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Date: 7th July 2010

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1.0 Purpose of Document

This document has been prepared as part of the Development Application submission to the Urban Land Development Authority (ULDA) for a proposed residential development located at 16 Hamilton Place, Bowen Hills.

The purpose of this report is to address the stormwater quantity and quality issues at a conceptual level for the proposed development.

This report was prepared using information obtained from the following sources:

- Contour and Detailed Survey of the site prepared by RPS Australia East P/L, dated 4 June 2010.
- Architectural Plans of the proposed development prepared by ML Design (MLD)
- Brisbane City Council eBimap information
- Dial-Before-You-Dig (DBYD) services
- MUSIC Modelling
- Site investigation

2.0 Introduction

2.1 Project Description

The proposed re-development is for multi residential units and shop. The re-development will consist of a 12 storey residential tower with 194 units, small retail outlet (116.8m²) on the ground level and 2 levels of basement carparking. Refer Appendix A for the proposed Architectural Ground Floor Plan by ML Design.

The proposed site is located on land described as Lots 1 and 4 on RP99817.

The site is presently fully developed and is currently occupied by Australian Red Cross. The existing building is a two level older style office building approximately 882m² fronting Hamilton Place. There is off-street car parking for three visitor vehicles. A 1,940m² high clearance "saw-tooth" designed warehouse is adjacent to the office building.

The site is bound by Hamilton Place to the east, commercial buildings to the north, retail and commercial buildings and an open on-grade bitumen carpark to the south, residential properties and Tufton Street to the west.

Currently vehicles can access the site from Hamilton Place and from Tufton Street.

The site is located in the Brisbane City Council (BCC) local government area, approximately 3km north-east of the Brisbane CBD. Under the City Plan Area Classification, the site is classified as Bowen Hills Urban Development Area – under the Bowen Hills Local Plan – Precinct 3.

The area of the subject site for the purposes of this report is 3,404m².

Table 2.1 – Pre Development Land Characteristic Summary

	Roof Area (m ²)	Impervious Area (m ²)	Pervious Area (m ²)	Total Site Area (m ²)
Pre-development	2,645	677	82	3,404

Note: The pervious and impervious areas for the existing development are derived from the detail survey plan prepared by RPS. Refer Section 6.3 for more details on the pre development scenario.

Table 2.2 – Post Development Land Characteristic Summary

	Roof Area (m ²)	Impervious Area (m ²)	Pervious Area (m ²)	Total Site Area (m ²)
Post-development	1,699	1,127	578	3,404

Note: The pervious and impervious areas for the proposed development are calculated from the architect's ground floor plan. Refer Appendix A for the plan.

2.2 Risk Assessment

According to BCC's Subdivision and Development Guidelines and the completed Erosion Hazard Assessment Form, the proposal is classified as a "high risk" development for erosion potential. Refer Appendix D for a copy of the completed form.

2.3 Study Team

The study team preparing this conceptual SBSMP is the Robert Bird Group, consulting engineers and the plan is being prepared on behalf of the developer, Metro Property Development Pty Ltd.

3.0 SITE CHARACTERISTICS

3.1 Location

The street address for the site is 16 Hamilton Place, Bowen Hills. The site location is shown in Figure 3.1 below.

Figure 3.1 - Site Location



3.2 Topography and Site Drainage

The existing site is fully developed therefore the site topography is generally flat. Survey level information shows that Lot 4 falls towards the western boundary at around 5% (1 in 20) slope while Lot 1 (which is an existing driveway only) falls towards Tufton Street at around 10%.

The site does not appear to have an upstream catchment area. The majority of the rainfall on the site lands on the roof of the warehouse and office and is piped underground to the west along the existing driveway and across Tufton Street via an existing 450mm diameter pipe.

Overland flow generated from the site either flows along the western driveway to Tufton Street or, on the eastern side the site falls away from the street and flows are collected in stormwater field inlets located on the driveway adjacent Hamilton Place.

Overland flows along Hamilton Place and Tufton Street eventually discharge to Breakfast Creek.

3.3 Soils

According to the Brisbane City Council's eBimap system, the site is not flagged as being in an acid sulphate soil (ASS) area.

Given that the elevation of the site varies between 14m and 21m AHD, it is unlikely that ASS's will be encountered.

Excavation for the bottom basement will go down to approximately RL12.0m AHD. This is well above RL 5m AHD.

However, should future testing for ASS's indicate that ASS's do exist on the site, then a suitable Acid Sulphate Soils Management Plan will be developed and implemented to minimise any potential impacts due to the disturbance of ASS's.

3.4 Waterway Corridor

The north eastern corner of the site is approximately 300m from Brisbane River and is therefore considered to be outside any Brisbane City Council designated waterway corridor (30m from high-water mark in built up areas). Under the Brisbane City Council eBimap, the site is not affected by any other waterway corridors. Therefore, no further consideration of waterway corridor issues has been documented in this SBSMP.

4.0 SITE DATA

4.1 Information

Water quantity and quality assessments have been based upon:

- Brisbane City Council (BCC) eBimap information.
- Brisbane City Council FloodWise Property Report.
- Brisbane City Council Water Quality Objectives.
- Site inspection.
- Satellite imagery from Google Earth.
- ML Design Architects Plans.
- Detail and Contour Survey plan 103574-1[A], dated 23/06/10 by RPS.

4.2 Existing Stormwater Infrastructure

According to the Survey Plan produced by RPS and Brisbane City Council's eBimap information the following stormwater infrastructure is located in the vicinity of the site.

The existing stormwater system consists of the following:

On-site drainage:

- On site drainage consists of a 450mm diameter stormwater pipe runs west along Lot 1 from the western side of the warehouse building connecting into a stormwater manhole located at the end of the existing concrete driveway that leads off Tufton Street.
- This stormwater manhole is connected to a 450mm pipe which runs to the west across Tufton Street to an unknown destination.

External Drainage:

- Two gully pits are located on corner of Hamilton Place and Jeays Street, across from the site's eastern boundary
- These gully pits are connected to a stormwater manhole (K16000138) located at the Campbell Street and Hamilton Place intersection
- Two other field inlets adjacent to the stormwater manhole (K16000138) drain to it
- A 450mm diameter pipe of unknown material runs from K16000138 along Campbell Street
- This stormwater drainage line then continues in a westerly direction along Campbell Street which then connects to a stormwater manhole before the Inner City Bypass intersection which then drains into Breakfast Creek

It is proposed that stormwater from the site is to be discharged into the existing stormwater manhole located on site adjacent to the western boundary of the site.

Further details will be provided at the design development stage.

4.3 Water Quantity

The Brisbane City Council's FloodWise Property Report for the site indicates the subject site is not affected by flooding.

4.4 Water Quality

Based on the Queensland Government EPA "A city-wide assessment of water quality in Brisbane's creeks" October 1999-April 2000, water quality in Breakfast Creek was poor. Water Quality Objectives (WQO's) for concentrations of most nutrient fractions and dissolved oxygen are frequently exceeded. The assessment also indicates the major source of nutrients in this creek is likely to be water from the Brisbane River via tidal exchange.

5.0 STORMWATER MANAGEMENT – OPPORTUNITIES AND CONSTRAINTS

5.1 Site Opportunities

The proposed development enables a number of opportunities to address any negative impacts that the proposal may have on the quantity and quality of the stormwater discharging from the subject site. The main limiting factor is the footprint of the development which consists of a basement carpark. This restricts the use of deep planting zones

The opportunities identified are as follows:

- **Stormwater Quantity**

- The collection of roofwater and stormwater runoff in rainwater tanks which may be used for toilet flushing, swimming pool top up and irrigation purposes. Rainwater and stormwater harvesting can reduce the quantity of stormwater being discharged into the natural waterways. This can also reduce the site's demand on an external water supply.

- **Stormwater Quality**

- It is proposed that all groundwater entering the basement perimeter subsoil drainage system as well as runoff from access ramps and cars will be collected and treated in a silt arrestor. The quality of the water shall be tested and if the results are satisfactory the water will be pumped to the stormwater system. If the water quality results prove unsatisfactory the developer shall either install a package treatment plant or enter a trade waste agreement with Council and discharge the water to the sewer.
- Implementation of Stormwater Quality Improvement Devices (SQID's) in the form of Gross Pollutant Trap (GPT) and rainwater tanks as appropriate to reduce the levels of pollutants in stormwater being discharged from site.

5.2 Site Constraints

The proposed residential development presents specific constraints. Generally sites of this nature would result in the following:

- Limited areas on site to implement SQID's due to the nature of the development (i.e. the maximum utilisation of space for residential floor area and car parking spaces).
-

6.0 STORMWATER QUANTITY ASSESSMENT

6.1 Flooding Objectives

The proposed finished building floor levels and carpark access will be designed to be in accordance with the flood immunity freeboard requirements as documented in Brisbane City Council's Subdivision and Development Guidelines.

