University of Technology Sydney

UTS Kuring-gai Campus

Transport Assessment

ARUP

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Transport Assessment

September 2007

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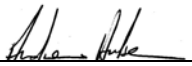
		Signature			
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1 INTRODUCTION

This report has been prepared by Arup on behalf of the University of Technology, Sydney (UTS). In July 2006, Hutcheson Transport Solutions Pty Limited prepared a report assessing the traffic and parking implications of a proposed rezoning and future development of the University of Technology, Kuring-gai campus. The site is bounded by Eton Road to the north, Lady Game Drive to the West and Millwood Avenue to the south. It is currently used as a university campus with some ancillary uses (childcare centre, gymnasium etc.). An adjoining site is occupied by Film Australia.

UTS is investigating the potential alternate uses for the site. A concept plan has been developed to support the State Significant Site Application to the Department of Planning.

This report assesses existing traffic conditions at the site and surrounding road network. It also analyses the potential traffic generation and the consequences of these traffic levels as a result of the development in line with the proposed rezoning and concept plan for the roads and intersections near the site.

Arup has collected new traffic data on the approach road system and relies on previous advice provided by Hutchinson Transport Solutions and by Sinclair Knight Merz in relation to the site.

2 EXISTING CONDITIONS

2.1 Site Location and Existing Development

The site location is shown in **Figure 1 Site Location**. The site is located between Lady Game Drive and Eton Road, Lindfield. The site is occupied by the University of Technology, Sydney (UTS).

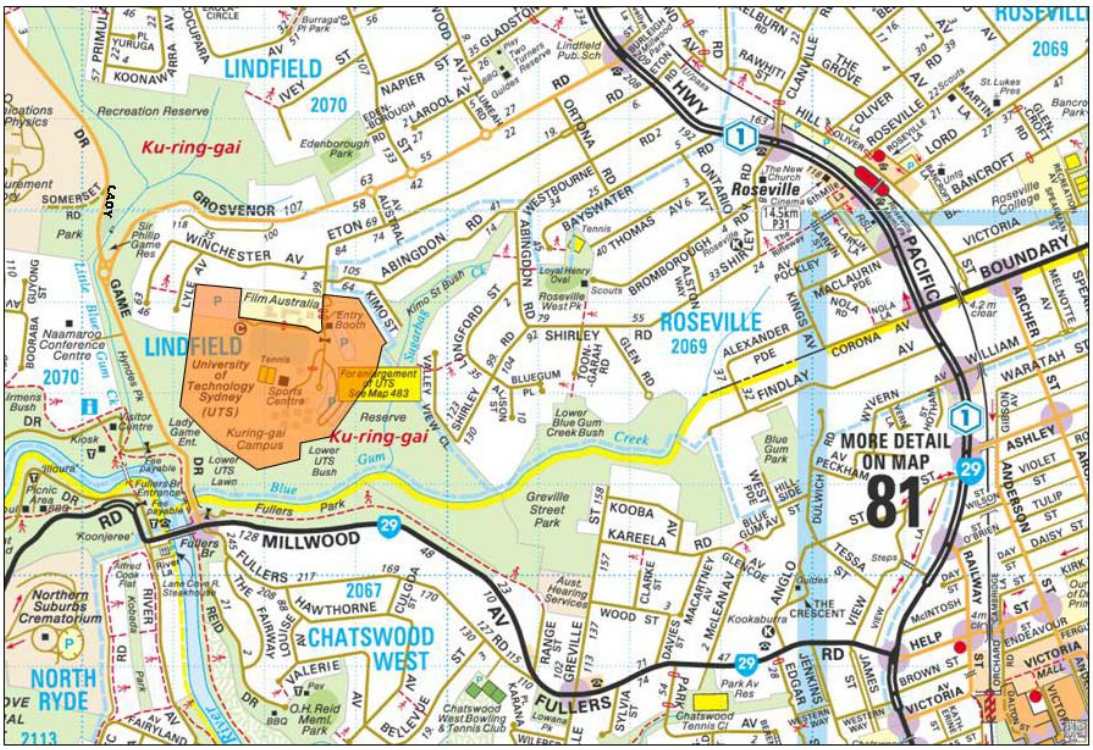


Figure 1 Site Location

2.2 Road System and Traffic Flows

In the late 1970s, the Traffic Authority of New South Wales (now the Roads and Traffic Authority of New South Wales, RTA) published guidelines for the classification of roads using a functional system. A report titled "Updated Guidelines for the Functional Classification of Roads in Urban Areas" was published in 1993

The functional classification system is based on an assessment of traffic volumes, composition and management. Four road types are defined. They are arterial, sub-arterial, collector, and local roads. The following criteria are used in assessing the functional classification of roads:

- Arterial Road - typically a main road carrying over 15,000 vehicles per day and fulfilling a role as a major inter-regional link (over 1,500 vehicles per hour)
- Sub-arterial Road - defined as secondary inter-regional links, typically carrying volumes between 5,000 and 20,000 vehicles per day (500 to 2,000 vehicles per hour)
- Collector Road - provides a link between local roads and regional roads, typically carrying between 2,000 and 10,000 vehicles per day (250 to 1,000 vehicles per hour). At volumes greater than 5,000 vehicles per day, residential amenity begins to decline noticeably. Trunk collector and spine roads with limited property access can reasonably carry these traffic flows greater than 5,000 vehicles per day.
- Local Road - provides access to individual allotments, carrying low volumes, typically less than 2,000 vehicles per day (250 vehicles per hour).

Table 1 Summarises the road characteristics under the functional classification system. Peak hour flows are typically eight to twelve per cent of daily flows.

Table 1 Functional Classification of Roads

Road type	Traffic volume (Average annual daily traffic flow - AADT)	Through traffic	Inter-connections	Speed limit (km/h)	Heavy vehicle Restrictions
Arterial/ Freeway	Over 15,000	Yes	Sub-arterial	70 – 110	No
Sub-arterial	Between 5,000 and 20,000	Some	Arterial/ Collector	60 – 80	No
Collector	Between 2,000 and 10,000	Little	Sub-arterial/ Local	40 – 60	Yes, if residential
Local	<2,000	No	Collector	40–50	Yes, if residential

The roads most commonly used to access the site are Grosvenor Road and Eton Road. Austral Avenue is used to travel between Grosvenor Road and Eton Road. Abington Road is also used to access the site, but to a much lesser degree. The roads surrounding the site are described below in accordance with the functional classification system.

Abingdon Road, Austral Avenue, and Westbourne Street are local roads.

Eton Road is nominally a local road. However, it performs a collector road function by providing direct access to the UTS campus and Film Australia. It is 8 to 9 metres wide and its speed limit is 50 km/h. A white line separates the two traffic lanes. There is a bus stop in front of the university.

Grosvenor Road is a collector road. Its intersections with Lady Game Drive and Austral Avenue are roundabouts.

Lady Game Drive is a sub-arterial road. Its width is 8.5 metres. Its intersection with Millwood Road is controlled by traffic signals. Its intersection with Grosvenor Road is a roundabout.

Millwood Avenue is an arterial road. It has one travel lane in each direction.

Fullers Road is an arterial road. It has two lanes traffic eastbound and one lane westbound.

