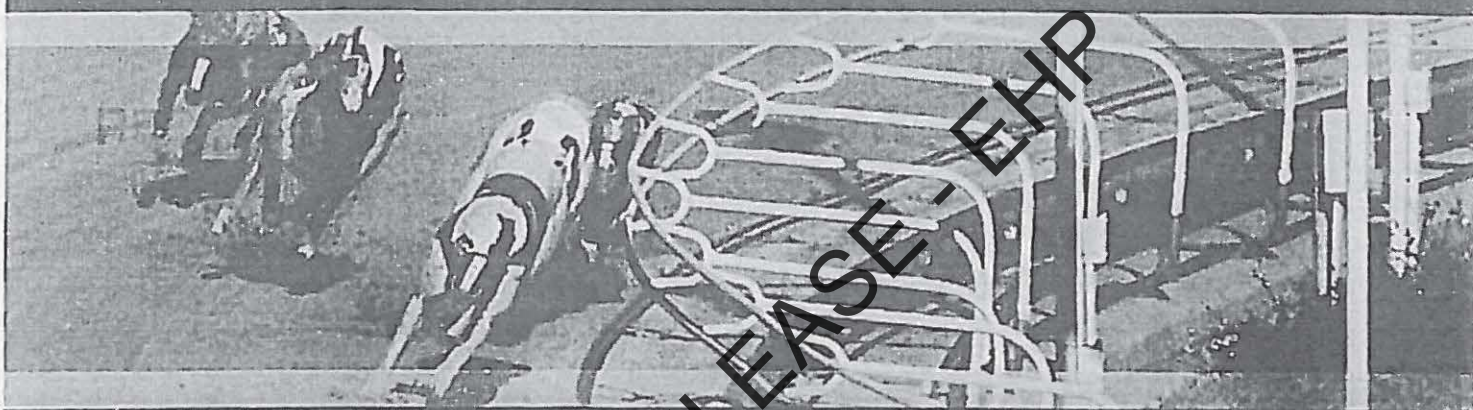




Town Planning Assessment Report

Supporting a development application for:
Material Change of Use (Development Permit) Outdoor
Entertainment and Restaurant;

Operational Work (Development Permit) removal of
native vegetation (for site access purposes); and

Building Works (preliminary approval).

For property located at:
146-178 Kingston Road, Slacks Creek
Lot 658 on SL12298

March 2010



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- Attachment 6** - Infrastructure Servicing Plan and Site Based Stormwater Management Plan
- Attachment 7** - Proposed External Lighting details data sheet
- Attachment 8** - Property Vegetation Management Plan

1. INTRODUCTION

1.1 PROJECT OVERVIEW

This town planning assessment report has been prepared by ML Design on behalf of Greyhounds Queensland Ltd for the purpose of gaining a Development Permit for use of the site located at 146 - 178 Kingston Road, Slacks Creek for a new Greyhound Racing facility generally in accordance with the plans and elevations prepared by ML Design shown at Attachment 2.

The subject site (SS) has previously been used as a landfill site which ceased operations in the mid 1980's. Since this time the site has been vacant and used for passive informal open space purposes under the trusteeship of Logan City Council.

The proposed development involves the construction of three new buildings on the site and the required racetracks. The new building works result in a combined site coverage of approximately 1.7%. Significant new building works will not occur over the majority of the site, which is currently capped to ensure appropriate separation from potential contamination sources. The proposed development is considered to be a sensitive reuse given the restrictions which result from prior use and the unstable geotechnical conditions which are likely to result from further minor settling of the refuse matter under the capping surface.

Upon detailed technical investigation of the site and assessment of the proposal against Logan City Council's Planning Scheme and other relevant statutory documents it is concluded that the proposed development is an appropriate reuse of the site and should be approved subject to reasonable and relevant conditions.

RTI DL RELEASE - ENP

2. SITE AND APPLICATION DETAILS

2.1 SITE DETAILS

Address of site:	146 Kingston Road, Slacks Creek, Queensland 4127
Real property description:	Lot 658 on SL 12298
Area of site:	10.24 ha
Zoning:	Public Open Space
Owner:	State Government



Commercial Uses

Industrial Uses

Image 1 – Aerial photograph showing subject site, Compton and Kingston Roads and surrounding development

The site has previously been used as a general purpose refuse (dump) and has been left in a predominantly 'open' state with no built form or significant improvements aside from fencing of the property to Compton and Kingston Roads and the creation of internal sealed pathways across the site from Kingston Road.

The site includes a number of gas 'monitoring devices' (Image 4) which are used to provide readings of the type and amount of gas being released by the decomposing landfill. Previous discussions with Council have raised the possibility of either modifying or repositioning the vents to be more visually sympathetic with the proposed development's overall site layout. Modification of these vents is considered possible and is will be discussed further with Council.



Image 2

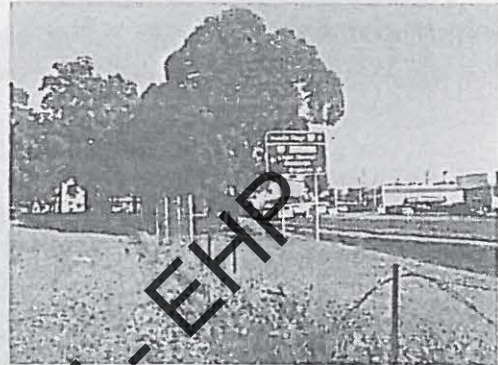


Image 3

Image 2 - taken from centre of site looking towards south-western corner

Image 3 - taken from northern end of site towards Kingston and Compton Roads intersection

Image 4 - onsite monitoring vents



Image 4

A portion of the site's western and southern boundary (Image 5) contains what is considered to be regrowth vegetation which provides a degree of visual screening of the site from Kingston and Compton Roads. This vegetation is located within the site and within the Kingston Road, road reserve area.

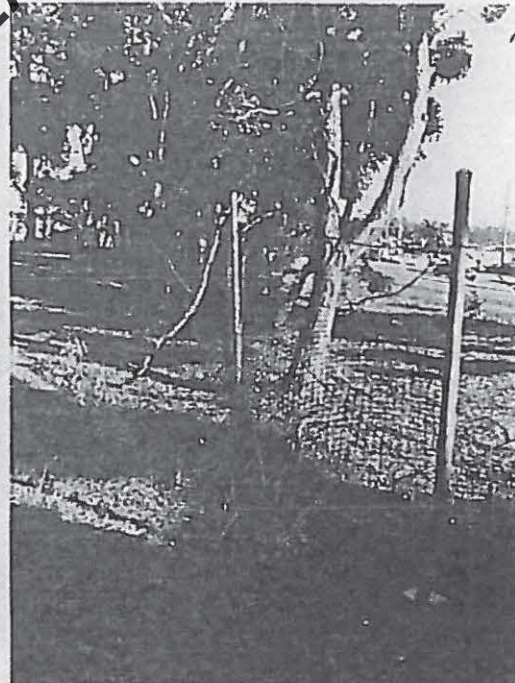


Image 5

The site has principal frontages, Compton and Kingston Roads, approximately 219 and 190m respectively. There is an existing vehicle crossover and gate to the site from Kingston Road only, approximately 110m south from the Kingston and Compton Roads intersection. An existing 'bus stop' is also located on the eastern side of Kingston Road approximately 90 m south of the Kingston and Compton Roads intersection. The road reserve area of Compton Road contains a Council maintained spoon drain which transfers stormwater runoff from Compton Road to the east.



Image 6

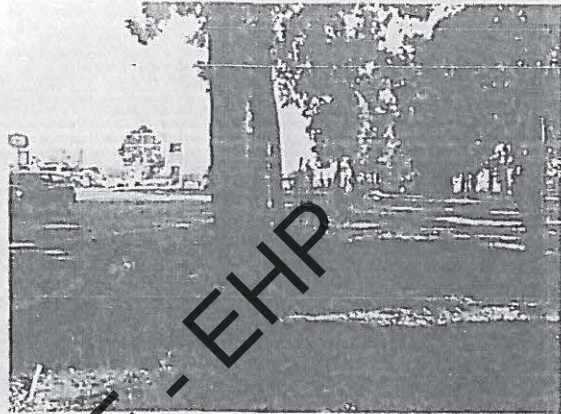


Image 7

Image 6 - taken from north-western corner looking towards Compton Road

Image 7 - taken from south-western corner looking north along Kingston Road

As Image 1 indicates the site is surrounded by non-residential uses. These activities comprise predominantly industrial uses adjacent to the site's southern, eastern and north-eastern boundaries. Existing industrial access for sites located to the south and east of the subject site is provided by the existing road network from Kingston Road. Vehicle access for existing industrial developments located to the northeast of the subject site is currently provided from Cronulla Court. The proposed development does not intend to alter these existing industrial access arrangements.

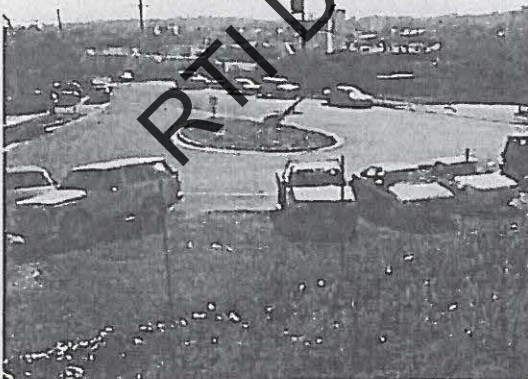


Image 8

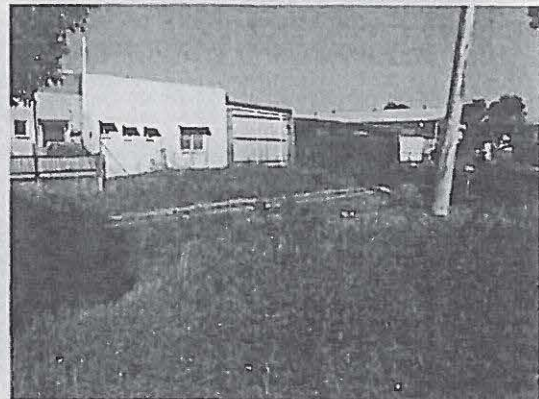


Image 9

Image 8 - taken from north-eastern corner of site looking north east towards Cronulla Court

Image 9 - taken from south-eastern corner of site looking west along the southern property boundary

2.2 SURROUNDING BUILT FORM

The surrounding development comprises a mix of light industrial and commercial buildings only. Development is predominately a mix of a Service station, Car service centres, Car yards, Smash repairs etc.

As indicated at Image 1 the subject site fronts either major roads or industrial buildings. Industrial buildings located to the south, east and north-east of the site are predominantly smaller finer grained 1980's/ 90's factory units typically not exceeding 8.5 m in height.

Development located to the north and west of the subject site comprises predominantly service industry buildings which also typically do not exceed 8.5 m in height.

2.3 APPLICANT DETAILS

Applicant: Greyhounds Queensland Ltd
c/ ML Design
GPO Box 714
Brisbane QLD 4001

Contact: Andrew Gaffney - Senior Town Planner
Ph: 3237 7248
Fax: 3229 6863
Email: andrew.gaffney@ml-design.com.au

2.4 PROPOSED DEVELOPMENT

This application seeks approval for the following;

- **Material Change of Use (Development Permit) Outdoor Entertainment and Restaurant;**
- **Operational Work (Development Permit) removal of native vegetation (for site access purposes); and**
- **Building Works (preliminary approval).**

The proposed development is outlined on detailed plans and elevations of the proposal shown at **Attachment 2**.

The project objectives have been to;

- Provide a cost sensitive architectural response which will provide the necessary facilities required for the use to occur;
- mitigate any impacts resulting from the use of the site in relation to on site contamination and sensitive location of buildings; and
- to accommodate the facility to ensure minimal impact to the surrounding environment and existing surrounding development.

New development at the site focuses on providing fundamental infrastructure within the site, this will entail the construction of:

- appropriate vehicle access points and internal parking and circulation areas;
- three new buildings on the site; and
- the necessary racing track and lighting.

The following information highlights the key elements:

Proposed built form

The following information indicates the GFA of the proposed structures to be located on the site.

Main 'Facility Building' - 2,400m² (Excludes plant, switch room and deck) maximum building height 17m above ground level;

Kennel Block - 363m²; and

Trialling Kennels: - 170m²

Maintenance shed - 270m²

o *Facility Building*

The Facility Building is located near to the northern boundary of the site and directly to the north of the race tracks. Its location within the property is determined by a number of factors primarily to ensure that viewing from the building for patrons and televising purposes is not interfered with by late afternoon sunlight.

As the attached plans and elevations indicate the building includes an elevated 'lookout' which at its maximum height would be approximately 15 m above ground level.

The building is simplistic in its overall layout representing a rectangular shape accommodating;

at ground level

- the main entrance and required administration areas;
- a central concourse area/ patron amenities and Tote administration for general recreation and viewing of racing events;
- a kitchen and bar area for the preparation of meals and light refreshments for patrons; and
- at the eastern side of the building; necessary back of house/ plant rooms and an open deck area.

at first floor level

- a Restaurant /General function / Kitchen / Bar and patron amenities;

at second level;

- the main control room for racing supervision and broadcast.
- the Restaurant and Function Room area is intended to be open up to 3 - 4 times a week.

It is not intended for the Restaurant to 'trade' on a typical 7 day a week basis. Similarly, the frequency use of this area for 'general functions' which may include wedding receptions, conferences etc is unknown at this time.

The above uses have been considered with the traffic assessment report which has generally concluded that the facility building can be accommodated on the site and included the aforementioned functions without having an adverse impact on local traffic operations (see traffic assessment report at Attachment 5 for further information).

Kennel Block

The kennel Block is located directly to the southwest of the main Facilities Building and will provide the necessary housing for the Greyhounds prior to a racing event. This building will accommodate the necessary racing officials, trainers, vets and weigh in room which are required by national greyhound rules. Once dogs arrive at the site they are taken into the kennels by the trainers and securely restrained within the building prior to racing. No dogs are kept on site overnight.

Maintenance Shed

A maintenance shed is located within the car parking area for trailers which is required for maintenance of the race track and property. This building will accommodate tractors/ water carts etc for site maintenance purposes.

Trialling Kennel Block & track

This facility is located directly to the south of the main tracks and provides a standalone 'one way - straight track' intended to be used by trainers with younger dogs as an 'introduction' to the racing environment. Typically trainers will release dogs at the track's western end and retrieve them from the eastern end, walk them back to the start of the track and repeat.

The kennel block provides the necessary housing of dogs to allow trainers to concentrate on one dog at a time. No dogs are kept within the Trialling Kennel Block overnight.

Site Use - Typical racing activity

A typical racing week would involve 4 formal races events,

- 2 of these occurring at approx 6:30pm with racing events finished by approximately 9:30 p.m.; and
- 2 events occurring at 4.00pm and finishing approximately 7.00pm.

The 'site' is also intended to be available for trainers etc to use for informal 'training secessions' during the week, however access to all site facilities during these times will be limited.

An exact number of patrons to a typical race event is difficult to predict however for the purposes of this planning assessment we have allowed for approximately 100 to 150 persons per racing meet.

The major race meet of the week, Thursday nights, we have allowed for approximately 250 - 300 persons per racing meet.

Vehicle access and internal circulation

The primary vehicle access/ exit to the site will be gained from Kingston Road only via a 'left in left out' arrangement. Egress from the site is proposed from both Compton Road and Kingston Road (left out only).

The site will accommodate 142 car parking spaces for patrons and a separate area for Greyhound 'Trainers' which will accommodate a further 50 larger spaces required for dog trailers.

The site layout also includes a 'drop off' area located near to the Facility Building which will accommodate persons arriving at the site by taxi and/or private vehicle who do not intend to park at the site for the duration

of an event. The proposed internal roads and car parking areas will be appropriately signed to allow for easy driver orientation.

The attached site plan indicates the way in which these internal car parking areas will function and is discussed further with the traffic assessment report at **Attachment 5**.

Racetrack and lighting

A plan of the racetrack is shown at **Attachment 2** with more detailed information regarding the form of the track and potential impact on matters such as topography and drainage patterns outlined in **Attachment 6**.

Due to the falling nature of the site from approximately RL34 (western boundary) to RL29 (eastern boundary) and the need to keep the track in a 'horizontal alignment', an amount of filling/battering will be required at the eastern end of the tracks. This battering will be integrated with intended stormwater drainage design prior to discharge.

The proposed lighting of the tracks will be provided by a total of 9 pole mounted lights. The intended lighting system to be used is shown at **Attachment 7** and are up to 30m in height. Lights located toward the southern end of the site are approximately 20m in height with lights located towards the northern side of the property approximately 30m in height.

All neighbouring and nearby development located to the north northeast, east and south of the site and consists of either commercial or light industrial developments. It is not considered that the proposed 'lighting' intended for the track will cause any detrimental impact to surrounding development.

Removal of Vegetation

An assessment of the proposed removal of remnant vegetation has been undertaken for the proposed development and is contained at **Attachment 8**. As indicated within this document and the 'Site Plan' contained at **Attachment 2** the removal of the vegetation is required to facilitate appropriate vehicle access to and within the site.

The PVMP assessment concludes that the proposed development and removal of a number of trees from the site is reasonable to allow for safe site access.

3. MATTERS FOR CONSIDERATION

The previous use of the site for general refuse purposes presents a number of unique site based constraints which stem from the fact that existing landfill is to remain onsite.

From a project viability position, a key consideration was the ability to feasibly construct the required buildings and other structures whilst ensuring the existing contamination is not substantially disrupted to ensure appropriate ongoing safety for future users.

Similarly, the way in which stormwater management and vehicle access to and from the site is achieved and managed were also important considerations during the assessment of the project. This has involved investigation into a number of key areas which include;

- On-site contamination and management,
- Infrastructure provision;
- Hydraulic/stormwater management; and
- Traffic assessment.

The following information highlights the key findings of the technical investigations. Further detailed information can be obtained within the technical reports attached to this town planning assessment (see **Attachment 4** – Contamination Site Investigation, **Attachment 5** - Traffic Impact Assessment and **Attachment 6** - Infrastructure Servicing Plan and Site Based Stormwater Management Plan).

3.1 SITE CONTAMINATION

An investigation of Cronulla Park was undertaken to establish whether the site its current condition poses an unacceptable risk to human health and/or the receiving environment, and subsequently, whether remediation will be required for the redevelopment of the site for the Logan Greyhound Facility.

The investigation confirmed that a capping layer has been installed over most of the site, however an engineered liner was not found.

Elevated concentrations of inorganic and organic contaminants have been found in groundwater; these however are unlikely to pose an unacceptable risk to off-site ground and surface water receptors.

Long term landfill gas monitoring undertaken by Logan City Council indicates that landfill gas is unlikely to pose an unacceptable risk to off-site receptors. However elevated concentrations of methane and vapours have been detected beneath the capping layer which pose a risk to future site users. The key remedial measures required for the redevelopment of the site include;

- building on the capping layer in the eastern embankment of the site;
- the inclusion of gas protection measures in future buildings; and
- maintaining the integrity of the cap through the appropriate redevelopment methods.

The site is listed on the Environmental Management Register (EMR) for the notifiable activity "Landfill". DERM has advised that the site is not managed under a Site Management Plan (SMP). The site is not listed on the Contaminated Land Register (CLR). A copy of the EMR search result is contained within the Contamination assessment report prepared by Cardno at **Attachment 4**.

3.2 INFRASTRUCTURE SERVICING

The infrastructure servicing assessment has identified relevant available services in close proximity to the development site. Dial-Before-You-Dig information has noted the presence of water supply reticulation, sewerage reticulation, electrical services (Energex) and communications services (Telstra) along Kingston Road and Compton Road.

Discussions held with Logan City Council have also noted that the capacities of existing water and sewerage reticulation networks are adequate for the facility.

Electrical and communications connection points will be identified during the Operational Works phase.

3.3 STORMWATER MANAGEMENT

Hydrologic and hydraulic models have been completed to quantify and assess the peak runoff at the development's discharge locations for the existing and developed scenarios. The stormwater strategy focuses on attenuating developed discharges with the use of detention basins.

The modelling results have demonstrated that there is no nett increase of peak discharge from the developed scenario for all storm events up to and including a Q100 event. A capacity check of the existing open stormwater channel which flows north east along the southern and western boundaries has been completed taking into consideration contributing upstream catchments and the generated flows associated with the new development. This check has confirmed that the capacity exists and it is intended that the open channel be ceded to Logan City Council with appropriate easement rights in the future.

Water quality modelling has also been completed based on a treatment train approach and utilising best management practices with the results demonstrating load reduction targets are within Council requirements. Detailed design in conjunction with appropriate landscape measures will be undertaken during the Operational Works phase.

3.4 TRAFFIC ASSESSMENT

The traffic impact assessment (TIA) has determined that traffic associated with the proposed development will have no significant impact on the capacity and operation of the surrounding road network. Development traffic movements is estimated to coincide with the commuter peak periods during the PM peak. Detailed intersection analysis confirmed that development traffic will not significantly impact on the current levels of service of the key intersections of Kingston Road with Compton Road and Moss Street during the opening year and 10 year (post opening) design horizons. In addition, the TIA also demonstrates that the traffic and transport aspects of the DA comply with the requirements of Australian Standards, the Department of Transport and Main Roads and the Logan City Council, including those for access, car parking, servicing and pedestrian provisions.

Mitigation measures for minimising impacts on the surrounding road network associated with development traffic include the implementation of signage provisions and way finding measures, ensuring that sight lines are maintained at the access points, particularly at the proposed Compton Road access (via tree management), and the implementation of traffic control plans during the construction of the development.

4. DEVELOPMENT ASSESSMENT

3.5 OVERVIEW

The planning framework relevant for assessment of this Development Application is the Sustainable Planning Act 2009 (SPA) and the Logan City Council Planning Scheme.

In accordance with Section 238 of the SPA a Development Permit is required for assessable development. Accordingly this development application seeking an approval for a Development Permit for Material Change of Use for an Outdoor Entertainment and Restaurant use and a Preliminary Approval to Carry out Building and Operational Work.

Section 313 of the SPA requires that the following matters are to be assessed for a 'Code Assessable' development application.

(2) The assessment manager must assess the part of the application against each of the following matters or things to the extent the matter or thing is relevant to the development—

- (a) the State planning regulatory provisions;
- (b) the regional plan for a designated region, to the extent it is not identified in the planning scheme as being appropriately reflected in the planning scheme;
- (c) any applicable codes, other than concurrence agency codes the assessment manager does not apply, that are identified as a code for IDAS under this or another Act;
- (d) State planning policies, to the extent the policies are not identified in—
 - (i) any relevant regional plan as being appropriately reflected in the regional plan; or
 - (ii) the planning scheme as being appropriately reflected in the planning scheme;
- (e) any applicable codes in the following instruments—
 - (i) a structure plan;
 - (ii) a master plan;
 - (iii) a temporary local planning instrument;
 - (iv) a preliminary approval to which section 242 applies;
 - (v) a planning scheme;
- (f) if the assessment manager is an infrastructure provider—the priority infrastructure plan.

Note—

See chapters 2 to 4 for particular provisions about the relationship between the matters or things mentioned in subsection (2).

(3) In addition to the matters or things against which the assessment manager must assess the application under subsection (2), the assessment manager must assess the part of the application having regard to the following:

- (a) the common material;
- (b) any development approval for, and any lawful use of, premises the subject of the application or adjacent premises;
- (c) any referral agency's response for the application;
- (d) the purposes of any instrument containing an applicable code.

(4) If the assessment manager is not a local government, the laws that are administered by, and the policies that are reasonably identifiable as policies applied by, the assessment manager and that are relevant to the application, are taken to be applicable codes in addition to the applicable codes mentioned in subsection (2)(c) or (e).

(5) The assessment manager must not assess the application against, or having regard to, anything other than a matter or thing mentioned in this section.

(6) Subsection (2)(a), (b) and (d) does not apply for the part of an application involving assessment against the Building Act.

3.6 INTERPRETATION

The proposed development is defined as an 'Outdoor Entertainment' use. The following definition is provided under Schedule 1 – Dictionary, of the Logan City Council Planning Scheme;

"Outdoor Entertainment" means the use of premises for any form of entertainment, game, recreation or sport which occurs primarily outdoors and for which admission is limited by a charge, an invitation or the like. The use also includes an associated activity being—

- (a) a food outlet where the GLA does not exceed 50m² and involves a kiosk or a light refreshment booth; or
- (b) the sale to the public of liquor pursuant to a licence under the Liquor Act 1992; or
- (c) a shop where the GLA does not exceed 100m² and involves the sale of a good or a service related to an activity which characterises the use of the premises; or
- (d) a spa pool, sauna, solarium or other sport or recreation facility.

Example of an outdoor entertainment activity—Boating; cycling track; drive-in theatre or outdoor film or theatre; equestrian centre; golf course; golf driving range; playing fields (where enclosed and a fee is charged for admission); race track; rifle or pistol range; swimming pool; tennis court; tourist attraction (outdoor); trail or mountain bike riding; trotting track; waterslide; zoo; fetes, fairs; carnivals; an animal related event such as an animal nursery, a dog show or trial, gymkhana, and a rodeo; concert, jamboree; motor vehicle event such as a car or bike show; fireworks; propagating plant event such as a flower show; orienteering and outdoor activities such as a sporting event.

"Restaurant" means the use of premises for the regular supply, by table service, of substantial meals to the public, primarily for consumption on the premises. The use also includes an associated activity being—

- (a) the provision of takeaway meals; or
- (b) the provision of music, entertainment and dancing.

The intended use of the site for "Outdoor Entertainment" and "Restaurant" is generally in accordance with Council's definitions as listed above.

3.7 PRELODGE MEETING DISCUSSIONS

A formal pre-lodgement meeting was held at Logan City Council on 19 November 2009.

The meeting was attended by Council officers representing Traffic, Transportation, Development, Parks Planning, Health and Environmental Management sections.

Greyhounds Queensland Ltd was represented by relevant Design and Town planning staff from ML Design and technical staff from Sinclair Knight Merz. A full list of persons in attendance is provided within the attached pre-lodgement meeting checklist (see Attachment 3).

In general, the response from Logan City Council was favourable. Matters for consideration included;

- o On-site contamination and management;
- o Potential requirement for a footpath/cycleway along Compton Road;
- o Stormwater quality;
- o Retention of existing vegetation primarily adjacent to the site's Kingston Road frontage.

All of the above matters have been considered during the preparation of the required technical reports.

o Infrastructure contributions

Preliminary discussions have occurred with Council regarding the potential infrastructure charges which would be applicable for this proposed development. The required infrastructure elements will include;

- o Water and Sewerage supply; and
- o Trunk Road infrastructure.

The methodology used for the calculation of the applicable charges have been based upon Council's existing contributions required for 'Centres', which calculate the contribution based on 30EP for water supply and sewerage. Information contained within our engineering assessments indicate that this rate is significantly higher than what would normally be applicable to a development of this intensity.

Potential Easement for Stormwater

Stormwater runoff from external catchments (as shown on Figure D1 of Attachment 6) is discharged through the site generally adjacent and parallel to the southern and eastern boundaries. Preliminary discussions with Council have conveyed the potential for an easement over this area of the site in favour of Logan City Council for access and maintenance purposes. The applicant generally supports this concept and will work with Council during the application process to determine the limits of any potential easement area.

3.8 LEVEL OF ASSESSMENT AND RELEVANT CODES

The subject site is located within the 'Non Urban and Conservation Locality' and within the 'Public Open Space Zone - PO5' zone.

Table 3.4.4 listed under Chapter 3 - Assessment Provisions for Localities, Zones and Sub areas states that a Material Change of Use for an 'Outdoor Entertainment' is a code assessable development where located within a Public Open Space Zone, in any sub area. Similarly Table 3.4.4 also states that a 'Restaurant' is Code Assessable in the Public Open Space Zone, in any sub precinct.

The proposed Operational Works for removal of vegetation is listed as Code Assessable Development and requires assessment against the Vegetation Management Area Code.

The relevant codes are stated as being;

- o Non urban and conservation locality and zones code (Section 3.4 .9) (see below);
- o Vegetation Management Area Code (see below);
- o Works Codes (Section 5.3 .1); the Works code includes the following sub codes;
 - o Parking code; (see Attachment 5)
 - o Landscaping code;
 - o Earthworks code (see Attachment 6);
 - o Advertising devices code (not applicable to development application); and
 - o Infrastructure code. (see Attachment 6)

The following information highlights the proposed development's assessment against the;

Non urban and conservation locality and zones code (Section 3.4 .9);

Non Urban and Conservation Locality and Zones code

Table 3.4.11 - Specific outcomes and prescribed solutions for the Non Urban and Conservation Locality

Performance Criteria	Acceptable Solution	Complies with Acceptable Solution/ intent of Performance Criteria or Performance Solution	Applicant Response
Protection and enhancement of amenity and character			
<p>O1 Development protects and enhances the amenity and character of the zone and sub-area by providing that-</p> <p>(a) development does not introduce into an urban access road or a minor urban collector road, non-residential traffic, through traffic or traffic that does not ordinarily use the urban access road or minor urban collector road; and</p> <p>(b) a major road does not have an adverse social impact on a neighbourhood; and</p> <p>(c) there is no adverse impact on a character area in particular a streetscape and a public place; and</p> <p>(d) there is no adverse impact on visual amenity; and</p> <p>(e) there is no adverse impact on the privacy of an existing or a planned</p>	S1.1 None applicable.	<p>Complies with intent of Performance Criteria</p> <p>Complies with intent of Performance Criteria</p> <p>Complies with intent of</p>	<p>The subject site is located at the corner of two major roads, Compton and Kingston Roads. Surrounding the Subject Site is a significant area of land designated for industrial and commercial use. The issue of traffic to and from the site has been discussed in detail within the attached SKM Traffic Assessment report. This report concludes that the proposed development can be located at the site without adverse traffic impacts on the local road network.</p> <p>The site is not located within a character area and therefore complies with this performance criteria.</p> <p>The subject site will be developed generally in accordance with the architectural plans and elevations show at Attachment 2. These plans indicate that buildings on the site will be located behind existing trees with the existing streetscape to Compton and Kingston roads remaining primarily intact.</p> <p>It is not considered that the proposed development will adversely impact on visual amenity.</p> <p>Not applicable to the development application</p>

<p>Complies with intent of Performance Criteria</p>	<p>Whilst the subject site is located at the corner of Corn are minor when compared to the site area and will b trees at the site will remain apart from those which a car parking areas. An assessment of the proposal's PVMP contained at Attachment</p>
<p>Complies with intent of Performance Criteria</p>	<p>It is not considered that an extensive amount addition portion of the site will remain in an 'open' setting. I streetscape in a high standard of visual amenity.</p>
<p>Complies with intent of Performance Criteria</p>	<p>The proposed development is for the Queenslan development will remain at a high level.</p>
<p>Complies with intent of Performance Criteria</p>	<p>Not applicable to the application.</p>
<p>Complies with intent of Performance Criteria</p>	<p>Not applicable to the application.</p>
<p>Complies with intent of Performance Criteria</p>	<p>Not applicable to the application.</p>

			Not applicable to the application.
Noise and vibration emissions			
<p>O2 Development protects and enhances the amenity and character of the zone and sub-area by preventing and minimising emissions of noise and vibration which-</p> <p>(a) cause environmental harm, environmental nuisance or a nuisance to adjacent premises and a noise sensitive place; and</p> <p>(b) cause harm to personal health and safety or property damage; and</p> <p>(c) cause adverse impacts to native animals; and</p> <p>(d) exceed the intended ambient noise levels for the zone and sub-area</p>	<p>S2.1 Development being assessable development complies with the requirements of section 1.1 (Noise emission and immission standards) in schedule 3 (Standards).</p>	<p>Complies with intent of Performance Criteria</p>	<p>The proposed development incorporates two primary functions those being;</p> <ul style="list-style-type: none"> ▪ a Facilities Building to accommodate (patrons and customers at the Restaurant); and ▪ a Greyhound racing tracks. <p>It is not considered that the proposed development will create environmental harm in relation to an adjacent or nearby sensitive place. All development adjoining or surrounding the subject site is non-residential. The nearest residential areas to the subject site are located at Southgate Drive approximately 184 m to the southwest of the site. 'Noise' generated from the subject site is minor and would include;</p> <ul style="list-style-type: none"> ○ vehicles entering and leaving the site; ○ low-level noise associated with the facilities building; ○ maintenance activities which may include mowing and general maintenance involving a tractor within the site. <p>NB: the Kennel Building is an acoustically treated and air-conditioned environment to ensure that the greyhound dogs are relaxed and not excited prior to a race. As previously mentioned dogs are not kept onsite overnight.</p> <p>Sensitive receiving environments do not adjoin or are located within proximity to the subject site.</p>
Air emissions			
<p>O3 Development protects and enhances the amenity and character of the zone and the sub-area by</p>	<p>S3.1 Development being assessable development complies with the requirements of section</p>	<p>Complies with intent of Performance</p>	<p>The proposed development is not a use which courses environmental harm or adverse impact on regional air quality. The existing monitoring of air quality which is required due to the site's previous use will continue and is discussed further in Attachment 4. The contamination assessment investigation concludes that the</p>

<p>preventing and minimising emissions of odour, dust and other pollutants, including greenhouse gases, which-</p> <p>(a) cause environmental harm, environmental nuisance or a nuisance beyond the premises; and</p> <p>(b) cause harm to personal health and safety and property damage; and</p> <p>(c) have an adverse impact on regional air quality.</p>	<p>1.2 (Air emission standards) in schedule 3 (Standards).</p>	<p>Criteria</p>	<p>proposed development can occur on the site. It is not considered that an air quality investigation report is required in this instance.</p>
<p>Light and radiation emissions</p>			
<p>O4 Development protects and enhances the amenity and character of the zone and sub-area by preventing and minimising light and radiation emissions which-</p> <p>(a) cause environmental harm, environmental nuisance, a nuisance or glare; and</p> <p>(b) cause harm to personal health or safety or property damage; and</p> <p>(c) cause adverse impacts to native animals; and</p> <p>(d) exceed the intended ambient light and radiation levels for the zone and sub-area.</p>	<p>S4.1 Development being assessable development complies with the requirements of section 1.3 (Light emission standards) in schedule 3 (Standards).</p>	<p>Complies with intent of Performance Criteria</p>	<p>The proposed development does include lighting around the track.</p> <p>Technical Data contained at Attachment 7 indicates the proposed lighting system.</p> <p>Lighting which is required for the racetrack is limited to the outer periphery of the track which is setback well within the subject site.</p> <p>Development surrounding the site is not a sensitive receiving environment. It is not considered the proposed lighting will impact on surrounding development.</p>
<p>Vehicle repair station</p>			

<p>O5 Development for a vehicle repair station is not carried out on the premises.</p>	<p>S5.1 Development ensures that a motor vehicle is not repaired on the premises unless-</p> <p>(a) the repairs are day-to-day maintenance; and</p> <p>(b) the motor vehicle is owned by the occupier of the premises and normally parked on the premises for use by the occupier of the premises.</p>		<p>Not applicable to the development application.</p>
<p>Protection and enhancement of ecosystems</p>			
<p>O6 Development protects and enhances ecosystems including their biodiversity from the adverse impacts of-</p> <p>(a) land degradation, land contamination or land subsidence; and</p> <p>(b) a worsening or nuisance; and</p> <p>(c) stormwater pollution through the application of water sensitive urban design; and</p> <p>(d) groundwater pollution, by maintaining existing levels of shallow groundwater where acid sulphate soils are present and not permitting the unsustainable ingress of saline water to freshwater aquifers; and</p> <p>(e) environmental harm, environmental nuisance or a nuisance; and</p>	<p>S6.1 None applicable</p>	<p>Complies with intent of Performance Criteria</p>	<p>The site has been used as a "landfill site" for domestic waste purposes.</p> <p>The attached Contamination Assessment states that the site can be used for the proposed development purpose whilst managing on-site contamination matters.</p> <p>Stormwater management has also been addressed within the attached reports. This report indicates that stormwater can be managed on the site without cross contamination.</p> <p>The general design principle engaged during the formulation of the attached proposed development has been cognizant of the fact that any new development on the site would need to ensure that the existing capping which is in place across the majority of the site is only penetrated where required for building or track footing purposes, therefore containing contamination 'as is' minimising environmental harm.</p> <p>See attached reports for further information regarding these matters.</p>

(f) an environmental weed or a noxious plant; and			
(g) a contaminant or a waste; and			
(h) acid sulphate soils ; and			
(i) a hazard or a disaster.			
Protection and enhancement of nature conservation values			
<p>O7 Development protects and enhances nature conservation values by providing that development does not have an adverse impact on-</p> <p>(a) land and soils; and</p> <p>(b) the environmental values and integrity of waters, a waterway or a wetland; and</p> <p>(c) native plants which are a significant tree or have significant biodiversity and ecological values; and</p> <p>(d) a core area, linkage area and remaining bushland; and</p> <p>(e) riparian habitat; and</p> <p>(f) koala habitat; and</p> <p>(g) the natural and rural landscapes between the urban areas of the planning scheme area and the urban areas of the Redland Shire Council and between the</p>	S7.1 None applicable.	<p>Complies with intent of Performance Criteria</p>	<p>The proposed development will not have an adverse impact on the site's conservation values. At present there is an existing area of mature trees located adjacent to Kingston Road which will be primarily retained aside from trees which will be required to be removed for access purposes.</p> <p>A PVMP has been prepared for the application and is contained at Attachment 8.</p>

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urban areas of the planning scheme area and the urban areas of the Ipswich City Council; and			
(h) nature conservation values.			
O8 Development rehabilitates and enhances degraded or cleared areas by-	S8.1 None applicable	Complies with intent of Performance Criteria	The applicant does not object to a condition which requires that the numbers of trees to be removed by the proposed development will be recorded and replanted in an appropriate location elsewhere on the site.
(a) planting a native plant endemic to the zone and sub-area; and			
(b) rehabilitating a waterway and a wetland to function to its natural capacity; and			
(c) enhancing a riparian habitat, a core area, a linkage area and remaining bushland			
Protection of natural physical processes			
O9 Development does not have an adverse impact on natural physical processes in particular groundwater quality and recharge processes.	S9.1 None applicable.	Complies with intent of Performance Criteria	The proposed development does not intend to significantly modify the existing ground levels across the site which will ensure that the impact on groundwater will be minimal if not negligible. See Attachment 6 for further detail.
Protection and enhancement of character areas			
O10 Development maximises public access to public recreation areas and conservation areas.	S10.1 None applicable.	Complies with intent of Performance Criteria	The proposed development will not prohibit general public access. Council has been aware of the proposal for use of the land for a greyhound facility and have provided informal consent to proceed with this application (Council Minute contained at Attachment 1).

O11 Development protects and enhances parks and other character areas in the locality.	S11.1 None applicable		<p>The proposed development enhances the existing site by providing a viable use which is in accordance with Council's intent.</p> <p>Future use and development of the site would always be restrained given its former use as a general-purpose tip.</p> <p>The use of the site for Outdoor Entertainment and Restaurant functions are appropriate uses which are suited to the existing site constraints and will enhance the local area by providing a specialised recreational facility which is available to members of the public.</p>
Protection and enhancement of personal health and safety and property			
<p>O12 Development protects and enhances personal health and safety and property by the application of crime prevention through environmental design principles which provides that-</p> <p>(a) a building, a structure or a space can be easily observed by people passing by, living, working or recreating in or nearby to the development through-</p> <p>(i) the avoidance of a blind corner in a pathway, stairwell, hallway and a parking area; and</p> <p>(ii) the provision of an entry to a building which is clearly visible to prevent unwanted access and to assist persons trying to find the building; and</p> <p>(iii) the avoidance of a fence and landscaping which obstructs casual surveillance and allows an intruder to hide; or</p> <p>(iv) the lighting of an entry, service</p>	<p>S12.1 Development being assessable development does not provide-</p> <p>(a) a blind corner involving a change in direction of 75 degrees or greater; and</p> <p>(b) a pathway that is longer than 20 metres; and</p> <p>(c) an entry to or an exit (other than an emergency exit) from a building which is not located at the front of the building; and</p> <p>(d) planting along a pathway or a pedestrian shelter of a tree with a trunk which is not clear to a height of 1.2 metres or with other plants which grow to a height of more than 600mm.</p> <p>S12.2 Development other than for house, caretaker's dwelling, development display and sales, public recreation, group dwelling, dual occupancy, home business,</p>	<p>Complies with Acceptable Solution</p>	<p>Not applicable to the development application.</p> <p>The proposed car parking areas and Facility Building will contain suitable lighting to ensure a safe environment is created between areas car park and other buildings on site.</p> <p>Not applicable to the development application.</p> <p>Detailed landscape design has not been prepared for the site however will be addressed during the submission of an Operational Works application. The applicant does not object to Council including a condition which reflects the aforementioned planting requirements along pathways.</p> <p>Noted.</p>

<p>area, pathway and a parking area which does not produce glare or a dark area; and</p> <p>(v) the provision of security hardware such as a security grille, a shutter and a door which allows for casual surveillance; and</p> <p>(b) access to a building, a structure or a space is restricted through-</p> <p>(i) the clear identification of the building to prevent unintended access and to assist persons trying to find the building; and</p> <p>(ii) the provision of an entry to a building which is not confusing; and</p> <p>(iii) the provision of a fence and landscaping which deters access to the premises and does not allow an intruder to gain access to the premises; and</p> <p>(iv) the provision of security hardware to reduce opportunities for unauthorised access; and</p> <p>(c) a building, a structure or a space-</p> <p>(i) creates a cared for image; and</p> <p>(ii) uses materials which reduce the</p>	<p>animal husbandry, agriculture or forestry provides street numbers with a minimum height of 300mm visible from the road.</p>		
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<p>opportunity for graffiti or vandalism; and</p> <p>(iii) is clearly defined from a public place to express a sense of ownership and to reduce illegitimate use or entry.</p>			
<p>O13 Development protects and enhances personal health and safety and property of the community from-</p> <p>(a) a hazard; and</p> <p>(b) a disaster; and</p> <p>(c) in the case of a residential use, the use of chemicals, gases and other potential contaminants on the premises in quantities that would not be reasonably expected from the residential use</p>	<p>S13.1 Development is not located on premises which is contaminated land.</p>	<p>Complies with the intent of the Performance Criteria</p>	<p>The proposed development is located on site which contains contamination.</p> <p>The Contamination Assessment report (Attachment 4) demonstrates that the proposed use can occur whilst maintaining suitable separation between existing contamination and proposed users of the site.</p>
<p>O14 Development involving the disposal of putrescible waste protects and enhances operational airspace within the Archerfield aviation buffer area from the impacts of wildlife, particularly flying vertebrates.</p>	<p>S14.1 Development involving the disposal of putrescible waste is not located on premises situated within the operational airspace of the Archerfield aviation buffer area⁴³.</p>	<p>Complies with Acceptable Solution</p>	<p>Not applicable to the development application.</p>
<p>O15 Development for-</p> <p>(a) a hospital and associated institutions and local emergency services facilities, has a ground floor level which is above the 0.2% annual exceedance</p>	<p>S15.1 None applicable.</p>	<p>Complies with Acceptable Solution</p>	<p>Not applicable to the development application.</p>

probability (AEP) flood; and (b) strategic community infrastructure not specified in paragraph (a), has a ground floor level which is above the 0.5% annual exceedance probability (AEP) flood.			
O16 Development for strategic community infrastructure is able to function effectively during and immediately after bushfire and landslide events.	S16.1 Development for strategic community infrastructure is located on premises that- (a) is not in the bushfire hazard area; and (b) does not have a slope with a gradient of 15% or greater	Complies with Acceptable Solution	Not applicable to the development application.
Surveillance infrastructure			
O17 Development protects the line of sight of the existing and planned safety camera network.	S17.1 None applicable.	Complies with Acceptable Solution	Not applicable to the development application.
O18 Development is protected from a reverse amenity impact of the operation of a lawful use of other premises which would have an adverse impact on the development.	S18.1 None applicable	Complies with Acceptable Solution	Not applicable to the development application.
O19 Development does not put in jeopardy the continued operation of a lawful use of other premises which is not a lawful non-conforming use.	S19.1 None applicable	Complies with Acceptable Solution	Not applicable to the development application.

<p>O20 Development in respect of a lawful use which is a lawful non-conforming use does not-</p> <p>(a) prolong the life of the operation of the lawful non-conforming use beyond the likely duration of the lawful non-conforming use; and</p> <p>(b) increase the magnitude of the operation of the lawful non-conforming use; and</p> <p>(c) increase any adverse impact of the operation of the lawful non-conforming use.</p>	<p>S20.1 None applicable</p>	<p>Complies with Acceptable Solution</p>	<p>Not applicable to the development application.</p>
<p>Protection of the retail centre hierarchy</p>			
<p>O21 Development for a local service function or a district service function which is not a consistent development in the non urban and conservation locality is developed in the Local Business zone, in the case of a local service function and the District Business zone, in the case of a district service function.</p>	<p>S21.1 None applicable.</p>	<p>Complies with Acceptable Solution</p>	<p>Not applicable to the development application.</p>
<p>O22 Development for a major service function is carried out in the centres locality, other than the Local Business zone and the District Business zone.</p>	<p>S22.1 None applicable</p>	<p>Complies with Acceptable Solution</p>	<p>Not applicable to the development application.</p>

Satisfaction of community and economic need and protection against adverse impacts on existing or planned development providing services or facilities			
O23 Development provides a benefit to and satisfies both a community need and an economic need of the residents of the planning scheme area.	S23.1 None applicable.	Complies with the intent of the Performance Criteria	The proposed development represents a non-residential use which contributes to diversification of Logan City Council's economic base. The closure of Greyhounds Queensland facility at the Gold Coast provides a need for Greyhound racing facilities within the southern areas of the city, generally between Brisbane and the Gold Coast. It is considered that there is an economic and community need for this type of facility.
O24 Development makes good any detriment to the residents of the planning scheme area as a result of existing or planned services or facilities being put in jeopardy by the development due to adverse physical or financial impacts	S24.1 None applicable	Complies with the intent of the Performance Criteria	It is not considered that the proposed development represents a competing commercial use. The proposed use of the site for Greyhound racing is a standalone development which essentially does not compete with other development located adjacent or near to the site.
Consolidation of development			
O25 Development in a zone and any sub-area is limited to development which is consistent development in the zone and sub-area.	S25.1 None applicable	Complies with the intent of the Performance Criteria	Outdoor Entertainment / Restaurant uses are 'code assessable' within this Public open space zone.
O26 Development for a non-residential use which is not consistent development in the zone and sub-area, is to be developed in the centres locality	S26.1 None applicable	Complies with the intent of the Performance Criteria	Not applicable to the development application.
Protection against development of an inconsistent scale form and intensity and which is inconsistent with the reasonable expectations of residents			
O27 Development being- (a) a material change of use or reconfiguring a lot for a residential use has a density which does not exceed the density specified in Section 3.1 (Residential density standards) in	S27.1 None applicable.	Complies with the intent of the Performance Criteria	Not applicable to the development application.

