LEGACY WAY

CONNECTING THE WESTERN SUBURBS TO THE NORTH

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The Legacy Way Project
Application for Project Change

Tollroad Control Centre
Bowen Hills

October 2011

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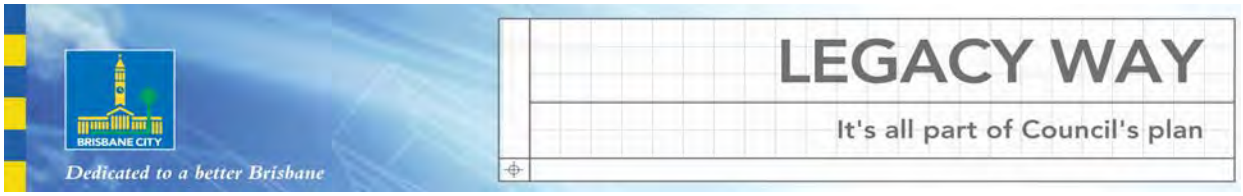

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Contents

Executive Summary

The Legacy Way Project is a tolled cross-city tunnel, just under 5km in length, linking the Centenary Motorway at Toowong in the west of Brisbane with the Inner City Bypass at Herston to the north of Brisbane. Legacy Way will provide the missing link in the motorway network between the Centenary Motorway and the Inner City Bypass, and is consistent with Council's Transport Plan for Brisbane 2006-2026. The Project is expected to deliver $10.5 billion in economic benefits from travel time, vehicle operating costs, road savings and environmental benefits. It is currently under construction and is expected to start operating in early 2015.

This Application for Project Change addresses the Tollroad Control Centre (TCC), which is an essential component of the Project. The TCC is required in order to provide a base to monitor, maintain and control a number of services required for the safe and effective operation and maintenance of the tunnel.

This application is submitted as required by the Coordinator-General's Condition 41 for the Project. The proposed change involves development of the TCC in a different location to that identified in the reference design. However, the function of the TCC remains the same. The proposed site is situated on the corner of O'Connell Terrace and Sneyd Street, Bowen Hills. This site was selected from a number of options due to the compatibility with the adjoining land use of the Clem7 ventilation outlet and Clem7 TCC.

The subject land at O'Connell Terrace is located within the Bowen Hills Urban Development Area (UDA) declared under the *Urban Land Development Authority Act 2007* (ULDA Act). Under the ULDA Act, land within the Bowen Hills UDA is subject to the provisions of the Bowen Hills UDA Development Scheme (Development Scheme). The proposed TCC building is consistent with the land use plan under the Development Scheme. Subject to detailed feasibility, the proposal also includes a component of commercial office and retail floor space. The commercial and retail uses would not be part of the Project and therefore do not require assessment by the Coordinator-General.

In addition to this Application for Project Change, Council will also prepare and submit a development application to the ULDA for the proposed building which will be assessed against the Development Scheme. This is required as the proposed commercial and retail components of the building are considered to be assessable development (permissible development) in the UDA, and require a development approval under the ULDA Act. The ULDA would assess the development application for the building against the development requirements in the Development Scheme.

The potential environmental effects of the TCC building have been considered in the development of the building design, with the key issues considered to be planning and urban design, air quality, noise and traffic. The potential impacts from construction of the TCC building

have been assessed and can be managed appropriately through a construction environmental management plan.

The key issue for air quality relates to the operation of the adjoining Clem7 ventilation outlet. Being a tall building, the TCC would generate downwind effects with the potential to affect the dispersion of vitiated air from the Clem7 ventilation outlet. These wake effects may change the concentrations of nominated pollutants from the Clem7 ventilation outlet. The air quality impact assessment study undertaken for the proposed development found that the TCC building would not adversely affect dispersion of the plume from the Clem7 ventilation outlets, with concentrations predicted at existing receptors unlikely to change as a result of the development.

The main acoustic issues associated with the TCC would be air conditioning, maintenance activities and construction activities. Preliminary noise modelling has been undertaken for the development to predict construction noise from the site, and operational noise from the building, to the nearest noise sensitive receptors. The modelling has shown that exceedances of the Coordinator-General's noise conditions may occur during construction of the TCC building which will require mitigation measures. However, none of the construction activities would be considered "high noise impact" as defined in the Coordinator-General's conditions for the Project as the predicted construction noise levels are less than the existing background noise levels.

The proposed development of the site for use as the TCC and retail and commercial office would not significantly impact on the local traffic performance. Calculation of the likely trip generation for the TCC, commercial and retail uses shows no significant impact on the surrounding intersections and network as a result of the proposed development.

Several other key projects are also occurring within the locality of the proposed TCC site, namely the Royal National Agricultural and Industrial Association of Queensland (RNA) Showgrounds redevelopment and the proposed Cross River Rail (CRR) project. Should CRR proceed, it would involve the widening and raising of O'Connell Terrace, effecting the subject site. The planned redevelopment of the RNA Showgrounds includes commercial and residential land uses along O'Connell Terrace. Council is liaising with the ULDA to consider design responses to the potential requirements of CRR, and the developer of the RNA Showgrounds to enable a compatible approach on the future streetscape for O'Connell Terrace in the vicinity of the TCC site.

1. Introduction

Legacy Way (formally known as the Northern Link Road Tunnel project), is a tolled cross-city tunnel, just under 5km in length, linking the Centenary Motorway at Toowong in the west of Brisbane with the Inner City Bypass at Herston to the north of Brisbane. A complete description of the Project is available in the first (October 2010) Application for Project Change (APC) for the Legacy Way Project (the Project). Brisbane City Council (Council) is the proponent of the Project.

This APC addresses the Tollroad Control Centre (TCC), which is essential to the operation of the Project.

1.1. Background on TCC

The Environmental Impact Statement (EIS)[1] for the Project identified that in the operational phase of the Project, a number of services would be required for the safe and effective operation of the tunnel.

The services, to be monitored, maintained and controlled from the TCC, would include:

- tunnel safety;
- traffic management;
- ventilation;
- power;
- lighting; and
- other systems required for the safe and efficient operation of the tollroad.

The Reference Design for the project, which was subject to the EIS and subsequent evaluation by the Coordinator-General[2], identified a location for the TCC within the rehabilitated western worksite adjacent to the Centenary Motorway.

In October 2010 an APC was made to the Coordinator-General, which included a proposed change to the location of the TCC by Council's design and construction Contractor for the project to an area opposite the entry to the Botanic Gardens on Mt Coot-tha Road. Due to

[1] Northern Link Environmental Impact Statement dated September 2008

[2] Coordinator-General's Report, Northern Link Road Tunnel, released April 2010 – Report evaluating the Environmental Impacts Statement pursuant to section 35(3) of the *State Development and Public Works Organisation Act 1971.*

public feedback on the suitability of that site, that location for the TCC was later withdrawn by Council.

No assessment or any decision on the location of the TCC location was therefore made in the Coordinator-General's report on project changes (December 2010). However, Condition 41 required that:

Prior to commencement of the operations phase, the proponent is to request consideration by the Coordinator-General on the revised proposed location for the TCC through the making of an application under section 35C of the State Development and Public Works Organisation Act 1971.

1.2. Summary of proposed change

The proposed change involves development of the TCC in a different location to that identified in the reference design. The proposed site is situated on the corner of O'Connell Terrace and Sneyd Street, Bowen Hills (refer to **Figure 1-1**). It comprises three freehold lots owned by Council and an area of road reserve which is currently subject to a road closure application. The function of the TCC remains as described in the reference design. The ventilation outlet for Legacy Way would remain in its approved location next to the Inner City Bypass (ICB) adjacent to the Inner Northern Busway. It would not be included in the proposed TCC at Bowen Hills.

This application is submitted as required by the Coordinator-General's Condition 41. It includes sufficient information about the proposal and its effects on the project to allow the Coordinator-General to make the evaluation. This application:

- Outlines the reasons for the proposed change and its effects on the project (**Section 2**);
- Provides a description of the subject site and the locality (**Section 3**);
- Describes the proposed change (**Section 4**);
- Describes the effects of the proposed changes and mitigation measures (**Section 5**). Specific effects on planning, heritage, land use and urban design (**Section 5.1**), air quality (**Section 5.2**), noise (**Section 5.3**) and traffic and transport (**Section 5.4**) are included.

- **Figure 1-1 Site Location**

1.3. Process for Evaluation of Project Change

Under the provisions of Division 3A of the *State Development and Public Works Organisation Act 1971* (SDPWO Act), Council, as the proponent, can apply to the Coordinator-General to assess a proposed change to the project or a condition of the project and to evaluate the environmental effects of the proposed change, its effects on the project and any other related matters. The application must:

- describe the proposed change and its effects on the project;
- state reasons for the proposed change; and
- include sufficient information about the proposed change and its effects on the project to allow the Coordinator-General to make the evaluation.

After receiving the application, the Coordinator-General may:

- refer details of the proposed change, its effects on the project or any other related matter to anyone the Coordinator-General considers may be able to give comments or information to help the making of the evaluation.

- ask the proponent for further information about the proposed change, its effects on the project or any other related matter.
- require the proponent to publicly notify the proposed change and its effects on the project, in a way decided by the Coordinator-General.
- In making the evaluation, the Coordinator-General must consider each of the following:
  - the nature of the proposed change and its effects on the project;
  - the project as currently evaluated under the Coordinator-General's Report for the EIS for the project;
  - the environmental effects of the proposed change and its effects on the project;
  - if public notification was required, all properly made submissions about the proposed change and its effects on the project;
  - the submissions made to the EIS to the extent that it is relevant to the proposed change and its effect on the project.

The Coordinator-General may refer the proposed changes to anyone to seek input on the changes, and within this, may decide to publicly notify the change request for comment. Submissions made in relation to this application would be relied upon by the Coordinator-General in forming his decision on the changes. The Coordinator-General must prepare a report (a Coordinator-General's Change Report) that makes an evaluation and may make recommendations, amend any conditions, impose conditions or refuse to allow the proposed change.

After completing the Change Report, the Coordinator-General must:

- give a copy of it to the proponent; and
- publicly notify the report.

To the extent that there is any inconsistency between the Coordinator-General's Report and the Change Report, the Change Report prevails.

1.4. Approvals

The subject land at O'Connell Terrace is located within the Bowen Hills Urban Development Area (Bowen Hills UDA) declared under the *Urban Land Development Authority Act 2007* (ULDA Act).

Under the ULDA Act, land within the Bowen Hills UDA is subject to the provisions of the Bowen Hills UDA Development Scheme (Development Scheme). The Development Scheme is administered by the Urban Land Development Authority (ULDA). The Development Scheme outlines the level of assessment for the carrying out of development within the Bowen Hills UDA.

The development and use of the TCC is exempt from assessment against the Development Scheme under Schedule 1 of the Development Scheme. The exemption covers all aspects of development involving the construction, maintenance or operation of roads and things associated with roads, on behalf of, or under contract with the ULDA, Brisbane City Council or the Queensland Government. Things associated with roads include:

- activities undertaken for road construction;
- traffic signs and controls;
- depots;
- road access works;
- road construction site buildings;
- drainage works;
- ventilation facilities, including exhaust fans and outlets;
- rest area facilities and landscaping;
- parking areas;
- control buildings; and
- toll plazas.

This means that the TCC does not require development approval from the ULDA. However, within the location of the subject site, commercial and retail land uses are assessable development (permissible development) and require a development approval under the ULDA Act.

Therefore, as Council is proposing a multi-use building that could also accommodate retail and commercial uses, in addition to this APC Council will also prepare and submit a development application to the ULDA for the proposed building. This application would be assessed against the Development Scheme. Council intend to submit this application in late October 2011. The proposed retail and commercial uses are not related to the Project and therefore do not require assessment by the Coordinator-General as part of this APC.

2. Reasons for Proposed Change and its Effects on the Project

This section discusses the rationale of the proposed change, explaining the alternatives considered in the selection of the proposed site. The consequences of not proceeding with the proposed change and the benefits of the proposed change are also outlined.

2.1. Rational of the proposed change

Council considered a number of different locations for the TCC, with sites at the western and eastern ends of the Legacy Way tunnels included in the assessment. Key factors considered in the assessment of the alternatives were:

- Functionality – ability of the site to provide the required functions of the TCC. This includes sufficient space for monitoring and controlling systems, maintenance facilities, vehicle and equipment storage as well as good access to the tunnels for maintenance vehicles.
- Commercial costs and land tenure – the differentiating factors in the costs were considered to be the required distance for the connection of data services with the tunnel and if land needed to be acquired.
- Constructability and environment – issues that could affect the environment or construction of the TCC building.
- Community – Legacy Way will be operational day and night, requiring the TCC to be operational 24 hours a day. Compatibility with the surrounding land uses is important to reduce potential amenity impacts.

Excluding the site previously proposed in the October 2010 APC, a total of 9 site options were considered for the location of the TCC. These were:

1) A site within the Mt Coot-tha Botanic Gardens adjacent to Centenary Motorway (as referred to in the EIS);
2) An alternative site within the Mt Coot-tha Botanic Gardens, off Mt Coot-tha Road;
3) The construction project office as proposed in the October 2010 APC at 95 Sir Samuel Griffith Drive;
4) Within the Council Bus Depot off Miskin Street;
5) Park and Ride area between Dean and Miskin Streets;
6) Adjacent to the Inner City Bypass (ICB) and the eastern ventilation station within Victoria Park;
7) Co-located with the Clem Jones Tunnel (Clem7) TCC at Bowen Hills;

8) Adjoining Clem7 TCC and Clem7 northern ventilation outlet site (west of Snyed St) (the site subject to this application); and
9) Adjacent to the Clem7 TCC and northern ventilation outlet (east of Snyed St).

A summary of the key considerations in the evaluation of each alternative site is provided in **Appendix A**. Site option 1 is the location referred to in the EIS. It is not considered to be a viable location as it does not have suitable access with the changed project design.

Site option 2 was not preferred by Council due to proximity to residents and potential effects on the amenity of the entrance to the Mt Coot-tha Botanic Gardens. Site 3 was not progressed as an option once the site was no longer proposed to be used as a construction office. Site 4 was not preferred due to potential impacts on the existing operations of the bus depot. Site 5 is now required as part of the workforce parking plan for the Legacy Way project and is not preferred by Council for the TCC. Site 6 is not considered to be a suitable alternative due to the potential land use impacts. Site 7 was not considered viable by Council due to the different procurement and operating requirements for Clem7 and insufficient space within the Clem7 TCC. Site 9 is not considered viable due to the volumetric restrictions at the site from the underground ventilation tunnel infrastructure for Clem7.

The proposed site, being site option 8 adjoining the Clem7 TCC and Clem7 northern ventilation outlet was considered to be the most suitable site out of the alternatives. It satisfies the functionality requirements of the TCC. Although it does have relatively higher costs for the connection of data services to the tunnel due to the greater distance, it has reduced residential amenity and land use impacts compared to the other identified alternatives that are closer to the tunnel portals. The assessment recommended that as the site is located within the Bowen Hills UDA, the design of the building consider measures which would contribute to a high quality and safe public realm as intended by the Development Scheme, such as providing opportunities for passive surveillance. This would enable a better planning outcome for the site, consistent with the objectives of the Development Scheme.

2.2. Consequences of not proceeding with proposed change

The TCC functions of monitoring and controlling operational systems and incident management are critical for the safe operation of the Project, such that it would not be able to operate without them. If this proposed change was not to occur, an alternative TCC site to those previously evaluated would need to be identified.

Construction of the TCC building will need to be completed by early 2014, to allow sufficient time for building fit-out prior to the commencement of operations of Legacy Way. Not proceeding with the proposed change would affect the commencement of operations of the

project due to the required time to identify and possibly acquire an alternative site, and to design and construct a TCC building.

2.3. Benefits of proposed change

The proposed site would reduce community impacts compared to the site previously proposed in the October 2010 APC and the site proposed as part of the reference design, which were both located at Mount Coot-tha. The mixed-use locality of Bowen Hills is very different to the residential and bushland locality of Mount Coot-tha. The proposed site is located adjacent to similar land uses for the Clem7 tunnel. The proposed development of the site also provides the opportunity to create an active street frontage along the northern side of O'Connell Terrace (refer to **Section 5.1**).

The site satisfies the requirements for access to each of the Legacy Way tunnels for maintenance vehicles, and data services and provides sufficient space to house required activities. The site location allows for a number of alternative routes to access the Legacy Way tunnel (refer to **Section 4.3**).

3. Site and Locality

The proposed location is land at Bowen Hills on the northern side of O'Connell Terrace between Sneyd Street and the ICB.

3.1. Land tenure

The subject site comprises three freehold lots and an area of road reserve which is currently subject to a road closure application (refer to **Figure 3-1**). The property details are included in **Table 3-1**. The total area of the site is approximately 2,327m^2.

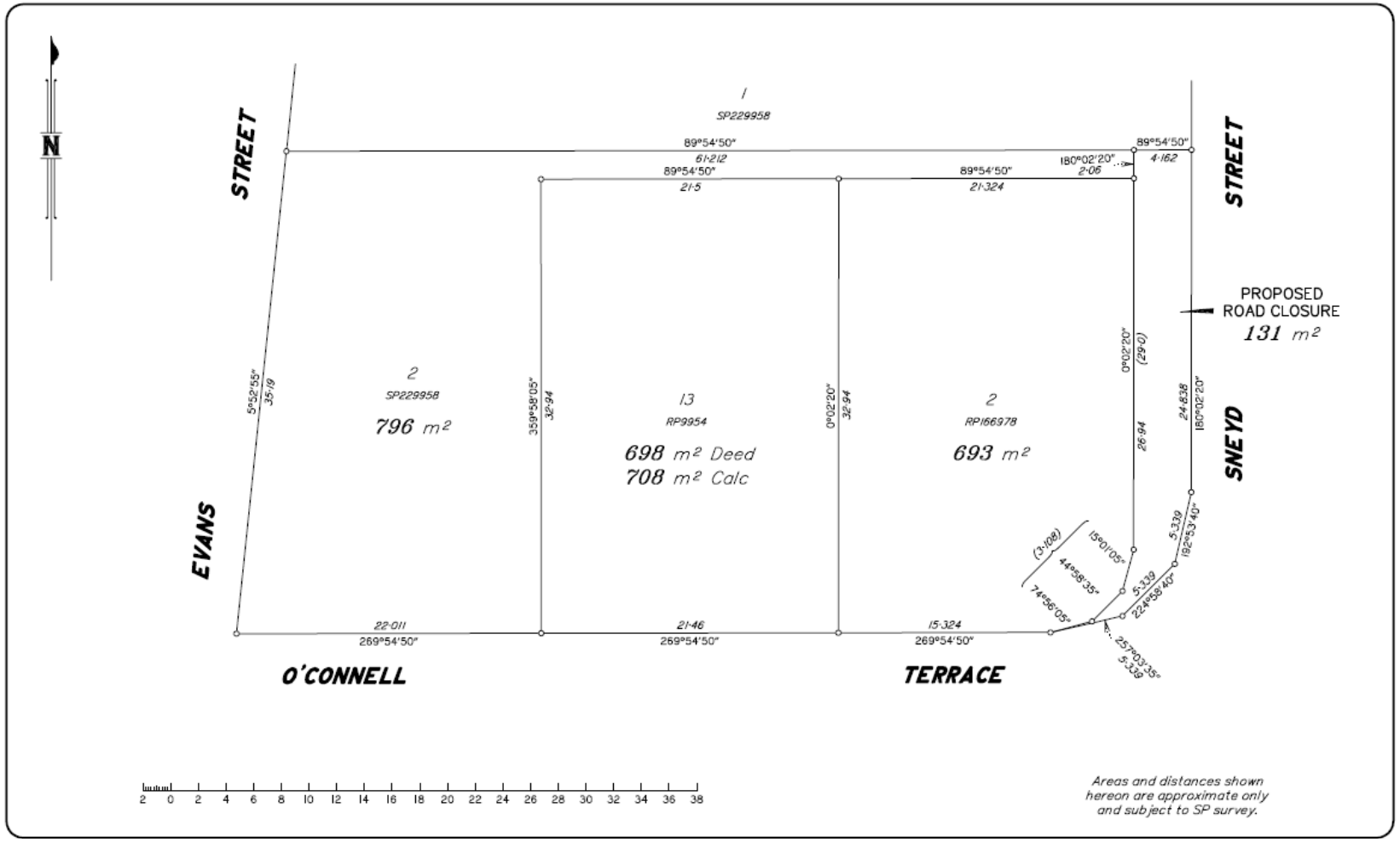
The three individual freehold lots are owned by Council (estate in fee simple). They were originally compulsorily acquired by Council under the *Acquisition of Land Act 1967* (ALA Act) for purposes associated with Clem7. As this land was no longer required for Clem7, and in accordance with the requirements of the ALA Act, the land was offered back to the former property owner. The former property owner rejected the offer to purchase the land, so the land now remains in the name of Brisbane City Council and may now be used for another purpose. The section of road reserve is in the process of being closed following an application to the Department of Environment and Resource Management (DERM). This road closure is expected to be finalised well in advance of construction commencement. Any potential native title over the area of road reserve will be addressed as part of the road closure process. Once closed, the area of road reserve is proposed to also be held as freehold by Council. In the event the road closure is unable to be completed, development of the TCC building could still proceed with a small change to the proposed building footprint.

- **Table 3-1 Property details**

Lot	2	13	2	
Plan	SP229958	RP9954	RP166978	
Street address	3 Evans Street, Bowen Hills	45 O'Connell Terrace Bowen Hills	41 O'Connell Terrace Bowen Hills	
Size	796 m^2	698 m^2	693 m^2	131 m^2
Tenure	Freehold	Freehold	Freehold	Road reserve

3.2. Site description and topography

The site is cleared vacant land that is relatively flat (refer to **Photo 3-1** and **Photo 3-2**). This site is not listed on the Environmental Management Register or the Contaminated Land Register. The site was previously part of the construction site for the Clem7 project, housing construction site offices and workforce amenities. Following completion of construction for Clem7, the buildings were removed and the site reinstated. There are no volumetric impediments on the site.



- **Figure 3-1 Sketch Plan**

- **Photo 3-1 Proposed TCC site from O'Connell Terrace**

- **Photo 3-2 Proposed TCC site from Sneyd St**

3.3. Surrounding Land Uses and Built Form

The land adjoins the site of the Clem 7 TCC and ventilation station to the north (refer to **Photo** 3-3) and the ICB to the west.

The Clem7 tolled road surfaces south of O'Connell Terrace, with the tunnel portal approximately 50m east of the proposed TCC site. There is no access into Clem7 from O'Connell Terrace. A car park for Clem7 staff and an emergency access into Clem7 are located off Sneyd Street (refer to **Photo 3-4**). These are not available for public use.

The adjacent site on the opposite side of Sneyd Street is vacant, having also been used as part of the construction worksite for Clem7 (refer to **Photo 3-5**). The ventilation shaft for Clem7 crosses underneath this site as a volumetric lot.

The Royal National Agricultural and Industrial Association of Queensland (RNA) Showgrounds are located on the opposite (southern) side of O'Connell Terrace from the TCC site. The Dairy Cattle Pavilion is located directly across from the TCC site (refer to **Photo 3-6**). A master plan to redevelop the RNA showgrounds has been approved (refer to **Section 3.4.1**).

Within the vicinity of the TCC site, existing development does not address the street frontage of O'Connell Terrace. This creates the potential feeling of an unsafe pedestrian environment due to the lack of opportunity for passive surveillance (refer to **Photo 3-7** and **Photo 3-8**).

Land uses along Wren Street, located to the west of the ICB, are a mixture of residential, commercial and light industrial/warehouse activities (refer to **Photo 3-9**). The residential land uses on Wren Street are considered to be the nearest sensitive receivers to the subject site, with the boundary of the closest residence approximately 55m to the west of the site.

Bowen Park, located on the southern corner of Bowen Bridge Road and O'Connell Terrace provides important visual relief to the locality in the form of green space (refer to **Photo 3-10**). The park is listed on the Queensland Heritage Register (refer to **Section 5.1.1**).

The Royal Brisbane and Women's Hospital (RBWH) is located approximately 200m west of the site on Bowen Bridge Road. The buildings and elevated busway on the RBWH site have significant built form and are a dominant feature in the visual environment of the local area (refer to **Photo 3-11**).

- **Photo 3-3 Clem 7 TCC as viewed from Campbell Street**

- **Photo 3-4 Clem 7 employee car park and emergency access**

- **Photo 3-5 Adjacent land on Sneyd Street**

- **Photo 3-6 RNA Showgrounds cattle pavilion as viewed from O'Connell Terrace entrance**

- **Photo 3-7 O'Connell Street facing west**

- **Photo 3-8 O'Connell Street facing east**

- **Photo 3-9 Wren Street**

- **Photo 3-10 Bowen Park**

- **Photo 3-11 RBWH and Northern Busway**

3.4. Other projects within the site locality

3.4.1. RNA Showgrounds

The RNA is implementing the redevelopment of the RNA Showgrounds to include a mixed-use precinct of private development and upgraded exhibition facilities. This will change significantly the streetscape along the southern side of O'Connell Terrace.