2.3 Traffic Volumes

Arup has undertaken recent counts at four locations as shown on **Figure 2.**

1. UTS Access between speed hump and turnaround loop (north of access road to east car park)
2. Abington Road east of Eton Road
3. Eton Road west of Austral Avenue
4. UTS Access between north and south junctions of turnaround loop. This assists with gaining an understanding of the use of the turnaround loop.

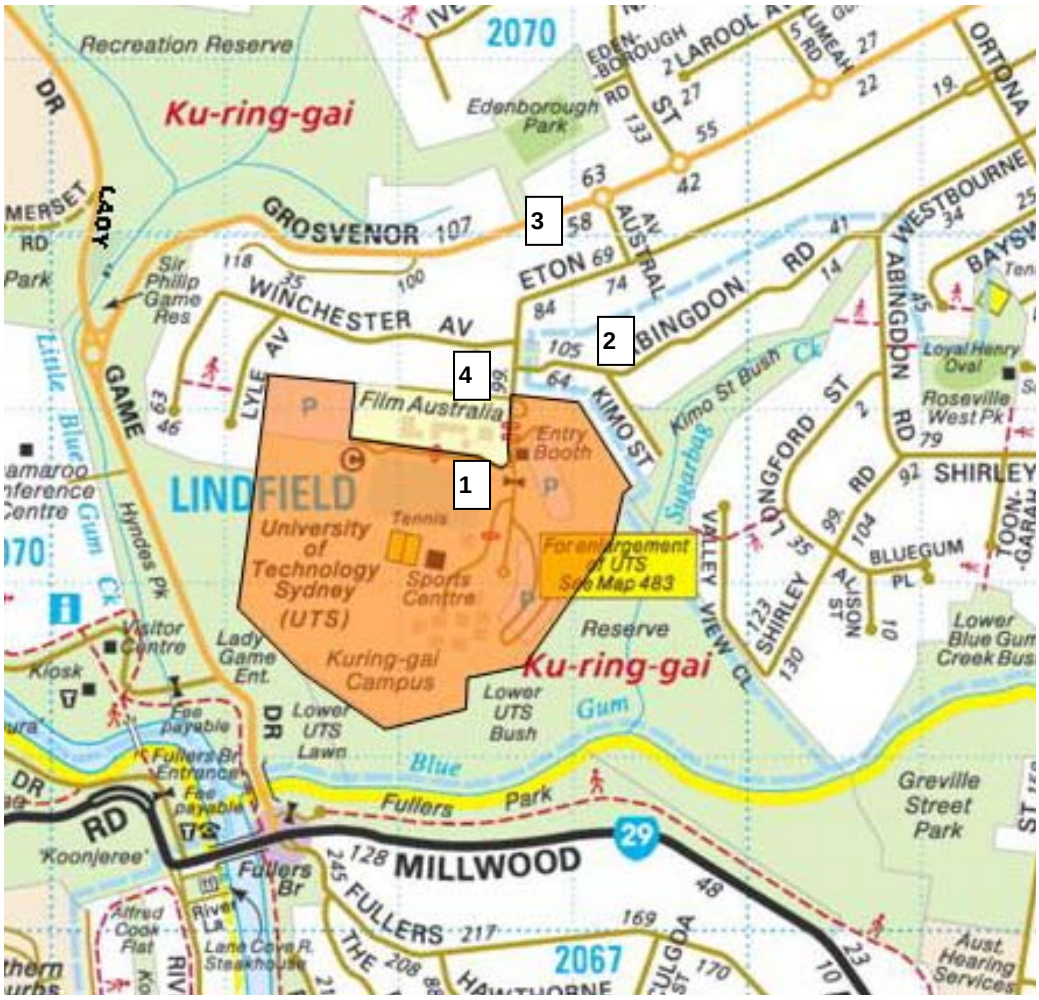


Figure 2 Arup Survey Locations

Counts were undertaken by Masson Wilson Twiney in 1998 for UTS around the university and at key intersections in order to establish traffic flows during the morning and evening peak traffic volumes. The roads surveyed close to the study development site were:

- Grosvenor Road, East of Lady Game Drive;
- Eton Road, East of Austral Avenue;
- Eton Road, North of Abingdon Road;
- Eton Road, South of Abingdon Road;
- Abingdon Road, East of Eton Road;
- Austral Avenue, South of Grosvenor Road;
- Exit / Entrance of the UTS campus.

Additional counts were undertaken by GHD in a report prepared for Ku-ring-gai Council in January 2000 ("Traffic and Transport Base Study"). The counts were undertaken in 1999. Counts close to the development site were located at:

- Pacific Highway, South of Shirley Rd / Clanville Rd, Roseville;
- Pacific Highway, South of Millwood Avenue;
- Millwood Avenue, East of Lady Game Drive;
- Millwood Avenue, West of Lady Game Drive;
- Lady Game Drive, North of Millwood Avenue.

More recent traffic surveys were undertaken by Corner Counters in October 2003 on the following roads:

- Eton Road, West of Austral Avenue;
- Grosvenor Road, West of Austral Avenue;
- Grosvenor Road, East of Austral Avenue;
- Abingdon Road, East of Kimo Street.

Table 2 presents a summary of the morning and evening peak traffic volumes on the roads surrounding the site.

Table 2 Current Morning And Evening Peak Traffic Volumes Around The Site

Location		Classification	Year	Morning Peak Hour (8 to 9 am)	Evening Peak Hour (5 to 6 pm)
Pacific Highway	South of Shirley Rd / Clanville Rd, Roseville	Arterial / Hwy	1999	4,913	4,235
	South of Millwood Road	Arterial / Hwy	1999	4,895	4,670
Millwood Avenue	East of Lady Game Drive	Sub-Arterial Rd	1999	2,630	2,163
	West of Lady Game Drive	Sub-Arterial Rd	1999	2,250	2,240
Lady Game Drive	North Of Millwood Avenue	Sub-Arterial Rd	1999	978	1,125
Grosvenor Road	East of Lady Game Dr	Local Rd	1998	792	622
	East of Austral Avenue	Local Rd	2003	799	783
	West of Austral Avenue	Local Rd	2003	921	875
Eton Road	East of Austral Avenue	Local Rd	1998	210	131
	West of Austral Avenue	Local Rd	2003	455	333
	West of Austral Avenue	Local Rd	2007	388	317
	North of Abingdon Road	Local Rd	1998	453	252
	South of Abingdon Road	Local Rd	1999	416	236
Abingdon Road	East of Eton Road	Local Rd	1998	93	48
	East of Kimo Street	Local Rd	2003	74	89
	East of Eton Road	Local Rd	2007	78	85
Austral Avenue	South of Grosvenor Road	Local Rd	1998	371	204

Source: Gutteridge Haskins & Davey Pty Ltd, Planning and Urban Design, “Traffic and Transport Base Study,

Ku-ring-gai Municipal Council, Study Report”, January 2000

Masson Wilson Twiney, “Lady Game Drive Access to UTS Kuring-gai Campus Traffic Issues Report”, for University of Technology, September 1998.

October 2003, CFE Information Technologies

September 2007, Skyhigh Traffic Surveys

Table 3 presents traffic volumes surveyed at the entrance / exit of the University of Technology, Sydney at Kuring-gai campus.

