Northern Link

TECHNICAL REPORT NO. 7A

CONSTRUCTION AIR QUALITY ASSESSMENT

24 September 2008

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Contents

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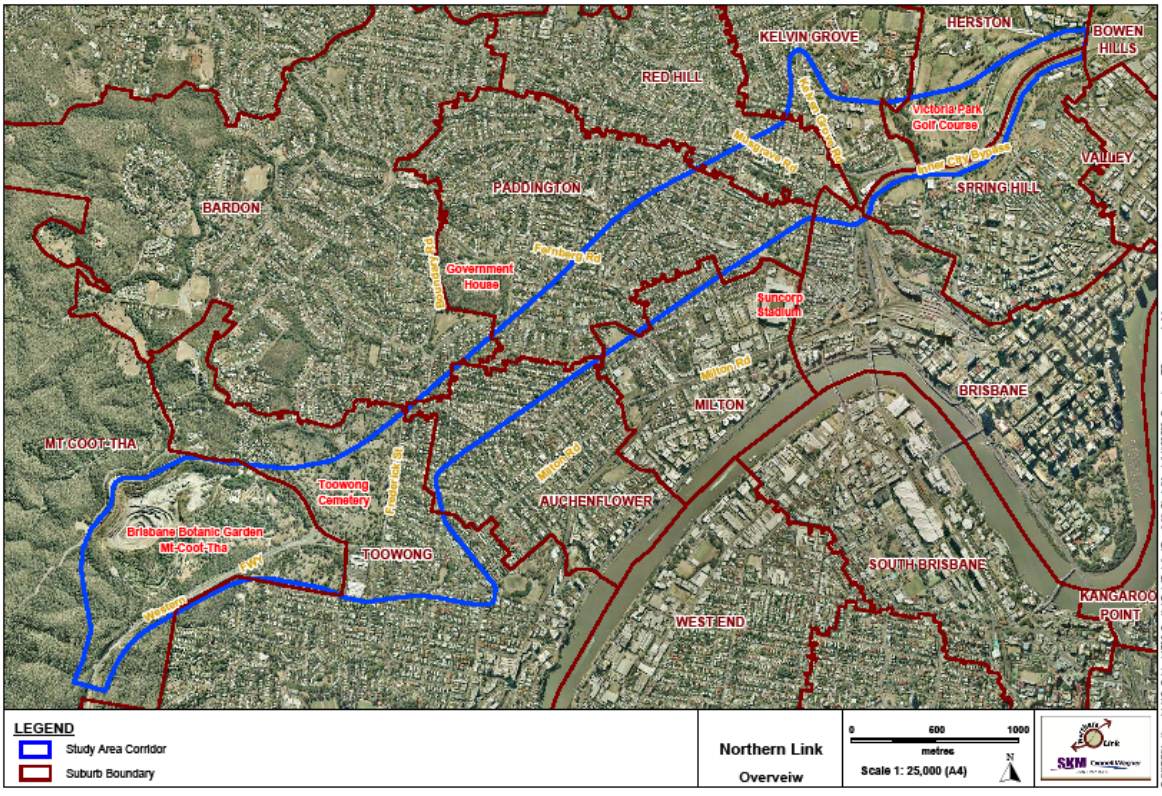
1. Introduction

1.1. Project Overview

Northern Link ("the Project") is a significant element in an overall strategy to alleviate congestion on Brisbane's road network. The Project will link the Western Freeway at Toowong with the Inner City Bypass (ICB) at Kelvin Grove. Northern Link would be constructed mostly in parallel tunnels. Refer to **Figure 1-1** for the location of the Project and study corridor.

Following the declaration by the Coordinator-General that the Project is a "project of State significance for which and EIS is required", Brisbane City Council has commissioned the Joint Venture (JV) between Sinclair Knight Merz (SKM) and Connell Wagner (CW) to prepare an Environmental Impact Statement (EIS) for the Project.

- **Figure 1-1: Study Corridor Boundary**



1.2. Terms of Reference

The Terms of Reference (ToR) for the Project are set in accordance with the requirements of the State Development and Public Works Organisation Act 1971 (SDPWO Act). The ToR identify

matters that should be addressed in the EIS. For construction air quality the following work elements are required:

- Detailed description of the existing environment including analysis of ambient air quality;
- Identification of sensitive receptors;
- Review of activities which are likely to cause nuisance dust or odour;
- Identify locations for possible dust monitoring locations; and
- Recommendations for construction work methods and management practices which could best minimise dust nuisance impacts.

These are required to be conducted with reference to environmental values as defined by the Environmental Protection (Air) Policy 1997.

1.3. Report Outline

To address the ToR as described above the following work elements were undertaken:

- A summary of the relevant air quality guidelines as specified in the *Environment Protection Policy (Air) 1997* (EPP(Air));
- A description of the existing environment including local dispersion meteorology, air quality and surrounding land uses;
- An assessment of potential dust impacts from construction related activities such as surface works, worksites and Mt Coot-tha quarry;
- A discussion of dust mitigation measures which may be implemented to reduce nuisance dust impacts; and
- A discussion of potential dust monitoring activities which may be implemented to monitor dust impacts and aid in reactive dust management strategies.

2. 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 EPA in the Queensland *Environment Protection Policy (Air) 1997* (EPP(Air)).

The current goals for criteria pollutants considered relevant to the assessment of air quality impacts during construction of the Project, as shown in Schedule 1 of the EPP (Air), are as follows:

- PM_{10} maximum 24-hourly average – 150 µg/m^3;
- PM_{10} annual average - 50 µg/m^3;
- TSP annual average - 90 µg/m^3.

The National Environment Protection Measure (NEPM) for Air Quality was released by the National Environment Protection Council (NEPC, 2003). The relevant standard for PM_{10} in the NEPM is:

- PM_{10} maximum 24-hourly average, 50 µg/m^3 (with 5 allowable exceedences per year).

The application of the NEPM is intended to provide a representative measure of regional air quality, rather than a project specific target. Although the NEPM is not considered strictly applicable to construction projects it is recognised that projects should work towards achieving the NEPM goals.

The policy is designed for consideration when siting industrial developments and is not necessarily relevant to the assessment of construction impacts associated with this project. Given the expected duration of the construction works and the location of residences near the construction site, it would be considered prudent to adopt these goals as part of the environmental performance criteria for the Project.

Deposited dust, if present at sufficiently high levels, can reduce the amenity of an area. No formal criteria for dust deposition exist within Queensland, although an informal draft guideline of 120 mg/m^2/day was introduced some years ago by the then Department of Environment and Heritage (now the EPA) and was applicable at nearby sensitive residential places. Dust deposition monitoring has historically been undertaken as part of mining and large scale construction projects to assist with the monitoring of satisfactory performance. The EPA (2003) recommends this guideline for preparing environmental management plans for non-standard mining projects. The informal guidelines are consistent with the NSW Department of Environment and Climate Change (DECC, 2005) guidelines for deposited dust, which limit the maximum dust deposition rate to 4 g/m^2/month.

A dust deposition guideline of 120 mg/m^2/day is therefore considered appropriate for the construction of the Project.

The air quality goals for the assessment of construction impacts are presented in Error! Reference source not found..

- **Construction Air Quality Goals for the Project**

Pollutant	Construction Air Quality Goals	
	Aim to achieve	Not to be exceeded
Particles as PM_{10}	50 µg/m^3 (24 hr average)	150 µg/m^3 (24 hr average)
	-	50 µg/m^3 (annual average)
Total Solid Particulates	-	90 µg/m^3 (annual average)
Dust deposition	120 mg/m^2/day	-

3. Existing Environment

3.1. Overview

This section of the report provides an overview of the existing air environment and land uses in the study corridor.