A master plan for the RNA Showgrounds was approved by the ULDA in December 2010. The master plan provides for a staged development over a 15-25 year timeframe. The master plan outlines the intent for private development to be focused on the perimeter of the site. This includes commercial and residential land uses along O'Connell Terrace, with ground floor shops and restaurants where appropriate. The master plan provides for buildings fronting O'Connell Terrace to be up to 16 storeys in height. The master plan also suggests that development within the O'Connell Terrace area would be developed between 2019 and 2022. However, discussions with the developers have indicated that this area could potentially be developed sooner.

The RNA Showgrounds are listed on the Queensland Heritage Register. The heritage assessment report submitted with the master plan development application identifies buildings and structures of heritage significance within the Showgrounds which are proposed to be removed as part of the redevelopment of the site. This includes the Dairy Cattle Pavilion building and the O'Connell Street Wall that are adjacent to the proposed TCC site. No alternate use or adaptive re-use of the Dairy Cattle Pavilion was considered viable by the master plan. Removal of the wall and pavilion is also required to allow for the widening of O'Connell Terrace.

3.4.2. Cross River Rail

The Cross River Rail (CRR) project is proposed by the State Government. It has been declared a significant project under the SDPWO Act. CRR involves constructing a new north-south rail line from Bowen Hills in the north to Salisbury in the south. The CRR environmental impact statement is currently available for public review and comment. Should CRR proceed, it would involve significant surface works within the locality of O'Connell Terrace. These works include a new surface railway station within the RNA Showgrounds, as well as widening and raising O'Connell Terrace. This would also require the removal of the Dairy Cattle Pavilion building and the O'Connell Street Wall. These construction works are estimated to take approximately 40 months. Should approval and funding be gained, construction for CRR is anticipated to start in 2015, the same year Legacy Way is scheduled to open.

CRR has three main implications for the development and use of the subject site as a TCC. The first is the proposal to use the subject site as a construction worksite for the CRR project. Consultation with the CRR project team has indicated that the site was selected due to its past use as a worksite and as it is currently vacant. During discussions with Council, the CRR project

team have indicated that an alternative location for the construction worksite could be considered during the detailed design process.

The second implication of CRR is the proposal as part of that project to raise O'Connell Terrace. Council understands that this is proposed in order to provide clearance of 6.1m for rail freight in accordance with Queensland Rail (QR) requirements at the new O'Connell Terrace rail bridge. To accommodate this, the rail bridge would be raised by approximately 2m. The regrading of O'Connell Terrace would extend approximately 150m west. This would affect the grade of the O'Connell Terrace and Snyed Street in front of the proposed TCC site.

The third implication is widening of O'Connell Terrace. The reference design for CRR described in the Environmental Impact Statement for that project proposes widening that impacts the subject site. The exact requirements for road widening of O'Connell Terrace are currently being determined through discussions between Council, Department of Transport and Main Roads and the ULDA.

4. Description of Proposed Change

The proposed change involves development of the TCC on land at the corner of O'Connell Terrace and Sneyd Street, Bowen Hills.

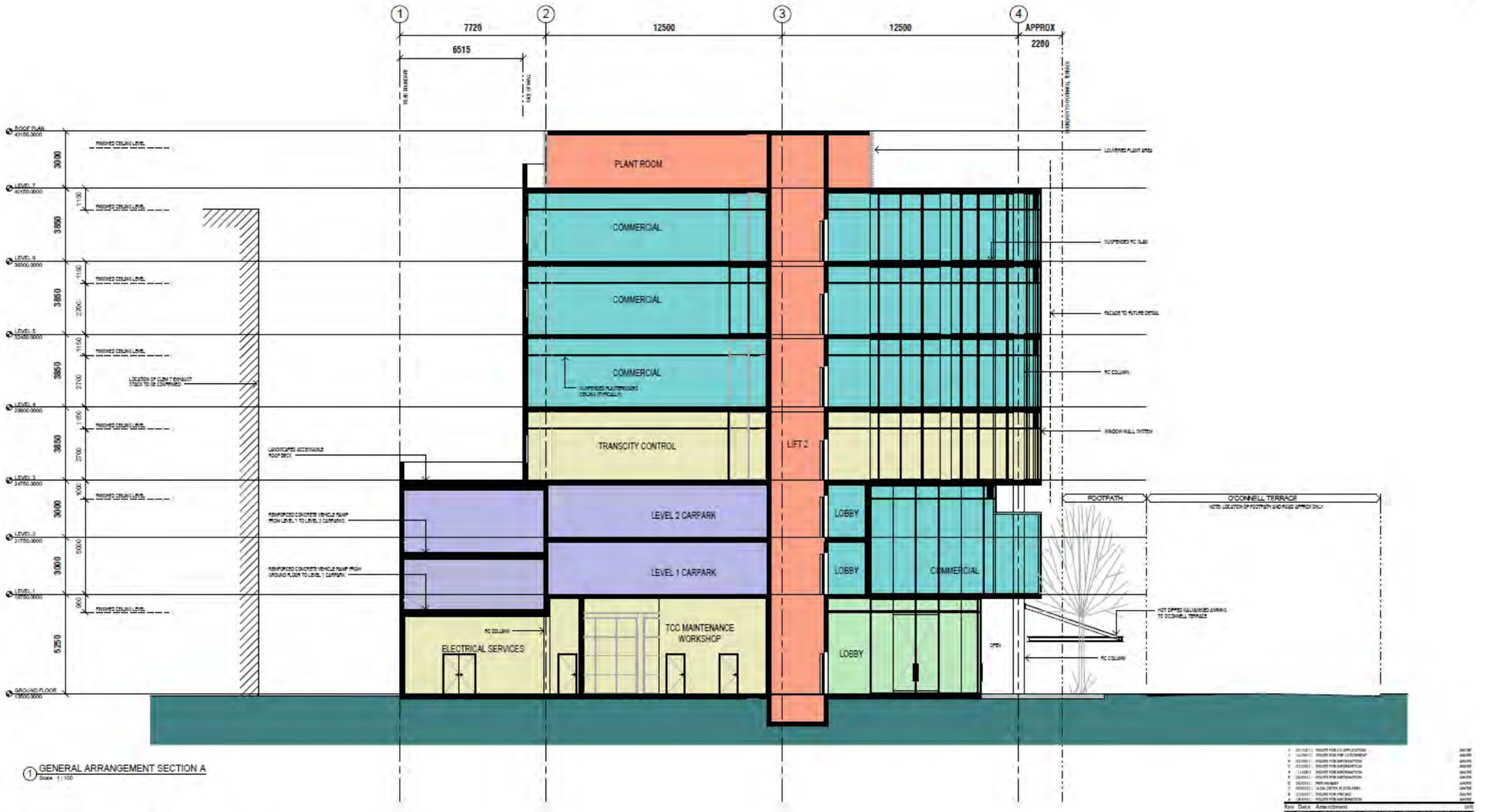
4.1. Development Description

The TCC would include all facilities necessary for the operations and maintenance of the Tollroad. These facilities include:

- A Tunnel Control Room - the Tunnel Control Room would be used by trained operators to monitor and control the safe operation of the Tollroad. All data collected by the in-tunnel monitoring systems would be processed and all the services controlled from this location;
- Training / incident room suitable for use as an emergency or major incident control centre;
- A dedicated equipment room for computer and communications equipment;
- A dedicated plant room;
- Workshop space - plant maintenance and repairs, such as to lighting and ventilation fans would be undertaken within associated workshops and garages;
- Spare parts store;
- Office Areas - the TCC would contain office space for the operation and maintenance staff with spare space for visitors as well as dedicated space for Council or emergency services personnel, including a reception area for visitors;
- Staff Workplace Facilities and Amenities - benching, cupboards, lunch rooms, male and female fixed toilets, male and female shower and change rooms.
- Garage and Parking Facilities - Garaging facilities for up to 5 breakdown and maintenance vehicles would be provided on site, however when on duty, response vehicles will be positioned in areas close to the tunnel portals. Approximately 25 car parking spaces would be provided for TCC operations staff and visitors.

The ventilation outlet for Legacy Way would remain in its approved location adjacent to the Inner City Bypass (ICB) at Herston, adjacent to the Inner Northern Busway. It would not be included in the proposed TCC at Bowen Hills.

The TCC building is also proposed to include a component of commercial office and retail floor space. The proposed building would be 7 storeys high. An indicative cross section of the building is shown in **Figure 4-1** which illustrates the potential composition of the building. It is intended that the top 3 floors would be developed as commercial office space. The retail space could be included at the ground level, to the east or west of the lobby. The details of the proposed design and composition of the building are being finalised in consultation with the ULDA and will also be subject to a detailed feasibility assessment.



- **Figure 4-1 TCC Building Indicative Cross Section**

4.2. Construction

Construction of the TCC building is anticipated to take between 12 to 18 months and, subject to obtaining the required approvals, would commence in mid 2012. During construction, land adjacent to the site at 37 O'Connell Terrace is proposed to be used to support construction activities. It is anticipated this land would be used for a site office, workforce amenities, deliveries, general storage and construction workforce parking. This land is owned by Council (in fee simple). Following construction this site would be reinstated. There are no plans to permanently develop this site as part of the Project.

The construction workforce is estimated to range between 60 and 100 workers over the course of the construction period. Construction traffic is discussed in **Section 5.4**.

4.3. Operation

The average day time workforce for the TCC would be approximately 20 people Monday to Friday. The average night time and weekend workforce would be approximately seven people.

The workshop would be used for minor corrective maintenance to electrical and mechanical equipment. The garage area would be used for the storage of spare parts, specialised maintenance equipment and vehicles.

The site provides a number of alternative access routes to both the eastern and western Legacy Way entry portals. Three options for each portal are outlined in **Table 4-1**. The shortest access routes would be used unless blocked due to an incident or if they are heavily congested.

- **Table 4-1 Legacy Way Access routes**

Access to Eastern Entry Portal	**Option 1**	**Option 2**	**Option 3**
	▪ TCC site ▪ O'Connell Terrace ▪ Bowen Bridge Road ▪ Travel on ICB to eastern entry portal ▪ Approximately 3.2km	▪ TCC site ▪ Clem 7 emergency access from Snyed Street (would require access agreement with Clem7) ▪ Travel on ICB to eastern entry portal ▪ Approximately 3km	▪ TCC ▪ Hamilton Place ▪ Campbell Street ▪ Abbotsford Road ▪ Edmondstone Road ▪ Thompson Street ▪ Allison Street ▪ Travel on ICB to eastern entry portal ▪ Approximately 4.6km
Access to Western Entry Portal	**Option 1 - Tunnel Route**	**Option 2 - Surface Route**	
	▪ TCC site ▪ Travel on ICB to eastern entry portal (via Eastern Entry Portal Option 1 or 2) ▪ Through tunnel ▪ Travel on Centenary Motorway (CM), turn at Moggill Road ▪ Travel back to western portal entry on Centenary Motorway, ▪ Approximately 16km	▪ TCC site ▪ Travel back to Hale Street on ICB (via Eastern Entry Portal Option 1 or 2) ▪ Travel down Hale Street to Milton Road ▪ Travel to Centenary Motorway on Milton Road ▪ Travel on CM, turn at Moggill Road ▪ Travel back to western portal entry on CM ▪ Approximately 15.5km	

5. Effects of project change

The changed location of the TCC building would modify the relative environment and community effects of the Project. The key issues relating to the effects of the TCC building are planning, land use, heritage and urban design, air quality, noise and traffic. The potential impacts of the proposed TCC building are can be adequately managed through implementing a site specific environmental management plan.

5.1. Planning, land use, heritage and urban design

This section considers the potential impacts on the existing land use and visual environment of the locality and the intended future urban environment under the existing planning controls, being the Bowen Hills UDA Development Scheme (Development Scheme). Potential impacts on heritage places are also considered.

5.1.1. Existing environment

The proposed development is subject to the provisions of the land use plan within the Development Scheme. The land use plan articulates the preferred form of development within the UDA, its precincts and sub-precincts. The components of the land use plan are shown in **Appendix B**.

An overview of land uses within the vicinity of the subject site is provided in **Section 3.3**. The area has a mix of land uses. The visual environment of the site locality is dominated by the RBWH to the west and the Clem7 TCC and ventilation building to the north. The character of the locality is also influenced by the road infrastructure of the ICB, Clem7 and the Airport Link flyover structures. The long expanse of wall along the O'Connell Terrace frontage of the RNA Showgrounds does not enliven the street and provides no opportunity for passive surveillance. The lack of passive surveillance and the dominance of road transport infrastructure within the vicinity of the site reduces the quality of the pedestrian environment.

The Development Scheme seeks to improve the current situation and create a high quality streetscape along O'Connell Terrace. The subject site and the adjacent site on the eastern side of O'Connell Terrace represent the only opportunity for development on the northern side of the road along the 150m strip between the ICB and the rail bridge. Therefore they way the proposed TCC building addresses the street will be important for achieving the ULDA's objectives for O'Connell Terrace in this area.

Two places listed on the Queensland Heritage Register are located within 100m of the site, Bowen Park and the Brisbane Exhibition Grounds (RNA Showgrounds). There is also one local heritage place, the Sneyd Street drain that is located in close proximity to the site.

Bowen Park is located approximately 65m south west of the subject site. It is important as one of Brisbane's first public gardens and has been in continuous use since 1863. Elements contributing to its historical and aesthetic qualities include ornamental planting beds, stonewalls, and a 1914 bandstand rotunda.

The RNA Showgrounds are listed on the Queensland Heritage Register. They have been in use as a showground since 1876 and were important in furthering the expansion and development of the agriculture industry in Queensland. As part of the RNA redevelopment, a number of buildings and structures of heritage significance within the site are proposed to be removed. This includes the heritage-listed Dairy Cattle Pavilion building and the O'Connell Street wall that are adjacent to the proposed TCC site.

The Sneyd Street drain is listed on the BCC Heritage Register. It is located within road reserve between 67 Campbell Street, Bowen Hills to Alexandria Street, Fortitude Valley. Within the vicinity of the site the drain travels under Sneyd Street. The Sneyd Street drain is significant in demonstrating the development of stormwater drainage in Brisbane during the latter part of the 19th century. The location of the drain was surveyed for the Clem7 project as the northern ventilation tunnel passes below the drain.

5.1.2. Impact Assessment and Mitigation

The proposed TCC building is consistent with the structure plan and the intent of the RBH Precinct under the Development Scheme. The ULDA will assess the development application for the building against the development requirements in the land use plan. The relevant provisions include UDA wide criteria, RBH Precinct outcomes and RBH Precinct development intensity and built form requirements. A high level summary of the proposed response to key provisions on the Development Scheme is included in (**Appendix B**).

To mitigate the potential land use impacts and to capture the potential urban design benefits, the TCC building would be designed in accordance with the land use plan of the Development Scheme. The final concept design of the building and any associated streetscape works would be assessed by the ULDA as part of the UDA development application.

The proposed development has the potential to improve the existing visual environment of O'Connell Terrace. It would reduce the existing visual impacts of the Clem7 ventilation building through partial screening of the building from O'Connell Terrace and improve passive surveillance. An indicative perspective illustration of what the building could look like is included in **Figure 5-2**.

The visual qualities of the building are guided by the development intensity and built form requirements in the Development Scheme. An attractive streetscape is achieved through a well articulated building façade and an awning extending over the O'Connell Terrace footpath. The car parking areas are located to the rear of level 1 and 2 and would not be visible from O'Connell Terrace due to the office space at the front of the building. This is consistent with the Development Scheme requirements for car parking to be located away from the public realm.

External lighting of the building would be designed so that light does not overspill into other buildings or the sky in accordance with the requirements of the Development Scheme.

- **Figure 5-1 Indicative building perspective (looking north east across the site)**

The building design would comply with the existing Coordinator-General's Condition (11) Building works, which requires that TCC buildings associated with the project are designed sympathetically to the surrounding environment. It would also comply with Condition (24) Urban design and landscape which requires the project to be constructed in a manner that minimises the visual impact of infrastructure.

The proposed regrading of O'Connell Terrace as part of CRR would impact how the TCC building addresses the street. Council is working to provide a building design that could be adjusted to accommodate a regraded O'Connell Terrace in the future if required, while maintaining functionality. Council will also liaise with the ULDA, the developer of the RNA Showgrounds (in this case Bovis Lend Lease) and the State as the developer of CRR to enable a consistent approach on the future streetscape for O'Connell Terrace in the vicinity of the TCC site.

The proposed use of the site for the TCC would not impact on the heritage values of Bowen Park or the RNA Showgrounds. The built form of the TCC building would not affect the setting of either heritage place, as it is located on the opposite side of O'Connell Terrace and would not

be visually dominant in the streetscape, considering the surrounding built form of the Clem7 ventilation station and RBWH.

The existing cultural heritage management plan for the Project would be updated to include the subject site as it is outside of the existing study area.

The Sneyd Street drain is located under the road reserve of Sneyd Street on the western side of the road. It is located very close to the area of road reserve that is proposed to be closed and included in the development site. The proposed development has the potential to affect the Sneyd Street drain if excavations for the building footings or bored piers for building support are located over the top of the drain. The detailed design of the building footings and pier supports would avoid any activity that could affect the structure or integrity of the Sneyd Street drain in order to mitigate any potential impacts.

5.2. Air quality

An assessment has been carried out into the potential air quality impacts during construction and operation of the proposed Legacy Way TCC by:

- Reviewing legislative requirements and ambient air quality goals;
- Identifying the nearest sensitive receivers to the site;
- Describing the existing air quality and surrounding emission sources within the project area;
- Qualitatively assessing air quality assessment of construction activities; and
- Discussing the potential impacts associated with building wake influences on the Clem 7 ventilation outlet (refer to **Appendix C** for a full report on potential effects of the TCC building on plume dispersion of the outlet).

5.2.1. Air quality guidelines

The *Environmental Protection Act 1994* provides for the management of the air environment in Queensland. Air quality guidelines are specified by the DERM in the Queensland *Environment Protection Policy (Air) 2008* (EPP(Air)).

Deposited dust, if present at sufficiently high levels, can reduce the amenity of an area. No formal criteria for dust deposition exist within Queensland however, the EPA[3] (2003) recommends a nuisance guideline of 120 mg/m^2/day averaged over one month.

The air quality goals outlined in the Coordinator-Generals Condition (20) for the Project are relevant to the construction of the TCC, and are presented in **Table 5-1**.

- **Table 5-1 Ambient Air Quality Guidelines**

Project Phase	Air Quality Indicator	Air Quality Guideline		Averaging Time
		µg/m^3	ppm	
Construction	Particles (as TSP)	80	-	24 hour
	Particles (as PM_{10})	50[#]	-	24 hour
	Insoluble dust	120 mg/m^2/day	-	1 month

[#] - Level not to be exceeded more than 5 times per year

The ambient air quality goals for the Clem7 ventilation outlet are also relevant to the TCC building, in terms of any potential impacts from the TCC building on the operation of the outlet.

[3] EPA, 2003, Environmental management of mining activities: Preparing an environmental management overview strategy (EMOS) for non-standard mining projects, version 1.1, Environmental Protection Agency, Ecoaccess Guideline 8, 03/2003

These goals are outlined in the Coordinator-Generals Condition 17(f) for the Clem7 Project and are included in **Table 5-2**.

- **Table 5-2 – Clem 7 Ventilation Station Ambient Air Quality Goals**

Pollutant	Goal	Unit	Measuring Period
Carbon monoxide (CO)	8 or 10	ppm mg/m^3	8 hour maximum*
Nitrogen dioxide (NO_2)	0.12 or 245	ppm $\mu m/m^3$	1 hour maximum
Particulate matter less than 10 μm (PM_{10})	50 50	$\mu m/m^3$ $\mu m/m^3$	24 hour maximum ** annual mean
Particulate matter less than 2.5 μm ($PM_{2.5}$)	25 8	$\mu m/m^3$ $\mu m/m^3$	24 hour maximum annual mean
Total suspended particulate matter (TSP)	90	$\mu m/m^3$	average annual mean

* One day per year maximum allowable exceedence;

** Five days per year allowable exceedence, not including exceedence in ambient goals due to external events (eg dust storms, fires, major construction works)

5.2.2. Existing Environment

This section describes the local environment, including meteorology and ambient air quality. The nearest sensitive receivers are identified in **Section 3.3**.

Climate and Dispersion Meteorology

Meteorological data recorded by the Bureau of Meteorology (BoM) in Brisbane has been reviewed to assess the existing meteorological and climatological influences in the project area. The project area has a subtropical climate, typically with warm moist summers and fine dry winters. Maximum mean temperature during the summer is 30.3ºC in January and minimum mean temperature is 9.9 ºC in July. Mean annual rainfall is 968 mm and mean number of days of rain over 1mm is 82.

The predominant wind in Brisbane is from the southwestern quadrant, with some easterly winds up between 10-20km/hr in the summer and calmer conditions in the winter with predominant southwesterly winds generally below 10km/hr.

Existing Air Quality

Existing air quality within the local area is influenced by local sources of air emissions and sources from within the wider Brisbane City region. These sources include motor vehicle emissions from major roads in the area, including Bowen Bridge Road and ICB, Clem7 ventilation outlet, the inner northern busway and the railway.

The EIS for the Project (September 2008) included a detailed air quality assessment within Brisbane. The EIS reviewed air quality monitoring data from Brisbane CBD, Rocklea, South

Brisbane, Woolloongabba, Bowen Hills and Kedron. A summary of this monitoring data from 2004 to 2007 includes:

- Short term (24-hour) PM_{10} concentrations have exceeded the EPP(Air) goal of 50 µg/m^3 at all monitoring locations on at least one occasion in recent years. These events generally coincide with widespread dust storms or bushfires which can influence large areas; and
- Annual average PM_{10} concentrations were below the then Environmental Protection Agency's air quality goals at all monitoring locations.

The air quality modelling included in **Appendix C** used conservatively high background levels of ambient air quality for various traffic pollutants. The levels are based on a review of 2010 air quality monitoring data from three DERM monitoring sites (South Brisbane, Rockela and Woolloongabba), and selecting the maximum concentration of each pollutant out of the three sets of results. These levels are presented in **Appendix C**.

- **Table 5-3 Background levels of ambient air quality for various traffic pollutants**

Pollutant	Averaging Period	Background level (µg/m^3)
Nitrogen dioxide	1-hour (95th percentile)	57.5
Carbon monoxide	8-hour (95th percentile)	1625
PM_{10}	24-hour (95th percentile)	25.3
	Annual	19.3
$PM_{2.5}$	24-hour (95th percentile)	13.6
	Annual	8.4

5.2.3. Construction Impacts and Mitigation Measures

Potential Impacts

The most significant air quality impacts from the construction of the proposed TCC are expected to be particulate matter resulting from excavation activities and wheel-generated dust from haul vehicles entering and exiting the site.

The site is currently cleared and vacant so no demolition activities would be required. Excavation would be required to establish the building foundations, however no basement storeys are proposed for the TCC.

Open excavations and areas where spoil is handled (stockpiled, loaded into trucks etc.) are recognised as key risks in relation to potential nuisance dust impacts on nearby sensitive receivers. Excavation works would involve typical construction methods, including excavators, graders and cranes.

The greatest potential for dust impacts arising from these activities is likely to include:

- Excavation, handling and transport of spoil;

- Wind erosion from exposed areas; and
- Wheel generated dust from vehicles travelling along unpaved or dirty paved surfaces.

The dust emissions during construction are unlikely to result in exceedances of the air quality objectives described in EPP (Air) or the Coordinator-General's Condition 20 for the Project. There is potential for nuisance impacts at nearby sensitive receivers and mitigation measures have been recommended below to minimise these impacts.

There would also be small emissions of carbon monoxide (CO), oxides of nitrogen (NO_x), sulphur dioxide (SO_2) and PM_{10} from exhaust emissions from construction equipment and haul trucks. These emissions are not expected to be significant for the development due to the low intensity of the work on site.

Mitigation Measures

The following mitigation measures are recommended during the construction of the proposed TCC:

- Surface excavation works to incorporate consideration of prevailing winds (speed and direction) with works potentially ceasing if high winds are blowing in the direction of sensitive receivers during extensive ground works;
- Water sprays would be implemented during drilling and exposed excavation activities;
- Loaded trucks would be washed down prior to exit from the worksites to ensure that loose material is not tracked onto the adjacent paved road network;
- Trucks transporting excavated material would be covered to prevent wind-blown dust during transport;
- Water sprays to be used on stockpiles during dry periods and times of high winds, or stockpiles should be covered appropriately to reduce windblown dust;
- Avoiding queuing of construction traffic entering the site;
- Vehicles and machinery should be fitted with appropriate emission control equipment and be maintained sufficiently to enable design specifications to be met;

The implementation of such mitigation measures would be governed through a site specific environmental management plan and would be in accordance with Condition (20) Air quality for the Project.