<p>Schedule 3 (Standards); and</p> <p>(b) reconfiguring a lot complies with-</p> <p>(i) the standards in section 2.1 (Reconfiguring a lot standards) in schedule 3 (Standards); and</p> <p>(ii) in the case of the subdivision of land outside the Urban Footprint, the Regulatory Provisions of the South East Queensland Regional Plan.</p>			
<p>O28 Development is consistent with the scale and form of development intended for the zone and sub-area by providing that the development-</p> <p>(a) is of a scale and form which is compatible with the existing and planned buildings or structures in the zone and sub-area having regard to-</p> <p>(i) height, mass and proportion; and</p> <p>(ii) roof form and pitch; and</p> <p>(iii) building materials, patterns, textures and colours and other decorative elements; and</p> <p>(iv) windows and doors; and</p> <p>(v) verandas, towers and eaves; and</p> <p>(vi) fencing, landscaping and entry</p>	<p>S28.1 Development has a site cover which does not exceed the site cover standards specified in section 5.1 (Site cover standards) in Schedule 3 (Standards).</p> <p>S28.2 Development provides a road boundary clearance which meets or exceeds the road boundary clearance standards specified in section 5.2 (Road boundary clearance standards) in schedule 3 (Standards).</p> <p>S28.3 Development provides a side and rear boundary clearance which meets or exceeds the side and rear boundary clearance standards specified in section 5.3 (Side and rear boundary clearance standards) in schedule 3 (Standards).</p>	<p>Complies with the intent of the Performance Criteria</p>	<p>The proposed development has a very low site coverage. The total gross leasable area of the proposed development is 3,203m². Based on the current site area the proposed development represents a site coverage of approximately 14%.</p> <p>The specified road boundary clearance is 20 m. The proposed development complies with this criteria for that part of the site fronting Kingston Road. The proposed facility building is located within 20 m to Compton Road. However given that;</p> <ul style="list-style-type: none"> the site has frontage to two roads; is required to accommodate a significant area of the site to 'racetracks'; and the majority of the Facility Building and other buildings are 'low-levelled' structures which typically does not exceed more than 8.5m above ground level (aside from lookout tower) a portion of the building within a 20 m setback to Compton Road is considered to be an acceptable outcome in this instance. <p>The proposed development complies with side boundary setbacks.</p>

<p>treatments; and</p> <p>(vii) parking, manoeuvring and access areas; and</p> <p>(viii) existing buildings, structures and plants; and</p> <p>(b) is consistent with the scale and form of development as shown on a structure plan map; and</p> <p>(c) is integrated with the physical attributes and topography of the premises, including appropriate provision for access to natural light and ventilation, privacy, drainage and outlook</p>	<p>S28.4</p> <p>Development provides that the height of a building and a structure does not exceed the building height standards specified in section 5.5 (Building height standards) in Schedule 3 (Standards).</p>		<p>Table 5.5 building height standards of Part 5 Design and Siting standards states a maximum building height within the locality of 8.5 m.</p> <p>The majority of development on the site will comply with this maximum height however there is a portion of the Facility Building which will exceed this height limit.</p> <p>Part of the Facility Building will approach 15 m above ground level required for the televising of racing events. This height limit is required so appropriate vision can be obtained of the individual races without obstruction from lower-level structures. The portion of the building and development on the site which exceeds 8.5 m is very minor. The outlook tower is a necessary function of the proposed use and is considered to be an appropriate height in this instance.</p> <p>As previously mentioned throughout this report the site is currently surrounded by non-residential uses. An increase in the maximum height above 8.5 m is not considered to have an adverse impact on surrounding development. The proposed increase in maximum height is integrated with the facility building and does not impact on surrounding development.</p> <p>Lighting proposed for the site will also exceed 8.5m however given the slender nature of the lighting poles they are not considered to be an obtrusive feature of the site.</p>
<p>O29 Development-</p> <p>(a) has an attractive and functional appearance; and</p> <p>(b) is oriented toward the road network and has a safe, efficient and legible vehicular and pedestrian access; and</p> <p>(c) provides a positive frontage with access and parking areas not being a dominant feature of the frontage; and</p> <p>(d) contributes positively to the streetscape and the built form of the zone and sub-area; and</p> <p>(e) provides a positive relationship between the development and adjacent</p>	<p>S29.1 Development for a non-residential use, other than development display and sales, caretaker's dwelling, a rural use and public recreation use, provides that-</p> <p>(a) a building has an unarticulated length of a maximum of 15 metres; and</p> <p>(b) a wall of a building is punctuated by-</p> <p>(i) a roofed veranda or balcony which is a minimum of 3 metres wide and a minimum of 2 metres deep; or</p> <p>(ii) wall offsets which are a</p>	<p>Complies with the intent of the Performance Criteria</p>	<p>The attached plans and elevations (Attachment 2) highlights the intended architectural form of both the Facility Building and Kennel Block. The architectural treatment can be described as a 'modern' with the use of glass and contemporary finishes.</p> <p>The location of buildings within the site has been dictated by the position of the race track as well as other matters such as site lines/ finishing lines and the most appropriate location for car parking areas. It is considered that the proposed buildings have an attractive and functional appearance and located in appropriate positions within the site to ensure an efficient and viable facility.</p> <p>It is not considered that the car parking areas will present as a dominant feature of the streetscape as car parking areas are setback from Kingston Road and are screened by existing vegetation.</p>

<p>public places; and</p> <p>(f) is integrated with existing buildings and is refurbished if it is in respect of an existing building; and</p> <p>(g) provides a cohesive and legible built form; and</p> <p>(h) provides permeability.</p>	<p>minimum depth of 1.2 metres.</p> <p>S29.2</p> <p>Development provides that a building and a structure is-</p> <p>(a) oriented towards the primary frontage; and</p> <p>(b) to face and be visible from a road or other public place that constitutes the focal point of public activity.</p> <p>S29.3</p> <p>Development provides that the exterior of a building and structure does not have reflective material which has-</p> <p>(a) a level of light reflectivity greater than 20%; or</p> <p>(b) a level of heat transmission less than 20%.</p> <p>S29.4</p> <p>Development is not in respect of-</p> <p>(a) a removal building; or</p> <p>(b) a class 10 building where there is no existing lawful use of the</p>		
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	<p>premises; or</p> <p>(c) a container.</p> <p>S29.5</p> <p>Development being building work for a class 10 building-</p> <p>(a) provides that the maximum area of the building is 100m²; and</p> <p>(b) does not exceed the building height standards specified in section 5.5 (Building height standards) in schedule 3 (Standards); and</p> <p>(c) provides that any metal clad wall, door or roof with a pitch in excess of 5 degrees is powder coated.</p>		
<p>O30 Development provides landscaping which protects and enhances the streetscape and the amenity and character of the zone and sub-area.</p>	<p>S30.1 Development provides a landscape area within the area of-</p> <p>(a) the road boundary clearance which meets or exceeds the road boundary clearance standards specified in section 5.2 (Road boundary clearance standards) in schedule 3 (Standards); and</p> <p>(b) the side and rear boundary clearance which meets or exceeds the side and rear boundary clearance standards specified in section 5.3 (Side and rear boundary clearance standards) in schedule 3</p>	<p>Complies with the intent of the Performance Criteria</p>	<p>Existing areas of mature landscaping intended to be retained. New areas of landscaping will be supplied Council through the preparation of an appropriate operational works application.</p>

	(Standards).		
O31 Development adequately screens activities which are carried on outside a building or a structure when viewed from adjoining premises and a public place	S31.1 Development provides for a loading area, a refuse storage area, an outdoor storage area, plant and equipment such as a transformer and a gas bottle and a charity bin, which is visible from a public place or a residential use to be screened from view by a solid structure, landscaping or a feature of the premises.	Complies with the intent of the Performance Criteria	Servicing areas located to the North East of the facility building which is not located within close proximity to any road frontages. The proposed development complies with this criteria.
O32 Development for a residential use, development display and sales and caretakers dwelling which adjoins the centres locality, provides visual and acoustic screening between the main internal and external living areas of the residential use and the adjoining premises to protect the visual and acoustic privacy of residents of the residential use.	S32.1 Development for a residential use, development display and sales and caretakers dwelling which adjoins the centres locality, provides that all habitable rooms have a side and rear boundary clearance which meets or exceeds the side and rear boundary clearance standards specified in section 5.3 (Side and rear boundary clearance standards) in schedule 3 (Standards).	Complies with the intent of the Performance Criteria	Not applicable to the development application.
O33 Development for a non-residential use other than development display and sales, caretakers dwelling and public recreation which adjoins a public recreation area or a conservation area- (a) avoids adverse impacts on the appearance, security, use and environmental and social values of the	S33.1 Development being for a non-residential use other than development display and sales, caretaker's dwelling and public recreation, which adjoins a public recreation area or a conservation area, provides a side and rear boundary clearance which meets or	Complies with the intent of the Performance Criteria	Not applicable to the development application.

public recreation area or the conservation area; and (b) provides for the protection and enhancement of a high quality streetscape along a road with frontage to a public recreation area or a conservation area.	exceeds the side and rear boundary clearance standards specified in Section 5.3 (Side and rear boundary clearance standards) in schedule 3 (Standards).		
<p>O34 Development for a non-residential use other than development display and sales, caretakers dwelling, a rural use and public recreation which adjoins a residential use, development display and sales and caretakers dwelling-</p> <p>(a) reflects the type, form, scale and density of development in the zone and sub-area; and</p> <p>(b) provides a setback and landscaping which are consistent with the existing and planned development in the zone and sub-area; and</p> <p>(c) provides a parking area on the premises that addresses the road and does not adversely impact on adjacent development; and</p> <p>(d) provides noise attenuation and privacy measures to an adjoining residential use.</p>	<p>S34.1 Development for a non-residential use other than development display and sales, caretaker's dwelling, a rural use and public recreation which adjoins a residential use, development display and sales and caretaker's dwelling, provides-</p> <p>(a) a side and rear boundary clearance which meets or exceeds the side and rear boundary clearance standards specified in section 5.3 (Side and rear boundary clearance standards) in schedule 3 (Standards); and</p> <p>(b) a landscape area within the road boundary clearance which meets or exceeds the road boundary clearance standards specified in section 5.2 (Road boundary clearance standards) in schedule 3 (Standards).</p> <p>S34.2 Development for a non-residential</p>	Complies with the intent of the Performance Criteria	Not applicable to the development application

	use other than development display and sales, caretaker's dwelling, a rural use and public recreation which adjoins a residential use, development display and sales and caretaker's dwelling, limits access by a service vehicle to the development to between 7:00am and 6:00pm.		
O35 Development being building work for a private pool protects and enhances the personal health and safety of the persons using the private pool.	<p>S35.1 Development being building work for a private pool provides that no more than 50% of the circumference of the private pool contains a landscape area.</p> <p>S35.2 Development being building work for a private pool is within the line of sight of a dwelling unit or a rooming unit.</p>	Complies with the intent of the Performance Criteria	Not applicable to the development application.
Best practice environmental management			
<p>O36 Development provides that the orientation and form of buildings and the orientation of roads and lots facilitate the construction of energy efficient buildings that respond to local climatic conditions by-</p> <p>(a) maximising solar access to the north in winter; and</p> <p>(b) minimising solar access to the east</p>	S36.1 None applicable.	Complies with the intent of the Performance Criteria	The way in which the proposed development endeavours to ensure best practice environmental management is outlined in the Attached technical reports Numbers 4, 6 & 8.

and west in the summer; and			
(c) maximising access to any prevailing summer breezes; and			
(d) minimising exposure to prevailing winter winds.			

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Table 3.4.36 Specific outcomes and prescribed solutions for the PO5 sub-area of the Public Open Space

Performance Criteria	Acceptable Solution	Complies with Acceptable Solution/ Performance Solution	Applicant Response
Protection and enhancement of amenity and character, protection against development of an inconsistent scale, form and intensity and consolidation of development			
<p>O1 Development of the sub-area which relates to Cronulla Park-</p> <p>(a) protects the integrity of the sub-area as a decommissioned waste facility; and</p> <p>(b) protects the operation of a gas extraction plant on the premises; and</p> <p>(c) provides for a recreation area which predominantly comprises-</p> <p>(i) recreation activities;</p> <p>(ii) small scale community activities being limited to child care centres, community care centre and educational establishment; and</p> <p>(iii) limited commercial uses associated with the recreation activities and community activities; and</p> <p>(d) provides for the development of a key site at the intersection of Kingston Road and Compton Road which predominantly comprises a retail</p>	S1.1 None applicable.	Complies with the intent of the Performance Criteria	<p>The proposed development will protect the integrity of the sub area as outlined in Attachment 4.</p> <p>The existing gas extraction vents which are contained on the site will be retained and/or repositioned to ensure that adequate monitoring of gas levels can be maintained.</p> <p>The proposed development is defined as an Outdoor Entertainment and Restaurant use which is in accordance with code assessable requirements under the scheme. It is acknowledged that Council's current planning for the site includes an area located at the north-western corner identified as a 'Key Site' which is available for non-residential functions such as retail activity or catering. This area of the site is intended to be retained in its current state which does not preclude its future use for development.</p>

<p>activity or a catering activity; and</p> <p>(e) provides for the future use of part of the sub-area along the frontage of Kingston Road or Compton Road as a motel; and</p> <p>(f) provides for the use of part of the sub-area as retail plant nursery and market.</p>			<p>The proposed development has been designed so that the future use of the 'Key Site' may occur in the future. The proposed development does not identify buildings and/or other uses within this area and does not compromise the future development of non-residential functions within this corner of the site subject to future development applications.</p>
<p>O2 Development protects and enhances the role of the sub-area as a recreation area and a key site for commercial uses by ensuring that specific development being-</p> <p>(a) accommodation building is a motel; and</p> <p>(b) food outlet is carried out with, but subordinate to, a recreation activity or is carried out as part of the key site in the sub-area; and</p> <p>(c) restaurant is carried out with, but subordinate to, a recreation activity or is carried out as part of the key site in the sub-area; and</p> <p>(d) shop-</p> <p>(i) is limited to a retail showroom; and</p> <p>(ii) does not exceed a GLA of 2000m²; and</p> <p>(iii) has a frontage to Kingston Road.</p>	<p>S2.1 None applicable.</p>		<p>See above response 01.</p> <p>Complies with performance criteria.</p>

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<p>O3 Development for a key site-</p> <p>(a) has a retail and commercial character; and</p> <p>(b) dominates the streetscape.</p>	<p>S3.1 None applicable.</p>		<p>See above response 01.</p>
<p>O4 Development is consistent with the pattern of development specified on SP Map 1B.</p>	<p>S4.1 None applicable</p>		<p>See above response 01.</p>
<p>O5 Development provides for the protection and enhancement of a high quality streetscape along all roads to which the sub-area has a frontage.</p>	<p>S5.1 None applicable.</p>		<p>See above response 01.</p>
<p>O6 Development is consistent with the scale and form of development intended for the zone and sub-area.</p>	<p>S6.1 Development has a site cover which does not exceed 20% of the sub-area.</p> <p>S6.2 Development provides a road boundary clearance of a minimum width of 3 metres.</p> <p>S6.3 Development provides a side and rear boundary clearance in accordance with the <i>Standard Building Regulation 1993</i>.</p> <p>S6.4 Development provides that a</p>		<p>See above response 01.</p>

	<p>parking area other than an access area is not within the area of the road boundary clearance.</p> <p>S6.5 Development provides a landscape area within the road boundary clearance and the side and rear boundary clearance.</p>		
Provision of a safe, efficient and legible road network and protection of the road hierarchy			
<p>O7 Development provides a safe, efficient, legible and integrated road network which has vehicle connectivity within the PO5 sub-area as specified on SP Map 1C.</p>	<p>S7.1 Development is accessed from an internal road network, with no direct access from the development to Kingston Road.</p>		<p>This requirement endeavours to achieve access to the site from Cronulla court.</p> <p>Discussion of this matter with Council's traffic engineering section has revealed that this requirement was based on an internal Council traffic study undertaken a number of years ago which is now considered to be redundant. Furthermore, the ability to gain access from Cronulla Court through the site is considered to be unviable given the modifications which would be required to ground levels across the eastern surface of the site which would require modification and removal of the contamination capping material.</p> <p>The attached traffic assessment report has reviewed the proposed development's traffic impact on the local road network. Given the geometry of Compton Road it is not considered to be a safe or practicable outcome to gain entrance/ entrance to the site from this frontage.</p> <p>An existing vehicle crossover point is located along Kingston Road and upon investigation of the traffic volumes within Kingston Road it is considered appropriate to gain access to the site for the proposed development from this frontage.</p> <p>Kingston Road is a state-controlled road and preliminary discussions regarding this matter with the Department have occurred. A general acknowledgement that a legal point of access is required suggests that a reasonable approach is to permit access to the site from Kingston Road upon satisfactory investigation.</p> <p>The report concludes that the proposed development can occur at the site and appropriately mitigate any negative traffic impacts.</p>

Table 4.2.9 Specific outcomes and prescribed solutions for the vegetation management area

Protection and enhancement of ecosystems, protection of natural physical processes and protection and enhancement of nature conservation values			
O1 Development protects an of concern regional ecosystem and an endangered regional ecosystem on the premises and adjacent to the premises.	S1.1 None applicable.		See attached vegetation management plan at Attachment 8
O2 Development protects an of concern regional ecosystem and an endangered regional ecosystem on the premises and adjacent to the premises from weed invasion and edge effects.	S2.1 None applicable.		See attached vegetation management plan at Attachment 8
O3 Development provides for a buffer to an of concern regional ecosystem and an endangered regional ecosystem on the premises and adjacent to the premises which will ensure the long term protection and enhancement of the of concern regional ecosystem and the endangered regional ecosystem.	S3.1 None applicable.		See attached vegetation management plan at Attachment 8

Landscaping Code

The landscaping Code contains a number of prescriptive Prescribed Solutions in relation to the provision of landscaped areas. We request that the requirement for the preparation of a landscaping plan generally in accordance with the requirements of the code to be prepared as a condition of a Decision.

5. STATUTORY PLANNING FRAMEWORK

5.1 Referral Agencies

As listed in SPA Regulations 2009 and as identified on the attached Assessment Checklists the proposed development triggers referral to the following agencies;

Agency	Matter and Role	Trigger
Department of Environment and Resource Management (DERM)	Contaminated land - Concurrence	Land listed on the EMR & use of site formerly a Notifiable Activity
Department of Environment and Resource Management (DERM)	Clearing of Native Vegetation - Concurrence	Clearing of Native Vegetation.
Department of Transport and Main Roads	State Controlled Road - Concurrence	IPA Regs Schedule13C& 13D for MCU involving a Sports Facility with a site area more than 5ha.

5.2 Public notification requirements

This application is subject to Code Assessment and therefore no public notification is required for this application.

5.3 Southeast Queensland Regional Plan

The Southeast Queensland Regional plan is the pre-eminent planning instrument for Southeast Queensland. The latest update to the Regional Plan was released in July 2009 and provides a framework to accommodate a substantially increased population within Southeast Queensland until 2031.

The document highlights that an additional 754,000 dwellings will be required to cater for increased population growth in Southeast Queensland.

The strategic directions contained within the regional plan include;

- o Creating A More Sustainable Future;
- o Addressing Climate Change And Oil Supply Vulnerability;
- o Protecting The Regional Landscape;
- o Supporting Rural Production;
- o Accommodating Future Residential Employment Growth;
- o Facilitating Growth In The West;
- o Delivering Smart Growth;
- o Regional Accessibility;
- o Building A Series Of Strong, Identifiable Communities;
- o Providing Infrastructure And Services;
- o Supporting Strong and Healthy Communities.

Applicant Response

The proposed development is in accordance with the strategic directions of the Southeast Queensland Regional Plan by facilitating appropriate infill development within urban areas supporting Smart Growth Strategies by developing an urban framework which includes integration with existing development, opportunities for local employment and environmentally sensitive and healthy neighbourhood design.

5.4 Relevant State Planning policies

There are six (6) current State Planning Policies set out by the Queensland Government, these being:

- SPP 1/92 Development and the Conservation of Agricultural Land
- SPP 1/02 Development in the Vicinity of Certain Airports and Aviation Facilities

The subject site is located within the Logan City Council Archerfield Aviation Buffer area as listed on DA Map 5 policy map.

- SPP 2/02: Planning and Managing Development Involving Acid Sulphate Soils
- SPP 1/03: Mitigating the Adverse Impacts of Flood, Bushfire and Landslide
- SPP 1/07 Housing and Residential Development
- SPP 2/07 Protection of Extractive Resources.

No Planning Policies are relevant to this Development Application.

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6. CONCLUSION

The proposed reuse of the subject site for an Outdoor Entertainment and Restaurant use is defined as a Code assessable development under the Logan City Council planning scheme.

This town planning assessment report including the secondary consultant specialist reports clearly demonstrate that the proposed use can be accommodated at the site while managing site constraints in relation to contamination, traffic management, stormwater management and servicing.

The proposed development will assist with diversifying Logan City Council's local economy by introducing a new sporting facility which will enhance recreational choice for the local community and is considered to be a low impact use considering surrounding and adjacent land uses.

A small portion of the Facility Building and lighting will be above the maximum height for development within the Public Open Space zone however is not considered to adversely impact on surrounding development.

The proposed development should be approved subject to reasonable and relevant conditions.

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7. ATTACHMENTS

Attachment 1 - Relevant IDAS forms and owners consent

Attachment 2 - Architectural plans and Elevations of proposed development

Attachment 3 - Logan City Council Prelodgement Meeting Minutes

Attachment 4 - Contamination Site Investigation

Attachment 5 - Traffic Impact Assessment

Attachment 6 - Infrastructure Servicing Plan and Site Based Stormwater Management Plan

Attachment 7 - Proposed external lighting data sheet

Attachment 8 –Property Vegetation Management plan

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Architectural Plans and Elevations
of Proposed Development

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Logan City Council Prelodgement Meeting Minutes

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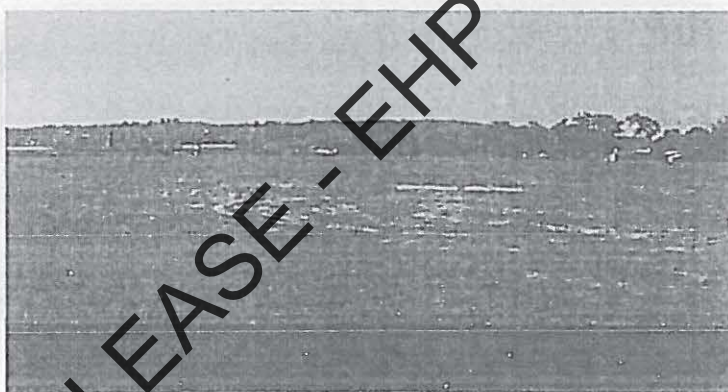


Contamination Site Investigation

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Logan Greyhound Facility



CONTAMINATED SITE INVESTIGATION

- Draft
- March 2010



Logan Greyhound Facility Cronulla Park

CONTAMINATED SITE INVESTIGATION

- Draft
- March 2010

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Appendix F Volatile Gas Sampling

Appendix G QA/QC Data Validation Assessment

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Appendix H Stage 1 Search Data

Appendix I Limitations of Investigation



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1. Introduction

Greyhounds Queensland Limited (GQL) is planning the development of the Logan Greyhound Facility ("the Project") at Cronulla Park, Slacks Creek ("the site"). Cronulla Park was formerly used a landfill ("the Landfill") between the 1970s and 1980s. A plan showing the location of the site is provided in **Figure 1, Appendix A**.

The proposed development includes:

- main facilities building with an open air viewing stand;
- kennel block;
- maintenance shed;
- greyhound racing track;
- car park with 70 spaces;
- trailer park for trainers with 50 spaces; and
- internal access roads with connections to Kingston Road and Compton Road.

Plans of the proposed development are provided in **Appendix B**.

GQL has engaged Sinclair Knight Merz (SKM) to undertake a Contaminated Site Investigation ("the Investigation") of the site. The aims of the Investigation were to establish:

- whether the site in its current condition poses an unacceptable risk to human health and/or the receiving environment; and
- whether remediation will be required to enable the site to be used for a commercial land use (greyhound racing facility), and if so, the required remedial measures.

The primary objectives of the Investigation were:

- to investigate the quality of groundwater entering and exiting the site, and whether the groundwater exiting the site poses an unacceptable risk to the receiving environment;
- to investigate the presence of groundwater underlying the site, and whether the site is likely to pose an unacceptable risk to this aquifer;
- to investigate the risk to human health from the material used in the capping of the site, and the permeability of this material;
- to investigate the concentration of landfill gas in shallow ground deposits on the periphery of the Landfill; and
- to investigate the risk to human health from shallow ground conditions (<0.3 m below ground level or bgl).

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This report provides a summary of the findings of the Investigation and should be read in conjunction with the limitations described in Appendix I.

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2. Background Information

2.1. Site Description

The site comprises 10.24 hectares of Crown Land located at the corner of Compton Road and Kingston Road, Slacks Creek, Queensland. The land is described as Lot 658 on Plan SL12298. Current title records show that the site is held in trust by Logan City Council (LCC), as gazetted on the 25 June 1988. The designated purpose of the site is local government (entertainment and recreation). A copy of the current certificate of title and registered plan is provided in Appendix H.

2.2. Surrounding Land Uses

Light industrial and commercial properties are located on the northern, eastern, and southern boundaries of the site. Kingston Road bounds the western portion of the site, and light industrial and commercial properties are located to the west of Kingston Road.

Land uses within the vicinity of the site with the potential to cause contamination include the following:

- Up-gradient:
 - service station across Kingston Road
 - two car service centres across Kingston Road
 - two car yards and a car rental agency across Kingston Road¹
- Cross-gradient:
 - smash repairs adjacent to the northern boundary
 - two car body repairs workshops adjacent to the southern boundary
 - air conditioning repairs workshop adjacent to the southern boundary
- Down-gradient:
 - exhaust repair workshop
 - panel beater workshop
 - suspension workshop
 - commercial bakery and truck parking facility
 - radiator repair workshop.

¹ These land uses have the potential for petroleum product storage.



2.3. Environmental Management Register

The site is listed on the Environmental Management Register (EMR) for the notifiable activity "Landfill". The Queensland Department of Environment and Resource Management (DERM) has advised that the site is not managed under a Site Management Plan (SMP).

The site is not listed on the Contaminated Land Register (CLR).

A copy of the EMR search result is provided in Appendix H.

2.4. Topography and Drainage

The site and surrounding land slopes in an easterly direction towards Slacks Creek. Surface water discharges to Slacks Creek which is located approximately 320 m east of the site.

The topography and overland flow drainage of the site is shown in Figure 3, Appendix A.

The highest point of the site is approximately 34.5 m Australian Height Datum (AHD) close to Kingston Road and falls to approximately 22.2 m AHD close to the north east corner industrial lots. The average gradients on the site are relatively flat ranging from 0.8 % to 2.0 %. The main form of drainage is a combination of overland sheet flows and open channel flows. The north east corner is steeper than the majority of the site with grades up to a maximum of 12.5 % towards the east.

Several low bunds have been placed across the predominant gradient of the site (in a north-south configuration) which intercept and divert the overland flow towards the north and south into existing open channel drains.

An open channel drain to the south and east separates the site from the adjoining industrial lots. The open channel drain conveys surface runoff from Kingston Road, cross-catchment flows from across Kingston Road, and from several culverts from the south. The open channel eventually discharges into a large open chamber with its invert level (base) well below the level of the open channel base of 20.4 m AHD.

The north eastern portion of the site falls to the north and north east into an earth drain alongside Compton Road and into existing stormwater gully pits along Cronulla Court.

Water quality in Slacks Creek is not monitored by LCC or DERM. The Healthy Waterways initiative of the Queensland Government provides a long-term data set for Logan River (Slacks Creek is a tributary of the Logan River) (South-east Queensland Healthy Waterways Partnership 2007). The overall Waterway Report Card indicates that Logan Catchment is generally in a poor condition. Both nutrient cycling and physico-chemical indicators suggest that there is some level of degradation to the ecosystem, and has resulted in a rating of "D" (South-east Queensland Healthy



Waterways Partnership 2009). This rating has been relatively consistent since monitoring of the Catchment began in 1999, and has been based on high nutrient loading in the Catchment. High nutrient loads have historically been attributed to a range of factors such as urban (residential, commercial, and industrial) and rural land uses, and discharges from sewage treatment plants.

2.5. Regional Geology

The regional geology of the site is described in the Beenleigh area (1:100,000 series) as: alluvium soils, mainly clay, silt and gravel overlaying shale, siltstone and sandstone (with possible coal seams). The regional geology is part of the tertiary Oxley Group, a subset of the early tertiary continental basins of the area (Moreton Regional Geology Map 1980) (CMPS&F Environmental, May 1995. *Preliminary Site Investigation and Management Plan for The Former Compton Road Landfill Site* ("the CMPS&F Report")).

The geology encountered on the site during the investigation is described in **Section 6.1**. A cross-section showing the conceptual geology on the site is provided in **Figure 5, Appendix A**.

2.6. Regional Hydrogeology

A review of the Groundwater Resources Map of Queensland (1987) indicates that regional groundwater yield is hosted in sedimentary strata and is expected to be less than 5 L/sec. The total dissolved solids (TDS) in groundwater is generally within the range of 500-1500 mg/L, and is suitable for domestic applications (e.g. potable water, recreation, irrigation) and stock watering. Further information on groundwater encountered in sedimentary on the site is provided in **Section 6.2**.

Based on topography groundwater flow direction across the site is expected to be northeast towards Slacks Creek.

A search of the DERM groundwater bore records indicates that there are no registered operational bores (groundwater users) in the vicinity of the site. The closest operational registered bore is approximately 0.7 km north of the site (registration number – 134259). This bore is sub-artesian and although registered as a potable water source, notes on the bore card indicate that it supplies water for garden irrigation only. The screened interval of this bore is between 8 m bgl and 30 m bgl.

2.7. Historical Land Use

The CMPS&F Report states that the site was used as a municipal landfill from the 1970s to 1983. This is consistent with historical aerial photography which shows the site in use as a landfill during this time period. Further information regarding the operation and closure of the Landfill is provided in **Section 2.8**.

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Following closure of the Landfill, the site has been used for open space recreational purposes by the general public, such as bike riding, and dog walking. The current configuration of the site does not provide park facilities such as seating, cooking, and playgrounds which would facilitate more frequent recreational use of the site.

Prior to the use of the site as a landfill in the 1970s, the site was vegetated and undeveloped. Further information on the history of the site based on a review of the historical aerial photography is provided in Table 2-1. A copy of the historical aerial photographs reviewed is provided in Appendix H.

■ Table 2-1 Historical Aerial Photography

Year	Site Description
1955	The site is covered in trees and other vegetative cover. A small valley can be seen running to the east toward Slacks Creek. This is presumed to be the tributary aforementioned.
1968	The site is predominantly covered in trees. A dirt track runs west to east across the site, and there is a small clearing present in the middle.
1973	Distinct zones of activity (areas of disturbed land) can be seen across the site, however the nature of activity (e.g. type of waste material being disposed) within each zone cannot be determined. These zones generally align with the known differing disposal areas. There are several buildings visible in the south western corner of the site, consistent with the area used for washdown. There is a heavily vegetated strip to the south and west of the site.
1983	The site is bare soil, with few areas of what appears to be weed and grass growth. A small area of concrete or roofing is present in the south western corner, consistent with the area used for washdown. Tree cover to the south and west of the site has thinned. The date of this photo coincides with the closure of the facility.
1993	The site is grassed, and several dirt access roads pass across the property. No buildings are visible on-site. No vegetative cover exists along the southern border of the site.
1997	The entire surface of the site has been cleared and appears to have been re-capped.
2002	As per the 1993 aerial photography. The general location of access roads has changed across the site.

2.8. Landfill Operation and Closure

The following provides a summary of the operation and closure of the Landfill, and is based on the CMPS&F Report.

2.8.1. Landfill Operation

A tributary of Slacks Creek historically ran through site. Prior to the commencement of the construction of the Landfill, the tributary was diverted around the site in an open drain located on



the southern and eastern boundary of the site. The location of the former tributary is shown as Area 7 in Figure 4, Appendix A.

The Landfill was operated by Albert Shire Council (now LCC), and JJ Richards & Sons Pty Ltd. The Landfill was formed using a method which involved the excavation of trenches, and then the placement and compaction of wastes within each trench. The quantity of waste received at the site is not known. The maximum depth of waste was said to be 4 m in the CMPS&F Report. The Investigation however found the depth of waste to be up to approximately 10 m bgl, and waste has been placed directly over natural ground strata including weathered sandstone, and sandstone (refer to Section 6.1).

Based on the CMPS&F Report it is understood that the construction of the Landfill did not include the installation of a liner, or leachate and landfill gas collection system. This was confirmed during the undertaking of the Investigation.

Waste Acceptance

Based on the CMPS&F Report, wastes which were accepted at the Landfill included:

- domestic waste;
- commercial and light industrial solid waste;
- sanitary solid waste; and
- construction and demolition waste.

The Landfill may have also received asbestos, and hazardous domestic wastes (e.g. paints and pesticides). The Landfill received approximately 2,000 to 3,000 animal carcasses including dogs, cats, cows and horses; these were placed in Area 3 and Area 4 (refer to Figure 4, Appendix A).

Wastes which were not accepted at the Landfill included:

- heavy industrial waste;
- hazardous solid waste;
- medical waste; and
- liquid waste (hazardous and non-hazardous).

Landfill Layout

The layout of the Landfill can be divided into 10 areas based on the type of waste received, and when the areas was utilised. These areas are shown in Figure 4, Appendix A, and are summarised in Table 2-2.



Table 2-2 Landfill Layout

Area No.	Wastes Received	Comments
1	Domestic refuse	Wastes were placed in north-south aligned trenches
2	Domestic refuse	Wastes were placed in east-west aligned trenches
3	Sanitary waste and animal remains	Wastes were placed in east-west aligned trenches
4	Sanitary waste and animal remains	Wastes were placed in small trenches located between existing trees
5	Steel and tyres	None
6	None	None
7	Domestic refuse and light industrial	Historical creek alignment which was filled with wastes
8	None	Workshop and washdown area
9	General waste	None
10	None	None

Other Infrastructure

Infrastructure located at the site which was decommissioned following closure of the Landfill included a sewerage line and sewage holding tank, site buildings, hardstanding, and the washdown area.

2.8.2. Landfill Closure

The Landfill was capped using a clay based soil. After the closure of the Landfill in 1983, Albert Shire Council used the site for the stockpiling of soil and concrete demolition wastes. These wastes were subsequently removed.

In 1991 a new sewerage line was installed at the northern boundary of the site. The installation of the sewer line required trenches to be cut into the northern and southern embankments of the Landfill. It was stated in the CMPS&F Report that geofabric was laid over the trenches to contain exposed waste and act as a drainage medium for leachate collection into the sewerage line.

The CMPS&F Report made a number of recommendations for the retrofitting of the Landfill post closure. Table 2-3 provides a summary of these measures, and whether they were implemented based on discussions with LCC (B. Lee, 2009), and site observations.

Table 2-3 CMPS&F Recommended Landfill Retrofit Measures

CMPS&F Recommendation	Implementation
1. Install a landfill gas venting system	LCC has installed four landfill gas vents. LCC however does not have records on how and when the vents were installed. A review of the aerial photography suggests that they may have been installed between 1997 and 2003.



CMPS&F Recommendation	Implementation
2. Install a leachate collection system to collect leachate seeping from embankments	The CMPS&F Report states that sewer lines installed on the northern boundary of the site included a mechanism to enable the collection of leachate in the line. It is not known whether the system installed is effective; however, seepage from the eastern embankment of the landfill was observed during the Investigation.
3. Install a surface water drainage system to direct rainfall runoff off the surface layer	LCC has installed diversion drains over the surface to assist with the shedding of rainfall runoff off the surface layer. Additional surface material is said to have been placed over the Landfill in 1998 ² however LCC has no records to confirm whether this occurred.
4. Remove the stockpiled soil and concrete demolition waste	LCC has removed the stockpiled material.
5. Remove the remaining landfill infrastructure including hardstanding and a building	LCC has removed the remaining infrastructure.
6. Place additional surface material over the eastern and northern embankment to cover over exposed waste, and vegetate embankments	LCC has placed additional surface material over a majority of the embankments; exposed waste is no longer visible. The embankments have been revegetated.
7. Remove the underground fuel tank located in Area 3	LCC has advised that the tank has been removed, however no record of its removal is available. Verification of this is discussed in Section 9.

2.9. Historical Analytical Data

This section provides a summary of the soil, groundwater and landfill gas data for the site. This includes data collected by CMPS&F in 1995, and data collected by LCC from July 2000 to August 2008.

2.9.1. Soil Data

Six samples of the Landfill surface material were collected by CMPS&F in 1995. The location of the soil samples is shown in Figure 2, Appendix A.

The samples were analysed for metals, asbestos, and organochlorine pesticides. All samples had metal analytes with concentrations which were below the health-based NEPM³ HIL-F guidelines for a commercial/industrial land use. Asbestos and organochlorine pesticides were not detected in any soil samples analysed.

² CPR Group. 2004. Regional Trail Bike Site Survey Site Assessment, Cronulla Park, Kingston Road and Compton Road, Slacks Creek

³ the National Environment Protection (Assessment of Site Contamination) Measure 1999 ("the NEPM")



2.9.2. Groundwater Data

LCC has monitored groundwater quality from three monitoring wells (CR13, CR14 and CR15, "the LCC Wells") since July 2000. The location of the LCC wells is shown in Figure 2, Appendix A. LCC has advised that records of how the wells were installed are not available. The depths of these wells are approximately 4.4, 8.4, and 5.0 m bgl respectively. Based on the location of the wells either on the other side of the drainage channel or within the remnant vegetated area to the west of the site, it is considered likely that the monitoring wells targeted groundwater in the weathered sandstone.

Data has been compared to a combination of the following guidelines:

- Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000, Australian and New Zealand Water Quality Guidelines for Fresh and Marine Waters ("ANZECC Guideline").
- The Netherlands Ministry of Housing, Spatial Planning and Environment's *Circular on target values and intervention values for soil remediation* (2000) ("the Dutch Guidelines") which consider both the risk to human health and the environment;
- The National Health and Medical Research Council (2004) *Australian Drinking Water Guidelines* ("the Australian Drinking Water Guidelines"); and
- *United States Environmental Protection Agency (2009) Region 9 Preliminary Remediation Goals* ("the USEPA guidelines").

A full description of the Human Health Assessment Criteria and Environmental Assessment Criteria adopted in this investigation has been included in Sections 4.3.1 and 4.3.2 respectively.

The following provides a summary of the analytical data for the LCC wells, and a comparison of these with the Human Health Assessment Criteria and Environmental Assessment Criteria. A full tabulation of the analytical results is provided in Appendix D.2.1.



Monitoring Well CR13

Monitoring well CR13 is located down gradient and east of the Landfill. Table 2-4 provides a summary of the groundwater monitoring results for CR13. The analytes copper, lead, zinc, ammonia, total phosphorus, and TPH exceeded the Environmental Assessment Criteria in some of the samples analysed. Ammonia exceeded the Human Health Assessment Criteria in all of the samples analysed. TPH exceeded the Human Health Assessment Criteria in some of the samples analysed.

Table 2-4 CR13 Groundwater Results 2000 to 2008

Analyte	No. of Samples	Minimum Value	Maximum Value	Quartile Range	Average $\pm$ Standard Deviation	Environmental Assessment Criteria	No. of Samples Exceeding Environmental Assessment Criteria	Human Health Assessment Criteria	No. of Samples Exceeding Human Health Assessment Criteria
Inorganics (mg/L)									
pH (pH units)	30	4.82	6.21	5.48 - 5.6	5.47 $\pm$ 0.27	6.5-8.0	-		-
Aluminium	1	0.05	0.05	0.05 - 0.05	n/a $\pm$ n/a		-		-
Iron	30	<0.01	8.3	1.42 - 3	1.84 $\pm$ 1.86		-		-
Copper	6	<0.001	0.012	0.001 - 0.008	0.004 $\pm$ 0.005	0.0025	1	1	-
Manganese	30	0.03	0.08	0.04 - 0.05	0.05 $\pm$ 0.01	3.6	-	0.5	-
Nickel	6	0.003	0.006	0.005 - 0.006	0.005 $\pm$ 0.001	0.017	-	0.1	-
Lead	6	<0.001	0.03	0.001 - 0.002	0.006 $\pm$ 0.012	0.0094	1	0.05	-
Zinc	30	<0.003	0.069	0.01 - 0.015	0.014 $\pm$ 0.013	0.031	2	5	-
Ammonia	30	6.5	39.3	13 - 15.7	13.8 $\pm$ 6.3	2.3	30	0.5	30
Nitrate	30	<0.002	1.9	0.02 - 0.095	0.181 $\pm$ 0.418	17	-	10000	-
Phosphate	17	<0.1	<0.1	n/a	n/a		-		-
Total Phosphorus	6	0.03	1.21	0.4 - 0.7	0.48 $\pm$ 0.46	0.05	5		-
Organics (μg/L)									
TPH (C6-C9)	6	<20	<20		n/a		-		-
TPH (C10-C14)	6	<50	293		131 $\pm$ 95		-		-
TPH (C15-C28)	6	<100	1230		437 $\pm$ 435		-		-
TPH (C29-C36)	6	<50	265		97 $\pm$ 85		-		-
TPH (C10-C36)	6	<220	1788		663 $\pm$ 609	600	3	600	3



Monitoring Well CR14

Monitoring well CR14 is located in the south western corner (up-gradient) of the Landfill. Table 2-5 provides a summary of the groundwater monitoring results for CR14. The analytes copper, nickel, lead, zinc, and total phosphorus exceeded the Environmental Assessment Criteria in some of the samples analysed.

Table 2-5 CR14 Groundwater Results 2000 to 2008

Analyte	No. of Samples	Minimum Value	Maximum Value	Quantile Range	Average $\pm$ Standard Deviation	Environmental Assessment Criteria	No. of Samples Exceeding Environmental Assessment Criteria	Human Health Assessment Criteria	No. of Samples Exceeding Human Health Assessment Criteria
Inorganics (mg/L)									
pH (pH units)	28	3.35	6.86	4.44 - 4.73	4.54 $\pm$ 0.65	6.5-8.0	-	-	-
Aluminium	1	0.08	0.08	0.08 - 0.08	n/a $\pm$ n/a	-	-	-	-
Iron	28	<0.002	41	0.071 - 0.133	1.59 $\pm$ 7.726	-	-	-	-
Copper	6	0.003	0.089	0.008 - 0.015	0.021 $\pm$ 0.009	0.0025	6	1	-
Manganese	28	<0.003	0.21	0.026 - 0.031	0.034 $\pm$ 0.036	3.6	-	0.5	-
Nickel	6	0.002	0.027	0.003 - 0.004	0.007 $\pm$ 0.001	0.017	1	0.1	-
Lead	6	<0.001	0.017	0.001 - 0.001	0.004 $\pm$ 0.007	0.0094	1	0.05	-
Zinc	28	<0.003	0.031	0.011 - 0.019	0.013 $\pm$ 0.007	0.031	1	5	-
Ammonia	28	<0.01	0.12	0.1 - 0.1	0.07 $\pm$ 0.04	2.3	-	0.5	-
Nitrate	28	<0.004	0.06	0.02 - 0.033	0.029 $\pm$ 0.024	17	-	10000	-
Phosphate	15	<0.1	<0.1	n/a	n/a	-	-	-	-
Total Phosphorus	6	0.28	1.02	0.6 - 0.83	0.62 $\pm$ 0.29	0.05	6	-	-
Organics (μg/L)									
TPH (C6-C9)	6	<20	<20	-	n/a	-	-	-	-
TPH (C10-C14)	6	<50	<50	-	n/a	-	-	-	-
TPH (C15-C28)	6	<100	105	-	101 $\pm$ 2	-	-	-	-
TPH (C29-C36)	6	<20	55	-	46 $\pm$ 13	-	-	-	-
TPH (C10-C36)	6	<160	160	-	210 $\pm$ 24	600	-	600	-



Monitoring Well CR15

Monitoring well CR15 is located along the southern boundary of the Landfill. Table 2-6 provides a summary of the groundwater monitoring results for CR15. Total phosphorus exceeded the Environmental Assessment Criteria in some of the samples analysed. Ammonia exceeded the Human Health Assessment Criteria in the majority of the samples analysed.

Table 2-6 CR15 Groundwater Results 2000 – 2008

Analyte	No. of Samples	Minimum Value	Maximum Value	Quartile Range	Average $\pm$ Standard Deviation	Environmental Assessment Criteria	No. of Samples Exceeding Environmental Assessment Criteria	Human Health Assessment Criteria	No. of Samples Exceeding Human Health Assessment Criteria
Inorganics (mg/L)									
pH (pH units)	28	5.31	6.77	5.92 - 6.13	5.97 $\pm$ 0.36	6.5-8.0	-	-	-
Aluminium	1	0.2	0.2	0.2 - 0.2	n/a $\pm$ n/a	-	-	-	-
Iron	28	<0.02	78	9.3 - 14	10.99 $\pm$ 14.55	-	-	-	-
Copper	4	<0.001	0.001	0.001 - 0.003	n/a $\pm$ n/a	0.0025	-	1	-
Manganese	28	0.022	0.08	0.039 - 0.045	0.039 $\pm$ 0.011	3.6	-	0.5	-
Nickel	4	<0.001	0.009	0.002 - 0.004	n/a $\pm$ n/a	0.017	-	0.1	-
Lead	4	<0.001	0.002	0.001 - 0.001	n/a $\pm$ n/a	0.0094	-	0.05	-
Zinc	28	<0.001	0.025	0.007 - 0.01	0.007 $\pm$ 0.005	0.031	-	5	-
Ammonia	28	0.06	0.8	0.6 - 0.7	0.58 $\pm$ 0.16	2.3	-	0.5	23
Nitrate	28	<0.01	0.16	0.02 - 0.03	0.03 $\pm$ 0.03	17	-	10000	-
Total Phosphorus	4	<0.01	0.7	0.18 - 0.31	n/a $\pm$ n/a	0.05	3	-	-
Organics (μg/L)									
TPH (C6-C9)	4	<20	<20	-	n/a	-	-	-	-
TPH (C10-C14)	4	<50	89	-	n/a $\pm$ n/a	-	-	-	-
TPH (C15-C28)	4	<100	165	-	n/a $\pm$ n/a	-	-	-	-
TPH (C29-C36)	4	<100	99	-	n/a $\pm$ n/a	-	-	-	-
TPH (C10-C36)	4	<55	353	-	n/a $\pm$ n/a	600	-	600	-

Summary of Groundwater Data

pH

Although there was some variation in pH between July 2000 and August 2008 (particularly in CR14), the overall change in pH has been small in all three wells (-0.08 in CR13, -0.3 in CR14 and +0.34 in CR15). All wells consistently reported pH levels which were mildly acidic and below the Environmental Assessment Criteria range of 6.5 to 8.0.



Metals

The concentration of zinc exceeded the Environmental Assessment Criteria of 0.008 mg/L in samples from all three groundwater monitoring wells. There are generally no trends in zinc concentration over time.

Copper exceeded the Environmental Assessment Criteria in all samples from CR14. The concentration of copper in samples from CR13 and CR15 were generally below the LOR and/or the Environmental Assessment Criteria.

In general no other metals analytes regularly exceeded the Environmental Assessment Criteria.

Ammonia

Ammonia concentrations were reported above the Environmental Assessment Criteria of 2.3 mg/L in CR13 (down-gradient of the Landfill). The concentrations of ammonia in CR13 were consistently higher than the samples from CR14 and CR15. The monitoring data indicates that the concentration of ammonia in CR13 has decreased over time, from 39.9 mg/L in October 2000 to 12 mg/L in August 2008.

Ammonia concentrations exceeded the Human Health Assessment Criteria (0.01 mg/L) in all of the samples from CR13 and CR15, and approximately half the samples in CR14.

Nitrate

Nitrate concentrations were below the Environmental Assessment Criteria in all samples from CR13, CR14, and CR15. Although variable over time, higher concentrations of nitrate have generally been found in the samples from CR13 in comparison to the other groundwater samples.

Total Phosphorus and Phosphate

The majority of samples analysed from CR13, CR14, and CR15 had concentrations of total phosphorus which exceeded the Environmental Assessment Criteria in monitoring events in 2002. Total phosphorus has not been monitored since 2002. Phosphate was included in the monitoring program from 2004-2008 and was found to be below laboratory detection limits in all monitoring wells.

Total Petroleum Hydrocarbons (TPH)

TPH was included in the monitoring program from July 2000 to January 2002. During this time period TPH was reported in the samples from CR13 at concentrations which exceeded the Environmental Assessment Criteria (600 µg/L). TPH was detected in some of the samples from CR14 and CR15 with concentrations which were below the Environmental Assessment Criteria.

Additional testing to confirm the nature or species of the hydrocarbons was not undertaken as part of the LCC monitoring program. However it should be noted that the TPH measured may be

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comprised of non-polar based organic substances present in landfill leachate which were being generated through the decomposition of putrescible waste materials rather petroleum products, for reasons outlined in Section 7.2.3.

2.9.3. Groundwater Levels

Groundwater levels were monitored in 2003 and 2004. Based on this data the inferred groundwater flow direction is to the north east towards Slacks Creek.

2.9.4. Landfill Gas Data

A landfill gas assessment was undertaken by CMPS&F in 1998. The investigation included the sampling and analysis of landfill gas from the monitoring wells G1, G2, G3, G5, G6, G7 and GW3. The CMPS&F Report indicates that these wells were constructed to allow gas monitoring, and included measures such as appropriately screened intervals and specialised free-venting well caps. The gas assessment detected elevated concentrations of methane from monitoring wells within the Landfill with concentrations which exceeded the lower explosive limit (LEL) for methane (5%⁴). However the concentrations of methane in the monitoring wells located around the boundary of the Landfill were below the LEL.

LCC has monitored landfill gas concentrations from monitoring wells located around the boundary of the site since July 2000. The monitoring wells which have been monitored include GW1, G2, G3, CR13, CR14 and CR15. The location of the monitoring wells is show in **Figure 2, Appendix A**. Since monitoring commenced in July 2000, the concentrations of methane in all boundary monitoring wells have been found to be less than the LEL.

The monitoring data is summarised in **Appendix D.3.1**.

⁴ ERA 75 – Waste Disposal, Landfill siting, design, operation and rehabilitation.



3. Conceptual Site Model

3.1. Contaminants of Concern

Based on the site history described in Section 2.8 and previous investigations of the site (refer to Section 2.9), potential contaminants of concern include the following:

- A broad range of metals (including arsenic, cadmium, chromium, nickel, lead, and zinc) associated with a range of materials potentially disposed at the site.
- Ammonia and other landfill leachate products formed during the decomposition of organic materials (e.g. fatty acids).
- Organochlorine/organophosphate pesticides (OCP/OPP) discarded as agricultural wastes.
- Volatile or semi-volatile organic compounds (VOCs/SVOCs), including polycyclic aromatic hydrocarbons (PAHs), associated with the disposal of lubricants, paints, oils and fumigants; and the burning of various wastes.
- Total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene and xylenes (BTEX compounds) associated with the disposal of fuels, lubricants and oils.
- Polychlorinated biphenyls (PCBs) associated with transformers, refrigerants and fluorescent lighting.
- Asbestos containing materials (ACM) such as fibrous sheeting.

3.2. Potential Pathways

Potential pathways for which contamination may cause a risk to specific receptors include:

- Human health:
 - inhalation of soil through dust;
 - ingestion of soil through handling;
 - dermal absorption from soils through handling; and
 - inhalation of vapours and landfill gases.
- Environmental:
 - migration of potential contaminants in surface water runoff; and
 - migration of potential contaminants in groundwater.

3.3. Receptors

The current potential on and off-site receptors include:

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- On-site:
 - members of the public; and
 - future users of the site (including construction workers, staff, and patrons).
- Off-site:
 - down gradient properties;
 - groundwater which is expected to provide to provide a base flow to Slacks Creek; and
 - surface water (Slacks Creek).

Slacks Creek is a highly disturbed system which has been heavily modified from its natural state. Slacks Creek is not a recreational water body or used as a source of potable water.

Groundwater within the region is generally not used as a potable resource. The closest operational registered bore is approximately 0.7 km to the north of the site. This bore is sub-artesian and although registered as a potable water source, notes on the bore card indicate that it supplies water for garden irrigation only.

3.4. Potential Pollutant Linkages

Table 3-1 provides a summary of the potential source-pathway-receptor (pollutant) linkages with respect to human health.

■ Table 3-1 Potential Pollutant Linkages With Respect to Human Health

Source	Pathways	Receptors
Potential contaminants in soil, landfill leachate	Ingestion of soil through handling	1) Members of the public accessing the site
	Dermal absorption through skin through handling	2) Future site workers
	Inhalation of airborne dust and vapours, and build up landfill gases in confined spaces	3) Users of down gradient Properties

Table 3-2 provides a summary of the potential source-pathway-receptor (pollutant) linkages with respect to the environment.



Table 3-2 Potential Pollutant Linkages With Respect to the Environment

Source	Pathways	Receptors
Potential contaminants in soil	Migration of landfill leachate to shallow groundwater and Slacks Creek	1) Surface Water
	Migration of potential contaminants as sediment in rainfall runoff	2) Shallow Groundwater

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4. Regulatory Framework

This Section highlights the key elements employed from the relevant regulatory framework in preparing and implementing the investigation methodologies, assessing the data gathered and recommending remediation / management approaches.

4.1. Commonwealth Legislation

4.1.1. National Environmental Protection Measure

The National Environment Protection Council, in co-operation with environmental health agencies, prepared national guidelines for contaminated land matters in the National Environment Protection (Assessment of Site Contamination) Measure 1999 ("the NEPM").

The purpose of the NEPM is to establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices by the community which includes regulators, site assessors, contaminated land auditors, land owners, developers and industry.

The NEPM contains two schedules:

- Schedule A which identifies the recommended process for the Assessment of Site Contamination, indicating guiding principles to be applied to preliminary and detailed site investigations; and
- Schedule B which comprises 10 general guidelines for the Assessment of Site Contamination, including outlines for assessment criteria, field activities and health and ecological risk assessments.

The key element applicable from the NEPM is the nomination of investigation levels (HILs) for contaminant concentrations above which potential health or environmental risks may occur and require further investigation. The HILs adopted for the investigation are discussed further in Section 4.3.

4.2. State Legislation

4.2.1. Environmental Protection Act 1994

In Queensland, the Environmental Protection Agency (EPA) administers the *Environmental Protection Act 1994* (EP Act). The EP Act's emphasis is on managing Queensland's environment within the principles of ecologically sustainable development. Chapter 7, Part 8 of the EP Act details matters relating to the investigation and management of contaminated land. Further, current



Queensland guidelines for contaminated land include the *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland* (DoE, 1998) ("the Draft Guidelines").

The key elements applicable from the EP Act and the Draft Guidelines include:

- Environmental Management Register (EMR): land that has been or is being used for a Notifiable Activity or has been contaminated by a hazardous contaminant, and about which the EPA is notified, is recorded on the EMR. Sites recorded on the EMR pose a potential risk to human health and the environment under the current land use. Entry on the EMR does not mean the land must be cleaned up or that the current land use must cease.
- Disposal Permit: Section 424 of the EP Act states that a Disposal Permit must be obtained for soil that is contaminated and originates at a site listed on the EMR prior to removal of that soil from the subject site. If the chosen remediation option includes the removal of contaminated soil from the subject site to an EPA-licensed landfill, then appropriate sampling and analysis results must be forwarded to the EPA, together with supporting documentation and the appropriate application form, to obtain a Disposal Permit. In the case where the subject site is not listed on the EMR, the EPA may exercise its discretion to issue an 'approval letter' or similar document to acknowledge that the appropriate contaminated soil management approach is being taken in the soil removal.

4.2.2. Environmental Relevant Activity Guidelines (ERA)

Regulations governing aspects of proposed, operational and decommissioned landfills (incorporating landfills) are outlined in the *Old EPA Guidelines ERA 75 (Waste Disposal) – Landfill Siting, Design, Operation and Rehabilitation* (ERA 75). The Guidelines are designed to create a unified approach to landfill management in Queensland.

Specific to this Project, relevant stipulations on the management and rehabilitation of landfills have been discussed below.

- Landfill Gas Criteria: The guideline defines a Lower Explosive Limit (LEL) of 5% and Upper Explosive Limit (UEL) of 15% for methane based on safety requirements.
- Site Management Plan (SMP): The ERA 75 outlines triggers for long-term management of decommissioned landfills through an SMP (pursuant to Chapter 7, Part 8, Division 5 of the EP Act). This also includes future land use planning and ongoing environmental monitoring constraints.