Table 3 Summary of UTS Traffic Generation (Vehicles / Hour)

	Ingress	Egress	Total	Year
Morning Peak Hour	400	n.a.	n.a.	1990
Evening Peak Hour	350	200	550	1990
Morning Peak Hour	317	29	346	June 1993
Evening Peak Hour	215	222	437	June 1993
Morning Peak Hour	324	62	386	November 1993
Evening Peak Hour	182	249	431	November 1993
Morning Peak Hour	300	53	353	1998
Evening Peak Hour	199	169	368	1998
Morning Peak Hour	280	56	336	2007 (including loop traffic)
Evening Peak Hour	90	243	333	2007 (including loop traffic)

From **Table 3** it can be seen that the total traffic generated by the site has ranged from around 350 to 550 vehicles in peak hours. Variations between surveyed years is related to differences in days surveyed, changes in full time / part time and bachelor / post graduate student mixes, and differences in class scheduling.

The recent 2007 traffic surveys confirm that the campus has been generating less traffic in more recent years. The volumes tabulated here include drop-off and pick-up activity in the turnaround loop.

Traffic generation associated with students parking on street is not included in the above surveys. This amounts to around 50 vehicles in peak hours. Hence, the overall traffic generation of the UTS campus site is about 400 vehicles in peak hours in recent years.

2.4 Issues Associated with Surrounding Roads

2.4.1 On Street Parking

On street parking by students has been an issue of concern for local residents. Whilst the campus provides parking for students on site, the amount of parking available has not always satisfied demands. This has resulted in some instances in a reduction in amenity for local residents.

2.4.2 Traffic Calming Issues

GHD completed a study in January 2000 for Ku-ring-gai Council of traffic and transport conditions and issues within the area. In relation to traffic, the report indicated that:

- Traffic calming can benefit some residents and disadvantage others. The study mentions that, for example, speed humps or similar local area traffic management advantage some sections of the community by slowing down the traffic and increasing safety (as traffic is moving slower). On the other hand, it increases traffic noise, as vehicles have to break and accelerate. Such measures also restrict bus services and emergency vehicles access.
- Road closures that redirect traffic flows from one street to another have the advantage of reducing traffic through some streets but increase traffic through others.

No issues specifically relating to the UTS Kuring-gai site were identified in the GHD report. No new traffic measures were recommended in the report for the streets surrounding UTS.

It is understood that Ku-ring-gai Council has also not proposed new traffic measures for the immediate area.

The recent traffic surveys undertaken for Arup indicate 85% vehicle speeds on the local access roads as shown in **Table 4.** The 85% speed is that travelled on average by 85% of vehicles and should represents the signposted speed. All of these roads have a 50km/h speed limit and therefore the speeds being travelled by drivers could be considered to be acceptable.

Table 4 Vehicle Speeds

	Direction	85% speed
Abingdon Road	Eastbound	52.0
	Westbound	52.8
Eton Road	Eastbound	48.5
	Westbound	50.2
UTS Access	Northbound	49.6
	Southbound	51.4

Existing traffic calming devices are located in Grosvenor Road in the form of roundabouts and angled slow points. The other locals streets are considered to operate satisfactorily without traffic calming. Parked cars assist with traffic calming on these streets by narrowing the carriageway, even if it is only a single parked car.

2.4.3 Traffic Volumes

The average weekday two-way traffic volumes on key roads providing access to the UTS site are presented in **Table 5.**

Table 5 Traffic Volumes at Roads Surrounding the Development

Road	Average Weekday Two-Way Traffic	Function	Desirable Maximum Daily Two-way Traffic Volume
Abingdon Road	810	Local	2000
Austral Avenue	3,500	Local/Collector	5000
Eton Road	3,955	Local/Collector	5000
Grosvenor Road	7,385	Collector	10,000
Lady Game Drive	15,192	Sub-Arterial	20,000

From **Table 5** the following can be said:

- Traffic volumes along Eton Road and Austral Avenue are above the desirable maximum for a local road (2,000 vehicles per day). The higher flows reflect the collector road function that these roads currently perform. This is to be expected as the road provides access to both the UTS Kuring-gai and Film Australia sites as well as local residences. The desirable maximum of 2,000 vehicles per day for local roads assumes that they service residential areas only which is not the case for this area.
- Traffic volumes along Grosvenor Road are less than the desirable maximum for the collector road (10,000 vehicles per day) function that the road performs.

- Traffic volumes along Lady Game Drive are less than the desirable maximum for the Sub-arterial (20,000 vehicles per day) function that the road performs.

There are significant queues and delays during peak hours on the approach to Millwood Avenue / Delhi Road on Lady Game Drive, Lindfield traffic associated with feeding from Grosvenor, Highfield and Fiddens Wharf Roads.

Residents tend to use Lady Game Drive as a bypass route avoiding congestion on the Pacific Highway and Delhi Road / Millwood Avenue / Fullers Road. This is an established route for residents of Killara, East Killara and East Lindfield to access the western and north western suburbs.

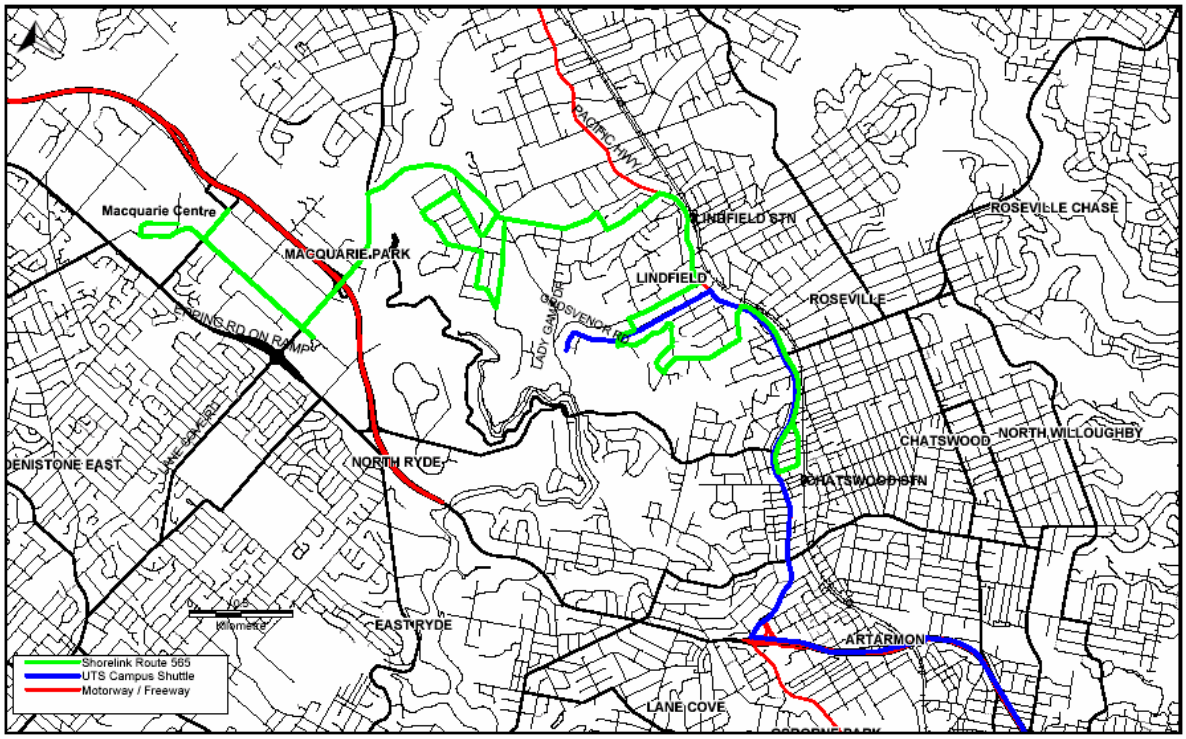
2.5 Public Transport Services

2.5.1 Bus Services

Shorelink (Route 565) provide regular services to and from UTS to / from Lindfield, Roseville, and Chatswood train stations. Services operate from 6.30 am to 9.35 pm during weekdays and run on average every 30 minutes. There is also an hourly service from 9.20 am to 5.20 pm during week ends. The bus routes currently serving the Kuring-gai campus are shown in **Figure 3**.