3.2. Local Meteorology

The *Air Quality Impact Assessment: Brisbane Northern Link* (Holmes Air Sciences, 2008) provides a comprehensive analysis of local meteorology in the study area which may be referred to for further detail. A brief summary of wind fields for four locations around the study area is presented in **Table 3-1**. These sites include:

- Kedron – approximately 4.5 km to the north of the northern end of the Projects northern end;
- Brisbane CBD – approximately 1.5 km south of the Projects northern end;
- Woolloongabba – approximately 3.7 km to the south east of the Project; and
- Rocklea – approximately 7.1 km to the south of the Project.

Table 3-1: Dispersion Meteorology Summary (Holmes Air Sciences, 2008)

Location	Description
Kedron	▪ Simtars (Safety in mines testing and research station, established by the Queensland Government) conducted monitoring at Kedron between January 2006 and January 2007. ▪ Annually, winds were predominantly from the south-southwest or north-northeast. Summer winds are generally from the north-northeast to east-southeast, representing the direction of the sea-breeze. Winds are generally much lighter during winter and originate from the southwest quadrant. Spring and autumn winds show similarities between both summer and winter. ▪ The annual average wind speed at the Kedron site in 2006 was 1.6 m/s and the percentage of calms, where winds are less than or equal to 0.5 m/s, was 13.9%.
Brisbane CBD	▪ During 2006 annual winds were predominantly from the north, east or south. Very little to no winds are derived from the southwest and northwest quadrants and it was noted by EPA that nearby tall buildings shelter the sensors from these winds and also lead to turbulence at this site. ▪ The annual average wind speed at the Brisbane CBD site in 2006 was 0.8 m/s and the percentage of calms, where winds are less than or equal to 0.5 m/s, was 51%.
Woolloongabba	▪ During 2006 winds were variable from this site with winds from the southwest, southeast and northeast quadrants. Very few winds from the northwest are measured at this site. Winds from the southeast and east-southeast prevail in summer while winds in autumn and winter are mainly from the southwest quadrant. ▪ The annual average wind speed in 2006 at this site was 1.9 m/s and the percentage of calms was 6.2%.
Rocklea	▪ During 2006 winds in Rocklea were predominantly from the south to southwest, with some winds also from the north-northeast and east-southeast quadrants. Winds from the east-southeast prevailed during summer while winds in winter were

Location	Description
	mostly from the southwest. ▪ Winds in the Rocklea area tend to be stronger than at the other meteorological sites examined, as the annual average wind speed for 2006 was 2.4 m/s. The percentage of calms in 2006 was 5.9%.

3.3. Existing Air Quality

Holmes Air Sciences (2008) have provided a comprehensive analysis of air quality currently experienced in the Brisbane. Full detail has not been reproduced here, although a brief summary of particulate monitoring is provided below.

Air quality monitoring data for the project has been summarised for four sites:

- Brisbane CBD;
- Rocklea;
- South Brisbane; and
- Woolloongabba.

Table 3-2 provides a summary of PM_{10} monitoring at these locations.

Table 3-2: Particulate Matter Monitoring Results (µg/m^3), Brisbane (2004 – 2006)

Parameter	Brisbane CBD	Rocklea	South Brisbane	Woolloongabba
PM_{10}, 24-hour* maximum	62.4	52.6	88.3	66
PM_{10}, Average	16.6	17.4	20	21.8

* 24-hour clock average

Here it can be seen that maximum 24-hour PM_{10} concentrations exceed the NEPM goal of 50 µg/m^3 at all four monitoring locations. However, they do not exceed the project maximum goal of 150 µg/m^3. These high concentrations of PM_{10} are usually attributed to widespread events such as dust storms or bushfires. Average PM_{10} concentrations do not exceed the relevant goal of 50 µg/m^3.

In addition air quality investigations have been included for the area surrounding Mt Coot-tha Quarry. This information has been sourced from an investigation undertaken by Air Noise and Environment (2005) between April 2004 and March 2005. In this instance two methods were used to assess particulate impacts from the quarry – dust deposition (total fall out) and directional dust monitoring. The directional dust method assesses the relative contribution of emissions from four

wind directions (each with an angle of 90°) to particulate loadings at the receptor position. In both cases, monitoring was completed for a 30 day period (+/- 2 days).

Seven monitoring locations were commissioned and are detailed in **Table 3-3**. A meteorological monitoring station was also installed at 334 Bridwood Terrace.

Table 3-3: Monitoring Locations (Air Noise and Environment, 2005)

Site	Location	Community	Quarry Boundary	Deposition Gauge	Directional Gauge
1	333 Birdwood Tce	✓		✓	✓
2	15 Walter St	✓		✓	
3	"Dingo Hill" above primary crusher		✓ (inside boundary)	✓	
4	Botanical Garden / Quarry back entrance		✓	✓	✓
5	Stuartholme School, Birdwood Tce	✓		✓	
6	Truck entry, Mt Coot-tha Rd		✓	✓	
7	Botanical Garden / Quarry boundary		✓	✓	✓

Monitoring results are summarised in **Table 3-4**. Here it can be seen that the dust deposition criterion of 120 mg/m^2/day was met at all residential sites and all quarry sites excluding Site7 (on the boundary between the Quarry and the Botanical Garden) where a dust deposition rate of 146.5 mg/m^3 was experienced.

March 2005 results show the highest average monthly levels recorded, and it is considered possible that the blasting at the quarry and resurfacing works to the north of Stuartholme College influenced this peak. The March results are similar, however, to those for February, and the most likely cause of the higher dust fallout rates was thought to be the meteorological conditions.

- **Table 3-4: Total Insoluble Matter (mg/m^2/day) (Air Noise and Environment, 2005)**

Site	2004								2005			Average
	Apr	May	June	July/Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	
Community												
1[1]	33.3	13.3	26.6	23.3	26.6	59.9	-[4]	16.7	30.0	59.9	30.0	28.2
2	59.9	36.6	30.0	28.3	26.6	53.3	-[4]	-[4]	-[4]	23.3	50.0	28.0
5	63.3	16.7[3]	43.3	-[4]	33.3	76.6	73.3	50.0	76.6	40.0	46.6	43.6
Quarry												
3	50.0	16.7	53.3	35.0	36.6	73.3	33.3	26.6	33.3	83.3	93.2	46.5
4	53.3	10.0	40.0	31.6	30.0	83.3	40.0	3.3	36.6	63.3	96.6	42.4
6	-[2]	50.0	40.0	-[4]	30.0	59.9	36.6	56.6	53.3	76.6	79.9	40.8
7	46.6	33.3	23.3	23.3	36.6	59.9	10.0	33.3	146.5	30.0	86.6	44.3

[1]The monitoring period for Site 1 during April was 17 days only.

[2] The sample bottle was contaminated during the site inspection and not included in the analysis.

[3] The funnel was replaced during the sampling period as such the reported results may underestimate dust levels.

[4] The equipment was damaged during these months as such no results have been reported.

[5] Only one valid sample for these results.