5.2.4. Operational Impacts and Mitigation Measures

Building Wake Influence

Tall buildings generate downwind wake effects which have the potential to affect the dispersion of pollutants from the Clem7 ventilation outlet. The aerodynamic wake caused as air passes over the building can entrain the stack plume, effecting the concentration of air pollutants. An air quality impact assessment study has been undertaken by Katestone Environmental to determine the potential effect of the TCC building on plume dispersion of the Clem7 ventilation

outlet. The study also considered the likelihood of impact of the exhaust from the Clem7 ventilation outlet on the facade of the TCC building. The study is included in **Appendix C**.

Using conservatively high background levels, the study found that the TCC building would not adversely affect dispersion of the plume from the Clem7 Tunnel ventilation outlet. The modelling found that the predicted ground-level concentrations of NO_2, CO and PM_{10} would comply with the Coordinator-General's air quality goals for the Clem7 project. However, the modelling shows that the predicted annual average ground-level concentrations of $PM_{2.5}$ would exceed the Coordinator-General's air quality goal of 8µg/m^3 for the Clem7 project, with concentrations predicted to be up to 8.8µg/m^3 at one of the nearby sensitive receptors. This is due to the assumed elevated background concentration of 8.4µg/m^3, not as a result of the proposed TCC building. The results included in **Appendix C** show no difference between the predicted concentration of $PM_{2.5}$ at the near by sensitive receivers with the proposed TCC building and the predicted concentration without the building.

The predicted concentrations of NO_2, CO and PM_{10} and $PM_{2.5}$ on the facade of the TCC building also comply with the Coordinator-General's air quality goals for 2011 and 2021.

Traffic
The predicted 2014 traffic volumes with and without the proposed TCC building are outlined in **Section 5.4.4**. Air emissions from vehicles associated with the operation of the proposed TCC would not have a significant impact on air quality, as the predicted increase in traffic numbers due to the proposed TCC are insignificant in comparison with existing traffic numbers on the local road network

5.3. Noise environment

An acoustic assessment has been carried out to consider noise from construction activities and operational noise emissions from the TCC building to nearby residences. The acoustic assessment report is included in **Appendix D**.

5.3.1. Existing environment

The nearest relevant noise sensitive locations are residential buildings in Wren Street, immediately west of the ICB and approximately 55m from the site. Bowen Park is also a noise sensitive location and is approximately 65m to the southwest of the site. The Clem 7 TCC building, approximately 50m to the north, contains office space but will be significantly screened from noise by the intervening ventilation station.

Noise surveys were conducted to establish the existing noise environment at the residences near to the development site and to assist in determining noise criteria for the development.

The noise surveys were conducted in general accordance with the DERM *Noise Measurement Manual*.

Attended noise measurements were performed on Monday 5 September 2011 and Tuesday 13 September 2011 to measure existing significant sources of noise near to the development site.

Measurements were conducted with a RION NA-27 precision sound level meter configured to record a range of A-weighted noise levels, including the L_{A1}, L_{A10}, L_{Aeq}, and L_{A90} statistical parameters, over a 15-minute period. The calibration of the sound level meter was confirmed before and after the monitoring survey using a RION Type NC–73 Sound Level Calibrator. Measurements of ambient noise were taken at various times at the noise logger location as shown in **Figure 5-2**.

- **Figure 5-2 Noise Logger location**

Table 5-4 provides the results of the attended monitoring survey. The dominant source of noise during the survey was traffic using the ICB. Noise from traffic on O'Connell Terrace and Clem7 was also significant. Noise from the ventilation station and associated mechanical plant was not audible when observed at the measurement location near to the Wren Street residences. No other significant noise sources were identified during the noise surveys.

Table 5-4 Attended Noise Survey Results

Date / Time	Measured Noise Level, dBA			
	L_{A1}	L_{A10}	L_{Aeq}	L_{A90}
Monday 5 Sep 2011 4.20pm	78	75	73	72
Tuesday 13 Sep 2011 9.45pm[#]	75	69	65	58

[#] Construction work on the inner City Bypass reduced traffic speeds to approximately 40km/h

A continuous unattended noise monitoring survey was undertaken from Monday 6 September 2011 to Tuesday 12 September 2011. The monitoring survey was carried out using an Acoustic Research Laboratories Type EL-316 Environmental Noise Logger. The noise logger was configured to record a range of A-weighted noise levels, including the L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} statistical parameters, over consecutive 15-minute periods. The calibration of the logger was confirmed before and after the monitoring survey using a RION Type NC-73 Sound Level Calibrator. The measurement results have been analysed with regard to the DERM Ecoaccess Guideline: *Planning for Noise Control* document. A summary of the average measured noise levels has been presented in **Table 5-5**.

Table 5-5 Summary of Measured Ambient Noise Levels

Statistical Parameter	Period	Average Measured Noise Levels, dBA
L_{A1}	Daytime[1]	80
	Evening[2]	78
	Night[3]	76
L_{A10}	Daytime	78
	Evening	75
	Night	71
	18 hour[4]	77
L_{A90}	Daytime	73
	Evening	68
	Night	52
L_{Aeq}	Daytime	76
	Evening	74
	Night	72
	24 hour[5]	75
	Maximum 1 hour (day)	77
	Maximum 1 hour (night)	76

1. 7.00am to 6.00pm on a day
2. 6.00pm to 10.00pm on a day
3. 10.00pm on a day to 7.00am the next day
4. The LA10(18hour) is the arithmetic average of the hourly LA10 noise levels over hte 18-hour period between 6.00am and 12.00 midnight
5. The LA10(24hour) is the arithmetic average of the hourly LAeq noise levels measured over a 24-hour period.

The unattended and attended survey results were comparable and consistent with an area dominated by road traffic noise. It is expected that ambient noise levels in Bowen Park would be similar to those measured adjacent to the Wren Street residences due to the contributions from road traffic on the ICB, O'Connell Terrace and Bowen Bridge Road.

5.3.2. Noise Criteria

The noise emissions associated with the building must be considered in accordance with the Coordinator-General's Conditions for the Project. The Coordinator-General's Condition (22) Noise and vibration for the Project include acoustic quality objectives for construction activity. However, there are no specific operational noise criteria for sources of noise other than road traffic included in the Coordinator-General's conditions. It is considered appropriate to assess operational noise emissions from the TCC building with regards to the Development Scheme and the referral document *Environmental Protection (Noise) Policy 2008* (EPP (Noise)).

Noise criteria for the TCC development are outlined in **Table 5-6** and are based on the requirements of the Coordinator-General's conditions (for construction) and the EPP (Noise) (for operation).

Table 5-6 Limits for the TCC Development

Noise Source	EPA Period		
	Noise Criteria for Identified Noise Sources Relevant to the Development		
	Day (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 7am)
Mechanical Plant (Operational)	50 dBA $L_{Aeq,adj,1hr}$	50 dBA $L_{Aeq,adj,1hr}$	40 dBA $L_{Aeq,adj,1hr}$[1]
Workshop Activity (Operational)	65 dBA $L_{A1,adj,1hr}$	65 dBA $L_{A1,adj,1hr}$	50 dBA $L_{A1,adj,1hr}$[1]
Construction Activity	50 dBA $L_{Aeq,adj,1hr}$[2] 55 dBA $L_{A10,adj,1hr}$[2] 65 dBA $L_{A1,adj,1hr}$[2]		

1. Assuming a 10 dB reduction from outside to inside a sleeping area via a partially open window.
2. Applicable between 6.30 am and 6.30 pm Monday to Saturday.
3. Applicable between 6.30 pm and 6.30 am Monday to Saturday, if required.
4. In accordance with WHO Sleep disturbance criteria, if required.

It is noted that all reasonable and practical measures must be undertaken in an endeavour to achieve the construction noise objectives in accordance with the Coordinator-General's report. However, the noise survey measurement results show that the existing ambient noise levels in the area are significantly higher than the external noise objectives set by the Coordinator-General.

5.3.3. Assessment of noise sources and noise generating activities

Identified Noise Issues

The activities/sources at the development expected to generate noise at the nearest residences will be as follows:

- Noise from rooftop mechanical plant;
- Noise from workshop activities; and
- Noise from construction activities.

Noise from vehicles in the car parking areas of the building, and entering/exiting from Sneyd Street, is expected be negligible when observed at the Wren Street residences given the influence of the existing road traffic noise, and has not been considered further. Additionally, noise emissions associated with the retail and commercial operations at the building is also expected be negligible when observed at the Wren Street residences given the influence of the existing road traffic noise, and has not been considered further.

This assessment has considered noise from the project at the Wren Street residences. As these are the closest sensitive receivers to the subject site, a design that achieves noise criteria at this location will also be compliant at other noise sensitive locations that are further away from the TCC building, such as Bowen Park.

Rooftop Mechanical Plant

Mechanical plant selection and location will be finalised during the detailed design phase. Discussions with the project mechanical engineer indicated that a combination of packaged air handling units and reverse cycle condensers may be used to supply heat rejection and ventilation requirements. A central rooftop location, approximately 60m from the Wren Street residences, covering approximately 160m^2 has been anticipated.

The most critical time in terms of mechanical plant noise emissions will be the night-time. A design compliant with the night-time limit will be compliant at other times when the limits will be higher. However, it is expected that heat rejection and ventilation requirements will be significantly lower for the night-time period and not all the plant items would be operational at that time.

Based on the night time noise limit (40 dBA L_{Aeq}) and the separation distance between the Wren Street residences and the proposed rooftop plant location, the maximum **sound power level (SWL)** allowed for all rooftop plant items (combined) will be **88 dB**. This means that compliance with the night time noise objectives will be achieved if the maximum noise output for all rooftop plant items operating during the night period does not exceed 88 dB SWL. Likewise, the maximum SWLs for the day and evening periods, when the noise limit will be 50 dBA L_{Aeq}, will be **98 dB**.

Noise control by way of screening may also be considered if required. Screening would provide noise reductions of the order of 10 dB – 15 dB, allowing plant with higher noise output to be considered.

A detailed investigation must be undertaken when mechanical plant selection, design and operating conditions have been finalised to determine if acoustic screening will be required. However, it is expected that mechanical plant with appropriate noise output, combined with noise control screening if required, will be readily able to achieve the EPP (Noise) objectives at all times.

Workshop Activities

The workshop will be located on the ground floor of the proposed building. The walls to the ground floor areas will be precast concrete. There will be no openings in the façade which faces west towards the Wren Street residences. There will be a roller door facing O'Connell Terrace, and this will be the main emission point for workshop activity noise for the Wren Street residences.

Noise-generating activities in the workshop area are expected to be of a minor corrective and maintenance nature. Such activities would generally involve hand-held equipment with SWLs of up to 105 dBA L_{Amax}. It is expected that the power tools would be used for short periods at a time, and that noise associated with power tools would have a prominent tonal and/or impulsive character.

Based on the above, the location of the workshop within the building, the proposed building design (including the roller door in a closed position), and the separation distance to the Wren Street residences, workshop noise levels of the order of 45 dBA $L_{A1,adj,15\ min}$ are predicted at the Wren Street residences.

Therefore, the workshop noise levels would be expected to comply with the EPP Noise objectives at all times.

Construction Activities

Table 5-7 shows the acoustically significant plant and equipment items to be used at various stages during construction as provided by the project team. The SWL and operating duration has also been shown in **Table 5-7**.

- **Table 5-7 Construction Plant and Equipment Sound Power Levels and Operating Duration**

Plant/Equipment Item	Sound Power Level (dBA LAmax)	Operating Duration (minutes per hour)
Mobile/Tower crane	105	30
Fork lift	102	30
Truck/Semi-trailer[1]	114	30
Concrete truck[2]	112	60
Concrete pump	107	60
Excavator	114	60
Power tools	105	30
Roller	118	60
Compressors	100	60

1. 5-10 concrete trucks on one day per week, fewer following structure completion.
2. 2-6 trucks on alternate days, fewer following structure completion.

Table 5-8 provides the predicted construction noise levels at the Wren Street residences. The predicted levels have been shown including the effects of solid screens of three different heights (2m, 3.5m, and 5m). The screens would run the length of the western site boundary and would return along the northern and southern site boundaries for approximately 50m. Predicted construction noise values that exceed the Coordinator-General's objectives are shaded.

The predicted construction noise levels have been based on L_{Amax} SWL adjusted for expected variations in noise output of the plant/equipment item. The predicted levels also include adjustments for tonal and/or impulsive noise character where applicable, and also have been adjusted for estimated audible duration in a one hour period.

- **Table 5-8 Predicted Construction Noise at External Areas of Wren Street Residences**

Plant / Equipment Item	Predicted Noise Level, dBA $L_{Aadj,1\ hr}$ including effect of solid screen[1]								
	2 metre screen			3.5 metre screen			5 metre screen		
	L_{Aeq}	L_{A10}	L_{A1}	L_{Aeq}	L_{A10}	L_{A1}	L_{Aeq}	L_{A10}	L_{A1}
Mobile/Tower crane	51	54	57	47	50	53	43	46	49
Fork lift	45	48	51	41	44	47	37	40	43
Truck/Semi-trailer	57	60	63	53	56	59	49	52	55
Concrete truck	55	58	61	51	54	57	47	50	53
Concrete pump[2]	58	60	61	54	56	57	50	52	53
Excavator	60	63	66	56	59	62	52	55	58
Power tools[3]	54	57	59	50	53	55	46	49	51
Roller	61	64	67	58	61	64	56	59	62
Compressors	52	54	55	48	50	51	44	46	47
Noise objective (dBA)[4]	**50**	**55**	**65**	**50**	**55**	**65**	**50**	**55**	**65**

1. The screen must be constructed from a sold material with a minimum surface density of 12 kg/m3 (eg 20 mm timber, 15 mm plywood, 9 mm cement sheet, or colourbond sheet etc).
2. Includes a +2 dB adjustment for tonal character.
3. Includes a +5 dB adjustment for tonal and/or impulsive character.
4. As per Coordinator-General's report.

It is noted that the predicted construction noise levels are less than the existing background noise levels during the daytime (6:30 am – 6.30 pm) at the Wren Street residences for all scenarios. Therefore, none of the construction activities would be considered "high noise impact"[4] as defined in the Coordinator-General's report.

The predicted construction noise levels in **Table 5-8** suggest that construction noise would generally achieve the noise objectives in the Coordinator-General's report when a 5m high screen is in place. Noise associated with the roller and excavator may be expected to exceed the objectives by up to 6 dB for short periods during day time works. Excesses of construction noise of this magnitude are considered to be minor. It would also be insignificant in the context of the existing noise environment which is dominated by noise from traffic using the ICB.

For screen heights of 3.5m and 2m, the excesses would increase to 8 dB and 11 dB respectively, in addition to a greater number of the construction noise sources exceeding the objectives. Construction noise excesses of these magnitudes would be considered moderate, as they are less than the existing background noise levels.

5.3.4. Construction Noise Minimisation and Management

In accordance with the Coordinator-General's report, it will be appropriate to identify reasonable and practical measures designed to minimise construction noise emissions as part of a site

[4] 'High Noise Impact' means works which generate noise greater than the background noise level without the Project plus 20dB(A) (adjusted), at a Sensitive Place when measured in accordance with the most recent edition of the Noise Measurement Manual (Queensland Government).

specific Construction Environmental Management Plan (CEMP) and in accordance with Condition (22) Noise and vibration.

There will be several techniques available that would be considered reasonable and practical, which could be incorporated into the CEMP, including:

- Installing noise reduction screens - the screens should be as high as practicable (and consider safety constraints etc to be determined in the detail design phase) in order to obtain maximum noise reduction. The screens would run the length of the western site boundary and extend along the northern and southern site boundaries for approximately 50m. The screens should be constructed as per Note 1 in **Table 5-8**.
- Selecting plant/equipment with lower noise output (ie with silencers, mufflers or other noise control devices fitted), than listed in **Table 5-7** to reduce noise construction noise emissions.
- The delivery area of material to the site should be arranged to eliminate the need for vehicles to reverse, thereby eliminating reverse alarms. Plant items on site full-time should be fitted with reverse alarms of the broadband type (i.e. bland, “quacking” type).
- Position compressors behind structures that act as barriers or locate them on the east of the site.
- Orientate concrete pumps/trucks so that noise emissions are directed to the east.
- Encourage contractors and construction workers to practice “quiet” work methods, including:
  - avoid creating “impact” noises, particularly during loading/unloading activities; and
  - maintain plant/equipment in good working order in accordance with manufacturer specifications.

5.4. Traffic and transport

5.4.1. Assessment Methodology

This assessment considers the potential impacts of the TCC in its proposed location together with other proposed office and retail land uses on the same site.

The methodology used undertakes a preliminary traffic impact assessment of the development site which:

- Identifies the baseline transport environment;
- Applies trip generation rates consistent with the current building plans; and
- Assesses the expected impact of the development traffic on the surrounding road network.

Results and findings are reported in the following sections.

5.4.2. 2014 Baseline (Without TCC) transport environment

The Northern Link Traffic Model has been used to determine the baseline traffic volumes on the road network around the TCC development site for the opening year of 2014. These model volumes take into account network operations on O'Connell Terrace and the surrounding area following the opening of Airport Link.

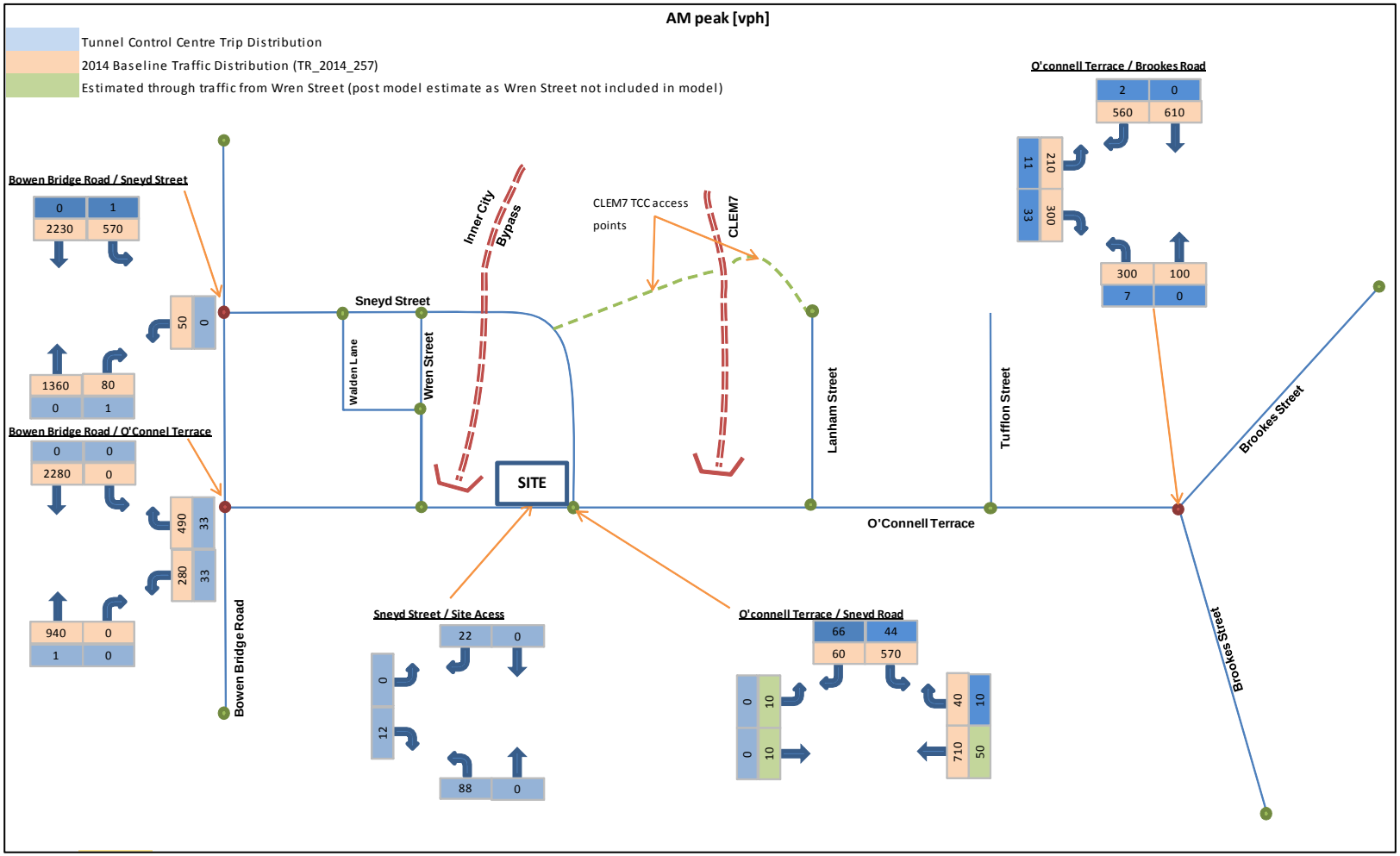
The forecast weekday AM peak hour traffic volume on O'Connell Terrace is expected to be 770 vph west of Sneyd Street and 1,320 vph east of Sneyd Street. Sneyd Street is forecast to have a peak hour traffic volume of 670 vph in the AM peak.

The PM peak hour traffic volume on O'Connell Terrace is expected to be the larger of the peaks with 1,350 vph west of Sneyd Street and 1,570 vph east of Sneyd Street. Expected PM peak volumes on Sneyd Star are 310 vph.

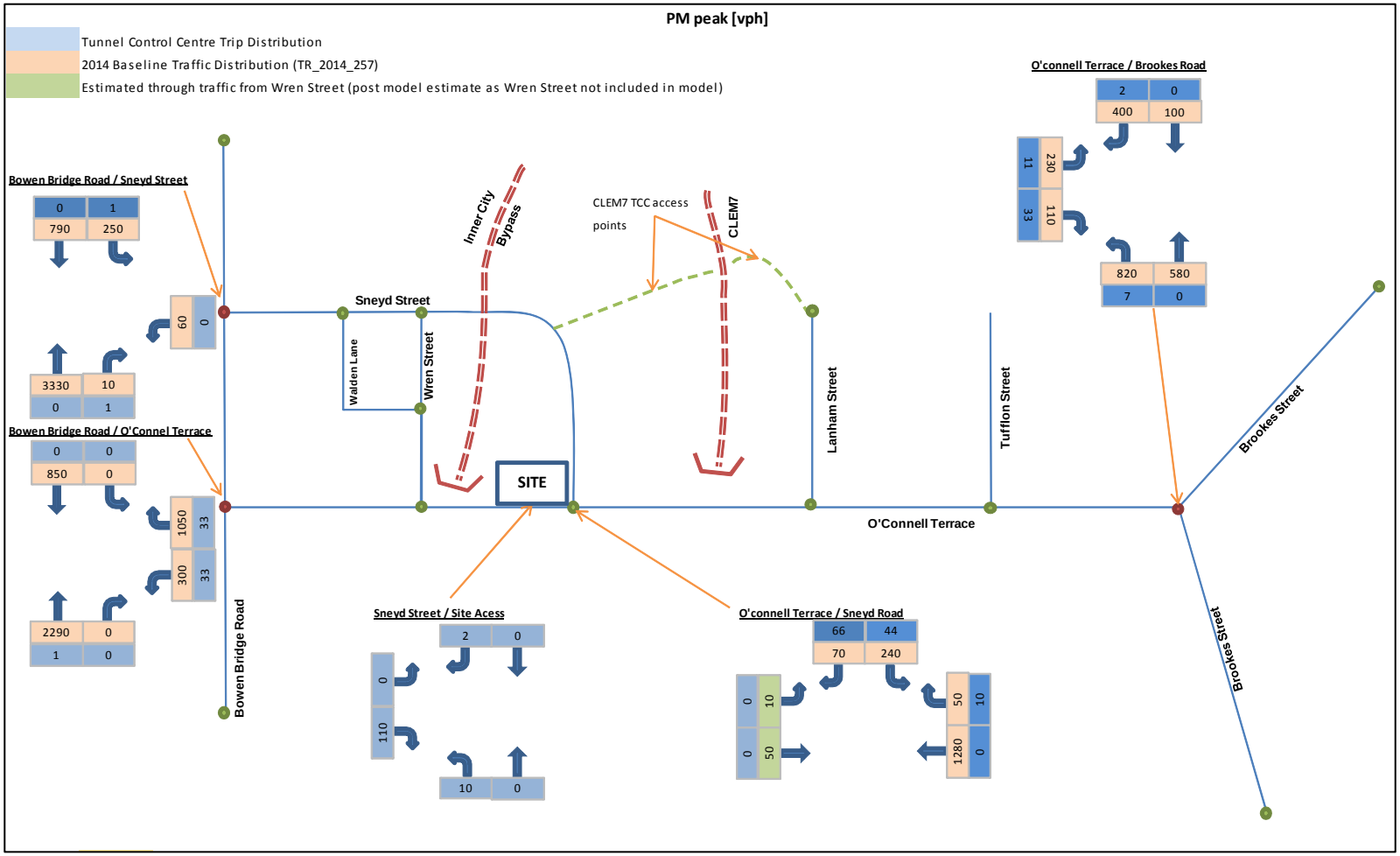
AM peak and PM peak hour baseline turning volumes in the vicinity of the TCC are shown in **Figure 5-3** and **Figure 5-4** respectively.

