SYDNEY LIGHT RAIL
LEICHHARDT NORTH STOP

FINAL REPORT

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Executive Summary

Department of Transport has commissioned the GSE 844 Macquarie University students consultancy team to prepare a concept plan for the immediate site of the proposed Leichhardt North light rail stop at Darley Road and Francis Street Leichhardt as well as the local vicinity.

The brief is to consider current land uses, appropriate potential land uses and land use changes for the immediate site and an area within 800 metres of the light rail stop.

Our concept plan aims to:

1. Integrate the transit stop with other modes of transport;

2. Integrate the transit stop with current and potential land uses in the 800 metre subject area; and

3. Improve socioeconomic and ecological outcomes in the local area and contribute to regional sustainability.

The key to achieving all these objectives is connectivity. Connectivity in a planning sense is about creating proximity in time and space between different land uses and modes of transport. If this proximity can be achieved, the transport, socioeconomic and ecological systems of a district or region will work more efficiently and effectively and be 'sustainable'.

Our plan specifically aims to address barriers to good connectivity in the local area and also improve regional connectivity. The plan consists of:

- An integrated transport infrastructure plan that will not only greatly improve the connectivity of the local area, but contribute to regional sustainability by significantly reducing travel times on the City West Link and linking the Greenway to the proposed White Bay

redevelopment area; and

- An integrated land use plan of the transit site and an area within 800metres, that conforms to 'new urbanism' and ESD principles.

The Integrated Transport Infrastructure Plan consists of recommendations that are designed to increase connectivity and sustainability; we recommend the following:

1) Three combined road, cyclist, pedestrian and ecological bridges over the City West Link in a north/south direction. By removing 3 sets of traffic lights at James Street, Norton St. and Balmain Rd the bridges will speed up traffic travelling between Sydney's West and the CBD, as well as greatly improving local connectivity across the City/West Link

2) A low rising ramp from Lilyfield stop that will bring pedestrians and cyclists up to the road level along the northern end of the rail cutting, proceed under Balmain Road and then link up with the Greenway salient at the eastern end of the rail tunnel. Between Balmain Road and the tunnel the pedestrian/cyclist shared user path would have to be excavated into the rock face on a level with Lilyfield Road. This would extend the Greenway Shared User Path (SUP) from Iron Cove all the way to Lilyfield SLR stop and represent a quantum leap for sustainable transport in the region.

3) A large bike parking and bike hiring area in the open space at Lilyfield SLR stop.

4) An environmentally friendly shuttle bus service that would connect with trams every 15 minutes at Leichhardt North stop and link key land uses in the 800 metres subject area.

5) Relocation of the existing bus depot on Balmain Road to the large area of vacant land at Rozelle freight yard near Eastern Park on Lilyfield Road.

6) A bridge over the Hawthorne canal near Blackmore Oval so residents of Haberfield can access the SLR transit stop.

Our Integrated Land Use Plan contains potential land use recommendations for the 800 metre subject area as follows:

1) Leichhardt North Stop Site

A five-story high- density, transit oriented development (TOD) incorporating mixed residential/commercial uses, environmentally friendly design and a sense of place.

2) Present Bus Depot & Adjoining Derelict Site

The southern derelict part of Leichhardt Bus Depot could be redeveloped for offices, shops and residences that would include preservation of old buildings where possible. The proceeds of the sale of this land to a private developer could be used to relocate the bus depot to a larger site on vacant Rail-Corp land at nearby Rozelle freight yard. The part of the site presently used for bus parking could be converted to a new sporting and cultural centre of modest capacity that fits with the character of the neighbouring “Little Italy” tourism and entertainment precinct. Concerts, soccer matches and other sporting or cultural events could be staged at the new centre. Such a project may attract Federal funding as part of Australia’s program to attract international tourists to one of Sydney’s most lively and culturally significant areas.

3) Blackmore Park

A reconfiguration of Blackmore Park as an ecological park, incorporating a small wetland, grey water recycling facility for local residents and small amphitheatre to stage concerts and plays.

4) Film Studio & Warehouses near Blackmore Park

A rezoning of the presently underutilized film studio and warehouse site opposite Blackmore Oval to allow for redevelopment as medium- density housing with provision for limited mixed commercial and light industrial uses.

5) Warehouses between Charles Street and Canal Road

Rezoning of the presently underutilized large ex -Brownfield site bounded by Charles Street and Canal Road on the northern side of the City-West Link to allow for use of the existing buildings for mixed residential/commercial uses as well as the present community uses.

6) Rozelle Hospital

Conversion of the disused Heritage buildings of Rozelle Hospital to a community mental health centre with provision to lease space to private consultants and associated health services.

7) Orange Grove Public School

The rezoning of Orange Grove Public School to incorporate a Long Day Care centre on the presently underutilized site.

