affecting nearby properties.

Similarly, lighting within the acoustic shed would be screened from nearby properties through strict implementation of the 'doors closed' procedure between the hours of 18.30hrs and 06.30hrs.

(a) *Night lighting, including security lighting, for the Rose Street worksite must be designed, positioned and installed to avoid light spill onto adjoining land that is a Sensitive Place (as defined in Schedule 5 of the Coordinator-General's evaluation report) at intensities exceeding 8 lux measured at the common boundary.*

8.10 Decommissioning

Decommissioning of the proposed Rose Street worksite would entail a number of activities which, if not controlled and managed in accordance with the Coordinator-General's conditions, have the potential to impact adversely on the amenity and environmental quality of the locality. Such activities would include the breaking up and removal of the reinforced concrete hardstand areas, the removal of the acoustic shed, the back-filling and compaction of material in the shaft, and the transportation of materials from and back-filling soil to the proposed worksite.

In order to mitigate and manage potential noise, vibration and air quality impacts during the decommissioning phase, it is recommended that the following condition be included in relation to the Rose Street worksite:

Decommissioning of the Rose Street worksite must be staged such that:

(a) *backfilling and reinstatement of the shaft area occurs within the acoustic shed; and*

(b) *the acoustic barrier required in 1.6(a) remains in place for the duration of decommissioning.*