4.2.3. Waste Regulations

The *Environmental Protection (Waste Management) Policy 2000* and the *Environmental Protection (Waste Management) Regulation 2000* clarify waste management practices in Queensland and provide improved environmental safeguards. Developed in conjunction with local government and industry, the legislation benefits Queensland communities through safer disposal practices and cost savings from improved planning and management of waste services.

In relation to the identification and evaluation of remediation options for this Project, the key elements considered from this legislation are:

- The waste management hierarchy of reduce, reuse, recycle also applies to contaminated land management, the management options (in order of decreasing preference) being:
 - Treatment of contaminated soil on-site, followed by on-site reuse;
 - Management of contaminated soil on-site with appropriate mitigation measures to protect human health and the environment;
 - Off-site treatment; and
 - Off-site disposal.
- The setting of Waste Acceptance Criteria specific to individual landfill sites and differentiation between contaminated soil and regulated wastes.

4.3. Assessment Criteria

4.3.1. Risk to Human Health

Potential Contaminants in Soils

The HILs in *National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999* ("the NEPM") 'HIL-F for Commercial/Industrial Land' have been adopted as the assessment criteria ("the Human Health Assessment Criteria") for the Investigation. These guidelines are considered appropriate on the basis that the proposed use of the site is commercial.

The soil Human Health Assessment Criteria adopted for the Investigation are summarised in Table 4-1.

■ Table 4-1 Human Health Assessment Criteria (Soil)

Analyte	Assessment Criteria (mg/kg)	Assessment Criteria Source
Lead	1500	NEPM HIL-F
Arsenic	500	
Cadmium	100	
Chromium (III+VI)	500	

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Analyte	Assessment Criteria (mg/kg)	Assessment Criteria Source
Copper	5000	
Mercury	75	
Nickel	3000	
Zinc	35000	

Potential Contaminants in Groundwater

As discussed in Section 2.6 there are no registered operational bores (groundwater users) in the vicinity of the site. This is likely to be due to the low yield of groundwater, which occurs in the vicinity of the site and the presence of other reliable and higher quality water sources (i.e. reticulated water). The nearest registered bore is located 700 m north of the site and north of Slacks Creek. Accordingly the site would not influence groundwater at the location of this bore.

Groundwater is not planned to be used on the site post development (e.g. for irrigation) due to the low yield and presence of landfill leachate (refer to Section 8.2). Whilst the majority of leachate from the landfill is discharged into groundwater via sub-surface flow, a small portion of leachate from the landfill seeps from the eastern embankment into the drain. Post development access to the eastern embankment will be controlled by fencing and is not expected to be accessed by human receptors (e.g. for recreational use).

Landfill leachate from the site discharges to Slacks Creek located 320 m east of the site via seepages into the drain, and groundwater migration. Parts of Slacks Creek down-gradient of the site are within parks and accessible by the public for recreational purposes. Accordingly the analytical results have been compared to the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000, *Australian and New Zealand Water Quality Guidelines for Fresh and Marine Waters* ("ANZECC Guideline") for secondary contact recreational use.

A number of potential contaminants were detected for which there is no ANZECC Guideline. In the absence of an ANZECC Guideline in order of decreasing preference the following Assessment Criteria have been applied.

- The Netherlands Ministry of Housing, Spatial Planning and Environment's *Circular on target values and intervention values for soil remediation* (2000) ("the Dutch Guidelines") which consider both the risk to human health and the environment;
- The National Health and Medical Research Council (2004) *Australian Drinking Water Guidelines* ("the Australian Drinking Water Guidelines"); and



- United States Environmental Protection Agency (2009) Region 9 Preliminary Remediation Goals ("the USEPA guidelines")

In summary, the Human Health Assessment Criteria adopted for this Investigation and their source are summarised in Table 4-4.

Table 4-2 Human Health Assessment Criteria (Water)

Analyte (µg/L unless stated)	Assessment Criteria	Assessment Criteria Source
Ammonia as N (mg/L)	0.5	Australian Drinking Water Guidelines 2004
Arsenic (mg/L)	0.05	ANZECC 2000 Recreational Water Quality
Cadmium (mg/L)	0.005	ANZECC 2000 Recreational Water Quality
Chromium (mg/L)	0.05	ANZECC 2000 Recreational Water Quality
Copper (mg/L)	1	ANZECC 2000 Recreational Water Quality
Lead (mg/L)	0.05	ANZECC 2000 Recreational Water Quality
Nickel (mg/L)	0.1	ANZECC 2000 Recreational Water Quality
Zinc (mg/L)	5	ANZECC 2000 Recreational Water Quality
TPH C10-C40	600	Dutch Guidelines
Benzene	10	ANZECC 2000 Recreational Water Quality
Toluene	1000	Dutch Guidelines
Ethylbenzene	150	Australian Drinking Water Guidelines 2004
meta- & para-Xylene	200	USEPA 2009 Region 9 Tap Water
ortho-Xylene	400	USEPA 2009 Region 9 Tap Water
Isopropylbenzene	150	Dutch Guidelines (aromatic solvents)
n-Propylbenzene	150	Dutch Guidelines (aromatic solvents)
1,2,4-Trimethylbenzene	15	USEPA 2009 Region 9 Tap Water
p-Isopropylbenzene	-	-
Dichlorodifluoromethane	390	USEPA 2009 Region 9 Tap Water
Chlorobenzene	300	Australian Drinking Water Guidelines 2004
1,4-Dichlorobenzene	40	Australian Drinking Water Guidelines 2004
1,2-Dichlorobenzene	1500	Australian Drinking Water Guidelines 2004
Naphthalene	70	Dutch Guidelines
Phenanthrene	-	-
2-Methylphenol	200	Dutch Guidelines (Cresols)
3- & 4-Methylphenol	200	Dutch Guidelines (Cresols)
2,4-Dimethylphenol	730	USEPA 2009 Region 9 Tap Water
2,4-Dichlorophenol	200	Australian Drinking Water Guidelines 2004
4-Chloro-3-methylphenol	350	Dutch Guidelines
2,4,5-Trichlorophenol	1	ANZECC 2000 Recreational Water Quality



Landfill Gases

Volatile organic gas data has been compared to the *National Occupational Health and Safety Commission (NOHSC) 1995, Exposure Standards for Atmospheric Contaminants in the Occupational Environment* ("the NOHSC Guidelines"). Guideline values provide both a time weighted average (TWA) and short-term exposure limit (STEL) for human exposure to ambient gas concentrations within an enclosed building or space, assuming a standard workplace scenario.

The NOHSC Guidelines do not include methane which is a volatile gas produced during the degradation of putrescible wastes in landfills. Methane is an asphyxiant and is highly flammable. As an asphyxiant in an unventilated enclosed space, methane at 7 % concentration can displace normal air and reduce oxygen concentrations to levels below the US Occupational Safety & Health Administration (OSHA) allowable level (19.5 % O₂) (Doyle, 2001). At 5 % concentration in air (the LEL, refer to Section 4.2.2) methane is flammable. Accordingly a Human Health Assessment Criteria of 5 % concentration of methane in air has been used on the basis that it considers both safety (LEL) and health (asphyxiant) concerns.

The NOHSC Guidelines are summarised in Table 4-3.

■ Table 4-3 NOHSC Guidelines

Analyte	NOHSC Guideline	
	TWA (mg/m ³)	STEL (mg/m ³)
n-pentane	1770	2210
n-hexane	178	-
cyclohexane	1035	-
methylcyclohexane	1610	-
n-heptane	1640	2050
n-octane	1400	1750
n-nonane	1050	-
chlorobenzene	46	-
benzene	16	-
ethylbenzene	434	543
1,2,3-trimethylbenzene	123	-
1,2,4-trimethylbenzene		
1,3,5-trimethylbenzene		
p/m-xylene	350	655
o-xylene		
acetone	1185	2375



4.3.2. Risk to the Environment

Potential Contaminants in Soils

Soil guidelines for the protection of ecological health, such as the NEPM ecological-based investigation levels (EILs) are not recommended for application at this site on the basis that the ecological sensitivity of the site is considered to be low (i.e. the site does not support ecosystems with high ecological value), and the site in its current condition does not appear to be impairing plant growth. It should also be noted that the NEPM acknowledges in Schedule B(1) Section 3.2 that the EILs for an urban setting *"have not been derived to protect nominated ecological values and are somewhat arbitrary"*. For these reasons the use of the EILs is not recommended. It should be noted that the CSIRO is currently working on a methodology to give more scientifically robust and ecologically relevant EILs⁵.

Potential Contaminants in Groundwater

A qualitative assessment of groundwater receptors at the site indicates that the nearest receiving water body is Slacks Creek. As Slacks Creek is a freshwater system, the appropriate primary screening criteria are the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000, *Australian and New Zealand Water Quality Guidelines for Fresh and Marine Waters* ("ANZECC Guideline").

On the basis that the current ecological condition of Slacks Creek is a highly disturbed and heavily modified system, the 80% trigger value for freshwater ecosystems has been used.

A number of potential contaminants were detected for which there is no ANZECC Guideline. In the absence of an ANZECC Guideline, the following Assessment Criteria have been applied.

- *United States Environmental Protection Agency (2004) Region 9 Preliminary Remediation Goals* ("the USEPA Guidelines"); and
- the Dutch Guidelines.

The Dutch Guideline for hydrocarbon in groundwater has been derived for mineral-based (petroleum) hydrocarbons. The guideline value was used to compare samples of Total Petroleum Hydrocarbons (TPH) where the source of the hydrocarbons was petroleum based. This applied to TPH analytes which had been prepared using a silica gel clean-up to remove interference from polar organics⁶.

⁵ CSIRO, 2008, *Draft Proposal for an Australian Methodology to Derive Ecological Investigation Levels in Contaminated Soils*. Report 18/08

⁶ Polar organics such as lipids, proteins, sugars etc. are removed by running the sample extract over a charged



It should be noted that the NEPM includes Groundwater Investigation Levels (GILs) for freshwater ecosystems. These however are based on the *Australian Water Quality Guidelines for Fresh and Marine Waters* (ANZECC, 1992) for the protection of freshwater ecosystems which have now been withdrawn. Accordingly the NEPM GILs have not been used.

The extraction of groundwater for use (e.g. irrigation) is considered unlikely for reasons outlined in Section 4.3.1). Accordingly ecological risks associated with extractive uses are considered to be low and do not require further consideration.

In summary, the Environmental Assessment Criteria adopted for this Investigation and their source are summarised in Table 4-4.

Table 4-4 Environmental Assessment Criteria

Analyte (µg/L unless stated)	Assessment Criteria	Assessment Criteria Source
Ammonia as N (mg/L)	2.3	ANZECC 2000 Freshwater Ecosystems (80%)
Arsenic (mg/L)	0.36	ANZECC 2000 Freshwater Ecosystems (80%)
Cadmium (mg/L)	0.0008	ANZECC 2000 Freshwater Ecosystems (80%)
Chromium (mg/L)	0.04	ANZECC 2000 Freshwater Ecosystems (80%)
Copper (mg/L)	0.0025	ANZECC 2000 Freshwater Ecosystems (80%)
Lead (mg/L)	0.0094	ANZECC 2000 Freshwater Ecosystems (80%)
Nickel (mg/L)	0.017	ANZECC 2000 Freshwater Ecosystems (80%)
Zinc (mg/L)	0.034	ANZECC 2000 Freshwater Ecosystems (80%)
TPH C10-C40	600	Dutch Guidelines
Benzene	2000	ANZECC 2000 Freshwater Ecosystems (80%)
Toluene	180	ANZECC 2000 Trigger Value for Freshwater Slightly-Moderately Disturbed Systems
Ethylbenzene	80	ANZECC 2000 Trigger Value for Freshwater Slightly-Moderately Disturbed Systems
meta- & para-Xylene	340	ANZECC 2000 Freshwater Ecosystems (80%)
ortho-Xylene	640	ANZECC 2000 Freshwater Ecosystems (80%)
Isopropylbenzene	30	ANZECC 2000 Trigger Value for Freshwater Slightly-Moderately Disturbed Systems
n-Propylbenzene	128	USEPA Ecological Risk Assessment Freshwater Screening Benchmarks
1,2,4-Trimethylbenzene	33	USEPA Ecological Risk Assessment Freshwater Screening Benchmarks
p-Isopropyltoluene	85	USEPA Ecological Risk Assessment Freshwater Screening Benchmarks
Dichlorodifluoromethane	390	USEPA 2009 Region 9 Tap Water
Chlorobenzene	55	ANZECC 2000 Trigger Value for Freshwater Slightly-Moderately Disturbed Systems
1,4-Dichlorobenzene	60	ANZECC 2000 Trigger Value for Freshwater Slightly-Moderately Disturbed Systems
1,2-Dichlorobenzene	160	ANZECC 2000 Trigger Value for Freshwater Slightly-Moderately Disturbed Systems
Naphthalene	85	ANZECC 2000 Freshwater Ecosystems (80%)

silica gel. Non-polar petroleum components then remain in the sample extract for analysis.

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Analyte (µg/L unless stated)	Assessment Criteria	Assessment Criteria Source
Phenanthrene	2	ANZECC 2000 Trigger Value Freshwater/Marine (95% protection)
2-Methylphenol	13	USEPA Ecological Risk Assessment Freshwater Screening Benchmarks
3- & 4-Methylphenol	543	USEPA Ecological Risk Assessment Freshwater Screening Benchmarks
2,4-Dimethylphenol	2	ANZECC 2000 Trigger Value Freshwater/Marine (95% protection)
2,4-Dichlorophenol	120	ANZECC 2000 Trigger Value for Freshwater Slightly-Moderately Disturbed Systems
4-Chloro-3-methylphenol	350	Dutch Guidelines
2,4,5-Trichlorophenol	0.5	ANZECC 2000 Trigger Value for Freshwater Slightly-Moderately Disturbed Systems

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5. Investigation Methodology

5.1. Scope of Investigation

The scope of the Investigation comprised:

- 1) a site inspection.
- 2) the review of historical aerial photography obtained from the Department of Environment and Resource Management (DERM).
- 3) the review data provided by Logan City Council (LCC) including:
 - CMPS&F Environmental, May 1995. *Preliminary Site Investigation and Management Plan for The Former Compton Road Landfill Site*. Prepared for the Logan City Council ("the CMPS&F Report").
 - groundwater and landfill gas monitoring data from July 2000 to August 2008 ("LCC Environmental Data") including an assessment of historical groundwater trends within three previously installed monitoring wells ("the LCC wells").
- 4) the undertaking of a groundwater monitoring event from monitoring wells present at the site, and the collection of a water sample from the drain exiting the site.
- 5) the preparation of a Sampling and Analysis Plan (SAP) based on the findings of 1) to 3) above for the undertaking of further intrusive ground investigation to establish whether the site in its current condition poses an unacceptable risk to human health and/or the receiving environment.
- 6) the undertaking of the intrusive ground investigation which comprised:
 - a review of the "Dial Before You Dig Records" of the site and confirmation of service locations by a Telstra Accredited Underground Service Locator;
 - the installation and development of nine groundwater monitoring wells around the periphery of the site, including:
 - a total of five combined shallow groundwater/landfill gas wells intersecting the perched leachate water ("the perched wells") within materials contained within the Landfill ("the waste material").
 - A total of four deeper groundwater wells intersecting the natural groundwater table below the Landfill ("the groundwater wells").
 - the excavation of ten shallow test pits within the surface material and sampling of shallow surface soils for contamination testing at a National Association of Testing Laboratories (NATA) Accredited Laboratory;
 - the undertaking of four Talsma-Hallam Permeameter (permeability) tests from four of the shallow test pits.

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- 7) the undertaking of two rounds of landfill gas and groundwater monitoring comprising:
 - landfill gas monitoring from the perched wells and the Landfill vents; and
 - groundwater monitoring and sampling from the four groundwater wells and five perched wells (collectively referred to as "the monitoring wells") and from the discharge point of the drainage channel and the testing of the samples collected at a NATA Accredited Laboratory.
- 8) the preparation of an Interim Report on the findings of the intrusive ground investigation following completion of the two monitoring rounds referred to in 7) above.
- 9) the undertaking of a further four rounds of landfill gas monitoring and two rounds of groundwater monitoring comprising:
 - landfill gas monitoring from the perched wells and the Landfill vents; and
 - one round of volatile gas sampling from the perched wells by SIMTARS, and the testing of the samples collected for a range of volatile organic contaminants; and
 - groundwater monitoring and sampling from the four groundwater wells and five perched wells (collectively referred to as "the monitoring wells") and from the discharge point of the drainage channel and the testing of the samples collected at a NATA Accredited Laboratory.
- 10) the preparation of an interpretative report (this report) on the findings of the Investigation.

A Preliminary Geotechnical Investigation was undertaken in October 2009 which comprised the drilling of 10 boreholes over the site to provide preliminary characterisation of ground conditions in the vicinity of the proposed buildings, the car/trailer park, and racing track. Ground conditions encountered during the Preliminary Geotechnical Investigation have been summarised in this report.

5.2. Installation of Monitoring Wells

A total of nine monitoring wells were installed as part of the Investigation. All monitoring wells were installed based on the requirements of the *Minimum Construction Requirements for Water Bores in Australia (2003)*. Bore logs of the groundwater wells installed as part of the investigation have been presented in **Appendix C**.

Perched Wells

The perched wells only intersected the waste material and not the natural materials beneath the Landfill. The five perched wells were screened across the static water level and into the waste material above to intersect phase separated hydrocarbons and allow for landfill gas monitoring.



A bentonite plug⁷ was used to seal the perched wells through the surface material.

A summary of the perched well construction details is provided in Table 5-1.

■ Table 5-1 Perched Well Installation Details

Monitoring Well	Total Depth (m bgl)	Screened Interval (m bgl)
MW03	2.0	1.0-2.0
MW04	5.0	2.0-5.0
MW05	6.0	1.0-6.0
MW07	5.0	1.0-5.0
MW08	3.0	1.0-3.0

Groundwater Wells

The four groundwater wells were installed through the waste material, and screened within natural ground below the waste materials.

Where the groundwater wells intersected loose or wet waste material, the hole was advanced to the base of the waste material. The hole was then cased with a concrete-bentonite slurry and allowed to cure overnight. Following this, a second augur was advanced through the concrete casing and into the natural material below.

The groundwater wells were screened through the natural material only. A bentonite plug⁸ was installed at the base of the concrete casing to ensure that an adequate seal between the waste material and natural material was achieved.

A summary of the groundwater well construction details is provided in Table 5-1.

■ Table 5-2 Groundwater Well Installation Details

Monitoring Well	Total Depth (m bgl)	Screened Interval (m bgl)
MW01	7.0	5.0-7.0
MW02	7.5	4.5-7.5
MW06	9.0	8.0-9.0
MW09	8.0	5.0-8.0

Well Development

All monitoring wells at the site were developed by removing a minimum of three well volumes of water (or until well purged dry), until groundwater parameters stabilised.

⁷ of a minimum thickness of 1 m

⁸ of a minimum thickness of 1 m.



5.3. Soil Sampling

During the installation of monitoring wells, samples of surface soils were collected incrementally until the intersection of the waste material, and from trial pits excavated over the capping layer.

Soil samples were screened using a photo-ionisation detector (PID)⁹ for the presence of volatile hydrocarbons. No detects were noted in any sample across the site.

Samples were immediately placed in appropriately preserved containers and placed on ice for transportation to the laboratory.

Selected soil samples from within the shallow soil profile¹⁰ were submitted for analysis of a broad range of potential contaminants including:

- Inorganic analytes:
 - Metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc and mercury);
 - pH;
 - Asbestos;
- Organic analytes:
 - Total petroleum hydrocarbon (TPH);
 - Volatile Organic Compounds (VOC) including BTEX (benzene, toluene, ethylbenzene and xylenes);
 - Semi-volatile Organic Compounds including:
 - Polycyclic Aromatic Hydrocarbons (PAH);
 - Phenols;
 - Polychlorinated Biphenyls (PCB);
 - Organochlorine Pesticides (OCP); and
 - Organophosphate Pesticides (OPP).

5.4. Landfill Gas Monitoring and Analytical Testing

Perched wells were fitted with gas monitoring well caps to allow for landfill gas¹¹ monitoring.

⁹ Calibration certificates are included in Appendix D.

¹⁰ Depths less than 0.3 m bgl.

¹¹ Including methane, oxygen, carbon dioxide, carbon monoxide and hydrogen sulphide



Wells were sealed for a minimum of 48 hours prior to monitoring. A landfill gas meter (GA2000 or similar)¹² was used to monitor gas concentrations from within the monitoring wells for three consecutive minutes. Peak and average landfill gas readings were recorded.

Four existing landfill vents at the site were also monitored for three consecutive minutes from sampling ports at the base of the vent.

5.5. Groundwater Sampling

Groundwater levels were recorded using a Solonist Oil-Water Interface Probe¹³. Wells were then purged until groundwater parameters stabilised, or until the well was dry. Post purge groundwater physico-chemical parameters¹⁴ of recharging water were recorded.

Samples were collected using a disposable bailer. Samples were placed into appropriately preserved sample containers and placed on ice for transportation to the laboratory.

Samples for metals analysis were filtered to 0.45 µm prior to placing in a sample container.

Groundwater samples were submitted for analysis of a broad range of potential contaminants including:

- Inorganic analytes:
 - Metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc and mercury);
 - pH;
- Organic analytes:
 - Total petroleum hydrocarbon (TPH) fractions;
 - Volatile Organic Compounds (VOC) including BTEX (benzene, toluene, ethylbenzene and xylenes);
 - Semi-volatile Organic Compounds including:
 - Polycyclic Aromatic Hydrocarbons (PAH);
 - Phenols;
 - Polychlorinated Biphenyls (PCB);
 - Organochlorine Pesticides (OCP); and
 - Organophosphate Pesticides (OPP).

¹² Calibration certificates are included in Appendix D.

¹³ Calibration certificates are included in Appendix D.

¹⁴ Including pH, dissolved oxygen (DO), reduction potential, total dissolved solids (TDS) and temperature



6. Site Conditions

6.1. Ground Conditions

A conceptualisation of the ground conditions at the site is provided in **Figure 5, Appendix A**. Exploratory bore logs, including the logs from the Preliminary Geotechnical Investigation are included in **Appendix B**.

Surface Material

For the majority of the Landfill, the surface material was found to be comprised of a layer of silty sand (0-0.1 m thickness) and an underlying clay based material comprised of sandy clay to clayey sand (0.2-0.8 m thickness).

The surface material layer of the eastern embankment of the Landfill was found to be comprised of well compacted clayey sand (0.2-0.5 m thickness).

Waste Materials

The thickness of waste materials encountered varied from 1.2 m to 10.5 m. Where encountered, waste materials (30-90%) were found to be mixed in a damp to saturated grey unconsolidated clay or sandy clay matrix (10-70%). The waste intersected in the investigation was domestic in origin, and appeared to contain infrequent residual putrescible materials. Common items noted in the waste materials included plastic packaging, plastic bags, metal fragments and glass bottles. No regulated wastes were noted in the waste material intersected.

The waste materials have been placed directly over natural materials in the majority of exploratory boreholes.

Natural Material

The natural material was generally a sandy or silty clay of weathered sandstone. This was underlain by the coarse grained red and white low strength sandstone. The sandstone was incised with a medium strength siltstone in several locations across the site.

In background locations across the site (including in locations within the wooded area along the western portion of the site), the soil profile was a silty sandy clay material consistent with the weathered sandstone.

6.2. Groundwater

Two groundwater systems have been observed on the site. These include:

- groundwater within the weathered sandstone beneath the Landfill; and
- perched water within the Landfill.

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Perched water within the Landfill is expected to be recharged from the lateral migration of groundwater entering the Landfill and the vertical migration of rainwater through the surface material.

The CMPS&F Report describes the Landfill as being constructed using a method which involved the excavation of trenches, and the placement and compacting of waste within the trench. The report does not describe the construction of a liner system.

The absence of an engineered liner was confirmed during the Preliminary Geotechnical Investigation which involved the drilling of 10 boreholes over the former landfill site. The Preliminary Geotechnical Investigation confirmed that waste materials have been placed directly over natural materials. This was found to be the sandy clay strata (weathered sandstone) in the majority of boreholes. In BH4 waste materials were found to have been placed directly over the sandstone. Consequently it is considered highly likely that the perched water within the Landfill is in connection with groundwater in the weathered sandstone.

Evidence of a connection between the two groundwater systems within the site can be drawn from the presence of organic contaminants and ammonia from groundwater samples taken from MW06 and MW09. MW06 and MW09 are monitoring wells which target groundwater in the weathered sandstone beneath and at the eastern (down-gradient) boundary of the Landfill (refer to **Appendix D.2.2**). If there was not a connection between the perched water within the Landfill and the groundwater in the weathered sandstone, elevated concentrations of organics and ammonia would not have been expected to be found in the samples from MW06 and MW09.

Figure 6, Appendix A provides a summary of the groundwater levels monitored during the investigation. Both the groundwater within the weathered sandstone and perched groundwater within the Landfill flow in a north easterly direction towards Slacks Creek. The perched groundwater within the Landfill is expected to combine with the groundwater in the weathered sandstone down gradient of the site. This is evident from ammonia and organic contaminants detected in CR13 which is a groundwater monitoring well installed by LCC down gradient of the Landfill.

Perched water within the Landfill potentially seeps into the drain on the eastern boundary of the site, as the elevation of the drain is below perched water levels within the Landfill. In addition seepages from the eastern embankment of the Landfill were observed in the north eastern corner of the site.

Appendix 0 provides a summary of groundwater observations made during the undertaking of the investigation. Odours and sheens were observed in some of the monitoring wells within the site.



Further discussion on the quality of the perched water within the Landfill and groundwater within the weathered sandstone is provided in Section 7.2.

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7. Analytical Results

This Section provides a summary of the analytical results of the investigation. A complete tabulation of the analytical results and a comparison of these with the Human Health and Environmental Assessment Criteria are provided in **Appendix D**. A copy of the laboratory analytical reports is provided in **Appendix E**. An assessment of the quality of the data is provided in **Appendix F**. A discussion of implications of the analytical results in regard to the risk to the environment and human health is provided in **Section 8**, and the remedial requirements in **Section 9**.

7.1. Soil Analytical Results

Seventeen samples of capping material (0-0.1 m or 0.2-0.3m) were analysed for a range of potential contaminants including metals¹⁵, asbestos, and/or organic analytes¹⁶. **Table 7-1** provides a summary of the analytical results for metals.

■ **Table 7-1 Metals, Surface Material**

Analyte (mg/kg)	Assessment Criteria	Minimum Value	Maximum Value
Arsenic	500	<5	<5
Cadmium	100	<1	<1
Chromium	500	2	28
Copper	5000	<5	16
Lead	1500	<5	18
Nickel	3000	<2	10
Zinc	30000	<5	31
Mercury	75	<0.1	<0.1

Metals (chromium, copper, lead, nickel and zinc) were found in some of the samples analysed in low concentrations which were well below the Human Health Assessment Criteria.

Asbestos fibres were not detected in any of the samples analysed.

All organic analytes were below laboratory detection limits in the samples analysed.

¹⁵ metals included arsenic, cadmium, chromium, copper, lead, nickel, zinc, and mercury

¹⁶ organics included total petroleum hydrocarbons (TPH); BTEX – benzene, toluene, xylene isomers, and ethyl benzene; polycyclic aromatic hydrocarbons (PAH); phenolic compounds; total polychlorinated biphenyls (PCBs); and organochlorine / organophosphate pesticides (OCPs/OPPs).



Permeability and Drainage of Surface Material

In-situ Talsma-Hallam Permeameter tests of the clay based material within the surface material indicates that the permeability of this material varies between 10^{-6} and 10^{-8} m/s. The test results, and an estimated permeability of the clay based material based on particle size analysis are summarised in Table 7-2.

Table 7-2 Permeability Test Results

Exploratory Location	Depth to Clay Based Material (m bgl)	Thickness of Clay Based Material (m)	Talsma-Hallam Permeameter Result of Clay Based Material	Estimated Permeability Based on Particle Size Distribution Testing
TP2	0.2	0.4	$k = 1.0 \times 10^{-7}$ m/s	(k = 10^{-8} m/s) Estimate only
TP3	0.1	0.8	$k = 1.1 \times 10^{-6}$ m/s	
TP4	0.1	0.5	$k = 1.4 \times 10^{-7}$ m/s	
TP5	0.1	0.5	(k = 4.4×10^{-8} m/s)	
TP9	0.15	0.2	Not measured	-

Low bunds have been constructed over parts of the site to assist with the shedding of rainfall runoff off the surface material into the drains on the northern and southern boundaries of the site (refer to Section 2.4). These surface water drainage measures and the low permeability of the clay based surface material will assist with limiting the infiltration of rainfall into the Landfill. The temporary ponding of water has been observed on the site in some locations following rainfall in capping areas which have formed depressions following ground subsidence.

7.2. Groundwater Analytical Results

Five rounds of groundwater monitoring have been undertaken at the site. Groundwater samples collected were tested for a range of inorganic¹⁷ and organic¹⁸ analytes.

¹⁷ inorganic analytes included metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc, and mercury) and ammonia

¹⁸ organic analytes included:

- total petroleum hydrocarbons (TPH)
- volatile organic compounds: BTEX – benzene, toluene, xylene isomers, and ethyl benzene; monocyclic aromatic hydrocarbons; oxygenated compounds, fumigants, halogenated aliphatic/aromatic compounds; trihalomethanes; naphthalene)
- semi-volatile organic compounds: polycyclic aromatic hydrocarbons (PAH); phenolic compounds; total polychlorinated biphenyls (PCBs); and organochlorine / organophosphate pesticides (OCs/OPs).



7.2.1. Physico-Chemical Parameters and Ammonia

Table 7-3 provides a summary of the physico-chemical parameters and ammonia analytical results for the on-site monitoring wells.

Table 7-3 Physico-Chemical Parameters and Ammonia, On-site Locations

Analyte	Environmental Assessment Criteria	Human Health Assessment Criteria	Groundwater Beneath Former Landfill				Perched Water Within Former Landfill			
			Cross-gradient (MW02)		Down-gradient (MW06, MW09)		Cross-gradient (MW03, MW04, MW08)		Down-gradient (MW05, MW07)	
			Min	Max	Min	Max	Min	Max	Min	Max
Dissolved Oxygen (mg/L)			1.1	5.8	1.1	5.0	0.1	7.1	0.1	1.9
Total Dissolved Solids (ppK)			2.9	4.9	0.3	2.4	0.4	2.2	1.1	3.2
pH			3.4	4.1	3.8	6.4	4.4	7.7	6.8	7.6
Reduction Potential (eH)			279	458	-44	275	-197	262	-150	-87
Temperature (°C)			22.4	23.7	19.5	24.1	19.4	25.3	20.3	23.7
Ammonia as N (mg/L)	2.3	0.01	0.02	0.12	0.5	50.4	<0.01	228	43.4	120

Perched water within the Landfill generally tended to contain low salt content, low dissolved oxygen (DO), and acidic to slightly alkaline pH.

In general, groundwater in the weathered sandstone was generally acidic and saline, as observed in samples from the cross-gradient, and down-gradient monitoring wells.

Elevated concentrations of ammonia which exceed the Environmental and Human Health Assessment Criteria were found in groundwater samples from down-gradient monitoring wells which targeted perched water within the Landfill (MW05 and MW07), and groundwater monitoring wells in the weathered sandstone (MW06). The results show that the Landfill is producing elevated concentrations of ammonia in leachate, which is impacting on both the perched groundwater and the underlying aquifer.

Table 7-4 provides a summary of the physico-chemical parameters and ammonia analytical results for the off-site monitoring wells and the surface water drain.



Table 7-4 Physico-Chemical Parameters and Ammonia, Off-site Locations

Analyte	Environmental Assessment Criteria	Human Health Assessment Criteria	Off-site Wells						Drain	
			Up-gradient (CR14, MW01)		Cross-gradient (CR15)		Down-gradient (CR13)			
			Min	Max	Min	Max	Min	Max	Min	Max
Dissolved Oxygen (mg/L)			1.9	5.9	2.4	4.6	2.9	4.0	4.0	6.6
Total Dissolved Solids (ppK)			0.2	7.3	0.1	0.9	0.2	0.4	0.2	0.3
pH			3.8	4.3	5.0	6.0	5.0	5.7	7.0	7.5
Reduction Potential (eH)			148	407	18	100	2	111	-16	68
Temperature (°C)			21.2	22.6	19.7	21.2	21.6	22.4	19.4	25.7
Ammonia as N (mg/L)	2.3	0.01	0.14	0.06			9.79	9.79	4.21	4.21

Table 7-4 shows that the physico-chemical parameters for the up-gradient and cross-gradient off-site monitoring wells were similar to the results from groundwater samples taken from up-gradient and cross-gradient monitoring wells beneath the Landfill in the weathered sandstone.

Elevated concentrations of ammonia which exceeded the Environmental and Human Health Assessment Criteria were found in the monitoring well down-gradient of the Landfill (CR13) and the drain. The maximum concentration of ammonia detected in CR13 (9.79 mg/L) was lower than the maximum concentrations detected in the perched water within the Landfill (228 mg/L). This may be partly attributed to the dilution of ammonia as the perched groundwater within the Landfill mixes with the groundwater within the weathered sandstone, and further attenuation in the aquifer as groundwater moves beneath the site to CR13.

Perched groundwater within the Landfill potentially seeps into the drain on the eastern boundary of the site on the basis that the elevation of the drain is below perched water levels within the Landfill. The elevated concentration of ammonia found in the drain is likely to be attributed to seepage of perched groundwater from the Landfill and possibly other off-site commercial/industrial sources (refer to Section 2.4).

7.2.2. Metals

The analytical results for metals are summarised in Table 7-5 for the on-site monitoring wells, and Table 7-6 for the off-site monitoring wells.



Table 7-5 Metals, On-site Locations

Analyte (mg/L)	Environmental Assessment Criteria	Human Health Assessment Criteria	Groundwater Beneath Former Landfill				Perched Water Within Former Landfill			
			Cross-gradient (MW02)		Down-gradient (MW06, MW09)		Cross-gradient (MW03, MW04, MW08)		Down-gradient (MW05, MW07)	
			Min	Max	Min	Max	Min	Max	Min	Max
Arsenic	0.36	0.05	<0.001	0.001	<0.001	0.025	<0.001	0.018	0.002	0.008
Cadmium	0.0008	0.005	0.0003	0.0006	<0.0001	0.0002	<0.0001	0.0007	<0.0001	0.0006
Chromium	0.04	0.05	0.001	0.009	<0.001	0.001	<0.001	0.012	<0.001	0.019
Copper	0.0025	1	0.003	0.018	<0.001	0.006	<0.001	0.02	<0.001	0.009
Lead	0.0094	0.05	0.001	0.043	<0.001	0.003	<0.001	0.048	<0.001	0.002
Nickel	0.017	0.1	0.002	0.1	<0.001	0.019	<0.001	0.124	0.012	0.122
Zinc	0.031	5	0.06	0.359	0.021	0.042	<0.001	0.463	<0.001	0.043
Mercury	0.0054		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table 7-6 Metals, Off-site Locations

Analyte (mg/l)	Environmental Assessment Criteria	Human Health Assessment Criteria	Off-site Wells							
			Up-gradient (CR14, MW01)		Cross-gradient (CR15)		Down-gradient (CR13)		Drain	
			Min	Max	Min	Max	Min	Max	Min	Max
Arsenic	0.36	0.05	<0.001	0.002	<0.001	0.002	0.016	0.022	<0.001	0.001
Cadmium	0.0008	0.005	<0.0001	0.0003	<0.0001	0.0003	<0.0001	0.0004	<0.0001	0.0011
Chromium	0.04	0.05	<0.001	0.021	<0.001	<0.001	<0.001	<0.001	<0.001	0.007
Copper	0.0025	1	0.014	0.028	<0.001	0.002	<0.001	0.007	0.002	0.02
Lead	0.0094	0.05	0.026	0.115	<0.001	0.002	<0.001	<0.001	<0.001	0.013
Nickel	0.017	0.1	0.028	0.038	<0.001	0.003	0.001	0.001	0.001	0.005
Zinc	0.031	5	0.072	0.154	0.014	0.07	0.016	0.042	0.09	0.173
Mercury	0.0054		<0.0001	<0.0001	<0.0001	<0.001	<0.0001	<0.001	<0.0001	<0.0001

Elevated concentrations of copper, lead, nickel and zinc with concentrations above the Environmental Assessment Criteria were found in MW01 (refer to Table 7-6) which is a monitoring well located up-gradient of the Landfill in the weathered sandstone.

Elevated concentrations of copper and zinc with concentrations which exceed the Environmental Assessment Criteria were also found in CR14 which is an off-site monitoring well located up-gradient of the Landfill. Lead was found with concentrations which exceeded the Human Health Assessment Criteria in groundwater samples from off-site well MW01.

MW01 and CR14 are considered to be up-gradient of the Landfill on the basis that: these monitoring wells are located on the western boundary on the known extent of the Landfill (refer to Section 2.8); elevated concentrations of ammonia (which is an indicator of the presence of landfill leachate) have not been detected in groundwater samples from these wells (refer to Table 7-4); and



the absence of waste materials encountered when drilling the monitoring well in MW01¹⁹ (refer to Appendix B).

Table 7-5 shows that the majority of samples from the on-site monitoring wells had concentrations of copper, lead, nickel and zinc with concentrations above the Environmental Assessment Criteria. The maximum concentrations detected, however, were lower than those found in MW01. The findings indicate that elevated concentrations of metals occur in the vicinity (and up-gradient) of the site. The source of these metals is unknown, and are potentially derived from industrial sources in the vicinity of the site, or naturally occurring within groundwater. Notwithstanding this, leachate from the Landfill is unlikely to be having a deleterious effect on groundwater with respect to metals.

An elevated concentration of cadmium which exceeded the Environmental Assessment Criteria was detected in the drain on the eastern boundary of the site in one of the sampling rounds. All other samples from the drain and groundwater had concentrations of cadmium which were below the Environmental Assessment Criteria.

7.2.3. Hydrocarbons

The analytical results for Total Petroleum Hydrocarbons (TPH) are summarised in Table 7-7 for the on-site monitoring wells, and Table 7-8 for the off-site monitoring wells.

■ Table 7-7 Total Petroleum Hydrocarbons, On-site Locations

Analyte (µg/L)	Environmental Assessment Criteria	Groundwater Beneath Former Landfill				Perched Water Within Former Landfill			
		Cross-gradient (MW02)		Down-gradient (MW06, MW09)		Cross-gradient (MW03, MW04, MW08)		Down-gradient (MW05, MW07)	
		Min	Max	Min	Max	Min	Max	Min	Max
C6 - C9		<20	<20	<20	50	<20	50	30	60
C10 - C14		<50	<50	<50	840	<50	580	90	800
C15 - C28		<100	<100	<100	2500	<100	1700	300	1900
C29 - C36		<50	<50	<50	710	<50	710	<50	680
C10 - C36		<50	<50	<50	4050	<50	2990	440	3170

¹⁹ Note LCC has been unable to provide the exploratory logs and well construction records for CR13, CR14, and CR15.

■ Table 7-8 Total Petroleum Hydrocarbons, Off-site Locations

Analyte (µg/L)	Environmental Assessment Criteria	Off-site Wells							
		Up-gradient (CR14, MW01)		Cross-gradient (CR15)		Down-gradient (CR13)		Drain	
		Min	Max	Min	Max	Min	Max	Min	Max
C6 - C9		<20	<20	<20	<20	<20	<20	<20	<20
C10 - C14		<50	60	<50	<50	<50	<100	<50	80
C15 - C28		<100	400	<100	160	200	300	<100	350
C29 - C36		<50	240	<50	100	<50	330	<50	130
C10 - C36		<50	690	<50	260	200	1100	<50	560

Concentrations of TPH were generally higher in samples from down-gradient groundwater monitoring wells when compared to samples of perched water from monitoring wells located around the boundary of the Landfill. Whilst not directly sampled in this investigation, high concentrations of TPH would also be expected to be found in perched water within the central parts of the Landfill.

Due to the presence of elevated concentrations of TPH in the first monitoring round, aliphatic/aromatic hydrocarbons were included the laboratory analysis in addition to TPH in the second and third monitoring rounds for selected samples. The analytical results for aliphatic/aromatic hydrocarbons are summarised in Table 7-9.

■ Table 7-9 Aromatic/Aliphatic Hydrocarbons, On-site Locations

Analyte (µg/L)	Human Health/ Environmental Assessment Criteria	Groundwater Beneath Former Landfill				Perched Water Within Former Landfill			
		Cross-gradient (MW02)		Down-gradient (MW06, MW09)		Cross-gradient (MW03, MW04, MW08)		Down-gradient (MW05, MW07)	
		Min	Max	Min	Max	Min	Max	Min	Max
Aliphatic C10-C14		-	-	<50	<50	<50	<50	<50	<50
Aliphatic C15-C28		-	-	<100	<100	<100	<100	<100	400
Aliphatic C29-C36		-	-	<50	<50	<50	<50	<50	150
Aliphatic C10 - C36		-	-	<50	<50	<50	<50	<50	550
Aromatic C10-C14		-	-	<50	<50	60	70	60	180
Aromatic C15-C28		-	-	<100	<100	<100	<100	<100	<100
Aromatic C29-C36		-	-	<50	<50	<50	<50	<50	<50
Aromatic C10 - C36		-	-	<50	<50	60	70	60	180
Aliphatic/Aromatic C10 - C36	600	-	-	<50	<50	60	70	60	730



An elevated concentration of aliphatic/aromatic hydrocarbons which exceeded the Environmental and Human Health Assessment Criteria was detected in the sample from MW05 (730 µg/L C₁₀-C₃₆) in the second monitoring round. All other samples tested however had concentrations of aliphatic/aromatic hydrocarbons (C₁₀-C₃₆) which were below the Environmental Assessment Criteria.

With the exception of the sample from MW05 in the second monitoring round, the concentrations of aliphatic/aromatic hydrocarbons (C₁₀-C₃₆) were lower than concentrations of TPH (C₁₀-C₃₆) in the samples analysed (refer to **Appendix D.2.2**). For example, in the third monitoring round, the sample from MW04 had a TPH (C₁₀-C₃₆) concentration of 1430 µg/L, and an aliphatic/aromatic hydrocarbon (C₁₀-C₃₆) concentration of 60 µg/L. The difference between these results is attributed to the removal of polar based organics²⁰ via silica gel clean up which is a standard procedure for the analysis of aliphatic/aromatic hydrocarbons. The aliphatic/aromatic hydrocarbons remaining in the sample following silica gel clean up are largely petroleum derived non-polar hydrocarbons. Conversely it should be noted that TPH analysis includes all recoverable hydrocarbons (polar and non-polar) and includes non-petroleum based hydrocarbons.

In the fourth monitoring round samples were analysed for TPH, and TPH 'with silica gel clean up'. The analytical results for the on-site monitoring wells are shown in **Table 7-10**, and the off-site monitoring wells in **Table 7-11**.

■ **Table 7-10 Total Petroleum Hydrocarbons, 7 October 2009, On-site Locations**

Analyte (µg/L)	Human Health/ Environmental Assessment Criteria	Groundwater Beneath Former Landfill			Perched Water Within Former Landfill				
		Cross- gradient MW02	Down-gradient		Cross-gradient		Down-gradient		
			MW06	MW09	MW03	MW04	MW08	MW05	MW07
Total Petroleum Hydrocarbons									
C6 - C9		<20	30	<20	<20	50	50	50	50
C10 - C14		<50	350	60	70	410		370	590
C15 - C28		<100	960	180	120	880		1190	1300
C29 - C36		<50	220	60	60	290		410	270
C10 - C36		<50	1530	310	250	1580		1970	2160
Total Petroleum Hydrocarbons (Silica Gel Clean Up)									
C10 - C14		<50	<50	<50	<50	<50		<50	<50
C15 - C28		<100	<100	<100	<100	<100		<100	<100
C29 - C36		<50	<50	<50	<50	<50		<50	<50
C10 - C36	600	<50	<50	<50	<50	<50		<50	<50

²⁰ Such as fatty acids, lipids, proteins, sugars etc.



Table 7-11 Total Petroleum Hydrocarbons, 7 October 2009, Off-site Locations

Analyte (µg/L)	Human Health/ Environmental Assessment Criteria	Off-site Wells				Drain
		Up-gradient	Up-gradient	Cross-gradient	Down-gradient	Down-gradient
		MW01	CR14	CR15	CR13	
Total Petroleum Hydrocarbons						
C6 - C9		<20	<20	<20	<20	<20
C10 - C14		60	<50	<50	110	80
C15 - C28		130	<100	160	330	350
C29 - C36		60	<50	100	80	130
C10 - C36		250	<50	260	520	560
Total Petroleum Hydrocarbons (Silica Gel Clean Up)						
C10 - C14		<50	<50	<50	<50	<50
C15 - C28		<100	<100	<100	<100	<100
C29 - C36		<50	<50	<50	<50	<50
C10 - C36	600	<50	<50	<50	<50	<50

Table 7-10 and Table 7-11 show that whilst elevated concentrations of TPH were detected, the concentrations of TPH with silica-gel clean up were below laboratory detection limits in the majority of samples analysed. In regard to the TPH detected in the fourth monitoring round, the laboratory advised that the main source of hydrocarbons found were not petroleum based, however the source of the hydrocarbons could not be confirmed.

These findings, and those for the analysis of aliphatic/aromatic hydrocarbons (with the exception of the aliphatic/aromatic sample result from MW05 in the second monitoring round) show that the elevated concentrations of TPH detected in groundwater, are likely to be comprised of mainly non-polar and non-petroleum based organic substances present in landfill leachate which are being generated through the decomposition of putrescible materials.

7.2.4. Volatile Organic Compounds

The analytical results for the volatile organic compounds (VOC) found in samples with concentrations above laboratory detection limits are summarised in Table 7-12 for the on-site monitoring wells, and Table 7-13 for the off-site monitoring wells.



Table 7-12 Volatile Organic Compounds, On-site Locations

Analyte (µg/L)	Environmental Assessment Criteria	Human Health Assessment Criteria	Groundwater Beneath Former Landfill				Perched Water Within Former Landfill			
			Cross-gradient (MW02)		Down-gradient (MW06, MW09)		Cross-gradient (MW03, MW04, MW08)		Down-gradient (MW05, MW07)	
			Min	Max	Min	Max	Min	Max	Min	Max
Monocyclic Aromatic Hydrocarbons										
Benzene	2000	10	<1	<1	<1	2	<1	6	3	5
Toluene	180	1000	<2	<2	<2	10	<2	<2	<2	10
Ethylbenzene	80	150	<2	<2	<2	2	<2	11	<2	5
meta- & para-Xylene	340	200	<2	<2	<2	2	<2	10	<2	9
ortho-Xylene	640	1400	<2	<2	<2	<2	<2	4	<2	3
Isopropylbenzene	30	150	-	-	<5	<5	<5	5	<5	<5
n-Propylbenzene	128		-	-	<5	<5	<5	8	<5	<5
1,2,4-Trimethylbenzene	33		-	-	<5	<5	<5	24	<5	14
p-Isopropyltoluene	85		-	-	<5	<5	<5	29	<5	18
Halogenated Aliphatic Compounds										
Dichlorodifluoromethane	390	390	-	-	<50	<50	<50	60	<50	<50
Halogenated Aromatic Compounds										
Chlorobenzene	55	300	-	-	<5	7	<5	8	7	26
1,4-Dichlorobenzene	60	40	-	-	<5	11	<5	6	<5	47
1,2-Dichlorobenzene	160	1500	-	-	<5	<5	<5	<5	<5	8
Polycyclic Aromatic Hydrocarbons										
Naphthalene	85	70	-	-	<7	20	<7	20	10	24



Table 7-13 Volatile Organic Compounds, Off-site Locations

Analyte (µg/L)	Environmental Assessment Criteria	Environmental Assessment Criteria	Off-site Wells						Drain	
			Up-gradient (CR14, MW01)		Cross-gradient (CR15)		Down-gradient (CR13)			
			Min	Max	Min	Max	Min	Max	Min	Max
Monocyclic Aromatic Hydrocarbons										
Benzene	2000	10	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	180	1000	<2	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	80	150	<2	<2	<2	<2	<2	<2	<2	<2
meta- & para-Xylene	340	200	<2	<2	<2	<2	<2	<2	<2	<2
ortho-Xylene	640	1400	<2	<2	<2	<2	<2	<2	<2	<2
Isopropylbenzene	30	150	<5	<5	<5	<5	<5	<5	<5	<5
n-Propylbenzene	128		<5	<5	<5	<5	<5	<5	<5	<5
1,2,4-Trimethylbenzene	33		<5	<5	<5	<5	<5	<5	<5	<5
p-Isopropyltoluene	85		<5	<5	<5	<5	<5	<5	<5	<5
Halogenated Aliphatic Compounds										
Dichlorodifluoromethane	390	390	<50	<50	<50	<50	<50	<50	<50	<50
Halogenated Aromatic Compounds										
Chlorobenzene	55	300	<5	<5	<5	<5	<5	<5	<5	<5
1,4-Dichlorobenzene	60	40	<5	<5	<5	<5	<5	<5	<5	<5
1,2-Dichlorobenzene	160	1500	<5	<5	<5	<5	<5	<5	<5	<5
Polycyclic Aromatic Hydrocarbons										
Naphthalene	85	10	<1	<1	<7	<7	<1	<1	<1	<1

VOCs were detected in samples from the perched water within the Landfill, and from groundwater samples from down-gradient monitoring wells within the Landfill. The concentrations of VOCs detected did not exceed the Environmental Assessment Criteria.

1,4-Dichlorobenzene was detected in a sample of perched water from MW05 in the second monitoring round with a concentration which exceeded the Human Health Assessment Criteria. All other samples of perched water from MW05, the other groundwater monitoring wells and the drain, had concentrations of 1,4-Dichlorobenzene which were below the Human Health Assessment Criteria.

VOCs were not detected in any off-site groundwater samples, or in water samples from the drain.



7.2.5. Semi-Volatile Organic Compounds

The analytical results for semi-volatile organic compounds (SVOC) found in samples with concentrations above laboratory detection limits are summarised in **Table 7-14** for the on-site monitoring wells, and **Table 7-15** for the off-site monitoring wells.

■ **Table 7-14 Semi-Volatile Organic Hydrocarbons, On-site Locations**

Analyte (µg/L)	Environmental Assessment Criteria	Human Health Assessment Criteria	Groundwater Beneath Former Landfill						Perched Water Within Former Landfill			
			Up-gradient (MW01)		Cross-gradient (MW02)		Down-gradient (MW06, MW09)		Cross-gradient (MW03, MW04, MW08)		Down-gradient (MW05, MW07)	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Polycyclic Aromatic Hydrocarbons												
Phenanthrene	2	-	-	-	-	-	<1	1.8	<1	1.1	<1	<1
Phenolic Compounds												
2-Methylphenol	13	200	-	-	-	-	<1	2	<1	<3.8	<1	225
3- & 4-Methylphenol	543		-	-	-	-	<2	<2	<2	<7.7	<2	49
2,4-Dimethylphenol	2	730	-	-	-	-	<1	1.2	<1	<3.8	<1	4.6
2,4-Dichlorophenol	120	200	-	-	-	-	<1	<1	<1	<3.8	<1	1.3
4-Chloro-3-methylphenol	350	350	-	-	-	-	<1	<1	<1	<3.8	<1	36.4
2,4,5-Trichlorophenol	0.5	1	-	-	-	-	<1	<1	<1	<3.8	<1	1

■ **Table 7-15 Semi-Volatile Organic Compounds, Off-site Locations**

Analyte (µg/L)	Environmental Assessment Criteria	Human Health Assessment Criteria	Off-site Wells									
			Up-gradient (CR14, MW01)		Cross-gradient (CR15)		Down-gradient (CR13)		Drain			
			Min	Max	Min	Max	Min	Max	Min	Max		
Polycyclic Aromatic Hydrocarbons												
Phenanthrene	2	-	<1	<1	-	-	<1	<1	<1	<1		
Phenolic Compounds												
2-Methylphenol	13	200	<1	<1	-	-	<1	<1	<1	<1		
3- & 4-Methylphenol	543		<2	<2	-	-	<2	<2	<2	<2		
2,4-Dimethylphenol	2	730	<1	<1	-	-	<1	<1	<1	<1		
2,4-Dichlorophenol	120	200	<1	<1	-	-	<1	<1	<1	<1		
4-Chloro-3-methylphenol	350	350	<1	<1	-	-	<1	<1	<1	<1		
2,4,5-Trichlorophenol	0.5	1	<1	<1	-	-	<1	<1	<1	<1		

As shown **Appendix D.2.2**, elevated concentrations of phenolic compounds which exceeded the Environmental and Human Health Assessment Criteria were found in a sample of perched water from MW05 in the second monitoring round. All other samples of perched water from MW05, the other groundwater monitoring wells and the drain, had concentrations of phenolic compounds which were below the Environmental and Human Health Assessment Criteria.