The UTS provides an Inter Campus service. This shuttle links Broadway Campus and the Kuring-gai campus. It runs half hourly between mid morning till mid afternoon and hourly at other times. During the holidays, the service is reduced to a two hour frequency.

Figure 3 Bus Routes



2.5.2 Train Services

The site is located approximately 25 minutes walk from Lindfield station and 20 minutes walk from Roseville station. During the morning peak hour (8.00 to 9.00 am) there are 8 trains southbound (towards the city) and 14 trains northbound which stop at Lindfield and Roseville stations.

2.6 Pedestrians and Cyclists

Footpaths are provided on at least one side of all local streets providing access to the UTS Campus, with the exception of Austral Street.

Cycling on the access road system is in a shared road arrangement with traffic volumes and local road cycling conditions considered to be adequate.

3 PROPOSED DEVELOPMENT

3.1 The Proposal

The concept plan for the site has been assessed as part of the rezoning process. It includes adaptive re-use of the main campus building plus residential dwellings with a mix of detached dwellings, townhouses and apartments.

The residential component of the concept plan is estimated to provide around 440 dwellings comprising:

- 10 Residential dwellings on traditional sized lots;
- 40 integrated / townhouse lots;
- 195 two bedroom apartments;
- 195 three bedroom apartments.

The adaptive reuse of the main campus building involves retention of some existing uses, relocation of uses from outside to within the main building, conversion of some of the building for residential use, and provision of commercial floorspace. The exact breakdown will be subject to market demands. However, for the purposes of the traffic assessment, a reasonable range of uses has been considered. The breakdown of the usable floorspace is estimated to be:

- 9,131 m^2 GFA available for commercial and/or continued educational use.
- 3,880 m^2 GFA taken up by relocation of the existing gymnasium to the main building.
- 1,000 m^2 GFA taken up by relocation of the existing child care centre within the main building.
- 4,264 m^2 GFA taken up by retention of the existing library
- 2,769 m^2 GFA taken up by retention of the existing auditorium.

3.2 Vehicle Access and Circulation

The concept plans utilises the existing road system that serves the campus with minimal introduction of new roads. The additional new roads relate mainly to the emergency bushfire truck access and where possible the bushland character of the roads will be maintained. The existing access road will be maintained as will the bus turnaround loop.

The existing car parking areas that occur along the circulation road system and those that follow the contours around the eastern edge of the site will be maintained. New car parking areas will be integrated into new development. For the medium density dwellings and townhouses this will be in basements and for the integrated small lot housing and individual housing these will each have their own car spaces.

There are a number of key pick-up and drop-off points already located around the campus and these will be maintained where appropriate to service the new development.

3.3 Traffic Generation

Typical traffic generation rates of different types of developments are contained in the RTA Guide to Traffic Generating Developments. They have been used to establish current traffic generation and to estimate the likely traffic generation of the proposed development.

For the purposes of assessing potential ranges of traffic impacts, the split between commercial / educational use has been assessed for four scenarios as follows:

Scenario 1 - 70% Commercial / 30% Educational

Scenario 2 - 90% Commercial / 10% Educational

Scenario 3 - 0% Commercial / 100% Educational

Scenario 4 - 100% Commercial / 0% Educational

These four scenarios have been assessed to provide an indication of the impacts of varying the commercial / educational mix.

3.3.1 Residential Component

Standard traffic generation rates for the residential component of the proposed development are:

- Residential dwellings on traditional sized lots – 0.85 peak hour vehicle trips per dwelling;
- Integrated / townhouse lots – 0.45 peak hour vehicle trips per dwelling;
- 2 Bedroom Apartments – 0.45 peak hour vehicle trips per dwelling.
- 3 Bedroom Apartments – 0.50 peak hour vehicle trips per dwelling.

Around 20 percent of the trips would be inbound in the morning peak hour and 80 percent inbound in the evening peak hour.

3.3.2 Adaptive Re-use of Main Building

The traffic generated by the adaptive re-use of the main building will be affected by a number of factors. Key factors include the employee density of the commercial use and the use of certain components (library, child care, gymnasium) by people residing within the residential component of the development. These factors have been addressed in the traffic assessment as discussed below.

3.3.2.1 Commercial Component

The commercial component of the adaptive re-use has been assessed on the basis that it is predominantly occupied by high technology and computer based business and financial related services. This is typical of commercial developments in the area. The mix of uses used to assess traffic and parking implications are:

- 50 to 65% of the total floor area occupied by computer / high technology industry
- 5 to 7% of the total floor area occupied by health related industry
- 10 to 15% of the total floor area occupied by insurance related industry
- 10 to 15% of the total floor area occupied by accountancy / management related industry
- 10 to 13% of the total floor area occupied by legal related industry

This mix could vary. However, the impacts on traffic and parking conditions would be marginal.

The RTA guidelines specify that traffic conditions for office and commercial developments should be assessed at a base rate of 2 evening peak hour vehicle trips per 100 m^2 GFA.

development. The resultant traffic generation rate ranges from 1.30 to 1.41 trips per 100 m^2 GFA in peak hours.

Further adjustments to the standard rate maybe justified because access to public transport would be well suited to meet the needs of potential future occupants of the commercial floor space. This is due to the presence of a regular bus route which currently is not suitable for the needs of the current use and student population. However, the existing bus route could be further improved to meet the peak hour requirements of future workers on the site. Furthermore, the use of the bus services by office workers on the site would further improve the viability of public transport as it would mean that the services will be used in both directions during both peak periods as a result of the proposed mixed uses. For the purposes of this traffic and parking assessment, no adjustment has been made.

3.3.2.2 Educational Component

The RTA guidelines do not specify a rate for traffic generation of education establishments. However, a rate for the subject site can be estimated based on the surveys reported in **Section 2.3** where traffic generated by the existing campus ranged from 400 to 600 vehicles in peak hours. This equates to a traffic generation rate of 1.30 to 1.95 trips per 100 m^2 GFA in peak hours (based on the existing floorspace of 30,695 m^2 GFA for the campus buildings).

3.3.2.3 Gymnasium Component

The RTA guidelines specify a peak hourly generation of 9 trips per 100 m^2 GFA of gymnasium floorspace. However, this peak rate relates to the evening period between 6.00 and 7.00 pm which does not coincide with the evening peak associated with the remainder of the adaptive re-use of the main building. Morning and evening peak hour rates of 1.2 trips per 100 m^2 GFA have been applied for the purposes of assessing cumulative impacts of the overall changes to the campus. This includes an allowance for the fact that significantly less traffic is generated in the commuter peak hours (around 1/6th of the 6.00 to 7.00 pm rate) and an allowance for 20 percent of the patrons being locals who work or live within the site.