In addition we recommended that zoning regulations be changed to provide for densification and to allow for mixed-use land uses along Darley Road that will become a transit boulevard under our plan. Development should be set back from the footpath to allow for ecological corridors.

The multi-purpose sports stadium, the medium density residential development and the TOD at or near the transit stop are major potential trip generators that will make Leichhardt North SLR stop sustainable.

PART ONE

CURRENT LAND-USES

1) Introduction

The Sydney Light Rail project involves the 5.6 kilometre expansion of the existing light rail network that currently runs between Central station and Lilyfield. The new light rail line will be located within the disused Rozelle freight corridor and will run on the same tracks. Nine new light rail stops Leichhardt North (red circle in the Figure1), Hawthorne, Marion, Taverners Hill, Lewisham West, Waratah Mills, Arlington, Dulwich Grove and Dulwich Hill Interchange will be constructed (Indicative Design Guidelines).

The Leichhardt North stop project fits into a larger Department of Transport project which has been approved and funding was allocated in the 2010-11 NSW Budget. The anticipated capital cost for the light rail extension is $120 million and the Greenway will cost $30 million. The construction program is due to commence in the first quarter of 2011 and take about 12 months to complete (Parsons Brinkerhoff 2010). Approved features of SLR/ Greenway project include:

- Integration of 'the Greenway' pedestrian and cycle path that runs between Iron Cove at Dobroyd point to the northern bank of the Cooks River;

- Bushcare and vegetation remediation sites along the Greenway SUP to provide for increase in existing local habitat for fauna; and

- New infrastructure (including a new pedestrian/cycle bridge across Hawthorne canal at Hawthorne stop) to ensure accessibility and connectivity between the Greenway, local streets and light rail stops.

The purpose of this report is to prepare an integrated land-use plan for the Department of Transport regarding the proposed Sydney Light Rail (SLR) stop at Leichhardt North and an area of 800metres surrounding that stop.