6.2 Stormwater Quantity Modelling Approach

Stormwater runoff quantity has been considered for both pre-development and post-development scenarios. Modelling of stormwater runoff has been undertaken using the Rational Method of calculation.

6.3 Pre-Development Scenario

The site is currently occupied by Australian Red Cross. The pre-development scenario has therefore based on the site's existing usage to the land.

The existing site consists of approximately 2,645m² roof area, 677m² impervious area and 82m² pervious area. Summary of the site's pre-development stormwater discharge parameters used are as listed below:

- Coefficient of discharge values for 1 in 10 year ARI storm event (C10) as listed below:
 - Roof = 0.90
 - Impervious area = 0.88
 - Pervious area = 0.7
- Time of concentration (tc) = 5 minutes

Table 6.3 below summarises peak flows from the existing site.

Table 6.3 - Pre-development Site Hydrology

Average Recurrence Interval - ARI (years)	Rainfall Intensity - I (mm/hr)	Peak Flow - Q (m ³ /s)
1	117	0.079
2	151	0.109
5	191	0.154
10	215	0.181
20	248	0.220
50	291	0.274
100	325	0.306

6.4 Post-Development Scenario

The proposed residential development will consist of approximately 1,699m² roof area, 1,127m² impervious area and 578m² pervious area. The summary of post-development site's stormwater discharge parameters used is as listed below:

- Coefficient of discharge for 1 in 10 year ARI storm event (C10) as listed below:
 - Roof = 0.90
 - Impervious area = 0.88
 - Pervious area = 0.7
- Time of concentration (tc) = 5 minutes

The following Table 6.4 summarises peak flows from the proposed development.

Table 6.4 - Post-development Site Hydrology

Average Recurrence Interval - ARI (years)	Rainfall Intensity - I (mm/hr)	Peak Flow - Q (m ³ /s)
1	117	0.076
2	151	0.105
5	191	0.148
10	215	0.175
20	248	0.212
50	291	0.266
100	325	0.299

The comparison between pre-development and post-development flow has demonstrated that stormwater runoff from the proposed development will decrease slightly. Post-development flows will decrease as a result in the increase in landscape area on site from the proposed re-development. This will result in a reduction of the peak stormwater flow being discharged into the council stormwater system.

6.5 Legal Point of Discharge

The legal points of discharge for the minor and major storm events for the proposed re-development remain unchanged and are as follows:

- Minor Storm (piped drainage) is proposed to discharge into the existing stormwater manhole located at the western end of Lot 1 on RP99817 which then discharges via an existing 450mm diameter pipe across Tufton Street. Further details will be provided at the Operational Works submission stage.
- Major Storm events will discharge via overland flow to the west of the site via Tufton Street then into the Breakfast Creek.

7.0 STORMWATER QUALITY ASSESSMENT

7.1 Pollutants of Concern

The key pollutants generated by various developments are listed by Brisbane City Council Subdivision and Development Guidelines Part C Water Quality Management Guidelines (2008c). During the operational (post-construction) phase of a residential development, Brisbane City Council (Table C4.2, 2008c) identifies the following pollutants as being typically generated:

- Litter
- Sediment
- Nutrients (Nitrogen & Phosphorous)
- Pathogens/Faecal coliforms (bacteria and viruses)
- Hydrocarbons (including oil and grease) - unlikely
- Heavy Metals (often associated with fine sediment)
- Surfactants (e.g. detergents from car washing)
- Thermal pollution (heat)

Brisbane City Council (2008c) recognizes that the heterogeneity of residential developments requires that site-specific assessment needs to be undertaken in order to determine which of the potential pollutants is likely to occur and require trapping. Considering that the proposed development involves large area of roof and basement car park, the source points for the above pollutants are fairly limited. Key pollutants which may be of concern in runoff from the podium level and basement include:

- Litter
- Sediments
- Nutrients
- Surfactants
- Hydrocarbons

During the construction phase of a development, the pollutants listed in Table 7.1 have been identified by Brisbane City Council (Table C4.1, 2008c) as being typically generated. Measures should be put in place during the construction phase to manage each of these pollutants.

Table 7.1 - Pollutants Typically Generated During the Construction Phase

Pollutant	Source
Litter	Paper, construction packaging, food packaging, cement bags, off-cuts
Sediment	Unprotected exposed soils and stockpiles during earthworks and building
Hydrocarbons	Fuel and oil spills, leaks from construction equipment
Toxic Materials	Cement slurry, asphalt prime, solvents, cleaning agents, washwaters (e.g. from tile works)
pH Altering Substructures	Acid sulfate soils, cement slurry and washwaters

7.2 Environmental Values and Water Quality Objectives (WQO's)

Based on the nature of the development proposed as described above we have assessed this site to be "low risk" and have identified that the site does not require additional measures to treat stormwater other than those defined in this report to be in accordance with Brisbane City Council Stormwater Management Plan.

However, MUSIC modelling will be undertaken to demonstrate the intention of proposed development in achieving BCC's WQO's.

The Environmental Values (EV's) of the receiving environment and the Water Quality Objective (WQO's) for discharges from the site has been identified by using "Guidelines on Identifying and Applying Water Quality Objectives in Brisbane City" (BCC, 2000).

The information contained in Table 2 of Appendix 5 of BCC (2000) may be used to identify the relevant WQO's for tidal estuary. This information is reproduced in Table 7.3 below. It should be noted that this table of WQO's only accounts for the waterway affected by the development, not the proposed activities associated with the development.

Table 7.3 - WQO's for Combined Wet and Dry Periods involving Land-Disturbing, Vehicle-Related and Acid Sulfate Soil-Related Activities

	SET A Environmental Values (EV's)	SET B EV's	SET C EV's
Indicator	Modified ecosystem, wildlife, cultural heritage, secondary and visual recreation, industry, stock and irrigation	Human consumer (except oysters)	Primary contact
PH	6.5 to 8.5		
Dissolved oxygen	80 to 100 percent saturation		
Organic matter	NR		
Total phosphorus	60 µg/L		
Total nitrogen	450 µg/L		
Chlorophyll-a	10 µg/L		
Turbidity	20 NTU		
Secchi depth	>0.5m		>1.2m
Suspended Solids	30 mg/L for combined wet and dry periods 90 th ile < 100 mg/L for wet weather periods		
Total aluminium	NR		
Total Iron	NR		
Total Arsenic	50 µg/L		
Total Cadmium	2 µg/L		
Total Chromium	50 µg/L		
Total Copper	5 µg/L	1.0 µg/L (tainting)	
Total Nickel	15 µg/L		
Total Lead	5 µg/L		
Total Zinc	50 µg/L	5.0 µg/L (tainting)	
TPH	NR		
Oils and grease	No visible films or odour		
PAH	3 µg/L		
Faecal coliforms	1000 organisms/100mL (minimum of 5 samples)		150 organisms/100mL (minimum of 5

	taken at regular intervals not exceeding one month, with 4 of 5 not exceeding 4000 organisms/100 mL)		samples taken at regular intervals not exceeding one month, with 4 of 5 not exceeding 600 organisms/100 mL)
Total Chlorine	0.02 mg/L		
Litter/gross pollutants	No anthropogenic (man-made) material greater than 5mm in any dimension		
Riparian vegetation and habitat	Protect and restore consistent with Council policy and plans (see Council's City Plan)		
Cultural heritage	Protect and restore consistent with Council policy and plans (see Council's City Plan)		

The following minimum key indicators have been evaluated:

- Suspended Soils (sediment)
- Nutrients (nitrogen and phosphorus)
- Litter
- Faecal Coliforms
- Metals
- Hydrocarbons

The final set of WQO's which need to be evaluated for the development is therefore presented in Table 7.4.

Table 7.4 – WQO's for the Minimum Number of Indicators

Indicator	WQO
Suspended Solids	30mg/L for combined wet and dry periods 90 th ile < 100mg/L for wet weather periods
Turbidity	20NTU
Total Phosphorus	60µg/L
Total Nitrogen	450µg/L
Litter	No anthropogenic (man-made) material greater than 5mm in any dimension
Faecal Coliforms	1000 organisms/100mL (minimum of 5 samples taken at regular intervals not exceeding one month, with 4 of 5 not exceeding 4000 organisms/100mL)
Oils and Grease	No visible films or odour
PAH	3 µg/L

Total arsenic	50 µg/L
Total cadmium	2 µg/L
Total chromium	50 µg/L
Total copper	5 µg/L
Total nickel	15 µg/L
Total lead	5 µg/L
Total zinc	50 µg/L

7.3 Modelling/Assessment Approach

A quantitative assessment of stormwater runoff quality was considered only for the operational phase of the development.

The pollutants of concern during the construction phase are not readily modelled due to the site-specific nature of typical construction pollutant sources that are dependent largely on site management practices and vary throughout the construction phase depending on the particular activities being undertaken.

A Best Management Practice (BMP) approach was adopted in selecting management options for the construction phase.