The site is well served by public transport due to the close proximity of the Northern Busway along Bowen Bridge Road and the nearby Bowen Hills rail station. O'Connell Terrace is already well serviced with bus routes to and from the city as well as connection into the Northern Busway.

Pedestrian access to site and to local public transport facilities is provided for with sidewalks and a signalised crossing at Bowen Bridge Road which provides safe access to the Northern Busway. A strong potential therefore exists for strong mode share for public transport and active transport travel to the development.



- **Figure 5-3 2014 AM peak 1 hour baseline and site trip distribution**



- **Figure 5-4 2014 PM peak 1 hour baseline and site trip distribution**

5.4.3. Trip Generation and traffic impacts of TCC

The assumed trip generation and distribution for the AM and PM peak hour traffic for the TCC have been calculated based on the expected land use of the mixed use building to be constructed. Trip rates have been based upon the Roads and Traffic Authority's *Guide to Traffic Generating Developments Section 3.* Transcity has provided expected daily trip generation rates for the day to day operation of the TCC as follows:

- Typical day:
  - 8 commercial vehicle movements per 24 hours (road patrollers tow trucks); and
  - 60 light vehicle movements per 24 hours.
- Tunnel closure events (once per week):
  - 10 commercial vehicle movements; and
  - 50 light vehicle movements.

As outlined in the October 2010 APC the Project, the expected peak trip generation is approximately 25% of the daily vehicle trips (60), based on experience with other facilities of similar size. This equates to 15 vehicles per hour (vph) in the peak with an additional heavy commercial vehicle movement into and out of the site to take into account incident management vehicles and trucks for the movement of tunnel maintenance parts. In total a trip generation of 17 vph in each peak is expected during normal day to day operations of the TCC.

During the AM peak the estimated direction distribution of traffic is 90% inbound / 10% outbound, with the opposite in the PM peak. Exit traffic from the site would be expected to take the most direct route via O'Connell Terrace. Entry traffic would be expected to distribute between O'Connell Terrace (80%) and Bowen Bridge road via Sneyed Street (20%).

Table 5-9 shows an expected peak hour trip generation for the site of 123 vph based on the floor plans of the proposed TCC building and using a breakdown of the anticipated land uses for the TCC site. It shows the forecast baseline trip distribution for the AM and PM peak periods respectively, with the expected distribution for TCC and associated retail and commercial office space superimposed.

- **Table 5-9 Legacy Way TCC trip generation**

Use	Description	Peak Period Trip Generation [vph]
Non TCC usage[1]	Office and retail land uses on ground level and floors 4,5,6	106
TCC usage	Office use on floors, 1 and 3 and garage and maintenance usage on ground floor	17
Total		123

Table Note: 1.) Source RTA Guide to Traffic Generating Development Section 3

During construction the expected trip generation for the workforce is estimated to be 24 vph, based on the following assumptions:

- A normal working day starting at 6:00am and ending at 6:00pm with the construction work force (approximately 90 vpd) arriving and leaving outside of peak periods.
- Parking and site office access occurs on Sneyd Street opposite the proposed development site, with movements and distribution similar to those proposed for the TCC after construction.
- 10 concrete trucks (maximum) could be expected in the peak period due to the limited hours of operation (4-7hrs) equalling a trip generation **20 vph**.
- A peak generation of approximately 2 MRV/van/utes for deliveries is estimated to occur during peak periods leading to a total construction trip generation of **4 vph** in the peak period.

5.4.4. Impacts and Mitigation

Table 5-10 shows the expected impacts of the development on the total intersection volumes around O'Connell Terrace and Sneyd Street. The largest increase (7%) is forecast at the intersection of O'Connell Terrace and Sneyd Street. A Sidra intersection analysis has been carried out as outlined in **Table 5-11** and **Table 5-12**. The analysis shows the forecast operation of the O'Connell / Sneyd Street intersection with and without the TCC in place. The assessment shows:

- A small decrease in level of service in the PM peak for traffic exiting Sneyd Street occurs, with a small change from level of service A (good operation) to B (acceptable delays and spare capacity).
- The impact expected at the other major intersections in the area around the TCC is less than 5% and would not be expected to have a material impact on the operation at these intersections.
- Construction impacts are not expected to have a material impact on the operation of the intersection around the site as the total peak period trip generation (56 vph) is under half the trip generation (123 vph) forecast during normal day to day operations of the TCC after construction.
- The site office and construction workforce parking access will be located on Sneyd Street so no significant impacts would be expected on public transport, pedestrian or cyclist usage along O'Connell Terrace.

- **Table 5-10 2014 Intersection Traffic Volume Comparison**

Intersection	Without TCC [vph]	With TCC [vph]	Difference [vph]	% Change
AM Peak				
O'Connell /Sneyd	1450	1551	101	7%
Bowen Bridge / O'Connell	3990	4008	18	0%
Bowen Bridge / Sneyd	4290	4312	22	1%
O'Connell / Brookes	2080	2173	93	4%
				PM Peak
O'Connell /Sneyd	1700	1820	120	7%
Bowen Bridge / O'Connell	4490	4558	68	2%
Bowen Bridge / Sneyd	4440	4442	2	0%
O'Connell / Brookes	2240	2294	54	2%

- **Table 5-11 2014 peak period without development: O'Connell Terrace / Sneyd Street**

Approach	Demand Flow [veh/h]	Deg. Satn (Vol/Capacity	Level of Service [LoS]	95% Back of Queue [m]
AM Peak				
East: O'Connell Terrace (East)				
Through	760	0.21	LOS A	9
Right	40	0.21	LOS A	9
Total	**800**	**0.21**	**NA**	**9**
North: Sneyd Street				
Left	570	0.46	LOS A	19.5
Right	60	0.46	LOS A	19.5
Total	**630**	**0.46**	**LOS A**	**19.5**
West: O'Connell Terrace (West)				
Left	10	0.01	LOS A	0
Through	10	0.01	LOS A	0
Total	**20**	**0.01**	**NA**	**0**
All Vehicles	**1450**	**0.46**	**NA**	**19.5**
PM peak				
East: O'Connell Terrace (East)				
Through	1280	0.35	LOS A	18
Right	50	0.35	LOS A	18
Total	**1330**	**0.35**	**NA**	**18**
North: Sneyd Street				
Left	240	0.41	LOS A	16.3
Right	70	0.41	LOS A	16.3
Total	**310**	**0.41**	**LOS A**	**16.3**
West: O'Connell Terrace (West)				
Left	10	0.03	LOS A	0
Through	50	0.03	LOS A	0
Total	**60**	**0.03**	**NA**	**0**
All Vehicles	**1700**	**0.41**	**NA**	**18**

Table Note: 5% commercial vehicles assumed

- **Table 5-12 2014 peak period with development: O'Connell Terrace / Sneyd Street**

Approach	Demand Flow [veh/h]	Deg. Satn (Vol/Capacity	Level of Service [LoS]	95% Back of Queue [m]
AM Peak				
East: O'Connell Terrace (East)				
Through	760	0.24	LOS A	10.2
Right	128	0.24	LOS A	10.2
Total	**888**	**0.24**	**NA**	**10.2**
North: Sneyd Street				
Left	575	0.49	LOS A	20.9
Right	68	0.49	LOS A	20.9
Total	**643**	**0.49**	**LOS A**	**20.9**
West: O'Connell Terrace (West)				
Left	10	0.01	LOS A	0
Through	10	0.01	LOS A	0
Total	**20**	**0.01**	**NA**	**0**
All Vehicles	**1551**	**0.49**	**NA**	**20.9**
PM Peak				
East: O'Connell Terrace (East)				
Through	1280	0.36	LOS A	18.2
Right	60	0.36	LOS A	18.2
Total	**1340**	**0.36**	**NA**	**18.2**
North: Sneyd Street				
Left	284	0.69	LOS B	54
Right	136	0.69	LOS B	54
Total	**420**	**0.69**	**LOS B**	**54**
West: O'Connell Terrace (West)				
Left	10	0.03	LOS A	0
Through	50	0.03	LOS A	0
Total	**60**	**0.03**	**NA**	**0**
All Vehicles	**1820**	**0.69**	**NA**	**54**

Table Note: 5% commercial vehicles assumed

5.4.5. Conclusion

The proposed development of the site for use as the TCC and retail and commercial offices would not significantly impact on the local traffic performance. The intersection of O'Connell Terrace / Sneyd Street would operate at a satisfactory level of service with the proposed TCC.

5.5. Cumulative impacts

There is potential for cumulative construction impacts on the locality of O'Connell Terrace due to the TCC building and the significant works planned for CRR and the RNA redevelopment.

Should the CRR project proceed, construction is anticipated to take five and a half years, with works at the proposed O'Connell Terrace worksites estimated to take approximately 40 months. The construction schedule within the Project Description chapter of the CRR EIS indicates these works would occur between 2015 and the first quarter 2018. The cumulative effect of the two projects would be the extension of the time period O'Connell Terrace is subjected to construction activity, with the TCC construction finished by mid 2014 and CRR planned to commence in 2015. The RNA redevelopment would also add to this effect.

If development of the RNA site within the O'Connell Terrace area occurs sooner than the 2019-2022 timeframes indicated in the master plan, there is potential for cumulative impacts on O'Connell Terrace as construction could be occurring on both sides of the road simultaneously. The probability of this occurring is high as the RNA redevelopment project have indicated they are seeking to attract the QHealth tender for 30,000 square metres of office space in the Bowen Hills area, which would commence construction in 2012 and be finished by 2014. The simultaneous construction periods would have cumulative impacts in terms of construction traffic and effects on the quality of the pedestrian environment. This could affect the pedestrian connectivity between the Bowen Hills Station and the RBWH, which is currently provided by O'Connell Terrace. The traffic function of O'Connell Terrace would also need to be maintained during construction to continue to provide access for emergency vehicles to the RBWH. Therefore mitigation measures would need to be in place to ensure pedestrian connectivity and emergency vehicle access to the RBWH is maintained.

In term of noise, it is expected that the construction noise from the TCC building would be acoustically dominant when observed at the Wren Street residences, owing to the greater separation distance to the RNA development. Additionally, construction noise maxima from both projects would be unlikely to occur at the same time. Therefore, any cumulative impact of construction noise would be acoustically negligible or minimal.

To manage the construction impacts a detailed CEMP for the TCC building would be prepared.

6. Conclusions and Proposed Conditions

This application is submitted as required by the Coordinator-General's Condition 41 for the Project. The proposed change involves development of the TCC in a different location to that identified in the reference design. The function of the TCC remains as described in the reference design.

The proposed site at O'Connell Terrace, Bowen Hills is between Sneyd Street and the ICB. The proposed site would reduce community impacts compared to the site previously proposed in the October 2010 APC and the site proposed as part of the reference design, which were both located at Mount Coot-tha. The proposed site is located adjacent to similar land uses for Clem7.

The proposed TCC building is consistent with the intent of the RBH Precinct under the Development Scheme. This indicates that the proposed location for the TCC is appropriate, as it is in line with the land use planning intentions for the Bowen Hills UDA.

The potential environmental effects of the TCC building have been considered in the development of the building design, with the key issues considered to be air quality, noise and traffic. Potential construction impacts from dust, noise and construction traffic can be managed appropriately through a construction environmental management plan in accordance with the existing Conditions for the project, including Condition (16) Traffic management, Condition (20) Air quality and Condition (22) Noise and vibration.

The building design would comply with the existing Condition (11) Building works, which requires that TCC buildings associated with the project are designed sympathetically to the surrounding environment. It would also comply with Condition (24) Urban design and landscape which requires the project to be constructed in a manner that minimises the visual impact of infrastructure. Council is continuing to liaise with the ULDA on the design of the TCC building and streetscape.

In addition to this Application for Project Change, Council would also prepare and submit a development application to the ULDA for the proposed building which would be assessed against the Development Scheme. A development application is required due to the potential inclusion of commercial and retail uses within the building. The ULDA would assess the development application for the building against the development requirements in the land use plan.

The changed project described in this application should proceed, subject to the complete list of conditions contained in the Coordinator-General's Report on project changes dated December 2010 and the following recommended condition.

1. A site specific Construction Environmental Management Plan (CEMP) Sub-Plan for the Tollroad Control Centre site must be prepared to address in detail specific environmental

impacts of the construction works of the site. The CEMP Sub-Plan must be developed and approved prior to construction commencing at the TCC site. Key issues to be addressed include:

- construction dust management
- construction noise management including the provision of appropriate noise screens and management of machinery noise
- coordination with other construction traffic using O'Connell Terrace during the TCC construction period.
- avoiding or minimising construction traffic during RNA Showground major events.

Appendix A Site Alternatives

Site	Functionality	Commercial costs and land tenure	Constructability and Environment	Community
1. Botanic Gardens, off Mt Coot-tha Road **Location not preferred by Council due to potential community impacts**	▪ Access to the western portal is approximately 8km via Centenary Motorway, turning at Moggill Road. ▪ Shortest access to eastern portal is approximately 10.5km ▪ Required connection of data services from the TCC to the tunnel is relatively direct	▪ BCC Freehold land ▪ Low data connection costs	▪ Construction would require the removal of existing vegetation within the Botanic Gardens. ▪ Topography is also not favourable.	▪ Lighting and noise from Mt Coot-tha Rd access would be facing north towards local residents. ▪ The building would be visible from nearby residences and incompatible with the Gardens entry. ▪ Would reduce the amount of land within the Botanic Gardens
2. EIS location Rehabilitated Western Worksite, Botanic Gardens off Centenary Motorway **Site not considered viable by Council due to lack of access**	▪ Required connection of data services from the TCC to the tunnel is relatively direct. ▪ Access to the western portal is approximately 8km via Centenary Motorway, turning at Moggill Road. ▪ Shortest access to eastern portal is approximately 10.5km ▪ Site does not have acceptable access to the Centenary Motorway	▪ BCC freehold land ▪ Low data connection costs	▪ Constructible but without acceptable access to the Centenary Motorway.	▪ Would reduce the amount of land within the Botanic Gardens ▪ Visual impact on the Botanic Gardens
3. 95 Sir Samuel Griffith Drive	▪ The site is not available for the TCC as it is no longer proposed as a construction project office.			
4. Miskin Street **Location not preferred by Council due to use of site as a bus depot**	▪ Required connection of data services from the TCC to the tunnel is relatively direct. ▪ Potential space constraints due to bus depot operations	▪ Expensive construction requirements	▪ Steeply sloping land with requirement to retain existing parking capacity under new structure	▪ Potential impacts on the existing on-site operations of the bus depot and adjacent residences at Miskin Street ▪ Site is currently used as a bus depot with limited space
5. Park and Ride area between Dean and Miskin Streets **Location not preferred by Council due to existing use as a park and ride car park and plan to use part of the site for construction workforce car parking.**	▪ Required connection of data services from the TCC to the tunnel is relatively direct. ▪ Access similar to other western end site options ▪ Conflict with intent to use part of the park and ride site for construction workforce car parking	▪ State Land in Trust to Council for Road Purposes	▪ Site within overland flow path from Anzac Park	▪ Site is currently used as a park and ride facility ▪ Potential for flow on impacts to local streets if parking at the park and ride site is affected.
6. Adjacent to the ICB and the eastern ventilation station **Location not preferred by Council due to potential community impacts**	▪ Required connection of data services from the TCC to the tunnel is relatively direct. ▪ Access to the western portal is approximately 16.5km via surface roads, and 11km utilising tunnel and emergency opening near portal. ▪ Access to the eastern portal is approximately 6km by surface roads.	▪ Low data connection costs ▪ Additional area of land acquisition would be required	▪ Site does not have acceptable access to the Inner City Bypass. Access to the site would need to be provided through the Grammar School playing fields or golf course, increasing potential community impact	▪ Site would require use of a greater area of the Victoria Park Golf Course which may impact the layout of the course
7. Co hosted with the Clem7 TCC **Location not considered viable by Council**, given the contractually different structures of the Clem7 project and the apparent lack of space at the Clem7 TCC	▪ Access to the western portal is approximately 15.5km via surface roads and 8km utilising tunnel and emergency opening near portal ▪ Access to / from the eastern portal is approximately 3km by surface roads ▪ Required connection of data services from the TCC to the tunnel is distant. ▪ Considered unlikely that additional space is available within the Clem7 TCC	▪ Different procurement and operating requirements for Clem7 would make use of site unviable ▪ Moderate connection costs for data services	▪ Considered unlikely that additional space is available within the Clem7 TCC	▪ Unlikely to be impacts as existing TCC site ▪ Compatible land use (if space were available)
8. Adjacent to the Clem7 TCC (Western side of Snyed St) **Preferred location**	▪ Required connection of data services from the TCC to the tunnel is relatively distant ▪ Access to the western portal is approximately 15.5km via surface roads and 8km utilising tunnel and emergency opening near portal ▪ Access to / from the eastern portal is approximately 3km by surface roads	▪ Council owned land (acquired for Clem 7) ▪ Moderate connection costs for data services	▪ Compatible with adjacent tunnel uses – but would need to suite ULDA objectives	▪ Should be designed to suite ULDA Development Scheme objectives ▪ Compatible with adjacent tunnel and transport uses
9. Adjacent to the Clem7 TCC (eastern side of Snyed St)	▪ Required connection of data services from the TCC to the tunnel is distant	▪ Council owned land (acquired for Clem 7)	▪ Site has some volumetric restrictions due to underground	▪ Should be designed to suite ULDA Development Scheme objectives

Site	Functionality	Commercial costs and land tenure	Constructability and Environment	Community
Location not preferred by Council due to site constraint issues	▪ Access to the western portal is approximately 15.5km via surface roads and 8km utilising tunnel and emergency opening near portal ▪ Access to / from the eastern portal is approximately 3km by surface roads	▪ Moderate connection costs for data services	volumetric tunnel infrastructure	▪ Compatible with adjacent tunnel and transport uses

Appendix B Bowen Hills UDA Development Scheme

The below table provides a summary of the land use plan in the Development Scheme as relevant to the proposed TCC location and the intended design response for the proposed building which will be subject to detailed design and feasibility assessment.

Summary of relevant land use plan requirements		TCC building response
Vision Broad outcomes and Structure Plan	The successful renewal of Bowen Hills and the creation of a unique and complementary employment centre is critical to enhancing the appeal and competitiveness of Brisbane's city centre The site area is located within the mixed use precinct of the structure plan. This precinct is intended to provide for hospital related activities and a strong built form along O'Connell Terrace and Bowen Bridge Road, complementing the prominent built form of the hospital complex and creating a clearly defined northern gateway to the city centre.	The proposed TCC building will contribute to the Bowen Hills employment centre through employment of staff to operate the TCC and the potential opportunities provided through the commercial and retail floor space. The building would also contribute towards a strong built form along O'Connell Terrace.
UDA wide criteria Affordable housing Urban design and sustainability Transport, access, on-site parking and servicing Environment Lot design	Key criteria of relevance to the proposed TCC site are: ■ Urban design and sustainability ■ Placemaking ■ Sub-tropical design ■ Community safety and well-being ■ Heritage, character and culture ■ Building form ■ Lighting ■ Accessibility, permeability and movement ■ Transport, access, on-site parking and servicing ■ Transport Corridors ■ Car parking ■ Circulation ■ End of trip facilities ■ Environment ■ General noise requirements ■ General air quality ■ Energy efficiency ■ Lifecycle costs and materials	■ The building would contribute towards an attracting streetscape in line with the placemaking objectives. ■ The proposal includes elements of sub-tropical design and provides opportunity for passive surveillance in line with the community safety provisions ■ A continuous awning is provided across the O'Connell Terrace frontage and the building design is well articulated in line with the Building form requirements ■ The proposal includes a bike storage area and end of trip facilities (eg showers) and car parking that is in line with the transport, access, on-site parking and servicing requirements. ■ The proposal complies with the air quality and noise requirements ■ The building design would contain energy efficiency measures.
Precincts Precinct and zoning plan Precincts Precinct intent Precinct outcomes Preferred land uses Level of assessment table Development requirements	The development site is located within the RBH Precinct of the land use plan. The intent of the RBH Precinct is to provide a mixture of residential and commercial development while delivering a range of hospital support activities including short stay and step-down accommodation, medical research and other specialist medical services. Office is a preferred land use in the Precinct. Development requirements include a maximum plot ratio of 3.5 and a maximum building height of 8 storeys.	■ Although the proposal is not for hospital support activities it provides for commercial development which is within the intent of the precinct. ■ Complies with requirement for commercial buildings to incorporate awnings over entries ■ Complies with requirement for car parking that is ancillary to a use to be delivered within the building footprint ■ Complies with requirement for car parking to be sleeved by uses which activate streets

Appendix C Air Quality Modelling Report

Air Quality Modelling for Proposed Legacy Way Toll Road Control Centre, RL 43.15 m

Prepared for

Brisbane City Council

KE1109066

October 2011

FINAL

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Prepared by: Tania Haigh and Natalie Shaw

Reviewed by: Simon Welchman

Revision	Date	Approved	Signature
Final 1.0	6/10/11	Simon Welchman	

Contents

Tables

Figures

Glossary

Term	Definition
BCC	Brisbane City Council
°C	degrees Celsius
CO	Carbon monoxide
DERM	Department of Environment and Resource Management
m	metre
m/s	metres per second
m^2	square metres
mg	milligram
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PM	Particulate matter (fine dust)
$PM_{2.5}$ and PM_{10}	Particulate matter less than 2.5 or 10 microns, respectively
$\mu g/m^3$	micrograms per cubic metre
µm	microns

Executive Summary

Katestone Environmental was commissioned by the Brisbane City Council (BCC) to quantify concentrations of air pollutants associated with the ventilation system of the Clem Jones Tunnel at the proposed Toll Road Control Centre for the Legacy Way Tunnel Project (The Legacy Way TCC), at Bowen Hills. A building with a height of 43.15m (RL) has been considered.

An air quality impact assessment study has been conducted to determine the likelihood of impact of the exhaust from the Clem7 northern ventilation outlet on the facade of the Legacy Way TCC and the affect of the Legacy Way TCC on plume dispersion of the Clem7 northern ventilation outlet.

The assessment has found that:

- *The Legacy Way TCC was not found to adversely affect dispersion of the plume from the Clem7 Tunnel ventilation outlets, with concentrations predicted at existing receptors unlikely to change.*

- *Predicted ground-level concentrations of NO_2, CO and PM_{10} comply with the Coordinator General's air quality goals across the modelling domain for the 2011 and 2021 model simulations*

- *The predicted annual average ground-level concentrations of $PM_{2.5}$ exceed the Coordinator General's air quality goal for all modelled scenarios; however this is due to the elevated background concentration of 8.4 $\mu g/m^3$, not due to the Legacy Way TCC, which is predicted to contribute less than 0.4% to the total predicted annual average concentrations*

- *Predicted concentrations of NO_2, CO and PM_{10}, and the predicted 24-hour average concentration of $PM_{2.5}$ comply with the Coordinator General's air quality goals at all heights on the proposed TCC building facade*

1. Introduction

In August 2005, the Coordinator General approved the construction and operation of the Clem7 Tunnel to link Kangaroo Point and Woolloongabba to Bowen Hills while bypassing Fortitude Valley and the CBD. Katestone Environmental was commissioned by the Brisbane City Council (BCC) to quantify concentrations of air pollutants associated with the ventilation system of the Clem7 Tunnel at the proposed Toll Road Control Centre for the Legacy Way Tunnel Project (The Legacy Way TCC), at Bowen Hills. The significance of air pollutant concentrations is to be assessed against the Coordinator General's air quality goals for the Clem7 Tunnel.

The proposed development site is on land on the northern side of O'Connell Terrace, between Sneyd Street and the Inner City Bypass; which adjoins the Clem7 northern ventilation outlet and TCC (Figure 1). The current concept design for the TCC is seven storeys high, with a maximum height of approximately 43.15 m AHD. However, this height is subject to change as the concept design is still being developed. This report considers a building with a maximum height of 43.15 m AHD.

This assessment has considered the likelihood of impact of the exhaust from the ventilation outlet on the facade of the Legacy Way TCC and the affect of the Legacy Way TCC on plume dispersion.

The ventilation design and emission rates of air pollutants from the ventilation outlets of the Clem7 Tunnel are unchanged from those presented in the supporting information provided by River City Motorways to the Coordinator General (Katestone Environmental, 2008). The dispersion model and meteorological model are unchanged from those presented in Katestone Environmental' Report to Brisbane City Council, "Clem Jones Tunnel Ventilation Outlet Air Quality Modelling Methodology, 2010".

2. Ambient air quality goals

The Coordinator General's Condition of Development, Schedule 3, Condition 17(f) specifies that:

"…

(e) The ventilation system must be designed so that the system is capable of meeting…the appropriate NEPM goals for ambient air quality set out in Table 5."

Table 5 of Schedule 3 of the Coordinator General's Condition of Development is reproduced in the Table 1 below and are the air quality goals used in this assessment.