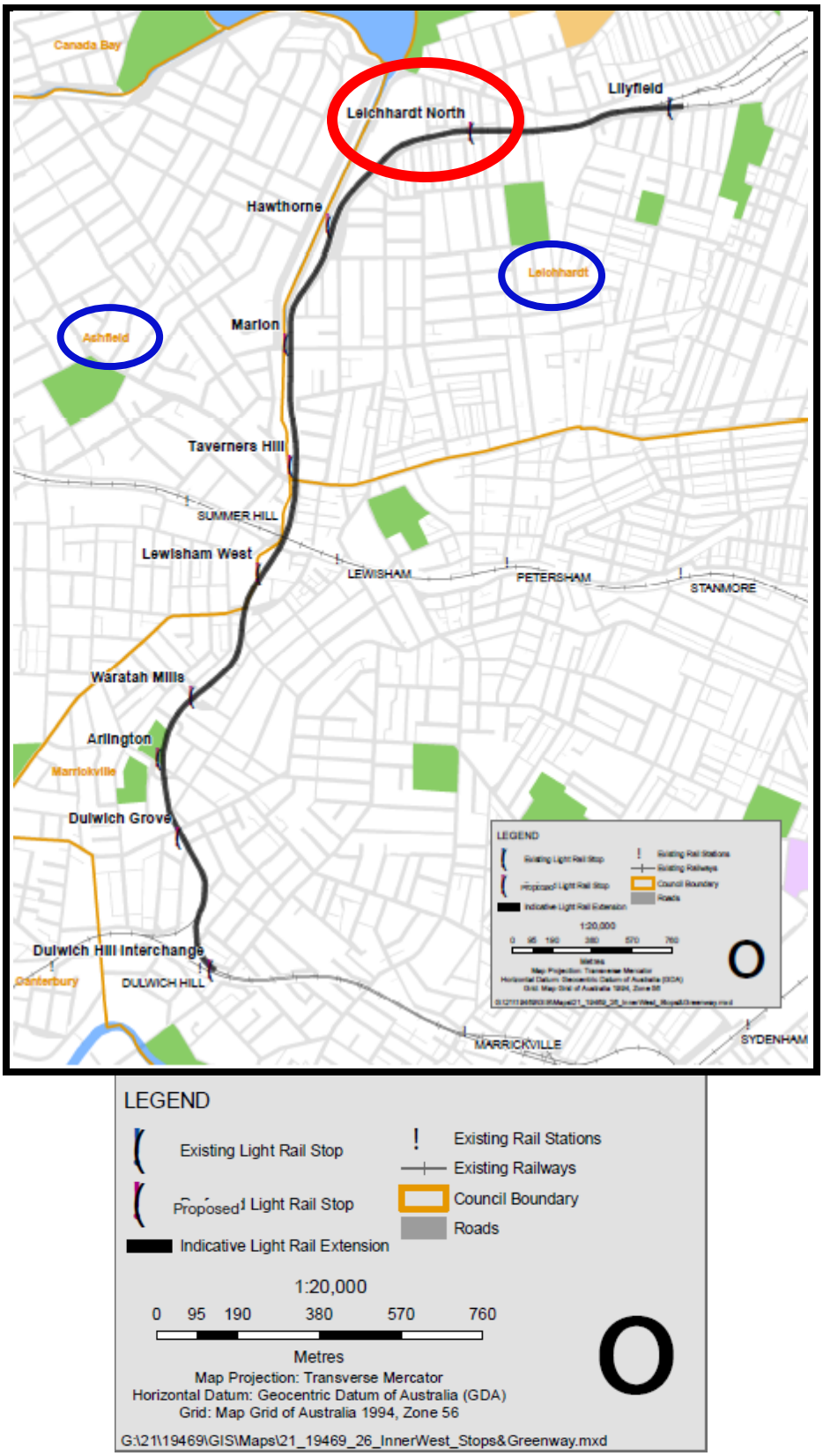


Fig1. Sydney Light Rail Inner West Extension, Location of Proposed Stops

Source : Indicative Design Guideline

1.1) 800 Metres Catchment Area

Brezina (2008) argues that the potential pedestrian catchment area of a Light Rail Transit (LRT) stop is 'the circular area around a stop, wherein potential riders-inhabitants and workers-are attracted to use the LRT line' (45). This area radiates out to a maximum of 800 metres from the centre.

The 800 metres circular catchment area only works if access to the stop within that area is well connected for a pedestrian use. The better the stop connects to 'major trip generators' (47) in the 800 metres pedestrian catchment area, the more successful will the stop be in terms of passenger traffic.

1.2) Major Trip Generators

The 800 metre catchment area of the Leichhardt North stop consists of mainly low-density residential uses. The demographic profile indicates that the residents are mainly high income individuals with good jobs in the local area or the city. Thus a major trip generator would be commuter trips to and from the city.

Another major trip generator is Hawthorne Reserve with its popular recreational uses such as dog-walking, tennis or family outings. This area is linked to the beautiful Iron Cove foreshore via a pedestrian walkway and cycle path that passes under the City West Link. These active transport linkages proceed north along the foreshore to important recreational uses such as Leichhardt Oval, Leichhardt Aquatic Centre and the sporting fields of Callan Park.

To the east another potential trip generator is the lively Norton Street restaurant and entertainment precinct. The proposed transit stop is less than 200 metres from Norton Street

along which there are frequent bus routes servicing this destination that is known as "Little Italy ".

2) Context

2.1) Department of Transport Corporate Plan

The NSW Department of Transport Corporate Plan lays down a vision to positively influence land use planning by enhancing the light rail network within the inner city. Following are objectives of the corporate plan:

1. Increase the number of jobs closer to home
2. Grow cities and centres as functional and attractive places to live, work and visit
3. Improve housing affordability
4. Integrate connectivity between different modes of transport throughout Sydney
5. To inform the planning processes by working with the community to develop an integrated transport approach
6. To contribute to cutting greenhouse gas emissions by 2050
7. To contribute to the renewable energy consumption targets for 2020.

By unlocking the economic, social and environmental value of a disused transport corridor, the SLR project can facilitate the in- fill of the city, enhance connectivity between different modes of transport and reduce greenhouse gases.

2.2) Objectives of the Leichhardt North Stop

The main object of the exercise is to apply creative thinking and academic discipline to come up with outcomes 'outside the box' for the Leichhardt North Stop which consider environmental, social and economical aspects of appropriate land-uses in the area. The objectives of the project are set out below:

1. To prepare a concept plan for the proposed Leichhardt North Light Rail stop and the immediate site, together with the local area within 800 metres of that stop.

2. To think creatively and conceptualize 'out of the box' ideas for the potential land uses.

3. To apply good planning and sustainability principles to the concepts.

4. To benchmark the recommended land uses in the concept plan by reference to 'best practice' for transport and Light Rail planning; and

5. To point out any constraints on the recommended land uses in the Leichhardt Council LEP.

The main output for the brief will comprise a written report including maps, photographs, graphs etc that will outline the proposed land uses and connections.

3) Method

Identifying the project is based on desk research and site inspection. Desk research includes 'best practice' of transport and land use planning for light rail and from relevant overseas and Australian case studies. This literature is used to benchmark the possible land uses in the concept plan. Site and area inspections are carried out to assist conceptualizing appropriate land uses for inclusion in the report.