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All other SVOC analytes were below the Environmental Assessment Criteria in the samples analysed. Organo-pesticides, oxygenated compounds, fumigants, and PCB were not detected in any of the groundwater samples tested. SVOCs were not detected in groundwater sampled from off-site wells, or in water sampled from the drain.

7.3. Landfill Gas Monitoring

Historical Monitoring

LCC has undertaken an ongoing landfill gas monitoring program (2000 to 2008) from monitoring wells fitted with free-venting gas well caps installed around the boundary of the site. The monitoring program has detected low levels of methane gas over this time period with concentrations which were well below the LEL for methane (5%). These findings indicate that gas from the Landfill is unlikely to pose an unacceptable risk to off-site receptors (refer to Section 2.9.4).

Concentrations of methane ranged between 0% and 1.7% along the eastern boundary of the site, 0% and 0.3% along the northern, southern and western boundaries.

Concentrations of CO₂ ranged between 0% and 11.2% along the eastern boundary of the site, 0% to 6.3% along the northern boundary, 0% and 7.3% along the western boundary and 0% to 10.1% along the southern boundary.

Full copies of the gas monitoring data have been included in **Appendix D.3.1**.

Landfill Gas Monitoring

As part of the Investigation landfill gas monitoring wells were installed within the Landfill, as described in Section 5.2. Five rounds of landfill gas monitoring have been undertaken, the results of which are summarised in **Appendix D.3.2**. Six rounds of landfill gas monitoring were undertaken by SKM for the Investigation. The methodology used for landfill gas monitoring is summarised in Section 5.4.

Concentrations of methane which exceeded the LEL were detected in monitoring wells MW04, MW05, MW08 and MW09 in the majority of monitoring rounds undertaken during the Investigation at a maximum concentration range of between 49.7% (MW07) and 99.3% (MW08).

Elevated concentrations of carbon dioxide have also been detected in these wells at a maximum concentration range of between 9.5% (MW07) and 15.5% (MW04).

It should be noted that portable landfill gas analysers report hydrocarbon vapours in addition to methane. Consequently a methane reading from the analyser can be comprised of methane and other hydrocarbon vapours.



Gas samples from the monitoring wells MW03, MW04, MW05, MW07, and MW08 were collected by Simtars on the 29 October 2009 and analysed for 73 volatile organic compounds (VOC). A copy of the report prepared by Simtars on the gas analysis is provided in Appendix F. The analytical results from the VOC gas analysis are summarised in Table 7-16. It should be noted that the VOC analytical methodology used by Simtars does not include methane. Simtars advised that there were unable to test for methane in the VOC gas analysis.

Table 7-16 Volatile Organic Compound Gas Analysis

Analyte	NOHSC Guideline		MW03	MW04	MW05	MW07	MW08
	TWA (mg/m ³)	STEL (mg/m ³)					
Rate of Flow (L/min)			<0.005	<0.005	<0.03	<0.03	<0.05
Aliphatic Hydrocarbons							
2-methylbutane			<0.2	0.1	0.2	0.6	2.1
n-pentane	1770	2210	<0.2	1.5	<0.2	0.6	1.3
2-methylpentane			<0.2	0.9	<0.2	0.5	1.9
3-methylpentane			<0.2	0.7	<0.2	0.3	1.3
methylcyclopentane			<0.2	0.3	<0.2	0.3	1
n-hexane	176	-	<0.2	1.1	0.3	0.6	2.3
3-methylhexane			<0.2	0.9	<0.2	0.4	1.6
cyclohexane	1035	-	<0.2	0.6	<0.2	0.4	1.6
methylcyclohexane	1610	-	<0.2	2.7	0.6	0.7	4.1
2,2,4-trimethylpentane			<0.2	0.6	<0.2	0.3	1.8
n-heptane	1640	2050	<0.2	0.7	<0.2	0.4	1.7
n-octane	1400	1750	<0.2	0.2		0.4	1.5
n-nonane	1050	-	<0.2	<0.2	2	2.5	7.7
n-decane			<0.2	<0.2	5.1	1.7	14.7
n-undecane			<0.2	<0.2	1.8	<0.2	7.8
n-dodecane			<0.2	<0.2	<0.2	<0.2	0.3
alpha-pinene			<0.2	<0.2	<0.2	<0.2	2.4
D-limonene			<0.2	<0.2	<0.2	<0.2	1.2
Chlorinated Hydrocarbons							
chlorobenzene	46	-	<0.2	0.8	0.7	<0.2	<0.2
1,4-dichlorobenzene			<0.2	0.8	2.1	1.1	<0.2
Aromatic Hydrocarbons							
benzene	16	-	<0.2	0.6	0.3	0.7	0.7
ethylbenzene	434	543	<0.2	0.1	1.1	0.2	6.6
isopropylbenzene			<0.2	2.1	1.5	1.5	1.9
1,2,3-trimethylbenzene	123	-	<0.1	0.2	<0.1	0.4	<0.1
1,2,4-trimethylbenzene			<0.2	0.5	3.5	0.6	6.2
1,3,5-trimethylbenzene			<0.2	<0.1	1.7	0.2	1.8
p/m-xylene	350	655	<0.2	<0.1	2.7	0.8	5.2
o-xylene			<0.2	0.1	0.7	<0.1	0.7
Ketones							
acetone	1185	2375	<0.2	<0.2	0.6	<0.2	<0.2
Alcohols							
2-ethyl hexanol			<1.0	<1.0	3.8	4.9	<1.0
Total VOC			<2.0	374	342	481	666



Table 7-16 shows that a range of VOCs were detected in the gas samples collected with concentrations which were below the NOHSC Guideline. Simtars interpretation of the results indicated the profile of gases in the four perched wells was consistent with a mineral turpentine solvent mixture.

The rate of flow was measured using a portable flow meter by Simtars prior to sampling at each location. The rate of flow varied within each perched well, and ranged between <0.005 L/min and 0.3 L/min.

Landfill Vent Monitoring

In the majority of monitoring rounds, low or non-detectable concentrations of methane and carbon dioxide were detected from the monitoring ports attached to the landfill vents (refer to Appendix D.3.2). This may be attributed to atmospheric dilution in the vents, as evident from measured oxygen concentrations at approximately 21%. In the monitoring round on 4 November 2009, an elevated detection of methane which exceeded the LEL was found in Vent 2; all other vents however had concentrations of methane which were below the LEL or below detection limits.

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8. Qualitative Risk Assessment

8.1. Risk to Human Health

8.1.1. Capping Materials

The findings of the soil sampling of the capping material indicate that potential contaminants are at concentrations which would not pose an unacceptable risk to future site users.

The capping layer of the eastern embankment of the Landfill was found to be comprised of poorly structured clayey sand (0.2-0.5 m thickness). The thickness of the surface material at this location does not provide an adequate barrier between the surface and the waste material below. It is recommended that the capping layer of the eastern embankment be built up to provide a minimum thickness of 0.5 m.

8.1.2. Landfill Gases

Monitoring of landfill gases from the perched wells indicates that the waste materials are generating methane at concentrations well above the LEL. Landfill gas which includes methane, is considered to pose a risk to future site users as an asphyxiant and flammable gas (refer to Section 4.2.2). The primary risk to future site users will be the migration of gases along pathways created by foundations (including pipes) and underground services or service trenches into buildings located on the site, or other confined spaces (e.g. service pits). Controls will need to be put in place to mitigate potential risks to future site users; these are summarised in Section 9. It is expected that the control of gas accumulation in buildings will also mitigate any potential odour issues associated with landfill gases. Note no ambient odours were noticed at the site. Odours were only noted in monitoring wells installed within the Landfill.

A range of volatile organic compounds have been detected in landfill gases at concentrations which were below the NOHSC Guidelines, and accordingly are unlikely to pose an unacceptable risk to future uses of the site.

8.2. Risk to the Environment

Two groundwater systems have been observed on the site. These include:

- groundwater within the weathered sandstone beneath the Landfill; and
- perched groundwater within the Landfill.

It is considered highly likely that the perched water is in connection with the groundwater in the weathered sandstone, and these systems combine down-gradient of the Landfill for reasons outlined Section 6.2. These groundwater systems flow in a north-easterly direction towards Slacks



Creek. Slacks Creek is located approximately 320 m east of the site, and is considered to be the main environmental receptor of groundwater from the site. Accordingly, the potential risks to ecosystems in the creek are assessed by comparison of contaminant concentrations in site groundwater to ecosystem-based Environmental Assessment Criteria, and Human Health Assessment Criteria associated with recreational contact.

Metals

Elevated concentrations of copper, lead, nickel and zinc with concentrations above the Environmental Assessment Criteria have been found in groundwater samples from monitoring wells up-gradient of the Landfill, and within the Landfill. Lead was found in a monitoring well up-gradient of the Landfill with a concentration which exceeded the Human Health Assessment Criteria. The highest concentrations detected were from the up-gradient monitoring well (MW01). An increase in the concentration of metals was not observed in the monitoring wells down-gradient of the Landfill. These findings indicate that elevated concentrations of metals occur in the vicinity (and up-gradient) of the site, however it is unknown whether the elevated concentrations are associated with surrounding industrial land use, naturally occurring background conditions, or a combination of both these factors. Leachate from the Landfill is unlikely to be having a deleterious effect on groundwater with respect to metals.

Ammonia

Ammonia was detected at concentrations which exceed the Environmental and Human Health Assessment Criteria in groundwater samples from monitoring wells within and down-gradient of the Landfill. Ammonia is widely recognised as one of the most prevalent and continuous contaminants sourced from former landfills (Kjeldsen et al 2002). The site investigation data for CR13 which is a monitoring well located down-gradient of the Landfill shows that the concentrations of ammonia have attenuated from 39.9 mg/L in 2000 (refer to Section 2.9.2) to approximately 10 mg/L in 2008-09. Notwithstanding this, elevated concentrations of ammonia were detected in other monitoring wells along the eastern boundary of the Landfill.

A review of the Australian Drinking Water Guidelines (2004) and the World Health Organisation Guidelines for Drinking-water Quality²¹ was undertaken to determine the human health implications of high concentrations of ammonia in water. Conclusions from these guidelines indicate that ammonia is not of direct importance for health (via ingestion) in concentrations to be expected in drinking water. The Australian Drinking Water Guideline value derived is instead based on other considerations such as attacking copper pipes and fittings, or nuisance growths of micro-organisms which may lead to skin irritation. Accordingly the risk to human health through ingestion from ammonia in groundwater is considered to be low. It is noted, however, that

²¹ WHO, 1996, Ammonia in Drinking-water. World Health Organisation, Geneva.



ammonia can have a toxic effect on humans only if the intake becomes higher than the detoxification capacity of the body. In studies with animals, high doses of ammonia (over 100 mg/kg body weight per day) have generally not produced any significant toxic effects.

Ammonia is a known toxicant to fish and can have a deleterious effect on aquatic ecosystem health. However factors such as dilution would lower the concentration of ammonia prior to discharge to the nearest receiving watercourse (Slacks Creek, 320 m east of the site).

Nitrate

Nitrate concentrations in samples from CR13 which is a monitoring well located down-gradient of the Landfill consistently exceeded the Environmental Assessment Criteria between November 2004 and May 2006. However since July 2006, the concentrations of nitrate in samples from CR13 have been below the Environmental Assessment Criteria (refer to Section 2.9.2).

Total Phosphorus and Phosphate

Total phosphorus was found in groundwater samples with concentrations which exceeded the Environmental Assessment Criteria in 2002. Total phosphorus has not been monitored since 2002, however phosphate was included in the monitoring program from 2004-2008 and was found to be below laboratory detection limits (refer to Section 2.9.2).

Hydrocarbons

Elevated concentrations of hydrocarbons have been consistently detected in groundwater. The analytical results and interpretation of the source hydrocarbons by the laboratory indicate that the elevated concentrations of hydrocarbons found in groundwater samples are predominately organic substances being produced by the Landfill through the decomposition of putrescible materials rather than petroleum based hydrocarbons (e.g. oils).

An elevated concentration of petroleum based aliphatic hydrocarbons was detected in one groundwater sample in the second monitoring round with a concentration which exceeded the Environmental and Human Health Assessment Criteria. However, no other exceedances of the Environmental and Human Health Assessment Criteria for petroleum based hydrocarbons was found.

Volatile Organic Compounds

A range of VOCs were detected in groundwater samples with concentrations which were below the Environmental Assessment Criteria.

An elevated concentration of 1,4-Dichlorobenzene which exceeded the Human Health Assessment Criteria was found in a perched water sample from one of the monitoring wells (MW05) in the second monitoring round. On the basis that elevated concentrations of 1,4-Dichlorobenzene which exceed the Human Health Assessment Criteria were not consistently found and dilution factors in



the receiving environment, the risk to human health from 1,4-Dichlorobenzene is considered to be low. All other samples from MW05 and samples from the other groundwater monitoring wells had concentrations of phenolic compounds which were below detection limits or below the Human Health Assessment Criteria.

Semi-Volatile Organic Compounds

The majority of SVOCs including PAH (with the exception phenanthrene), pesticides, oxygenated compounds, fumigants, and PCB were not detected in any of the groundwater samples tested. Phenanthrene was detected in some of the samples analysed with concentrations below the Environmental Assessment Criteria.

An elevated concentration of phenolic compounds which exceeded the Environmental Assessment Criteria was found in a perched water sample from one of the monitoring wells (MW05) in the second monitoring round. All other samples from MW05 and samples from the other groundwater monitoring wells had concentrations of phenolic compounds which were below detection limits or below the Environmental Assessment Criteria. On the basis that elevated concentrations of phenolic compounds which exceed the Environmental Assessment Criteria were not consistently found, the risk to the receiving environment from phenolic compounds is considered to be low.

Summary of Findings

Slacks Creek is a highly disturbed system which has been heavily modified from its natural state.

It is considered likely that landfill leachate from the site which contains elevated concentrations of ammonia and organics is potentially having some deleterious impact on Slacks Creek. It should be noted that the site is located within a large urban catchment with residential and commercial/industrial areas which would also be contributing to the degradation of Slacks Creek.

Landfill leachate is discharged from the site via seepages into the drain, and groundwater migration. Leachate discharged from the site will be diluted via other sources of surface water discharged to the drain, groundwater occurring in the vicinity of the site, and water present in Slacks Creek.

As the Landfill has not been constructed with an engineered liner or leachate collection system it is not considered feasible to modify the Landfill to effectively capture and treat landfill leachate. The concentration of contaminants in leachate from the Landfill will decrease with time, as the putrescible material in the Landfill degrades. This is evident from the decrease in ammonia concentrations in monitoring well CR13 from 2000 to 2008-09. Accordingly the most appropriate approach for the ongoing management of the site is considered to be the continuation of the monitoring program currently being undertaken to confirm that attenuation of contaminants is occurring over time. The proposed development will also need to be constructed in a way which minimises percolation of rainfall into the landfill (by contouring and surface drainage design) and

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which does not exacerbate potential pathways (e.g. through uncontrolled breaches in the capping layer) on the site. Construction methods for the proposed development are discussed further in Section 9.

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9. Remediation Strategy

This section provides a summary of the remediation strategy proposed for the development of the site. The key remedial measures required for the redevelopment of the site include:

- the building up of the capping layer in the eastern embankment of the site;
- the inclusion of gas protection measures in buildings;
- the re-construction of gas vents closed during the construction phase for the proposed development;
- the location of services above the capping material where practicable;
- the use of sensitive construction and piling measures to minimise disturbance to the capping material;
- the use of low permeability materials or membranes for proposed water storage areas on the site;
- the undertaking of an ongoing monitoring program during and post development of the site; and
- the confirmation that former underground tank on the site has been removed.

These measures are summarised as follows and described in further detail in the Remediation Plan prepared for the Project.

9.1. Capping Layer

The capping layer of the eastern embankment of the Landfill was found to vary from 0.2-0.5 m in thickness. The capping layer of the eastern embankment will be built up to provide a minimum thickness of 0.5 m using uncontaminated fill material. As the embankment may be acting as a pathway for the venting of landfill gases, it is not recommended that a low permeability material be used to build up the embankment. Such a material could potentially change the landfill gas migration and venting regime along the embankment.

9.2. Gas Protection

Three buildings have been proposed on the site including:

- main facilities building with an open air viewing stand;
- kennel block; and
- maintenance shed.

The proposed location of these buildings is shown in **Figure 2, Appendix A**.

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Main Facilities Building

The boreholes drilled for the Preliminary Geotechnical Investigation shows that eastern half of the Main Facilities Building is likely to be located over soil/waste materials, and the western half over soil materials. Further ground characterisation during the detailed design phase will confirm the ground conditions beneath this building.

It is proposed that the Main Facilities Building will be founded on piles and a slab suspended off-the-ground. An open void will be located between the slab and the ground to allow for the free venting of air beneath the building.

Kennel Block and Maintenance Shed

The boreholes drilled for the Preliminary Geotechnical Investigation show that ground beneath the Kennel Block and Maintenance Shed is unlikely to contain waste materials. Further ground characterisation during the detailed design phase will confirm this. Slab-on-ground foundations are proposed for these buildings. Gas protection measures proposed for these buildings include:

- well-constructed ground slab located above the capping layer;
- low-permeability gas/vapour membrane;
- the location of services above the capping layer and entering buildings from the side (rather than through floor slabs); and
- passive in-ground venting, with the venting system being located above the capping layer and beneath the floor slab to allow for the venting of landfill gases.

During the detailed design phase of the Project, monitoring will be undertaken at the location of these proposed buildings to characterise the Landfill gas regime at these locations. Should the findings of landfill gas monitoring indicate that the gas regime at these locations is of low risk, the protection measures proposed may be amended in consultation with DERM.

9.3. Landfill Gas Vents

The proposed development will involve the removal of two of the existing landfill gas vents. It is proposed that two additional vents will be constructed in the vicinity of the vents being removed during the construction process.

The height of the vents will be reduced to allow for improved viewing and the functioning of the site as a greyhound racing facility. A reduction in the height of the vents is not expected to impair their functionality.



9.4. Services

All services will either run above or within the capping material. Where services are located within the capping material, they will be exposed to the atmosphere to vent potential landfill gases prior to a worker entering any confined spaces. Services will not be located beneath the capping layer.

9.5. Construction Methods

Piling Methods

Piling will be required for the construction of the Main Facilities Building. The piles will be founded on the sandstone strata beneath the site. Piling will require disturbance to the capping material. The capping material surrounding the piles will be resealed with a low permeability clay based material.

Racing Track

Preloading will be undertaken over the racing area to accelerate the settlement process and stabilise the surrounding ground. Groundwater mounding may occur as a result of preloading however it is not expected to result in any further risk to human health or the environment. Pad foundations are to be used for the running rail around the racing track and lighting following preloading. This will negate the need to pile through the Landfill cap for the running rail.

9.6. Stormwater and Surface Drainage

Surface drainage and stormwater management features of the proposed development are described in the *Infrastructure Servicing and Site Based Stormwater Management Plan* (SKM, 2009). The main features of the proposed stormwater management system are shown in **Appendix B**.

Stormwater collected from the surface of the site will be diverted to vegetated swales to capture litter, suspended solids and other matter prior to discharging into the drainage system. The installation of swales minimises the need to excavate through the surface material and into the waste material below.

During periods of heavy rainfall, surface water is to be captured and temporarily held within retention basins on-site. The retention basin will be lined high density poly-ethylene (HDPE) liners or equivalent to prevent vertical seepage into the Landfill.

The drain skirting the south and east of the site is to be managed by LCC as an easement. It is proposed that some restoration of this drain be undertaken by LCC as part of the redevelopment. The level of restoration to be undertaken will be confirmed during the detailed design phase. It is not anticipated that the restoration work will involve disturbance to the Landfill.



9.7. Monitoring

Monitoring of groundwater quality and landfill gases will be undertaken during the construction of the Project.

Post development the site will be managed under a Site Management Plan (SMP). The SMP will be prepared during the detailed design phase and held on record with DERM.

The SMP will provide a framework for ongoing environmental monitoring as well as stipulate any ongoing operational controls for the site.

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10. Conclusions and Recommendations

10.1. Project Overview

Greyhounds Queensland Limited (GQL) is planning the development of the Logan Greyhound Facility ("the Project") at Cronulla Park, Slacks Creek ("the site"). Cronulla Park was formerly used a landfill ("the Landfill") between the 1970s and 1980s.

GQL engaged Sinclair Knight Merz (SKM) to undertake a Stage 1 and Stage 2 Contaminated Site Investigation ("the Investigation") of the site. The aims of the Investigation were to establish:

- whether the site in its current condition poses an unacceptable risk to human health and/or the receiving environment; and
- whether remediation will be required to enable the site to be used for a commercial land use (greyhound racing facility), and if so, the required remedial measures.

10.2. Site Conditions

Surface Material

For the majority of the Landfill, the surface material was found to be comprised of a layer of silty sand (0-0.1 m thickness) and an underlying clay based material comprised of sandy clay to clayey sand (0.2-0.8 m thickness).

The surface layer of the eastern embankment of the Landfill was found to be comprised of poorly structured clayey sand (0.2-0.5 m thickness).

Waste Material

Where encountered, waste materials varied in thickness from 1.2 to 10.5 metres in thickness. An engineered liner was not found beneath the Waste Material.

Natural Material

The natural material was generally a sandy or silty clay of weathered sandstone. This was underlain by the coarse grained sandstone.

Groundwater

Two groundwater systems have been observed on the site. These include:

- groundwater within the weathered sandstone beneath the Landfill; and
- perched water within the Landfill.

The perched water is likely to be in connection with the groundwater in the weathered sandstone beneath the Landfill. These two systems also combine together down-gradient of the Landfill.

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These groundwater systems flow in a north-easterly direction to Slacks Creek which is located approximately 320 m east of the site.

Slacks Creek is the main environmental receptor of both groundwater and surface water from the site.

10.3. Analytical Results

Capping Material

Shallow soils in the capping material at the site were found to contain contaminant concentrations which were below the Human Health Assessment Criteria. Shallow soils at the site would subsequently not pose an unacceptable risk to human health.

Landfill Gases

Monitoring of landfill gases from the perched wells indicates that the waste materials are generating methane at concentrations well above the LEL. Landfill gas which is primarily methane, is considered to pose a risk to future site users as an asphyxiant and flammable gas. Volatile organic compounds have been detected in landfill gases at concentrations which were below the NOHSC Guidelines, and accordingly are unlikely to pose an unacceptable risk to future uses of the site.

Groundwater

Slacks Creek is a highly disturbed system which has been heavily modified from its natural state. It is considered likely that landfill leachate from the site which contains elevated concentrations of ammonia and organics is potentially having some deleterious impact on water quality in Slacks Creek. Residential and commercial/industrial areas located within the catchment will also contribute to the degradation of Slacks Creek.

On the basis that the Landfill has not been constructed with an engineered liner or leachate collection system it is not considered feasible to modify the Landfill to effectively capture and treat landfill leachate. The concentration of contaminants in leachate from the Landfill will decrease with time as the putrescible material in the Landfill degrades. This process is occurring as evident from the decrease in ammonia concentrations in groundwater from 2000 to 2008-09. The most appropriate approach for the ongoing management of the site in regard to groundwater is considered to be the continuation of the monitoring program currently being undertaken to confirm that attenuation of contaminants is occurring over time.

10.4. Suitability of Site for Proposed Development

Based on the findings of the Investigation the site is considered to be suitable for the proposed development and use provided that potential risks relating to landfill gas and contaminated groundwater are addressed in the design, construction, and future management stages of the site. It

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is intended the site will be constructed in accordance with a Remediation Plan (RP), and managed post-construction under a Site Management Plan (SMP). The SMP will provide a framework for ongoing environmental monitoring as well as stipulate any ongoing operational controls for the site, and will be administered by LCC. The SMP will include groundwater and landfill gas monitoring at the site.

The key remedial measures required for the redevelopment of the site include:

- the building up of the capping layer in the eastern embankment of the site;
- the inclusion of gas protection measures in buildings;
- the re-construction of gas vents closed for the proposed development;
- the location of services above the capping material where practicable;
- the use of sensitive construction and piling measures to minimise disturbance to the capping material;
- the use of low permeability materials or membranes for proposed water storage areas on the site;
- the undertaking of an ongoing monitoring program during and post development of the site; and
- the confirmation that former underground tank on the site has been removed.

Further detail regarding the proposed remediation strategy are to be provided in the Remediation Plan which is being prepared for the redevelopment of the site.



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Appendix A Figures

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Appendix I Limitations of Investigation

1. This report has been prepared by Sinclair Knight Merz Pty Limited ("SKM") for the sole use of Greyhounds Queensland Limited ("the Client") and in accordance with the scope of services detailed in the SKM proposal dated 26 August 2009 and accepted by the Client on the 2 September 2009 ("the Agreement").

2. Undertaking an assessment or study of the on-site conditions may provide information regarding the potential for exposure to the presence of contaminated or inadequate bearing ground and/or groundwater. All reports and conclusions that deal with subsurface conditions are based on interpretation and judgement and as a result have uncertainty attached to them.

You should be aware that this report contains interpretations and conclusions which are uncertain, due to the nature of the investigations. No study can completely eliminate risk, and even a rigorous assessment and/or sampling programme may not detect all problem areas within a site. The following information sets out the limitations of this report.

3. This report should only be presented in full and should not be used to support any objective other than those detailed within the Agreement. In particular, this report does not contain sufficient information to enable it to be used for any use other than the Project specific requirements for which this report was created/prepared, which are detailed in the Agreement.

SKM accepts no liability to the Client for any loss and/or damage incurred as a result of changes to the usage, size, design, layout, location or any other material change to the intended purpose contemplated under the Agreement.

4. It is imperative to note that this report only considers the site conditions current at the time of investigation, and to be aware that conditions may have changed due to natural forces and/or operations on or near the site. Any decisions based on the findings of this report must take into account any subsequent changes in site conditions and/or developments in legislative and regulatory requirements. SKM accepts no liability to the Client for any loss and/or damage incurred as a result of a change in the site conditions and/or regulatory/legislative framework since the date of this report and/or the time at which the investigation took place.

5. This report is based on an interpretation of factual information available and the professional opinion and judgement of SKM. Unless stated to the contrary, SKM has not verified the accuracy or completeness of any information received from the Client or a third party during the performance of the services under the Agreement, and SKM accepts no liability to the Client for any loss and/or damage incurred as a result of any inaccurate or incomplete information.



6. This report provides information on-site conditions as revealed through selective sampling. The findings are the result of standard assessment techniques used in accordance with normal practices and standards, and (to the best of our knowledge) they represent a reasonable interpretation of the current conditions at the site. However, these findings, interpretations and assumptions cannot be substantiated for areas that remain untested. For these untested areas, this report should be regarded as preliminary advice only.

7. Any reliance on this report by a third party shall be entirely at such party's own risk. SKM provides no warranty or guarantee to any third party, express or implied, as to the information and/or professional advice indicated in this report, and accepts no liability for or in respect of any use or reliance upon this report by a third party.

8. This report makes no comment on the presence of hazards or hazardous materials, not specifically covered in its scope.

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ATTACHMENT

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Traffic Impact Assessment

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Logan Greyhound Facility

TRAFFIC IMPACT ASSESSMENT

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Logan Greyhound Facility

TRAFFIC IMPACT ASSESSMENT

■ 15 March 2010

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1 Introduction

This Traffic Impact Assessment (TIA) has been prepared for Greyhounds Queensland, in support of a material change of use (MCU) development application (DA) for the Logan Greyhound Facility, a proposed Outdoor Sports and Recreation development in Logan City. The development details are as follows:

- Lot 658 on SL12298.
- Cnr Kingston Road and Compton Road.

1.1 Objective of assessment

The objective of this assessment is to determine the traffic and transport related impacts of the proposed development and to recommend mitigation measures (if any). The objective of this assessment is to also demonstrate that the traffic and transport aspects of the DA comply with state and local Council requirements.

1.2 Scope of assessment

Pre-lodgement discussions with representatives of both the Department of Transport and Main Roads (DTMR) and Logan City Council (LCC) officers have determined that the assessment of the development's operational traffic impacts is to focus on issues related to on site access and impacts on the state controlled road network (refer to DTMR and LCC pre lodgement records in Appendix A). These issues have been addressed in detail in Chapter 4. The demonstration of LCC code compliance is also documented as part of this assessment in Section 2.8.

1.3 Assumptions and limitations

The following assumptions and limitations apply to this assessment:

- Traffic information has been obtained from DTMR Census data, which include data that has been collected over 12 or 24 hour periods on specific days, and may therefore be affected by weekly or seasonal variations.
- Assumptions on traffic generation and distribution have been made in consultation with Greyhounds Queensland from information from the existing Brisbane Racing Club, a similarly sized facility located in Albion, Brisbane. The basis of such assumptions are discussed in detail in this report and where a range of values has been determined, the worst case scenario has been adopted in the assessment.

- This assessment provides an overview of the potential traffic and transport related impacts associated with the proposed development. If required, detailed Road Use Management Plans (RUMPs) and/or Traffic Management Plans (TMPs) will be developed and submitted for approval subsequent to detailed project design.

1.4 The content and layout of this document

This traffic impact assessment consists of the following parts:

- ▣ Part 1 contains an overview of the report and its scope.
- ▣ Part 2 contains a description of the proposed development and its design compliance with LCC and Australian Standards requirements.
- ▣ Part 3 contains a description of the existing traffic and transport conditions.
- ▣ Part 4 contains a summary of the traffic impact assessment.
- ▣ Part 5 contains a summary of conclusions drawn from this assessment.
- ▣ The Appendices contains supplemental Technical Notes and drawings and diagrams that are not available in a published form.

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2 Proposed development

2.1 Uses and operation

The development proposal comprises the redevelopment of Cronulla Park, a 10.24 hectare site, located in the corner of Kingston Road and Compton Road in Slacks Creek (Figure 2-1). The subject site is currently designated as public open space. The subject site was previously used as waste transfer station and is now decommissioned. The proposed development plan is attached as Appendix B, and (as shown) it includes a greyhound racetrack with a grassed tiered viewing area for patrons, parking for patrons and greyhound trailers, and ancillary uses within a proposed facility building. These ancillary uses include:

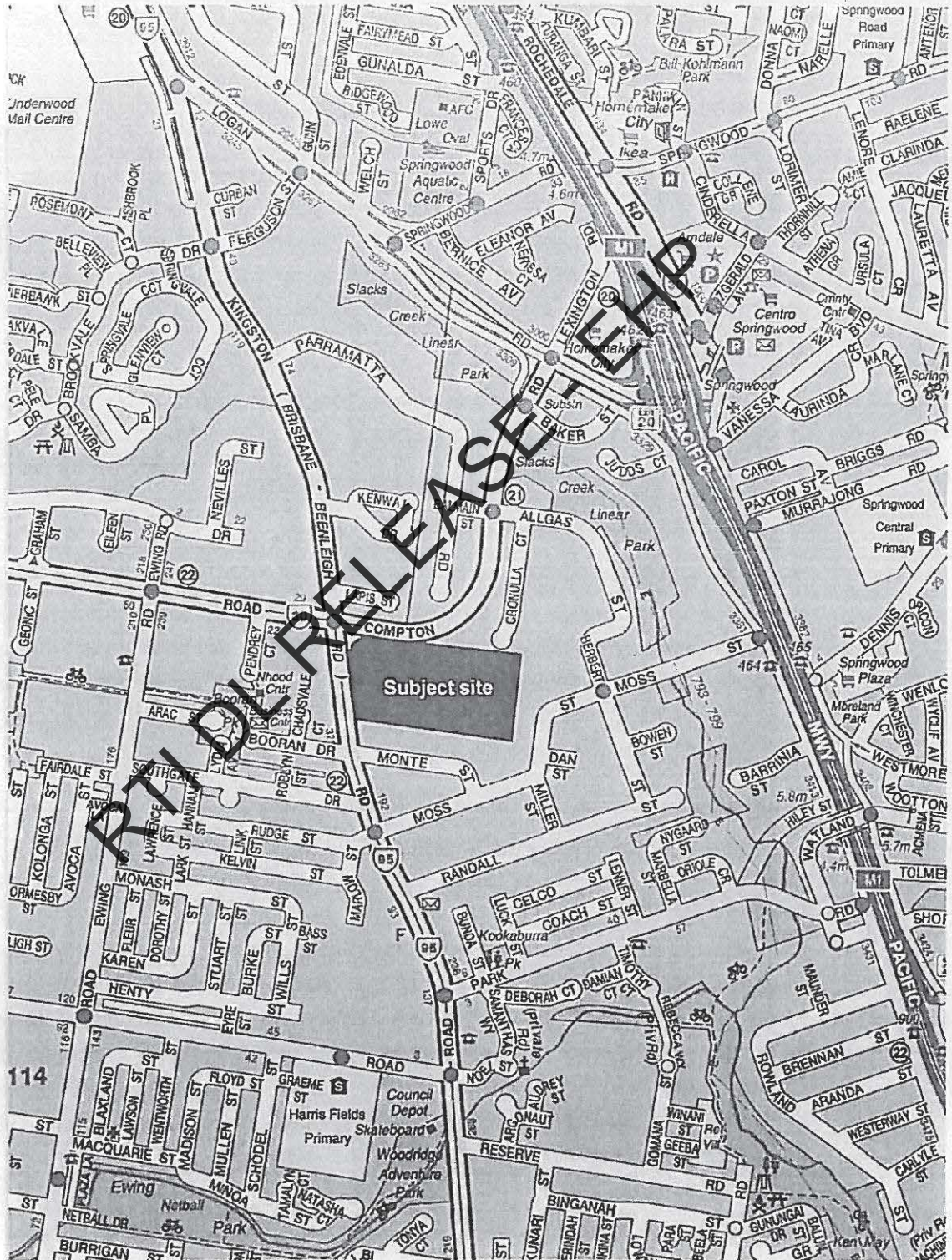
- Offices, including meeting and viewing rooms
- Restaurant, concours area and kitchen.
- Kennels and associated greyhound facilities and
- Amenities and plant/storage rooms

The proposed development will cater for four race meets per week, two of these events starting at approximately 6:30 pm with racing finished at 9:30pm, and Friday twilight, and the other two events starting at approximately 4:00pm and finishing at 7:00pm. The restaurant component (when open) open 30 minutes before and after the races. Operation of the facility will be similar to that of the existing facility at Albion, Brisbane, with expected attendance as follows:

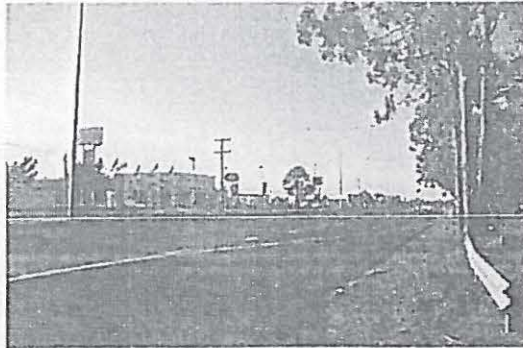
- Normal race meet, approximately 100-150 patrons.
- Race meet with restaurant operational, up to an additional 100 patrons.

2.2 Location

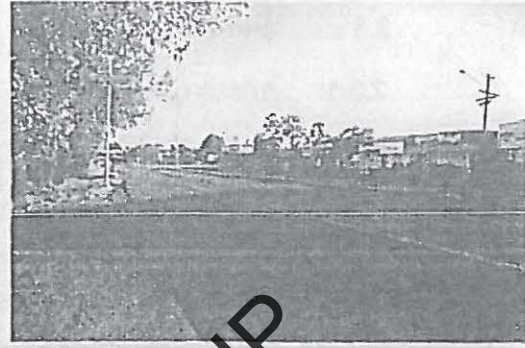
The subject site (refer to Figure 2-1) is located approximately one kilometre southwest of the Pacific Motorway interchange with Logan Road, and is at the intersection of Kingston Road and Compton Road, which front its western and northern boundaries respectively. Its northern boundary is also bounded by a light industrial estate and the terminus of Cronulla Court, a local industrial road. The subject site's eastern and southern boundaries are entirely bounded by adjoining industrial lots. Images of the subject site and surrounding road infrastructure are shown in Figure 2-2.



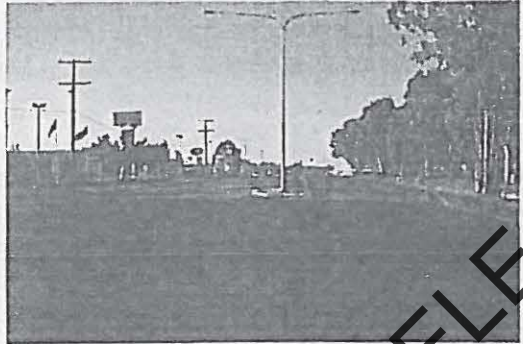
■ Figure 2-1 Subject site locality (image courtesy of UBD™)



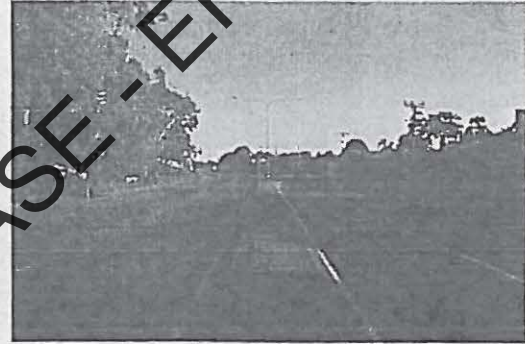
Existing Kingston Rd site access, viewing north



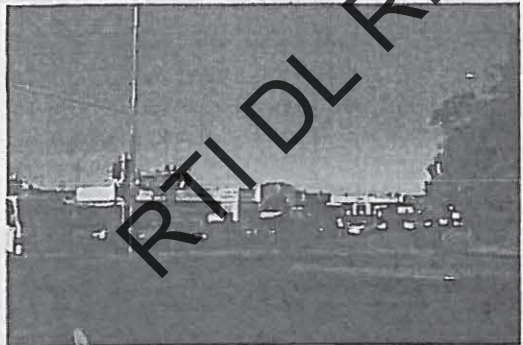
Existing Kingston Rd site access, viewing south



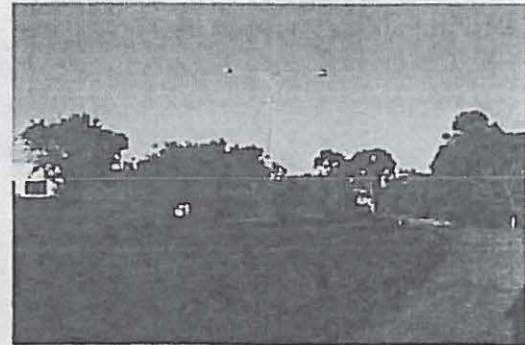
Kingston Rd median break, viewing north



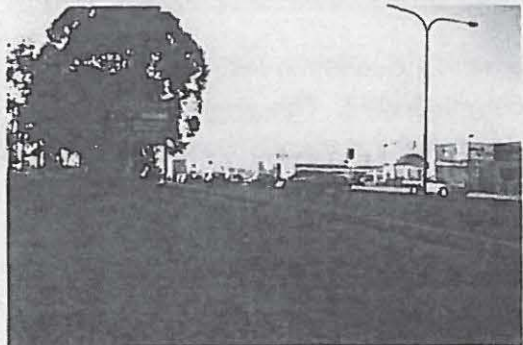
Kingston Rd median break, viewing south



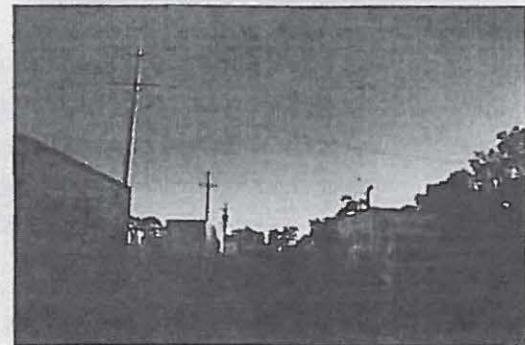
Kingston Rd/Compton Rd intersection, viewing east



Compton Rd access location, viewing east



Compton rd access location, viewing west



Cronulla Ct terminus, viewing south

■ **Figure 2-2 Images of surrounding road infrastructure**

2.3 Site access

2.3.1 Access operation

Two access points to the development are proposed; the first, an entry/egress in Kingston Road, in the vicinity of the existing site access and the second, an egress only on Compton Road, approximately 120 metres east of Kingston Road. The proposed Kingston Road access is intended to cater for all movements with exception of right turn egress. This development access arrangement has been agreed with LCC and DTMR officers in pre-lodgement discussions.

The egress-only access point in Compton Road is proposed as a left turn exit only, with a culvert proposed to be constructed over the existing swale to allow the crossover.

Overall, the proposed access arrangements allow ingress development movements from all possible directions. Egress is possible to all directions, with the movements to the east along Compton Road utilizing the existing U turn facility at Moss Street (if exiting via Kingston Road) or U turns further downstream in Compton Road (if exiting via Compton Road).

This overall arrangement is acknowledged as inefficient for the eastbound egress development movements in Compton Road and alternative provisions to allow direct eastbound egress were explored. An option to allow right-turn egress in Compton Road was considered but was determined as inappropriate due to issues associated with sight distance and the potential queuing in the Compton Road approach to the Kingston Road signals.

Retaining the current all-movement arrangement in Kingston Road was considered, however, this option was rejected because it would introduce additional conflict to bus movements, and has potential safety issues with respect to development traffic merging with the northbound queues.

The proposed development plan therefore includes the restriction of right-turn egress from the Kingston Road access, as agreed with DTMR. This arrangement would therefore eliminate development traffic conflict with the northbound queues. The implementation of signage provisions and way-finding measures would mitigate any issues associated with egress retrace movements on the immediate road network.

An existing regular TransLink bus stop is located 25 metres to the north of the proposed access point. Potential conflicts between bus and development traffic movements at the Kingston Road access will be minimised as follows:

- Locating the access point a further five metres south of the bus merge taper, further increasing the separation distance for weaving between development ingress and bus movements.
- Ensuring that the proposed access has unobstructed sight lines to the bus stop (and complies with sight distance requirements).
- Restricting right turn egress movements, as discussed previously.

In addition, the frequency of conflicting movements during race meets will be very low because as development demand is low (with in- and out-flow of patron traffic will be spread through the race meets), and the service frequency for the bus stop is currently one bus every 30 minutes. The last service currently occurring at 7:40pm (refer to Section 3.4) which is prior to the end of the night race meets.

2.3.2 Access geometry

The proposed crossovers have been designed in accordance with LCC requirements, with the crossover in Kingston Road as a Type D driveway. The crossover in Compton Road, proposed as restricted to left turn movements only, has been designed as a modified Type D driveway, with dimensions as per its exit lane requirements. Assessment of design vehicle movements through the proposed crossover provisions is discussed in detail in Section 2.4.

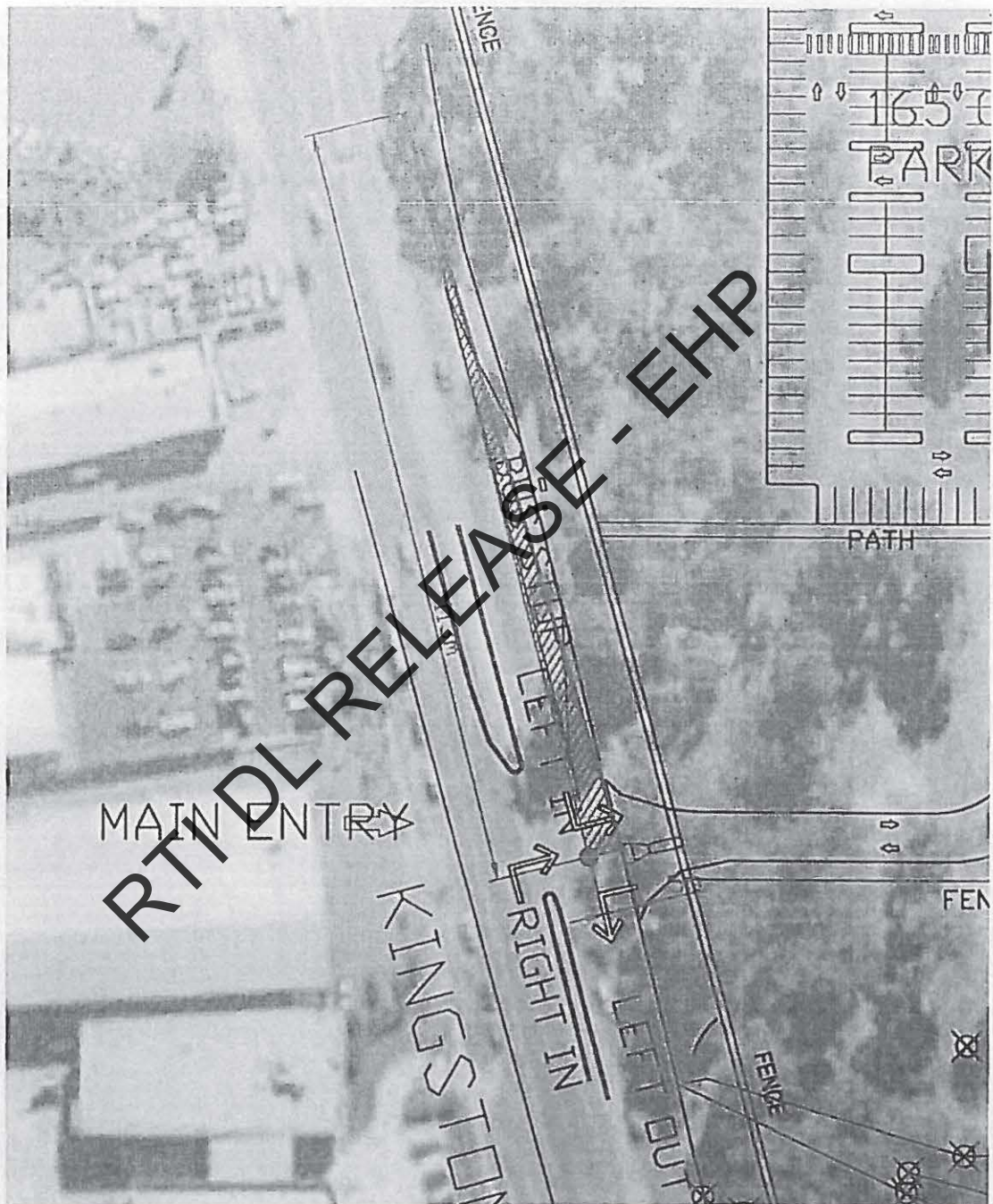
2.3.3 Access sight distance

A sight distance assessment at both intersections was performed in accordance with the *Austroads Guide to Traffic Engineering Practice (GTEP) Part 5* (Section 6.2). Parameters used included the following:

- Sight distance measured 1.05 metres eye height and 5 metres from the carriageway edge.
- For a speed environment (posted speed limit) of 70 km/hr in Compton Road, safe intersection sight distances of no less than 140 metres.
- For a speed environment (posted speed limit) of 60 km/hr in Kingston Road, safe intersection sight distances of no less than 113 metres.
- Maximum observation angles of 110 degrees right and 120 degrees left of vehicle centreline.

The measured safe intersection sight distances are depicted in Figure 2-3 and Figure 2-4. As shown, the proposed access locations comply with sight distance requirements at the proposed Kingston Road access. However on-site measurements determined that additional growth that would overhang the pavement at the southern edge of the centre median in Compton Road may obstruct the required sight line to the east. It is recommended that the necessary trees and foliage be trimmed back from the pavement edge initially (prior to development construction) then periodically as required, to comply with sight distance requirements.