In order to assess post-development discharge concentration of key pollutants from the site, modelling of stormwater runoff quality for the post-development scenario has been undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software package. The MUSIC modelling has been undertaken with reference to the BCC Guidelines to Pollutant Export Modelling in Brisbane Version 7 – draft (Supplement to BCC Water Quality Management Guidelines)

The site has been developed into one model, which simulates the entire site discharging into the existing council stormwater drainage system.

7.4 Pre-Development Scenario

The existing site is occupied by Australian Red Cross. The site is currently consists of office building, warehouse and carparks. The approximate usages of the site are shown as follows:

- The total roof area = 2,645m²
- The total impervious area = 677m²
- The total pervious area = 82m²

7.5 Post-Development Scenario

The post-development total area of the site remains at 0.3404ha. This will consist of 0.1699ha of roof area, 0.1127ha of impervious area and 0.578ha of pervious area.

It is intended to incorporate a number of stormwater quality improvement devices into the stormwater drainage design as part of the development of the site. These devices include:

- Gross Pollutant Trap (GPT)
- Rainwater storage tanks
- Silt arrestors

The MUSIC modelling results for the post-development scenario can be found in Appendix E and is summarised in Table 7.5 and Table 7.6 below.

Table 7.5 - MUSIC Modelling Results Water Quality Objectives (WQO's) – Post Development Scenario (Residential Development with Stormwater Treatment)

Pollutant	Median Concentration achieved (mg/L)	Target WQO's (median – mg/L)
Total Suspended Solids [90%ile]	29 [79.4]	30 [100]
Total Phosphorous	0.23	0.06
Total Nitrogen	1.36	0.45

Results in Table 7.5 have demonstrated the Water Quality Objectives for Total Suspended Solids (TSS's) are achieved; however targets for Total Phosphorous and Total Nitrogen are unable to be achieved even with best practice techniques.

However, Table 7.6 shows the model has achieved the requirements in Best Practice Discharge Guidelines as defined in Council's Guideline on Identifying and Applying Water Quality Objectives in Brisbane City BCC 2000.

Table 7.6 - MUSIC Modelling Results (Best Practice Discharge Guidelines) – Post Development Scenario (Residential Development with Stormwater Treatment)

Pollutant	Objectives Achieved	BCC Required Objectives
Total Suspended Solids	84.3%	80%
Total Phosphorous	48.3%	45%
Total Nitrogen	45.3%	45%
Gross Pollutants	98.1%	N/A
Gross Pollutants (< Q3months)	100%	100%

8.0 STORMWATER QUALITY MANAGEMENT OPTIONS

8.1 Construction Phase

Best management practices are proposed to be implemented at various stages of the construction to manage the pollutants generated during the construction phase of the development as discussed in Section 7.1.

It is expected that due to the nature of basement excavations, a sump pit will be required to trap sediment in the stormwater runoff, and hence reduce the sediment concentration of the stormwater discharging from the site during the construction period.

In addition to the sump pit mentioned above, it is anticipated that the following erosion and sediment control measures would be implemented either prior to and/or during construction of the development to minimise the impact of stormwater quality discharging from the site.

During the construction phase of the development, an Erosion and Sediment Control Program (E&SCP) will be implemented to minimise water quality impacts.

- **Pre-Construction**

Before construction activities begin, the following measures need to be implemented to ensure minimal disturbance and adverse water quality impacts. These measures may be adopted in a staged approach, and may be implemented prior to construction beginning in any one section of the project.

- Sediment fences constructed to the perimeter of the construction area.
- Designation of areas for plant and construction material storage.
- Diversion of upstream stormwater runoff around disturbed areas of the development.
- Immediate stabilisation of disturbed areas.
- Monitoring of stormwater quality discharging from the development and the implementation of additional measures / modification of existing measures if the quality of stormwater discharging from the site is having a negative impact.
- Designation and marking of transport routes across the site to minimise dust disturbance.
- Drainage structure protection devices installed to existing stormwater inlet structures within the site, and within the road ways adjacent to the site.
- Education of site personnel to the sediment and erosion control measures implemented on site.

- **During Construction**

Runoff should be directed through an appropriately sized treatment unit (sump pit) before discharging into stormwater utilities. Measures to mitigate water quality impacts during construction will include:

- Construction of a sump pit and provision of pump out facilities to the satisfaction of Brisbane City Council.
- Construction activities to be confined within the necessary construction area(s).
- Regular inspection and maintenance of the erosion control measures. Following rainfall events greater than 20mm, inspection of erosion control measures and removal of collected material shall be undertaken. Replacement of any damaged equipment shall be performed immediately.
- Monitoring of water quality impacts from construction activities as appropriate.

8.2 Operational Phase

It is proposed to implement stormwater quality Best Management Practices on the developed site.

Best Management Practices were selected by giving due consideration to the proposed development layout, and other unique site characteristics.

Due to the nature of the proposed development, the Best Management Practices presented in Table 8.2 is thought to be most suitable for the proposed site.

Table 8.2 - Stormwater Best Management Practices Selection Matrix

Stormwater Quality Best Management Practice	Discussion
Gross Pollutant Trap	Gross Pollutant Traps are effective at capturing coarse sediment, oil and grease, rubbish and vegetation matter found in stormwater runoff.
Silt Arrestor	Silt arrestors are recommended for the capture and treatment of all groundwater entering the basement perimeter subsoil drainage system as well as runoff from access ramps and cars. The quality of the water shall be tested and if the results are satisfactory the water will be pumped to the stormwater system. If the water quality results prove unsatisfactory the developer shall either install a package treatment plant or enter a trade waste agreement with Council and discharge the water to the sewer
Rainwater Storage Tanks	Rainwater storage tanks enable the reuse of roof runoff, primarily for irrigation, toilet flushing and top up of swimming pools. The main contaminant removal process is the diversion of runoff from roof (impervious) areas to either pervious areas (irrigation) or to the sewer system (toilet flushing).

9.0 STORMWATER QUALITY MONITORING PROGRAM

Although stormwater from this development will discharge to the existing stormwater system and eventually to the Breakfast Creek, stormwater quality best management practices are proposed and therefore no stormwater quality monitoring has been proposed.

The proposed measures for stormwater quality are reasonably well understood and their effectiveness has been demonstrated at numerous sites throughout Queensland.

10.0 MAINTENANCE PLANS

Maintenance plans are required to be developed for the following stormwater items proposed for the development: consistent with the requirements of this report and the manufacturer's instructions.

- **Gross Pollutant Trap**
 - In accordance with the manufacturer's recommendations / owners manual.
- **Rainwater Storage Tanks**
 - In accordance with the manufacturer's recommendations / owners manual.
 - Inspect the bottom of the tank for sludge at least every 2 - 3 years. If sludge covers the bottom of the tank, remove it by siphoning or completely emptying.
- **Silt Arrestor**
 - Regular inspection of the bottom of the chamber and removal of silt in accordance with the manufacturer's recommendations / owners manual.

11.0 ASSET HAND-OVER

It is intended that the stormwater quantity and quality controls detailed in this document will remain under private ownership and will not become a council asset. Therefore, no further assessment of asset handover is relevant to this site.

12.0 CONCLUSION

This Site Based Stormwater Management Plan demonstrates that under the proposed concept plan, stormwater runoff from the proposed re-development will be able to be treated to acceptable levels.

The consideration of the proposed stormwater runoff and drainage demonstrates the viability of the proposed re-development, with regards to stormwater quantity and quality.

Further details of the proposed stormwater drainage system will be provided to Council in future applications (i.e. Operational Works submission), however this document demonstrates that sufficient treatment of stormwater runoff from the site is achievable under the current re-development proposal.

13.0 REFERENCES

Brisbane City Council (2000) Water Quality Management Guidelines (Supplement to Councils Subdivision and Development Guidelines).

Brisbane City Council (2000) Guideline on Identifying and Applying Water Quality Objectives in Brisbane City.

Brisbane City Council (2008) Subdivision and Development Guidelines.

Brisbane City Council (2003) Guidelines for Pollutant Export Modelling in Brisbane Version 7 - Draft (Supplement to BCC Water Quality Management Guidelines).

Queensland Urban Drainage Manual (2007).

APPENDIX A

Proposed Ground Floor Plan by ML Design



PROPOSED RESIDENTIAL DEVELOPMENT, 16 HAMILTON PLACE, BOWEN HILLS

METRO PROPERTY DEVELOPMENT PTY LTD



architecture | master planning | urban design | interior design

DA-011-A JOB NO: METR0003

APPROVED FOR ISSUE: 06/07/2010 ©

SCALE: 1:100 @ A1



DA-011-A
06/07/2010
1:100 @ A1
METRO PROPERTY DEVELOPMENT PTY LTD

Appendix B

Concept Stormwater Quality Treatment Plan by Robert Bird Group

Appendix C

Concept Erosion and Sediment Control Plan

by Robert Bird Group

Appendix D

Brisbane City Council's Erosion Hazard Assessment Form

**Erosion Hazard Assessment - June 2006**

10395C

Brisbane City Council (BCC), *Erosion Hazard Assessment* form must be read in conjunction with the *Erosion Hazard Assessment- Supporting Technical Notes* (June 2006 or later version) for explanatory terms and Certification information.