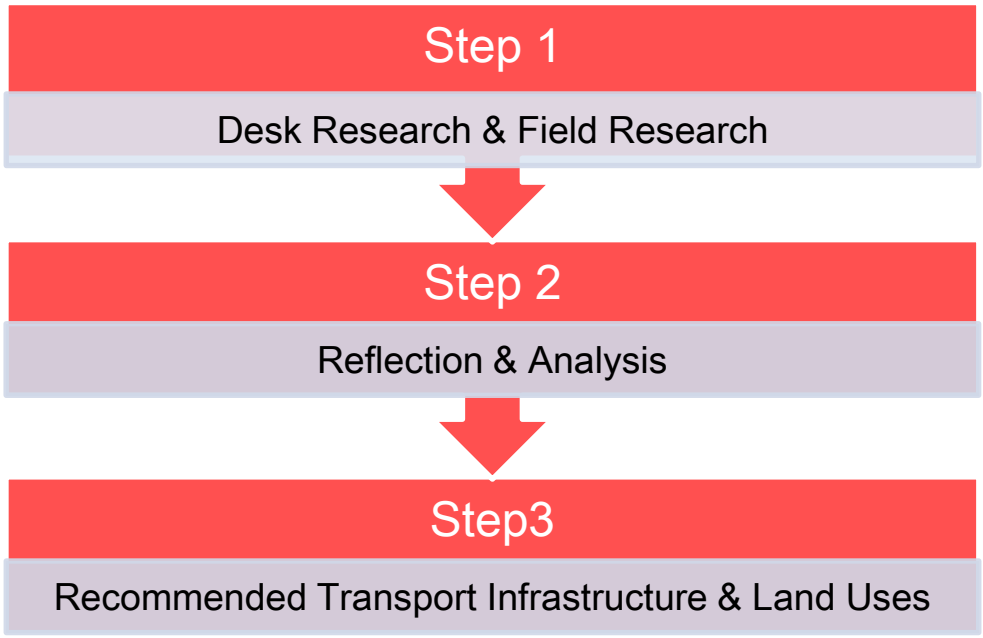


Figure.2 Project overview

Figure 2 shows the method adopted for the project. The Macquarie University student planners carried out desk research on the EA, SIA, LEP, Design Guidelines, best practice case studies, planning and design literature and other relevant materials. Many site inspections were conducted and photographs taken. The Macquarie University team then carefully reflected on these inputs and analyzed them in relation to the project objectives. A rigorous review and consultation process between the student planners and Macquarie University academic staff

took place. After due process the recommended transport infrastructure and land uses were decided upon.

Any recommended land uses were to be sympathetic to the current urban form and be low impact in nature. Ecologically sustainable principles were applied to the discovery of appropriate land uses. While direct consultation with community stakeholders and Leichhardt Council was outside the brief, the consultancy team endeavoured to take account of community preferences based on existing studies and documented knowledge.

The EA, the Greenway project and other documents specified in the Department of Transport Project Summary such as ABS Community Profile and statistics comprised inputs for the environmental, economic and social planning aspects of the report. In this project focus was on ways to stimulate creative thought processes through:

- Reading illustrated planning and design literature
- Looking at 'best practice' examples of Australian and Overseas case studies of successful integrated transport and land use planning.
- Brainstorming sessions
- Walking around the site
- Visiting other areas in Sydney to give us ideas for the Leichhardt site
- Exchanging ideas with planners and academics
- Putting ourselves in the place of stakeholders in the area and imagining what land uses would meet community expectations

3.1) Summary of Inputs

Desk Research

- Context research
- Overseas case studies & Planning/Design literature
- Other relevant academic references
- Leichhardt Council LEP
- SLR EA
- Greenway project
- Sydney Light Rail Inner West Extension Design Guidelines
- Community submissions (Dept of Planning website); and
- Other inputs as deemed relevant by the Macquarie University team

Field Research

- Site inspections
- Existing light rail stops and surrounding precincts
- Inspection of relevant existing developments at Leichhardt and other areas

3.2) Summary of Outputs

The agreed outputs for the project are as follows:

- A written report including maps, diagrams, photographs etc that will include a concept plan for the proposed Leichhardt North Rail stop, the immediate site and land uses within 800 metres of the stop.