Table 1 Air quality goals specified by the Coordinator General for the Clem Jones Tunnel ventilation outlets

Pollutant	Goal	Unit	Measuring Period
Carbon monoxide (CO)	8 or 10	ppm mg/m³	8-hour maximum*
Nitrogen dioxide (NO_2)	0.12 or 245	ppm µg/m³	1-hour maximum
Particulate matter less than 10 µm (PM_{10})	50 50	µg/m³ µg/m³	24-hour maximum** Annual mean
Particulate matter less than 2.5 µm ($PM_{2.5}$)	25 8	µg/m³ µg/m³	24-hour maximum Annual mean
Total suspended particulate matter (TSP)	90	µg/m³	Annual mean

Note *Allowable exceedances, one day per year
**Five days per year allowable exceedence, not including exceedence in ambient goals due to external events (e.g. dust storms, fires, major construction works)

3. Background air quality

The existing air quality at sensitive receptor locations, such as houses or schools, will depend on the proximity to major roads and industry. For receptors close to the major roads, vehicle emissions will be the primary source of air pollution. Air quality at locations more than 500 metres from major existing roads will be dominated by background urban pollution sources and any local industrial emissions.

In order to estimate background levels of relevant pollutants, data from the Department of Environment and Resource Management (DERM) monitoring sites at South Brisbane, Rocklea and Woolloongabba have been analysed for 2010. These results are summarised in Table 2.

Table 2 Ambient air quality monitoring data for various traffic pollutants (µg/m³)

Pollutant	Averaging period	Monitoring station		
		South Brisbane	Rocklea[1]	Woolloongabba
Nitrogen oxides	1-hour (95th percentile)	-	-	-
Nitrogen dioxide	1-hour (95th percentile)	-	57.5	-
Carbon monoxide	8-hour (95th percentile)	-	-	1,625[1]
PM_{10}	24-hour (95th percentile)	-	25.3	-
	Annual	-	19.3[3]	-
$PM_{2.5}$	24-hour (95th percentile)	-	13.6	-
	Annual	6.9[2]	8.2	8.4[2]

Note: [1] Data sourced from "Queensland 2010 air monitoring report", DERM
[2] Data sourced from "Air Quality Bulletin South-East Queensland, December 2010", DERM
[3] Data sourced from Katestone Environmental 2010 based on 2008 data, as annual PM_{10} is not reported in sources 1 and 2.

For this study, the maximum concentration of each pollutant from the three monitoring stations has been used as a background level for the impact assessment as indicated in Table 3. This is a conservative method as data from all of the monitoring sites will contain varying degrees of emissions from local anthropogenic sources and, consequently, this method will provide an overestimate of background levels.

Table 3 Background levels of ambient air quality for various traffic pollutants

Pollutant	Averaging period	Background level (µg/m³)
Nitrogen dioxide	1-hour (95th percentile)	57.5
Carbon monoxide	8-hour (95th percentile)	1625
PM_{10}	24-hour (95th percentile)	25.3
	Annual	19.3
$PM_{2.5}$	24-hour (95th percentile)	13.6
	Annual	8.4

4. Modelling methodology

A multi-stage approach was used to generate the meteorological data fields. The prognostic model TAPM (developed by CSIRO, version 4) was used to generate wind information for 2008. The results from TAPM were used in conjunction with site specific meteorological data to develop a three-dimension wind field representing wind flows in the region using the diagnostic meteorological model CALMET (developed by EarthTec, version 6.326). Data for 2008 from DERM monitoring sites at Rocklea and South Brisbane were used for data assimilation in both the TAPM and CALMET models.

The dispersion model CALPUFF (developed by EarthTec, version 6.263) was used in the assessment to estimate concentrations of air pollutants emitted by the ventilation system of the Clem7 Tunnel. The two ventilation outlets were modelled as point sources. Details of model configuration are presented in Katestone Environmental, 2010.

The modelling exercise has limitations as the distance between the Legacy Way TCC and the Clem7 northern ventilation outlet is less than the 100m resolution of the Calpuff model used. To provide better optimisation of impacts, wind tunnel modelling would be required.

4.1 Ventilation outlet configuration

The ventilation outlet configurations for the Clem7 Tunnel are summarised in Table 4 and are the same as those presented in supporting information submitted by River City Motorways to the Coordinator General (Katestone Environmental, 2008). Discharge velocities from these outlets vary over time and the values used in this study are summarised in Table 5 and Table 6.

Table 4 Ventilation outlet configurations for the Clem Jones Tunnel

Parameter	North Vent	South Vent
Stack locations	503.046 6963.871	503.570 6959.298
Outlet height	46.0 m AHD	51.7 m AHD
Discharge velocity	5.4 m/s – 8.2 m/s	5.4 m/s – 8.2 m/s
Discharge area	46.3 m^2	46.3 m^2
*Ground level is 11.16 m AHD at the north vent, and 9.87 m AHD at the south vent, so these heights correspond to 34.8 m and 41.8 m above ground, respectively.		

4.2 Emissions

Two scenarios were assessed to give an overview of the potential effect of the project:

- 2011 - the intended year for tunnel opening
- 2021 - ten years after intended year for tunnel opening

The emission rates of air pollutants from the ventilation outlets have been calculated for conditions that are representative of normal operations determined by Maunsell Parsons Brinckerhoff Design Joint Venture as detailed in Katestone Environmental (2008). These emission rates were based on PIARC emission tables (PIARC, 1995), which reflect the improvement in efficiency and reduction in pollutants emitted from vehicles over time as the Australian Design Rules are implemented.

Traffic flow, ventilation outlet discharge velocity and air pollutant emission rates used in this study are summarised in Table 5 and Table 6.

Table 5 Traffic flow, ventilation outlet discharge velocity and air pollutant emission rates for 2011 for the Clem Jones Tunnel ventilation system

Hour of Day	North Ventilation Outlet					South Ventilation Outlet				
	VPH	Velocity (m/s)	CO (g/s)	NO_x (g/s)	PM_{10} (g/s)	VPH	Velocity (m/s)	CO (g/s)	NO_x (g/s)	PM_{10} (g/s)
1	321	5.40	2.0	0.32	0.011	273	5.4	1.6	0.28	0.010
2	201	5.40	1.2	0.20	0.007	171	5.4	1.0	0.17	0.006
3	165	5.40	1.0	0.17	0.006	140	5.4	0.8	0.14	0.005
4	180	5.40	1.1	0.18	0.006	153	5.4	0.9	0.16	0.006
5	337	5.40	2.1	0.34	0.012	327	5.4	2.0	0.33	0.012
6	1133	5.40	6.9	1.14	0.039	962	5.4	5.8	0.98	0.036
7	3340	6.77	20.0	3.40	0.119	2837	6.5	16.5	2.89	0.110
8	3840	7.46	23.0	3.91	0.137	3262	7.2	19.0	3.32	0.126
9	3840	7.46	23.0	3.91	0.137	3262	7.2	19.0	3.32	0.126
10	3144	6.50	18.8	3.20	0.112	2671	6.3	15.5	2.72	0.103
11	2613	5.88	15.9	2.62	0.089	2220	5.7	13.3	2.25	0.084
12	2530	5.77	15.4	2.54	0.086	2149	5.6	12.9	2.18	0.081
13	2507	5.73	15.3	2.52	0.086	2261	5.7	13.5	2.30	0.085
14	2533	5.77	15.4	2.54	0.086	2286	5.8	13.7	2.32	0.086
15	2825	6.19	17.2	2.84	0.096	2548	6.2	15.3	2.59	0.096
16	3492	6.98	20.9	3.55	0.125	3150	7.0	18.3	3.21	0.122
17	3726	7.31	22.3	3.79	0.133	3361	7.3	19.5	3.43	0.130
18	3726	7.31	22.3	3.79	0.133	3361	7.3	19.5	3.43	0.130
19	3378	6.83	20.2	3.44	0.121	3047	6.8	17.7	3.11	0.118
20	1819	5.40	11.1	1.83	0.062	1640	5.4	9.8	1.67	0.062
21	1377	5.40	8.4	1.38	0.047	1242	5.4	7.4	1.26	0.047
22	1286	5.40	7.8	1.29	0.044	1160	5.4	6.9	1.18	0.044
23	1033	5.40	6.3	1.04	0.035	932	5.4	5.6	0.95	0.035
24	683	5.40	4.2	0.69	0.023	616	5.4	3.7	0.63	0.023
Total	50,029	-	1086[1]	182.2[1]	6.32[1]	44,031	-	933.8[1]	161.3[1]	6.06[1]
Note	[1]Total peak daily emission rate in kg.									

Table 6 Traffic flow, ventilation outlet discharge velocity and air pollutant emission rates for 2021 for the Clem Jones Tunnel ventilation system

Hour of Day	North Ventilation Outlet					South Ventilation Outlet				
	VPH	Velocity (m/s)	CO (g/s)	NO_x (g/s)	PM_{10} (g/s)	VPH	Velocity (m/s)	CO (g/s)	NO_x (g/s)	PM_{10} (g/s)
1	423	5.4	1.1	0.17	0.010	367	5.4	0.9	0.15	0.009
2	265	5.4	0.7	0.11	0.006	230	5.4	0.6	0.09	0.006
3	217	5.4	0.5	0.09	0.005	188	5.4	0.5	0.08	0.005
4	237	5.4	0.6	0.10	0.005	205	5.4	0.5	0.08	0.005
5	444	5.4	1.1	0.18	0.010	385	5.4	0.9	0.16	0.010
6	1822	5.4	4.6	0.73	0.042	1581	5.4	3.9	0.64	0.040
7	4167	7.9	10.2	1.70	0.100	3618	7.7	8.6	1.47	0.093
8	4401	8.2	10.8	1.79	0.105	3821	8.0	9.1	1.55	0.147
9	4401	8.2	10.8	1.79	0.105	3821	8.0	9.1	1.55	0.147
10	3961	7.6	9.7	1.61	0.095	3439	7.4	8.2	1.39	0.132
11	3532	7.2	8.8	1.42	0.081	3066	7.0	7.5	1.24	0.115
12	3371	7.0	8.4	1.35	0.077	2927	6.8	7.2	1.18	0.110
13	3406	7.0	8.5	1.37	0.078	3038	7.0	7.4	1.23	0.114
14	3464	7.1	8.7	1.39	0.079	3090	7.0	7.5	1.25	0.116
15	3878	7.7	9.7	1.56	0.089	3441	7.6	8.5	1.40	0.130
16	4342	8.2	10.6	1.77	0.104	3873	8.1	9.2	1.57	0.149
17	4342	8.2	10.6	1.77	0.104	3873	8.1	9.2	1.57	0.149
18	4342	8.2	10.6	1.77	0.104	3873	8.1	9.2	1.57	0.149
19	4233	8.0	10.4	1.72	0.101	3776	7.9	9.0	1.53	0.145
20	2693	6.0	6.7	1.08	0.062	2402	5.9	5.9	0.97	0.090
21	1962	5.4	4.9	0.79	0.045	1750	5.4	4.3	0.71	0.066
22	1732	5.4	4.3	0.70	0.040	1545	5.4	3.8	0.62	0.058
23	1384	5.4	3.5	0.56	0.032	1235	5.4	3.0	0.50	0.046
24	915	5.4	2.3	0.37	0.021	817	5.4	2.0	0.33	0.031
Total	63,934	-	569.5[1]	93.1[1]	5.40[1]	56,360	-	488.1[1]	82.2[1]	7.41[1]
Note	[1]Total peak daily emission rate in kg.									

For this assessment, concentrations of $PM_{2.5}$ have been calculated from PM_{10} assuming that 70% of PM_{10} is in the form of $PM_{2.5}$. This is consistent with the air quality assessment of the EIS air quality study (Holmes Air Sciences, 2004) and is based on monitoring of road tunnel emissions in Melbourne. Monitoring data from the M5 tunnel in Sydney shows a much lower ratio of $PM_{2.5}$ to PM_{10} of 35% and data from the Rocklea monitoring station in 2008 shows a ratio of approximately 33%, and so the use of a 70% ratio is conservative.

NO_2 is the component of the oxides of nitrogen (NO_x) that is considered due to its health impacts. Concentrations of NO_2 measured close to busy metropolitan roads such as Ipswich Road at Woolloongabba and the Ipswich Motorway at Goodna show that the percentage of NO_2 to NO_x in the air is inversely proportional to the distance from the emission source. Lower ratios are observed closer to the emission source and higher ratios are observed at greater distances. At locations close to roads, it is likely that the ratio is approximately 20% (Holmes Air Sciences, 2004). Therefore this percentage of NO_2 to NO_x has been used in this study to determine concentrations of NO_2.

4.3 Development details

The Legacy Way TCC is proposed to be built on land located on the northern side of O'Connell Terrace, between Sneyd Street and the Inner City Bypass. The building has two tiers; the first is proposed to be seven storeys in height while the second tier (the plant room) is a single story, located at the roof level of the main (7 storey) building. Details of the proposed building have been taken from the preliminary plans supplied by Brisbane City Council (Figure 2). Air pollutant concentrations have been predicted at various heights on the building facade nearest the Clem7 northern ventilation outlet, and directly above the building, as described in Section 4.4.

4.4 Discrete receptor locations

Locations at various positions on the facade of the proposed building facing the Clem7 northern ventilation outlet have been incorporated into the model as discrete receptors, as detailed in Figure 3. Each location was modelled at heights of 13.5 m, 23.5 m, 33.5 m and 43.5 m AHD to determine the potential impact of the Clem7 Tunnel ventilation system on the building facade.

4.5 Building downwash

Building downwash effects are important for stacks that are short or relatively close to buildings. The aerodynamic wake caused as air passes over the building can entrain the stack plume. Building downwash effects were included in the modelling and were derived using the BPIP (Building Profile Input Program) building downwash program for the stack sources. Modelling of the ventilation outlet emissions using the buoyant point sources algorithm incorporates wake effects for these sources. The locations of sources incorporated into the modelling are described in Table 4 and buildings included in the modelling are presented in Table 7. The Legacy Way TCC was separated into two tiers to account for the differences in the floor area of the plant room and the seven floors of the building.

Table 7 Building information included in the building wakes modelling

Building name	Building or tier height (m AHD)	Maximum building length (metres)	Maximum building width (metres)
North Ventilation Outlet Building	42.1	20	34.9
Legacy Way TCC Tier 1	40.15	59	16
Legacy Way TCC Tier 2	43.15	30	16

5. Assessment of air quality impacts

The results presented below are based on the maximum concentration of each pollutant that is predicted at the receptors over the one-year period. The results therefore represent the worst-case scenario. It is important to note that the contour plots are constructed such that the maximum value is obtained and stored at each point in the modelling domain. As these maximum values may occur at different times for receptors at different locations, these figures do not represent a single snapshot of conditions at any given time. The results presented also include a background level of each pollutant expected for the region.

5.1 Effects on building downwash

To establish the possible effect of the proposed building on the dispersion of the plume from the northern ventilation stack, predicted concentrations of pollutants from dispersion modelling with and without the proposed building are compared. Impacts have been considered for residential developments, The Mews and Tufton Street as well as the Royal Brisbane Hospital, which are located in close proximity to the Clem7 northern ventilation outlet.

Although the predicted concentrations at The Mews change slightly due to the proposed building, concentrations of CO, NO_2 and particulate matter as PM_{10} at the three receptors are still well below the Coordinator General's air quality goals. Particulate matter as $PM_{2.5}$ exceeds the Coordinator General's air quality goal; however, this is due to the background air quality. The proposed building has a minimal (less than 0.4%) effect on the concentration of $PM_{2.5}$.

Table 8 shows the maximum concentrations of air pollutants predicted to occur at Tufton Street with and without the Legacy Way TCC.

Table 8 Effect of the Legacy Way TCC on the predicted maximum concentrations of air pollutants due to the northern ventilation stack at Tufton Street for 2011. Concentrations include a background concentration

Pollutant	Averaging period	Maximum concentrations (µg/m^3) at elevated locations (m AHD)					Goal (µg/m^3)
		14.6	24.6	34.6	44.6	54.6	
Without Legacy Way TCC							
CO	8-hour	2001	2011	2134	2413	2781	10,000
NO_2	1-hour	109	111	116	143	223	245
PM_{10}	24-hour	26	26	27	28	28	50
	Annual	19	19	19	19	19	50
$PM_{2.5}$	24-hour	14	14	15	15	16	25
	Annual	8.4	8.4	8.5	8.5	8.5	8
With Legacy Way TCC							
CO	8-hour	2001	2011	2134	2413	2781	10,000
NO_2	1-hour	109	111	116	143	223	245
PM_{10}	24-hour	26	26	27	28	28	50
	Annual	19	19	19	19	19	50
$PM_{2.5}$	24-hour	14	14	15	15	16	25
	Annual	8.4	8.4	8.5	8.5	8.5	8

Note: Ground level at Tufton Street corresponds to 14.6 m AHD, therefore these heights correspond to 0m, 10m, 20m, 30m and 40m above ground level.

Table 9 shows the maximum concentrations of air pollutants predicted to occur at The Mews with and without the proposed building.

Table 9 Effect of the Legacy Way TCC on the predicted maximum concentrations of air pollutants due to the northern ventilation stack at the Mews for 2011. Concentrations include a background concentration

Pollutant	Averaging period	Maximum concentrations (µg/m^3) at elevated locations (m AHD)					Goal (µg/m^3)
		14.2	24.2	34.2	44.2	54.2	
Without Legacy Way TCC							
CO	8-hour	1981	2047	2306	2848	3228	10,000
NO_2	1-hour	77	78	91	144	187	245
PM_{10}	24-hour	26	27	28	29	30	50
	Annual	19	19	20	20	20	50
$PM_{2.5}$	24-hour	14	15	15	16	17	25
	Annual	8.5	8.5	8.6	8.7	8.8	8
With Legacy Way TCC							
CO	8-hour	1982	2048	2306	2844	3213	10,000
NO_2	1-hour	77	78	91	144	187	245
PM_{10}	24-hour	26	27	28	29	30	50
	Annual	19	19	20	20	20	50
$PM_{2.5}$	24-hour	14	15	15	16	17	25
	Annual	8.5	8.5	8.6	8.7	8.8	8

Note: Ground level at the Mews corresponds to 14.2 m AHD, therefore these heights correspond to 0m, 10m, 20m, 30m and 40m above ground level.

Table 12 shows the maximum concentrations of air pollutants predicted to occur at the Royal Brisbane Hospital with and without the proposed building.

Table 10 Effect of the Legacy Way TCC on the predicted maximum concentrations of air pollutants due to the northern ventilation stack at the Royal Brisbane Hospital for 2011. Concentrations include a background concentration

Pollutant	Averaging period	Maximum concentrations (µg/m^3) at 107.3 m AHD		Goal (µg/m^3)
		Without building	With building	
CO	8-hour	1994	1994	10,000
NO_2	1-hour	72	72	245
PM_{10}	24-hour	26	26	50
	Annual	19	19	50
$PM_{2.5}$	24-hour	14	14	25
	Annual	8.5	8.5	8

Note: Ground level at the Royal Brisbane Hospital corresponds to 17.3 m AHD, therefore this height corresponds to 80m above ground level.

5.2 Regional impacts

Table 11 shows the maximum ground-level concentration of air pollutants predicted to occur across the modelling domain for the two planning scenarios in 2011 and 2021 and compared with the Coordinator General's air quality goals. The modelling domain is a 4km by 8km area, centred at Easting 503000 m, Northing 6962000 m, in UTM Zone 56 S. The results include the increment due to the Clem7 ventilation outlets and the background concentrations as listed in Section 3. The maximum predicted concentrations of pollutants in all modelled scenarios are well below the Coordinator General's air quality goals. Figure 4 and Figure 5 present the ground-level concentrations of NO_2 predicted to occur for 2011 and 2021, respectively.

Table 11 Predicted maximum ground level concentrations of air pollutants due to the Clem7 Tunnel plus background

Pollutant	Averaging period	Maximum concentration at ground level		Goal (µg/m^3)
		2011	2021	
CO	8-hour	2154	1914	10,000
NO_2	1-hour	117	86	245
PM_{10}	24-hour	27	26	50
	Annual	20	19	50
$PM_{2.5}$	24-hour	15	14	25
	Annual	8.6	8.5	8

5.3 Site-specific impacts

Results of the dispersion modelling at various heights above ground level on the facade of the Legacy Way TCC are presented alongside the Coordinator General's air quality goals in Tables 12 and 13 for 2011 and 2021. These results include the predicted increment due to the Clem7 ventilation outlets and the background concentrations of air pollutants listed in Section 3.

Table 12 Predicted maximum concentrations of air pollutants for the Legacy Way TCC for 2011 including background levels

Pollutant	Averaging period	Maximum concentrations (µg/m^3) at elevated locations (m, AHD)				Goal (µg/m^3)
		13.5	23.5	33.5	43.5	
CO	8-hour	1707	1715	1743	1791	10,000
NO_2	1-hour	69	70	73	78	245
PM_{10}	24-hour	25	25	26	26	50
	Annual	19.3	19.3	19.3	19.3	50
$PM_{2.5}$	24-hour	14	14	14	14	25
	Annual	8.4	8.4	8.4	8.4	8
Note: Ground level at the Legacy Way TCC site corresponds to 13.5 m AHD, therefore these heights correspond to 0m, 10m, 20m and 30m above ground level.						

Table 13 Predicted maximum concentrations of air pollutants for the Legacy Way TCC for 2021 including background levels

Pollutant	Averaging period	Maximum concentrations (µg/m^3) at elevated locations (m, AHD)				Goal (µg/m^3)
		13.5	23.5	33.5	43.5	
CO	8-hour	1657	1658	1666	1702	10,000
NO_2	1-hour	63	64	65	67	245
PM_{10}	24-hour	25	25	25	26	50
	Annual	19.3	19.3	19.3	19.3	50
$PM_{2.5}$	24-hour	14	14	14	14	25
	Annual	8.4	8.4	8.4	8.4	8
Note: Ground level at the Legacy Way TCC site corresponds to 13.5 m AHD, therefore these heights correspond to 0m, 10m, 20m and 30m above ground level.						

The results show that concentrations of CO, NO_2 and PM_{10} and 24-hour $PM_{2.5}$ are well below the Coordinator General's air quality goals for all modelled scenarios. Annual concentrations of $PM_{2.5}$ are above the Coordinator General's air quality goal; however, this is due to the elevated background concentration of 8.4 $\mu g/m^3$. The contribution from the Legacy Way TCC is minimal (less than 0.4%).

6. Conclusions

An air quality impact assessment study has been conducted to determine the likelihood of impact of the exhaust from the Clem7 northern ventilation outlet on the facade of the Legacy Way TCC and the affect of the Legacy Way TCC on plume dispersion of the Clem7 northern ventilation outlet.

The assessment has found that:

- The Legacy Way TCC was not found to adversely affect dispersion of the plume from the Clem7 Tunnel ventilation outlets, with concentrations predicted at existing receptors unlikely to change.

- Predicted ground-level concentrations of NO_2, CO and PM_{10} comply with the Coordinator General's air quality goals across the modelling domain for the 2011 and 2021 model simulations

- The predicted annual average ground-level concentrations of $PM_{2.5}$ exceed the Coordinator General's air quality goal for all modelled scenarios; however this is due to the elevated background concentration of 8.4 $\mu g/m^3$, not due to the Legacy Way TCC, which is predicted to contribute less than 0.4% to the total predicted annual average concentrations

- Predicted concentrations of NO_2, CO and PM_{10}, and the predicted 24-hour average concentration of $PM_{2.5}$ comply with the Coordinator General's air quality goals at all heights on the proposed TCC building facade

7. References

DERM 2010, “Queensland 2010 air monitoring report”

DERM 2010 “Air Quality Bulletin South-East Queensland, December 2010”

Earth Tech Inc 2006, CALPUFF - Version 6.263, CALMET - Version 6.223, Concord, MA, USA, http://www.src.com/verio/download/download.htm#MOD6_VERSION

Holmes Air Sciences 2004, “Draft Air Quality Impact Assessment: Brisbane North-South Bypass Tunnel”, prepared for Sinclair Knight Merz - Connell Wagner Joint Venture on behalf of Brisbane City Council

Katestone Environmental 2008, “Air Dispersion Modelling of the Final Design of the NSBT Project”, report from Katestone Environmental to Maunsell Parsons Brinckerhoff Design Joint Venture

Katestone Environmental 2010, “Clem Jones Tunnel Ventilation Outlet Air Quality Modelling Methodology’ report from Katestone Environmental to Brisbane City Council.