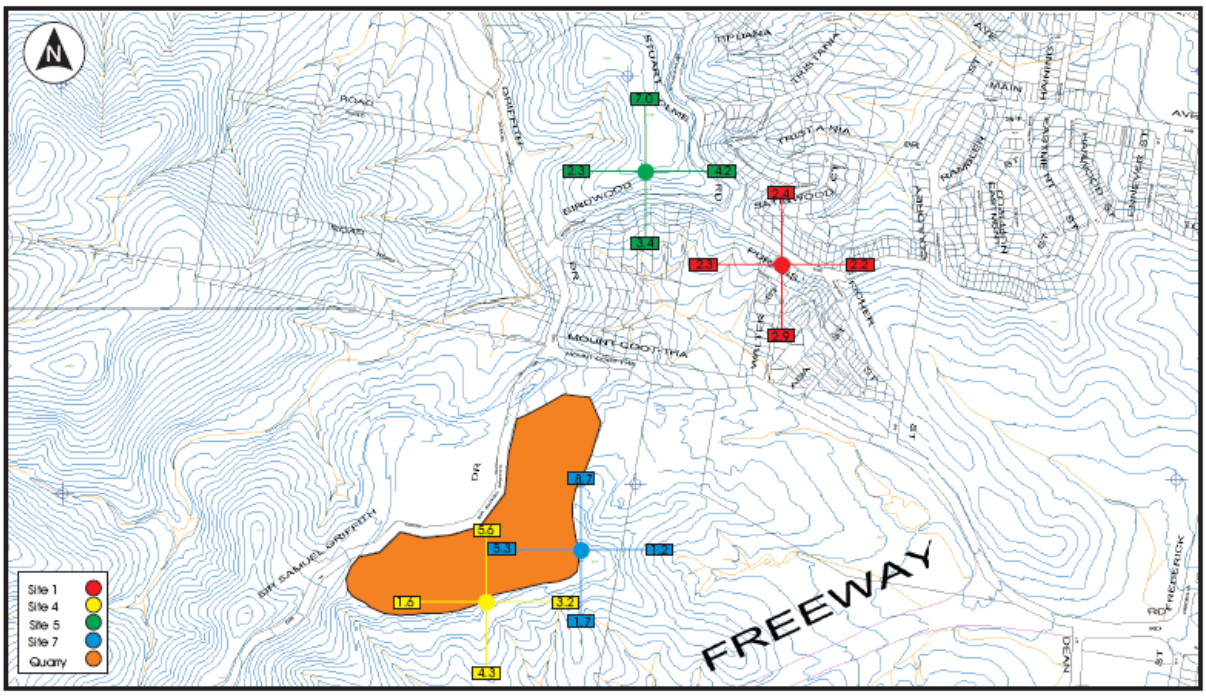
Results of the directional dust gauge monitoring are displayed in **Figure 3-1**. Here it can be seen that for the sites located at the quarry (Sites 4 and 7) the direction quadrants with a full or partial angle of view to the quarry workings have the highest mass loadings. This is the northern quadrant for site 4 and the northern and western quadrants for site 7. These results indicate that for these locations the quarry is a significant influence on dust impacts.

This is not necessarily the case for the monitoring stations located in the community area. At Site 1, located to the north east of the quarry, it was expected that the southern and western quadrants would display the highest dust loadings. This was not the case, however, with annual mass loadings highest for the south and north quadrants. This suggests that whilst the quarry (and perhaps other sources to the south such as the Western Freeway) may affect the dust occurring in the community, other sources of particulates are located to the north.

At Site 5 (located to the north-north east of the quarry) the most significant influence is from the north of the monitoring location with mass levels more than double that of the southern quadrant. The eastern quadrant has the second highest mass loading, again indicating other local particulate sources are affecting the measurement position.

The data collected by Air Noise and Environment (2005) suggests that the quarry clearly influences dust deposition rates at the sampling sites close or adjacent to the quarry. While monitoring located further from the quarry indicate a number of factors contribute to dust impacts, and the quarry is not necessarily the most significant contributor.

- **Figure 3-1: Directional Dust Gauge Monitoring Results (April 2004 – March 2005) (Air Noise and Environment, 2005)**

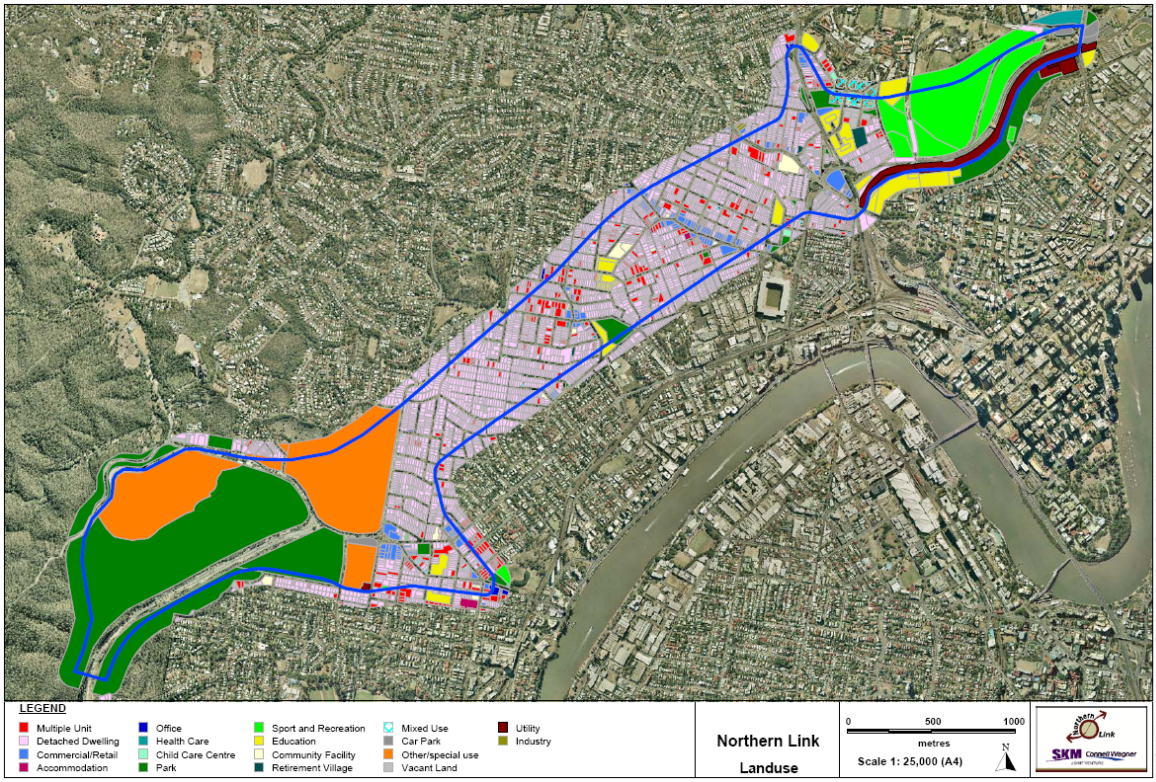


3.4. Surrounding Land Uses

Land uses surrounding the Project area are dominated by residential dwellings, recreational areas, educational facilities and business / commercial uses (refer to **Figure 3-2**). This section of the report provides a summary of land uses adjacent to key construction activities. Key construction activities included:

1) Surface works – several sections of surface works are planned;
2) Worksite 1 – Located in the southern section of Mt Coot-tha Botanical Gardens;
3) Worksite 2 – Located on the corner of Milton Road and Frederick Street; and
4) Worksite 3 – Worksite 3 will be located on the western side of Kelvin Grove Road, spanning from Victoria Street in the north, to the south of Lower Clifton Terrace; and
5) Mt Coot-tha Quarry - It is anticipated that the majority of spoil generated from tunnelling activities would be transported to Mt Coot-tha Quarry.