- Academically rigorous analysis in support of the concept plan, and

- A presentation to Department of Transport in relation to the report

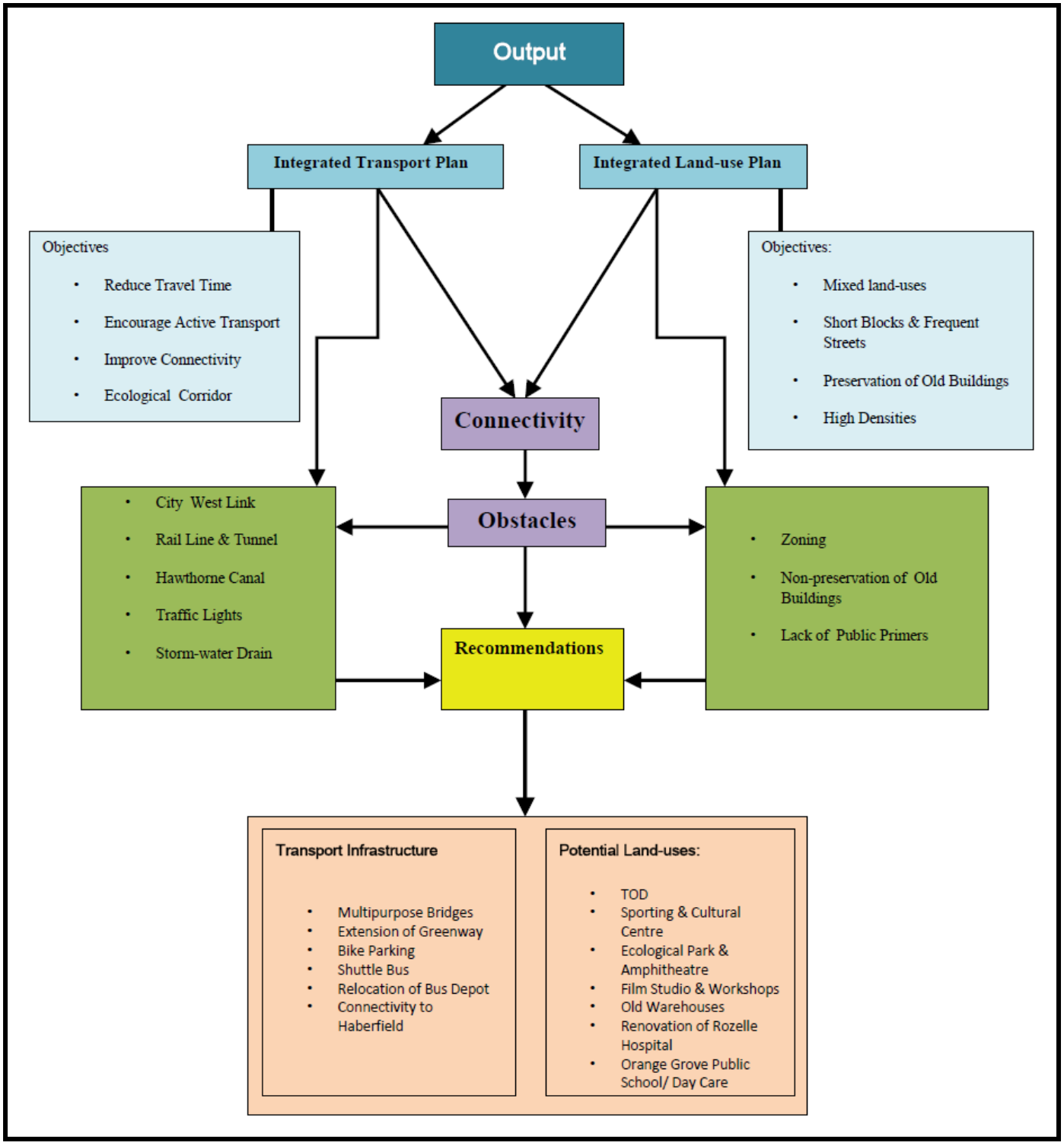


Figure 3 Output Process, Source: E Riazifar

4) Findings

4.1) Socio-economic Profile of Community

The Macquarie University team has prepared a socio-economic profile of the community who are potential users of the Leichhardt North stop. The profile is based on the 2006 Census for the Leichhardt LGA and the Hill PDA Social Impact Assessment (SIA) prepared for the Department of Transport.

The population in the Leichhardt North stop area is expected to show steady growth of 12% (from 51,554 in 2006 to 57,771 in 2036) and it is expected to increase almost 1,000 every 5 years (Figure4).