3.3.2.4 Childcare Component

The childcare centre has been assessed on the basis that 68 places are provided and that 40 percent are taken up by children related to people who live or work within the site. Peak hour traffic generation rates have been based on the RTA Guidelines. The resultant rates are 0.29 and 0.25 peak hour trips per place in the morning and evening peak hours respectively.

3.3.2.5 Library and Auditorium Components

The library and auditorium are unlikely to generate significant levels of traffic in peak hours. However, for the purposes of assessing traffic impacts, a conservatively high estimate has been applied for these components of the development. The rates applied are 0.8 and 0.5 peak hour trips per 100 m^2 GFA in the morning and evening peak hours respectively.

3.3.2.6 Total Traffic Generation

The total traffic generated by the residential dwellings and adaptive re-use of the main building is estimated to be between 442 and 502 vehicles in peak hours.

Table 6 contains a summary of the split between inbound and outbound vehicles. **Appendix A** contains a detailed output of the traffic generation calculations.

Table 6: Total Peak Hour Traffic Generation

Scenario		Vehicle Trips					
		AM Peak			PM Peak		
		Inbound	Outbound	Total	Inbound	Outbound	Total
1	440 dwellings 70% commercial 30% educational	193	252	445	238	221	460
2	440 dwellings 90% commercial 10% educational	209	245	454	225	232	457
3	440 dwellings 100% educational (no commercial)	164	281	445	288	213	501
4	440 dwellings 100% commercial (no educational)	205	239	445	217	225	442

It should also be noted that the above estimates of traffic generation should be treated as conservatively high based on a worst case scenario determined for the purposes of the traffic assessment.

Comparing these anticipated future traffic volumes with the recent survey results at the UTS entrance reveals that they are slightly higher than the 400 vehicles per hour current two-way traffic generation, although less than the historic levels of traffic generation which were up to 600 vehicles per hour.

3.4 Sustainable Transport Initiatives

The primary sustainable transport initiative is maintaining the regular bus service that currently services the UTS Campus. A person establishes their mode choice pattern within two weeks of moving to a new dwelling

It is considered appropriate to establish a Transport Behavioural Program that would comprise an information pack on transport options for all households, a face to face consultation with a facilitator able to offer advice on transport planning options, free travel incentives and discount offers arranged at local bicycle shops.

Information Pack:

- Bus routes, bus stop locations and timetables
- Train timetable information
- Bicycle facilities and route locations
- Travel time comparisons by various modes and routes to assist with choice
- Free travel incentives
- School access arrangements
- Discount schemes where available for bicycle shops, etc.
- Car pooling schemes available

Face To Face Consultation:

- Professional consultation offering advice on mode and route choice
- Advice on the incentives being offered

Free Travel Incentives

- An incentive scheme is being investigated whereby the first two months of travel by any new resident on the bus services serving the site will be free through a voucher scheme.

4 TRAFFIC IMPACTS

4.1 Impacts on Traffic Flows

The Scenario 3 traffic generation has been assigned to the road system on the basis of the Journey to Work data available from the 2001 Census. **Table 7** provides the major locations for residents of Ku-ring-gai travelling to work and home locations for employees working in Ku-ring-gai.

Table 7 Trip Distribution

RESIDENTIAL TRIP DISTRIBUTION (live in Ku-ring-gai)	
Ku-ring-gai	28.1%
Inner Sydney	26.1%
Willoughby	10.1%
North Sydney	7.8%
Ryde	5.1%
Hornsby	4.7%
Central Western Sydney	3.8%
Northern Beaches	3.5%
Lane Cove	2.3%
Other	8.5%
Total	**100.0%**
EMPLOYMENT TRIP DISTRIBUTION (work in Ku-ring-gai)	
Ku-ring-gai	44.4%
Hornsby	15.2%
Northern Beaches	6.9%
Gosford-Wyong	5.2%
Ryde	3.3%
Baulkham Hills	3.1%
Willoughby	2.7%
Central Western Sydney	2.6%
Inner Sydney	2.5%
North Sydney	1.7%
Other	12.4%
Total	**100.0%**

The predicted inbound and outbound flows have been assigned to travel east or west on Grosvenor Road to access Lady Game Drive or the Pacific Highway. Left turn traffic from the Pacific Highway has been assigned predominantly to Eton Road rather than Grosvenor Road as this is the shortest route. Figures 4 and 5 show the AM and PM peak traffic assignment.