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■ Figure 2-3 Safe intersection sight distance measurement at proposed Kingston Rd access

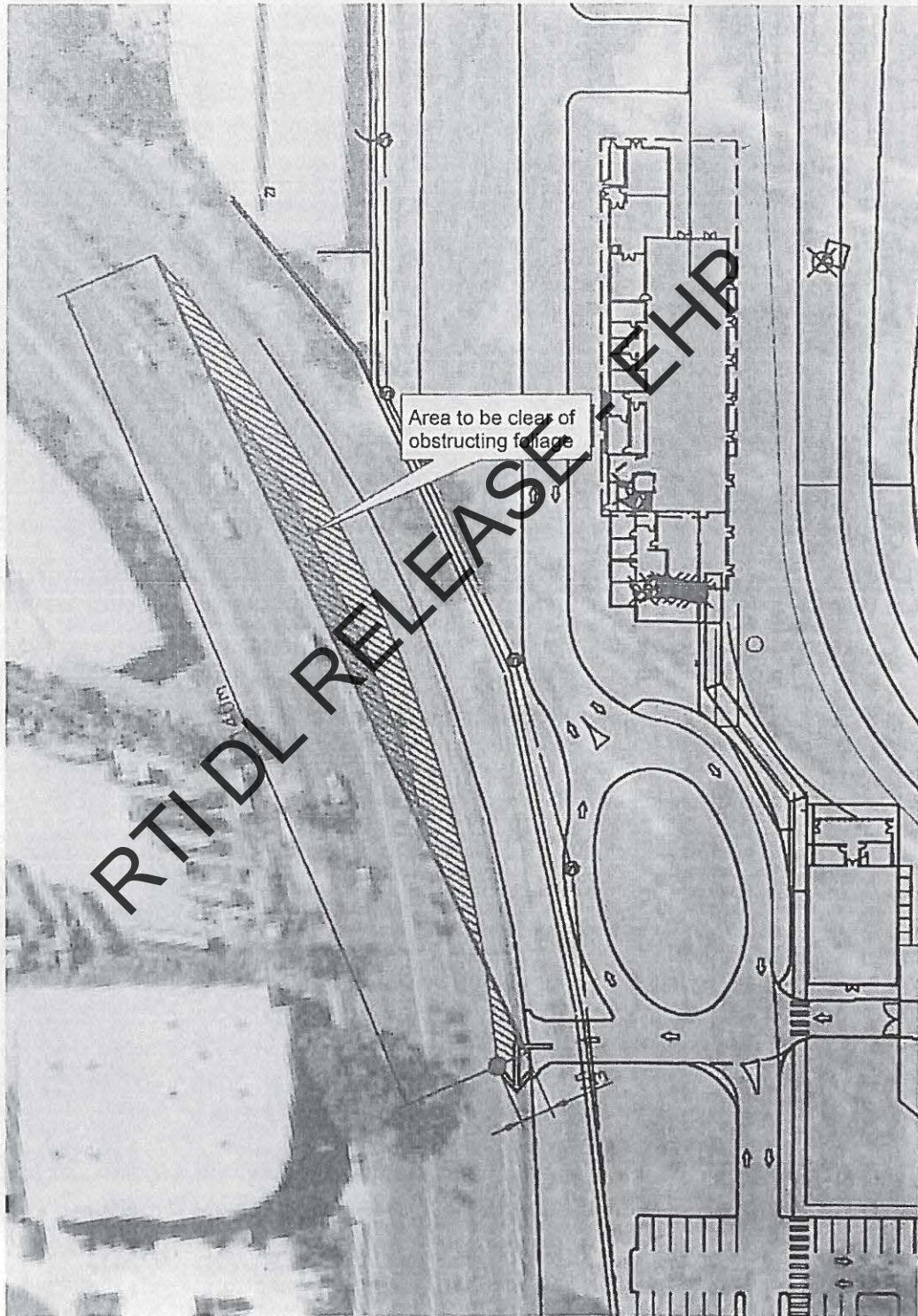


Figure 2-4 Safe intersection sight distance measurement at proposed Compton Rd access

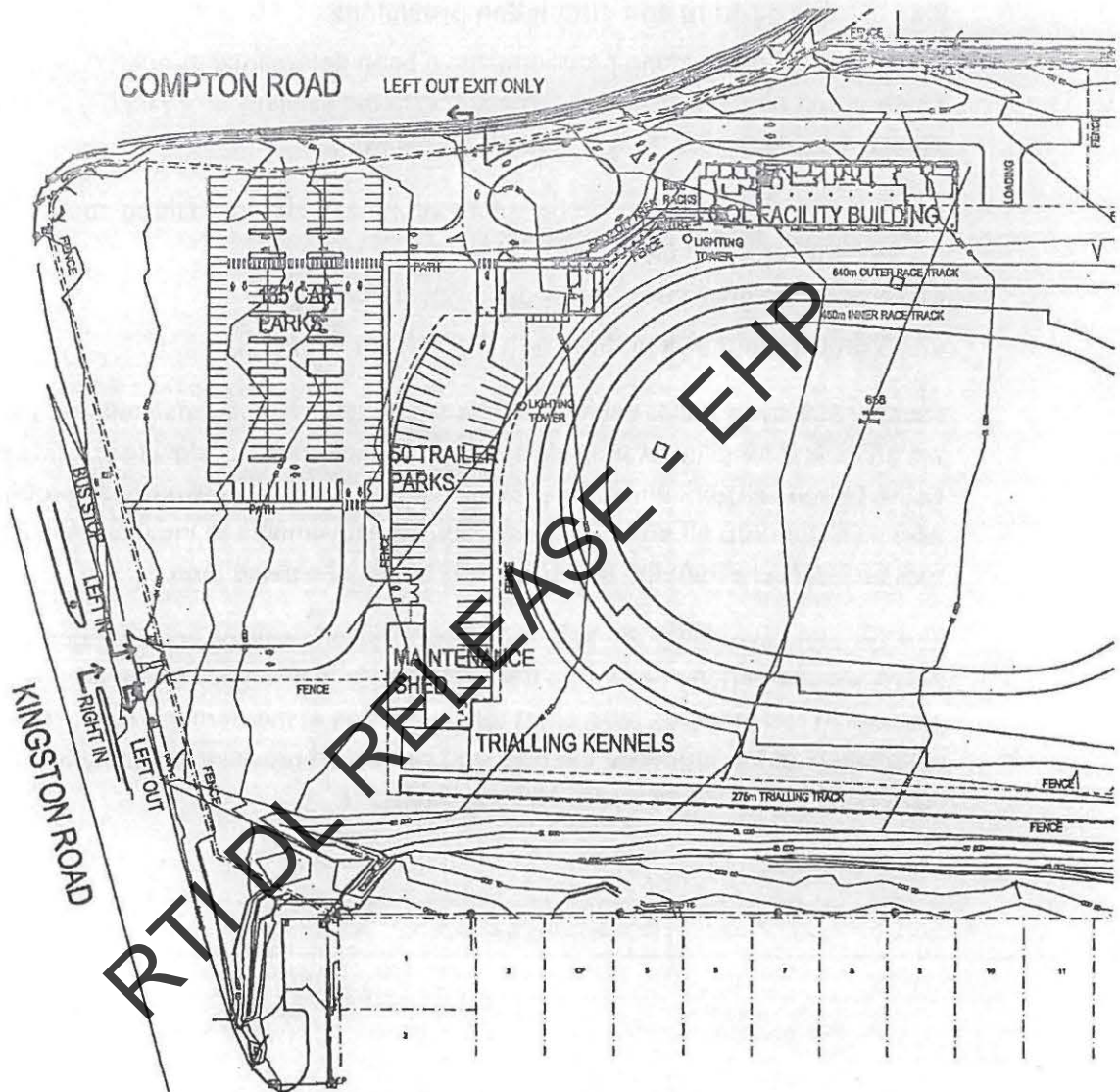
2.4 Car parking and circulation provisions

The proposed car parking provisions have been determined through Greyhounds Queensland and are similar in composition to the similarly sized facility in Albion. As depicted in Figure 2-5, they comprise the following:

- A single car park with 165 bays for patrons and staff, with three spaces dedicated for persons with disabilities (PWDs).
- A separate greyhound trailer park with 50 bays; and
- A drop off and pick up area with a seven car capacity.

Parking activity of trailer vehicles will be separated from patrons/staff and service vehicles via gates and fencing. A proposed internal roundabout will allow recirculation of vehicles to the patron car park and to the Kingston Road access. This proposed roundabout will also facilitate drop off and pick up activity and movements to the Compton Road exit, as well as access to/from the facility back of house or service area.

The car park layouts for the trailers and patron/staff vehicles are arranged in perpendicular parking bays. The trailer parking is in a single module and the patron/staff car park in two modules (with short terminal aisles at the northern end). The layout and dimensions of the proposed car park and circulation provisions comply with AS/NZS2890.1:2004 as summarised in Table 2-1.



■ Figure 2-5 Proposed parking and circulation provisions

Table 2-1 Car park and circulation provisions – AS/NZS2890.1:2004 compliance

Element	Proposed	AS/NZS requirement	Comments/reference
Patron bay	5.4m (L) x 2.6m (W)	5.4m (L) x 2.5m (W)	Complies, as per a Class 2 facility. Ref. AS/NZS 2890.1:2004 sections 1.4 and 2.4.1.
Patron car park aisle width	6.6m	5.8m	Complies, as per a Class 2 facility. Ref. AS/NZS 2890.1:2004 sections 1.4 and 2.4.1.
Trailer bay	10m (L) x 3.2m (W)	N/A	Complies with specific development requirement, identical to the greyhound facility in Albion.
Trailer park aisle width	9.7m	N/A	Complies with specific development requirement, identical to the greyhound facility in Albion.
Speed control devices	None	Aisles greater than 100m in length require traffic control devices (i.e. speed humps)	Complies. No aisle is more than 100 metres in length. Ref. AS/NZS 2890.1:2004 section 2.3.3.
Blind aisle length	Maximum 16m with 6 bays along each side	6 bays or less	Complies. Ref. AS/NZS 2890.1:2004 section 2.4.2.
Blind aisle extension	1m	1m	Complies.
Parking module gradient	Less than 1:50	Less than 1:20 parallel to parking, less than 1:16 in any other direction	Complies. Proposed minimum is 1:100 for drainage. Ref. AS/NZS 2890.1:2004 sections 2.4.6.
Straight circulation roadway	One-way: 4.8m Two-way: 5.6m	One-way: min. 3.0 m Two-way: min. 5.5m	Complies. Ref. AS/NZS 2890.1:2004 sections 2.5.2.

Element	Proposed	AS/NZS requirement	Comments/reference
Curved circulation roadway	One way: 4.8m inside radius, 16 m outside radius, 4.8m width Two-way: 13.5m inside radius, 19.5m outside radius, 6.8m width	One way: 4.0m inside radius, 7.6 m outside radius, width depending on curve radii Two way: 4.0m inside radius, 11.8m outside radius, width depending on curve radii	Complies. Ref. AS/NZS 2890.1:2004 sections 2.5.2.
Circulation roadway grade	Less than 1:50	Longer than 20m - less than 1:6, up to 20m - less than 1:5.	Complies. Ref. AS/NZS 2890.1:2004 sections 2.5.3.
Circulation roadway horizontal vehicle clearances	300mm for circulation roadways and 60mm for crossovers	As per ECC requirements, consistent with AS/NZS: 300mm for circulation roadways and 60mm for crossovers	Complies. Ref. AS/NZS 2890.1:2004 sections 2.5.2.

2.5 Pedestrian provisions

As determined from patron information from the existing greyhound facility in Albion, walk-up demand will be negligible with all patrons anticipated to either drive or take public transport to the development. Pedestrian provisions are therefore proposed to comprise internal footpaths and walkways, with a linkage to the bus stop in Kingston Road.

A two metre wide foot path is proposed to separate patron (pedestrian) movements to vehicle movements between the car park and drop-off /pick-up areas, and the kennel block and facility buildings. The alignment of pedestrian paths to the car park and bus station is the shortest possible route between these areas (refer to Figure 2-6). Within the car park, the foot paths connect to a proposed line marked crossing that connects both modules of the patron car park.

The pedestrian movements between the trailer park and the kennel facilities are proposed to be segregated from the patron trafficked areas by a barrier fence.

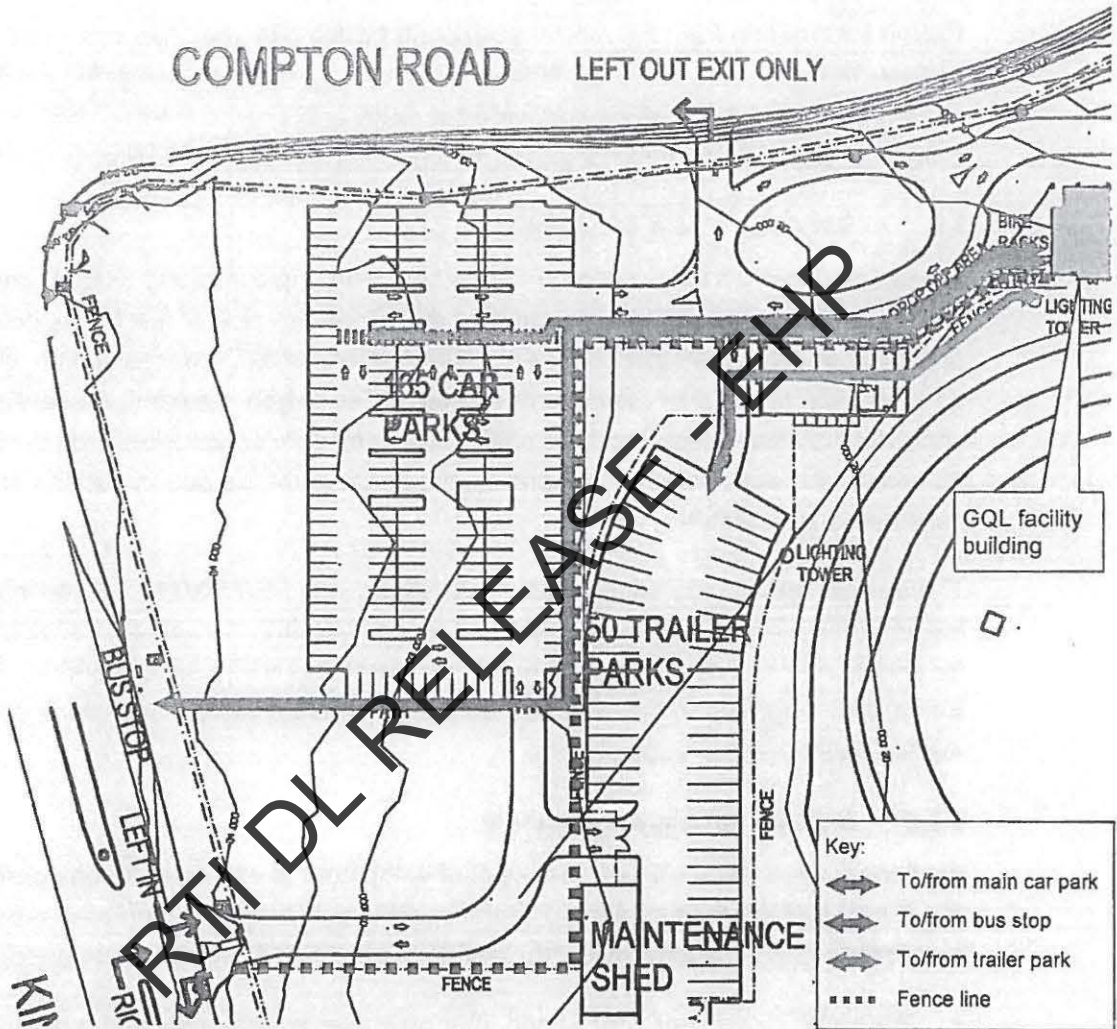


Figure 2-6 Development pedestrian desire lines

2.6 Bicycle provisions

Patron information from the Albion greyhound facility has identified that cyclist demand will be low. Although estimated demand is low, bicycle provisions comprising a standard outdoor rack, is proposed to be provided in close proximity to the entrance of the proposed GQL facility building, just to the east of the proposed patron drop off area.

2.7 Service vehicle provisions

A dedicated service bay to accommodate two heavy rigid vehicles (HRVs) and vehicle turn around/manoeuvre area is proposed at the eastern side of the facility building. The proposed development plan allows egress to occur via either access point, with service vehicles able to traverse the eastern module of the patron car park. As servicing will be conducted outside meet times, no conflict between service vehicles and patron/trailer movements is anticipated, and therefore the traversal of the patron parking areas is considered acceptable.

The design vehicle was adopted as a heavy rigid vehicle (HRV) as agreed in pre-lodgement meetings with LCC officers. Assessment of the proposed development plan for on-site manoeuvring was performed in accordance with AS/NZS2890.2:2002 (refer to swept path diagrams in Appendix C). As shown, service vehicle provisions comply with AS/NZS2890.2:2002 requirements.

2.7.1 Internal queuing provisions

As discussed in Section 2.3.1, in-flow of development is estimated to be spread through the duration of the race meets. In lieu of specific guidance, queuing area provisions have been calculated in accordance with Section 3.4 of AS/NZS2890.1:2004 as follows:

- For trailer movement prior to and after race meets, and assuming a peak in-flow of more than 75% capacity for a car park of not more than 100 vehicles, a queue length of two cars (with trailers) is required.
- For patron movements just prior to, during and just after race meets, assuming a peak in-flow of up to 75% of capacity for a car park of not more than 100 vehicles, a queue length of three cars is required.

The proposed development plan includes a queuing provision of more than 70 metres (equivalent to 12 car lengths), and therefore complies with Australian Standards.

2.8 LCC code compliance

Compliance of the proposed parking, access and circulation provisions with LCC constraint codes is documented in Appendix F.

3 Existing traffic and transport conditions

3.1 Subject site

The subject site is a decommissioned waste transfer station. Vehicular access is currently gained via a gated driveway in Kingston Road, located approximately 150 metres south of Compton Road. The majority of the site is relatively flat with slight landfall from west to east. Open channel drains parallel to the site's northern, eastern and southern boundaries provide drainage to the site. No off street foot paths are currently provided in either road frontages, while footpaths exist at the opposite side of the road in both Kingston Road and Compton Road.

3.1.1 Kingston Road

Kingston Road (Brisbane-Beenleigh Road) is an arterial road controlled by the DTMR; it provides an arterial route largely parallel to the Pacific Motorway between Brisbane and Beenleigh. It intersects Compton Road, a LCC controlled road, via a four-way signalised intersection, which has left turn slip lanes in all approaches except for the southern Kingston Road approach, and right turn auxiliary lanes in all approaches. Pedestrian crossings are also provided in all approaches.

At the southern approach, turning provisions comprise a shared left turn and through auxiliary lane with 50 metres storage, a continuous shared through and right turn lane (adjacent to a continuous through lane) and a right turn auxiliary lane with 30 metres storage. The shared left turn and through lane also provides access to a one-way crossover to service station and its ancillary uses at the southwest corner of the intersection. A regular TransLink bus stop is also located in this lane.

Adjacent to the site, Kingston Road has a 60 km/hr posted speed limit and has four through lanes, two in each direction, split by a raised central median. In the southern direction it has a four metre wide shoulder, while in the northern direction it has a parking lane. Adjacent to the subject site, Kingston Road has straight horizontal alignment, and a vertical alignment that has a gentle (less than 2% grade) downward slope from north to south.

A break in the central median currently allows all movements to occur to/from the existing driveway, located 150 metres south of Compton Road. A 30 metre right turn auxiliary lane allows storage of five cars. To the north, and immediately adjacent to the existing driveway, a regular TransLink bus stop is linemarked within the auxiliary (shoulder) lane, with the southern extremity of its egress taper roughly aligned with the northern edge of the central median break.

Adjacent to the southwest corner of the subject site, Monte Street, a LCC controlled industrial access road, intersects Kingston Road via a left in/left out T-intersection with a raised splitter island. Approximately 150 metres further south, Kingston Road intersects Moss Street, an LCC industrial road via a four-way signalised intersection. U turns to/from the north are allowed at this intersection, with a 30 metre long auxiliary lane allowing storage for U turn and right turn movements.

Property crossovers exist at the northbound side of Kingston Road, which are limited to left turn ingress and/or egress.

3.1.2 Compton Road

Compton Road is an LCC controlled arterial road which connects Beaudesert Road (a State controlled road) and the Gateway Motorway to the west and the Pacific Motorway to the east via Logan Road. At the subject site's northern boundary, Compton Road has a posted speed limit of 70 km/hr with four through lanes (two lanes in either direction) with a central raised median. No crossovers to properties exist in its segment to the east of Kingston Road. In the eastern approach to its intersection with Kingston Road, a single 60 metre long right turn auxiliary lane is provided, however U turns are prohibited (due to the absence of 'R215 U Turns Permitted' signage).

Approximately 600 metres to the northeast of its intersection with Kingston Road, Compton Road intersects Allgas Street and Balmain Street, two LCC controlled industrial access roads, via a four-way signalised intersection. A further 300 metres and 450 metres northeast respectively, Compton Road intersects Baker Street and Logan Road/Lexington Road (all LCC controlled roads).

Discussions with LCC officers indicate that a high standard off-road bicycle route is planned between Nyanza Street to the west of the subject site and the Springwood bus station to the east. This would allow a continuous off road link between the bus station to Gould Adams park in Kingston. LCC is not planning a similar facility at the subject site frontage currently due to the cost, constructability and safety issues associated with the existing swale drain in the road verge.

3.2 Surrounding land uses

The subject site is largely surrounded by commercial/light industrial land uses, with bulky goods centres located diagonally opposite at the corner of Kingston Road and Compton Road and at the corner of Lexington Road and Logan Road. Further afield, the Springwood Centro shopping complex and surrounding retail developments are located just to the east of the Pacific Motorway interchange with Logan Road.

At the periphery of the surrounding light industrial/commercial precinct, low density residential areas extend to the suburbs of Underwood to the north, Woodridge to the southeast, and Springwood to the east.

3.3 Traffic environment

A permanent count site is located in Kingston Road just north of Compton Road, which provides 24 hour two-way traffic data as part of the DTMR Census program. A summary of average weekday and weekly average traffic for each calendar year between 2003 and 2008 from this site is summarised in Table 3-1 and further detailed in Appendix D.

Table 3-1 Kingston Road surveyed daily traffic (DTMR permanent count site north of Compton Road)

Year	Two-way total volumes	
	Average week day [vpd]	Average day (including weekends) [vpd]
2003	26,600	24,200
2004	26,500	24,000
2005	22,400	20,300
2006	26,500	24,200
2007	26,700	24,400
2008	25,600	23,300

Traffic data from the permanent site (Table 3-1) indicates that average week day and average day through volumes in Kingston Road have been constant, with a decline recorded in 2005. A downward trend is possible based on comparative 2007 and 2008 averages.

For the purposes of the assessment, and due to the fluctuating historical trends, a 1.2% annual compound growth was derived from Brisbane City Council's Brisbane Strategic Transport Model (BSTM) and applied for background demand calculations for the assessment of traffic impacts. This growth rate is conservative, given the trend of the latest historical data.

Intersection counts were conducted by DTMR as part of their Census program at the Kingston Road/Compton Road intersection during Monday 20 May 2002 and again in Tuesday 26 September 2006, and at the Kingston Road/Rudge Street/Moss Street intersection in 2002. The Census intersection data is summarised in Figure 3-1 and further detailed in Appendix D. A comparison of the data yields the following:

- 12-hour survey period intersection totals decreased from the 2002 from 45,000 vehicles in 2002 to 43,000 vehicles in 2006;
- The morning peak period total (all movements) decreased from 4,800 vehicles per hour (vph) in 2002 to 4,500 vph in 2006.
- Similarly, the afternoon peak hour total decreased from 6,100 vph (2002) to 4,700 vph (2006).

While the above does not take into account possible seasonal variation, the latest (2008) DTMR permanent count data (refer to Appendix D) for the permanent count site north of Compton Road indicate that weekday demand in Kingston Road is lowest on a Monday and peaks on a Fridays.

On-site observations in October 2009 during a weekday (Tuesday) morning and afternoon peak periods confirms that, in terms of total volume, the dominant movements are the northbound (in the morning peak) and southbound (in the afternoon peak) movements in Kingston Road. The critical movement, however, was the opposing right turn from Compton Road (east); during the peak 15 minutes of the afternoon peak period, right turn queues were observed, to sporadically block the stop bar for through traffic due to high utilization of the right turn lane.

Other key observations were as follows:

- Few pedestrian movements in any approach of the Kingston Road/Compton Road signals (in the order of five pedestrians were observed traversing the crossings during each peak period).
- No U turn movements occurred (or are permitted) at the Kingston Road/Compton Road signals, with exception of the northern Kingston Road approach.
- The signal timing and split phasing in all approaches of the Kingston Road/Compton Road signals appear to be designed to accommodate coordinated (platooned) arrivals at each approach, favouring the north and southbound movements in Kingston Road. Both Kingston Road intersections with Compton Road and Moss Street appeared to be at, or close to saturation limits, with vehicles observed to progress the signals after two cycles (in particular at the Compton Road approaches to Kingston Road).
- Queuing in the southern Kingston Road approach to Compton Road was longest in the morning peak period. However queue extended to just beyond the existing median break opposite the existing site access.
- Queuing in the eastern Compton Road approach to Kingston Road was longest during the afternoon peak period, and extended to approximately 500 metres to the east, at the apex of its curve east of the signals.
- Queuing in the northern approach to Moss Street was longest in the morning peak period and extended past the northern driveway of an existing service station south of Monte Street, but well away from the existing site access.
- No vehicles used the existing median break in Kingston Road to access the site or to make a U turn.
- Low utilisation of the existing bus stops in Kingston Road (in the order of two patrons were observed in either peak period).

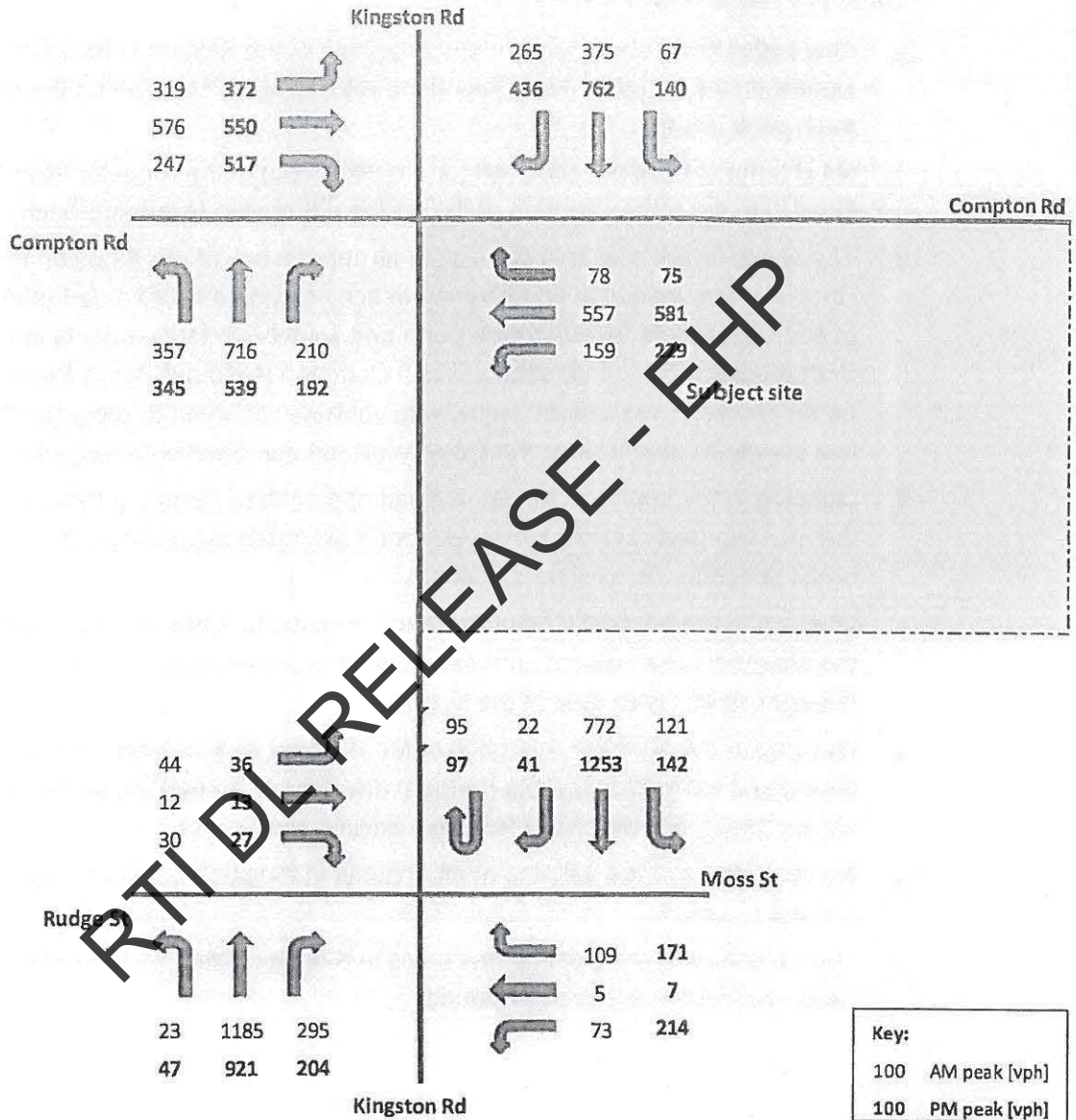


Figure 3-1 Summary of 2006 intersection count data (derived from the DTMR Census) – Kingston Road/Compton Road

3.4 Public transport

As discussed in Section 3.1.1, a regular bus stop is located in Kingston Road 25 metres to the north of the existing site access. The bus stop serves a single scheduled bus route, TransLink Route 545, which has a service frequency of every 30 minutes between 6:45am and 7:40pm on weekdays and hourly on weekends between 8:40am and 5:40pm on weekends and public holidays. This route connects the Garden City bus interchange and park and ride facility and the Grand Plaza in Browns Plains, via Browns Plains Road, Kingston Road and Logan Road. This route also services the Woodridge railway station via Wembley Road and Smith Road off Kingston Road.

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4 Traffic impacts

4.1 Development traffic generation

The proposed development will cater for two race meets per week, on Monday night around 6:40 pm, and Friday twilight, around 4:00 pm. Anticipated operation of the facility will be 50 patrons per meet initially. To be conservative, the development traffic is estimated to increase to levels comparable to the existing facility at Albion, Brisbane as summarised in Table 4-1.

Table 4-1 Anticipated facility operation and estimated vehicular demand

	Monday night race meeting	Friday twilight race meeting
Start of first race/start of last race	6:40pm/9:45pm	4:00pm/6:30pm
Arrival of trainers	4:45pm to 5:45pm	1:45pm to 2:45pm
Arrival of patrons	From 6:30pm (throughout the meeting)	From 3:45pm (throughout the meeting)
Estimated trainer demand [vehicles]	50 (max.)	50 (max.)
Estimated number of patrons [persons]	200	250
Estimated patron demand (static parking) [vehicles]	100	125
Estimated staff demand (static parking) [vehicles]	40	40
Estimated patron demand (set down/pick up) [vehicles]	48	56

Adopting the Albion operational characteristics would result in peak development traffic demand occurring during the Friday twilight race, with the commencement of patron arrivals to occur 15 minutes prior to the start of the afternoon peak period. Staff and trainer vehicles would begin arriving between half an hour and an hour prior to patron arrivals.

During a Friday race meet, inbound movements, plus some outbound movements by patrons would coincide with the PM peak period. To be conservative, and for the purposes of the capacity assessment, all patron ingress movements to the car park, plus all patron set down ingress and egress movements are assumed to occur during this period, with no linked set down and static parking activity. The total peak hour development demand would therefore total 180 ingress and 56 egress movements.

Outside the race meets, traffic would comprise those associated with the ancillary uses and servicing or maintenance, with the majority comprising trips to/from the office facilities. Average vehicular demand for this traffic is estimated to be low, in the order of 20 trips per day.

Total daily demand during a race meet day is therefore estimated as 200 and 290 trips per day on Monday and Friday respectively, and 20 trips per day during all other days.

4.2 Development traffic distribution

In lieu of unavailable market data for the proposed development, development traffic distribution has been estimated as 30% to/from the north, 20% to/from the east, 30% to/from the south, and 20% to/from the west, corresponding to background traffic distribution at the Kingston Road/Compton Road intersection. Application of this traffic distribution to estimated demand during the race meets results in development traffic movements as depicted in Figure 4-1.

As shown in the figure, left and right turn movements are estimated not to occur at the Compton Road/Balmain Street/Allgas Street signals. The proportion of estimated development demand to east-west through movements at this intersection is very low (in the order of 1%). Development impacts on this intersection would therefore be negligible.

Estimated development demands at the Kingston Road intersections of Compton Road and Moss Street indicate that development movements would be equivalent of just over 5% of estimated opening year background for the left turn movements (east to south) in Kingston Road/Compton Road, and U turn movements in Kingston Road/Moss Street. As required by DTMR, the detailed assessment of these intersections is warranted. The assessment of these two intersections (in addition to the Kingston Road/Site access intersection) is detailed in Section 4.3.

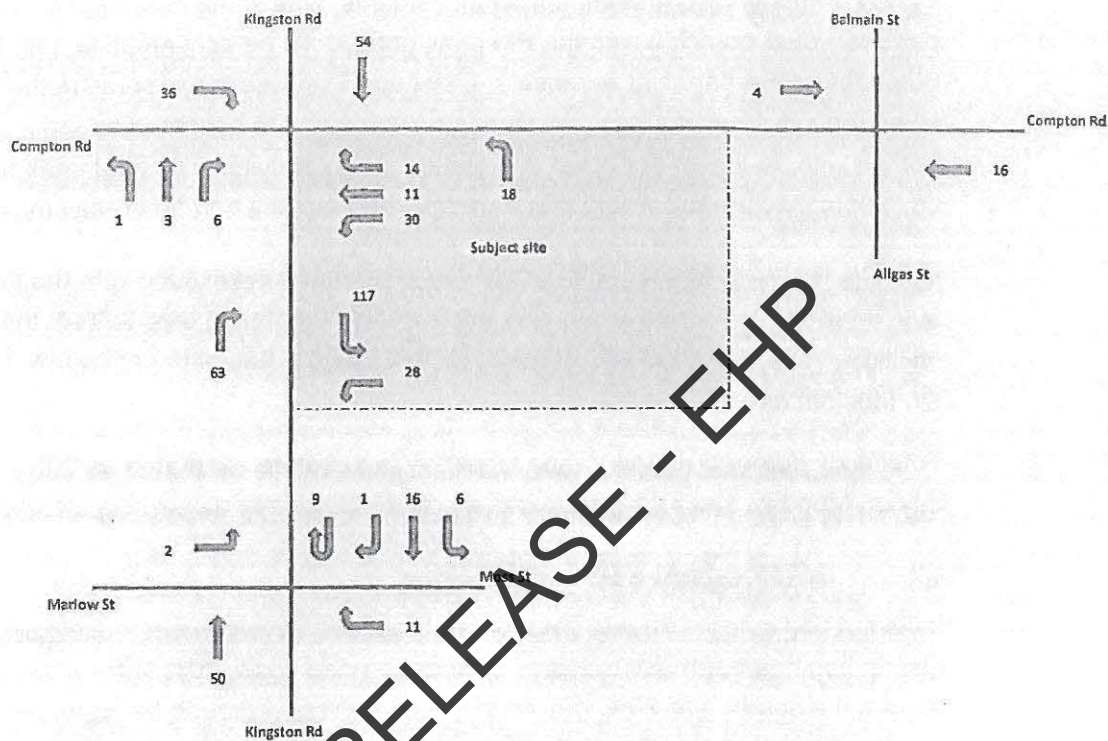


Figure 4-1 Estimated development traffic movements, PM peak hour

4.3 Intersection performance

Intersection performance for the Kingston Road intersections with Compton Road, the site access and Moss Street was determined using the aaSIDRA3.2 intersection analysis suite, for the following critical PM peak period. An opening year of 2011 and is discussed in Section 3.3, a background growth of 1.2% compound per annum were assumed for the assessment.

Signal cycle times and phasing were derived from DTMR (refer to Appendix D). Results of the analysis are summarised in Table 4-2 to Table 4-4, also further detailed in Appendix E. The intersection analysis results indicate the following:

- Confirmation that both Kingston Road intersections with Moss Street and Compton Road will respectively operate at and just beyond saturation levels.
- The additional development traffic demand is low and only represents additional estimated movements just greater than 5% of background movements for left turns (east to south) in the Compton Road approach and U turns in the northern Kingston Road approach at Moss Street. The additional development demands will not impact significantly on the operation of the signalised intersections.
- Current and future intersection capacity issues are due to inefficiencies in signal timing and phasing, and allowed movements, both at the signals and midblock in Kingston Road (in addition to of background demand). While the assessment of mitigation measures for these issues are outside the scope of this report, from first inspection, the provision of additional turn lanes in Kingston Road/Compton Road and rearranging of phasing may improve the intersection capacity. The provision of a midblock right turn lane at Monte Street would alleviate retrace routing via U turns at the Moss Street signals. Such measures would need to be assessed at the network wide level.
- Assessed as a priority intersection, the Kingston Road/site access intersection is estimated to operate acceptably. Since this intersection is mid block to a set of coordinated signals, estimates of intersection performance (and progression of development traffic) would see an improvement if arrival flow is more accurately analysed as platoons, i.e. the intersection under signal control.
- The assessment of the 2021 time horizon is not warranted due to capacity issues associated with background traffic, and as estimated development traffic movements would fall below the 5% threshold at 2021 volumes.
- Internal queuing capacity, as previously estimated in Section 2.7.1, are adequate.

Table 4-2 SIDRA intersection analysis results, Kingston Road/Compton Road 2011 PM peak period

Scenario	Direction / overall	Flow [vehicles]	Degree of saturation [X] ¹	Average delay [s]	95th percentile queue [m]
2011 without development	South	1,141	0.96	50.7	147
	East	939	0.99	116.6	326
	North	1,418	1.00	41.6	258
	West	1,513	0.97	73.2	249
	Overall	5,011	1.00	67.3	326
2011 with development	South	1,152	0.97	50.9	159
	East	994	1.00	63.4	267
	North	1,472	1.00	46.4	258
	West	1,549	1.01	62.8	259
	Overall	5,167	1.01	55.6	267

(1) The degree of saturation (or X value) tabulated is the ratio of demand to available capacity for the most critical movement at the intersection. An X of 0.90 represents a desirable maximum for acceptable operation of signalised intersections and roundabouts. For priority intersections an X above 0.80 indicates more formal control is warranted.

Table 4-3 SIDRA intersection analysis results, Kingston Road/Site access 2011 PM peak period

Scenario	Direction / overall	Flow [vehicles]	Degree of saturation [X] ¹	Average delay [s]	95th percentile queue [m]
2011 with development	South	1,341	0.80	5.9	30
	East	31	0.33	55.4	10
	North	2,029	0.54	0.5	0
	Overall	3401	0.80	3.1	30

(1) The degree of saturation (or X value) tabulated is the ratio of demand to available capacity for the most critical movement at the intersection. An X of 0.90 represents a desirable maximum for acceptable operation of signalised intersections and roundabouts. For priority intersections an X above 0.80 indicates more formal control is warranted.

Table 4-4 SIDRA intersection analysis results, Kingston Road/Moss Street/Rudge Street
2011 PM peak period

Scenario	Direction / overall	Flow [vehicles]	Degree of saturation [X] ¹	Average delay [s]	95th percentile queue [m]
2011 without development	South	1,369	0.79	10.2	70
	East	459	0.85	46.3	83
	North	1,791	0.90	12.6	138
	West	90	0.16	15.6	15
	Overall	3,709	0.90	15.9	15
2011 with development	South	1,424	0.86	9.5	73
	East	467	0.90	51.7	89
	North	1,829	0.89	11.3	125
	West	89	0.17	15.4	15
	Overall	3,809	0.90	15.7	125

(1) The degree of saturation (or X value) tabulated is the ratio of demand to available capacity for the most critical movement at the intersection. An X of 0.90 represents a desirable maximum for acceptable operation of signalised intersections and roundabouts. For priority intersections an X above 0.90 indicates more formal control is warranted.

5 Conclusions

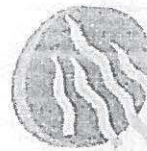
The traffic impact assessment (TIA) has determined that traffic associated with the proposed development will have no significant impact on the capacity and operation of the surrounding road network. Development traffic movements will coincide with the commuter peak periods during the PM peak, and detailed intersection analysis confirmed that development traffic will not significantly impact on the current levels of service of the key intersections of Kingston Road with Compton Road and Moss Street during the opening year and 10-year (post opening) design horizons.

The TIA also demonstrates that the traffic and transport aspects of the DA comply with the requirements of Australian Standards, the Department of Transport and Main Roads and the Logan City Council, including those for access, car parking, servicing and pedestrian provisions. Mitigation measures for minimising impacts on the surrounding road network associated with development traffic include the implementation of signage provisions and way-finding measures, ensuring that sight lines are maintained at the access points, particularly at the proposed Compton Road access (via tree management), and the implementation of traffic control plans during construction of the development.

SKM

Appendix A Pre-lodgement records

RTI DL RELEASE - EHP



Queensland
Government

13 October 2009

Greyhound Racing Authority
C/- ML Design
GPO Box 714
BRISBANE QLD 4001

Attention: Andrew Gaffney

Dear Sir/Madam

PRE-LODGE MENT ADVICE

Logan City Council: Brisbane-Beenleigh Road
Proposed Material Change of Use: Outdoor Sport and Recreation (Greyhound Track)
Lot 658 on SL12298
Situated at Kingston Road, Kingston

Thank you for your request for pre-lodgement advice received by this department on 25 September 2009 regarding the above proposal.

It is expected that the Department of Transport and Main Roads would be a Concurrence Agency for the proposal should a development application be formally lodged with the assessment manager under Section 3.2.1 of the *Integrated Planning Act 1997*. The department has undertaken an initial assessment of the proposal and assessed its impact on the State transport network.

Please refer to the attached 'Pre-lodgement Record' which list the department's areas of interest and possible requirements for the proposal.

The aim of this pre-lodgement advice is to provide initial advice on likely major issues relevant to a development proposal to assist in the timely processing of a future application. It cannot replace the in-depth investigation normally associated with the formal assessment of an application and consideration of any public submissions. While the advice is given in good faith, it in no way binds a decision by the Department of Transport and Main Roads.

Yours sincerely / / / /

49-Sch4 - Signature

for Paul Noonan
District Director (Logan)

Enc - Pre-lodgement Record

Roads Business Group/Regions
South Coast Region/Logan District Office
3912 Pacific Motorway, Loganholme
PO Box 7262, Loganholme Qld 4129
ABN 57 836 727 711

13-054

DL Documents

Our ref 240/204/658SL122998 djn-djn.155 10429

Your ref Grey0001

Enquiries Darren Nightingale

Telephone +61 7 5596 9135

Facsimile +61 7 5596 9511

Website www.transportandmainroads.qld.gov.au

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PRE-LODGEEMENT RECORD

APPLICANT		FILE REFERENCE - 240/204/658SL12298	
		10429	
Phone	3221 6188	Date	25 September 2009
Fax	3229 6863	Time	2:00pm
Email	<u>Andrew.gaffney@mldesign.com.au</u>	Location	Logan City Council Chambers
Company:	Greyhound Racing Authority C/- ML Design		
SITE			
Address	Corner Kingston and Compton Road, Kingston		
RPD	Lot 658 on SL12298		

Proposal:

Development of the site is proposed to replace the now defunct Greyhound Racing facility at the Gold Coast Parklands. The initial proposal is to establish the facility, described as Outdoor Sport and Recreation, with future development on the site to further intensify the uses on the site, namely establishment of restaurant etc.

Initially the facility will cater for two (2) race meets a week. Monday night, commencing around 6.40pm and Friday twilight, commencing around 4pm. Operation of this facility will operate similar to the existing facility at Albion, with expected attendance number of approximately 100 – 150 people per race meet.

Area Classification:

Public Open Space as per the Logan City Council Planning Scheme

Issues Identified by the Applicant for discussion:

- Access
- Traffic Impacts

Signed

49-Sch4 - Signature

Date

13 11 09

Disclaimer:

The aim of a pre-lodgement meeting is to provide initial advice on likely major issues relevant to a development proposal to assist in the timely processing of applications. It cannot replace the in-depth investigation normally associated with the formal assessment of an application. While the advice is given in good faith, it in no way binds a decision by the Department of Transport and Main Roads.

Please note that as this is a Department of Transport and Mains Road document it will be subject to the provisions of the Right to Information Act.

Supporting information provided by applicant (eg. plan/reports)

Greyhound Racing Authority Masterplan, prepared by ML Design – A-SK-01-01-A

Relevant Site History

The subject site was previously used as a Waste Transfer Facility. This facility has been disused for a number of years, and has undergone remediation treatments.

Issues Discussed

Access

Access to the proposed racing track is proposed to be from Kingston Road. Plans of the proposal identified that access to the facility was to be via a left-in/left-out access onto Kingston Road, with the potential for future accesses. It was also noted that plans of the proposal identified future entry and exit points onto Compton Road. However these access points are constrained by an existing swale drain within the Compton Road reserve and also the design and speed of this Road. Council noted that the Planning Scheme for the area identified a potential road through the east of the site connecting Cronulla Court and Monte Street. However this road is constrained due to the sites historical use as a waste transfer site, and also need for excavation of this waste material.

A right-in access from Kingston Road was also mooted. This principle is not objected to for the proposed use of the site solely for the greyhound track. However, it would need to be demonstrated that this type of access would not impact on the safety and efficiency of the road (eg - sufficient length of the existing turn pocket; how right turn manoeuvres out of the site be restricted, etc.). Additionally, this right turn would be reviewed upon receipt of any development application seeking to further intensify the use of the site.

It is also noted that an existing bus stop is located within close proximity of the proposed access location. An ingress/egress located in close proximity to a bus stop can cause significant safety concerns. The development should investigate how to minimize this impact.

A Traffic Impact Assessment assessing the above would be required in support of any development application. This assessment should determine any impact/s on the safety and efficiency of the state controlled road network, and how these impacts (if any) will be mitigated.

Traffic impacts

The departments key traffic concerns relate to the volumes of traffic associated with the development. While the facility is proposed to be utilized for two (2) meetings a week, this could expand dependant on the continuation of Authority's other venues. A Traffic Impact Assessment would be required to support any development application assessing the volume of traffic to utilize the facility, particularly during peak periods. This assessment should determine any impact/s on the safety and efficiency of the state controlled road network, and how these impacts (if any) will be mitigated.

Stormwater/Drainage

The proposed stormwater arrangements for the development will see stormwater treated on site, before being conveyed into the local stormwater catchment prepared by Logan City Council. The department will require the preparation of a stormwater management plan that demonstrates there will be a "no net worsening" to the state controlled road network.

Outcome Summary:

Proposal as discussed is supported in principal subject to detailed assessment. Any development application should be supported by a Traffic Impact Assessment demonstrating traffic volumes and access arrangements and a Stormwater Management Plan.

RTI DL RELEASE - EHP

SKM

Appendix B Proposed development plan

RTI DL RELEASE - EHP

SKM

Appendix C Service vehicle swept path diagrams

RTI DL RELEASE - EHP

SKM

Appendix D Traffic survey data

RTI DL RELEASE - EHP

District 13 METROPOLITAN DISTRICT

Road Section 204 BRISBANE - BEENLEIGH ROAD

Site 140055 North of Compton Road , Underwood

Type Permanent

TDist 3.06

Site Stream All Site Streams

Traffic Class 00 All Vehicles

Data Class 0 Volume

Range 0

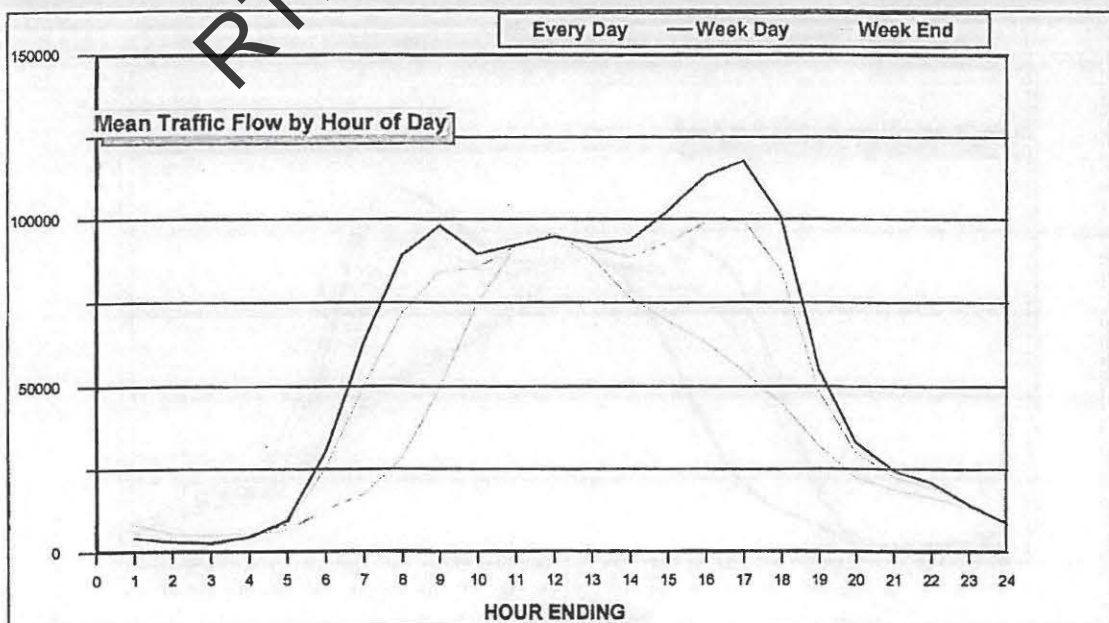
Mean Counts for

01-JAN-2003

30-DEC-2003

This data is affected by a
Calendar Event.

Hour	Wednesday %	Thursday %	Friday %	Saturday %	Sunday %	Monday %	Tuesday %	Average Week Day %	Average Week End %	Average Day %
00-01	90 .3	90 .3	108 .4	163 .8	168 1.1	62 .3	75 .3	85 .3	166 .9	108 .4
01-02	64 .2	64 .2	73 .3	109 .5	110 .7	46 .2	50 .2	59 .2	110 .6	74 .3
02-03	50 .2	56 .2	63 .2	104 .5	91 .6	42 .2	45 .2	51 .2	98 .5	64 .3
03-04	91 .3	93 .3	99 .4	124 .6	92 .6	81 .3	88 .3	90 .3	108 .6	95 .4
04-05	187 .7	188 .7	191 .7	146 .7	116 .6	173 .7	187 .7	165 .7	131 .7	169 .7
05-06	615 2.3	609 2.2	588 2.1	317 1.5	193 1.3	545 2.2	611 2.3	588 2.2	255 1.4	497 2.1
06-07	1282 4.8	1270 4.6	1178 4.3	431 2.0	266 1.8	1170 4.7	1292 4.9	938 4.7	349 1.9	984 4.1
07-08	1780 6.7	1774 6.4	1671 6.1	721 3.4	420 2.8	1675 6.8	1818 6.9	1732 6.6	571 3.2	1408 5.8
08-09	1953 7.4	1970 7.1	1858 6.7	1213 5.7	754 5.1	1840 7.4	1969 7.5	1818 7.2	984 5.4	1651 6.6
09-10	1757 6.6	1817 6.6	1775 6.4	1814 8.5	1175 7.9	1675 6.8	1732 6.6	1751 6.6	1495 8.3	1678 7.0
10-11	1795 6.8	1851 6.7	1882 6.8	2211 10.4	1417 9.5	1732 7.0	1769 6.7	1802 6.8	1814 10.0	1805 7.5
11-12	1836 6.9	1866 6.7	1952 7.1	2303 10.8	1506 10.1	1778 7.2	1824 6.8	1851 7.0	1905 10.5	1866 7.7
12-13	1789 6.7	1819 6.6	1965 7.1	2071 9.7	1453 9.7	1733 7.0	1778 6.8	1817 6.8	1762 9.7	1801 7.5
13-14	1778 6.7	1839 6.6	2039 7.4	1786 8.4	1255 8.4	1720 6.9	1772 6.7	1829 6.9	1521 8.4	1741 7.2
14-15	1964 7.4	2022 7.3	2205 8.0	1602 7.5	1152 7.7	1874 7.9	1946 7.4	2002 7.5	1377 7.6	1824 7.8
15-16	2203 8.3	2250 8.1	2334 8.5	1433 6.7	1076 7.2	2090 8.4	2177 8.3	2211 8.3	1255 6.9	1938 8.0
16-17	2328 8.8	2401 8.7	2285 8.2	1209 5.7	954 6.4	2199 8.8	2317 8.8	2301 8.7	1082 6.0	1953 8.1
17-18	1998 7.5	2089 7.5	1908 6.9	967 4.5	811 5.4	1800 7.1	1994 7.6	1966 7.4	889 4.9	1658 6.9
18-19	1066 4.0	1219 4.4	1170 4.2	714 3.4	559 3.7	916 3.7	1019 3.9	1078 4.1	637 3.5	952 3.9
19-20	619 2.3	820 3.0	700 2.5	489 2.3	397 2.7	520 2.1	575 2.2	647 2.4	443 2.4	589 2.4
20-21	456 1.7	615 2.2	485 1.8	377 1.8	384 2.4	388 1.8	450 1.7	478 1.8	371 2.0	448 1.9
21-22	407 1.5	499 1.8	428 1.6	366 1.7	285 1.9	329 1.3	381 1.5	409 1.5	326 1.8	385 1.6
22-23	270 1.0	285 1.0	383 1.4	348 1.6	193 1.1	212 .9	243 .9	279 1.0	271 1.5	276 1.1
23-24	155 .6	174 .6	282 1.0	256 1.2	116 .5	120 .5	142 .5	171 .6	186 1.0	175 .7
Peaks	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value
AM	8.45 2003	8.45 2013	12.45 1972	11.45 2315	12.45 1815	8.45 1889	8.45 2029	8.45 1999	12.00 1901	12.00 1885
PM	16.45 2367	16.45 2427	16.15 2362	13.00 2072	13.00 1452	16.45 2236	16.45 2347	16.45 2341	13.00 1758	16.30 2001
12 Hour	22,247 83.8	22,916 82.8	23,004 83.5	18,044 61.8	12,532 84.0	21,069 85.1	22,115 84.2	22,270 83.9	15,288 84.6	20,275 84.0
16 Hour	25,011 94.3	26,120 94.4	25,795 93.6	19,707 66.6	13,844 92.8	23,474 94.8	24,813 94.5	25,043 94.3	16,776 92.7	22,681 94.0
18 Hour	25,436 95.9	26,579 96.0	26,440 95.9	20,311 69.5	14,153 94.8	23,806 96.2	25,198 96.0	25,482 96.0	17,232 95.2	23,132 95.8
24 Hour	26,533 100.0	27,677 100.0	27,562 100.0	21,274 100.0	14,923 100.0	24,755 100.0	26,254 100.0	26,556 100.0	18,099 100.0	24,140 100.0
AVG Week Day	99.9%	104.2%	100.8%	82.5%	82.5%	93.2%	98.9%	100.0%	68.2%	90.9%
AVG Week End				117.5%	82.5%			146.7%	100.0%	133.4%
AVG Day	109.9%	114.7%	114.2%	88.1%	81.8%	102.5%	108.8%	110.0%	75.0%	100.0%

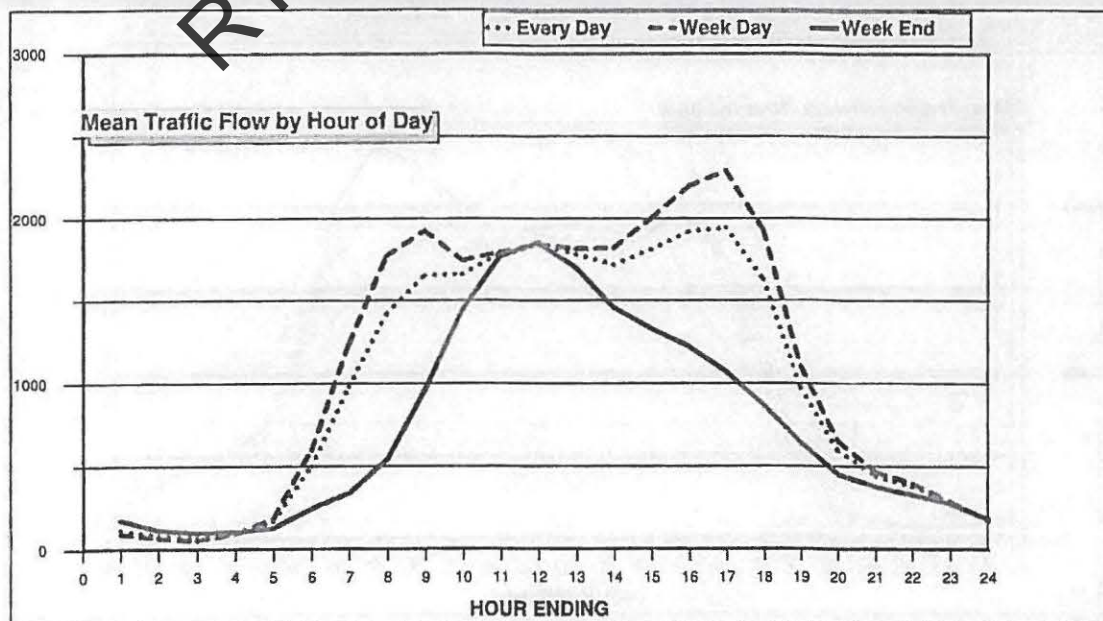


District 13 METROPOLITAN DISTRICT
Road Section 204 BRISBANE - BEENLEIGH ROAD
Site 140055 North of Compton Road, Underwood
Type PERMANENT TDist 3.06
Site Stream All Site Streams
Traffic Class 00 All Vehicles
Data Class 0 Volume Range 0

Mean Counts for
01-JAN-2004
29-DEC-2004

This data is affected by a
Calendar Event.