- **Figure 3-2: Land Uses in the Study Corridor**

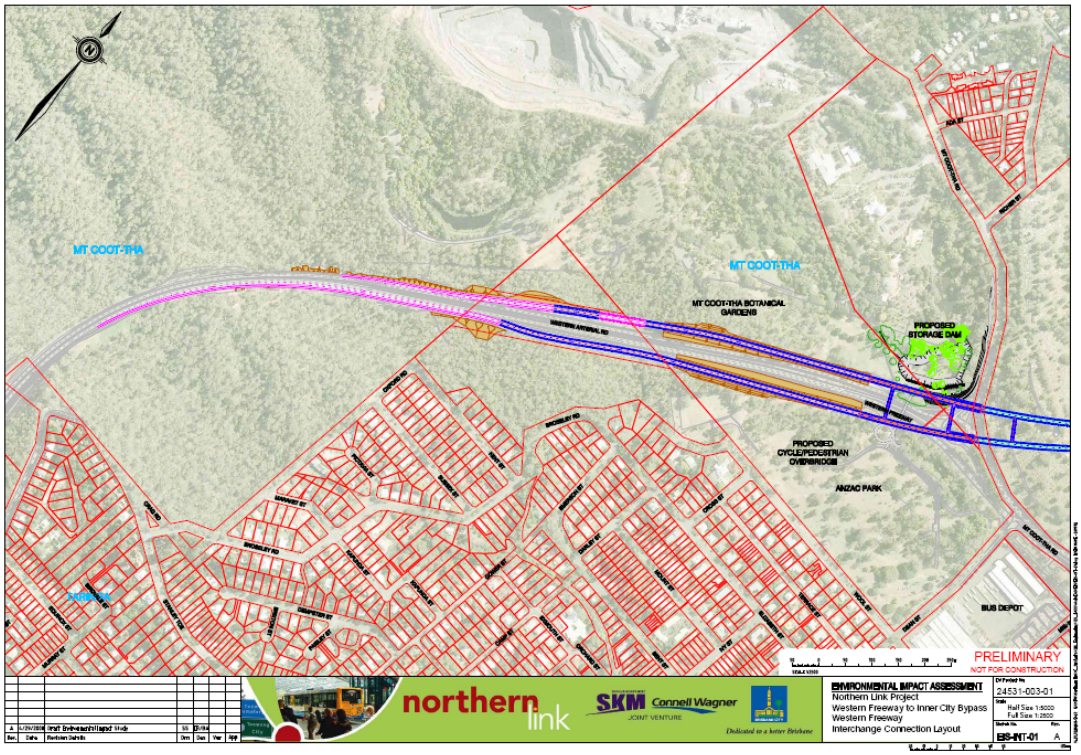


3.4.1. Surface Works

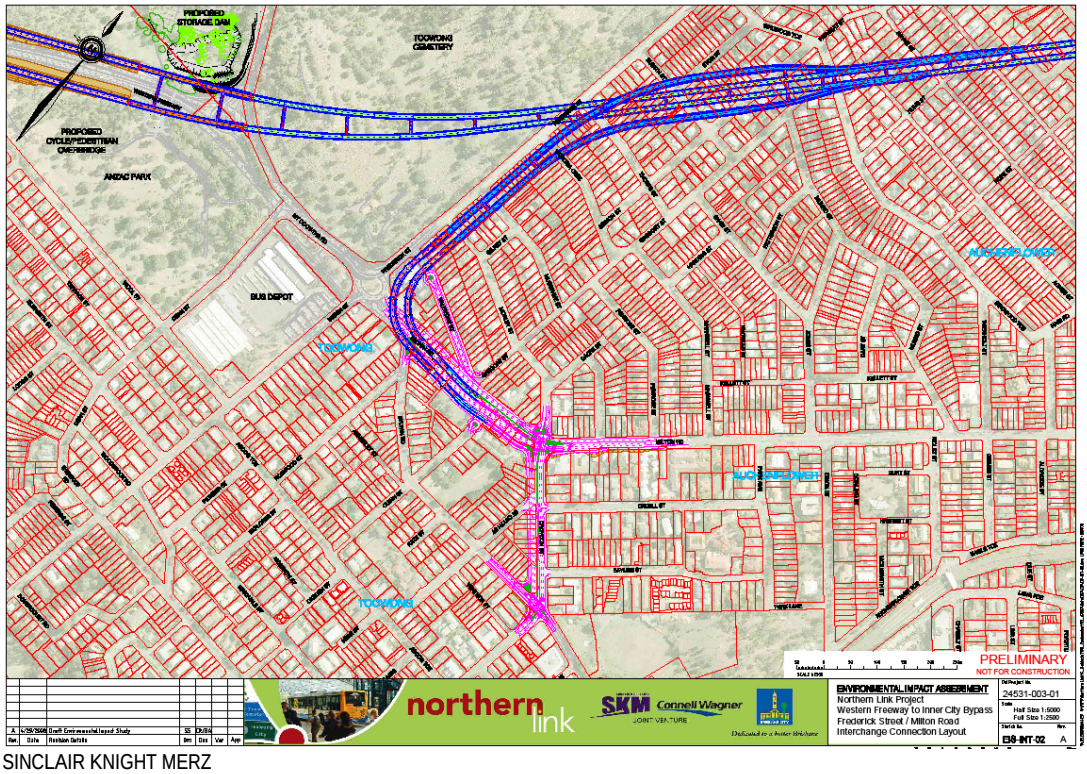
Surface works will be required for the construction of tunnel entry/exit ramps, existing road reconfiguration, cut and cover works and elevated structures. Surface works will occur at the following locations:

- Along the Western Freeway between Mt Coot-tha Gardens and Anzac Park (refer to **Figure 3-3**);
- On and around the intersection of Milton Road and Croydon Street, including Valentine Street (refer to **Figure 3-4**);
- On the southern end of Kelvin Grove Road, including Lower Clifton Terrace (refer to **Figure 3-5**);
- The western end of the Inner City Bypass (refer to **Figure 3-6**).

- **Figure 3-3: Surface Works along the Western Freeway (pink)**



- **Figure 3-4: Surface Works at Milton Road and Croydon Street (pink)**



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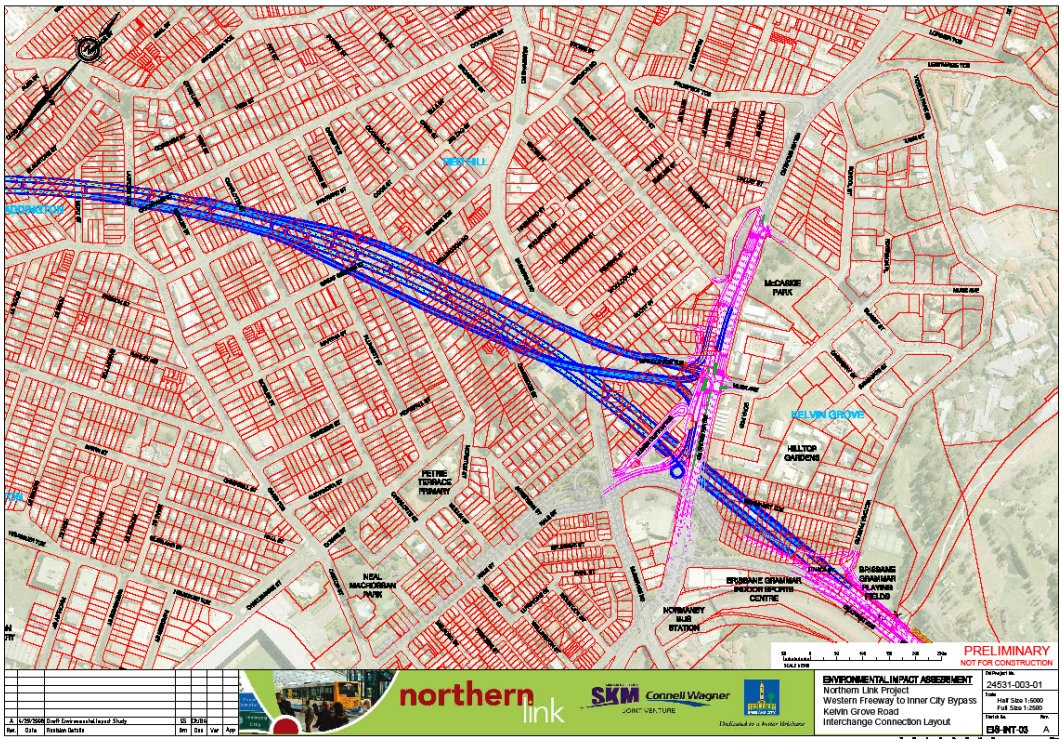
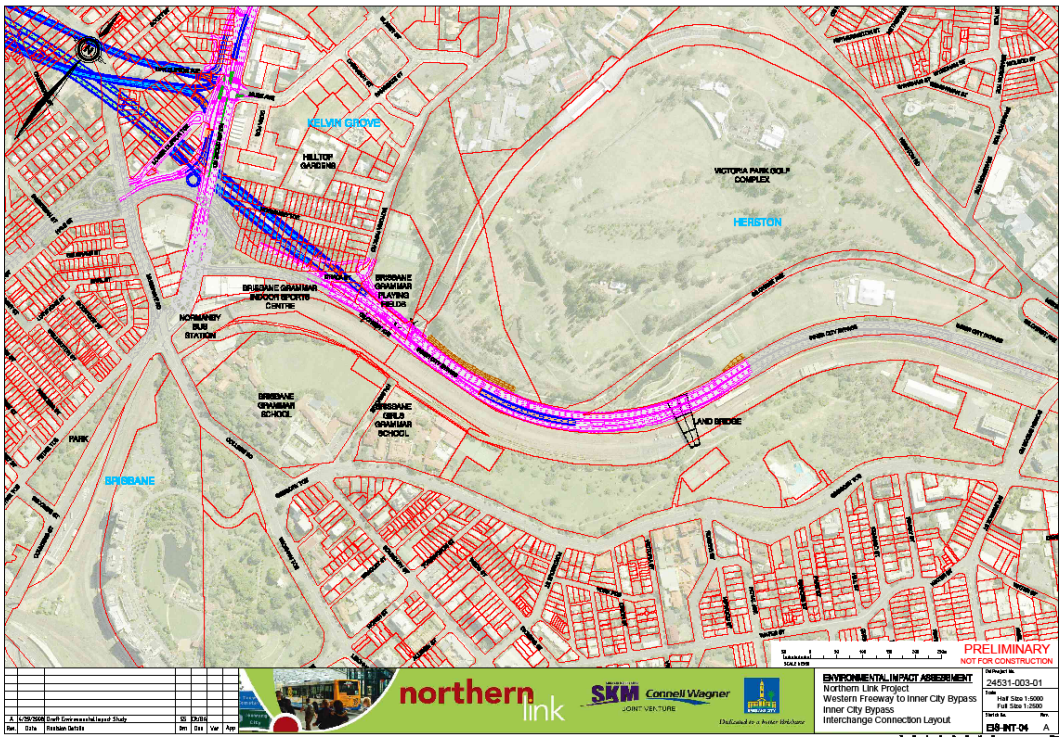
- **Figure 3-5: Surface Works on Kelvin Grove Road (pink)**