Figure 4 AM Peak Future Development Traffic

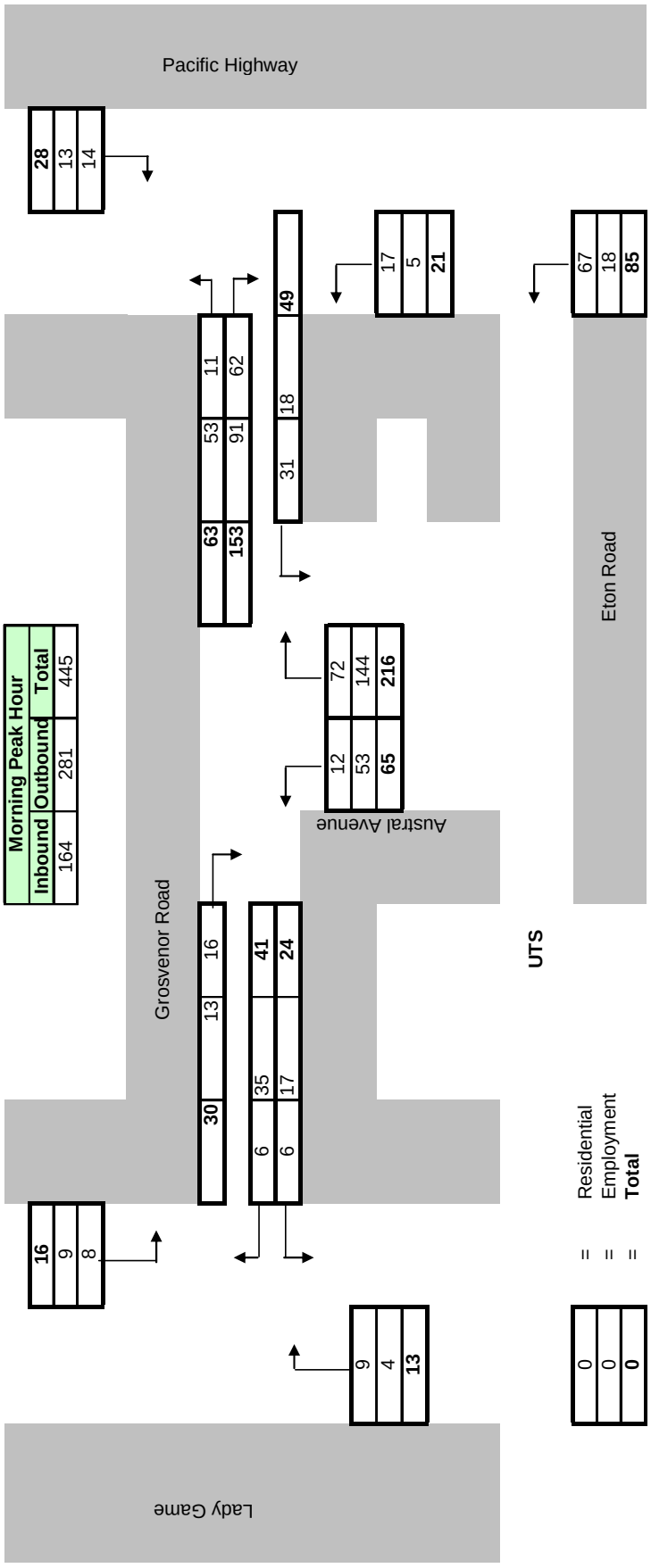
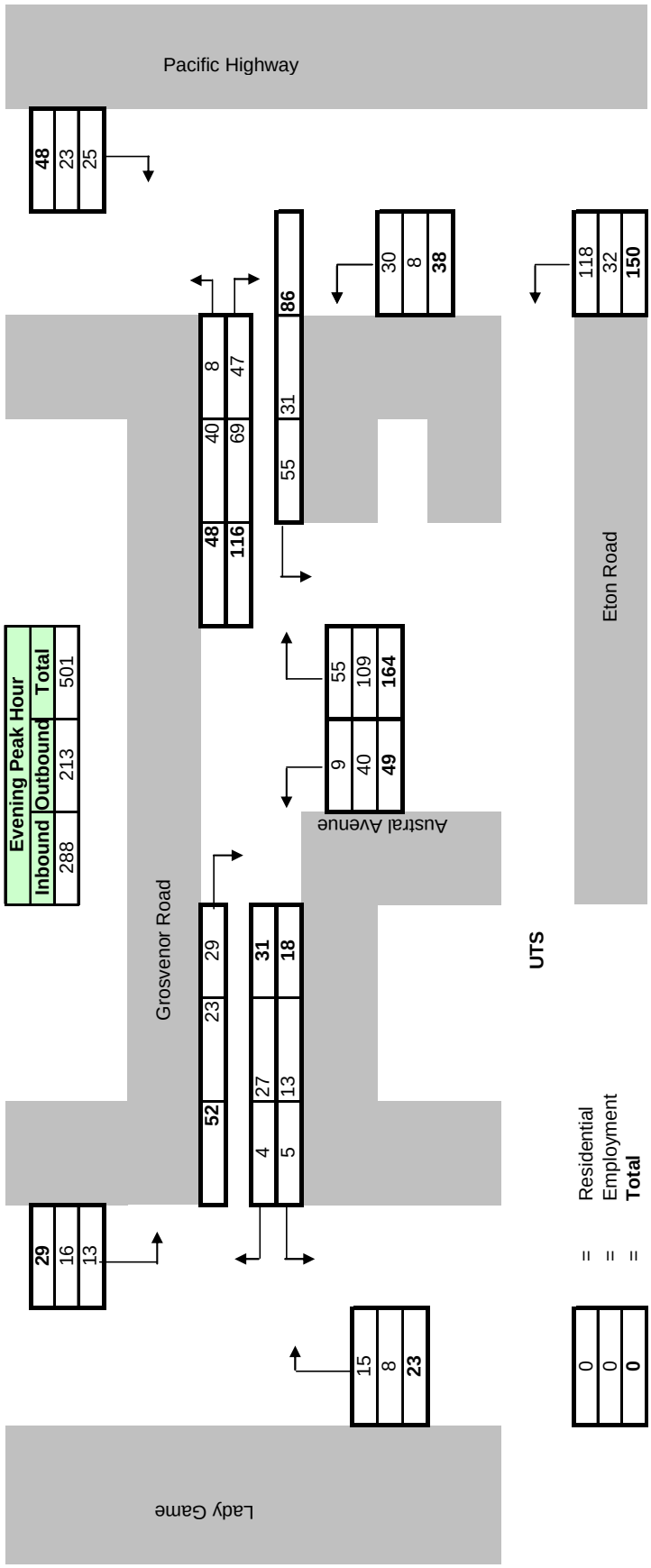


Figure 5 PM Peak Future Development Traffic



In order to assess the changes in traffic flow, the existing peak period traffic distribution has been considered based on the traffic count data. Table 8 provides a comparison between the existing peak period traffic flows and those proposed with the new development (refer to Figures 4 and 5). In the AM peak period there is approximately a 13% increase in traffic whilst in the PM peak period there is a 23% increase. Due to the change in nature of the development from predominantly educational to residential and mixed use, the traffic flow is more evenly balanced between entering and exiting traffic. The change in traffic flow is predominantly exiting the site in the morning and entering in the evening.

Table 8: Comparison of Existing and Proposed Peak Traffic Flows

		Ingress	Egress	Total
Morning Peak Hour	Existing	330	56	386
	Proposed	164	281	445
	Difference	-166	+225	+59
Evening Peak Hour	Existing	90	293	383
	Proposed	288	213	501
	Difference	+198	-80	+118

The distribution of this traffic increase on the roads accessing the site is shown in Table 9. These small traffic increases can be accommodated on these roads and are within the desirable maximum traffic flows expected for the function of these streets.

Table 9: Future Morning and Evening Peak Traffic Volumes

Location		Morning Peak Hour (8 to 9 am)		Evening Peak Hour (5 to 6 pm)	
		Existing	Future	Existing	Future
Grosvenor Road	East of Austral Avenue	799	833	783	843
	West of Austral Avenue	921	933	875	899
Eton Road	West of Austral avenue	388	400	317	350
Abingdon Road	East of Kimo Street	78	78	85	85

To test the traffic impact of the change in traffic flow on the main access road system, the intersection of Grosvenor Road with the Pacific Highway has been modelled using SIDRA.

The capacity of a road network in an urban area is determined by the capacity of key intersections. SIDRA, a computer program, is used to assess the operational performance of intersections, which may be either signal, roundabout or priority controlled.

Results of the intersection analysis are presented in terms of Level of Service (LOS), which is an index of the operational performance of traffic at an intersection and is based on the average delay per vehicle. LOS ranges from A – very good to F – highly congested conditions. Another common measure of intersection performance is the degree of saturation (DS), which provides an overall measure of the capability of the intersection to accommodate the traffic levels. A DS of 1 indicates that the intersection is operating at capacity, but the desirable (and practical) degree of saturation is less than 1.

Results of the analysis are summarised in Table 10. In both the morning and evening peak hours, the intersection overall experiences no noticeable change from existing operations. In the morning peak, the Grosvenor Road approach to the Pacific Highway is anticipated to experience an increased queue length with the level of service going down from D to E for that approach. In the afternoon peak the Grosvenor Road approach remains relatively unchanged.

Table 10: Pacific Highway / Grosvenor Road Intersection Analysis

Intersection	Control	Peak Hour	DS	AVD	LOS	HMD
AM Peak Hour	Signals	Existing	0.87	30	C	65
		Future	0.84	31	C	65
PM Peak Hour	Signals	Existing	0.92	26	C	99
		Future	0.94	31	C	97

Terms
DS Degree of Saturation
AVD Average Delay (seconds)
LOS Level of Service
HMD Highest Movement Delay (seconds) - Highest average delay for any movement at an intersection

LOS for signals and roundabouts is based on average overall delay, and based on highest movement delay for priority intersections

5 PARKING AND ACCESS

5.1 Parking

Parking requirements are based on Ku-ring-gai Council's Car Parking Development Control Plan (DCP). The latest plan was issued in November 1998.

Table 11 presents the parking requirements for the residential component of the development.