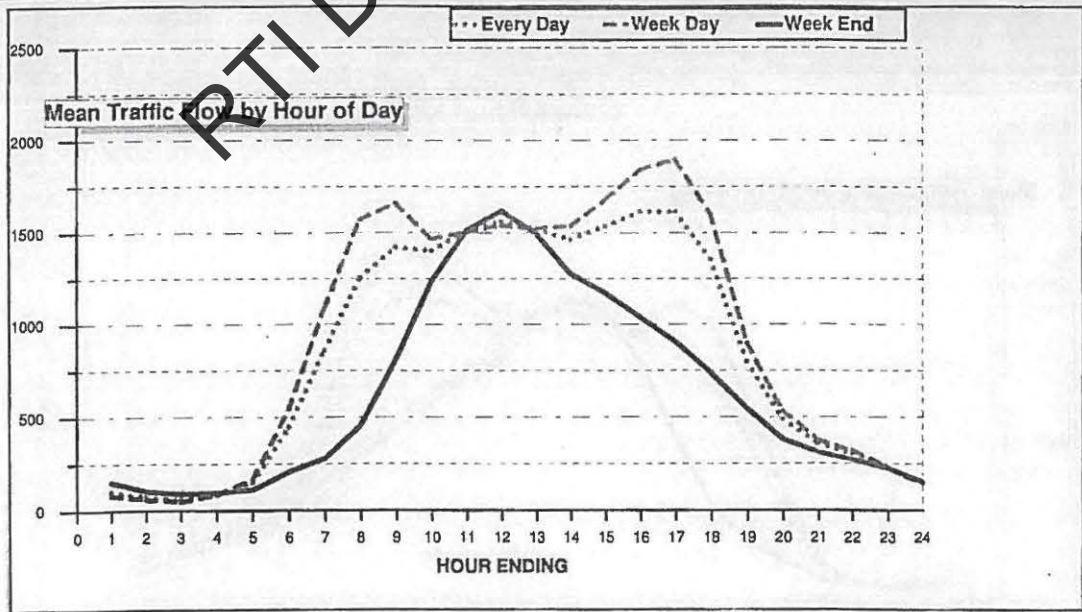
Hour	Thursday %	Friday %	Saturday %	Sunday %	Monday %	Tuesday %	Wednesday %	Average Week Day	Average Week End	Average Day
00-01	106 .4	116 .4	180 .9	174 1.2	65 .3	83 .3	90 .3	92 .3	177 1.0	116 .5
01-02	75 .3	75 .3	119 .6	113 .8	52 .2	58 .2	64 .2	65 .2	116 .7	79 .3
02-03	58 .2	61 .2	106 .5	95 .7	43 .2	46 .2	52 .2	52 .2	101 .6	66 .3
03-04	97 .4	103 .4	116 .5	95 .7	81 .3	90 .3	93 .4	93 .3	106 .6	96 .4
04-05	189 .7	199 .7	145 .7	114 .8	172 .7	187 .7	188 .7	187 .7	130 .7	171 .7
05-06	619 2.2	607 2.2	317 1.5	185 1.3	536 2.2	606 2.3	627 2.4	555 2.3	251 1.4	500 2.1
06-07	1284 4.6	1195 4.3	425 2.0	259 1.8	1127 4.6	1282 4.9	1286 4.9	1285 4.7	342 1.9	980 4.1
07-08	1814 6.6	1718 6.1	695 3.3	400 2.8	1641 6.7	1839 7.1	1844 7.0	1771 6.7	548 3.1	1422 5.9
08-09	1989 7.2	1924 6.9	1209 5.8	724 5.0	1802 7.4	1949 7.5	1958 7.4	1924 7.3	987 5.5	1651 6.9
09-10	1794 6.5	1785 6.4	1779 8.5	1111 7.7	1657 6.8	1728 6.6	1745 6.8	1744 6.6	1445 8.2	1658 6.9
10-11	1823 6.6	1897 6.8	2175 10.4	1364 9.4	1714 7.0	1740 6.7	1780 7.0	1791 6.8	1770 10.0	1785 7.4
11-12	1856 6.7	1972 7.0	2231 10.7	1475 10.2	1766 7.3	1792 6.9	1810 6.8	1839 6.9	1853 10.5	1843 7.7
12-13	1832 6.6	1993 7.1	2010 9.6	1388 9.6	1713 7.0	1746 6.7	1771 6.7	1814 6.8	1699 9.6	1781 7.4
13-14	1836 6.6	2072 7.4	1721 8.2	1197 8.3	1886 6.9	1739 6.7	1770 6.7	1821 6.9	1459 8.2	1717 7.2
14-15	2023 7.3	2230 7.9	1555 7.4	1107 7.6	1854 7.6	1923 7.4	1970 7.4	2000 7.5	1331 7.5	1809 7.5
15-16	2234 8.1	2385 8.4	1394 6.7	1049 7.2	2024 8.3	2151 8.3	2206 8.3	2197 8.3	1222 6.9	1918 8.0
16-17	2387 8.6	2285 8.1	1193 5.7	940 6.5	2139 8.8	2327 9.0	2317 8.7	2291 8.6	1067 6.0	1941 8.1
17-18	2051 7.4	1935 6.9	951 4.5	782 5.4	1767 7.3	1987 7.5	1958 7.4	1930 7.3	887 4.9	1626 6.8
18-19	1256 4.5	1233 4.4	720 3.4	566 3.9	924 3.8	1021 4.0	1066 4.0	1101 4.2	643 3.6	970 4.0
19-20	822 3.0	713 2.5	506 2.4	397 2.7	528 2.2	578 2.2	626 2.4	653 2.5	452 2.5	596 2.5
20-21	590 2.1	499 1.8	393 1.9	356 2.5	385 1.6	421 1.6	437 1.6	466 1.8	377 2.1	441 1.8
21-22	477 1.7	428 1.5	371 1.8	289 2.0	321 1.3	360 1.4	397 1.5	397 1.5	330 1.9	378 1.6
22-23	288 1.0	402 1.4	356 1.7	197 1.4	221 .9	243 .9	282 1.1	287 1.1	277 1.6	284 1.2
23-24	178 .6	267 1.0	255 1.2	116 .8	128 .5	144 .6	162 .6	176 .7	186 1.0	179 .7
Peaks	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value
AM	8:45 2039	12:45 2006	11:45 2244	12:15 1475	8:45 1841	8:45 2019	8:45 2013	8:45 1975	12:00 1854	12:15 1845
PM	16:45 2400	16:15 2375	13:00 2010	13:00 1992	16:45 2159	16:45 2337	16:45 2335	16:45 2311	13:00 1699	16:30 1973
12 Hour	22,895 82.7	23,419 83.4	17,633 84.3	12,103 83.5	20,687 85.0	21,901 84.2	22,209 83.8	22,222 83.8	14,868 84.0	20,121 83.8
16 Hour	26,068 94.2	26,254 93.5	19,333 92.4	13,404 92.5	23,049 94.7	24,542 94.4	24,955 94.1	24,974 94.2	16,369 92.4	22,515 93.8
18 Hour	26,534 95.9	26,923 95.9	19,944 95.3	13,717 94.6	23,398 96.1	24,929 95.9	25,399 95.8	25,437 95.9	16,831 95.0	22,978 95.7
24 Hour	27,678 100.0	28,084 100.0	20,927 100.0	14,493 100.0	24,347 100.0	25,999 100.0	26,513 100.0	26,524 100.0	17,710 100.0	24,006 100.0
AVG Week Day	104.3%	105.9%	118.6%	81.8%	91.8%	98.0%	100.0%	100.0%	66.8%	90.5%
AVG Week End									149.8%	135.5%
AVG Day	115.3%	117.0%	87.2%	60.4%	101.4%	108.3%	110.4%	110.5%	73.8%	100.0%



District 13 METROPOLITAN DISTRICT
Road Section 204 BRISBANE - BEENLEIGH ROAD
Site 140055 North of Compton Road , Underwood
Type PERMANENT
TDist 3.06
Site Stream All Site Streams
Traffic Class 00 All Vehicles
Data Class 0 Volume
Range 0

Mean Counts for
01-JAN-2005
30-DEC-2005
This data is affected by a Calendar Event.

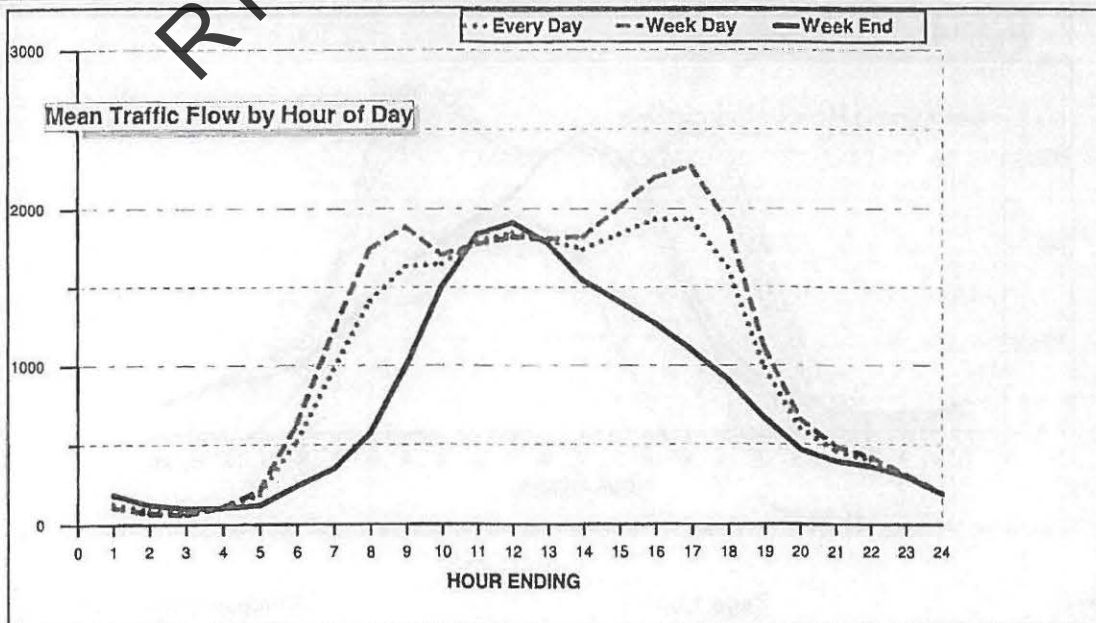
Hour	Saturday %	Sunday %	Monday %	Tuesday %	Wednesday %	Thursday %	Friday %	Average Week Day %	Average Week End %	Average Day %
00-01	159 .9	152 1.2	61 .3	70 .3	78 .3	90 .4	101 .4	80 .4	154 1.0	101 .5
01-02	108 .6	102 .8	45 .2	53 .2	60 .3	64 .3	72 .3	59 .3	105 .7	72 .4
02-03	91 .5	86 .7	39 .2	40 .2	43 .2	52 .2	55 .2	46 .2	89 .6	58 .3
03-04	89 .6	88 .7	74 .4	82 .4	84 .4	90 .4	91 .4	84 .4	94 .6	87 .4
04-05	126 .7	98 .8	152 .6	164 .7	166 .7	171 .7	173 .7	165 .7	111 .7	150 .7
05-06	268 1.5	147 1.2	489 2.4	560 2.5	549 2.5	559 2.3	551 2.3	542 2.4	208 1.4	446 2.2
06-07	353 2.0	207 1.7	970 4.8	1148 5.2	1125 5.0	1151 4.6	1059 4.3	1091 4.9	280 1.8	859 4.2
07-08	581 3.2	335 2.7	1421 7.1	1649 7.5	1618 7.2	1636 6.9	1535 6.5	1572 7.0	458 3.0	1254 6.2
08-09	1002 5.6	625 5.0	1505 7.5	1719 7.8	1686 7.5	1732 7.2	1656 7.0	1660 7.0	814 5.4	1418 7.0
09-10	1507 8.4	972 7.8	1342 6.7	1455 6.6	1477 6.6	1554 6.5	1507 6.4	1461 6.6	1240 8.2	1402 6.8
10-11	1854 10.3	1174 9.4	1417 7.1	1469 6.6	1487 6.7	1570 6.6	1582 6.7	1505 6.7	1514 10.0	1508 7.4
11-12	1949 10.9	1290 10.3	1435 7.2	1496 6.8	1511 6.6	1602 6.7	1646 7.0	1536 6.9	1620 10.7	1561 7.7
12-13	1771 9.9	1216 9.7	1397 7.0	1474 6.7	1501 6.7	1585 6.6	1658 6.7	1525 6.8	1494 9.8	1515 7.5
13-14	1504 8.4	1050 8.4	1398 7.0	1490 6.7	1507 6.7	1584 6.6	1697 6.7	1565 6.9	1277 8.4	1462 7.2
14-15	1362 7.6	979 7.8	1514 7.6	1632 7.4	1660 7.4	1747 7.3	1841 7.8	1679 7.5	1171 7.7	1534 7.5
15-16	1180 6.6	888 7.1	1660 8.3	1830 8.3	1846 8.3	1901 8.0	1970 8.4	1841 8.2	1039 6.8	1612 7.8
16-17	1011 5.6	798 6.4	1714 8.6	1915 8.7	1912 8.6	2037 8.5	1897 8.1	1895 8.5	905 6.0	1612 7.9
17-18	812 4.5	662 5.3	1404 7.0	1620 7.3	1627 7.3	1780 7.4	1580 6.7	1602 7.2	737 4.8	1355 6.7
18-19	610 3.4	482 3.9	719 3.6	826 3.7	878 3.9	1067 4.8	990 4.2	896 4.0	546 3.6	796 3.9
19-20	427 2.4	339 2.7	417 2.1	468 2.1	522 2.3	674 2.8	570 2.4	530 2.4	383 2.5	488 2.4
20-21	330 1.8	296 2.4	299 1.5	349 1.6	355 1.6	486 2.0	393 1.7	375 1.7	313 2.1	358 1.8
21-22	305 1.7	242 1.9	256 1.3	296 1.3	308 1.4	392 1.6	345 1.5	320 1.4	274 1.8	306 1.5
22-23	283 1.6	161 1.3	175 .9	199 .9	219 1.0	293 1.0	316 1.3	228 1.0	227 1.5	228 1.1
23-24	210 1.2	95 .6	106 .5	120 .5	135 .5	144 .6	213 .9	144 .6	153 1.0	146 .7
Peaks	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value	Time Value
AM	11:45 1938	12:00 1290	8:30 1585	8:30 1764	8:30 1764	8:30 1764	8:45 1710	8:45 1704	12:00 1610	12:15 1560
PM	13:00 1755	13:00 1216	16:45 1753	16:45 1907	16:45 1922	17:15 2022	16:15 2009	16:45 1910	13:00 1485	16:30 1632
12 Hour	15,153 84.6	10,471 83.9	16,927 84.6	18,576 84.6	18,710 83.7	19,787 82.8	19,559 83.2	18,714 83.6	12,812 84.3	17,028 83.8
16 Hour	16,568 92.5	11,555 92.6	18,869 84.3	20,837 94.2	21,072 94.0	22,485 94.1	21,926 93.3	21,030 94.0	14,062 92.5	19,039 93.7
18 Hour	17,071 95.3	11,811 94.6	19,150 95.7	21,156 95.7	21,775 95.6	22,872 95.7	22,455 95.6	21,402 95.6	14,441 95.0	19,413 95.5
24 Hour	17,918 100.0	12,482 100.0	20,010 100.0	22,125 100.0	22,355 100.0	23,898 100.0	23,498 100.0	22,377 100.0	15,200 100.0	20,327 100.0
AVG Week Day			89.4%	98.9%	99.9%	106.8%	105.0%	100.0%	67.9%	90.8%
AVG Week End	117.9%	82.1%						147.2%	100.0%	133.7%
AVG Day	88.2%	61.4%	98.4%	108.8%	110.0%	117.6%	115.6%	110.1%	74.8%	100.0%



Traffic Analysis and Reporting System WEEKLY SUMMARY REPORT

District **13 METROPOLITAN DISTRICT** Mean Counts for
Road Section **204 BRISBANE - BEENLEIGH ROAD** **01-JAN-2006**
Site **140055 North of Compton Road, Underwood** **30-DEC-2006**
Type **PERMANENT** TDist **3.06**
Site Stream **All Site Streams** This data is affected by a
Traffic Class **00 All Vehicles** Calendar Event.
Data Class **0 Volume** Range **0**

Hour	Sunday	%	Monday	%	Tuesday	%	Wednesday	%	Thursday	%	Friday	%	Saturday	%	Average Week Day	%	Average Week End	%	Average Day	%
00-01	172	1.1	66	.3	98	.4	109	.4	109	.4	136	.5	198	.9	104	.4	185	1.0	127	.5
01-02	118	.8	54	.2	62	.2	89	.3	68	.2	80	.3	128	.6	66	.3	123	.7	83	.3
02-03	97	.6	46	.2	59	.2	61	.2	64	.2	72	.3	104	.5	60	.2	101	.5	72	.3
03-04	92	.6	92	.4	100	.4	111	.4	111	.4	122	.4	114	.5	105	.4	103	.6	106	.4
04-05	109	.7	202	.8	206	.8	207	.8	216	.8	219	.8	132	.6	210	.8	121	.7	184	.8
05-06	177	1.2	590	2.4	624	2.4	639	2.4	655	2.4	635	2.2	299	1.4	639	2.4	238	1.3	517	2.1
06-07	270	1.8	1167	4.7	1251	4.9	1243	4.6	1270	4.6	1190	4.2	427	2.0	1224	4.6	349	1.9	974	4.0
07-08	436	2.8	1719	7.0	1764	6.9	1742	6.7	1788	6.4	1717	6.1	717	3.3	1716	6.6	577	3.1	1412	5.8
08-09	775	5.1	1828	7.4	1892	7.4	1863	7.1	1933	6.9	1889	6.7	1238	5.7	1881	7.1	1007	5.5	1631	6.7
09-10	1192	7.8	1624	6.6	1644	6.4	1708	6.5	1772	6.4	1778	6.3	1851	8.4	1705	6.4	1507	8.2	1648	6.8
10-11	1450	9.5	1694	6.9	1707	6.7	1755	6.7	1815	6.5	1889	6.7	2220	10.3	1772	6.7	1835	10.0	1790	7.4
11-12	1552	10.1	1709	6.9	1750	6.8	1783	6.8	1870	6.7	1989	7.0	2276	10.6	1820	6.9	1914	10.4	1847	7.6
12-13	1478	9.6	1692	6.8	1705	6.7	1783	6.8	1850	6.6	2022	7.2	2079	9.6	1808	6.8	1779	9.6	1800	7.4
13-14	1278	8.3	1702	6.9	1698	6.6	1772	6.8	1845	6.6	2063	7.4	1810	8.4	1820	6.9	1544	8.4	1741	7.2
14-15	1192	7.8	1885	7.6	1896	7.4	1958	7.5	2028	7.3	2251	8.0	1626	7.5	2005	7.6	1409	7.6	1835	7.6
15-16	1102	7.2	2110	8.5	2133	8.3	2157	8.3	2236	8.0	2344	8.3	1435	6.7	2196	8.3	1269	6.9	1931	8.0
16-17	954	6.2	2162	8.8	2248	8.8	2253	8.6	2368	8.5	2281	8.0	1238	5.7	2264	8.5	1096	5.9	1930	8.0
17-18	820	5.4	1803	7.3	1861	7.3	1910	7.3	2087	7.5	1893	6.7	1000	4.6	1911	7.2	910	4.9	1625	6.7
18-19	599	3.9	928	3.8	1033	4.0	1074	4.1	1298	4.1	1211	4.3	736	3.4	1110	4.2	668	3.6	984	4.1
19-20	422	2.8	534	2.2	594	2.3	620	2.4	838	3.0	718	2.5	517	2.4	661	2.5	470	2.5	606	2.5
20-21	376	2.5	387	1.6	451	1.8	450	1.7	622	2.2	519	1.8	412	1.9	486	1.8	394	2.1	460	1.9
21-22	314	2.1	326	1.3	375	1.5	405	1.5	508	1.8	466	1.7	405	1.9	416	1.6	360	1.8	400	1.7
22-23	220	1.4	239	1.0	257	1.0	288	1.1	311	1.1	430	1.5	377	1.7	305	1.2	299	1.6	303	1.3
23-24	122	.8	135	.5	155	.6	172	.7	192	.7	288	1.0	258	1.2	188	.7	190	1.0	189	.8
Peaks	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value
AM	12:15	1557	8:45	1869	8:45	1937	8:45	1937	8:45	1962	12:45	2028	11:30	2301	8:45	1920	11:45	1916	12:15	1850
PM	13:00	1478	16:45	2184	16:45	2253	17:15	2253	17:15	2373	16:15	2384	13:00	2079	16:45	2282	13:00	1779	16:15	1958
12 Hour	12,828	83.8	20,846	84.5	21,331	83.4	21,788	83.3	22,888	82.2	23,366	82.7	18,196	84.4	22,038	83.2	15,512	84.1	20,173	83.4
16 Hour	14,210	92.8	23,260	94.2	24,002	93.9	24,477	93.7	26,124	93.8	26,259	93.0	19,957	92.5	24,824	93.7	17,084	92.6	22,613	93.5
18 Hour	14,552	95.0	23,634	95.7	24,414	95.5	24,937	95.4	26,627	95.6	26,977	95.5	20,592	95.5	25,318	95.6	17,572	95.3	23,105	95.5
24 Hour	15,317	100.0	24,684	100.0	25,563	100.0	26,132	100.0	27,850	100.0	28,241	100.0	21,567	100.0	26,494	100.0	18,442	100.0	24,193	100.0
AVG Week Day		93.2%		96.5%		98.6%		105.1%		106.5%				100.0%		69.6%		91.3%		
AVG Week End		83.1%												116.9%		143.7%		100.0%		131.2%
AVG Day		63.3%		102.6%		105.7%		108.0%		115.1%		116.7%		89.1%		109.5%		76.2%		100.0%



Traffic Analysis and Reporting System WEEKLY SUMMARY REPORT

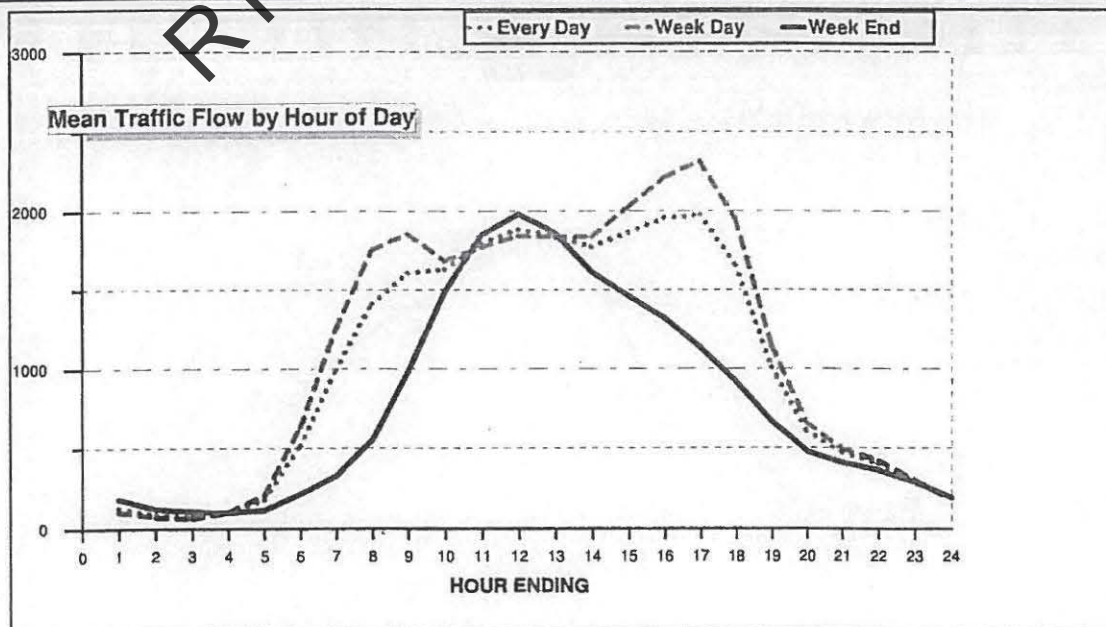
District **13 METROPOLITAN DISTRICT** Mean Counts for
Road Section **204 BRISBANE - BEENLEIGH ROAD** **01-JAN-2007**
Site **140055 North of Compton Road, Underwood** **30-DEC-2007**
Type **PERMANENT** TDist **3.06**
Site Stream **All Site Streams** This data is affected by a
Traffic Class **00 All Vehicles** Calendar Event.
Data Class **0 Volume** Range **0**

Hour	Monday %	Tuesday %	Wednesday %	Thursday %	Friday %	Saturday %	Sunday %	Average Week Day %	Average Week End %	Average Day %
00-01	69 .3	95 .4	106 .4	110 .4	136 .5	192 .9	177 1.1	103 .4	185 1.0	126 .5
01-02	58 .2	65 .2	73 .3	75 .3	87 .3	124 .6	122 .8	72 .3	123 .7	86 .4
02-03	49 .2	59 .2	62 .2	67 .2	71 .3	107 .5	113 .7	62 .2	110 .6	75 .3
03-04	89 .4	102 .4	99 .4	109 .4	112 .4	106 .5	93 .6	103 .4	100 .5	101 .4
04-05	202 .8	206 .8	201 .8	210 .7	210 .7	125 .6	108 .7	205 .8	117 .6	180 .7
05-06	584 2.4	643 2.5	637 2.4	663 2.3	628 2.2	268 1.2	165 1.1	584 2.4	217 1.2	513 2.1
06-07	1174 4.7	1286 4.9	1275 4.9	1318 4.7	1197 4.3	401 1.8	255 1.6	1254 4.7	328 1.7	987 4.0
07-08	1667 6.7	1807 6.9	1772 6.8	1807 6.4	1704 6.1	684 3.1	424 2.5	1751 6.6	554 3.0	1409 5.8
08-09	1768 7.1	1882 7.2	1852 7.1	1929 6.8	1840 6.5	1218 5.5	743 4.8	1854 7.0	981 5.2	1605 6.6
09-10	1606 6.5	1654 6.3	1654 6.3	1755 6.2	1740 6.2	1789 8.1	1142 7.7	1682 6.3	1491 8.0	1627 6.7
10-11	1707 6.9	1717 6.6	1723 6.6	1828 6.5	1862 6.6	2254 10.2	1444 9.3	1767 6.6	1849 9.9	1791 7.3
11-12	1772 7.2	1771 6.8	1797 6.9	1897 6.7	1963 7.0	2383 10.8	1585 10.2	1840 6.9	1984 10.6	1881 7.7
12-13	1742 7.0	1743 6.7	1780 6.8	1888 6.7	2010 7.2	2189 9.9	1388 9.9	1833 6.9	1864 9.9	1841 7.5
13-14	1737 7.0	1747 6.7	1751 6.7	1875 6.6	2061 7.3	1893 8.6	1338 8.6	1834 6.9	1616 8.6	1772 7.3
14-15	1904 7.7	1957 7.5	1967 7.5	2054 7.3	2238 8.0	1697 7.7	1227 7.9	2024 7.5	1462 7.8	1863 7.6
15-16	2094 8.5	2140 8.2	2169 8.3	2276 8.1	2367 8.4	1516 6.9	1125 7.3	2208 8.3	1321 7.0	1955 8.0
16-17	2195 8.9	2313 8.9	2304 8.8	2440 8.6	2318 8.2	1274 6.6	987 6.4	2314 8.7	1131 6.0	1976 8.1
17-18	1805 7.3	1950 7.5	1945 7.4	2108 7.5	1942 6.9	821 4.6	819 5.3	1950 7.3	920 4.9	1656 6.8
18-19	949 3.8	1091 4.2	1111 4.2	1327 4.7	1238 4.7	71 3.4	593 3.8	1143 4.3	669 3.6	1008 4.1
19-20	524 2.1	580 2.2	612 2.3	861 3.0	701 2.3	399 2.4	419 2.7	656 2.5	479 2.6	605 2.5
20-21	396 1.6	461 1.8	459 1.8	646 2.3	545 1.8	431 2.0	388 2.5	495 1.9	410 2.2	471 1.9
21-22	333 1.3	384 1.5	391 1.5	518 1.8	455 1.7	415 1.9	310 2.0	418 1.6	363 1.9	402 1.6
22-23	227 .9	248 1.0	283 1.1	304 1.1	425 1.8	374 1.7	204 1.3	297 1.1	289 1.5	295 1.2
23-24	130 .5	148 .6	166 .6	183 .6	276 1.0	267 1.2	117 .8	181 .7	192 1.0	184 .8

Peaks	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value	Time	Value
AM	8:45	1806	8:45	1938	8:45	1900	8:45	1955	12:45	2010	11:45	2388	12:15	1603	8:45	1896
PM	16:45	2216	17:00	2318	17:00	2303	17:00	2448	16:15	2386	13:00	2190	13:00	1538	16:45	2318

12 Hour	20,946	84.5	21,772	83.6	21,825	83.3	23,188	82.1	23,283	82.8	18,661	84.8	13,015	84.0	22,202	83.2
16 Hour	23,373	94.3	24,483	94.0	24,562	93.8	26,527	93.9	26,162	93.1	20,447	92.9	14,387	92.9	25,021	93.8
18 Hour	23,730	95.8	24,879	95.5	25,011	95.3	27,014	95.6	26,863	95.6	21,088	95.6	14,708	95.0	25,499	95.6
24 Hour	24,781	100.0	26,049	100.0	26,169	100.0	28,248	100.0	28,107	100.0	22,010	100.0	15,486	100.0	26,675	100.0

AVG Week Day	92.9%	97.7%	98.2%	105.9%	105.4%			100.0%	70.3%	91.5%
AVG Week End						117.4%	82.6%	142.3%	100.0%	130.2%
AVG Day	101.5%	106.7%	107.3%	115.7%	115.1%	90.2%	63.4%	109.3%	76.8%	100.0%



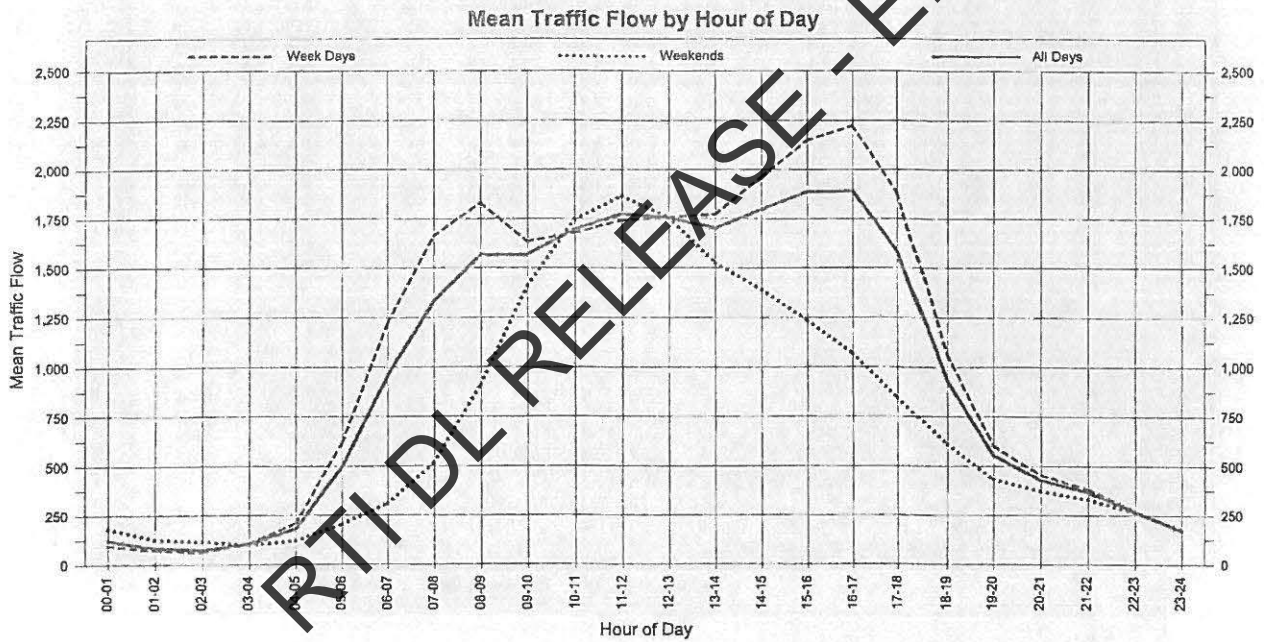
Traffic Analysis and Reporting System
Weekly Volume Report



District 13 - Metropolitan District
Road Section 204 - Brisbane - Beenleigh Road
Site 140055 - North of Compton Road, Underwood
Thru Dist 3.06
Type P - Permanent
Stream TB - Bi-directional traffic flow
Traffic Class 00 - All Vehicles
Date Range Monday 31-Dec-2007 - Sunday 28-Dec-2008

Data Profile

	Mondays	Tuesdays	Wednesdays	Thursdays	Fridays	Saturdays	Sundays
Days in Date Range	52	52	52	52	52	52	52
Days Included	50	52	50	50	52	51	50
Calendar Events	4	1	1	1	3	2	6



Traffic Analysis and Reporting System
Weekly Volume Report

Hour	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Average Week Day		Average Weekend Day		Average Day	
00-01	59	0.3%	95	0.4%	100	0.4%	103	0.4%	117	0.4%	178	0.9%	183	1.3%	95	0.4%	181	1.0%	119	0.5%
01-02	51	0.2%	70	0.3%	75	0.3%	77	0.3%	82	0.3%	123	0.6%	127	0.9%	71	0.3%	125	0.7%	86	0.4%
02-03	52	0.2%	60	0.2%	59	0.2%	62	0.2%	70	0.3%	103	0.5%	122	0.8%	61	0.2%	113	0.6%	75	0.3%
03-04	91	0.4%	108	0.4%	108	0.4%	111	0.4%	114	0.4%	96	0.5%	99	0.7%	106	0.4%	98	0.6%	104	0.4%
04-05	200	0.8%	210	0.8%	211	0.8%	208	0.8%	207	0.8%	126	0.6%	113	0.8%	207	0.8%	120	0.7%	182	0.8%
05-06	571	2.4%	636	2.5%	633	2.5%	642	2.4%	602	2.3%	253	1.2%	153	1.0%	617	2.4%	203	1.2%	499	2.1%
06-07	1,135	4.8%	1,281	5.1%	1,275	4.9%	1,270	4.8%	1,145	4.3%	365	1.8%	252	1.7%	1,221	4.8%	309	1.8%	960	4.1%
07-08	1,571	6.7%	1,737	6.9%	1,726	6.7%	1,692	6.3%	1,586	5.9%	644	3.1%	388	2.7%	1,662	6.5%	516	2.9%	1,335	5.7%
08-09	1,718	7.3%	1,897	7.5%	1,894	7.3%	1,849	6.9%	1,788	6.7%	1,125	5.5%	698	4.8%	1,829	7.1%	912	5.2%	1,567	6.7%
09-10	1,538	6.5%	1,630	6.4%	1,650	6.4%	1,671	6.3%	1,676	6.3%	1,701	8.3%	1,119	7.6%	1,633	6.4%	1,410	8.0%	1,569	6.7%
10-11	1,615	6.8%	1,642	6.5%	1,689	6.5%	1,700	6.4%	1,744	6.5%	2,132	10.4%	1,359	9.3%	1,678	6.6%	1,746	9.9%	1,697	7.3%
11-12	1,666	7.1%	1,684	6.7%	1,756	6.8%	1,760	6.6%	1,843	6.9%	2,245	11.9%	1,482	10.1%	1,742	6.8%	1,864	10.6%	1,777	7.6%
12-13	1,674	7.1%	1,689	6.7%	1,751	6.8%	1,765	6.6%	1,903	7.1%	2,051	10.0%	1,462	10.0%	1,756	6.9%	1,757	10.0%	1,756	7.5%
13-14	1,668	7.1%	1,706	6.7%	1,764	6.8%	1,768	6.6%	1,963	7.4%	1,781	8.7%	1,270	8.7%	1,774	6.9%	1,526	8.7%	1,703	7.3%
14-15	1,839	7.8%	1,913	7.6%	1,945	7.5%	1,961	7.3%	2,150	8.1%	1,608	7.9%	1,165	8.0%	1,962	7.7%	1,390	7.9%	1,798	7.7%
15-16	2,012	8.5%	2,098	8.3%	2,155	8.3%	2,180	8.2%	2,304	8.6%	1,402	6.8%	1,062	7.3%	2,150	8.4%	1,232	7.0%	1,888	8.1%
16-17	2,053	8.7%	2,260	8.9%	2,260	8.8%	2,335	8.8%	2,204	8.3%	1,195	5.8%	939	6.4%	2,222	8.7%	1,067	6.1%	1,892	8.1%
17-18	1,732	7.3%	1,876	7.4%	1,923	7.4%	2,009	7.5%	1,865	7.9%	919	4.5%	766	5.2%	1,881	7.3%	843	4.8%	1,584	6.8%
18-19	877	3.7%	991	3.9%	1,053	4.1%	1,230	4.6%	1,158	5.3%	666	3.2%	553	3.8%	1,062	4.1%	610	3.5%	933	4.0%
19-20	477	2.0%	551	2.2%	572	2.2%	783	2.9%	636	2.7%	476	2.3%	392	2.7%	603	2.4%	434	2.5%	555	2.4%
20-21	356	1.5%	425	1.7%	436	1.7%	587	2.2%	468	1.7%	392	1.9%	351	2.4%	453	1.8%	372	2.1%	430	1.8%
21-22	301	1.3%	358	1.4%	368	1.4%	470	1.8%	461	1.6%	372	1.8%	287	2.0%	384	1.5%	330	1.9%	368	1.6%
22-23	201	0.9%	226	0.9%	264	1.0%	276	1.0%	385	1.4%	341	1.7%	184	1.3%	270	1.1%	263	1.5%	268	1.1%
23-24	125	0.5%	143	0.6%	161	0.6%	174	0.7%	255	1.0%	245	1.2%	103	0.7%	172	0.7%	174	1.0%	172	0.7%
Peaks	Hour End & Count		Hour End & Count		Hour End & Count		Hour End & Count		Hour End & Count		Hour End & Count		Hour End & Count		Hour End & Count		Hour End & Count		Hour End & Count	
AM	08:45	1,750	08:45	1,930	08:45	1,924	08:45	1,881	12:00	1,842	11:45	2,255	12:00	1,483	08:45	1,858	12:00	1,863	12:00	1,775
PM	16:30	2,070	17:00	2,261	17:00	2,260	17:00	2,335	16:15	2,309	13:00	2,050	13:00	1,461	16:45	2,228	13:00	1,755	16:30	1,916
12-Hour	19,963	84.7%	21,123	83.5%	21,566	83.5%	21,920	82.1%	22,184	83.2%	17,476	85.1%	12,263	83.8%	21,351	83.4%	14,873	84.5%	19,499	83.6%
16-Hour	22,232	94.3%	23,738	93.9%	24,217	93.8%	25,030	93.8%	24,843	93.1%	19,081	92.9%	13,545	92.6%	24,012	93.8%	16,318	92.7%	21,812	93.5%
18-Hour	22,558	95.7%	24,107	95.3%	24,642	95.4%	25,480	95.5%	25,483	95.5%	19,667	95.7%	13,832	94.6%	24,454	95.5%	16,755	95.2%	22,252	95.4%
24-Hour	23,582	100.0%	25,286	100.0%	25,828	100.0%	26,683	100.0%	26,675	100.0%	20,546	100.0%	14,629	100.0%	25,611	100.0%	17,595	100.0%	23,317	100.0%
Avg Week Day	92.1%		98.7%		100.8%		104.2%		104.2%						100.0%		68.7%		91.0%	
Avg Weekend Day											116.8%		83.1%		145.6%		100.0%		132.5%	
Avg Day	101.1%		108.4%		110.8%		114.4%		114.4%		88.1%		62.7%		109.8%		75.5%		100.0%	

Time Periods

12-hour time periods extend from 07:00 to 19:00.
16-hour time periods extend from 06:00 to 22:00.
18-hour time periods extend from 06:00 to 24:00.
24-hour time periods extend from 00:00 to 24:00.

Days Included and Days Excluded

Days for which traffic counters did not operate for the entire day are excluded from the calculations. This is the only cause of differences between "Days in Date Range" and "Days Included". Days classified as Calendar Events are included in the calculations.

Calendar Events

Calendar Events include public holidays, local show holidays etc. Averages derived for such Calendar Event days will generally be different from the usual averages.

RTI DL RELEASE - EHP

Volume Classified Count sheet
 LOCATION: INTERSECTION 6/8 / COUNTY RD 6/8
 DATE: 10/12/06
 WEATHER: 104 F 112

4
 1-3
 2

COUNTER	ROAD 1/4 hr					ROAD 1/4 hr					ROAD 1/4 hr					ROAD 1/4 hr					Total
ENDING	FROM	1-2	1-3	1-4	U-Turn	FROM	2-1	2-4	2-3	U-Turn	FROM	3-2	3-1	3-4	U-Turn	FROM	4-3	4-2	4-1	U-Turn	Total
6:45am	8	52	34	1	0	75	77	37	0	1	87	128	11	0	0	26	33	18	0	1	854
7:00am	10	53	37	1	5	62	66	41	2	0	65	165	10	1	0	34	123	15	0	2	716
7:15am	8	54	34	2	0	63	101	52	0	0	67	103	12	0	0	16	138	10	0	1	851
7:30am	17	75	53	2	1	103	143	50	0	1	79	111	12	0	0	37	100	8	0	1	922
7:45am	12	81	44	2	0	89	108	13	0	0	101	225	10	0	1	37	126	13	0	0	855
8:00am	13	107	73	2	1	74	194	74	1	2	82	182	11	0	0	41	144	15	0	2	1012
8:15am	14	67	46	1	1	55	122	88	0	2	101	244	11	0	0	34	128	17	0	1	842
8:30am	24	120	78	5	0	81	180	63	0	0	73	144	41	0	0	45	105	11	0	2	843
8:45am	11	80	83	3	0	90	131	89	0	0	85	101	16	0	0	34	123	18	0	2	844
9:00am	15	119	68	2	0	100	173	75	0	0	76	114	44	0	0	35	101	19	0	2	742
9:15am	24	80	84	3	0	87	113	65	0	0	82	121	41	0	0	36	116	16	0	0	799
9:30am	26	134	84	6	0	81	152	46	0	0	88	102	41	0	0	39	93	14	0	2	802
9:45am	23	103	76	5	0	73	129	78	0	0	65	128	46	1	0	41	102	18	0	1	848
10:00am	45	109	78	6	0	83	136	72	0	0	88	158	35	0	0	52	102	20	0	0	844
10:15am	34	98	68	5	0	89	145	47	0	0	80	119	44	0	0	42	104	20	0	0	837
10:30am	28	121	63	4	2	82	124	61	0	2	67	108	48	0	0	33	102	10	0	0	839
10:45am	30	128	72	3	2	69	121	56	0	2	64	112	46	1	0	32	107	13	0	0	852
11:00am	31	135	83	2	1	76	107	48	0	2	61	116	44	1	0	33	112	16	0	0	840
11:15am	31	143	94	1	1	83	94	42	0	3	88	220	41	2	0	33	117	19	0	0	878
11:30am	43	131	68	3	1	89	126	58	0	0	65	105	42	1	0	36	110	22	0	0	857
11:45am	26	139	70	2	2	72	91	62	2	2	84	105	33	1	0	46	125	20	0	0	850
12:00pm	24	143	71	2	0	59	129	64	0	0	80	134	38	0	0	31	113	11	0	0	890
12:15pm	35	181	89	1	0	55	120	62	2	3	73	98	45	0	0	40	108	18	0	0	866
12:30pm	26	131	60	2	0	77	128	68	1	0	61	99	49	2	0	30	114	24	0	1	836
12:45pm	25	109	81	1	0	63	98	86	0	2	82	110	44	1	0	41	102	20	1	1	849
1:00pm	34	133	72	4	1	78	97	83	0	0	76	94	41	0	3	47	107	17	0	0	861
1:15pm	24	128	75	1	0	76	122	75	0	2	84	109	42	2	0	36	104	15	0	0	839
1:30pm	25	116	83	3	0	89	110	71	0	4	80	113	37	1	0	36	102	11	0	0	856
1:45pm	20	103	84	1	0	70	94	82	1	1	70	99	33	1	0	31	112	18	0	0	862
2:00pm	22	123	71	4	1	76	127	80	0	1	76	114	41	0	1	30	98	20	0	0	854
2:15pm	25	131	94	4	1	85	97	70	0	0	61	114	40	1	2	44	105	21	0	2	837
2:30pm	22	110	78	5	0	84	128	94	0	3	61	107	36	0	0	31	115	15	1	0	839
2:45pm	27	107	86	2	0	79	127	101	0	0	65	123	35	0	0	39	103	18	0	3	1028
3:00pm	26	141	101	2	0	82	113	84	0	1	85	122	37	0	1	39	130	25	0	0	1007
3:15pm	26	138	83	2	0	77	149	110	0	1	85	105	49	0	1	34	114	19	0	1	1017
3:30pm	28	168	105	4	2	85	124	89	1	4	73	143	60	0	1	46	153	10	0	1	1101
3:45pm	20	166	106	6	0	86	130	116	1	0	83	98	50	2	2	66	139	10	0	1	1120
4:00pm	22	180	112	5	0	80	136	123	0	2	83	126	41	0	2	41	138	16	0	2	1159
4:15pm	32	195	118	4	1	86	142	125	0	3	90	115	41	0	3	38	127	21	0	2	1201
4:30pm	39	202	83	1	0	91	128	119	0	1	76	133	49	1	1	31	153	17	0	2	1163
4:45pm	37	185	113	1	1	105	144	109	0	1	87	141	49	1	0	63	153	21	0	2	1229
5:00pm	36	204	107	5	0	102	132	118	0	0	89	111	29	0	2	40	148	19	0	2	1089
5:15pm	29	180	118	3	0	85	131	96	0	1	97	109	31	0	1	81	145	10	0	1	1124
5:30pm	21	196	115	1	0	80	128	109	0	1	85	111	31	0	0	87	171	11	0	1	1138
5:45pm	33	136	73	3	0	71	148	112	0	0	72	138	34	0	0	45	135	8	0	0	822
6:00pm	5	104	60	3	0	82	117	81	0	0	49	98	31	0	2	35	128	6	0	0	759
TOTALS	1218	1814	1017	120	27	1616	6718	3555	11	52	1387	6794	2035	20	24	1923	5541	769	3	28	
MCV	7.1	5.7	6.4	3.3		6.2	9.1	7.9	9.1		8.1	5.0	7.1	0.0		7.2	9.3	6.6	0.0		
COMMENTS:																					
Sidra Input																					
AM PEAK	87	373	265	10	3	318	678	578	1	2	357	718	210	0	1	153	567	78	0	4	
PM PEAK	140	782	436	11	2	372	560	511	0	7	345	530	192	3	8	220	581	75	0	8	