National Environment Protection Council (NEPM) 1998, “National Environment Protection Measure for Ambient Air Quality”

PIARC 1995, “Vehicle Emissions, Air Demand, Environment, Longitudinal Ventilation”, Committee on Road Tunnels, *XXth World Road Congress*, Montreal

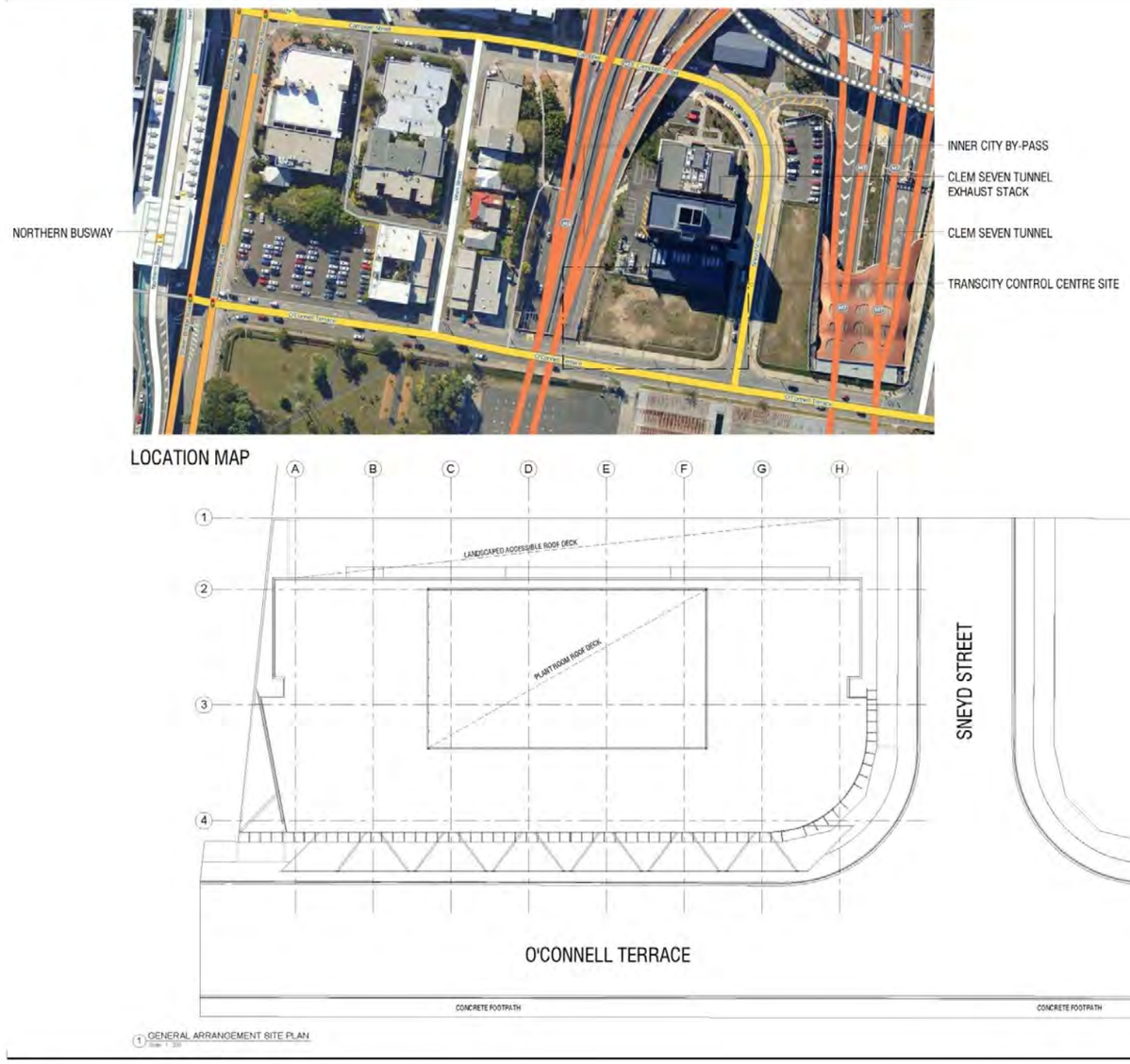

Figure 1 Location of Legacy Way TCC

Location: Bowen Hills, Qld	**Data source:** Brisbane City Council	
Type: Aerial image	**Prepared by:** Tania Haigh	**Date:** September 2011

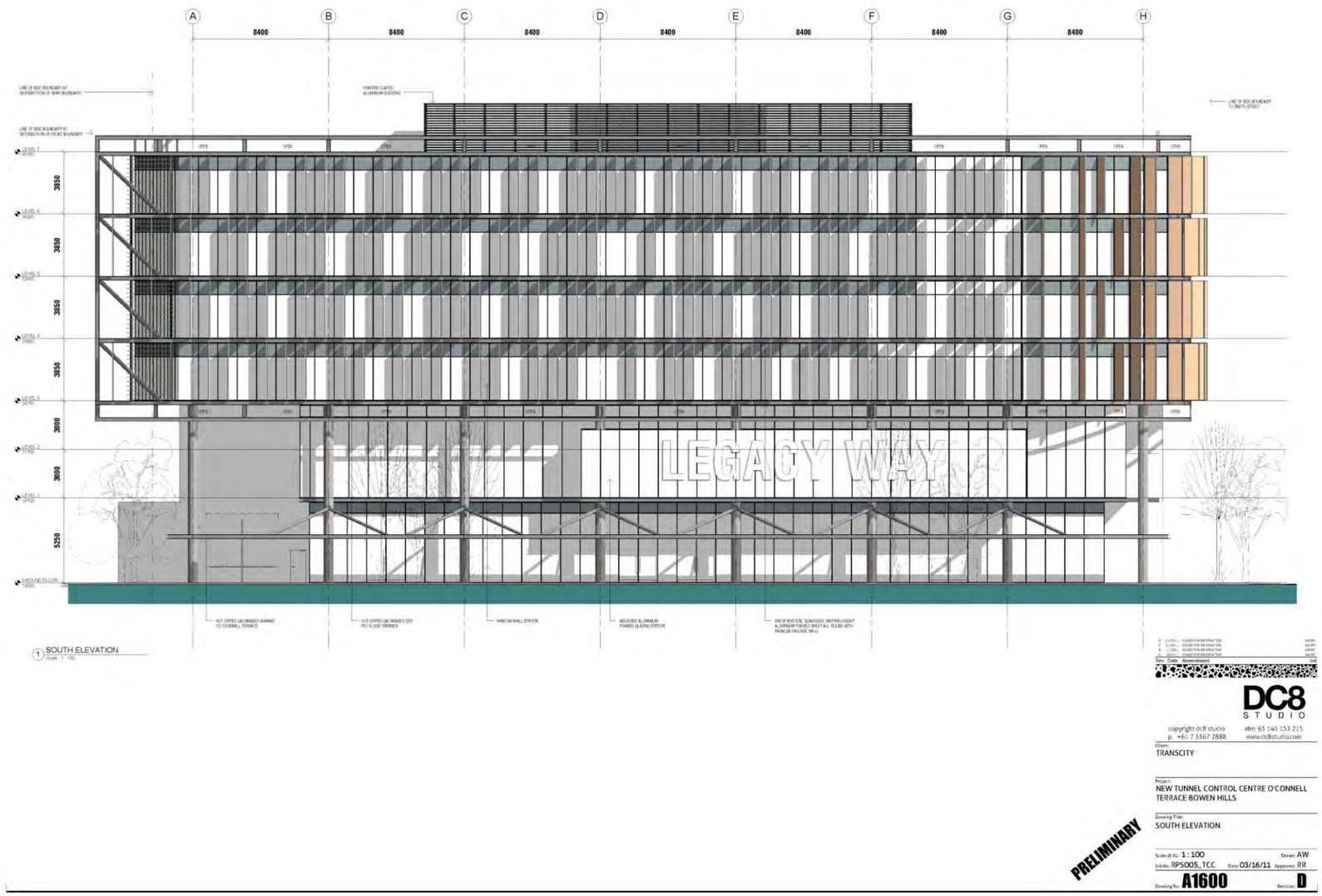

Figure 2 Planning scenario 1 – Building dimensions

Location: Bowen Hills, Qld	**Data source:** Brisbane City Council	
Type: South elevation diagram	**Prepared by:** Tania Haigh	**Date:** September 2011

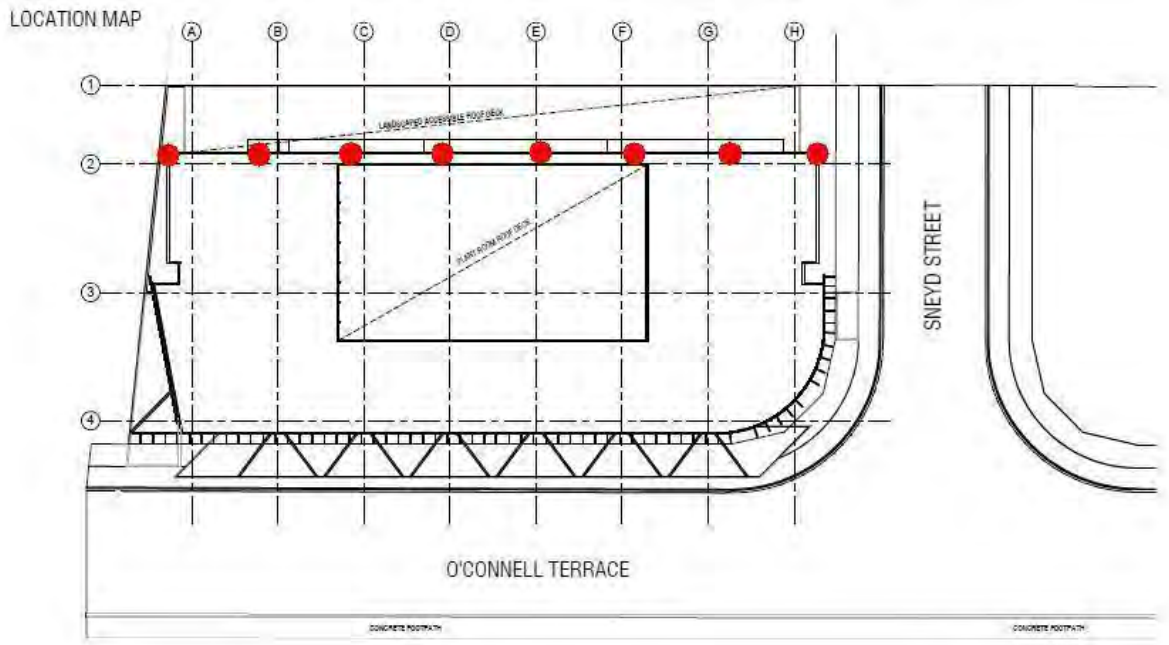

Figure 3 Location of receptors along Legacy Way TCC Facade

Location: Bowen Hills, Qld	**Data source:** Katestone Environmental	
Type: Schematic	**Prepared by:** Tania Haigh	**Date:** September 2011

Figure 4 Maximum predicted 1-hour average ground level NO_2 concentrations for 2011 including a background level of 59.5 µg/m³

Location: Brisbane, Qld	**Averaging period:** 1-hour	**Data source:** Calpuff	**Units:** µg/m³
Type: Maximum contours	**Objective:** 245 µg/m³	**Prepared by:** Tania Haigh	**Date:** September 2011

Figure 5 Maximum predicted 1-hour average ground level NO_2 concentrations for 2021 including a background level of 59.5 µg/m³

Location: Brisbane, Qld	**Averaging period:** 1-hour	**Data source:** Calpuff	**Units:** µg/m³
Type: Maximum contours	**Objective:** 245 µg/m³	**Prepared by:** Tania Haigh	**Date:** September 2011

Appendix D Acoustic Assessment

global environmental solutions

Tollroad Control Centre Building

O'Connell Terrace, Bowen Hills

Acoustic Assessment

Report Number 620.01854.00300-R1

4 October 2011

Brisbane City Council (City Projects Office)
Level 2
171 George Street
QLD 4004

Version: Revision 0

Tollroad Control Centre Building

O'Connell Terrace, Bowen Hills

Acoustic Assessment

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR Consulting) was engaged by the SKM-CW Joint Venture to conduct a noise assessment to support the development application for the proposed Tollroad Control Centre (TCC) building to be located at O'Connell Street, Bowen Hills.

The proposed TCC building will be a component of the Legacy Way Project (formerly Northern Link Project), which means that noise emissions associated with the building must be considered in accordance with the Queensland Department of Infrastructure and Planning (DIP) *Coordinator-General's Conditions of Approval* report.

In addition, the assessment has been carried out with regards to Section 3.9 Environment – General Noise Requirements of the *Bowen Hills Urban Development Area Development Scheme* (effective July 2009, amended April 2010) document issued by the Urban Land Development Authority (ULDA), and the referral document *Environmental Protection (Noise) Policy 2008*.

The purposes of this report are:

1. Assess operational noise emissions from the TCC building to nearby residences; and
2. Consider noise from construction activities to nearby residences.

Noise immission to the building from noise sources such as road or rail traffic or the adjacent ventilation station, does not require consideration as part of this assessment as the use of the building is not "noise sensitive" as defined in the ULDA development scheme document. It is expected that noise immission to the building would be considered as part of the detailed design process to ensure appropriate acoustic conditions for the use and occupancies of the building.

Appendix A provides descriptions and definitions of acoustic terminology used in this report.

2 PROPOSED DEVELOPMENT AND SURROUNDS

The location and surrounds of the proposed development has been shown on **Figure 1**.

The proposed TCC building will be within Bowen Hills on the northern side of O'Connell Terrace between Sneyd Street and the M3 Inner City Bypass (ICB). The Clem 7 (M7) TCC building and a ventilation station adjoin the site to the north. To the south of O'Connell Terrace are industrial premises associated with the RNA Showgrounds, and open parkland.

The nearest relevant noise sensitive locations are residential buildings in Wren Street, immediately west of the ICB, and approximately 55 metres from the site. Bowen Park will be approximately 80 metres to the southwest of the TCC building. The Clem 7 TCC building, approximately 50 metres to the north, contains office space but will be significantly screened from noise by the intervening ventilation station.

Site development plans A000 (Rev B), A001 – A006 (Rev H), A007 (Rev C), A1600 – A1603 (Rev D), A1610 (Rev H), A1622, A1900, A1901 (Rev C), A1910 and A1911 (Rev A) by DC8 Studio (provided by SKM) shows that the building will consist of four main areas: retail space, workshop area, commercial office space and car parking.

The proposed TCC building will be 7 storeys high. The ground floor will include a TCC maintenance workshop, garage, switch room, substation and potential retail space. It is intended that the top three floors will contain commercial office space.

Figure 1 Proposed TCC Building Site and Surrounds

3 EXISTING NOISE ENVIRONMENT

Noise surveys were conducted to establish the existing noise environment at the residences near to the development site and to assist in determining noise criteria for the development.

The noise surveys were conducted in general accordance with the Department of Environment and Resource Management (DERM) *Noise Measurement Manual*.

Weather conditions were obtained from the Bureau of Meteorology weather station in Brisbane and were generally acceptable (ie dry and calm or light winds) for the purpose of conducting noise surveys. Wind speeds were predominantly below 10 m/s. A rainfall event of up to 14 mm occurred between 12.00 pm and 3.00 pm on Friday 9 September 2011. Noise data was excluded from the analysis of the survey results when wind speeds exceeded 10 m/s and rainfall exceeded 0.2 mm.

3.1 Attended Noise Measurements

Attended noise measurements were performed on Monday 5 September 2011 and Tuesday 13 September 2011 to measure existing significant sources of noise near to the development site.

Measurements were conducted with a RION NA-27 precision sound level meter configured to record a range of A-weighted noise levels, including the L_{A1}, L_{A10}, L_{Aeq}, and L_{A90} statistical parameters, over a 15-minute period. The calibration of the sound level meter was confirmed before and after the monitoring survey using a RION Type NC–73 Sound Level Calibrator.

Measurements of ambient noise were taken at various times at the noise logger location as shown in **Figure 1**. **Table 1** provides the results of the attended monitoring survey.

The dominant source of noise was traffic using the ICB. Noise from traffic on O'Connell Terrace and Clem 7 was also significant. Noise from the ventilation station and associated mechanical plant was not audible when observed at the measurement location near to the Wren Street residences. No other significant noise sources were identified during the noise surveys.

Table 1 Attended Noise Survey Results

Date/Time	Measured Noise Level, dBA			
	L_{A1}	L_{A10}	L_{Aeq}	L_{A90}
Monday 5 Sep 2011 4.20 pm	78	75	73	72
Tuesday 13 Sep 2011 9.45 pm[1]	75	69	65	58

1. Construction work on the Inner City Bypass reduced traffic speeds to approximately 40 km/h.

3.2 Unattended Noise Monitoring

A continuous unattended noise monitoring survey was undertaken between Monday 6 September 2011 to Tuesday 12 September 2011.

The monitoring survey was carried out using an Acoustic Research Laboratories Type EL-316 Environmental Noise Logger. The noise logger was configured to record a range of A-weighted noise levels, including the L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} statistical parameters, over consecutive 15-minute periods. The calibration of the logger was confirmed before and after the monitoring survey using a RION Type NC-73 Sound Level Calibrator.

The location used for the noise logger measurements is indicated in **Figure 1**. SLR Consulting used that location as it was considered to be representative of the Wren Street residences with regards to the acoustic ambient environment.

The noise logger microphone was 2.5 metres above the existing ground level and was not influenced by reflective surfaces other than the ground.

The measured statistical noise levels are displayed graphically in **Appendix B**. The measurement results have been analysed with regard to the Department of Environment and Resource Management (DERM) Ecoaccess Guideline: *Planning for Noise Control* document. A summary of the average measured noise levels has been presented in **Table 2**.

Table 2 Summary of Measured Ambient Noise Levels

Statistical Parameter	Period	Average Measured Noise Levels, dBA
L_{A1}	Daytime[1]	80
	Evening[2]	78
	Night[3]	76
L_{A10}	Daytime	78
	Evening	75
	Night	71
	18 hour[4]	77
L_{A90}	Daytime	73
	Evening	68
	Night	52
L_{Aeq}	Daytime	76
	Evening	74
	Night	72
	24 hour[5]	75
	Maximum 1 hour (day)	77
	Maximum 1 hour (night)	76

1. 7.00 am to 6.00 pm on a day
2. 6.00 pm to 10.00 pm on a day
3. 10.00 pm on a day to 7.00 am the next day
4. The $L_{A10(18hour)}$ is the arithmetic average of the hourly L_{A10} noise levels over the 18-hour period between 6.00am and 12.00 midnight.
5. The $L_{Aeq(24\ hour)}$ is the logarithmic average of the hourly L_{Aeq} noise levels measured over a 24-hour period.

It can be seen that the unattended and attended survey results were comparable and consistent with an area dominated by road traffic noise.

It is expected that ambient noise levels in Bowen Park would be similar to those measured adjacent to the Wren Street residences due to the contributions from road traffic on the ICB, O'Connell Terrace and Bowen Bridge Road.

4 NOISE CRITERIA

4.1 Construction Noise

4.1.1 Legacy Way: Coordinator General's Conditions of Approval

In Queensland it is usual, where construction noise may affect sensitive receptors, to limit the hours of construction to 6.30 am to 6.30 pm from Monday to Saturday, in accordance with the *Environmental Protection Act (1994)* (EP Act).

For construction work occurring during those hours, specific noise limits are generally not applicable.

However, the Coordinator General's report, which contains noise objectives for construction of infrastructure associated with the Legacy Way Project, is relevant as the TCC building forms a component of the Legacy Way Project.

Noise objectives for noise from construction activity, which have been based on the long-term EPP Noise objectives, can be seen in **Table 3**. Note that the noise objectives for dwellings are applicable during "standard construction hours".

The report stipulates "standard construction hours" of 6.30 am to 6.30 pm Monday to Saturday (no construction activity of Sunday and Public Holidays), which is in line with the EP Act.

Table 3 Acoustic Quality Objectives as per Table 9 of Coordinator General's Report

Sensitive receptor	Time of day	Acoustic quality objectives, dB(A) (measured at the receptor)		
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$
Dwelling (for outdoors)	Standard Construction Hours[1]	50	55	65
Dwelling (for indoors)	Standard Construction Hours[1]	35	40	45
Commercial and retail activity (for indoors)	When the activity is open for business	45	---	---
Park or garden that is open to the public (whether or not on payment of an amount) for use other than for sport or organised entertainment	Anytime	The level of noise that preserves the amenity of the existing park or garden[5]		

1. 6.30 am to 6.30 pm Monday to Saturday, and at no time on Sundays or public holidays

The parameter/s chosen for assessment must be justified based on the character of the noise source.

At the time of this report, it is understood that construction will occur only during the standard construction hours.

The Coordinator General's report does however also contain noise criteria for construction activity occurring outside standard construction hours. Furthermore, the potential for sleep disturbance would exist if construction occurs between 6.30 pm and 6.30 am.

Therefore, it would also be appropriate to consider construction noise emissions, particularly shot-term impact noise, with regard to World Health Organisation (WHO) sleep disturbance criteria, in addition to the Coordinator General's criteria, should construction activity occur outside standard construction hours.

4.2 Operational Noise

The Coordinator General's report does not specify operational noise criteria for sources of noise other than road traffic relating to the Legacy Way Project.

It will be appropriate to assess noise emissions from the TCC building in accordance with the ULDA *Bowen Hills Urban Development Area Development Scheme* document (the "Development Scheme").

4.2.1 Urban Land Development Authority

The proposed development site lies within the boundaries of the Bowen Hills Urban Development Area and is subject to the requirements of the Development Scheme.

Section 3.9 (Environment – General Noise Requirements) of the Development Scheme states the following:

> *The design, siting and layout of development must address noise impacts and where necessary incorporate appropriate noise mitigation measures.*
>
> *Development is to achieve acceptable noise levels for noise sensitive uses in affected areas.*[8]
>
> *Where determined necessary by the ULDA, an acoustic report will be required to evaluate and address potential noise impacts and recommend appropriate noise mitigation measures.*
>
> [8] *Refer to the Environmental Protection (Noise) Policy 2008*

Schedule 2 of the Development Scheme defines "noise sensitive use" to mean any of the following:

- *house, multiple residential, other residential*
- *childcare centre, community facility, hospital or place of assembly*
- *park.*

Therefore the Environmental Protection (Noise) Policy 2008 (EPP Noise) will be used to establish "acceptable" noise levels, or noise criteria, for noise emissions from the proposed development.

4.2.2 Environmental Protection (Noise) Policy 2008

Schedule 1 of the EPP Noise provides acoustic quality objectives for enhancing or protecting the environmental values at noise sensitive receptors. The acoustic quality objectives relevant to the development, and the corresponding environmental values, have been summarised in **Table 4**.

The EPP Noise objectives are intended for use as long-term acoustic quality objectives to be progressively achieved as part of achieving the purpose of the EPP Noise. The objectives are not intended to assess impacts from temporary noise sources, and transportation noise or noise sources associated with safety (eg reverse alarms, pedestrian crossings) are specifically excluded.

As such, the values in **Table 4** would be applicable to operational noise from any mechanical plant (eg air conditioning, extraction fans, etc) and/or workshop activities.

Table 4 EPP Noise Acoustic Quality Objectives

Column 1	Column 2	Column 3			Column 4
Sensitive receptor	**Time of day**	**Acoustic quality objectives, dB(A) (measured at the receptor)**			**Environmental value**
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$	
Dwelling (for outdoors)	Daytime[1] and evening[2]	50	55	65	health and wellbeing
Dwelling (for indoors)	Daytime and evening	35	40	45	health and wellbeing
	Night-time[3]	30	35	40	health and wellbeing, in relation to the ability to sleep
Commercial and retail activity (for indoors)	When the activity is open for business	45	---	---	health and wellbeing, in relation to the ability to converse
Park or garden that is open to the public for use[4], other than for sport or organised entertainment	Anytime	The level of noise that preserves the amenity of the existing park or garden[5]			Community amenity

1. 7.00 am to 6.00 pm on a day
2. 6.00 pm to 10.00 pm on a day
3. 10.00 pm on a day to 7.00 am the next day, not applicable for construction noise assessment
4. Whether or not on payment of an amount
5. Criteria will be based on existing acoustic environment ("control of background creep" criteria)

The parameter/s chosen for assessment must be justified based on the character of the noise source.

Additionally, one of the aims of the EPP Noise is to prevent "background creep", which is the progressive increase in ambient background noise as new noise-emitting activities are introduced into an area.

Section 10 of the EPP Noise stipulates:

(2) To the extent that it is reasonable to do so, noise from an activity must not be -

(a) for noise that is continuous noise measured by $L_{A90,T}$ – more than nil dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$; or

(b) for noise that varies over time measured by $L_{Aeq,adj,T}$ – more than 5dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$.

Table 5 provides the noise criteria for the operational noise sources determined in accordance with the EPP Noise. The lower value of the acoustic quality objectives and "background creep" criterion will be applicable for the operational noise sources associated with the project.

Table 5 Operational Noise Criteria

Receiver	Time of Day	Acoustic Quality Objectives	"Background Creep"
Residential (for outdoors)	Daytime[1] and evening[2]	50 dBA $L_{Aeq,adj,1hr}$[3] 65 dBA $L_{A1,adj,1hr}$[4]	73 dBA L_{A90}[3] 78 dBA $L_{Aeq,adj,T}$[4]
Residential (for indoors)	Daytime and evening	35 dBA $L_{Aeq,adj,1hr}$[3] 45 dBA $L_{A1,adj,1hr}$[4]	---
	Night-time[5]	30 dBA $L_{Aeq,adj,1hr}$[3] 40 dBA $L_{A1,adj,1hr}$[4]	---
Commercial and retail activity (for indoors)	When the activity is open for business	45 dBA $L_{Aeq,adj,1hr}$	---
Park	Anytime	50 dBA $L_{Aeq,adj,1hr}$[3] 65 dBA $L_{A1,adj,1hr}$[4]	73 dBA L_{A90}[3] 78 dBA $L_{Aeq,adj,T}$[4]

1. 7.00 am to 6.00 pm on a day
2. 6.00 pm to 10.00 pm on a day
3. Applicable for mechanical plant noise (continuous noise source)
4. Applicable for workshop activity (time-varying noise source)
5. 10.00 pm on a day to 7.00 am the next day, not applicable for construction noise assessment

It can be seen in **Table 5** that the existing noise environment is very high relative to the acoustic quality objectives.