Table 11: Parking Requirements – Residential Component

Type	Quantity	Rate	Total required
Residential dwellings on traditional sized lots and integrated / townhouse lots	50	2 / dwelling	100
Apartments			
- two bedroom	195	1 / dwelling	195
- three bedroom	195	1.5 / dwelling	292.5
- visitor parking (apartments)	390	1 / 4 dwellings	97.5
Total			**685**

The parking requirement for the residential dwellings and integrated / townhouses will be accommodated within each individual lot and / or within designated parking areas. The parking requirements for the apartments will generally be accommodated in undercover carparks.

The parking requirements for the adaptive re-use of the main campus building will depend on the ultimate mix of uses. For the purposes of assessing the concept plan an estimate has been made of likely requirements for the upper end of the possible range of uses. This is presented in **Table 12**.

The rates applied for education, gymnasium, library, and auditorium are pro-rated from the traffic generation inbound for the commercial use. The pro-rata is based on a standard rate of 1 space per 33 m2 GFA for commercial floorspace. This is the rate from the Ku-ring-gai Council Car Parking Development Control Plan. This pro-rata process allows for co-use of parking that will occur as peak parking demands for the different components of the adaptive re-use will not necessarily coincide.

Table 12: Parking Requirements – Adaptive Re-use of Main Building

Type	Area/Places	Rate	Total required
Commercial	8,218 m^2 GFA	1 / 33 m2 GFA	249
Educational	913 m^2 GFA	1 / 36 m2 GFA	26
Gymnasium	3,880 m^2 GFA	1 / 70 m2 GFA	55
Childcare (68 places)	68 places	1 / 4 places	17
Library	4,264 m^2 GFA	1 / 105 m2 GFA	41
Auditorium	2,769 m^2 GFA	1 / 93 m2 GFA	30
Total			**417**

From **Table 12** it can be seen that the adaptive reuse of the main building will require provision of around 417 car parking spaces. However, it should be noted that this may be reduced depending on the final mix and usable floor area available for the uses.

It should also be noted that the standard rate of 1 space per 33 m^2 GFA for commercial floorspace used to determine the total parking requirement is the rate from the Ku-ring-gai Council Car Parking Development Control Plan. The RTA Guide to Traffic Generating Developments specifies provision of parking at a rate of 1 space per 40 m^2 GFA. Adoption of this rate would reduce the parking requirements for the adaptive re-use from around 417 to 347 spaces. It is anticipated that this will be generally accommodated in existing areas.

5.2 Access

Access to the site is currently provided via Eton Road only. A proposal for a secondary access via Lady Game Drive was previously approved by Ku-ring-gai Council, but this approval has since lapsed. Provision of a second road access connected directly to Lady Game Drive is not considered to be required. This is due to the following reasons:

- The secondary access is likely to reduce traffic onto the local road network (Grosvenor, Eton, and Abingdon Roads). However, as the proposed development generates less traffic than the university campus, a secondary access is not required.
- A second access would have little benefit during a bushfire emergency as it runs through the heavily treed area subject to such fires. Emergency access is adequately provided via the Eton Road main entry which will continue.
- Residents concerns have been the amount of cars parked on local streets which surround the campus (Eton Road, Grosvenor Road, Abingdon Road). The proposed development will improve parking conditions for the surrounding residents as parking will be provided in the site.
- A second access would not contribute to improved parking conditions.
- A second access would not resolve traffic congestion at the intersection of Millwood Avenue with Fullers Road, Delhi Road and Lady Game Drive.

It should also be noted that there are other environmental and engineering considerations (assessed elsewhere) which impact on the viability of the second road access.

6 SUMMARY AND CONCLUSIONS

6.1 Summary

This report has assessed the traffic related implications of a proposed rezoning and future development of the University of Technology, Kuring-gai campus. The concept plan for the site includes adaptive re-use of the main campus building plus residential dwellings with a mix of detached dwellings, townhouses and apartments.

Based on RTA guidelines and an assessment of potential variations in the mix of uses, the traffic generation of the development will be 442 to 501 vehicles in peak hours. This is slightly higher than the average generation of about 400 vehicles per hour associated with the existing use under current operations, although historically it did generate up to 600 vehicles per hour.

Traffic flows on local roads will be similar as a result of the concept plan. On street parking external to the site will be significantly reduced with no student parking occurring and parking provided on-site to accommodate the development mix.

The parking requirement of the residential component will be around 685 spaces (including visitor spaces). The parking requirement of the adaptive re-use of the main building will be around 417 spaces based on the Ku-ring-gai Council Parking DCP and 347 spaces based on RTA Guidelines.

A second access via Lady Game Drive is not required to accommodate the traffic generated by the concept plan of the site. The concept plan reduces traffic generation compared to the traffic that has been generated by the site. The second access would not substantially change traffic flows on local roads.

Access to the Film Australia site will not be affected by the concept plan as traffic flows past this location will remain at local collector road levels.

6.2 Conclusion

Overall, the proposed concept plan for the UTS Kuring-gai site will cause minimal traffic changes on the surrounded road network when compared with the existing university campus (compared with existing conditions). It is concluded that there is no impediment to the rezoning from a traffic viewpoint.

Appendix A

Peak Hour Traffic Generation

SCENARIO 1 - 440 DWELLINGS, ARUP RATES, LOWER BOUND

No. of Dwellings	Trip Rate		Inbound		Outbound		Total
			%	Veh Trips	%	Veh Trips	
10	0.85	per dwelling	20%	1.7	80%	6.8	8.5
40	0.45	per dwelling	20%	3.6	80%	14.4	18.0
0	0.40	per dwelling	20%	0.0	80%	0.0	0.0
195	0.45	per dwelling	20%	17.6	80%	70.2	87.8
195	0.50	per dwelling	20%	19.5	80%	78.0	97.5
440				**42.4**		**169.4**	**211.8**
10	0.85	per dwelling	70%	6.0	30%	2.6	8.5
40	0.45	per dwelling	70%	12.6	30%	5.4	18.0
0	0.40	per dwelling	70%	0.0	30%	0.0	0.0
195	0.45	per dwelling	70%	61.4	30%	26.3	87.8
195	0.50	per dwelling	70%	68.3	30%	29.3	97.5
440				**148.2**		**63.5**	**211.8**

m^2 GFA	Trip Rate		Inbound		Outbound		Total
			%	Veh Trips	%	Veh Trips	
6,392	1.3	per 100m^2	85%	70.6	15%	12.5	83.1
2,739	1.3	per 100m^2	50%	17.8	50%	17.8	35.6
3,880	1.2	per 100m^2	50%	23.3	50%	23.3	46.6
1,000	0.29	per place	50%	9.9	50%	9.9	19.7
4,264	0.8	per 100m^2	50%	17.1	50%	17.1	34.1
2,769	0.5	per 100m^2	85%	11.8	15%	2.1	13.8
21,044				**150.4**		**82.5**	**232.9**
6,392	1.3	per 100m^2	15%	12.5	85%	70.6	83.1
2,739	1.95	per 100m^2	50%	26.7	50%	26.7	53.4
3,880	1.2	per 100m^2	50%	23.3	50%	23.3	46.6
1,000	0.25	per place	50%	8.5	50%	8.5	17.0
4,264	0.8	per 100m^2	50%	17.1	50%	17.1	34.1
2,769	0.5	per 100m^2	15%	2.1	85%	11.8	13.8
21,044				**90.1**		**157.9**	**248.0**

Morning Peak Hour			Evening Peak Hour		
Inbound	Outbound	Total	Inbound	Outbound	Total
193	252	445	238	221	460