Volume Classified Count sheet

LOCATION: Compton Rd / Bris-Benleigh Rd
DATE: Monday 20/05/02
WEATHER: Fine

4
1+3
2

COUNTER	Kingston Rd					Compton Rd					Bris-Benleigh Rd					Compton Rd					Total
ROAD 1/4 hr ENDING	FROM 1-4	1-3	1-2	U-Turn	PEDS	FROM 2-1	2-4	2-3	U-Turn	PEDS	FROM 3-2	3-1	3-4	U-Turn	PEDS	FROM 4-3	4-2	4-1	U-Turn	PEDS	Traffic 1/4 hr
6.45am	4	26	23	0	0	86	79	21	0	0	53	104	27	0	0	15	84	2	0	0	524
7.00am	6	39	39	0	0	99	92	34	0	1	50	128	35	0	0	23	121	10	0	1	576
7.15am	12	48	30	0	0	106	86	28	0	0	55	172	45	0	0	32	113	3	0	1	730
7.30am	2	75	41	2	1	107	105	40	1	0	66	209	30	0	0	27	125	2	0	1	824
7.45am	10	95	58	0	0	101	194	64	0	0	91	210	42	0	0	40	147	7	0	0	972
8.00am	8	100	56	0	0	101	170	74	2	0	83	245	42	0	1	41	127	7	0	0	1054
8.15am	13	117	67	0	0	129	145	84	0	1	85	209	42	0	0	50	149	7	0	0	1097
8.30am	15	103	68	0	1	116	168	79	0	2	73	202	43	0	0	43	141	10	0	2	1054
8.45am	16	100	62	1	0	106	119	46	0	1	85	219	21	1	0	50	121	15	1	0	960
9.00am	15	102	64	0	0	90	163	53	2	0	61	198	36	0	0	34	100	15	0	0	933
9.15am	25	124	67	1	0	92	100	69	0	1	74	135	23	0	0	38	105	11	0	0	863
9.30am	24	102	60	1	0	79	93	44	0	0	55	147	27	0	0	43	102	7	0	0	783
9.45am	10	123	59	2	0	70	115	62	0	0	69	147	18	0	0	40	98	7	0	0	818
10.00am	31	118	57	0	1	105	104	38	0	1	69	159	42	0	1	36	96	5	0	0	860
10.15am	28	141	60	2	0	82	94	42	1	0	60	115	29	0	0	44	95	10	0	0	799
10.30am	24	127	62	1	0	89	116	62	1	0	61	166	26	0	0	52	115	17	0	0	919
10.45am	27	119	63	1	0	83	115	52	0	0	55	159	25	0	0	45	102	14	0	0	868
11.00am	30	110	61	1	0	76	113	43	0	0	50	153	25	0	0	48	102	14	0	0	814
11.15am	33	102	64	1	0	70	110	31	0	0	44	146	24	0	0	45	98	12	0	0	781
11.30am	26	119	62	2	0	73	111	64	0	0	63	149	24	0	0	53	98	8	0	1	841
11.45am	27	127	62	0	0	86	117	60	2	1	60	123	39	0	0	49	104	9	0	0	859
12.00pm	21	116	73	2	0	77	106	50	0	2	72	173	29	0	0	48	98	10	0	0	866
12.15pm	39	128	69	0	1	87	105	44	0	1	76	131	24	0	0	46	97	21	0	0	867
12.30pm	32	139	70	2	1	95	125	54	0	0	66	148	42	0	0	48	121	13	0	1	953
12.45pm	24	154	68	2	1	74	101	65	0	3	63	128	30	0	0	41	114	10	0	1	878
1.00pm	27	110	55	0	1	90	101	51	0	1	70	126	34	0	0	34	111	16	0	1	828
1.15pm	19	109	75	0	0	73	104	44	0	0	59	156	23	0	0	31	98	8	0	3	812
1.30pm	35	129	72	1	2	76	100	50	0	1	75	136	33	0	0	35	98	6	0	1	825
1.45pm	27	117	71	0	0	97	121	66	1	0	66	182	39	0	0	39	96	8	0	0	939
2.00pm	26	118	59	0	0	91	91	51	1	0	63	112	39	1	0	35	98	6	0	0	768
2.15pm	30	142	78	2	0	91	164	78	0	1	55	97	44	1	0	43	80	10	0	0	846
2.30pm	19	126	79	0	0	89	63	64	0	2	86	114	44	1	0	45	106	5	0	0	857
2.45pm	25	144	82	0	1	90	118	66	0	0	72	128	34	0	0	54	110	9	0	0	939
3.00pm	24	118	68	1	1	87	125	79	0	3	68	143	34	0	0	80	120	13	0	0	959
3.15pm	35	144	85	0	1	107	106	84	0	0	87	118	44	0	1	63	117	14	1	0	1014
3.30pm	22	167	85	2	1	97	132	97	0	1	86	112	50	0	1	68	125	10	1	1	1045
3.45pm	31	185	107	0	0	92	132	92	0	0	73	126	58	0	0	78	141	7	0	0	1122
4.00pm	44	208	136	1	0	101	175	132	0	0	83	167	70	0	0	66	146	15	0	0	1321
4.15pm	57	221	165	2	2	110	218	172	0	4	93	185	82	1	1	54	151	22	0	2	1538
4.30pm	43	204	138	2	1	127	187	179	1	0	108	199	55	0	1	45	176	20	0	0	1494
4.45pm	55	234	167	0	0	127	206	172	0	0	116	226	69	0	0	64	172	15	0	0	1613
5.00pm	34	208	174	1	1	122	196	133	0	0	116	200	69	1	1	50	186	17	0	0	1495
5.15pm	35	215	154	0	0	115	162	133	0	0	129	224	89	0	0	77	176	15	0	0	1524
5.30pm	25	187	144	0	3	123	166	128	0	0	86	177	88	0	2	37	205	11	0	0	1177
5.45pm	20	116	110	2	1	81	207	107	0	0	70	134	45	0	0	28	177	4	0	0	1099
6.00pm	14	135	81	0	0	46	148	81	0	0	98	129	33	0	1	26	158	9	0	1	978
TOTALS	1149	6019	3649	35	22	4304	5840	3356	33	33	3400	7224	1855	6	12	2091	5584	498	3	22	45026
%CV	7.4	5.4	6.1	3.1		6.3	9.2	7.5	9.0		9.7	4.7	5.7	9.0		6.4	10.3	5.5	0.0		

COMMENTS:

Sidra Input

AM PEAK:	48	415	248	0	1	449	587	294	2	3	332	866	168	0	1	174	566	33	0	5
PM PEAK:	180	877	841	5	4	482	807	658	1	10	421	794	275	2	3	223	685	88	0	2

ROAD 1/4 hr ENDING	Kingston Rd					Compton Rd					Bris-Benleigh Rd					Compton Rd					Total Traffic 1/4 hr
	FROM 1-4	1-3	1-2	U-Turn	PEDS	FROM 2-1	2-4	2-3	U-Turn	PEDS	FROM 3-2	3-1	3-4	U-Turn	PEDS	FROM 4-3	4-2	4-1	U-Turn	PEDS	

Volume Classified Count-sheet

LOCATION Sidra St / Dine-Kenneligh Rd
DATE Friday 22/11/92
WEATHER Fine

4
1-+3
2

COUNTER	Dine-Kenneligh Rd 1					Dine-Kenneligh Rd 2					Dine-Kenneligh Rd 3					Dine-Kenneligh Rd 4					Total		
ROAD	FROM	1-3	1-2	U-Turn	PEDS	FROM	2-1	2-4	2-3	U-Turn	PEDS	FROM	3-1	3-4	U-Turn	PEDS	FROM	4-3	4-2	4-1	U-Turn	PEDS	Traffic
ENDING	1-4					2-1						3-2					4-3						1/4 hr
6:45am	6	83	3	3	0	13	3	4	0	0	0	8	210	40	4	0	4	1	5	0	1	1	358
7:00am	9	35	2	7	0	6	2	2	0	0	0	4	260	70	7	0	11	0	12	0	1	1	477
7:15am	13	165	3	4	0	6	1	6	0	1	1	4	217	37	0	0	5	0	19	0	0	0	422
7:30am	18	113	2	11	0	10	4	6	0	1	1	7	284	74	7	0	6	0	21	0	0	0	510
7:45am	39	114	2	14	0	14	7	2	0	5	1	6	298	11	1	0	17	1	14	0	1	1	531
8:00am	11	145	6	14	0	12	11	4	0	1	1	5	234	11	3	0	21	4	12	0	2	2	524
8:15am	33	131	5	10	0	12	0	6	0	2	1	7	218	14	9	0	15	1	12	0	4	4	464
8:30am	33	227	6	19	0	3	3	10	0	3	1	7	286	70	2	0	18	0	25	0	2	2	484
8:45am	25	184	7	12	0	12	0	8	0	3	1	4	245	40	6	0	20	0	19	0	2	2	417
9:00am	32	191	6	20	0	9	3	6	0	4	1	7	258	54	4	0	26	0	13	0	0	0	425
9:15am	9	145	6	12	0	6	2	8	0	1	1	7	221	55	1	1	10	1	44	0	2	2	518
9:30am	32	160	6	17	0	12	1	9	0	1	1	7	140	19	6	0	27	1	43	0	1	1	514
9:45am	38	189	5	17	0	11	5	7	0	1	1	11	217	43	8	1	32	3	42	0	3	3	607
10:00am	29	221	6	19	0	6	2	9	0	1	1	5	155	66	3	0	46	1	29	0	1	1	415
10:15am	26	151	8	21	0	3	1	1	0	1	1	5	191	88	6	0	40	1	12	0	3	3	591
10:30am	12	250	6	15	0	8	4	2	0	1	1	7	131	42	8	0	10	2	47	0	7	7	445
10:45am	25	211	7	14	0	8	4	8	0	1	1	8	191	38	1	0	50	0	44	0	0	0	412
11:00am	27	224	11	17	0	7	4	6	0	2	1	8	192	35	8	0	45	0	42	0	0	0	412
11:15am	40	216	14	18	0	7	4	7	0	2	1	9	132	31	8	0	40	0	19	0	0	0	587
11:30am	24	222	2	21	0	7	0	10	0	0	0	8	114	45	11	0	32	1	80	0	0	0	419
11:45am	42	224	6	19	0	6	3	5	0	0	0	5	137	47	5	0	25	8	64	0	0	0	428
12:00pm	35	258	6	17	0	4	6	5	0	0	0	9	158	40	12	0	36	0	61	0	0	0	481
12:15pm	34	254	3	21	0	5	3	11	0	0	1	13	197	40	8	3	50	0	49	0	3	3	674
12:30pm	28	228	3	17	0	5	6	9	0	1	1	8	118	39	7	0	44	0	44	0	3	3	403
12:45pm	29	247	16	14	0	4	6	6	0	1	1	7	287	45	4	0	31	0	41	0	2	2	625
1:00pm	41	214	8	20	0	9	3	5	0	0	0	7	197	54	6	0	42	1	41	0	1	1	452
1:15pm	36	152	19	20	0	2	2	10	0	0	0	7	203	19	7	0	33	0	41	0	2	2	758
1:30pm	35	277	4	19	0	5	2	4	0	1	1	7	207	14	4	0	32	4	10	0	1	1	485
1:45pm	45	132	8	21	0	4	3	4	0	0	0	8	217	60	0	0	43	0	45	0	1	1	763
2:00pm	40	267	3	15	0	5	4	3	0	0	0	4	213	49	4	0	35	4	42	0	0	0	464
2:15pm	41	241	5	22	0	4	5	6	0	0	0	7	224	47	3	0	41	0	57	0	0	0	415
2:30pm	29	212	7	20	0	3	1	5	0	0	0	9	217	52	3	0	4	1	42	0	0	0	449
2:45pm	32	257	5	25	0	6	2	8	0	3	1	9	188	47	8	0	39	1	54	0	0	0	464
3:00pm	44	259	18	21	0	13	3	13	0	2	1	7	235	45	3	1	35	3	52	0	1	1	700
3:15pm	18	354	5	20	0	7	4	8	0	1	1	9	206	44	8	0	44	1	42	0	1	1	749
3:30pm	34	247	12	32	0	3	0	9	0	1	1	14	200	41	7	0	38	5	48	0	2	2	664
3:45pm	25	123	6	14	0	11	1	6	0	2	1	11	244	10	0	0	54	3	49	0	0	0	413
4:00pm	29	132	10	21	0	10	4	6	0	3	1	11	245	4	0	0	53	0	44	0	0	0	722
4:15pm	43	221	14	16	0	9	3	4	0	0	0	10	228	10	0	0	52	2	39	0	2	2	774
4:30pm	28	287	11	18	0	6	2	9	0	0	0	15	11	40	0	0	55	2	39	0	1	1	837
4:45pm	35	307	11	22	0	7	6	11	0	2	1	11	11	4	15	0	44	2	15	0	1	1	749
5:00pm	34	307	9	19	0	10	4	11	0	3	1	13	11	4	15	0	55	3	84	0	3	3	733
5:15pm	11	347	7	16	0	7	4	7	0	0	0	11	223	1	4	0	89	4	57	0	3	3	762
5:30pm	15	359	9	17	0	9	0	10	0	0	0	11	178	24	6	0	33	3	41	0	3	3	891
5:45pm	8	151	8	9	0	4	1	5	0	1	1	7	15	5	0	0	33	0	26	0	1	1	623
6:00pm	6	292	8	8	0	4	3	18	0	0	0	15	175	12	4	2	19	3	16	0	0	0	551
TOTALS	1391	1106	324	858	0	266	143	341	0	52	379	2022	2415	297	21	1548	98	1815	0	60	60	31093	
MOV	7.6	5.7	3.7	2.0		2.6	0.8	3.5	0.0			9	5.9	5.6	0.7		4.9	1.0	8.8	0.0			
COMMENTS:																							
Sidra Input																							
AM PEAK	121	772	22	76	0	44	12	20	0	9	23	1185	250	20	0	73	5	100	0	10	10	10	
PM PEAK	142	1253	41	97	0	39	13	27	0	3	47	821	204	33	0	214	7	171	0	3	3	3	

SKM

Appendix E aaSIDRA analysis results

RTI DL RELEASE - EHP

Table S14 from Sidra output tables

Kingston Rd/Compton Rd (PM Peak)
 2006 Base Case
 Intersection ID: 0
 Fixed-Time Signals, Cycle Time = 140 (Practical Cycle Time)

Lane No.	Demand Flow (veh/h)	Adj. Satf.	Eff. Satf.	Grn. Satf.	Deg. Sat	Aver. Delay (sec)	Longest Queue (m)	Shrt. Lane (m)
	L T R Tot				x			
South: Kingston Rd South								
1 LT	345 90	435	5	1970	21 29	0.909	30.2r	108*
2 T	260	260	5	1970	21	0.909	57.0	139
3 TR	189 68	258	5	1970	21	0.909	59.2	138
4 R	124	124	5	1964	21	0.909	63.7	67*
	345 539 192 1076	5				0.909	47.5	139
East: Compton Rd East								
1 LT	229 201	430	5	1950	5 33	0.938	88.9	244
2 T	380	380	5	1950	30	0.938	79.3	222
3 R	75	75	5	1999	30	0.376	57.5	39
	229 581 75 885	5				0.938	82.2	244
North: Kingston Rd North								
1 L	140	140	5	1970	36 59	0.280	14.1	30
2 T	381	381	5	1970	36	0.776	34.5	159
3 T	381	381	5	1970	36	0.776	34.5	159
4 R	436	436	5	1949	36	0.946	53.0	226*
	140 762 436 1338	5				0.946	38.4	226
West: Compton Rd West								
1 L	372	372	5	1949	29 77	0.293	11.7	59
2 T	366	366	5	1970	29	0.926	83.0	209
3 TR	184 173	357	5	1970	29	0.926	83.4	204
4 R	344	344	5	1960	29	0.926	82.7r	196*
	372 550 517 1439	5				0.926	64.6	209
ALL VEHICLES								
	Total Flow	1						
	4738	5						
				Cycle Time	Max X	Aver. Delay	Max Queue	
				140	0.946	56.6	244	

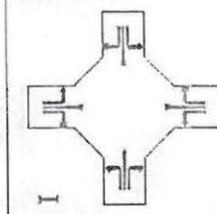
Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

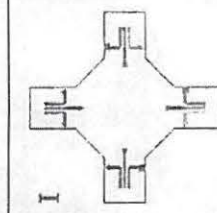
Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

* Queue length exceeds short lane length due to specification of a percentile queue in the Tools-Options (Model tab). For calculation of this statistic, you may specify the lane with full length.

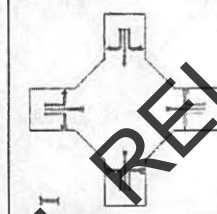
r Delay, stops and queue length for this lane have been cut down to fit in the queuing space. The amount cut may not be accounted for fully in the adjacent lane performance statistics. You may wish to change the short lane to a full lane to investigate the extent of this effect.

Phasing diagram
Phase A 27 sec

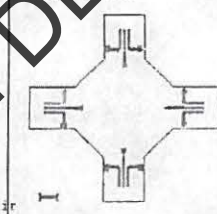
Phase B 42 sec



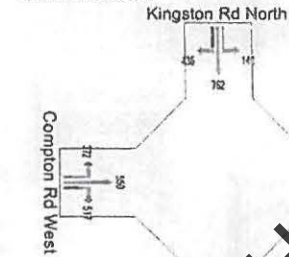
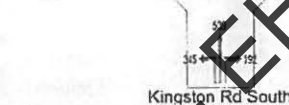
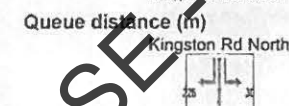
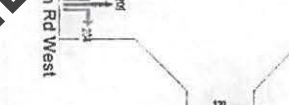
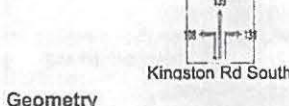
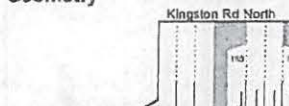
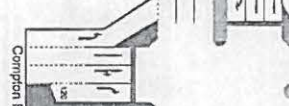
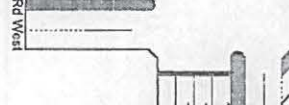
Phase C 35 sec



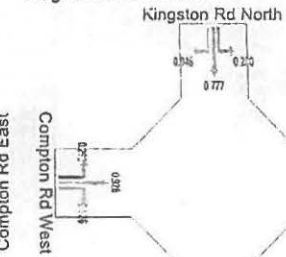
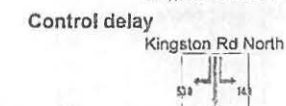
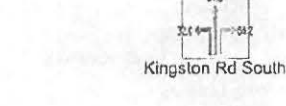
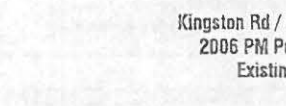
Phase D 36 sec



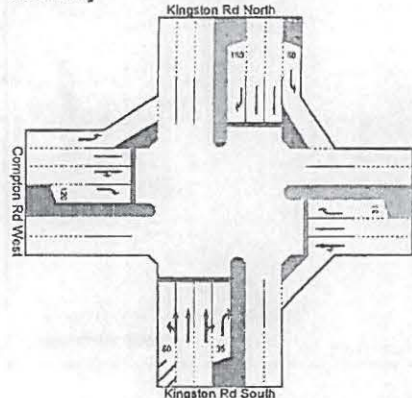
Demand flows



Degree of saturation



Geometry



SKM

Kingston Rd / Compton Rd
 2006 PM Peak analysis
 Existing base case

Table S14 from Sidra output tables

Kingston Rd/Compton Rd (PM Peak)
 2011 Base Case
 Intersection ID: 0
 Fixed-Time Signals, Cycle Time = 140 (Practical Cycle Time)

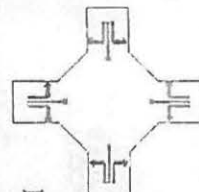
Lane No.	Demand Flow (veh/h)				Adj. Satf.	Eff. Satf.	Grn. Satf.	Deg. Sat	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
	L	T	R	Tot	tHV	Basic	1st 2nd	x			
South: Kingston Rd South											
1 LT	366	95		461	5	1970	21 29	0.964	28.4r	108*	60
2 T		276		276	5	1970	21	0.964	64.9	157	500
3 TR		200	73	273	5	1970	21	0.964	67.1	156	500
4 R			131	131	5	1964	21	0.964	65.0r	69*	35
	366	571	204	1141	5			0.964	50.7	157	
East: Compton Rd East											
1 LT	243	213		456	5	1950	5 33	0.995	129.0	326	500
2 T		403		403	5	1950	30	0.995	114.3	287	500
3 R			80	80	5	1899	30	0.401	57.7	41	50
	243	616	80	939	5			0.995	116.6	326	
North: Kingston Rd North											
1 L	148			148	5	1970	36 57	0.305	14.8	32	60
2 T		404		404	5	1970	36	0.824	35.7	176	500
3 R		404	1	404	5	1970	36	0.824	60.5	258	500
4 R			461	461	5	1949	36	1.000	60.5r	258*	160
	148	808	462	1418	5			1.000	41.6	258	
West: Compton Rd West											
1 L	394			394	5	1949	29 75	0.312	12.4	67	500
2 T		384		384	5	1970	29	0.972	102.5	249	500
3 TR		187	374	561	5	1970	29	0.972	103.0	243	500
4 R			361	361	5	1960	29	0.972	77.6r	196*	120
	394	571	548	1513	5			0.972	73.2	249	
ALL VEHICLES											
	Total	1				Cycle		Max	Aver.	Max	
	Flow	HV				Time		X	Delay	Queue	
	5011	5				140		1.000	67.3	326	

Peak flow period = 60 minutes.

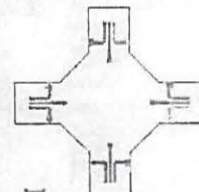
Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

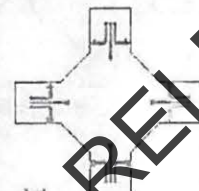
- * Queue length exceeds short lane length due to specification of a percentile queue in the Tools-Options (Model tab). For calculation of this statistic, you may specify the lane with full length.
- r Delay, stops and queue length for this lane have been cut down to fit in the queuing space. The amount cut may not be accounted for fully in the adjacent lane performance statistics. You may wish to change the short lane to a full lane to investigate the extent of this effect.

Phasing diagram
Phase A 27 sec

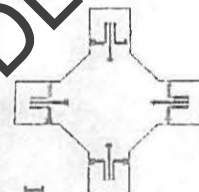
Phase B 42 sec



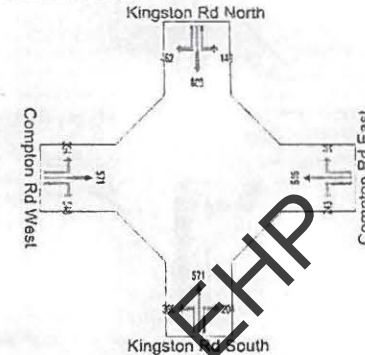
Phase C 35 sec



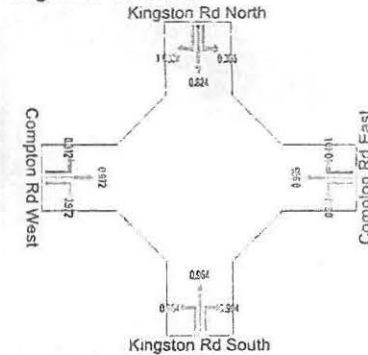
Phase D 36 sec



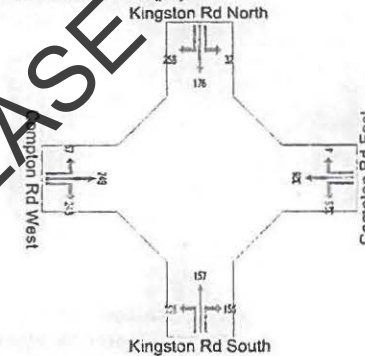
Demand flows



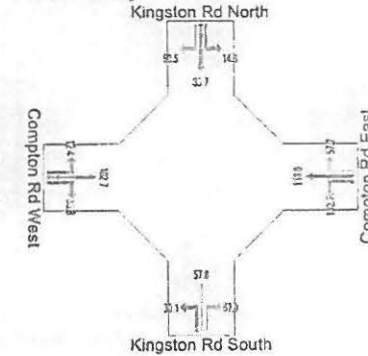
Degree of saturation



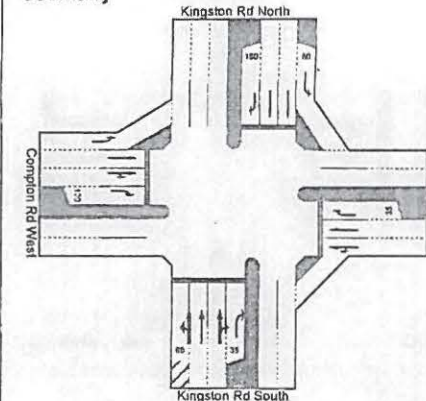
Queue distance (m)



Control delay



Geometry



SKM

Kingston Rd / Compton Rd
 2011 PM Peak analysis
 Existing base case

Table S14 from Sidra output tables

Kingston Rd/Compton Rd (PM Peak)
 2011 Design Case
 Intersection ID: 0
 Fixed-Time Signals, Cycle Time = 140 (Practical Cycle Time)

Lane No.	Demand Flow (veh/h)				HV	Adj. Basic Satf.	Eff Grn		Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
	L	T	R	Tot			1st	2nd				
South: Kingston Rd South												
1 LT	367	103		470	5	1970	21	29	0.967	28.3r	108*	60
2 T		277		277	5	1970	21		0.967	65.8	159	500
3 TR		194	79	274	5	1970	21		0.967	68.2	157	500
4 R			132	132	5	1964	21		0.967	64.8r	69*	35
	367	574	211	1152	5				0.967	50.9	159	
East: Compton Rd East												
1 LT	273	208		481	5	1950	4	34	1.002	51.0	244	500
2 T		419		419	5	1950	31		1.002	79.1	267	500
3 R			94	94	5	1899	31		0.468	57.2	47	50
	273	627	94	994	5				1.002	63.4	267	
North: Kingston Rd North												
1 L	148			148	5	1970	35	56	0.313	15.5	34	60
2 T		438		438	5	1970	35		0.919	41.9	214	500
3 R		424	14	437	5	1970	35		0.919	65.5	258	500
4 R			448	448	5	1949	35		1.000	65.5r	258*	160
	148	862	462	1472	5				1.000	46.4	258	
West: Compton Rd West												
1 L	394			394	5	1949	29	74	0.316	8.8	17	500
2 T		397		397	5	1970	29		1.006	92.0	259	500
3 TR		174	212	386	5	1970	29		1.006	92.4	252	500
4 R			372	372	5	1960	29		1.000	58.2r	196*	120
	394	571	584	1549	5				1.006	62.8	259	
ALL VEHICLES												
	Total			Flow	%		Cycle		Max	Aver.	Max	
	5167			5	HV		Time		X	Delay	Queue	
					5		140		1.006	55.6	267	

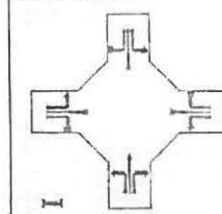
Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

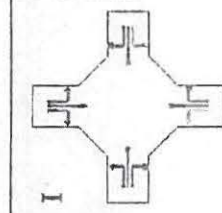
Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

- * Queue length exceeds short lane length due to specification of percentile queue in the Tools-Options (Model tab). For calculation of this statistic, you may specify the lane with full length.
- r Delay, stops and queue length for this lane have been cut down to fit in the queuing space. The amount cut may not be accounted for fully in the adjacent lane performance statistics. You may wish to change the short lane to a full lane to investigate the extent of this effect.

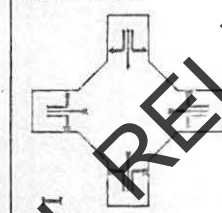
Phasing diagram
 Phase A 27 sec



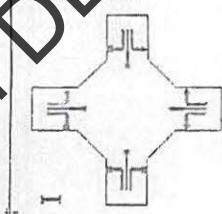
Phase B 42 sec



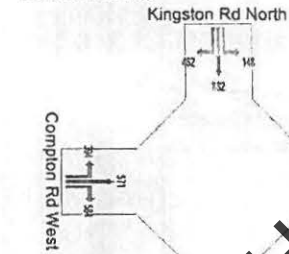
Phase C 35 sec



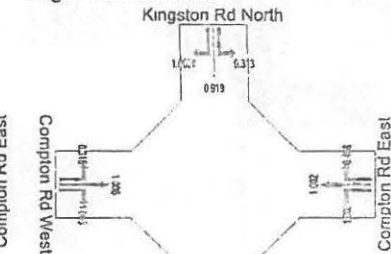
Phase D 36 sec



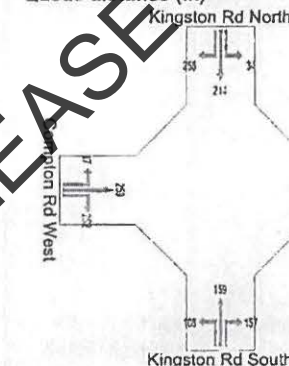
Demand flows



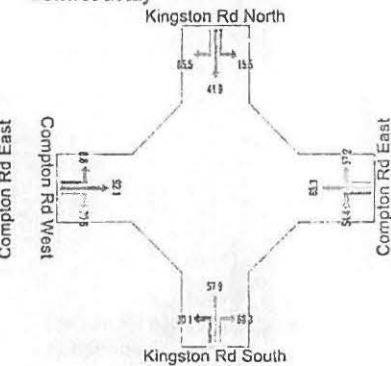
Degree of saturation



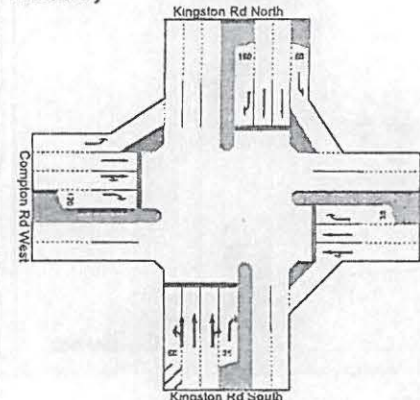
Queue distance (m)



Control delay



Geometry



SKM

Kingston Rd / Compton Rd
 2011 PM Peak analysis
 Design case

Table S14 from Sidra output tables

Kingston Rd/Site Access
2011 Design Case
Intersection ID: 0
Give-Way Sign Controlled Intersection

Lane No.	Demand Flow (veh/h)				Adj. Satf.	Eff. Basic (secs)	Grn 1st	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
	L	T	R	Tot	HV		2nd				
South: Kingston Rd South											
1 T		636		636	6			0.339	0.0	0	500
2 T		636		636	6			0.339	0.0	0	500
3 R			69	69	4			0.803	114.0	30	30
	0	1272	69	1341	6			0.803	5.9	30	
East: Site Access											
1 L	31			31	6			0.325	55.4	10	70
	31	0	0	31	6			0.325	55.4	10	
North: Kingston Rd North											
1 LT	129	883		1012	6			0.542	1.1	0	200
2 T		1017		1017	6			0.542	0.0	0	500
	129	1900	0	2029	6			0.542	0.5		
ALL VEHICLES											
	Total				1			Max	Aver.	Max	
	Flow				HV			X	Delay	Queue	
	3401				6			0.802	3.1	30	

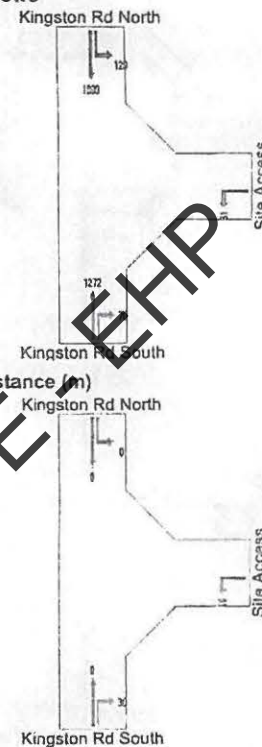
Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

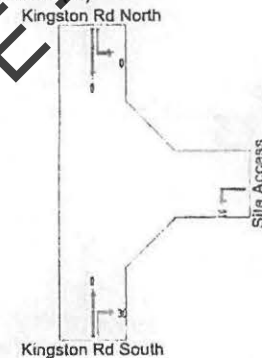
Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Phasing diagram

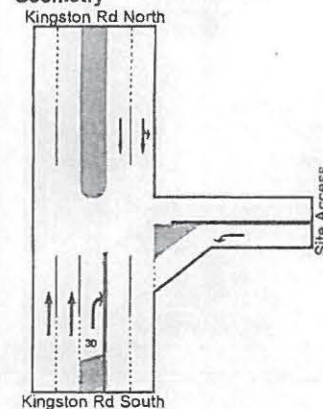
Demand flows



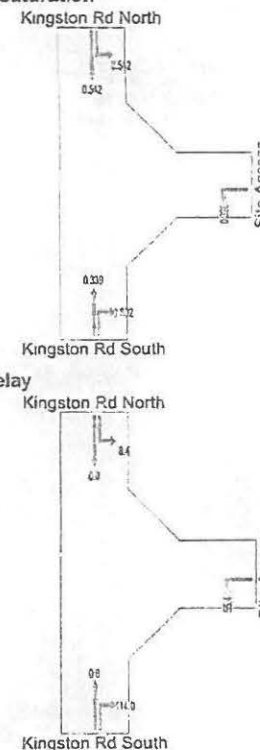
Queue distance (m)



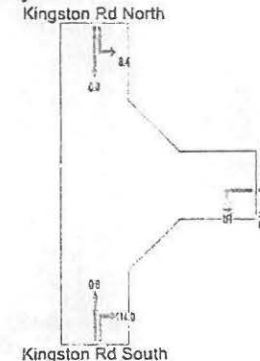
Geometry



Degree of saturation



Control delay



SKM

Kingston Rd / Site Access
2011 PM Peak analysis
2011 design case

Table S14 from Sidra output tables

Kingston/Moss/Rudge St (PM Peak)
 2006 Base Case
 Intersection ID: 0
 Fixed-Time Signals, Cycle Time = 70 (Practical Cycle Time)

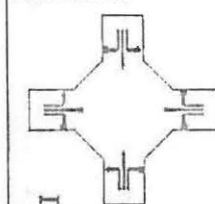
Lane No.	Demand Flow (veh/h)				Adj. Satf.	Eff. Grn Basic (secs)	Deg Sat	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
	L	T	R	Tot		1st 2nd	x			
South: Kingston Rd South										
1 LT	55	510		565	6	1970	30	1	0.694	5.7
2 T		564		564	6	1970	30		0.694	4.4
3 R			238	238	6	1919	12		0.791	34.2
	55	1074	238	1367	6				0.791	10.2
East: Moss St East										
1 L	250			250	6	1919	12		0.832	45.6
2 TR		9	200	209	6	1919	10		0.847	47.2
	250	9	200	459	6				0.847	46.3
North: Kingston Rd North										
1 L	166			166	6	1970	30		0.255	20.2
2 T		731		731	6	1970	30		0.900	8.7
3 T		731		731	6	1970	30		0.900	8.7
4 R			161	161	3	1970	12		0.512	39.2
	166	1462	161	1789	6				0.900	12.5
West: Rudge St West										
1 LTR	42	16	32	90	2	1970	18	9	0.164	15.6
	42	16	32	90	2				0.164	15.6
ALL VEHICLES										
	Total				Cycle Time		Max X		Aver. Delay	
	Flow				70		0.900		15.9	
	3705								138	

Peak flow period = 30 minutes.

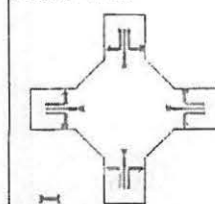
Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

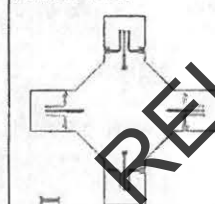
* Queue length exceeds short lane length due to specification of percentile queue in the Tools-Options (Model tab). For calculation of this statistic, you may specify the lane with full length.

Phasing diagram
Phase A 36 sec

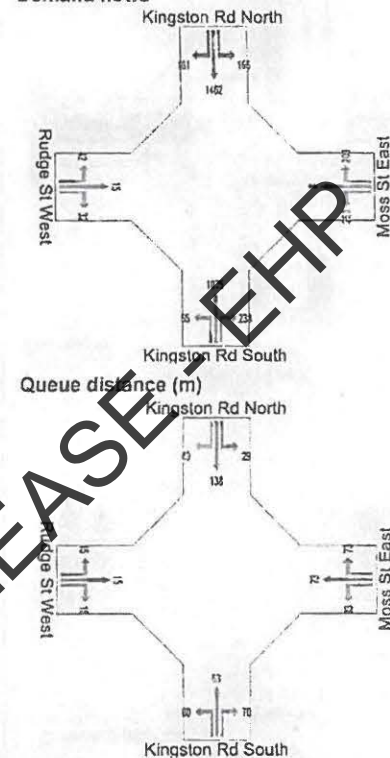
Phase B 18 sec



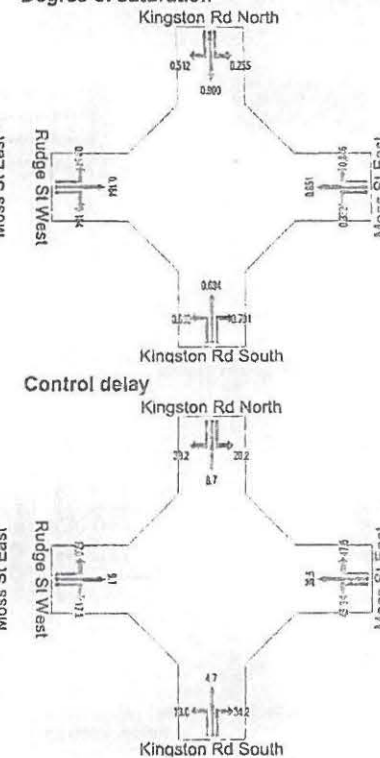
Phase C 16 sec



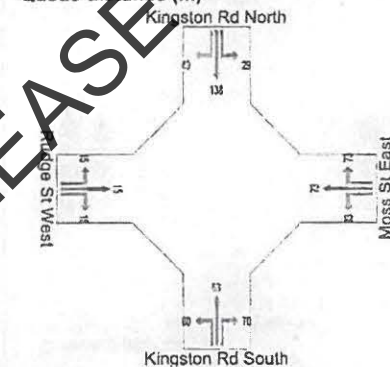
Demand flows



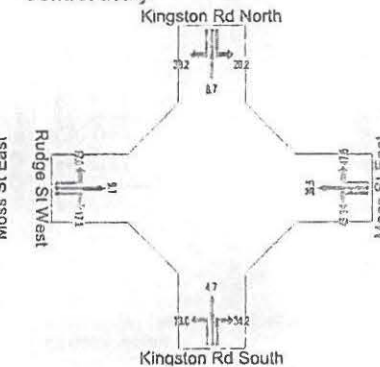
Degree of saturation



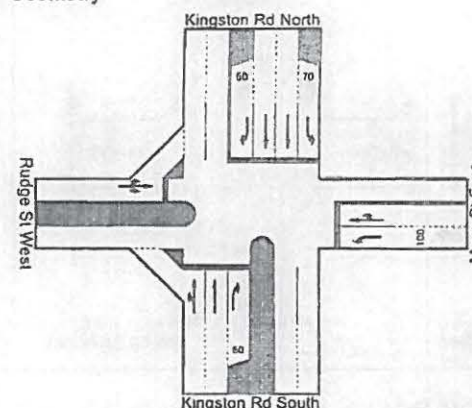
Queue distance (m)



Control delay



Geometry



SKM

Kingston Rd / Moss St / Rudge St
 2006 PM Peak analysis
 Existing base case

Table S14 from Sidra output tables

Kingston/Moss/Rudge St (PM Peak)
 2011 Base Case
 Intersection ID: 0
 Fixed-Time Signals, Cycle Time = 70 (Practical Cycle Time)

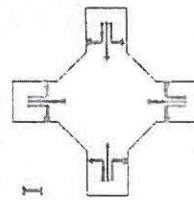
Lane No.	Demand Flow (veh/h)				Adj. Satf.	Eff. Basic (secs)	Grn. 1st	Deg. 2nd	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
	L	T	R	Tot							
South: Kingston Rd South											
1 LT	55	511		566	6	1970	30	1	0.695	5.7	61
2 T		565		565	6	1970	30		0.695	4.4	63
3 R			238	238	6	1919	12		0.791	34.2	70*
	55	1076	238	1369	6				0.791	10.2	70
East: Moss St East											
1 L	250			250	6	1919	12		0.832	45.6	83
2 TR		9	200	209	6	1919	10		0.847	47.2	73
	250	9	200	459	6				0.847	46.3	83
North: Kingston Rd North											
1 L	166			166	6	1970	30		0.255	20.2	29
2 T		732		732	6	1970	30		0.901	8.8	138
3 T		732		732	6	1970	30		0.901	8.8	138
4 R			161	161	3	1970	12		0.512	39.2	49
	166	1464	161	1791	6				0.901	12.6	138
West: Rudge St West											
1 LTR	42	16	32	90	2	1970	18	9	0.164	15.6	16
	42	16	32	90	2				0.164	15.6	15
ALL VEHICLES											
	Total				t	Cycle Time		Max X	Aver. Delay	Max Queue	
	3709				6	70		0.901	15.9	138	

Peak flow period = 30 minutes.

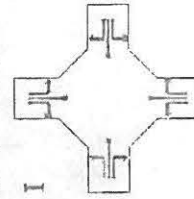
Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

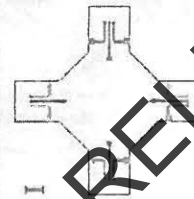
* Queue length exceeds short lane length due to specification of a percentile queue in the Tools-Options (Model tab). For calculation of this statistic, you may specify the lane with full length.

Phasing diagram
Phase A 36 sec

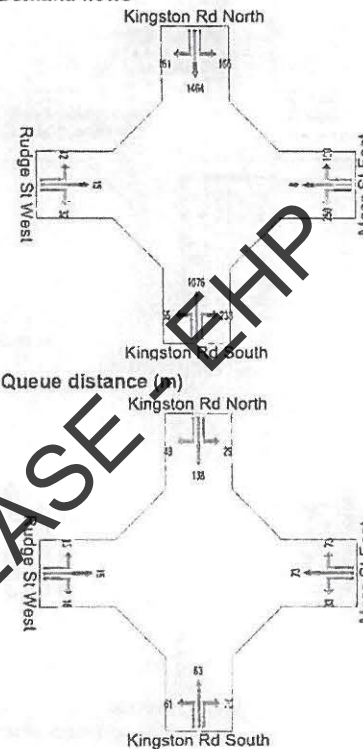
Phase B 18 sec



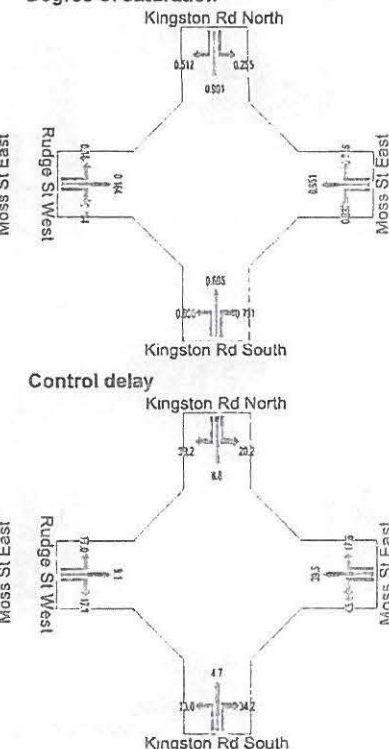
Phase C 16 sec



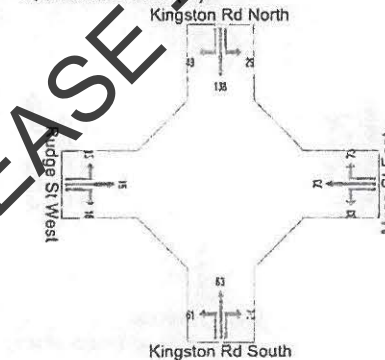
Demand flows



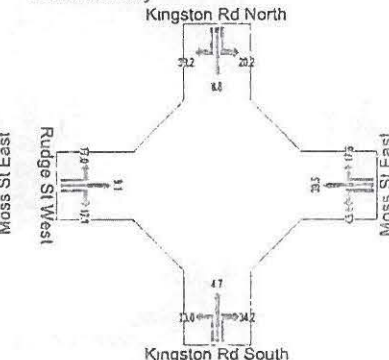
Degree of saturation



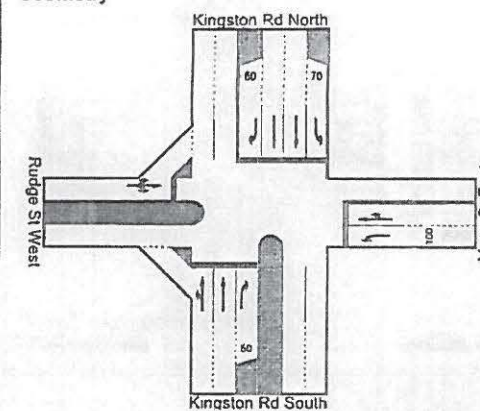
Queue distance (m)



Control delay



Geometry



SKM

Kingston Rd / Moss St / Rudge St
 2011 PM Peak analysis
 2011 Base case

Table S14 from Sidra output tables

Kingston/Moss/Rudge St (PM Peak)
 2011 Design Case
 Intersection ID: 0
 Fixed-Time Signals, Cycle Time = 70 (Practical Cycle Time)

Lane No.	Demand Flow (veh/h)				HV	Adj. Basic Satf.	Eff (secs)	Grn 1st 2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
	L	T	R	Tot								
South: Kingston Rd South												
1 LT	54	540		594	6	1970	31	1	0.707	4.7	55	500
2 T		594		594	6	1970	31		0.707	3.6	58	500
3 R			236	236	6	1919	11		0.856	36.7	73*	50
	54	1134	236	1424	6				0.856	9.5	73	
East: Moss St East												
1 L	248			248	6	1919	11		0.900	52.4	89	100
2 TR		9	210	219	6	1919	10		0.088	50.8	79	500
	248	9	210	467	6				0.900	51.7	89	
North: Kingston Rd North												
1 L	171			171	6	1970	31		0.255	19.4	29	70
2 T		749		749	6	1970	31		0.892	7.3	125	500
3 T		749		749	6	1970	31		0.892	7.3	125	500
4 R			160	160	3	1970	11		0.555	40.3	50	50
	171	1498	160	1829	6				0.892	11.3	125	
West: Rudge St West												
1 LTR	41	16	32	89	2	1970	19	9	0.165	15.4	15	500
	41	16	32	89	2				0.165	15.4	15	
ALL VEHICLES												
	Total Flow				% HV	Cycle Time	Max X	Aver. Delay	Max Queue			
	3809				6	70	0.900	15.7	125			

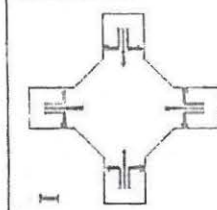
Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

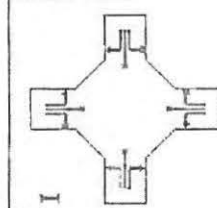
Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

* Queue length exceeds short lane length due to specification of a percentile queue in the Tools-Options (Model tab). For calculation of this statistic, you may specify the lane with full length.