- **Figure 3-6: Surface Works on Inner City Bypass (pink)**



These surface road works are located in close proximity to residential dwellings, educational facilities, recreational areas, and commercial and retail areas. **Table 3-5** provides a summary of sensitive receivers in near the surface work locations.

Table 3-5: Sensitive Receptors Close to Surface Works

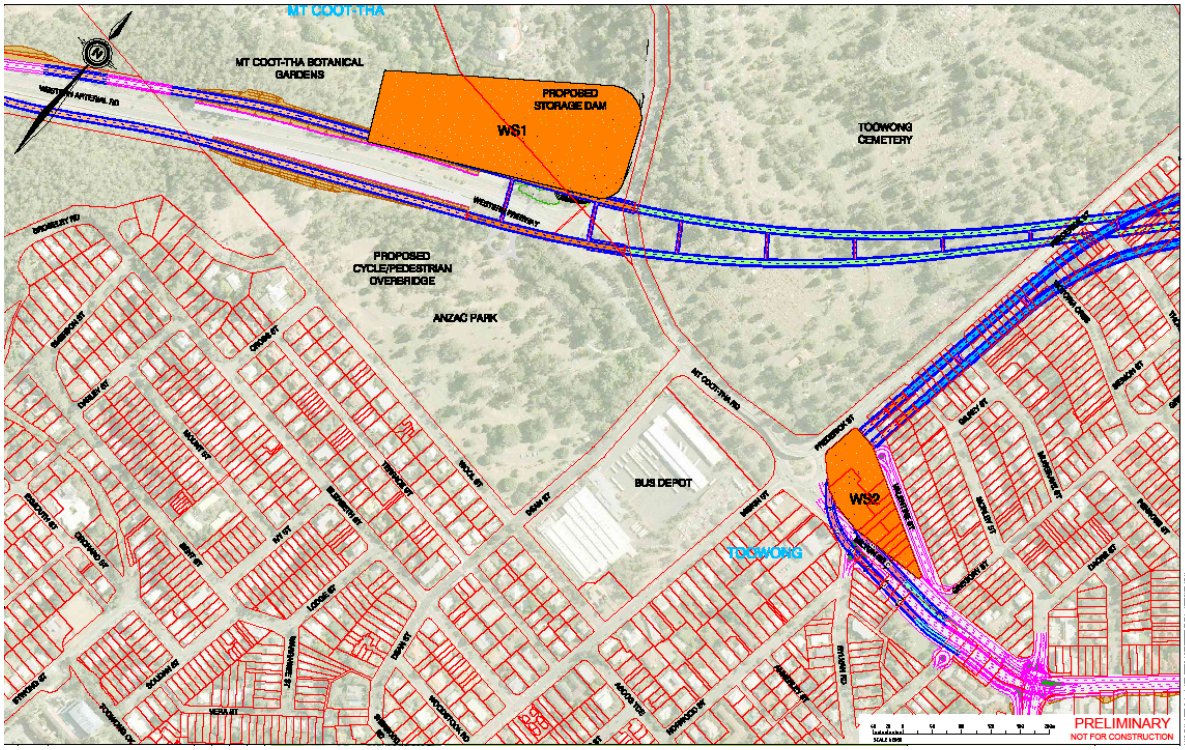
Location	Sensitive Receptors
Western Freeway	■ Residential dwellings on Wool and Broseley Road as close as 110 m to the south; ■ Mt Coot-tha Gardens immediately to the north; ■ Brisbane Forrest Park immediately to the north; ■ Bible College of Queensland approximately 160 m to the south; ■ Anzac Park approximately 200 m to the south east.
Croydon Street / Milton Street / Valentine Street	■ This area is particularly sensitive due to the proximity to residential dwellings i.e. within 10 m from the road side. In particular residences on: - Valentine Street; - Milton Road between Frederick and Markwell Street; - The southern end of Gregory Street - Croydon Street; - Sylvan Road between St Osyth Street and Earle Lane. ■ Toowong Cemetery approximately 50 m to the north west; ■ Commercial / retail area on Milton Street;
Kelvin Grove Road / Lower Clifton Terrace	■ This area is particularly sensitive due to the proximity to residential dwellings i.e. within 10 m from the road side. In particular residences on: - Lower Clifton Terrace; - Kelvin Grove Road between Dalley Street and the Inner City Bypass; - Westbury Street; - Upper Clifton Terrace; - Rusden Street. ■ Queensland University of Technology adjacent to Kelvin Grove Road; ■ McCaskie park adjacent to Kelvin Grove Road; ■ Petrie Terrace Primary School approximately 350 m to the south west of Lower Clifton Terrace; ■ Queensland University of Technology main campus approximately 350 m to the north east of construction on Kelvin Grove Road; ■ Kelvin Grove Urban Village;
Inner City Bypass	■ This area is particularly sensitive due to the proximity to residential dwellings i.e. within 10 m from the road side including: - Ithaca Street; - Southern end of Victoria Park Road; - Inner City Bypass. ■ Brisbane Grammar playing immediately fields to the north; ■ Brisbane Grammar School approximately 150 m to the south; ■ Brisbane Girls Grammar School approximately 75 m to the south; ■ Victoria Park Golf Complex immediately to the north

3.4.2. Worksite 1

Worksite 1 would be located in the southern section of Mt Coot-tha Botanical Gardens (refer to **Figure 3-7**). Sensitive receivers include:

- Residential dwellings on Wool Street approximately 200 metres to the south;
- Mt Coot-tha Botanical Gardens immediately to the north;
- Brisbane Forrest Park immediately to the north;
- Toowong Cemetery approximately 30 to the east;
- Anzac Park approximately 40 m to the south;
- Brisbane City Bus Depot approximately 290 m to the south west;
- Bible College of Queensland approximately 210 m to the south.