SCENARIO 2 - 440 DWELLINGS, ARUP RATES, UPPER BOUND

No. of Dwellings	Trip Rate		Inbound		Outbound		Total
			%	Veh Trips	%	Veh Trips	
10	0.85	per dwelling	20%	1.7	80%	6.8	8.5
40	0.45	per dwelling	20%	3.6	80%	14.4	18.0
0	0.40	per dwelling	20%	0.0	80%	0.0	0.0
195	0.45	per dwelling	20%	17.6	80%	70.2	87.8
195	0.50	per dwelling	20%	19.5	80%	78.0	97.5
440				**42.4**		**169.4**	**211.8**
			20%		**80%**		
10	0.85	per dwelling	70%	6.0	30%	2.6	8.5
40	0.45	per dwelling	70%	12.6	30%	5.4	18.0
0	0.40	per dwelling	70%	0.0	30%	0.0	0.0
195	0.45	per dwelling	70%	61.4	30%	26.3	87.8
195	0.50	per dwelling	70%	68.3	30%	29.3	97.5
440				**148.2**		**63.5**	**211.8**
			70%		**30.0%**		

m^2 GFA	Trip Rate		Inbound		Outbound		Total
			%	Veh Trips	%	Veh Trips	
8,218	1.41	per 100m^2	85%	98.5	15%	17.4	115.9
913	1.3	per 100m^2	50%	5.9	50%	5.9	11.9
3,880	1.2	per 100m^2	50%	23.3	50%	23.3	46.6
1,000	0.29	per place	50%	9.9	50%	9.9	19.7
4,264	0.8	per 100m^2	50%	17.1	50%	17.1	34.1
2,769	0.5	per 100m^2	85%	11.8	15%	2.1	13.8
21,044				**166.4**		**75.6**	**242.0**
			62%		**38%**		
8,218	1.41	per 100m^2	15%	17.4	85%	98.5	115.9
913	1.95	per 100m^2	50%	8.9	50%	8.9	17.8
3,880	1.2	per 100m^2	50%	23.3	50%	23.3	46.6
1,000	0.25	per place	50%	8.5	50%	8.5	17.0
4,264	0.8	per 100m^2	50%	17.1	50%	17.1	34.1
2,769	0.5	per 100m^2	15%	2.1	85%	11.8	13.8
21,044				**77.2**		**168.0**	**245.2**
Average Inbound/Outbound trip rate			**38%**		**62%**		

Morning Peak Hour			Evening Peak Hour		
Inbound	Outbound	Total	Inbound	Outbound	Total
209	245	454	225	232	457

SCENARIO 3 - 440 DWELLINGS, EDUCATIONAL ONLY (NO COMMERCIAL), LOWER BOUND

No. of Dwellings	Trip Rate		Inbound		Outbound		Total
			%	Veh Trips	%	Veh Trips	
10	0.85	per dwelling	20%	1.7	80%	6.8	8.5
40	0.45	per dwelling	20%	3.6	80%	14.4	18.0
0	0.40	per dwelling	20%	0.0	80%	0.0	0.0
195	0.45	per dwelling	20%	17.6	80%	70.2	87.8
195	0.50	per dwelling	20%	19.5	80%	78.0	97.5
440				**42.4**		**169.4**	**211.8**
10	0.85	per dwelling	70%	6.0	30%	2.6	8.5
40	0.45	per dwelling	70%	12.6	30%	5.4	18.0
0	0.40	per dwelling	70%	0.0	30%	0.0	0.0
195	0.45	per dwelling	70%	61.4	30%	26.3	87.8
195	0.50	per dwelling	70%	68.3	30%	29.3	97.5
440				**148.2**		**63.5**	**211.8**

m^2 GFA	Trip Rate		Inbound		Outbound		Total
			%	Veh Trips	%	Veh Trips	
0	1.3	per 100m^2	85%	0.0	15%	0.0	0.0
9,131	1.3	per 100m^2	50%	59.4	50%	59.4	118.7
3,880	1.2	per 100m^2	50%	23.3	50%	23.3	46.6
1,000	0.29	per place	50%	9.9	50%	9.9	19.7
4,264	0.8	per 100m^2	50%	17.1	50%	17.1	34.1
2,769	0.5	per 100m^2	85%	11.8	15%	2.1	13.8
21,044				**121.3**		**111.6**	**232.9**
0	1.3	per 100m^2	15%	0.0	85%	0.0	0.0
9,131	1.95	per 100m^2	50%	89.0	50%	89.0	178.1
3,880	1.2	per 100m^2	50%	23.3	50%	23.3	46.6
1,000	0.25	per place	50%	8.5	50%	8.5	17.0
4,264	0.8	per 100m^2	50%	17.1	50%	17.1	34.1
2,769	0.5	per 100m^2	15%	2.1	85%	11.8	13.8
21,044				**139.9**		**149.6**	**289.6**

Morning Peak Hour			Evening Peak Hour		
Inbound	Outbound	Total	Inbound	Outbound	Total
164	281	445	288	213	501

SCENARIO 4 - 440 DWELLINGS + COMMERCIAL ONLY (NO EDUCATIONAL)

No. of Dwellings	Trip Rate		Inbound		Outbound		Total
			%	Veh Trips	%	Veh Trips	
10	0.85	per dwelling	20%	1.7	80%	6.8	8.5
40	0.45	per dwelling	20%	3.6	80%	14.4	18.0
0	0.40	per dwelling	20%	0.0	80%	0.0	0.0
195	0.45	per dwelling	20%	17.6	80%	70.2	87.8
195	0.50	per dwelling	20%	19.5	80%	78.0	97.5
440				**42.4**		**169.4**	**211.8**
10	0.85	per dwelling	70%	6.0	30%	2.6	8.5
40	0.45	per dwelling	70%	12.6	30%	5.4	18.0
0	0.40	per dwelling	70%	0.0	30%	0.0	0.0
195	0.45	per dwelling	70%	61.4	30%	26.3	87.8
195	0.50	per dwelling	70%	68.3	30%	29.3	97.5
440				**148.2**		**63.5**	**211.8**

m^2 GFA	Trip Rate		Inbound		Outbound		Total
			%	Veh Trips	%	Veh Trips	
9,131	1.3	per 100m^2	85%	100.9	15%	17.8	118.7
0	1.3	per 100m^2	50%	0.0	50%	0.0	0.0
3,880	1.2	per 100m^2	50%	23.3	50%	23.3	46.6
1,000	0.29	per place	50%	9.9	50%	9.9	19.7
4,264	0.8	per 100m^2	50%	17.1	50%	17.1	34.1
2,769	0.5	per 100m^2	85%	11.8	15%	2.1	13.8
21,044				**162.9**		**70.1**	**232.9**
9,131	1.3	per 100m^2	15%	17.8	85%	100.9	118.7
0	1.95	per 100m^2	50%	0.0	50%	0.0	0.0
3,880	1.2	per 100m^2	50%	23.3	50%	23.3	46.6
1,000	0.25	per place	50%	8.5	50%	8.5	17.0
4,264	0.8	per 100m^2	50%	17.1	50%	17.1	34.1
2,769	0.5	per 100m^2	15%	2.1	85%	11.8	13.8
21,044				**68.7**		**161.5**	**230.2**

Morning Peak Hour			Evening Peak Hour		
Inbound	Outbound	Total	Inbound	Outbound	Total
205	239	445	217	225	442