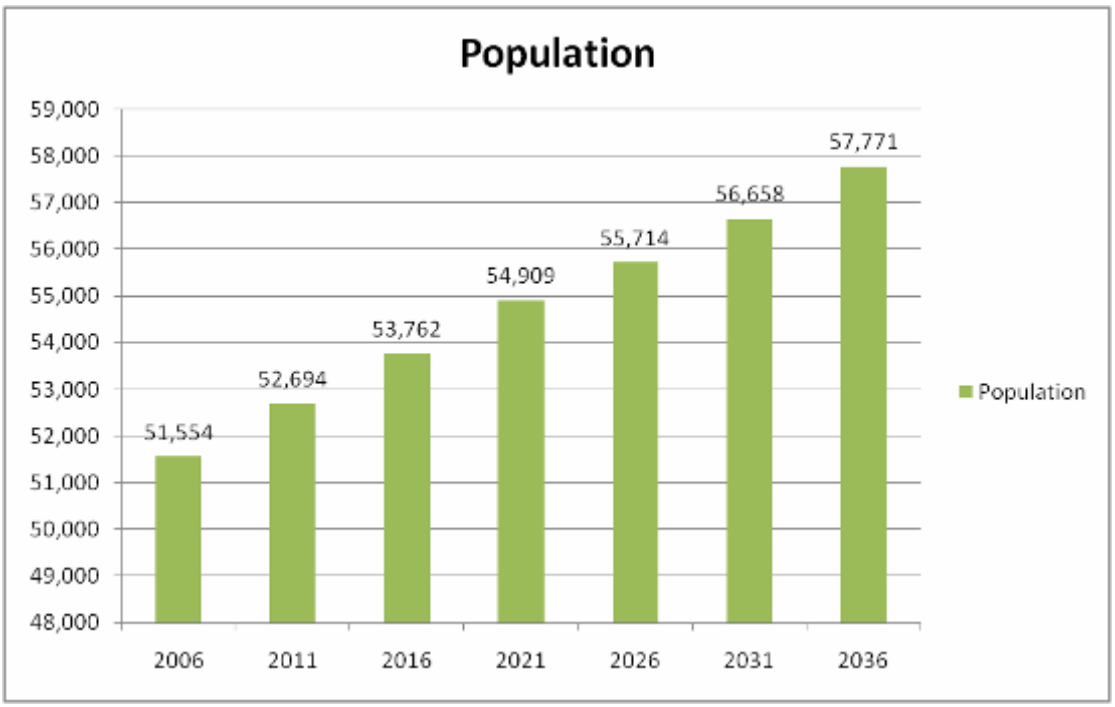


Figure4, Lechhardt LGA : Population Growth, Source: 2009 BTS Population Forecast

Table1 shows the greatest percentage of the population (73%) is in the working age group with a high percentage (58%) of females in the child- bearing age group contributing to household income. 10% of the population is of school age and 7% of pre-school age. Up to 8.5% of the population might be considered to be active seniors while a tiny percentage (1%) is in the high morbidity old age group (Table 1).

Working Age	73%
Women in full-time work	57%
School Age	10%
Pre- school Age	7%
Active Senior	8.5%
Highest employment group	Professional
Own house	81.37%
English spoken at home	78%
Low density housing	77.6%
Crime rate	Stable

Table 1, Summary of community profile, Source: 2006 ABS Census

Figures 5 and 6 (Also Table 2 in Appendix A) show that 74% of females and 72% of males are in the working age group of 19-64 years. 43% of females and 41% of males are in the peak income- earning age bracket of 41 to 64 years.

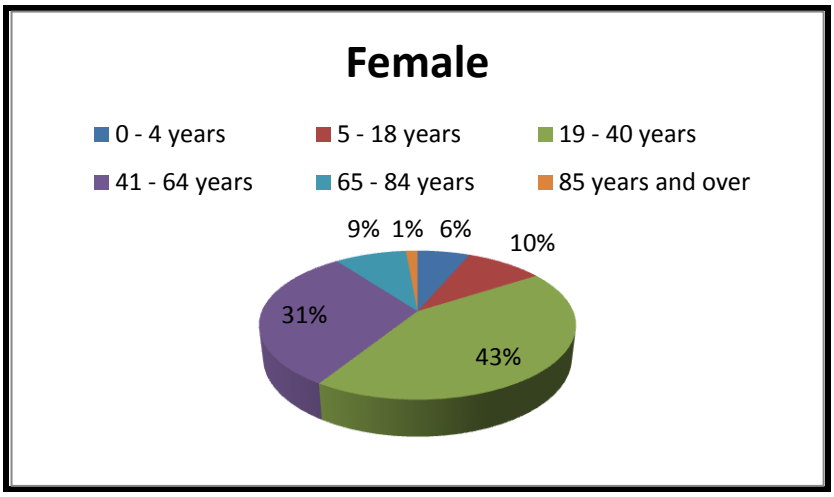


Figure.5
Leichhardt LGA: Age distribution by Sex
Source: 2006 ABS Census

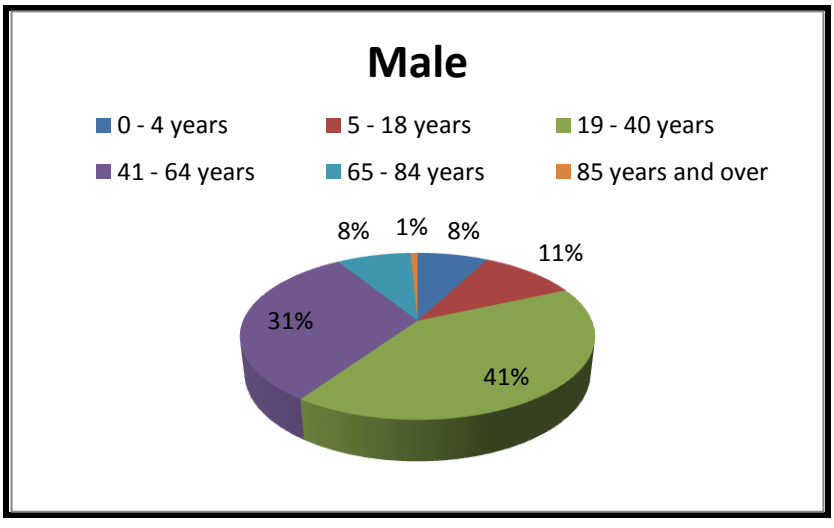


Figure.6
Leichhardt LGA: Age distribution by Sex
Source: 2006 ABS Census

Figure7 (alsoTable3, Appendix A) shows a relatively high percentage of women in the subject area are working (75%). This would suggest a high percentage of childless couples. Those women working full-time with children would have a demand for child -care and would have the means to pay for it.