- **Figure 3-7: Location of Worksite 1 and Worksite 2 (orange)**



3.4.3. Worksite 2

Worksite 2 occupies the block bound by Frederick Street in the west, Milton Road to the south, and Valentine Street to the north (refer to **Figure 3-7**). Sensitive receivers in close proximity to the worksite include:

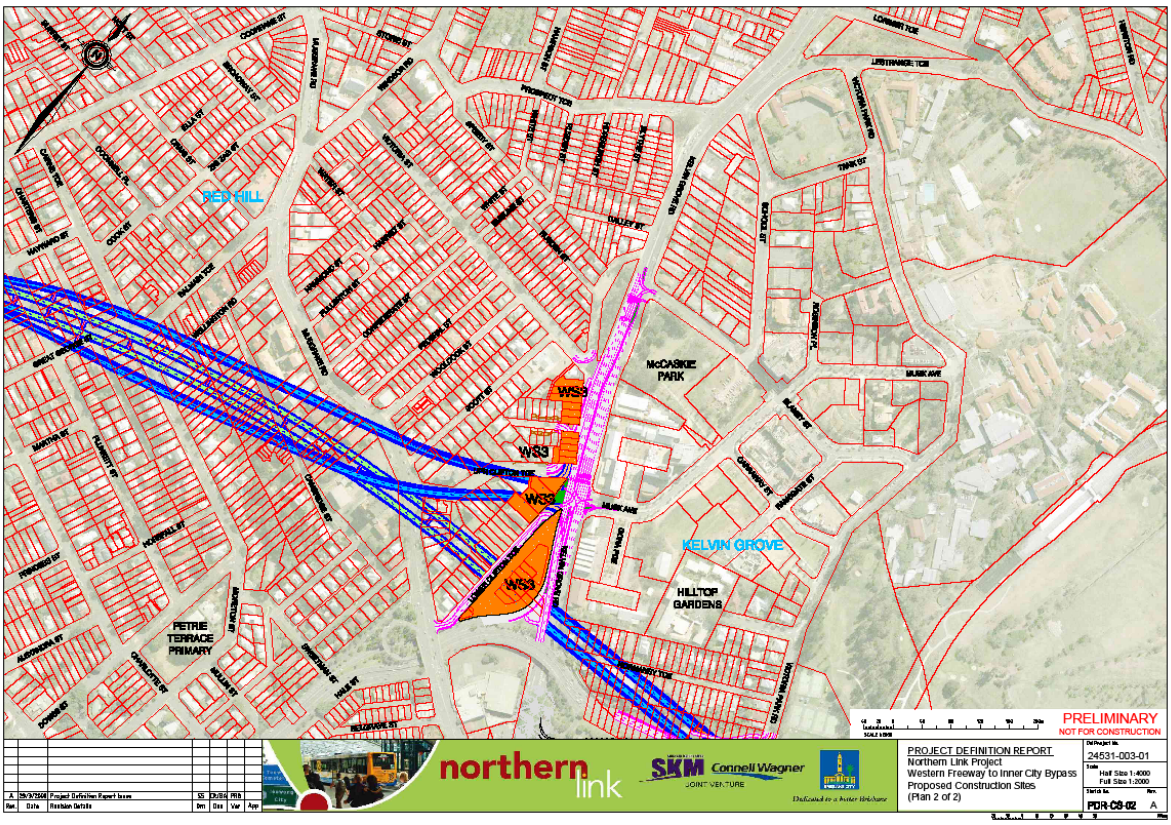
- Residences on the northern side of Valentine Street approximately 25 m from the worksite;
- Residence on Milton Road approximately 25 m to the south;
- Toowong Cemetery approximately 25 m to the west;
- Commercial / retail area on Milton Road approximately 30 m to the south;
- Brisbane Transport bus Depot approximately 100 m to the south west;

3.4.4. Worksite 3

Worksite 3 is made up of four discrete worksites located on the western side of Kelvin Grove Road, spanning from Victoria Street in the north, to the south of Lower Clifton Terrace (refer to **Figure 3-8**). For the purpose of this assessment the four worksites will be referred to as Worksite 3a to Worksite 3d from north to south. Sensitive receivers in the vicinity of Worksite 3 include:

- Residences on Westbury Street located directly adjacent to worksite 3a;
- Residences on Upper Clifton Terrace located directly adjacent to worksite 3b;
- Residences on Lower Clifton Terrace located directly adjacent to the worksite 3c;
- Residences on Lower Clifton Terrace located across the road (approximately 20 m) from worksite 3d;
- Queensland University of Technology adjacent to Kelvin Grove Road;
- McCaskie park adjacent to Kelvin Grove Road;
- Kelvin Grove Urban Village on Gona Parade;

- **Figure 3-8: Location of Worksite 3 (orange)**



3.4.5. Mt Coot-tha and Surrounds

Brisbane CityWorks operates the Mt Coot-tha Quarry which is located in the south west of the study corridor (refer to **Figure 1-1**). Current impacts of the quarry are relevant to this project as their operations may be affected by the construction of the Northern Link.

Land uses surrounding the quarry currently include:

- Mt Coot-tha Botanical Gardens to the east;
- Mt Coot-tha Forest to the west and north west;
- Residences on Mt Cooth-tha Road (and surrounds) approximately 140 m to the north east;
- Residences to the south of the Western Freeway (approximately 500 m to the south); and
- Toowong Cemetery approximately 500 m to the east.

4. Construction Impact Assessment

4.1. Overview

Construction methodologies have not yet been developed and it is anticipated that construction contractors will provide this detail at a later stage of the Project. However, it is anticipated that the main construction activities associated with the Project would include:

- Surface works; and
- Underground works i.e. tunnel boring machine (TBM) and road headers to construct the main tunnels.

A common community concern in relation to construction of road and tunnel projects is air quality. This typically relates to dust generation from excavation and material handling, potential odour emissions from excavated material, and exhaust emissions from diesel powered equipment. Given the extended duration of construction activities the management of dust emissions will be an important component of the Project.

This section of the report provides a summary of construction hours, and a qualitative assessment of impacts associated with the key construction activities including:

- Surface road works;
- Worksite activities;
- Mt Coot-tha Quarry;
- Diesel powered plant and equipment; and
- Cumulative impacts i.e. the combined impacts from the above impacts.

4.2. Construction Duration and Hours of Operations

Construction of the Project is expected to occur for 3.5 years, commencing in November 2009. The following construction hours are expected:

- Surface works – Between 6:30am – 6:30pm Monday – Saturday, and on no time during Sundays or Public holidays except in exceptional circumstances;
- Underground works – May occur 24-hours a day, seven days per week.

Exceptional circumstances include works on arterial roads (to avoid disruption to peak traffic flows), works in railway corridors, or works involving large prefabricated components such as

bridge elements or tunnel boring machines. Exceptional circumstances are approved by the Coordinator General.

4.3. Surface Road Works

Anticipated surface works may include:

- Demolition activities of existing buildings;
- Demolition of existing road pavements and sidewalks;
- Worksite preparation;
- Earthmoving and excavation works;
- Some drilling and blasting;
- Stockpiling, handling and transport of excavated material (including loading of spoil into trucks);
- Surface road and bridge construction works;
- Dust from vehicles moving around unpaved areas or dirty paved areas;
- Vehicle exhaust; and
- Operation of diesel powered equipment.

At this stage of investigations, surface works are anticipated to occur at the following locations:

- Western Freeway south of Mt Coot-tha Botanical Gardens;
- Valentine Street, Toowong;
- Eastern end of Milton Road between Frederick Street and Markwell Street, Toowong;
- Morley Street, Toowong;
- Croydon Street, Toowong;
- Northern block of Jepheson Street, Toowong;
- Sylvan Street between St Osyth Street and Earle lane, Toowong;
- Lower Clifton Terrace, Kelvin Grove;
- Kelvin Grove Road between Dalley Street and the Inner City Bypass;
- On the corner of Rudsen Street and Victoria Street, Kelvin Grove;
- Along the southern section of Victoria Park Road, Kelvin Grove; and
- Along the eastern end of the Inner City Bypass.