What is an Erosion Hazard Assessment?

Soil erosion and sediment from urban development, particularly during construction activities, is a significant source of sediment pollution in Brisbane's waterways. The Erosion Hazard Assessment determines whether the risk of soil erosion and sediment pollution to the environment is 'low' or 'high', using a point scoring system to assess the risk based on BCC's requirements for stormwater management and Erosion and Sediment Control (ESC).

When is the EHA required?

An *Erosion Hazard Assessment* form must be completed and lodged with BCC for any Development Application (DA), Operational Works ESC application, or Schedule 12 Compliance Assessment ESC application.

Failure to submit this form during lodgement of an application may result in assessment delays or refusal of the application.

Assessment Details

- 1 Does this development or operational works/detailed design ESC application trigger the Stormwater Management Code or House Code and involve soil disturbance?

No ☐ An Erosion Hazard Assessment is not required.
Go to 4

Yes ☒ **Complete Assessment Table on reverse side of this form.**

- 2 Is the total score equal to or greater than 17?

A 'low' risk score

Generally, if the Erosion Hazard Assessment produces a Total Score of **less than 17** and no individual score is equal to, or greater than its Trigger Score, the development proposal is considered to be 'low risk' with respect to soil erosion and sediment control.

A 'high' risk score

If the Erosion Hazard Assessment produces a Total Score of **17 or greater**, or any individual score is equal to or greater than its Trigger Score, the development proposal is considered to be 'high risk' with respect to soil erosion and sediment control. Applicants must lodge, with their Application, sufficient supporting information to demonstrate that the performance criteria of the Stormwater Management Code or House Code in the City Plan 2000 can be achieved.

No ☐ Refer to Council's *Erosion Hazard Assessment - Supporting Technical Notes*.

Yes ☒

- 3 Did you answer 'yes' to any Trigger Score questions?

No ☐ Refer to Council's *Erosion Hazard Assessment - Supporting Technical Notes*.

Yes ☒

- 4 Site Information and Certification

Application number (if known)

Site address

16 HAMILTON PLACE,
BOWEN HILLS
QLD

Postcode 4006

Prepared by Print name

LUCAS THEN

Business name

ROBERT BIRD GROUP

I certify that:

1. I have made all relevant enquiries and am satisfied no matters of significance have been withheld from the assessment manager; and

Where completion of the EHA Assessment Table was required, that:

2. I am a person with suitable qualifications and/or experience in erosion and sediment control; and
3. the Erosion Hazard Assessment was completed in accordance with the Erosion Hazard Assessment Supporting Technical Notes and the BCC Erosion and Sediment Control Standard (version 9 or later); and
4. the Erosion Hazard Assessment Score accurately reflects the site's overall risk of soil erosion and sediment pollution to the environment.

I acknowledge and accept that the BCC, as assessment manager, relies, in good faith, on this certification as part of its development assessment process and the provision of false or misleading information to the BCC constitutes an offence for which BCC may take punitive steps/ action against me/ enforcement action against me.

Certified by Print name

RICHARD MORRIS

Certifier's signature

Date

15/06/10

Assessment Table

	Points	Score	Trigger Score	BCC Use Only
[1] AVERAGE SLOPE OF DISTURBANCE AREA - less than 3% (3% = 33H:1V)0 - more than 3% but less than 5% (5% = 20H:1V)1 - more than 5% but less than 10% (10% = 10H:1V)2 - more than 10% but less than 15% (15% = 6.7H:1V)4 - more than 15%6		2	▶ Score equal to or greater than 4? No ☒ Yes ☐	
[2] SOIL CLASSIFICATION GROUP (AS1726) - GW, GP, GM, GC0 - SW, SP, SM, SC, Pt1 - MH, CH, OH2 - ML, CL, OL, if imported fill will be used, or if soils untested3		3		
[3] EMERSON (DISPERSION) CLASS NUMBER - Class 4, 6, 7, or 80 - Class 52 - Class 34 - Class 1 or 26		4	▶ Score equal to or greater than 4? No ☐ Yes ☒	
[4] DURATION OF SOIL DISTURBANCE (including stabilisation period) - less than 1 month0 - more than 1 month but less than 4 months2 - more than 4 months but less than 6 months4 - more than 6 months6		2	▶ Score equal to or greater than 4? No ☒ Yes ☐	
[5] AREA OF DISTURBANCE - less than 1000 m²0 - more than 1000 m² but less than 5000 m²1 - more than 5000 m² but less than 1 ha2 - more than 1 ha but less than 4 ha4 - more than 4 ha6		1	▶ Score equal to or greater than 4? No ☒ Yes ☐	
[6] WATERWAY DISTURBANCE - No disturbance to watercourse, open drain or stormwater pipe0 - Disturbance to watercourse, open drain or stormwater pipe4		4	▶ Score equal to or greater than 4? No ☐ Yes ☒	
[7] REHABILITATION METHOD Percentage of area (relative to total disturbance) stabilised by seeding without mulching (i.e. highest risk stabilisation method) - less than 1%0 - more than 1% but less than 5%1 - more than 5% but less than 10%2 - more than 10%4		0		
[8] RECEIVING WATERS - Open water body (e.g. creek, river, bay)1 - Enclosed water body (e.g. lake, boat harbour)2		1		
[9] SUBSOIL EXPOSURE - No subsoil exposure except for service trenches0 - Subsoils are likely to be exposed2		2		
[10] EXTERNAL CATCHMENTS - No external catchment0 - External catchment diverted around the soil disturbance1 - External catchment not diverted around the soil disturbance4		0		
[11] ROAD CONSTRUCTION - No road construction0 - Involves road construction works2		0		
[12] pH OF SOILS TO BE REVEGETATED - less than pH 61 - more than pH6 but less than pH 80 - more than pH8, or if pH testing not done at this stage1		1		

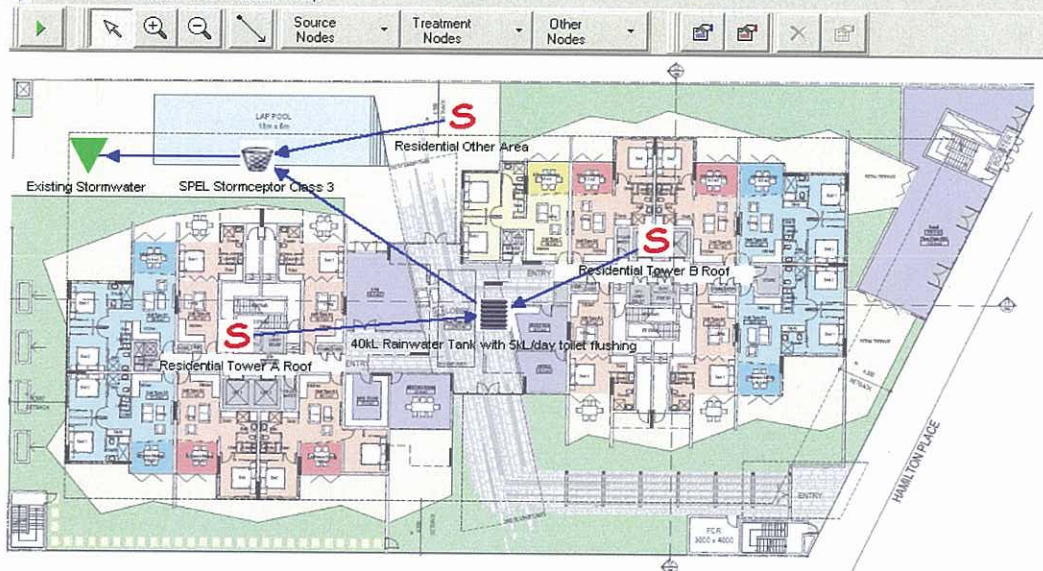
[13] Total Score = 20 Go to 2 (front page)

Appendix E

MUSIC Modelling Results Summary

MUSIC Results (Post Development with Treatment) for Residential Development on 16 Hamilton Place
MUSIC - Model for Urban Stormwater Improvement Conceptualisation - [100607 - MUSIC]