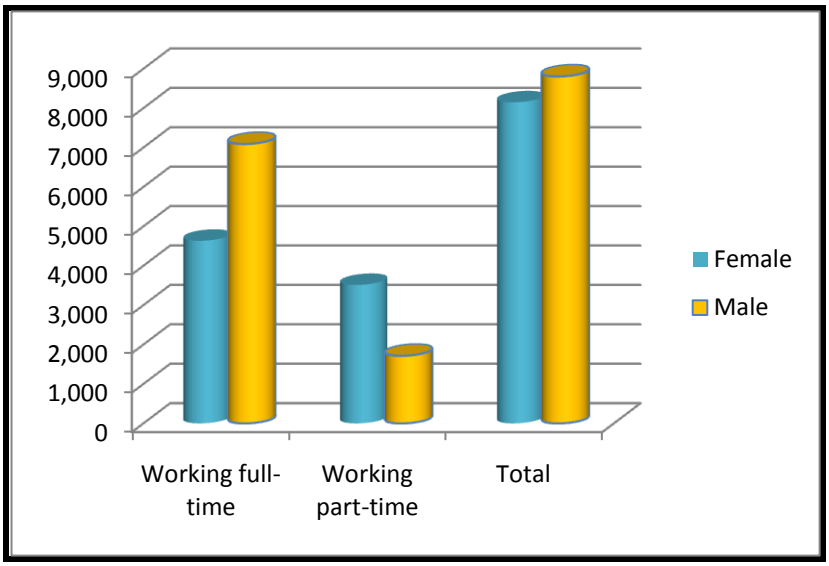


Figure.7
Leichhardt LGA: Work Type by Sex
Source: 2006 ABS Census

Figure 8 shows housing in the Leichhardt North stop subject area is 77.6% low density and 22.4% medium density. High density is negligible (alsoTable 4 (Appendix A)). The subject area has a moderate to high percentage of high- income households (40%) and a relatively low percentage of low-income households (16%). 44% of households fall within the wide middle-income bracket. Also, there is a relatively high incidence of owner occupied households.

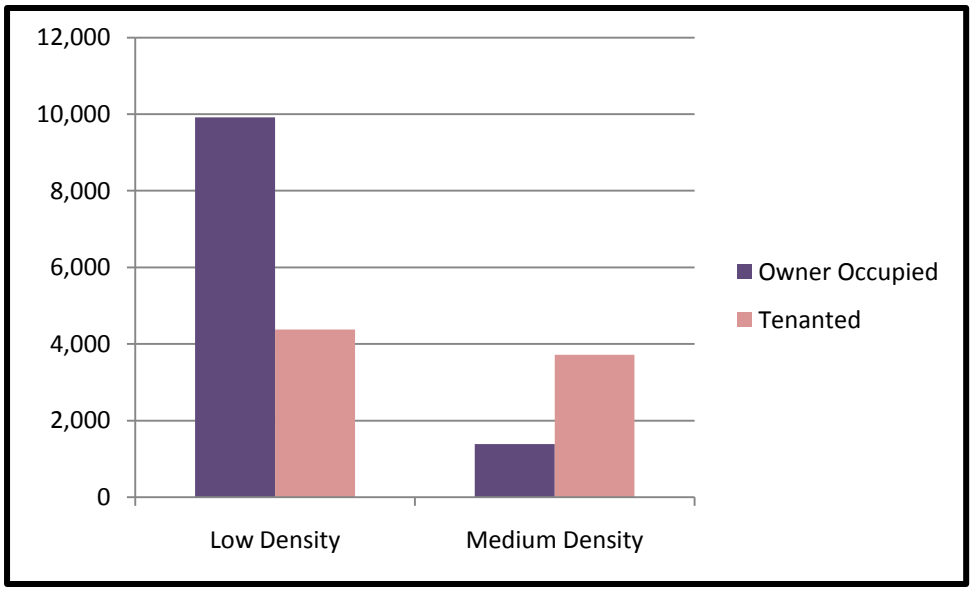


Figure.8 Leichhardt LGA: Housing Density, Source: 2006 ABS Census

Figure 9 shows 62% of low- income households, 94% of middle- income households and 74% of high- income households own their homes (Table 5 in Appendix A).