The L_{Aeq} and L_{A1} acoustic parameters described in the acoustic quality objectives of the EPP Noise will be appropriate for considering the noise emissions associated with the mechanical plant (continuous noise source) and workshop activities (time-varying source) respectively. These sources would be measured with regard to the L_{A90} and L_{Aeq} parameters for comparison with the "background creep" criteria of EPP Noise.

4.3 Summary of Project Noise Criteria

Based on the above, and the noise survey measurement results, the lowest applicable objectives for the development has been summarised in **Table 6**.

Table 6 Limits for the TCC Development

Noise Source	EPA Period		
	Noise Criteria for Identified Noise Sources Relevant to the Development		
	Day (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 7am)
Operational:			
Mechanical Plant	50 dBA $L_{Aeq,adj,1hr}$	50 dBA $L_{Aeq,adj,1hr}$	40 dBA $L_{Aeq,adj,1hr}$[1]
Workshop Activity	65 dBA $L_{A1,adj,1hr}$	65 dBA $L_{A1,adj,1hr}$	50 dBA $L_{A1,adj,1hr}$[1]
Construction Activity	50 dBA $L_{Aeq,adj,1hr}$[2] 55 dBA $L_{A10,adj,1hr}$[2] 65 dBA $L_{A1,adj,1hr}$[2]		

1. Assuming a 10 dB reduction from outside to inside a sleeping area via a partially open window.
2. Applicable between 6.30 am and 6.30 pm Monday to Saturday.
3. Applicable between 6.30 pm and 6.30 am Monday to Saturday, if required.
4. In accordance with WHO Sleep disturbance criteria, if required.

It is noted that all reasonable and practical measures must be undertaken in an endeavour to achieve the construction noise objectives in accordance with the Coordinator General's report. However, existing ambient noise levels in the area are already considerably higher than the noise objectives set by the Coordinator General and the EPP Noise. Compliance with the limits in **Table 6** would avoid further noise exposure at the Wren Street residences.

5 ASSESSMENT OF NOISE SOURCES AND NOISE-GENERATING ACTIVITIES

5.1 Identified Noise Issues

The activities/sources at the development expected to generate noise at the nearest residences will be as follows:

- Noise from rooftop mechanical plant;
- Noise from workshop activities; and
- Noise from construction activities.

Noise from vehicles in the car parking areas of the building, and entering/exiting from Sneyd Street, is expected be negligible when observed at the Wren Street residences given the influence of the existing road traffic noise, and has not been considered further.

Additionally, noise emissions associated with the retail and commercial operations at the building is also expected be negligible when observed at the Wren Street residences given the influence of the existing road traffic noise, and has not been considered further.

This assessment has considered noise from the project at the Wren Street residences. A design that achieves noise criteria at that location will also be compliant at other noise sensitive locations that are further away from the TCC building, eg Bowen Park.

5.2 Rooftop Mechanical Plant

Mechanical plant selection and location will be finalised during the detailed design phase.

Discussions with the project mechanical engineer indicated that a combination of packaged air handling units and reverse cycle condensers may be used to supply heat rejection and ventilation requirements. A central rooftop location, approximately 60 m from the Wren Street residences, covering approximately 160 m^2 has been anticipated.

The most critical time in terms of mechanical plant noise emissions will be the night-time. A design compliant with the night-time limit will be compliant at other times when the limits will be higher.

However, it is expected that heat rejection and ventilation requirements will be significantly lower for the night-time period and not all the plant items would be operational at that time.

Based on the night-time noise limit (40 dBA L_{Aeq}) and the separation distance between the Wren Street residences and the proposed rooftop plant location, the maximum **sound power level (SWL)** allowed for all rooftop plant items (combined) will be **88 dB**.

This means that compliance with the night-time noise objectives will be achieved if the maximum noise output for all rooftop plant items operating during the night period does not exceed 88 dB SWL.

The maximum SWLs for the day and evening periods, when the noise limit will be 50 dBA L_{Aeq}, will be **98 dB**.

Noise control by way of screening may also be considered if plant emissions exceed the nominated levels. Screening would provide noise reductions of the order of 10 dB – 15 dB, allowing plant with higher noise output to be considered.

A detailed investigation must be undertaken when mechanical plant selection, design and operating conditions have been finalised to determine if acoustic screening will be required or otherwise. However, it is expected that mechanical plant with appropriate noise output, combined with noise control screening if required, will be readily available to achieve the EPP Noise objectives at all times.

5.3 Workshop Activities

The workshop will be located on the ground floor of the proposed building. The walls to the ground floor areas will be precast concrete. There will be no openings in the façade which faces west towards the Wren Street residences. There will be a roller door facing O'Connell Terrace, and this will be the main emission point for workshop activity noise for the Wren Street residences.

Noise-generating activities in the workshop area are expected to be of a minor corrective and maintenance nature.

Such activities would generally involve hand-held equipment with sound power levels (SWL) of up to 105 dBA L_{Amax}. It is expected that the power tools would be used for short periods at a time, and that noise associated with power tools would have a prominent tonal and/or impulsive character.

Based on the above, the location of the workshop within the building, the proposed building design (including the roller door in a closed position), and the separation distance to the Wren Street residences, workshop noise levels of the order of 45 dBA $L_{A1,adj,15\ min}$ are predicted at the Wren Street residences.

Therefore, the workshop noise levels would be expected to comply with the EPP Noise objectives at all times.

5.4 Construction Activities

Construction of the TCC building is expected to last between 12 and 18 months. Construction activities will be limited to the standard construction hours of 6.30 am to 6.30 pm Monday – Saturday in accordance with the Coordinator General's report.

Table 7 shows the acoustically significant plant and equipment items to be used at various stages during construction as provided by the project team. The SWL and operating duration has also been shown in **Table 7**.

Table 7 Construction Plant and Equipment Sound Power Levels and Operating Duration

Plant/Equipment Item	Sound Power Level (dBA L_{Amax})	Operating Duration (minutes per hour)
Mobile/Tower crane	105	30
Fork lift	102	30
Truck/Semi-trailer[1]	114	30
Concrete truck[2]	112	60
Concrete pump	107	60
Excavator	114	60
Power tools	105	30
Roller	118	60
Compressors	100	60

1. 5-10 concrete trucks on one day per week, fewer following structure completion.
2. 2-6 trucks on alternate days, fewer following structure completion.

Table 8 provides the predicted construction noise levels at the Wren Street residences. The predicted levels have been shown including the effects of solid screens of three different heights (2 m, 3.5 m, and 5 m). The screens would run the length of the west site boundary and would return along the north and south site boundaries for approximately 50 metres.

Predicted construction noise values that exceed the Coordinator General's objectives have been bolded.

The predicted construction noise levels have been based on L_{Amax} sound power levels adjusted for expected variations in noise output of the plant/equipment item. The predicted levels also include adjustments for tonal and/or impulsive noise character where applicable, and also have been adjusted for estimated audible duration in a one hour period.

Table 8 Predicted Construction Noise at External Areas of Wren Street Residences

Plant / Equipment Item	**Predicted Noise Level, dBA $L_{Aadj,1\ hr}$ including effect of solid screen[1]**								
	2 metre screen			**3.5 metre screen**			**5 metre screen**		
	L_{Aeq}	**L_{A10}**	**L_{A1}**	**L_{Aeq}**	**L_{A10}**	**L_{A1}**	**L_{Aeq}**	**L_{A10}**	**L_{A1}**
Mobile/Tower crane	**51**	54	57	47	50	53	43	46	49
Fork lift	45	48	51	41	44	47	37	40	43
Truck/Semi-trailer	**57**	**60**	63	**53**	**56**	59	49	52	55
Concrete truck	**55**	**58**	61	**51**	54	57	47	50	53
Concrete pump[2]	**58**	**60**	61	**54**	**56**	57	50	52	53
Excavator	**60**	**63**	**66**	**56**	**59**	62	**52**	55	58
Power tools[3]	**54**	**57**	59	50	53	55	46	49	51
Roller	**61**	**64**	**67**	**58**	**61**	64	**56**	**59**	62
Compressors	**52**	54	55	48	50	51	44	46	47
Noise objective[4] (dBA)	**50**	**55**	**65**	**50**	**55**	**65**	**50**	**55**	**65**

1. The screen must be constructed from a sold material with a minimum surface density of 12 kg/m^3 (eg 20 mm timber, 15 mm plywood, 9 mm cement sheet, or colourbond sheet etc).
2. Includes a +2 dB adjustment for tonal character.
3. Includes a +5 dB adjustment for tonal and/or impulsive character.
4. As per Coordinator General's report.

It is noted that the predicted construction noise levels are less than the existing background noise levels during the daytime (6:30 am – 6.30 pm) at the Wren Street residences. Therefore, none of the construction activities would be considered "high impact" as defined in the Coordinator General's report.

The predicted construction noise levels in **Table 8** suggest that construction noise would generally achieve the noise objectives in the Coordinator General's report when a 5-metre high screen is in place. Noise associated with the roller and excavator may be expected to exceed the objectives by up to 6 dB on occasions. Excesses of that magnitude would be considered minor for construction noise, and insignificant in the context of the relatively high existing ambient noise environment.

The excesses rise to 8 dB and 11 dB for screen heights of 3.5 m and 2 m respectively, in addition to a greater number of the construction noise sources exceeding the objectives. Similarly, construction noise excesses of those magnitudes would be considered moderate. However, given the existing high noise ambient environment, it would be expected that the predicted construction noise levels would still be considered acceptable.

It is understood that construction activity at the RNA showground development may occur around the same time as the proposed TCC building. It is expected that the construction noise from the TCC building would be acoustically dominant when observed at the Wren Street residences, owing to the greater separation distance to the RNA development. Additionally, construction noise maxima from both projects would be unlikely to occur at the same time. Therefore, any cumulative impact of construction noise would be acoustically negligible or minimal.

5.4.1 Construction Noise Minimisation and Management

In accordance with the Coordinator General's report, it will be appropriate to identify reasonable and practical measures designed to minimise construction noise emissions as part of a Noise and Vibration Environmental Management Plan Sub-Plan (N&V EMP Sub-Plan).

There will be several techniques available that would be considered reasonable and practical, which could be incorporated into a N&V EMP Sub Plan, including:

- Installing noise reduction screens. The screens should be as high as practicable (and consider safety constraints etc to be determined in the detail design phase) in order to obtain maximum noise reduction (see **Table 8**). The screens would run the length of the west site boundary and would return along the north and south site boundaries for approximately 50 metres, and would be constructed as per Note 1 in **Table 8**.
- Selecting plant/equipment with lower noise output (ie with silencers, mufflers or other noise control devices fitted), than listed in **Table 7** will also reduce noise construction noise emissions.
- The delivery area of material to the site should be arranged to eliminate the need for vehicles to reverse, thereby eliminating reverse alarms. Plant items on site full-time should be fitted with reverse alarms of the broadband type (ie bland, "quacking" type).
- Adhere to the standard construction hours as far as practicable.
- Position compressors behind structures that act as barriers or on the east of the site
- Orientate concrete pumps/trucks so that noise emissions are directed to the east.
- Encourage contractors and construction workers to practice "quiet" work methods, including:
  - avoid creating "impact" noises, particularly during loading/unloading activities; and
  - maintain plant/equipment in good working order, eg engine tuning, sharp cutting blades, etc.

6 CONCLUSION

SLR Consulting has considered noise issues associated with the proposed TCC building at O'Connell Street, Bowen Hills.

Operational noise emissions from the development include noise from workshop activity and rooftop mechanical plant. Construction noise has also been assessed.

Attended and unattended noise monitoring surveys were conducted at the site to establish the existing ambient environment and to assist in determining limits for noise from the development site.

Noise associated with the project must be considered in accordance with the Queensland Department of Infrastructure and Planning *Coordinator-General's Conditions of Approval* report. Additionally, noise limits (see **Table 6**) were determined in accordance with the *Bowen Hills Urban Development Area Development Scheme* document issued by the Urban Land Development Authority, and the referral document *Environmental Protection (Noise) Policy 2008*.

Predictions of operational noise from the TCC building indicate that all applicable noise limits can be achieved. Further consideration of rooftop mechanical plant will be required during the detailed design stage to establish the need for noise control, or otherwise.

Construction noise would exceed the noise objectives specified in the Coordinator General's report (see **Table 6**) on occasion for some activities. However, construction noise would still be expected to be acceptable at the Wren Street residences provided noise screening and mitigation measures are employed at the site. This statement is made in the context of the relatively high existing ambient noise environment. Measures to minimise construction noise as far as reasonable and practical have been discussed in Section **5.4.1** of this report.

7 CLOSURE

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

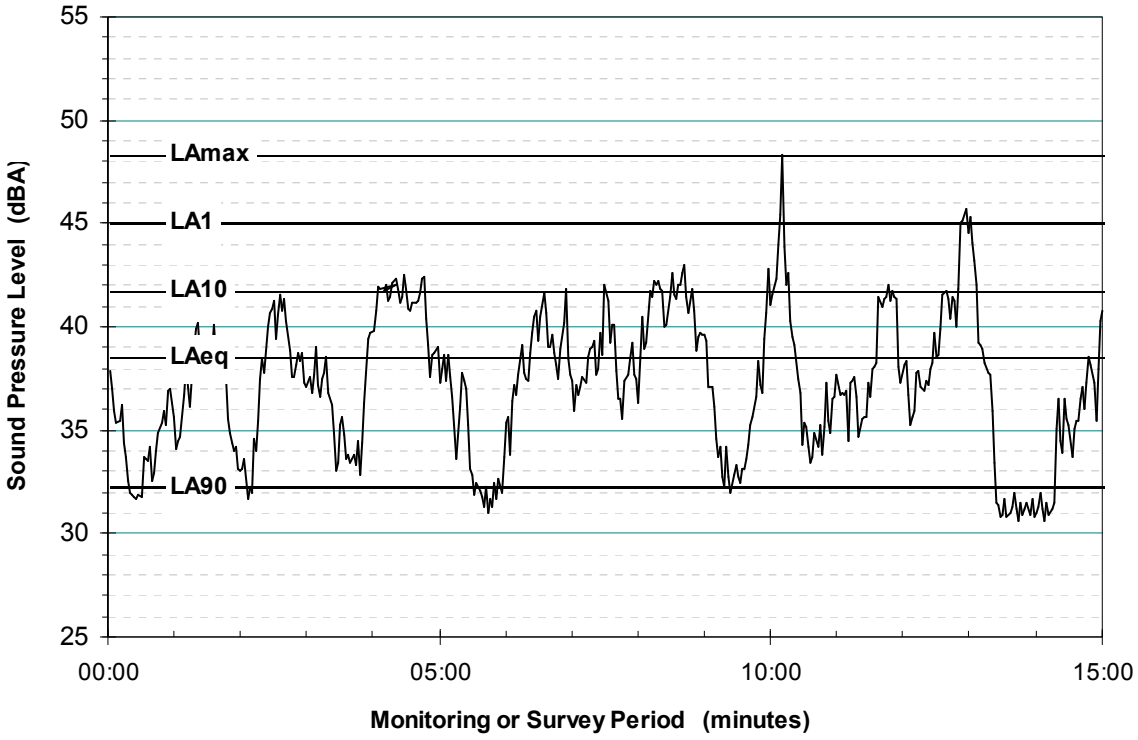
SLR Consulting disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

ACOUSTIC TERMINOLOGY

This report makes repeated reference to certain noise level indices (also known as statistical parameters), in particular the L_{A1}, L_{A10}, L_{A90}, L_{Aeq} and L_{Amax} noise levels. A graphical representation of these descriptors is shown below.

- The L_{Aeq} is a special type of average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound over the same measurement period.
- The L_{A90} noise level is the A-weighted sound pressure level exceeded 90% of a given measurement period (ie 13.5 minutes of a 15-minute period) and is representative of the average minimum background sound level (in the absence of the source under consideration). It is commonly referred to as the "background" noise level.
- The L_{A10} is the A-weighted sound pressure level exceeded 10% of a given measurement period (ie 1.5 minutes of a 15-minute period). It is representative of the average of a range of higher level noise events during the measurement period.
- The L_{A01} noise level is the A-weighted sound pressure level exceeded 1% of a given measurement period (ie 9 seconds of a 15-minute period) noise level is representative of the higher A-weighted noise levels associated with site activity.
- The L_{Amax} noise level is the maximum A-weighted noise level associated with site activity.
- The $L_{Amax,adj,T}$ noise level is the average of the maximum noise levels during time period, T.

Graphical Display of Typical Noise Indices



Sensitivity of People to Noise Level Changes

A change of up to 3 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness.

Sound Pressure and Sound Power Levels

The sound pressure level is a measure of the fluctuations in sound pressure relative to atmospheric pressure. It is measured using a microphone that responds proportionally to the sound pressure. The sound pressure due to a noise source (eg, an item of mechanical plant) will depend upon the distance from the source and/or the acoustic conditions ("reverberant" or otherwise) of the space in which it is located, as well as the "directionality" of the noise source and the location of any reflecting surfaces near to the source and/or the measurement location.

The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_W, or by the reference unit 10^{-12} W. It is not dependant on distance or acoustic conditions.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

A-Weighting or dBA Noise Levels

Sound pressure is not sensed equally by the human ear at all frequencies. The overall level of a sound is usually expressed in terms of dBA which is measured using the "A-weighting" filter incorporated in sound level meters. The filter is modified to have a frequency response corresponding approximately to that of human hearing. People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and is less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of a human's perception of loudness of that sound.

Sound levels expressed as dB, or "linear" levels have not been weighted.

Different sources having the same dBA level generally sound about equally as loud, although the perceived loudness can also be affected by the character of the sound (eg the loudness of human speech and a distant motorbike may be perceived differently, although they are of the same dBA level). The overall level of a sound may be adjusted for particularly strong (or annoying) characteristics (see below).

Adjustment for Noise Character

The L_{A1} indices, and to a lesser extent the L_{A10} indices, is particularly influenced by short-term noise events, which typically feature impulsive and/or intermittent characteristics. These events, when attributable to the noise source in question, have the potential to increase the subjective loudness of the noise at the receptor.

This is also true of noise that contains a tonal character such as a distinctive hum, whine, whistle, and the like.

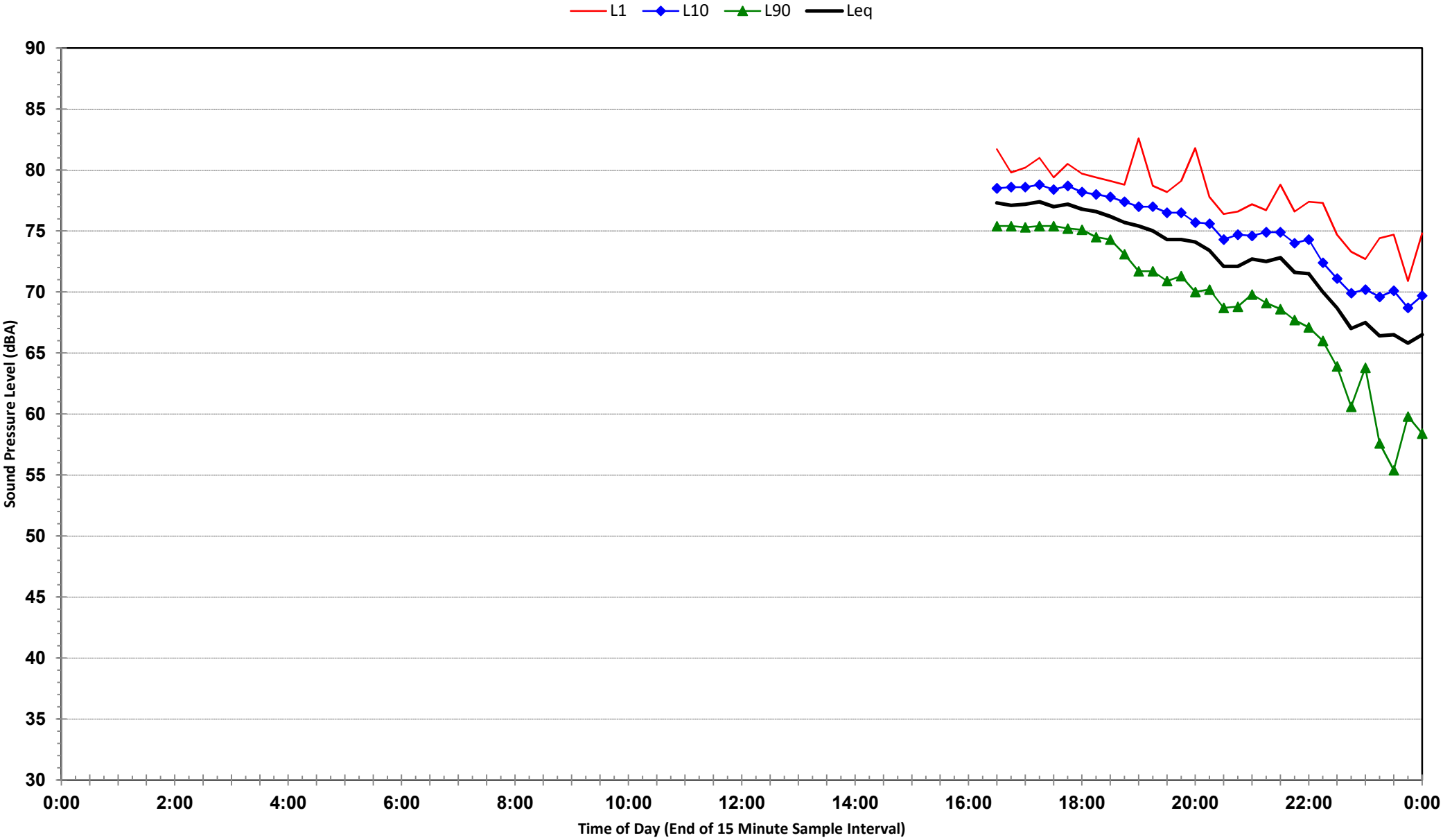
These "annoying" characteristics are considered during the assessment process in the form of an adjustment to the noise source in question when observed at the receiver. This is notated in the noise indices by the 'adj' term, eg $L_{A10,adj,15mins}$.