Given the close proximity of residences to these construction activities it is important to ensure the dust mitigation measures as provided in **Section 5** are followed. This will help keep nuisance dust impacts to a practical minimum.

4.4. Worksite 1

The two TBMs would be launched from Worksite 1. The primary function of Worksite 1 would be to service tunnelling activities and surface works on the Western Freeway. The main sources of potential air quality impacts at Worksite 1 include:

- Land clearing for site preparation;
- Earthmoving and excavation works;
- Tunnelling (driven and cut-and-cover) and emissions of tunnel ventilation air;
- Stockpiling, handling and transport of excavated material (including loading of spoil into trucks and conveyor);
- Wheel generated dust from vehicles moving around unpaved or dirty areas;
- Vehicle exhaust emissions; and
- Operation of diesel powered equipment.

To control dust emissions from the tunnelling and spoil movement, a Tunnel Portal Cover Shed (TPCS) would be constructed on site as part of the initial site establishment works. The area would also be surrounded by a fence covered with a cloth screen to help reduce dust emissions from the site.

It is anticipated that spoil generated during excavation would travel by conveyor from the tunnel mouths to a transfer station. All stockpiling, truck and conveyor loading activities would be undertaken entirely within the worksite sheds or within the tunnel excavation area. From here spoil would either be transferred from the site via enclosed conveyor to Mt Coot-tha Quarry approximately 350 m to the north west for processing and redistribution because it is of suitable quality to be recycled for the same uses as the current quarry product. The alternative would be to transport spoil by truck to Swanbank.

To maintain adequate air quality within the underground working environment, ventilation fans will need to be located within the tunnels. At each of the tunnel portal worksites, ventilation air from the tunnelling works would leave the work shed after passing through dust extraction equipment to remove particles from the ventilation air. Details on the dust extraction equipment would be provided during the detailed design stage of the Project construction works, when tunnel ventilation and air extraction rates are determined. The performance of the extraction equipment

would be detailed during the detailed design stage of the works but would be designed to satisfy the EPP (Air) requirements and be sufficient to minimise nuisance dust impacts on adjacent sensitive places.

A summary of excavation at Worksite 1 is provided in **Table 4-1**.

Table 4-1: Worksite 1 Excavation Works Summary

Parameter	Value
Total spoil (m^3)	1,105,000
- quantity sent to Mt Coot-tha Quarry (m^3)	840,000
- quantity sent to Swanbank (m^3)	265,000
Duration (months)	14
Average number of trucks per day	58

4.5. Worksite 2

Worksite 2 would primarily service activities associated with surface works on Milton Road and Valentine Street; the proposed overpass from Milton Road to Frederick Street; and road header works.

Activities likely to be undertaken at Worksite 2 include:

- Site preparation on the corner of Frederick Street and Milton Road including demolition of existing buildings and pavements;
- Cut and cover activities along Frederick Street;
- Road header excavated driven tunnels along Frederick Street;
- Spoil movement and stockpiling at Worksite 2;
- Loading of spoil to trucks and transport off site;
- Loading of spoil to conveyor for transport to Mt Coot-tha Quarry;
- Wind erosion from exposed surfaces;
- Wheel generated dust from vehicles travelling along unpaved or dirty paved surfaces;
- Surface road and bridge construction works;
- Potential drilling and blasting in areas with hard rock, or where particularly difficult conditions exist.

Spoil generated due to road works on Milton Road would not be stockpiled. This spoil would be immediately trucked from the site to Swanbank landfill or transferred by conveyor to the Mt Coot-tha quarry.

A fence with cloth screening would be erected around the Site to help reduce nuisance dust impacts.

Table 4-2 provides a summary of excavation work expected at Worksite 2.

Table 4-2: Worksite 2 Excavation Works Summary

Parameter	Value
Total spoil (m^3)	260,000
- quantity sent to Mt Coot-tha Quarry (m^3)	240,000
- quantity sent to Swanbank (m^3)	20,000
Duration (months)	19
Average number of trucks per day	43

4.6. Worksite 3

Worksite 3 would primarily service nearby surface works, road header works and recovery of the two TBMs. Activities likely to be undertaken at Worksite 3 include:

- Site preparation along Kelvin Grove Road including the demolition of existing buildings and pavements;
- Surface works along Kelvin Grove Road, Lower Clifton Terrace and Inner City Bypass;
- Spoil movement and stockpiling;
- Loading of spoil to trucks and transport off site;
- Wind erosion from exposed surfaces;
- Wheel generated dust from vehicles travelling along unpaved or dirty paved surfaces;
- Cut and cover activities on the Inner City Bypass; and
- Potential drilling and blasting in areas with hard rock, or where particularly difficult conditions exist.

Spoil would be removed from road works as it is produced and trucked to the Port of Brisbane, with the intention of having as few permanent stockpiles as possible.

A summary of excavation activities at Worksite 3 is provided in **Table 4-3**.

- **Table 4-3: Worksite 3 Excavation Works Summary**

Parameter	Value
Total spoil (to Port of Brisbane) (m^3)	300,000
Duration (months)	18
Average number of trucks per day	49

4.7. Mt Coot-tha Quarry

Mt Coot-tha Quarry currently extracts materials for asphalt and concrete aggregate. Current operations at the Quarry include:

- Excavation activities and occasional blasting;
- Crushing and screening;
- Product stockpiling and transfers; and
- Product loading to trucks and transport off site via Mt Coot-tha Road.

As discussed in **Section 4.4** the preferred option for tunnelling spoil removal is via an enclosed conveyor to the Quarry. Spoil would then need to be processed and distributed via truck to Project construction sites. Changes to activities at Mt Coot-tha Quarry are likely to include:

- Reduced blasting;
- Increased stockpiling;
- Possibly mobile crushing and screening unit;
- No change to the number of truck movements from quarry;

4.8. Diesel Powered Vehicles and Plant

The potential for air quality impacts from construction vehicle fleet exhaust emissions would depend on the size and type of vehicle fleet, the hours of operation and the type of controls adopted by the Construction Contractor. The main sources of exhaust emissions from diesel powered equipment are likely to include:

- Vehicles working at the surface construction site, such as excavators, front-end loaders, scrapers, rollers, backhoes, concrete trucks, delivery trucks, truck-mounted cranes, rock hammers etc;
- Trucks queuing adjacent to sensitive receivers located near the surface worksites;
- Fully-laden trucks exiting the main tunnel excavation worksites and commencing their journey to spoil placement areas;
- Stationary plant emissions (mobile generators, dewatering pumps, concrete pumps etc); and

- Vehicles and equipment operating within the underground excavation area or within the enclosed workshed, including front end loaders, trucks, and mobile diesel generators.

The main potential for impacts from diesel emissions is likely to result from trucks queuing adjacent to residents located near to the surface worksites and operation of diesel equipment within the underground excavation area. The exhaust emissions would contribute to volumes of particulates, carbon monoxide, carbon dioxide, hydrocarbons and nitrogen oxides in the atmosphere. The level of air quality impact on surface receivers adjacent to the construction site would be subject to the location of the tunnel ventilation exit point, the loading of these pollutants within the tunnel air, the local dispersion meteorology and the controls (including particulate removal) incorporated as part of the tunnel construction ventilation systems. The management measures in **Section 5.1.2** will assist in minimising impacts on adjacent receivers.