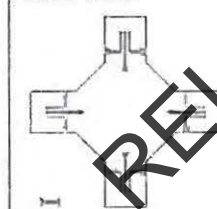
Phasing diagram
 Phase A 37 sec



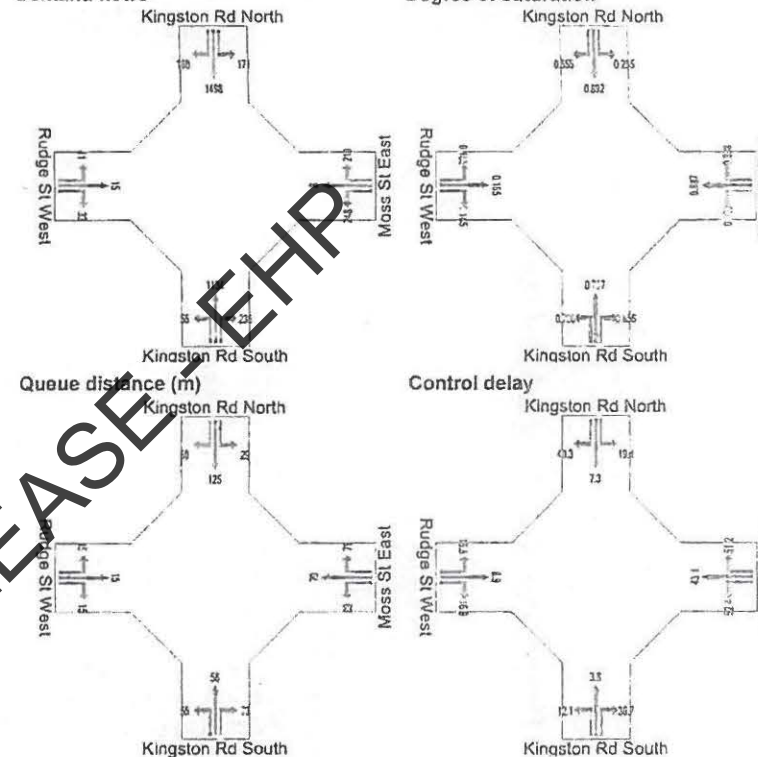
Phase B 17 sec



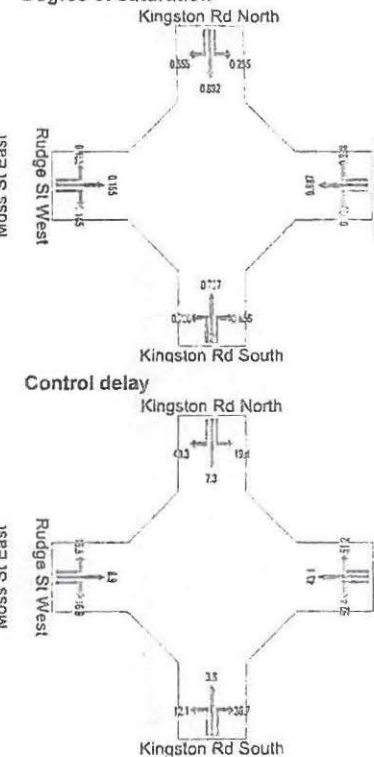
Phase C 16 sec



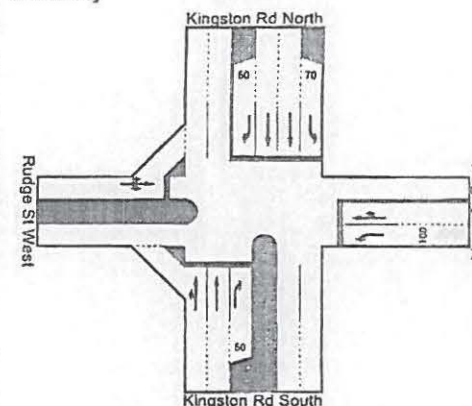
Demand flows



Degree of saturation



Geometry



SKM

Kingston Rd / Moss St / Rudge St
 2011 PM Peak analysis
 2011 Design case



Appendix F Responses to LCC constraint codes

RTI DL RELEASE - EHP

Specific outcomes and prescribed solutions for a parking area

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
Parking spaces for vehicles		
<p>O1 Development provides sufficient parking spaces on the premises to satisfy the expected demand for the number and type of vehicles likely to be generated by the activity having regard to—</p> <p>(a) the particular circumstances of the development including—</p> <p>(i) the nature, intensity and hours of operation of the development; and</p> <p>(ii) the desirability of providing car parking and attracting vehicles to the particular location; and</p> <p>(iii) the proposed layout; and</p> <p>(b) the particular characteristics of the premises including—</p> <p>(i) the existing development on the premises; and</p> <p>(ii) the size, levels and dimensions of the premises; and</p> <p>(c) the safety and convenience of access for vehicles, cyclists and pedestrians; and</p> <p>(d) the proximity of the development to existing or future public car parking facilities, other available car parking areas or public transport facilities; and</p>	<p>S1.1 Development provides parking spaces on the premises in accordance with column 2 of Table 5.3.4A (Vehicle parking spaces).</p> <p>S1.2 Development for a non-residential use provides parking spaces on the premises for persons with disabilities in accordance with column 2 of Table 5.3.4C (Vehicle parking spaces for persons with disabilities).</p> <p>S1.3 Development, which incorporates a facility for the issuing of a ticket to enter the premises or a security gate (<i>ticket and security facility</i>), provides parking spaces on the premises outside the ticket and security facility in accordance with column 2 of Table 5.3.4D (Vehicle parking spaces for uses incorporating a security gate).</p> <p>S1.4 Development in respect of a community title lot provides—</p> <p>(a) the required parking spaces on the lot; and</p> <p>(b) required visitor parking spaces on the common property.</p> <p>S1.5 Development provides that a parking space is—</p> <p>(a) kept exclusively for parking; and</p> <p>(b) used exclusively for parking; and</p> <p>(c) maintained for continued use for parking; and</p>	<p>S1.1 The type of development is not listed in Table 5.3.4A. The proposed parking yield (static capacity) of 50 greyhound trailer parks plus 165 patron car parks is consistent with anticipated parking demand, based on the existing greyhound facility in Albion.</p> <p>S1.2 Complies. A total of three (3) persons with disabilities (PWD) parking spaces are proposed.</p> <p>S1.3 Not applicable. The proposed development does not include a ticket and security facility.</p> <p>S1.4 Not applicable.</p> <p>S1.5 Complies.</p>

SINCLAIR KNIGHT MERZ

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
<p>(e) in the case of an extension to an existing development, whether—</p> <p>(i) the existing car parking area is fully utilised; and</p> <p>(ii) the car parking requirements of the proposed extension will result in a car parking problem on the premises or in the zone and sub-area during normal peak demand periods; and</p> <p>(f) the existence of a car parking area which—</p> <p>(i) is within 100 metres of the premises; and</p> <p>(ii) has convenient pedestrian access; and</p> <p>(iii) is the subject of a legal arrangement which prevents the parking area from being alienated, leased or otherwise disposed of so that it is available for the development which it is intended to serve; and</p> <p>(g) the maximum number of employees and customers to be on the premises at any one time; and</p> <p>(h) whether any relaxation of the number of car parking spaces will result in a car parking problem on the premises or in the zone and sub-area or cause a traffic problem on an adjacent road.</p>	<p>(d) available for use by both staff and visitors; and</p> <p>(e) not sold or leased (other than in accordance with a development approval for a carpark).</p> <p><i>Note: For the purposes of the calculation of parking spaces in these prescribed solutions—</i></p> <p>(a) <i>tandem parking spaces are only counted as one space unless—</i></p> <p>(i) <i>the tandem parking spaces are—</i></p> <p>(A) <i>provided for a residential use; or</i></p> <p>(B) <i>used by the occupants of the premises in one tenancy; or</i></p> <p>(C) <i>operated as part of a car park with management provided on the premises; and</i></p> <p>(ii) <i>the tandem parking spaces have a minimum length of 10.4 metres or 11 metres in the case of a tandem garage; and</i></p> <p>(iii) <i>the tandem parking spaces are provided on the premises; and</i></p> <p>(b) <i>a motorcycle parking space is counted as 0.25 of a parking space.</i></p>	

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
Manoeuvring areas within a parking area		
<p>O2 Development provides a manoeuvring area for vehicles on the premises—</p> <ul style="list-style-type: none"> (a) to satisfy the expected demand for the number and type of service vehicles likely to be generated by the activity; and (b) which allows for safe, efficient and legible vehicle circulation; and (c) which allows for safe, efficient and legible emergency vehicle access; and (d) to allow the free influx of traffic into a parking area; and (e) to prevent an adverse impact on the safety and efficiency of the existing or planned road network. 	<p>S2.1 Development provides manoeuvring areas for the design vehicles specified in Table 5.3.4E (Design vehicles for manoeuvring areas).</p> <p>S2.2 Development provides that in relation to access, the design vehicle is able to—</p> <ul style="list-style-type: none"> (a) enter and leave the premises in a forward direction; and (b) circulate around the premises on primary aisles; and (c) park in a manner allowing loading and unloading operations clear of circulating roadway aisles. <p>S2.3 Development provides—</p> <ul style="list-style-type: none"> (a) a loading bay, in accordance with column 3 of Table 5.3.4A (Vehicle parking spaces); and (b) a pick up/set down area, in accordance with column 4 of Table 5.3.4A (Vehicle parking spaces); and (c) vehicle queuing spaces, in accordance with column 5 of Table 5.3.4A (Vehicle parking spaces) and column 2 of Table 5.3.4B (Queuing spaces) unless— <ul style="list-style-type: none"> (i) the development is located on a minor road, a minimum queue length of six metres; or 	<p>S2.1 Complies. The proposed development plan includes manoeuvring areas for heavy rigid vehicles (HRVs), including refuse vehicles.</p> <p>S2.2 Complies. The proposed development plan's service vehicle parking and circulation provisions allows an HRV to enter and leave the premises in a forward direction, and circulate around the premises on primary aisles, and park in a manner allowing loading and unloading operations clear of circulating roadway aisles (refer to Section 2 of the traffic report).</p> <p>S2.3 (a) The type of development is not listed in Table 5.3.4A. However, a dedicated loading bay suitable for two HRVs within the site (refer to Section 2 of the traffic report). (b) Not applicable. The type of development is not listed in Table 5.3.4A. (c) Not applicable. The type of development is not listed in Table 5.3.4A. Queuing spaces has been provided in accordance with AS/NZS2890.1:2002 (refer to Section 2 of the traffic report).</p>

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
	<p>(ii) in the case of a residential use, the development provides a vehicle turning area and visitor parking spaces outside the security gates of the development in accordance with Table 5.3.4D (Vehicle parking spaces for users incorporating a security gate).</p> <p>S2.4 Development provides that the gradient of an area used for the manoeuvring of a vehicle is a maximum of 1 in 12.</p> <p>S2.5 Development provides a manoeuvring area for the design vehicle which complies with the critical dimensions and minimum turning paths derived geometrically from the dimensions specified in—</p> <p>(a) Figure 5.1 of <i>AS2890.1:1993: Parking facilities – Off-street parking</i>, for a car (B99); and</p> <p>(b) Figure 5.3 of <i>AS2890.2:2002: Parking facilities – Off-street commercial vehicle facilities</i>, for a small rigid vehicle (SRV); and</p> <p>(c) Figure 5.4 of <i>AS2890.2:2002: Parking facilities – Off-street facilities</i>; and</p> <p>(d) Figure B5 of <i>AS2890.2:2002: Parking facilities – Off-street commercial vehicle facilities</i>, for an articulated vehicle (AV).</p> <p>S2.6 Development provides a turning path with a design clearance of—</p>	<p>S2.4 Complies – refer to Section 2 of the traffic report.</p> <p>S2.5 Complies – refer to Section 2 of the traffic report.</p> <p>S2.5 Complies – refer to Section 2 of the traffic report.</p>

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
	<p>(a) a minimum of 300mm; or</p> <p>(b) a working clearance of a minimum of 600mm for a driveway and an accessway.</p> <p>S2.7 Development provides headroom to provide clearance for the design vehicle.</p> <p>S2.8 Development provides a loading bay for the design vehicle which has</p> <p>(a) a minimum width of 3.5 metres; and</p> <p>(b) a minimum length of—</p> <p>(i) 7 metres for a SRV; and</p> <p>(ii) 13.5 metres for a HRV; and</p> <p>(iii) 21 metres for a AV; and</p> <p>(c) a minimum vertical clearance of—</p> <p>(i) 3.5 metres for a SRV; and</p> <p>(ii) 4.5 metres for a HRV and a AV.</p>	<p>S2.7 Not applicable the proposed development does not include overhead structures in parking and circulation areas.</p> <p>S2.8 Complies – refer to Section 2 of the traffic report.</p>
Layout of a parking area		
<p>O3 Development provides that a parking area on the premises—</p> <p>(a) limits the maximum length of a parking aisle in a parking area to 100 metres; and</p> <p>(b) does not provide unnecessary space in a parking area which would encourage illegal parking; and</p> <p>(c) provides for a progressive reduction in the speed environment in moving between the road and parking spaces; and</p> <p>(d) provides a clear and safe pedestrian</p>	<p>S3.1 None applicable.</p>	<p>S3.1 None applicable. Refer to Section 2 of the traffic report.</p>

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
<p>circulation network; and</p> <p>(e) provides adequate sight distances at all potential conflict points; and</p> <p>(f) provides for efficient and simple parking space search patterns; and</p> <p>(g) provides for uncongested public transport and service vehicle movements through the premises; and</p> <p>(h) keeps a heavy vehicle out of a parking aisle; and</p> <p>(i) ensures that no heavy vehicle reverses across a pathway; and</p> <p>(j) does not provide cross intersections; and</p> <p>(k) does not provide for a parking or turning movement, an intersecting aisle or a speed hump in a queuing area; and</p> <p>(l) does not provide parking off a circulation road; and</p> <p>(m) provides a direct pathway with adequate storage capacity at a road crossing; and</p> <p>(n) is laid out so that vehicular and pedestrian traffic may conveniently connect and travel between adjoining development.</p>		
Design and construction of a parking area		
<p>O4 Development provides that a parking area on the premises—</p> <p>(a) is safe, efficient and legible in meeting the</p>	<p>S4.1 Development being assessable development provides a parking area which complies with the standards for a parking area specified in</p>	<p>S4.1 Complies – refer to Section 2 of the traffic report.</p>

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
(b) requirements of the use; and does not have an adverse impact on the safety and efficiency of the existing or planned road network.	<p><i>Planning Scheme Policy No 5 (Design and construction of work) 2006.</i></p> <p>S4.2 Development provides that a parking area complies with—</p> <p>(a) <i>AS 2890.1:1993: Parking facilities – Off-street car parking</i>; and</p> <p>(b) <i>AS 2890.2:2002: Parking facilities – Off-street commercial vehicle facilities</i>, in the case of commercial vehicles.</p> <p>S4.3 Development provides—</p> <p>(a) a parking area in accordance with standard drawing LCC 8-00806 in <i>Planning Scheme Policy No 5 (Design and construction of work) 2006</i>; and</p> <p>(b) for a median which is greater than 1 metre wide from the back of the kerb, to be landscaped as a mulched garden area; and</p> <p>(c) for a median and a traffic island less than 1 metre wide to be concreted.</p> <p>S4.4 Development provides that all signs, landscaping and other parking furniture are a minimum of 0.5 metre behind a kerb.</p> <p>S4.5 Development provides that a parking area is finished with an all weather paved surface, such as asphaltic concrete, insitu concrete or paving blocks.</p> <p>S4.6 Development provides that—</p> <p>(a) if the parking area is graded such that</p>	<p>S4.2 (a) and (b) Complies – refer to Section 2 of the traffic report.</p> <p>S4.3 (a) Island and kerb setbacks to car park areas will be in accordance with standard drawing LCC 8-00806 in detailed development design. (b) Will comply in detailed design (c) Will comply in detailed design</p> <p>S4.4 Will comply through detailed development design.</p> <p>S4.5 Will comply through detailed development design.</p> <p>S4.6 Will comply through detailed development design.</p>

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
	<p>stormwater would drain across the verge via a crossover, a grated inlet is provided for the full width of the crossover immediately inside the premises; and</p> <p>(b) all stormwater collected on the parking area is piped to a nominated legal point of discharge.</p> <p>S4.7 Development provides for the lighting of a car park in accordance with section 4 of AS 2890.1:1993: <i>Parking facilities- Off-street car parking</i>.</p> <p>S4.8 Development provides lighting of a parking area that illuminates</p> <p>(a) an open surface car park to 15 lux; and</p> <p>(b) a basement car park to 50 lux; and</p> <p>(c) the first 12 metres of the basement driveway from a daylight area to a minimum of 200 lux; and</p> <p>(d) the first 6 metres for a basement driveway from a daylight area to a minimum of 1000 lux; and</p> <p>(e) a pay station, ticket splitter and the like to a minimum of 300 lux; and</p> <p>(f) a footpath crossing to a minimum of 50 lux.</p> <p>S4.9 Development provides signs and line markings in accordance with Queensland Manual of Uniform Traffic Control Devices to indicate the location of the parking area and the position of an access</p>	<p>S4.7 Will comply through detailed development design.</p> <p>S4.8 Will comply through detailed development design.</p> <p>S4.9 Will comply through detailed development design.</p>

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
	<p>point for a parking area used by the public where—</p> <p>(a) the parking area is located at the rear of the premises; or</p> <p>(b) access to the parking area is not located on the primary frontage of the premises; or</p> <p>(c) there are a number of access points serving different parts of the premises.</p>	
Design and construction of a parking area for people with disabilities		
<p>O5 Development provides that a parking area on the premises is safe, efficient and legible in meeting the requirements of people with disabilities.</p>	<p>S5.1 Development provides parking spaces for use by people with disabilities which—</p> <p>(a) comply with the requirements of section 2 of AS 2890.1:1993: <i>Parking facilities – Off-street car parking</i>; and</p> <p>(b) have flat access between each parking space and the adjoining walkway, unless there is a change in level from the parking space to the walkway, in which case a kerb ramp is provided.</p> <p>S5.2 Development provides a wheelchair access to and from a parking space for the use of people with disabilities, which is clear of obstructions and in good condition.</p>	<p>S5.1 (a) Complies – refer to Section 2 of the traffic report.</p> <p>(b) Will comply through detailed development design.</p> <p>S5.2 Will comply through detailed development design.</p>

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
Access to a parking area		
<p>O6 Development provides access to the premises which—</p> <p>(a) is safe, efficient and legible in meeting the requirements of the intended use; and</p> <p>(b) does not have an adverse impact on the safety and efficiency of the existing or planned road network.</p>	<p>S6.1 Development provides that each lot and building site is accessible to a road.</p> <p>S6.2 Development (other than for a car park) provides a parking area which—</p> <p>(a) is freely accessible to all employees and visitors during the normal hours of operation of the development with no encumbrance, fee or charge; and</p> <p>(b) has no gateway, door or similar device which restricts vehicular access by employees or visitors.</p> <p>S6.3 Development provides that the gradient of a driveway does not exceed in the case of—</p> <p>(a) a single unit residential activity, a development display and sales and a dual occupancy, a maximum of 1 in 4; and</p> <p>(b) other uses, a maximum of 1 in 10.</p> <p>S6.4 Development provides a driveway which complies with section 3 of <i>AS 2890.1:1993: Parking facilities – Off-street car parking</i>; and</p> <p>S6.5 Development in respect of a community title lot provides for—</p> <p>(a) the proposed community title lot to abut the common property; and</p> <p>(b) the vehicular access—</p> <p>(i) to be located within the common</p>	<p>S6.1 Complies – facility is accessible by road.</p> <p>S6.2 (a) Complies- development will be freely accessible to all employees and visitors during the normal hours of operation of the development with no encumbrance, fee or charge.</p> <p>(b) Complies – development has no such restrictions with exception of the trailer park and maintenance shed area, for safety and security reasons.</p> <p>S6.2 (a) Not applicable.</p> <p>(b) Complies – proposed crossovers will have a grade of less than 1 in 10.</p> <p>S6.4 Complies – see Section 2 of traffic report.</p> <p>S6.4 Not applicable – proposal is not for a community title lot.</p>

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
	<p>property; and</p> <p>(ii) to be connected to a road which is constructed; and</p> <p>(iii) to have only one access point to the road.</p> <p>S6.6 Development which incorporates a facility for the issuing of a ticket to enter the premises or a security gate (<i>ticket and security facility</i>) provides that the ticket and security facility is located on the premises such that a vehicle does not queue across the footpath.</p> <p>S6.7 Development which incorporates a drive-through facility provides that the queue does not—</p> <p>(a) block access to the premises; and</p> <p>(b) interfere with a parking aisle.</p>	<p>S6.6 Not applicable – no ticket facility is proposed.</p> <p>S6.7 Not applicable – no drive-through facility is proposed.</p>
Vehicle washing bay in a parking area		
<p>O7 Development provides that a vehicle washing bay—</p> <p>(a) is safe and efficient in meeting the requirements of the use; and</p> <p>(b) does not cause environmental nuisance or environmental harm.</p>	<p>S7.1 Development provides that the run-off from a vehicle washing bay is captured and lawfully discharged to the sewerage system if the vehicle loading bay is not located on a grassed or turfed area.</p>	<p>S7.1 Not applicable – no washing bay facility is proposed.</p>

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
Pedestrian path in a parking area		
O8 Development provides for safe pedestrian access to a building's pedestrian entrance from the frontage and from any parking area or set down area.	<p>S8.1 Development provides for a pedestrian path to be separated from vehicle traffic.</p> <p>S8.2 Development provides for a pedestrian path along the shortest possible route from the parking area and the frontage of the premises to the building's pedestrian entrance.</p> <p>S8.3 Development provides a pedestrian path that is— (a) even and uses non-slippery pavement materials; and (b) at a gradient not exceeding 1 in 12.</p>	<p>S8.1 Complies – see Section 2 of traffic report</p> <p>S8.2 Complies – see Section 2 of traffic report</p> <p>S8.3 Will comply through detailed design.</p> <p>S8.3 Will comply through detailed design.</p>
Bicycle parking in a parking area		
<i>Provision of cyclist facilities and bicycle parking</i>		
O9 Development provides cyclist facilities and bicycle parking spaces on the premises that satisfies the expected demand for bicycles likely to be generated by the activity.	<p>S9.1 Development provides bicycle parking spaces on the premises at the rate specified in Table 5.3.4F (Bicycle parking spaces).</p> <p>S9.2 Development provides in respect of each bicycle parking space rail-type locking facilities which allow the frame and both wheels of a bicycle to be locked.</p> <p>S9.3 Development for a passenger terminal provides for— (a) 20% of the bicycle parking spaces to be available for rental on a monthly or a</p>	<p>S9.1 The type of development is not listed in Table 5.3.4F. refer to section 2 of the traffic report on bicycle provisions.</p> <p>S9.2 Not applicable – see Section 2 of traffic report.</p> <p>S9.3 Not applicable – proposal is not for a passenger terminal.</p>

Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
	<p>quarterly basis; and</p> <p>(b) enclosed bicycle lockers or a bicycle storage cage.</p> <p>S9.4 Development for a commercial use provides employees with shower cubicles and change rooms and makes provision for both males and females, at a minimum rate of—</p> <p>(a) one (1) cubicle, where the GLA of the development is between 1500m² and 5500m²; and</p> <p>(b) one (1) additional cubicle, where the GLA of the development exceeds 5500m²; and</p> <p>(c) two (2) additional cubicles, where the GLA of the development exceeds 30000m².</p> <p>S9.5 Development for an industrial use which has a GLA of 2000m² or greater, provides employees with shower cubicles and change rooms and makes provision for both males and females.</p>	<p>S9.4 Not applicable – see Section 2 of traffic report.</p> <p>S9.5 Not applicable – proposal is not for an industrial use.</p>
<i>Layout of bicycle parking spaces</i>		
<p>O10 Development provides bicycle parking spaces in areas which—</p> <p>(a) are visible; and</p> <p>(b) are well lit; and</p> <p>(c) are subject to significant pedestrian traffic; and</p> <p>(d) are well signed; and</p>	S10.1 None applicable.	S10.1 None applicable.

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Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
<ul style="list-style-type: none"> (e) are close to the major pedestrian entrance to the development; and (f) does not impede the movement of pedestrians or vehicles; and (g) are separated from vehicle traffic. 		
<i>Design and construction of cyclist facilities and bicycle parking spaces</i>		
O11 Development provides bicycle parking spaces on the premises that are safe, efficient and legible in meeting the requirements of the use.	S11.1 Development provides that cyclist facilities and bicycle parking spaces are designed and constructed in accordance with Part 14 of <i>Austrroads</i> .	S11.1 Not applicable – see Section 2 of traffic report.
Motorcycle parking in a parking area		
<i>Provision of motor cycle parking spaces</i>		
O12 Development provides motorcycle parking spaces on the premises that— <ul style="list-style-type: none"> (a) satisfies the expected demand for motorcycles likely to be generated by the activity; and (b) are safe, efficient and legible in meeting the requirements of the use. 	S12.1 Development provides motorcycle parking spaces in accordance with the provisions of section 2.4.7 of <i>AS 2890.1:1993: Parking facilities – Off-street car parking</i> .	S12.1 Not applicable – no demand for motorcycle parking has been determined.
<i>Layout of motorcycle parking spaces</i>		
O13 Development provides motorcycle parking spaces in an area which is—	S13.1 None applicable.	S12.1 Not applicable – no demand for motorcycle parking has been determined.



Column 1 Specific outcomes	Column 2 Acceptable solutions—if self-assessable Probable solutions—if code assessable	Column 3
(a) visible; and (b) well lit; and (c) subject to significant pedestrian traffic; and (d) well signed; and (e) close to the major pedestrian entrance to the development.		

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Infrastructure Servicing Plan and Site Based
Stormwater Management Plan

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SITE BASED STORMWATER MANAGEMENT PLAN

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Logan Greyhound Facility

INFRASTRUCTURE SERVICING PLAN AND SITE BASED STORMWATER MANAGEMENT PLAN

March 2010

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1. Introduction

This report has been prepared by Sinclair Knight Merz (SKM) on behalf of Greyhounds Queensland Limited (GQL) to support a Development Application for an outdoor greyhound racing facility. The development is referred to in this report as the Logan Greyhound Facility.

1.1. Description of development

The proposed development is to be situated on 10.24 ha of designated public open space known as Cronulla Park in the suburb of Slacks Creek. The park is described as Lot 658 on SL12298, under the jurisdiction of Logan City Council.

The location of the development site with respect to the surrounding suburbs and road network is shown on Figure A1 – Site Location.

The proposed development includes the construction of a double storey main facility building with a grassed viewing area, kennel blocks and support buildings serviced by two-way internal roads with access for patron car parks, and dedicated parking area for trainers and employees. An inner and outer greyhound race track will be constructed as the main attraction, with a separate trialling track being formed adjacent to the main tracks.

1.2. Objective of report

The objective of this report is to outline the requirements and provision of infrastructure services and the stormwater management for the site so as to effectively demonstrate that the proposed development can be adequately serviced and support the development application of the proposed facility.

1.3. Scope of report

The scope of this report covers the infrastructure servicing and stormwater management associated with the site to substantiate and support a code compliance submission prepared by the lead consultant, ML Design.

This report considers the bulk earthworks, roadworks and parking layout, stormwater drainage (quantity and quality), sewerage reticulation, water reticulation, electrical and telecommunication services. Further detailed investigation and analysis is required at the Operational Works phase.

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2. Site Characteristics

2.1. Location

The proposed development site is in Slacks Creek and is located west of the M1 Motorway, approximately 20km south of Brisbane's CBD and 2.5km north of Logan Central. The intersection of two main arterial roads, Kingston Road and Compton Road define the development's western and northern boundaries. Compton Road bends away from the site to the north approximately halfway along the site's northern boundary.

Industrial lots are located along the proposed development's southern and eastern property boundaries. Additional industrial lots are also located at the north-east corner which is serviced by an industrial access road and turnaround area, known as Cronulla Court. The site is generally fenced along its northern and western boundaries, albeit it is open to the public via existing open access points. Additional industrial lots are on the opposite sides of Kingston and Compton Roads.

2.2. Existing topography and drainage patterns

The highest point of the site is approximately RL34.5m Australian Height Datum (AHD) close to Kingston Road, falling to approximately RL22.2m adjacent to the north east corner industrial lots. The average gradients on the site are relatively flat ranging from 0.8% to 2.0% and the main form of drainage is a combination of overland sheet flows and open channel flows. The north east corner is steeper than the majority of the site with grades up to a maximum of 12.5% towards the east.

The site generally grades in a west to east direction, however during site inspections it was noted that several low bunds are present across the predominant gradient of the site (in a north-south configuration), which intercept and divert the overland flow towards the north and south into an existing open channel drain.

An open channel drain to the south and east separates the park from the adjoining industrial lots. The open channel drain conveys surface runoff from Kingston Road, cross-catchment flows from across Kingston Road and from several culverts from the south. The open channel eventually discharges into a large open chamber with its invert level (base) well below the level of the open channel base of RL 20.4m. Twin reinforced concrete pipes have been noted at the bottom of the chamber. The inlet structure is secured behind a fence and appears to be in private land. Logan City Council has advised the RCP sizes as 1200mm and this has been confirmed by the surveyor.

Based on Dial-Before-You-Dig information, the twin pipes appear to be located within a drainage easement which passes through an adjacent bread making factory, in a west-east direction. Review of the topographical survey information downstream of the pipes also indicates the presence of an

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overland flow path from the chamber through the factory's car park, onto Allgas Street to the east and finally into Slacks Creek. Refer to Appendix D – Open Channel Calculations for a sketch of the inlet structure.

The site inspections have also identified that parts of the park falls toward the north and north east and it was discovered that these areas do not ultimately discharge into the open channel drain. These areas discharge into an earth drain alongside Compton Road and into existing stormwater gully pits along Cronulla Court.

The existing topography and drainage patterns for Cronulla Park are shown on Figure A2 – Existing Topography and Drainage Patterns.

2.3. Existing land use & vegetation

The existing site is currently designated as an open space public park but was previously utilised as a managed landfill between 1970 and 1980. Based on preliminary geotechnical investigations, a low permeable clay capping layer was constructed when the landfill operations were completed to prevent infiltration into the waste material underneath, creating pollution potential beyond the site. Said investigations have indicated that the clay capping cover depths are not consistent, and range from 0.1m at the eastern embankment to 1.0m deep at the west.

It is understood that the landfilling operation was only associated with a proportion of the 10.24ha site. Geotechnical and contamination assessments of the site indicate that the landfill limits ended near the existing trees along Kingston Road to the west. The grass cover in the tree zone has been noted to be poor and sparse. A poorly maintained bituminous road within the tree zone provides vehicular access into the park.

Site inspections have indicated the majority of the area has been grassed at some point but the current condition has been noted as poor with large areas being worn and eroded exposing a compacted bare earth and/or clay layer. The general poor condition of the grass indicates the possibility of minimal depth of topsoil. As such, infiltration opportunities are expected to be limited.

More significant vegetation is limited to periodic clumps of thick grasses and small trees which are observed present in the north east corner of the existing site. The open channel drain running along the south and east boundaries is seen to be heavily vegetated on the park side with predominantly tall grasses and small shrubs. The base and opposite side batter adjacent the industrial lots remains sparsely vegetated and appears to be mostly exposed compacted earth.

The existing and condition of the vegetation at Cronulla Park can be seen on Figure A3 – Aerial Photograph.

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2.4. Proposed topography, land use & vegetation

The existing park's previous use as a landfill limits available options for major earthworks and the type of services that can be constructed.

As described in section 1.1, the development will consist of a double storey main building, kennel blocks and smaller support buildings, two racing tracks, a trialling track and associated support infrastructure such as roads, footpaths etc. The proposed main access will be from Kingston Road with a dedicated egress onto Compton Road. The proposed location of the access has taken into consideration the existing tree buffer zone along Kingston Road and existing median/opening geometry which is covered in a separate Traffic Impact Assessment report.

The construction of roads and vehicular parking as part of the development will further delineate and modify the site's existing drainage flow patterns. It will also mean removal of the north-south bunds currently present across the site which divert runoff toward the north and south.

The park's past land use as a managed landfill also limits options for standard stormwater conveyance networks incorporating gully pits, field inlets and underground pipes due to the existing clay capping layer protecting the landfill. For which it has been recommended that this capping depth's integrity is maintained throughout. An alternative solution in the form of vegetated trapezoidal swales that do not require excavation as deep as standard conveyance systems is proposed. The swales also provide a Water Sensitive Urban Design solution which provides benefits for water quality treatment. This is described further in section 5.

The development therefore creates an impact to the poorly grassed areas of the park, only with the vegetation along the open channel drain flowing north east remaining unaffected. Detailed landscaping proposals will be covered under future submissions by others.

The existing final discharge locations at the outlet headwall to the east, to Compton Road and Cronulla Court to the north will be maintained.

Preliminary discussions with Logan City Council noted that the existing infrastructure in proximity to the development is available and has adequate capacity for use by this development. Information from Dial-Before-You-Dig requests has not indicated locations of existing services being directly affected the development itself. In the event services are found which require diversion as the development progresses within the site boundaries, appropriate measures will be undertaken to protect or relocate the services with input from Logan City Council.

The proposed layout for the development of the Logan Greyhound Facility is shown on **Figure A4 –Developed Topography & Drainage Patterns.**

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2.5. Soils

At the time of writing a detailed geotechnical investigation is being finalised. The final geotechnical report will provide the analysis of existing soil characteristics, the clay capping layer and landfill depths for the site.

The site soil conditions on the site will be detailed in a separate geotechnical report by Sinclair Knight Merz.

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3. Earthworks

3.1. General Compliance

The earthworks to be carried out for the development will be in compliance with the standards for earthworks specified in Logan City Council's *Planning Scheme Policy No. 5 (Design and construction of work) 2006*, which will also requires compliance with *AS 3798:1996: Guidelines on earthworks for commercial and residential development*.

3.2. Preliminary activities

Prior to any building works commencing on site the existing grassed vegetation will be stripped within the working zone, grubbed of any remnant stumps and unsuitable material will be removed to a suitable location. Any grub holes will be adequately filled and compacted in accordance with appropriate council standards. Depending on the quality of the existing topsoil, there is the possibility that new topsoil may have to be imported. The areas of the site where minimal operational works will occur will not be cleared of existing grasses until completion of the works to minimise erosion. Care will be taken to ensure the clay capping cover is not penetrated. As a precautionary measure, the existing soils on site and imported material may be tested for fire ant infestation.

Extensive clearing is not anticipated but where necessary, the associated vegetation will be mulched and stockpiled at a nominated location within the site (outside of the work zone) for reuse in the landscaping works. Where possible, any existing trees are to be retained and damage minimised as part of the works. The maximum height of the stockpile will be limited to 1.5m to minimise the potential for combustion. Where areas are not to be developed, appropriate fencing or barriers will be provided before clearing commences. Clearing works will also be limited to within 5m from the boundaries where possible.

As described in section 2.5, the final geotechnical report will provide the analysis of existing soil characteristics and sub-strata conditions.

3.3. Bulk earthworks

3.3.1. Landfill clay capping

Based on preliminary geotechnical investigations, additional clay capping material may be imported to increase the clay capping layer depth on the eastern embankment on the site to a minimum of 0.5m depth. This requirement however is to be confirmed in the final geotechnical report. All reusable topsoil will be maintained and stockpiled as required.

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Method statements associated with the earthworks operations will be necessary to highlight the associated risks when working with the clay capping and therefore, should over-excavation occur (beyond the existing clay capping depth into landfill material), appropriate contamination management measures can be implemented.

3.3.2. Buildings, roads and race tracks

Prior to bulk earthworks commencing the existing topsoil will be stripped and stockpiled on the site at a location nominated by the superintendent. The location most suited would be out of the work zone and with minimal impact from external drainage catchments.

Measures will be employed by the civil contractor to minimise the generation of dust from the stockpile throughout the duration of the works. Following the completion of bulk earthworks the stockpile topsoil will be respread over the disturbed areas and stabilised by grassed seeding and/or hydro-mulching. The balance of the topsoil will be tested for potential reuse for landscaping.

An erosion and sedimentation management program will be employed on site to minimise the potential for erosion and the transportation of sediment from the site. A typical program will be described in section 5.7.10.

The bulk earthworks operations will include the establishment of a platform for the main building, kennel blocks, internal roads, vehicular parking layouts and for the racing / trialling tracks which will be designed in the Operational Works phase. A cut/fill investigation will be completed to minimise the requirement for importing excessive quantities of fill material. If required, a nominated haul route will be established to minimise the hauling distance and time period with consideration to surrounding land uses.

All fill material used for the development will be suitable fill material free of organic material and unwanted materials and will be sourced from reputable source.

The design of all bulk earthworks will limit developed batters to a maximum slope of 1 in 4, i.e. suitable for maintenance purposes. All batters required as part of the development will be no less than 1.5m from the development's real property boundaries. The appropriate treatment to batters will be grassed or turfed or otherwise in accordance with the batter treatment in Council Work Code, Table 5.3.10A (Batter treatments). The landscape treatment specified will be capable of achieving the required batter treatment within 3 months from completion.

For typical cross sections of the earthworks required for the track, refer to attached sketch in **Appendix A**.

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No retaining walls are anticipated to be included in the proposed development. Should retaining walls be deemed necessary during the Operational Works phase, the walls will not exceed minimum clearances as specified in the Logan Planning Scheme 2006, Chapter 5 – Assessment Criteria for Development of a Stated Purpose or of a Stated Type.

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4. Roadworks and carparks

The roadworks and carparks to be carried out for the assessable development will be in compliance with the standards for earthworks specified in Logan City Council's *Planning Scheme Policy No. 5 (Design and construction of work) 2006*.

4.1. Ingress / egress

The proposed site entry and exit to the development is from Kingston Road and egress to Compton Road with a dedicated egress onto Compton Road. Impacts to external roads will be addressed in a separate traffic report, *Logan Greyhound Facility: Traffic Impact Assessment* by Sinclair Knight Merz.

4.2. Internal roads

The internal road network within the development will provide access for the Logan Greyhound Facility patrons, trainers and employees of the facility.

The internal road formation is proposed to be 6.0m kerb to kerb minimum width with a one-way crossfall (typically 3%) and will cater for two-way vehicular movements. The roads are proposed to be flexible granular pavements with an Asphaltic Concrete (AC) surface. The category of road is designated as 'local access' with associated pavement depths kept in accordance with a design to reduce risk of over-excavating beyond the clay capping cover.

It is not anticipated that reinforced concrete hardstand areas will be required but a drop off area is to be provided adjacent to the main facility building and kennel block. Concrete footpaths are to be specified along the roads as required. The roads will be separated from the race tracks by a perimeter fence.

The internal road width and curve radii will be determined with considerations for swept path clearances for design vehicles. The road layout will be reviewed with consideration to a design vehicle specified in a separate Traffic Impact Assessment report referenced above.

The layout of internal roads and carparks are shown on **Figure A4 – Development Topography and Drainage Patterns**.

4.3. Vehicular parking

The development includes 165 number of patron car parks and 50 number of combined employee/greyhound trainer car parks. The car park dimensions will be typically 5.4m long and

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2.6m wide and the trailer parks to be 10.0m long by 3.2m wide. Design of the vehicular parks will be in accordance with the off-street parking codes under AS2890. The pavement will be similar to the flexible pavements with AC surface as per the internal roads. Designated concrete footpaths are to be provided to link the car parks to the main facility building and other areas of activities.

The layout of internal roads and carparks are shown on Figure A4 – Development Topography & Drainage Patterns.

4.4. Traffic impact study

Consideration to the impact of traffic movements generated by the development are detailed in the traffic report, *Logan Greyhound Facility: Traffic Impact Assessment* by Sinclair Knight Merz.

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5. Site Based Stormwater Management Plan

The proposed development site is located approximately 300m west of Slacks Creek which runs alongside the M1 Pacific Motorway. The stormwater drainage works to be carried out for the assessable development will be in compliance with the standards specified in Logan City Council's *Planning Scheme Policy No. 5 (Design and construction of work) 2006*.

5.1. Previous Studies

In discussions held with drainage officers in Logan City Council, it was ascertained that no stormwater management or infrastructure reporting was available for the area.

Logan City Council has also advised that the proposed development is not in a declared flooding zone. Refer to *Appendix G – Logan City Council Correspondence* for further details.

In the absence of previous studies or investigations, the basis for establishing strategies for stormwater conveyance and quality is by reference and compliance with Logan City Council's Policy guidelines.

5.2. Hydrologic Data

The hydrological analysis for the proposed development was completed by establishing a Runoff Routing and Flow Timing Simulation (RAFTS) model. RAFTS is a runoff-routing modelling program which simulates flood hydrographs based on rainfall, catchment and channel inputs. It is also used for stormwater detention design. RAFTS is one of the various modelling software packages recommended for use by the *Queensland Urban Drainage Manual* (2007).

The results from RAFTS were validated against estimated peak discharge from the proposed development using the Rational Method of analysis.

The water quantity modelling is detailed further in **section 5.6**.

5.3. Hydraulic Data

The extent of hydraulic analysis is limited to the preliminary design of proposed detention basin(s) with the RAFTS software. Basin outlet characteristics were estimated using CulvertW. CulvertW was used to calculate the state-discharge curves of a specified low flow culvert and overflow weir for the detention basin(s). The required detention is discussed under **section 5.6.7**. A capacity check of the existing open channel within the site will be completed using Flowmaster which uses Mannings equation.

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The detailed design and hydraulic modelling of the proposed stormwater conveyance system and the final design of the detention basin will be reviewed and completed during the Operational Works phase.

5.4. Water Quality Data

Discussions held with Logan City Council officers did not identify records of water quality data for stormwater runoff from the existing site. As such, pollutant generation and treatment effectiveness was simulated using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software. MUSIC allows the simulation of quality of runoff from catchments and the effect of a wide range of treatment facilities on the quality of runoff downstream.

The water quality modelling is detailed further in section 5.7.

5.5. Opportunities and constraints

5.5.1. Increase in discharge / runoff

As described in section 2.3, the existing site can be characterised as an undeveloped open space. Based on site inspections and knowledge of its past use as a managed landfill with a clay capping cover, the fraction impervious for the development has been estimated as a weighted average of 0.15 which is conservative. The previous managed landfill's protective clay capping cover also further limits infiltration. Vegetation retardance is expected to be minimal for most of the site due to the poor grass conditions and exposed earth / clay observed on site.

The proposed development with its associated paved roads, roofed area and footpaths will increase the amount of impervious area within the site.

The investigation of the extent of increase in runoff from the developed catchment is detailed in section 5.6.

5.5.2. Increase in generated pollutants

The impacts of development to an existing undeveloped catchment has the potential to create an increase in runoff, but also results in the introduction of a wide range of generated pollutants. During rainfall events these pollutants may be washed from the catchment surface and transported within the runoff. These pollutants have the potential to reduce the quality of stormwater discharging to downstream receiving water bodies.

The strategy to manage the levels of water pollutants generated by the proposed development is outlined in section 5.7.

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5.5.3. Limited potential for infiltration

Detailed geotechnical testing of the development site soils have not been completed at this time which will accurately identify the infiltration characteristics. Site inspections have indicated that the majority of the site has very poor grass cover. It is expected however, to bring about a minor increase in volume of runoff due to reduced infiltration opportunity and an increased nett peak discharge from the site.

Based on site observations and taking into consideration the site's previous use as a landfill, the potential of infiltration into the subsoil layer has been assessed as limited and restricted. Any infiltration into an ex-landfill site is to be minimised to reduce the risk of undermining the protective clay capping and to avoid contamination of receiving water bodies due to increased leachate.

5.5.4. Limited stormwater quantity and quality options

In addition to reducing infiltration, the presence of the clay capping places constraints on the selection of stormwater conveyance systems and available Water Sensitive Urban Design (WSUD) measures. Initial discussions with Logan City Council have indicated that certain WSUD measures may not be suitable, such as gross pollutant traps which require deep excavations have not been considered at this level of application. The site's ability to support these measures may be reconsidered once the final geotechnical report has been finalised.

Standard stormwater drainage systems utilising pits/chambers and pipes increase the risk of excavating beyond the clay cover into the landfill material underneath. As such, consideration has to be given to alternative options which have smaller depth footprints such as shallow vegetated swales. Alternatively, other options such as slot or grated channel drains may be considered in more detail as part of the Operational Works phase design.

5.5.5. Modification to existing drainage patterns

Inspections of the site have identified approximately half of Kingston Road along the site's western boundary as a contributing upstream catchment with associated runoff discharging as overland flow through the site. This section of Kingston Road is not kerbed and should be anticipated to remain that way during the construction and completion of the Logan Greyhound Facility.

The internal parking areas and roads will modify the existing overland flow path from Kingston Road. The configuration of the internal roads and carparks will be designed to promote the general flow direction is maintained as much as possible. The developed site will be self draining and all areas will be designed using a minimum crossfall of 1 in 100.

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The stormwater infrastructure works to be carried out for the assessable development will be in compliance with the standards for stormwater infrastructure specified in Logan City Council's *Planning Scheme Policy No. 5 (Design and construction of work) 2006*.

Refer to Figure A4 – Developed Topography and Drainage Patterns for additional information.

5.6. Water Quantity

5.6.1. Proposed strategy

The adopted strategy was to attenuate any increase of development discharge with detention basins up to and including Q100 storm events in accordance with the *Queensland Urban Drainage Manual* (2007). Additional water storage strategies for reuse will be considered in more detail as part of the Operational Works phase.

5.6.2. Proposed Methodology

The methodology adopted to analyse the magnitude of increase in discharge from the existing and developed catchment within RAFTS was by comparing the peak discharge flow rates for each design storm event including Q1, Q2, Q5, Q10, Q20, Q50 and Q100.

The results from RAFTS were then validated against the estimated peak discharge flows from the Rational Method based on the *Queensland Urban Drainage Manual* (2007).

5.6.3. RAFTS modelling

The RAFTS model was set up by dividing the site into sub-catchments based on drainage patterns and areas strategic for comparison. Typical RAFTS model schematic consists of nodes which represent the sub-catchments' outlets and links that connects the nodes to the respective downstream sub-catchment nodes.

As described in section 2.2, there are three discharge locations from the site and these have been represented by the following nodes in the RAFTS modelling:

- node 'East Chamber';
- node 'Cronulla Court'; and
- node 'Compton Road'.

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5.6.4. Modelling scenarios

Three RAFTS modelling scenarios were investigated:

- ▣ **Existing** – for current undeveloped conditions. The results from this model provides the comparison basis for the attenuation strategy;
- ▣ **Developed (without detention)** – for the developed Logan Greyhound Facility but without stormwater detention. The results the quantify peak discharge runoff increase against existing conditions;
- ▣ **Developed (with detention)** – for the developed Logan Greyhound Facility but incorporating stormwater detention. The results from this model show the improved peak discharge runoff against existing conditions by the use of detention basins, which demonstrates no nett increase of peak discharge as a result of development at the three discharge locations.

The RAFTS schematics for both existing and developed scenarios are shown in **Figure B1 – Existing Catchments & RAFTS Schematic** and **Figure B2 – Developed Catchments & RAFTS Schematic**.

5.6.5. Modelling parameters

5.6.5.1. RAFTS global setup

RAFTS calculates the design storm events using the *Australian Rainfall and Runoff*, 1987 (AR&R) method. For this report, it was therefore necessary to input the applicable temporal pattern zone, geographic location, Average Recurrence Interval (ARI) and duration of the storm events. Standard temporal patterns for Zone 3 apply to the catchment. As such, skew locations, F2 and F50 coefficients required to setup RAFTS were estimated from relevant charts in Volume 2 of the AR&R. These are tabulated below:

Table 5.6.1 – Global RAFTS settings

Description	Value
F2 geographic factor	4.4
F50 geographic factor	17.25
Location skew	0.125
Temporal pattern zone	3



Design flows were calculated for the Q1, Q2, Q5, Q10, Q20, Q50 and Q100 storm events. Storms with rainfall durations of 10, 15, 20, 25, 30, 45, 60, 90 and 120 minutes were generated to establish the critical storm duration.

The distribution of rainfall over the catchment was considered constant due to the relatively small size of the catchment. The rainfall intensities derived from Intensity-Frequency-Duration curves were calculated at the centroid of the catchment, and therefore adopted as being applied across the whole catchment.

The RAFTS model was used to generate theoretical inflow hydrographs for each of the modelling scenarios.

The required Intensity Frequency Duration (IFD) values were calculated with reference recommended coefficients in Table 2.9.1B in Logan City Council's *Planning Scheme Policy no. 5*.

5.6.5.2. Sub-catchment parameters

The following parameters were assigned to represent the properties that effect rainfall excess during storm events for each sub-catchment.

Rainfall losses

An initial and continuing loss rate approach to estimate excess rainfall from the catchment was used. These losses are used to predict the runoff volume generated from the catchment in response to rainfall and include two components:

- Initial loss – a loss (mm) accounting for infiltration effects that is deducted from rainfall prior to the occurrence of surface runoff to pervious areas; and
- Continuing loss – a constant loss rate (mm/h) that is deducted from the rainfall over the duration of the storm to pervious areas.

These values were assigned to the pervious portion of the sub-catchments. Zero losses were applied to the impervious portion of the sub-catchments. The loss rates are shown below:

Table 5.6.2 – Initial & continuing loss rates for pervious areas

Storm Event (years)	Initial Loss (mm)	Continuing Loss (mm)
100	0	2.5
50	3	2.5
20/10	5	2.5
5/2/1	10	2.5

Source: Australian Rainfall & Runoff: A Guide to Flood Estimation Vol. 1

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Percentage impervious

RAFTS allows a split catchment option for sub-catchments with different land use types. These are broadly classified as pervious and impervious surfaces. For this analysis, the first sub-catchment portion was set to represent the impervious area of the catchment and the second, the pervious catchment area. Assigning sub catchment percentages was determined from the Logan Greyhound Facility design layout in **Figure B2 – Developed Catchments & RAFTS Schematic**.

Surface roughness

Surface roughness is an empirical factor based on the average Manning's 'n' of the catchment surface. The weighted average for each sub-catchment for the existing situation was assessed by review of aerial photographs and a ground truth site inspection. Assumed values were assigned for each land use type in both existing and developed models with the typical Manning's values used in the RAFTS model as illustrated in **Table 5.6.3** below.

Table 5.6.3 – Typical land use surface roughness factors

Land Use Description	Manning's 'n' Roughness Factor	
	Impervious Areas	Pervious Areas
Poorly grassed areas	-	0.030
Bare compacted earth	-	0.025
Race Track (compacted sand)	-	0.025
Roof Concours areas	0.012	-
Concrete / smooth Surface	0.013	-
Asphalt / roadways	0.015	-

Source: Road Drainage Design Manual (2002) Queensland Department of Main Roads, Table 4.5

Vectored slope

The vectored slope for the pervious and impervious areas of each sub-catchment was determined by estimating the average slope across the catchment surface.

The input parameters used in RAFTS for all the modelling scenarios are tabulated in **Appendix B – RAFTS Model Data**.

5.6.6. External catchments

As described in **section 2.2**, several culverts discharge flows from external catchments into the open channel drain flowing north east. As the open channel drain will not be modified by the proposed development, it was assumed that these external catchments have a neutral impact on the development itself for the purposes of RAFTS modelling. They were not included in the result

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comparisons in section 5.6.9 in this report but are discussed separately under sections 5.6.11 and 5.6.12

5.6.7. Detention basin

The adopted attenuation strategy to attenuate post-developed peak discharge flows was by introduction of a detention basin. A dry detention basin does not store water once a rainfall event passes and as such, minimises the risk of infiltration potential into the clay capping layer.

Review of the developed layout has identified the most suitable location for a detention basin is at the south-western part of the site where the clay capping depth is understood to be thickest. The preliminary basin dimensions were estimated to be approximately rectangular in shape with 0.7m storage depth and maximum 1:4 side batters. The estimated required storage volume for a Q100 event was estimated to be 700m³. The exact plan configuration, storage depth and suitable impermeable lining material to further protect the clay capping layer, will be investigated in the Operational Works phase.

The configuration of the basin and outlet levels was modelled to achieve the required storage volume and flow attenuation. The preliminary outlet configuration consists of a low flow pipe modelled as a culvert and a high level spillway modelled as a broad-crested weir using CulvertW software.

Refer to Appendix B – RAFTS Model Data for additional information on the basin storage and outlet characteristics.

5.6.8. Critical storm duration

The RAFTS model results were reviewed for each of the storm durations and storm events to identify the critical storm durations. The critical storm provides the highest peak discharge. The critical storm durations for the site range from 25, 60 to 90 minutes for the existing and developed scenarios. The results in the following section refer to the critical storm durations for particular storm events.

A summary of the critical storm durations are on the cover of Appendix B – RAFTS Model Data.

5.6.9. Peak Discharge Comparison

The RAFTS peak discharge results for the critical storm durations at each of the three outlets are shown in the following tables:

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Table 5.6.4 – RAFTS Peak Discharge Comparison at node 'East Chamber'

Return Period ARI (years)	EAST HEADWALL				
	Pre-Developed (m ³ /s)	WITHOUT Basin (m ³ /s)	% Variance	WITH Basin (m ³ /s)	% Variance
1	0.817	0.963	+17.9%	0.749	-8.3%
2	1.215	1.438	+18.4%	1.156	-4.9%
5	1.782	2.021	+13.4%	1.620	-9.1%
10	2.314	2.564	+10.8%	2.074	-10.4%
20	2.791	3.098	+11.0%	2.605	-6.7%
50	3.355	3.713	+10.8%	3.292	-1.9%
100	3.921	4.322	+10.2%	3.921	0.0%

As shown in Table 5.6.4, the peak discharge as a result of development is higher than the existing scenario for all storm events up to and including the Q100 storm event. With a detention basin, the peak discharge has been attenuated to within existing values as demonstrated.

Table 5.6.5 – RAFTS Peak Discharge Comparison at node 'Cronulla Court'

Return Period ARI (years)	CRONULLA COURT		
	Existing (m ³ /s)	Developed (m ³ /s)	% Variance
1	0.054	0.039	-27.8%
2	0.083	0.058	-30.1%
5	0.132	0.092	-30.3%
10	0.165	0.124	-24.8%
20	0.197	0.145	-26.4%
50	0.218	0.160	-26.6%
100	0.248	0.182	-26.6%

The results in Table 5.6.5 demonstrate that there is no nett increase of peak discharge of the developed scenario against existing conditions for all storm events up to and including a Q100 storm for discharge towards Cronulla Court. The reduction is due to the reconfiguration of the existing catchments in the developed scenario which resulted in a smaller contributing catchment area.



Table 5.6.6 – RAFTS Peak Discharge Comparison at node 'Compton Road'

Return Period ARI (years)	COMPTON ROAD		
	Existing (m ³ /s)	Developed (m ³ /s)	% Variance
1	0.202	0.190	-5.9%
2	0.297	0.263	-11.4%
5	0.423	0.357	-15.6%
10	0.546	0.440	-19.4%
20	0.666	0.521	-21.8%
50	0.789	0.600	-23.9%
100	0.916	0.708	-22.7%

The results in Table 5.6.6 demonstrate that there is no nett increase of peak discharge of the developed scenario against existing conditions for all storm events up to and including a Q100 storm for discharge towards Compton Road. The reduction is due to the reconfiguration of the existing catchments in the developed scenario which resulted in a smaller contributing catchment area.

5.6.10. RAFTS model validation – against Rational Method

To validate the RAFTS modelling results, peak discharge at the largest subcatchment which discharges into the headwall outlet were estimated using the Rational Method. Several parameters are required to represent each of the properties that effect rainfall excess during a storm event and these are described below.

5.6.10.1. Rational Method Parameters

To simulate the runoff characteristics of the catchment, several parameters are assigned to represent each of the properties that effect rainfall excess during a storm event. These parameters were determined for each sub-catchment and then incorporated into the Rational Method model.

Fraction impervious, f_i

The development site consists of a main facility building with associated support structures and road infrastructure including the race tracks. An average fraction impervious ratio was estimated based on requirements in the *Queensland Urban Drainage Manual* (2007) or QUDM (2007).



Coefficient of Runoff

The coefficient of runoff is determined by application of the estimated Fraction Impervious, 60min duration 10-year ARI rainfall intensity, 10-year ARI Coefficient of Runoff and the Frequency Factor for each respective ARI event as referenced from Section 4, QUDM (2007).

The fraction impervious for the development site was determined from aerial photographs, proposed development plan and site inspections.

Rainfall Intensity

The rainfall intensities adopted for the development has been based on Table 2.9.1B from Logan City Council's *Policy Number 5: Design and Construction of Works*.

Time of Concentration

The time of concentration for the pre-developed sub-catchments has been estimated by reference to Figure 4.07 for sheet flow and Figure 4.09 of QUDM (2007) for stream flows.

The time in concentration for the developed sub-catchments was estimated by application of remaining overland sheet flow, natural channel and vegetated swale flows as per the figures above.

Refer to **Figure C1 – Rational Method Catchment & Flow Path** under **Appendix C – Rational Method Calculations** for the supporting figures and calculations.

5.6.10.2. Results Comparison of existing scenarios

Table 5.6.7 shows comparison at the node 'East Chamber' as this is the main catchment outlet.

Table 5.6.7 – RAFTS & Rational Method validated at node 'East Chamber'

Return Period (Years)	EXISTING		
	RAFTS (m ³ /s)	Rational (m ³ /s)	% Variance (over Rational)
1	0.817	0.859	-4.9%
2	1.215	1.166	+4.2%
5	1.782	1.633	+9.1%
10	2.314	1.934	+19.7%
20	2.791	2.308	+20.9%
50	3.355	2.965	+13.1%
100	3.921	3.431	+14.3%