Appendix B

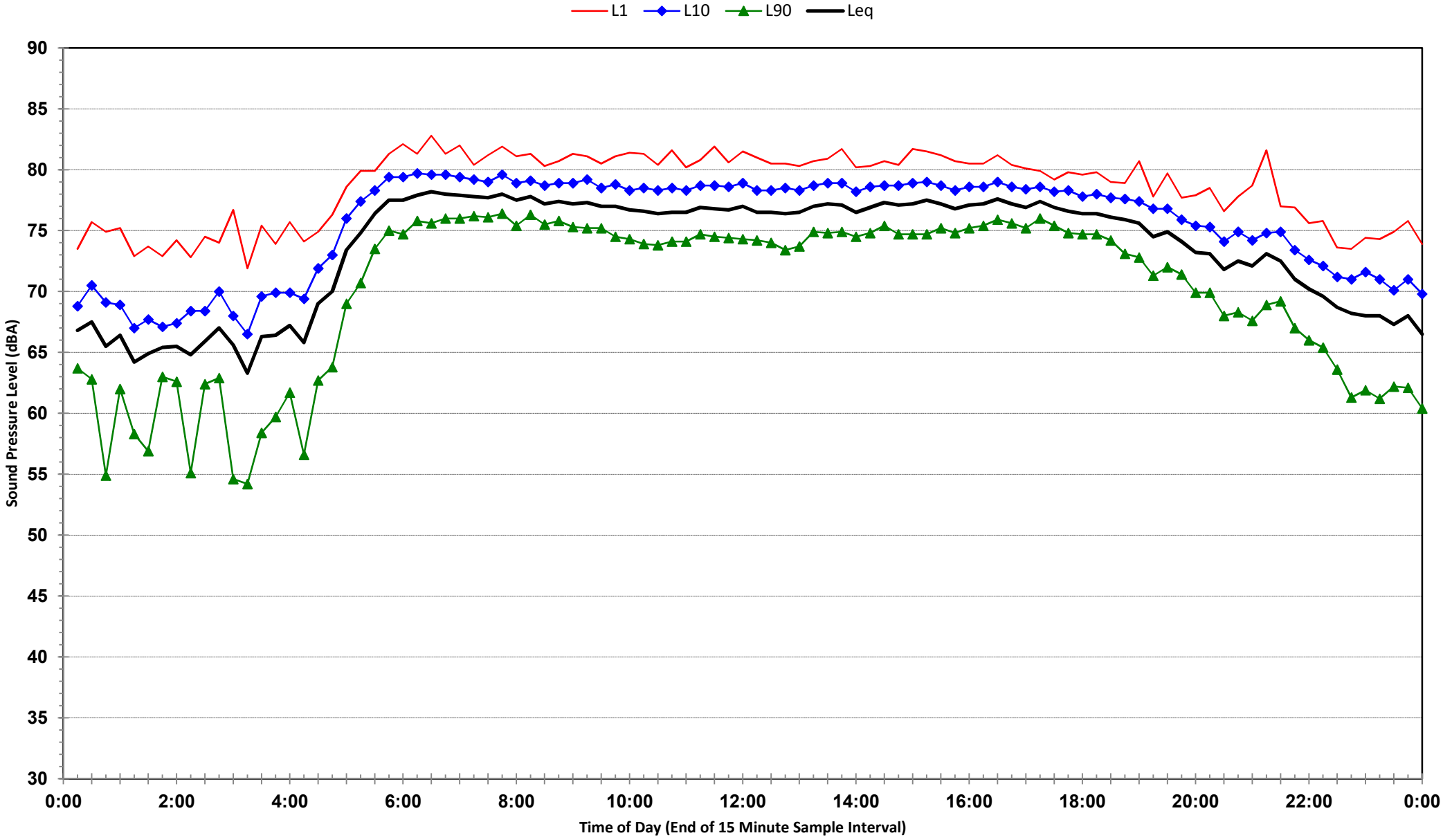
Report Number 620.01854.00300-R1

NOISE LOGGING MEASUREMENTS

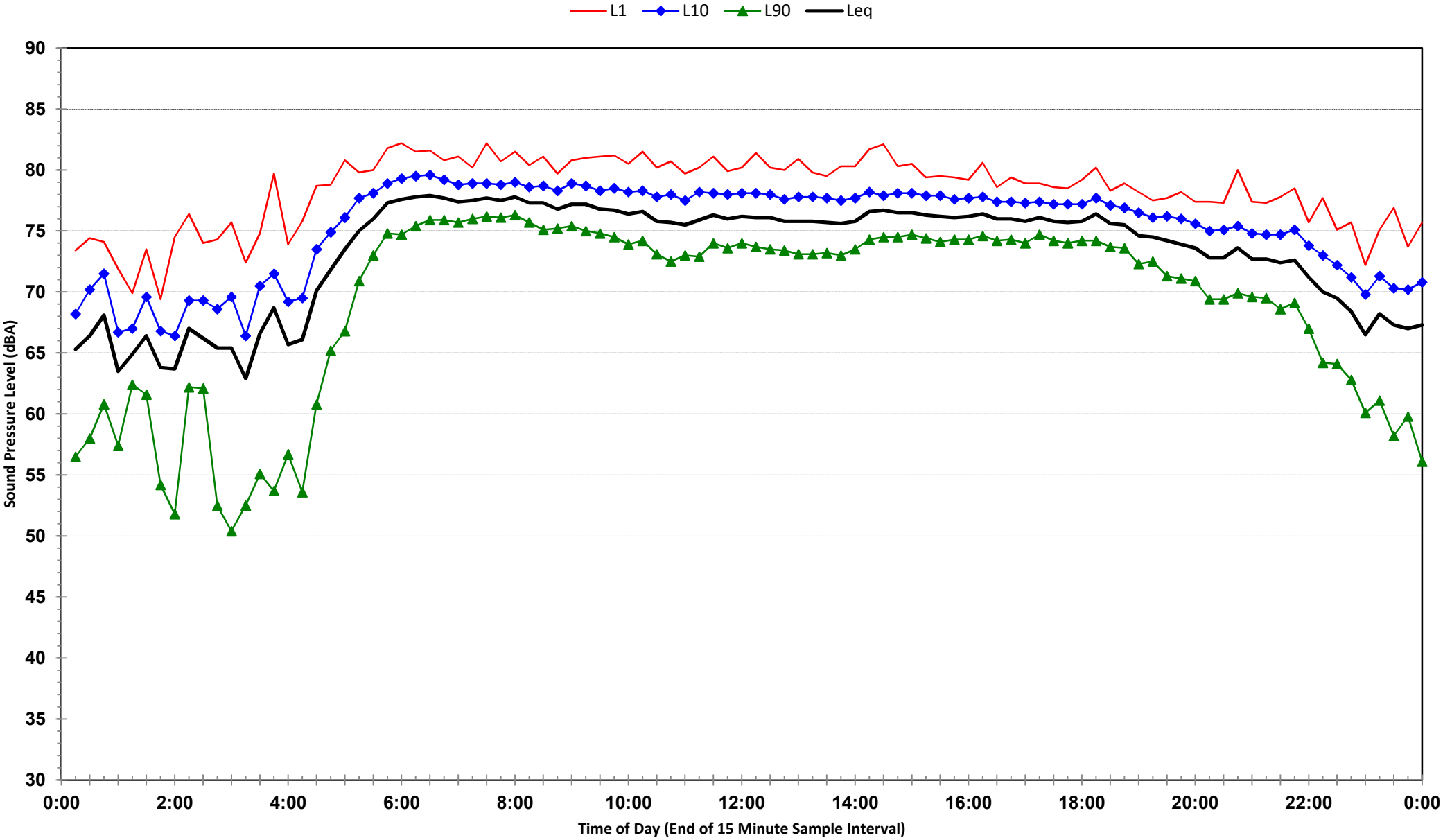
Statistical Ambient Noise Levels
TCC Building Area - Monday 5 September 2011



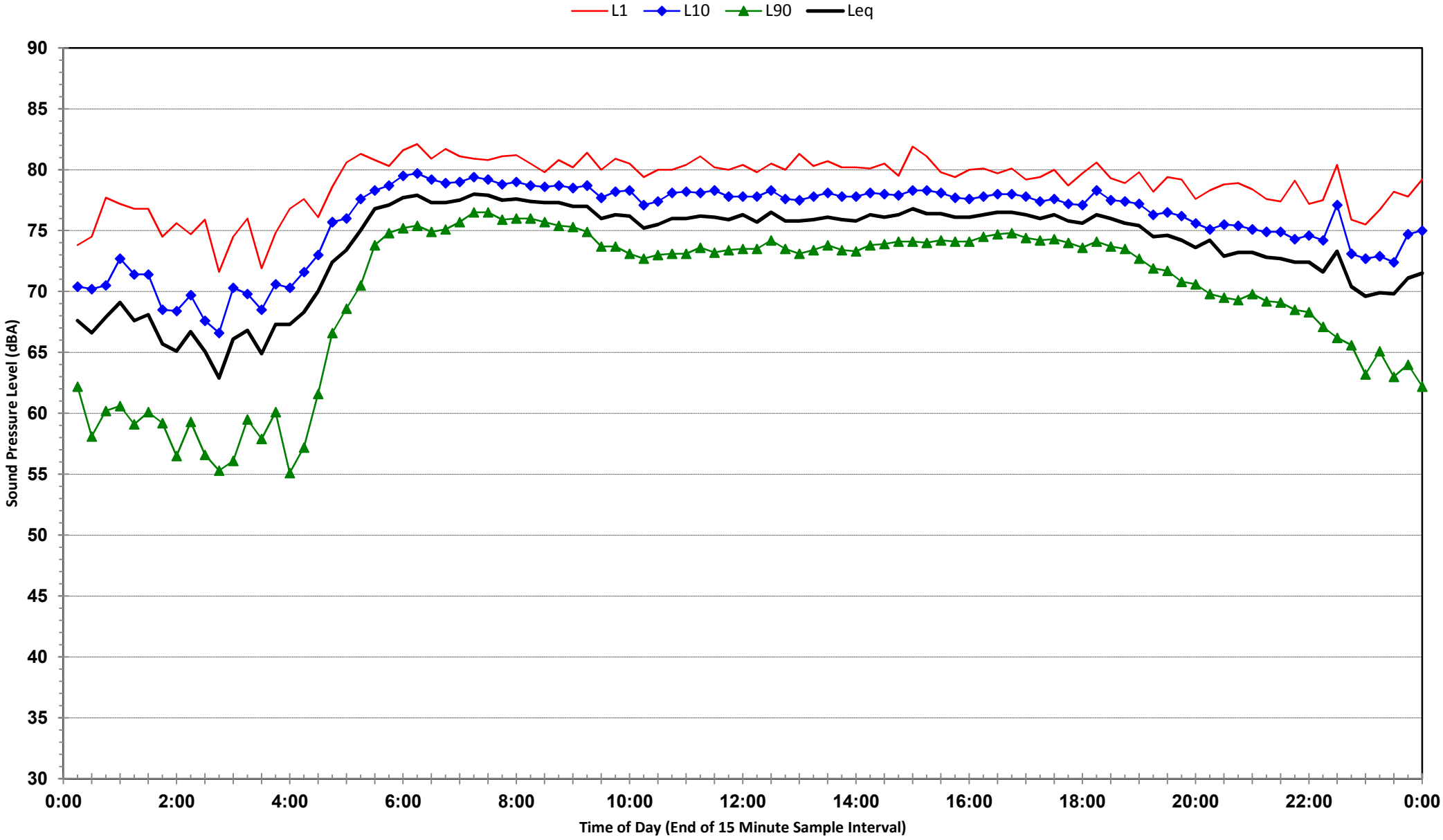
Statistical Ambient Noise Levels
TCC Building Area - Tuesday 6 September 2011



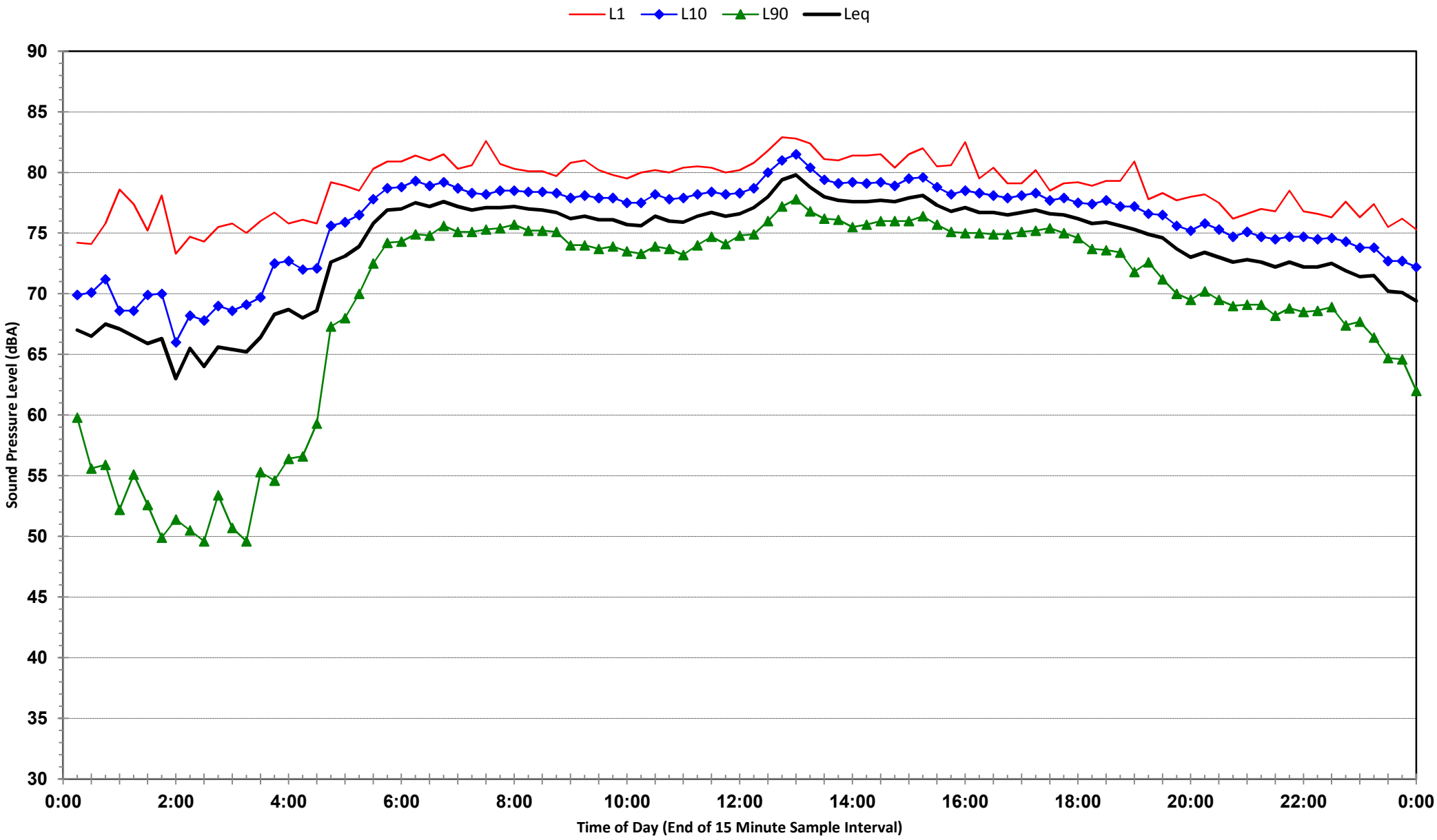
Statistical Ambient Noise Levels
TCC Building Area - Wednesday 7 September 2011



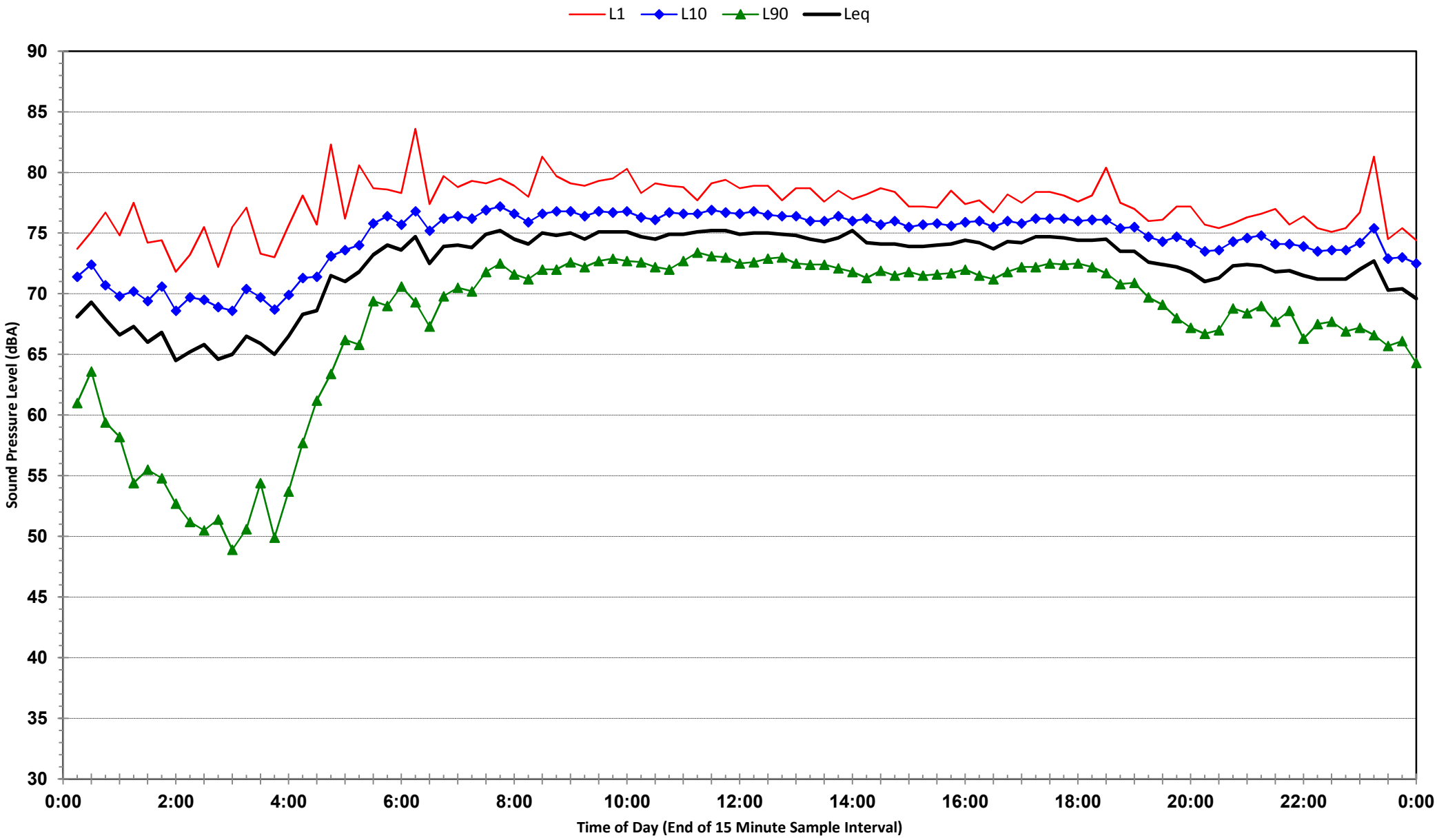
Statistical Ambient Noise Levels
TCC Building Area - Thursday 8 September 2011



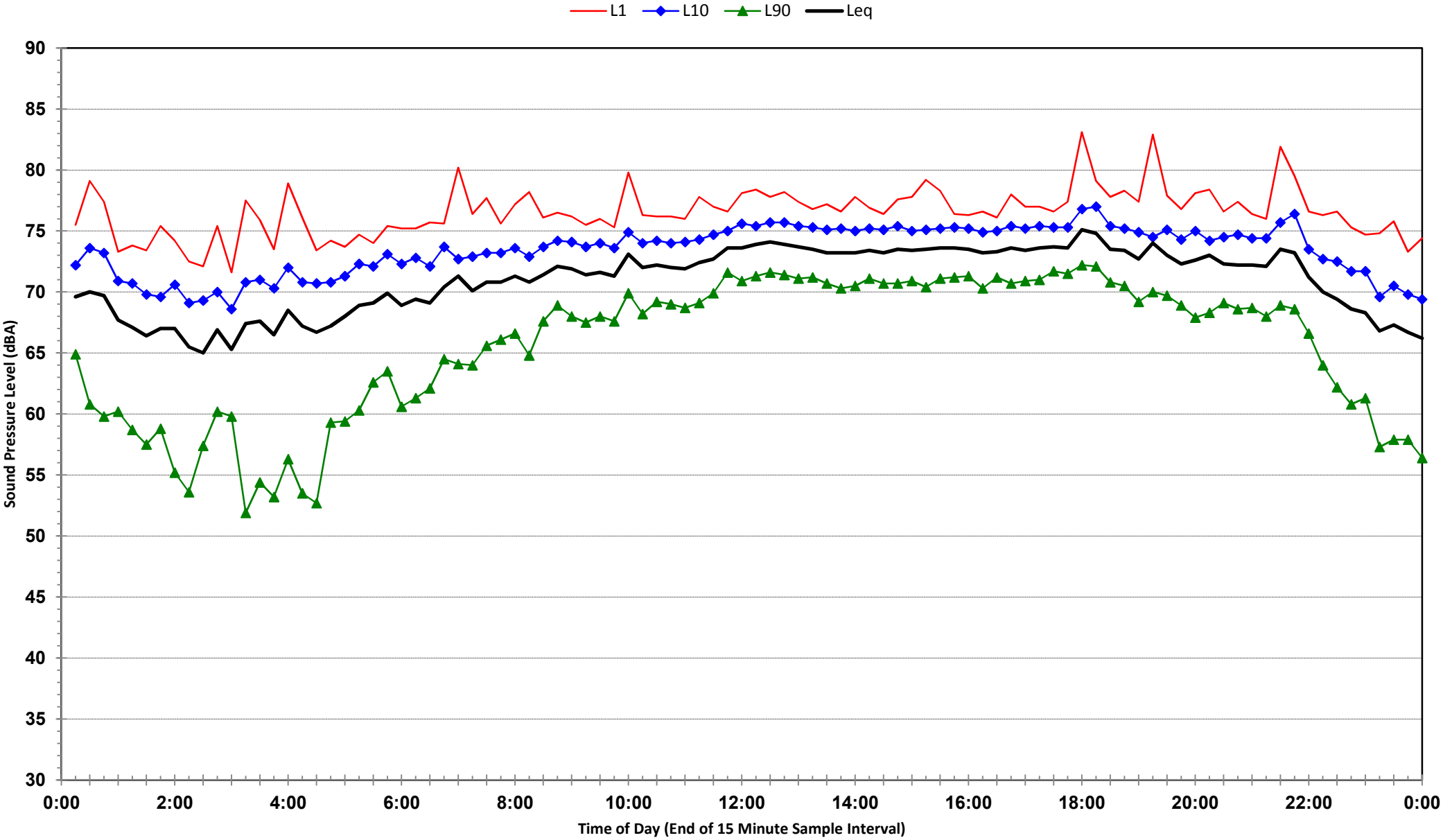
Statistical Ambient Noise Levels
TCC Building Area - Friday 9 September 2011



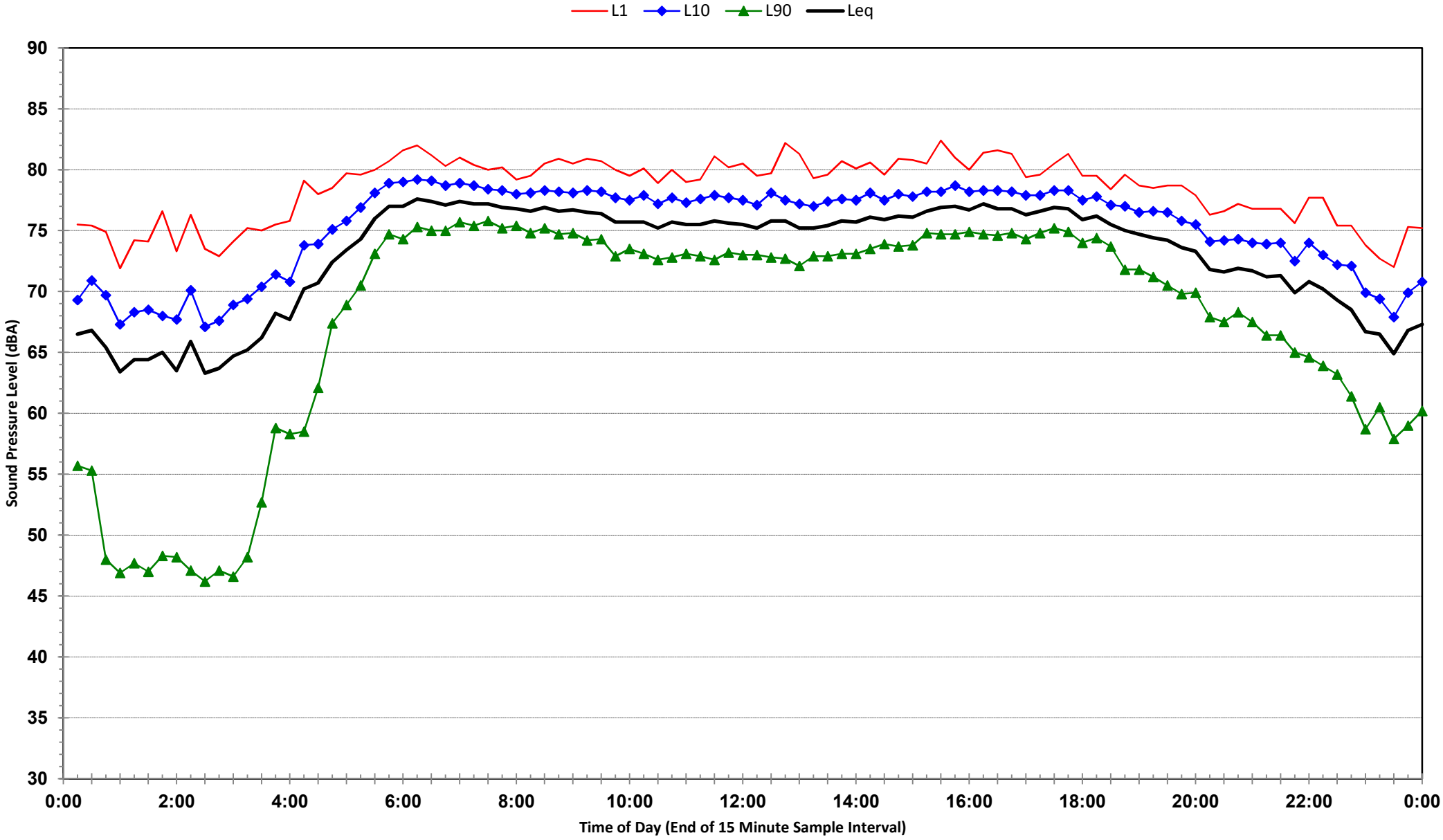
Statistical Ambient Noise Levels
TCC Building Area - Saturday 10 September 2011



Statistical Ambient Noise Levels
TCC Building Area - Sunday 11 September 2011



Statistical Ambient Noise Levels
TCC Building Area - Monday 12 September 2011



Statistical Ambient Noise Levels
TCC Building Area - Tuesday 13 September 2011