File Edit Catchment Tools Window Help



Inflow	Mean	Standard Deviation	Median	Maximum	Minimum	10 Percentile	90 Percentile
Flow (cubic metres/sec)	0.00418	0.00698	0.00224	0.20000	0.00100	0.00118	0.00814
TSS Concentration (mg/L)	40.1	38.5	29.0	673.0	1.5	11.8	79.4
Log [TSS] (mg/L)	1.47	0.33	1.46	2.83	0.17	1.07	1.90
TP Concentration (mg/L)	0.2840	0.1920	0.2340	2.1300	0.0124	0.1180	0.5060
Log [TP] (mg/L)	-0.6220	0.2540	-0.6300	0.3280	-1.9100	-0.9270	-0.2960
TN Concentration (mg/L)	1.480	0.692	1.36	10.2	0.147	0.796	2.29
Log [TN] (mg/L)	0.1290	0.1870	0.1340	1.0100	-0.8340	-0.0989	0.3610
TSS Load (kg/6 Minutes)	0.0702	0.2700	0.0258	14.3000	0.0007	0.0078	0.1260
TP Load (kg/6 Minutes)	4.39E-04	9.61E-04	2.05E-04	3.37E-02	9.56E-06	7.48E-05	8.65E-04
TN Load (kg/6 Minutes)	2.26E-03	5.00E-03	1.15E-03	0.268	7.71E-05	4.91E-04	4.38E-03
Gross Pollutant Load (kg/6 Minutes)	0.000928	0.00671	0.000303	0.328	0	0.00004	0.00123

	Sources	Residual Load	Pollutant Reduction Achieved (%)	Best Practice Discharge Guidelines Required (%)
Total Suspended Solids (kg/yr)	729	114	84.3	80
Total Phosphorus (kg/yr)	1.41	0.728	48.3	45
Total Nitrogen (kg/yr)	6.9	3.77	45.3	45
Gross Pollutants (kg/yr)	79.1	1.54	98.1 (100 for < Q3months)	100 (< Q3months)

Appendix F

BCC's Stormwater Management Code Response

Stormwater Management Code

Performance Criteria and Acceptable Solutions

GENERAL

Performance Criteria		Acceptable Solutions	Proposal Compliance Response
P1	The planning of the stormwater management system must provide for the integrated management of stormwater in order to:	A1.1 The proposal complies with the Subdivision and Development Guidelines. A1.2 A Site Based Stormwater Management Plan (SBSMP) is prepared for all major and minor stormwater management measures. The SBSMP must provide for the following where applicable: • an underground and/or open drain/overland flow path network maximising the use of natural channel design and water sensitive urban design principles • make provision for detention/retention storage basins • an Erosion and Sediment Control (ESC) Program where required by Council's Erosion and Sediment Control Standard • retention of natural waterway corridors • public safety factors and risk management measures • an acceptable level of flood immunity	R1.1: The development will be carried out to comply with the guidelines. R1.2: A conceptual SBSMP has been prepared by Robert Bird Group (RBG) to support the development application. The SBSMP describes how the design of the stormwater will comply with Brisbane City Council's (BCC's) Subdivision and Development Guidelines. All stormwater will be discharged into the existing stormwater drainage system. The proposed stormwater system consists of rainwater harvesting from the roofs for reuse and runoff from the ground level being collected and treated before being discharged into the council system. Existing stormwater flows will potentially be reduced slightly. An ESC program has been prepared as per the SBSMP and RBG's concept sketch. Retention of a waterway corridor is not applicable to this development. There is no risk to public safety factors from drainage from the development. All habitable and non habitable levels will have flood immunity in accordance with BCC's standards.

Performance Criteria		Acceptable Solutions	Proposal Compliance Response
			<i>Compliance achieved - further details to be included in the future Operational Works Application.</i>
	A1.3	The proposal complies with any Stormwater Management Plan (SMP), Local Stormwater Management Plan (LSMP), or Waterways Management Plan (WMP) prepared by Council. <i>Note: The Subdivision and Development Guidelines provide guidelines on the level of information required for different development types.</i>	R1.3: The proposal will comply with any BCC plans.

FLOODING

Performance Criteria		Acceptable Solutions	Proposal Compliance Response
P1	The proposed stormwater management system or site works must not adversely impact on flooding or drainage of properties that are upstream, downstream or adjacent to the subject site.	The proposal meets the requirements of Council's Subdivision and Development Guidelines and does not result in an increase in flood level or flood duration on upstream, downstream or adjacent properties <i>Note: Compliance with this acceptable solution can be demonstrated by the submission of a hydraulic and hydrology report (as part of a SBSMP) identifying potential flooding impacts on upstream, downstream or adjacent properties.</i>	R1: The proposal is the re-development of an existing site. Stormwater will be discharged to BCC's existing stormwater drainage system. The development will not alter existing flood levels. <i>Acceptable solution provided.</i>
P2	The drainage network must provide capacity to safely convey stormwater run-off resulting from relevant design storm events taking into account increased run-off from roof drainage.	A2.1 The design demonstrates that a drainage network will be provided that will comply with Council's Subdivision and Development Guidelines . <i>Note: Compliance with this acceptable solution can be demonstrated by identifying the conceptual drainage requirements for the proposal in a SBSMP.</i>	R2.1: Runoff from roofs and developed surfaces will be collected internally and piped to the existing stormwater drainage system. It is estimated that there will be a net reduction in peak stormwater flows from the re-development. Refer the SBSMP prepared for the site. Full details will be submitted with the Operational Works application. The design will be in accordance with BCC's Subdivision and Development Guidelines. <i>Acceptable solution provided.</i>
	A2.2	The design allows sufficient area to provide for a drainage network that will comply with Council's	R2.2: As above.

Performance Criteria		Acceptable Solutions	Proposal Compliance Response
		Subdivision and Development Guidelines. <i>Note:</i> Compliance with this acceptable solution can be demonstrated by the submission of a hydraulic and hydrology report (as part of a SBSMP) identifying the area required to accommodate the drainage network.	
P3	Development design must reduce property damage and, where applicable, ensure public safety by ensuring that the development levels are set above the relevant design flood level or storm surge level.	A3.1 All development is located above minimum flood immunity levels in accordance with Council's Subdivision and Development Guidelines. <i>Note:</i> Compliance with this acceptable solution can be demonstrated by the submission of a hydraulic and hydrology report identifying flood levels and development design levels (as part of a SBSMP).	R3.1: Levels for the proposed development will comply with BCC's current Subdivision and Development Guidelines. Compliance Achieved.
		A3.2 Road access is provided in accordance with the flood immunity levels identified in Council's Subdivision and Development Guidelines. <i>Note:</i> Compliance with this acceptable solution can be demonstrated by the submission of a hydraulic and hydrology report identifying flood levels and development design levels.	R3.2 Refer R3.1 above. Compliance Achieved.
P4	Any channel works that are part of the development, major drainage works or flood mitigation works must maintain and/or enhance the environmental values of the waterway corridor or drainage corridor.	A4 Design and construction of channel works incorporate water sensitive urban design and natural channel design features which will comply with: - Council's Subdivision and Development Guidelines, and - where applicable any SMP, LSMP or WMP prepared by Council. <i>Note:</i> Compliance with this acceptable solution can be demonstrated by the provision of conceptual details of any channel works (as part of a SBSMP).	R4: Not applicable to this development.
P5	Erosion treatment works along waterway banks and associated drainage structures must maintain or enhance the	A5 Design and construction of erosion treatment features incorporate natural channel design features which will comply with:	R5: Not applicable to this development.

Performance Criteria		Acceptable Solutions	Proposal Compliance Response
environmental values of waterways.		- Council's Subdivision and Development Guidelines, and - Council's Urban Creek Erosion – Guidelines for Selecting Remedial Works <i>Note:</i> Compliance with this acceptable solution can be demonstrated by the provision of conceptual details of any erosion treatment works (as part of an SBSMP).	
P6	Bridges and culverts provided for flood immunity to minimise traffic disruption must improve public safety and allow for fauna movement and recreation corridors where these needs are identified.	A6 The design complies with Council's Subdivision and Development Guidelines. <i>Note:</i> Compliance with this acceptable solution can be demonstrated by the provision of conceptual details of any bridge or culvert works (as part of a SBSMP).	R6: Not applicable to this development.
P7	The design and construction of detention and retention storage features must: - achieve acceptable impacts on environmental values - provide for recreational use where possible - achieve acceptable risk to public safety and property	A7 The design complies with Council's Subdivision and Development Guidelines and where applicable any SMP, LSMP or WMP prepared by Council. <i>Note:</i> Compliance with this acceptable solution can be demonstrated by the provision of conceptual details of any detention and retention storage features (as part of a SBSMP).	R7: Refer the prepared SBSMP for the site. None proposed. Acceptable solution provided.