4.9. Cumulative Impacts

In terms of dust impacts the most significant area where cumulative impacts may occur would be in the area surrounding Mr Coot-tha Quarry. As discussed in **Section 3.3** the quarry influences dust impacts in the areas immediately adjacent to the site, while in areas further from the quarry (for example on Walter Street approximately 280 m from the quarry) dust monitoring indicates a number of factors contribute to dust impacts, and the quarry is not necessarily the most significant contributor. As such, it is likely that the highest risk area in terms of cumulative impacts is likely to be Mt Coot-tha Gardens and Brisbane Forrest.

5. Dust Mitigation

5.1. Mitigation Measures for Construction Impacts

The following sections outline construction mitigation measures which may be implemented to minimise the potential for nuisance dust impacts during Project construction works.

The most effective way of avoiding nuisance from construction activities is to have in place a system that addresses the following:

- Effective management of dust generation;
- Effective monitoring of impacts;
- Effective communications with the local community on issues associated with the construction activities;
- A clearly identified point of contact should the community have comments or complaints;
- A well defined process to ensure that any issues are dealt with promptly and to a satisfactory level; and
- A well defined system of recording any incidents or complaints.

The contractor responsible for construction will implement a system which incorporates those elements for the duration of the tunnels and surface construction works. Further detail on the requirements for a comprehensive dust and odour management and communications system will be included as part of a Construction Dust Management Plan for the Northern Link Project. The requirements for monitoring of particulate levels within areas adjacent to the main worksites will also be included as part of this plan.

5.1.1. Management Measures for Nuisance Dust Mitigation

Components of the dust and odour management and mitigation strategy to be considered during the construction works are expected to include:

- Demolition activities (buildings on acquired land, kerbs and road pavements etc) would be performed using appropriate dust controls such as consideration of meteorological conditions, use of water sprays, erecting a fence around the site, and covering loads of material transported from the sites. If the site needs to be cleared in advance of work commencing, the site should be stabilised with appropriate dust suppressant;
- Excavation at the tunnel portals would be performed within enclosed work sheds. The sheds would be constructed prior to the commencement of underground works and would cover the excavated areas and tunnel portals;

- Work sheds would need to be large enough to allow stockpiling of the excavated tunnel material, access and egress of trucks and truck and conveyor loading operations;
- Conveyor system from Worksite 1 would be covered to ensure minimal dust emissions;
- Truck and wheel wash stations would be located at the worksites and locations where trucks would be moving from unsealed areas of pavement to sealed roads;
- The tunnel would be ventilated during excavation works. Ventilation air would be treated, by passing through a particulate filter, prior to exit from the work sheds. The particle filter would be regularly maintained and the performance of the particulate removal technology will meet required standards. Dust collected from the filtration system would be disposed of appropriately;
- All trucks transporting spoil should be covered to ensure dust is not blown from the trucks during transportation;
- Regular monitoring of TSP, PM_{10} and dust deposition levels at nearest sensitive places adjacent to the worksites, and locations representative of the work space, would provide a basis for compliance with appropriate criteria;
- Water sprays will be used on newly established stockpiles at the placement sites. Water sprays on newly established stockpiles could be activated when wind speed is above a certain threshold, say 5-8 m/s, and would be switched on more regularly during drier periods and times of higher winds;
- On un-sealed trafficked areas at the spoil placement locations the surface would be kept damp using a water truck, to prevent excess wheel generated dust emissions; and
- The sealed access roads to the worksite sheds will be kept relatively dust free by regular sweeping and washing if needed. At certain times of the year, natural rainfall should keep this surface washed.

5.1.2. Management Measures for Diesel Exhaust Emissions

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

- Avoiding queuing of the construction traffic vehicle fleet in the streets adjacent to the sites which will in turn minimise the amount of exhaust emissions generated during the construction works;
- Where possible, exhaust emissions from mobile and stationary plant would be directed away from the ground and sensitive receivers; and
- Vehicles and machinery would be fitted with appropriate emission control equipment and be maintained sufficiently to enable to design specifications to be met.

6. Air Quality Monitoring

6.1. Overview

The ToR state that the construction dust impacts should be monitored with the results made available to the public. This section provides an overview of suggested dust impact monitoring during construction.

6.2. Dust Monitoring

There are two methods for monitoring nuisance dust and particulate matter - real time PM_{10} monitoring and dust deposition monitoring.

6.2.1. Real time PM_{10} Monitoring

Real time PM_{10} and $PM_{2.5}$ monitoring has been established for the Project at two locations, one at Toowong and another at Kelvin Grove. Monitoring at Toowong commenced in November 2007 and covers the southern end of the Project. The Kelvin Grove site covers the northern end of the Project and was established in July 2008. Data monitored prior to construction commencing can be used as a baseline to compare construction impacts.

6.2.2. Dust Deposition

Dust deposition monitoring should also be undertaken to determine the level of nuisance dust at residential locations.

Dust deposition sampling should be undertaken in accordance with AS 3580.10.1-1991 – Particulates – deposited matter (gravimetric method). Dust deposition sample should be collected on a monthly basis and sent to an accredited lab for analysis.

All monitoring devices would be located in accordance with AS 2922-1987 – Ambient Air - Guide for Siting of Sampling Units (where practically possible). A number of potential monitoring sites have been identified to undertake dust deposition monitoring (refer to **Table 6-1**). These sites have been chosen as they represent the highest risk in terms of nuisance dust impacts due to their close proximity to surface works and worksite locations. In addition a site on Walter Street has been chosen as dust deposition is currently monitored there, and these sites provide baseline monitoring which any changes in dust deposition due to construction impacts can be compared to.

- **Table 6-1: Potential Dust Deposition Monitoring Locations**

Suggested monitoring location	Potential influence
15 Walter Street	Mt Coot-tha Quarry (monitoring currently undertaken)
Mt Coot-tha Botanical Garden	Surface works on Western Arterial Road, Worksite 1
Toowong Cemetry	Surface works on Western Arterial Road, Worksite 1, Worksite 2
Residence on Wool Street	Surface works on Western Arterial Road, Worksite 1
Residence on Valentine Street	Surface works on Valentine Street and surrounds, Worksite 2
QUT on Kelvin Grove Road	Surface works on Kelvin Grove Road, Worksite 3
Residence on Lower Clifton Road	Surface works on Kelvin Grove Road, Worksite 3
Brisbane Girls Grammar School	Surface works on Inner City Bypass

6.3. Meteorological Monitoring

Meteorological monitoring stations have been installed at the same location as air quality monitoring at Toowong and Kelvin Grove

One of the purposes of the meteorological monitoring station would be to collect data sufficient to identify adverse air quality impacts within nearest residential areas that could potentially be caused by construction works or operation of the terminals.

6.4. Data Display

The data collected would be made available to the public through the communication and consultation process. The information made available to the public would include:

- Dust deposition monthly monitoring results for all sites;
- Real time monitoring results for all sites; and
- Comparison of these results to the relevant criteria.

7. Conclusions

7.1. General Conclusions

The Northern Link Project will require significant construction works for a period of approximately 3.5 years. This report provides a qualitative assessment of air quality impacts associated with these works. Given the proximity of surface works and worksite locations to residential dwellings and other sensitive receivers, there is the potential for significant nuisance dust impacts. These impacts can be minimised through the implementation of dust mitigation measures as outlined in **Section 5**. Once construction contractors have been commissioned and a detailed work method statement has been developed, it is imperative that a comprehensive Environmental Management Plan (EMP) is developed and includes detailed dust mitigation measures for all surface works, worksite activities, diesel powered equipment, and tunnel ventilation. A preliminary EMP can be found in Chapter 18.

8. References

Air Noise and Environment (2005) *Mt Coot-tha Quarry Dust Impact and Control Survey – Stage 2 Final Report*

DECC (2005) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, NSW Department of Environment and Conservation, Sydney.

EPA, 2004, Queensland Greenhouse Strategy, Environmental Protection Agency, June 2004

Holmes Air Sciences (2007) *Existing Environment Review: Brisbane Northern Link Project*

NEPC, 2003, National Environment Protection (Ambient Air Quality) Measure, National Environment Protection Council, 7 July 2003.