WATER QUALITY AND DRAINAGE

Performance Criteria		Acceptable Solutions	Proposal
Low risk development			
P1	Water quality impacts must be minimised using best practice techniques.	A1.1 The design provides for stormwater quality best management practices that are sufficient to treat the target pollutants and will comply with Council's Subdivision and Development Guidelines.	R1.1: - Refer to the SBSMP. - The development proposal is classified as a 'low

Performance Criteria	Acceptable Solutions	Proposal
	Note: Compliance with this acceptable solution can be demonstrated by indicating the areas that are to be set aside for water quality best management practices. For most development this can be achieved by determining pollutant loads using hand calculations as set out in Council's Guidelines for Pollutant Export Modelling in Brisbane and identifying the type and size of stormwater quality best management practices based on their efficiencies identified in Council's Subdivision and Development Guidelines. A1.2 Stormwater quality best management practices are designed, constructed and maintained in accordance with Council's Subdivision and Development Guidelines. Note: Compliance with this acceptable solution can be demonstrated by providing conceptual detail of how stormwater quality will be managed (as part of a SBSMP).	risk' category development. Utilising BMP's water quality impacts will be minimised. - The proposal is not sited within a riparian zone. - The proposal comprises an impermeable surface area (not including roof area) which is less than 2,500m². - The proposed reconfiguration creates less than six (6) allotments. - The proposal does not include industrial activities. R1.2: Compliance Achieved.
P2 Release of sediment laden stormwater is minimised.	A2 All development complies with Council's Erosion and Sediment Control Standard. Note: Compliance with this acceptable solution can be demonstrated by providing conceptual details of how the requirements of Council's Erosion and Sediment Control Standard will be met (conceptual SBSMP). This will generally be conditioned and may require the submission of a subsequent detailed SBSMP for operational works.	R2: A SBSMP has been prepared in accordance with BCC's Subdivision and Development Guidelines. An ESC Program has been prepared and will be submitted to BCC under an Operational Works Application. A copy of BCC's Erosion and Sediment Control Standard (BCC, 2000a) will be given to the contractor for his reference during the project.
High risk development		

Performance Criteria		Acceptable Solutions	Proposal
P3 Environmental values and water quality objectives of receiving waters within or downstream of the proposal are protected or enhanced.	A3.1	Relevant water quality objectives for receiving waters are identified and site specific discharge standards met. <i>Note:</i> <i>Compliance with this acceptable solution may be demonstrated by following the process outlined in the Management of Urban Stormwater Quality Planning Scheme Policy. This can be documented in a SBSMP</i>	R3: Not applicable to this development.
	A3.2	The design provides for stormwater quality best management practices that are sufficient to treat the target pollutants and will comply with the Council's Subdivision and Development Guidelines	
	A3.3	Stormwater quality best management practices are designed, constructed and maintained in accordance with Council's Subdivision and Development Guidelines <i>Note:</i> <i>Compliance with this acceptable solution can be demonstrated by providing conceptual detail of how stormwater quality will be managed (as part of a SBSMP)</i>	
	A4	All development complies with Council's Erosion and Sediment Control Standard <i>Note:</i> <i>Compliance with this acceptable solution can be demonstrated by providing conceptual details of how the requirements of Council's Erosion and Sediment Control Standard will be met (conceptual SBSMP). This will generally be conditioned and may require the submission of a subsequent detailed SBSMP for operational works</i>	
P4 Release of sediment laden stormwater is minimised.			R4: Not applicable to this development.



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**Proposed Residential Development
16 Hamilton Place, Bowen Hills**

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

PLANS AND DOCUMENTS
referred to in the ULDA
APPROVAL dated 24/10/10

Prepared For:

Metro Property Development

Date Prepared:

8 July 2010

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1. INTRODUCTION

The following report is in response to a request by Metro Property Development to prepare an environmental noise impact assessment for the proposed residential development located 16 Hamilton Place, Bowen Hills. This report will form part of the development application for consideration by ULDA (Urban Land Development Authority).

In undertaking this assessment the following noise data was recorded:

- Unattended road traffic noise monitoring,
- Unattended ambient noise monitoring,
- Attended train passby measurements,
- Observations of offsite activity, and
- Attended noise measurements of offsite mechanical plant/activities.

Through modelling, predictions of noise impacts were produced. Based upon the predicted noise levels, recommendations regarding acoustic treatments and management controls were specified.

2. SITE DESCRIPTION

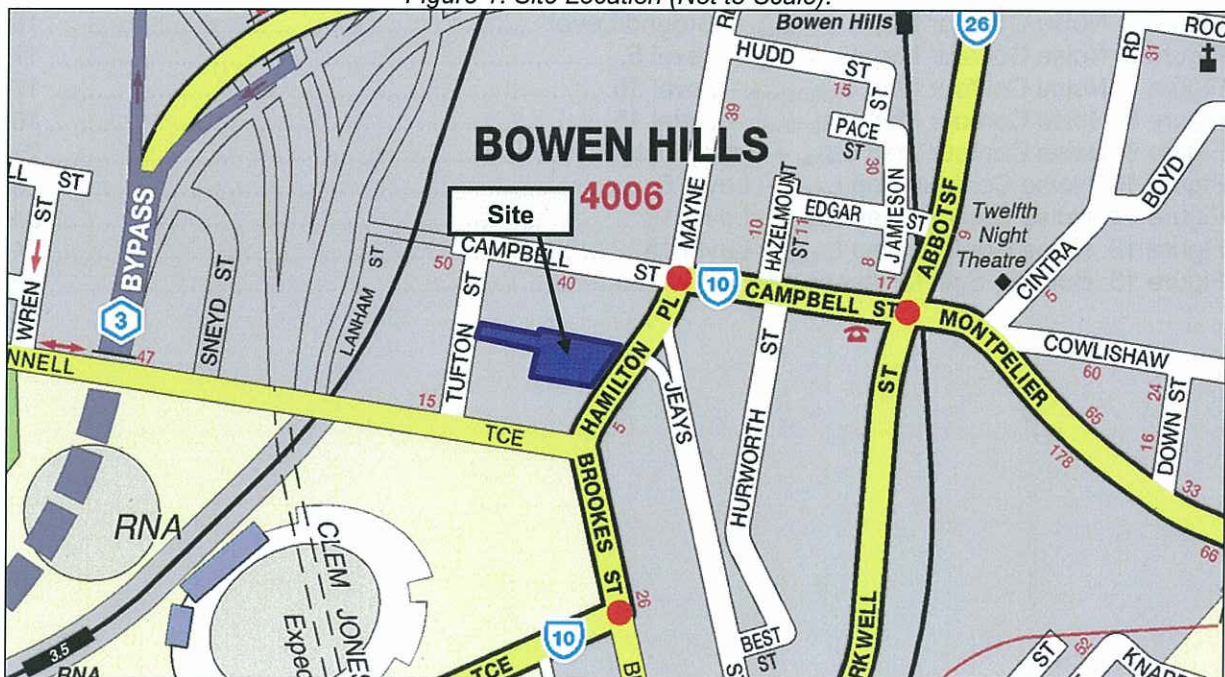
2.1. Site Location

The site is described by the following:

16 Hamilton Place and 7 Tufton Street, Bowen Hills,
Lots 1 and 4 on RP99817.

Refer to Figure 1 for the site location.

Figure 1: Site Location (Not to Scale).



A comprehensive site survey was conducted on the 8th of June, 2010. The survey identified the following:

- Hamilton Place is located adjacent the eastern boundary, separating the site from highset dwellings and multi-storey apartment buildings. These premises are currently utilised for housing commission.
- A mixture of commercial office and retail premises including a café bound the development to the south separating the site from O'Connell Terrace.
- "PGR Furniture" and commercial offices fronting Campbell Street are located adjacent the northern boundary and separate the development from the printing press for "The Courier Mail, Sunday Mail and The Australian" newspapers.
- Highset residential dwellings and "Charles Harrison & Associates" are located adjacent the western boundary, separating the site from residential apartments, commercial warehousing and the "North Coast Rail Line".
- The Clem7 tunnel and Inner City Bypass are located further west of the site (greater than 150metres).

2.2. Proposal

The proposed development comprises a 194 residential units (1 and 2 bedrooms) over two linked towers.

The development steps back from 10 to 13 storeys at the Hamilton Place tower (east tower); 11 storeys in the 'link zone'; and further steps back to 12 storeys and 9 storeys at the Tufton Street tower (west tower).

A small retail tenancy (116.8m²) provides streetscape activation at the Hamilton Street frontage. The development provides associated recreational facilities including pool, gym, sky and ground floor terraces, and basement parking.

A total of 138 visitor and tenant parking spaces are located in the 2 basement levels with vehicular access to the site via Tufton Street with pedestrian site access proposed via Hamilton Place. Designated waste collection and loading bays will be provided on site.

2.3. Description of Surrounding Environment

The site is primarily affected by road traffic noise associated with the surrounding road network and the North Coast Rail Line to the west. Commercial office/retail premises to the south and "PGR Furniture" may also affect the acoustic amenity. Activities associated with these premises were addressed in this assessment with results presented in Section 6.

A night time survey was also conducted on the 18th of May, 2010 between 11pm and 11:30pm to determine the potential noise impacts from offsite mechanical plant. During the survey, mechanical plant associated with the commercial buildings to the north and south were inaudible at the site and were not considered in this assessment.

2.4. Affected Receivers

The area surrounding the site comprises a mixture of commercial office/retail premises (north and south) and residential land uses (east and west). This assessment will focus on the nearest residential receivers described as follows:

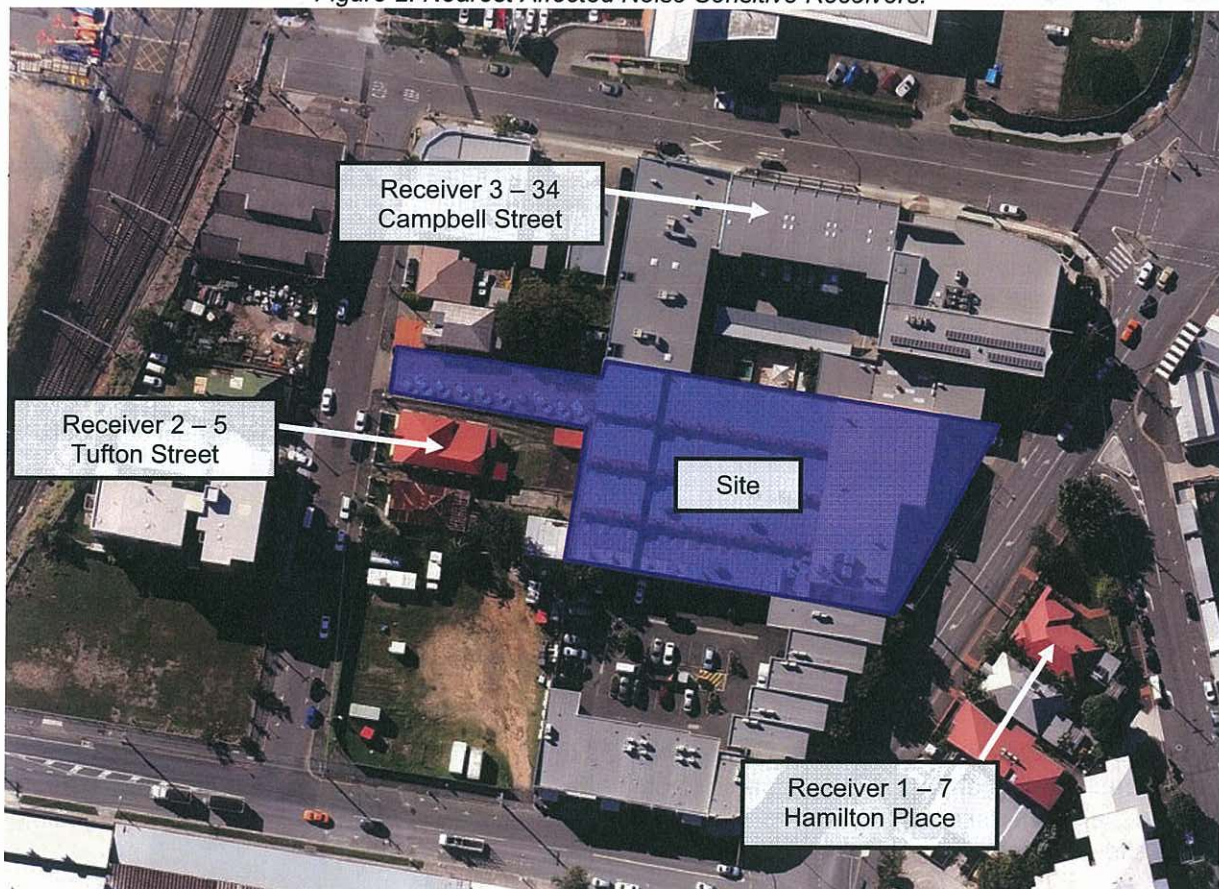
Receiver 1: A single storey highset residential building is located at 7 Hamilton Place east of the development. Approximately 20 metres separates the dwelling from the nearest site boundary.

Receiver 2: Located to the west at 5 Tufton Street is a single storey highset dwelling. A distance of approximately 5 metres separates the dwelling from the nearest site boundary.

Receiver 3: Located to the north at 34 Campbell Street on the top floor are residential apartments. A distance of approximately 25 metres separates the apartments from the nearest site boundary.

Refer to Figure 2 for the location of the nearest receivers in relation to the site.

Figure 2: Nearest Affected Noise Sensitive Receivers.



If compliance can be achieved at receivers 1 and 2, all remaining locations are predicted to comply.

2.5. Offsite Commercial Activities

To adequately assess the site, consideration must be given to the activities associated with commercial office and retail premises located in the vicinity of the development. During the site survey, the following offsite premises were identified as having the potential to impact the acoustic amenity:

- Commercial offices, retail and a café; operating hours range from 7am to 5pm Monday to Friday and 9am – 4pm Saturdays (double check).
- PGR Furniture operating hours range from 9am to 5pm Monday to Friday.

Refer to Figure 3 for the location of the nearest commercial premises.

Figure 3: Nearest Commercial Premises.



An assessment of the offsite activities which have the potential to impact the site was conducted with the results of the analysis presented in Section 6.3.

3. EQUIPMENT

The following equipment was used to record road traffic and ambient noise levels including train passby measurements in the vicinity of the site:

- Two ARL EL316 Environmental Noise Monitors (SN# 16-707-039 and 16-707-016);
- BSWA Technology Co.Ltd CA106 Acoustical Calibrator (SN # 44095);
- RION NA-28 Sound Level Meter (SLM) (SN# 01060055); and
- RION NA-74 Sound Calibrator (SN# 35073393).

The environmental noise monitors and sound level meter hold current NATA Laboratory Certification and were field calibrated before and after the monitoring sessions with no significant drift from the reference signal.

4. METHODOLOGY

4.1. Unattended Road Traffic Noise Monitoring

An ARL EL316 environmental noise monitor was placed in the front yard of 16 Hamilton Place to measure road traffic noise levels. The microphone was in a free field position approximately 1.4 metres above ground level and 4.5 metres from the nearest lane of traffic.

The monitor was set to record road traffic noise from the 8th to the 11th of June, 2010 as follows:

- "A" weighting,
- "Fast" response, and
- 15 minute statistical interval.

The statistical interval was chosen to allow application of AS/NZS 2107:2000 '*Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors*'.

Road traffic noise monitoring was conducted generally in accordance with Australian Standard AS2702:1984 '*Acoustics - Methods for the measurement of road traffic noise*'.

4.2. Unattended Ambient Noise Monitoring

An ARL EL316 environmental noise monitor was placed in the back yard of 9 Tufton Street to measure the existing ambient noise levels. The microphone was approximately 1.4 metres above ground level and in a position considered to be representative of the existing noise environment experienced by residents located within the area.

The unattended noise monitor was set to record noise levels from the 18th to the 27th of May, 2010 as follows:

- "A" weighting;
- "Fast" response; and
- 15 minute statistical interval.

The statistical interval was chosen to allow application of AS/NZS 2107:2000 '*Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors*'.

Rainfall was recorded on the 21st, 22nd and 25th of May, 2010. The data collected on these days was omitted from the analysis. Weather conditions for the remaining days were generally fine with light wind speeds.

Refer to Figure 4 for the location of the unattended noise monitors.

Figure 4: Unattended Noise Monitoring Locations.



4.3. Onsite Activity Noise Measurements

Typical noise levels associated with onsite activities were taken from similar investigations conducted by TTM Acoustics. All measurements were conducted generally in accordance with Australian Standard AS1055:1997 *"Acoustics – Description & Measurement of Environmental Noise"*.

4.4. Attended Train Noise Monitoring

Attended noise measurements of train passes were conducted on the 18th of May, 2010. The SLM was positioned in the vicinity of the site to record train noise levels with direct line of sight. The SLM was located approximately 7metres from the nearest railway line and 1.2metres above ground level.

Noise measurements were conducted as follows:

- "A" weighting;
- "Fast" response; and
- 1 – 5 minute statistical interval
- Statistics recorded: L_{Amax} , SEL (L_{AE}), L_{AEQ}

Note: the SEL or L_{AE} is the sound exposure level. A parameter closely related to L_{Aeq} for assessment of train events that have similar characteristics but are of different duration. The L_{AE} value contains the same amount of acoustic energy over a 'normalised' one second period as the actual noise event under consideration.

Based on the measured L_{AE} level, calculations are conducted utilising the number of trains per day to determine the $L_{Aeq,24hr}$ noise impact at proposed residential receivers.

The measurements were conducted generally in accordance with Australian Standard AS 2377:2002 'Acoustics – Methods for the Measurement of Railbound Vehicle Noise'.

5. NOISE ASSESSMENT CRITERIA

As the Urban Land Development Authority does not have specific noise criteria assessment procedures, we are recommending the application of the Brisbane City Council and Queensland Transport assessment requirements. The criteria applied to the site is divided into 4 sections (5.1 – 5.4) and details the relevant assessment methods for road traffic, onsite/offsite activities, rail noise and mechanical plant.

5.1. Road Traffic Noise – Brisbane City Council

The road traffic noise criteria applied to the proposed development is pursuant to the Brisbane City Council's (BCC) City Plan 2000 "Noise Impact Assessment Planning Scheme Policy" (NIAPSP). The assessment methodology requires that road traffic noise is investigated for the planning horizon. This assessment has considered road traffic for the year 2021. Road traffic noise levels are assessed as an outdoor level in recreation areas, as internal noise levels for living, work and sleeping areas.

The internal noise limits are the recommended design sound levels from Australian/New Zealand Standard AS/NZS2107:2000 and are presented in Table 1.

Since AS/NZS2107:2000 does not include limits for outdoor recreation areas, the BCC City Plan Noise Impact Assessment Planning Policy states that the L_{eq} averaged over a 24 hour period should not exceed 55 dB(A). The maximum $L_{Aeq, 1hr}$ for any hour should not exceed 60 dB(A).

Table 1: Internal Noise Limits for Residential Dwellings from AS/NZS 2107:2000.

Type of Occupancy / Activity	Recommended Design Sound Level, L_{Aeq} dB(A)
7. RESIDENTIAL BUILDINGS	
Houses and apartments near major roads –	
Living areas	35 – 45
Sleeping areas	30 – 40
Work areas	35 – 45

Table 2 outlines the assessment criteria based upon achieving the noise level objectives for Brisbane City Council.

Table 2: Road Traffic Noise Assessment Criteria.

Description	Predicted SPL dB(A)
Communal Recreational Areas	55dB(A) L_{Aeq} (24hour) (Free Field)
Private Recreational Areas	55dB(A) L_{Aeq} (24hour) (Façade Corrected)
External façade	60dB(A) L_{Aeq} (1hour) (Façade Corrected)
Internal noise limits	As per Table 1

5.2. Onsite and Offsite Activity Noise – Brisbane City Council

Brisbane City Council require onsite activities (i.e. vehicle movements excluding mechanical plant) are assessed in accordance with NIAPSP. The assessment should detail the location, extent and construction specifications for proposed attenuation measures including all assumptions and methodologies used.

Noise criteria associated with the proposed site activities are pursuant to the NIAPSP. In essence, NIAPSP requires the following:

- Assessment of immission¹ and emission².

Assessment of immission and emission levels are grouped into 3 fundamental methodologies:

- 1) **Comparison of like parameters or descriptors** – Comparison, using a suitable sound descriptor, of the ambient sound character of an area without the development to that resulting with the development.
- 2) **Application of AS/NZ2107** – Comparison with a defined set of sound pressure levels, for specified indoor areas occupied by people set out in Table 1 of AS/NZ2107:1997.
- 3) **Sleep awakenings** – Comparison with sleep levels. This type of assessment can be conducted using sound exposure levels (L_{AE}) to compare to the FICAN 1997 SEL(L_{AE})/percentage awakening curve

We recommend applying the comparison of like parameters for assessment of noise from all noise sources associated with the development as follows:

- L_{A10}^3 Vs L_{A10} for transient noise sources (i.e. waste collection, car parking and loading dock). NIAPSP allows the existing L_{A10} level to be exceeded by 3 dB by any proposed activities (taking into account the number of discreet noise events, character of the noise and time of occurrence);
- Application of AS/NZS2107:2000 for control of mechanical plant noise.

The use of L_{A10} levels is recommended as it reflects the average maximum level of noise associated with a source. The use of average maximum is referenced as an acceptable assessment method of transient noise sources in the "Noise Measurement Manual" produced by the Queensland Department of Environment & Heritage (2nd Edition, 1995). For short duration noise events, the application of AS/NZS2107:2000 (see point (2) above) is not considered appropriate, as it applies to continuous noise, such as mechanical plant.

Based on the above assessment requirements, the assessment criteria for residential receivers in the vicinity of the site are detailed in Tables 3 and 4.

Table 3: Assessment Criteria for Residential Receiver 1.

Time Period	Criteria L_{A10} dB(A)
Daytime (7am – 6pm)	71 ($L_{A10} + 3\text{dB(A)}$)
Evening (6pm – 10pm)	66 ($L_{A10} + 3\text{dB(A)}$)
Night time (10pm – 7am)	58 ($L_{A10} + 3\text{dB(A)}$)

¹ Immission is the noise received by the development when it is immersed in an ambient sound environment.

² Emission is the noise emitted by activities within the development.

³ L_{10} level is the level exceeded for 10% of the measurement time, and often termed the "average maximum"

Table 4: Assessment Criteria for Residential Receivers 2 & 3.

Time Period	Criteria L_{A10} dB(A)
Daytime (7am – 6pm)	58 ($L_{A10} + 3\text{dB(A)}$)
Evening (6pm – 10pm)	54 ($L_{A10} + 3\text{dB(A)}$)
Night time (10pm – 7am)	50 ($L_{A10} + 3\text{dB(A)}$)

Refer to **Appendix B** for graphical representation of measured noise levels.

Sleep Disturbance Criteria

Criteria for sleep disturbance is addressed under the is addressed in the User's Guide to the Environmental Protection (Noise) Policy, and states the following:

'In the case of fluctuating noise, the maximum level is correlated to sleep disturbance, rather than the ambient level. For good sleep, maximum noise levels of 45 dB(A) to 50 dB(A) should not be heard in a bedroom more than 10 to 15 times a night.'

'Where noise is continuous, the ambient level during the sleeping period should not exceed 30 – 35 dB(A) indoors in a bedroom.'

The research concerning the effect of maximum noise levels of 45 to 50 dB(A) and the number of events is not complete and there is still a lot of discussion about their application. This is because people are extremely variable in their reactions to noise and how well they acclimatise to new activities. The maximum level does not mean a person is awakened at these levels, but sleep may be disturbed.

Intrusiveness Criteria

Further to the above, we recommend applying a limit of L_{Amax} 45dB(A) inside dwellings for fluctuating noise as the World Health Organisation's Guidelines for Community Noise 1999 states that "speech in relaxed conversation" can be "understood fairly well in background levels of 45dBA". The L_{Amax} level is therefore considered unlikely to interfere with normal speech levels, watching television and other typical household activities.

5.3. Rail Noise – Queensland Transport

The site is located in the vicinity of a railway line currently under control by Queensland Transport. The following design criteria applicable to the proposed development is detailed as follows:

- External design levels of $L_{Aeq,24hr}$ 65dB(A), assessed at outdoor recreation areas.
- L_{Amax} 87dB(A), assessed at outdoor recreation areas.
- Indoor design level for bedrooms and living areas of L_{Amax} 50dB(A) average maximum sound level between 10pm and 6am.

It is noted that the indoor design level is set out in Queensland Transport's 'Interest in Planning Schemes No.3'; and the external design levels are set out in the Environmental Protection (Noise) Policy 1997.

From time to time, passing trains will blow a horn to warn people of its presence. It should be noted however that Queensland Rails' "Code of Practice, Railway Noise Management" (December 1999), states the following in relation to noise impacts from horns and other safety devices:

8. "HORNS AND OTHER WARNING DEVICES"

Horns and sirens are used within QR as warning devices to protect the safety of both employees and the public. Unfortunately, noise from these devices may cause annoyance to some residents from time to time.

In general, public and employee safety must be satisfactorily protected and hence it is not appropriate to apply any particular noise criteria to these warning devices (including the QR nominated interim levels and the EPP Noise planning levels). Where specific complaints are received, however, responsible Managers will consider whether there is sufficient justification to change standing orders on the use of horns or to nominate alternative warning devices.

In considering what constitutes "sufficient justification", responsible Managers will have regard to any relevant QR Safety Management Systems.

QR shall ensure driver training will include appropriate use of horns and warning devices.

5.4. Mechanical Plant – Brisbane City Council

Application of AS/NZ22107 for control of mechanical plant noise is in accordance with NIAPSP, and takes into account the acceptable R category for potentially affected premises as defined in Australian Standard AS1055.2 1997 "Acoustics – Description & Measurement of Environmental Noise". By categorising the dwellings adjacent to the development as being R3 (areas with medium density transportation or some commerce or industry), the noise design target level defined in AS/NZ22107 for dwellings near major roads is 40dB(A) $L_{eq}(15\text{ min})$ in sleeping areas.

Further to this, to prevent background creep, plant must be designed to not exceed the measured background noise levels. These various criteria equate to a design target for mechanical plant of the following levels:

Table 5: Mechanical Plant Assessment Criteria for Residential Receiver 1.

Time Period	Criteria L_{90} dB(A)
Daytime (7am – 6pm)	52
Evening (6pm – 10pm)	45
Night time (10pm – 7am)	43

Table 6: Mechanical Plant Assessment Criteria for Residential Receivers 2 & 3.

Time Period	Criteria L_{90} dB(A)
Daytime (7am – 6pm)	47
Evening (6pm – 10pm)	44
Night time (10pm – 7am)	42

Refer to **Appendix B** for graphical representation of measured noise levels

The above levels are quoted as a measured level, not a component level; hence, all plant proposed must be included in assessment. By designing plant noise to a measured level rather than a component level, the additive effect of multiple plant is taken into account.