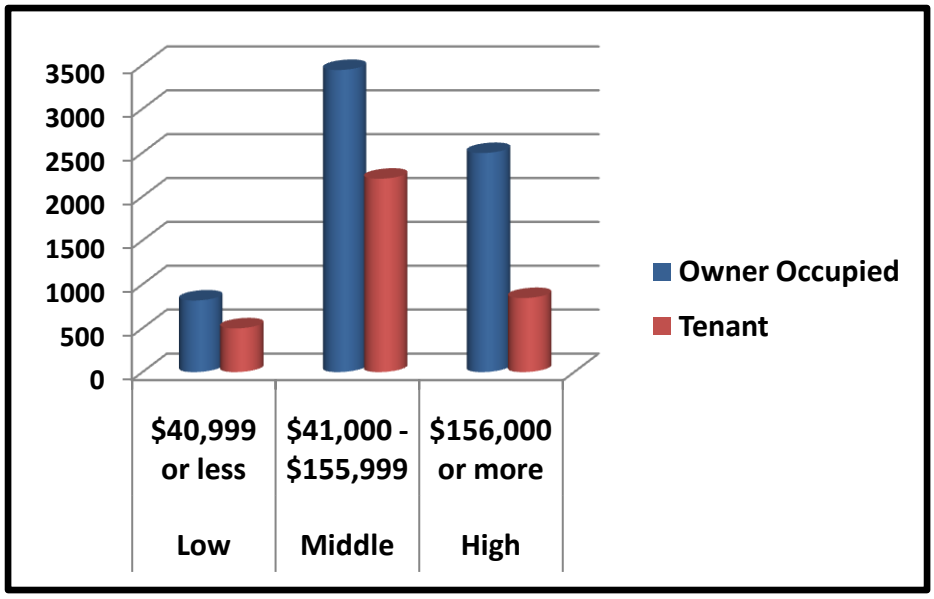


Figure 9, Household Income

Figure 10 shows the overwhelming majority of the subject area population (78%) speak English at home with much smaller percentages of 3.4% and 1.5% respectively, for the biggest ESL groups, Italian and Chinese (Table 6 in Appendix A).

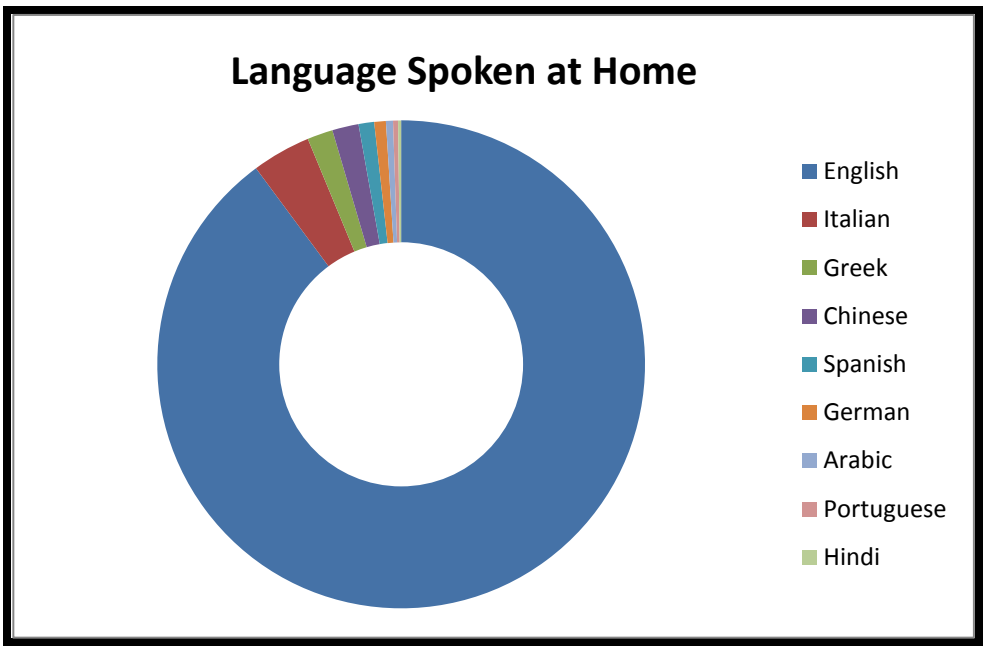


Figure.10 Language Spoken at Home, Source: 2006 ABS Census

Table7 (Appendix A) shows that the crime rate for all categories has been stable or decreasing over the last five years. This would indicate that the Leichhardt North precinct is a safe and socially cohesive area where people want to live.

Figure11 (Appendix A) shows employment by industry for working age people living in the Leichhardt North subject area. What stands out is that the largest percentage (15%) of employed people within the subject area works in high paid professional, scientific and technical occupations.

Figure 12 indicates that the rate of no car ownership (16%) is the highest over all the areas covered by the SLR project. Combined with the percentage for one car ownership, the figure indicates that 65% of residents in the Leichhardt North stop area make do with one car or less despite their relatively high household income.

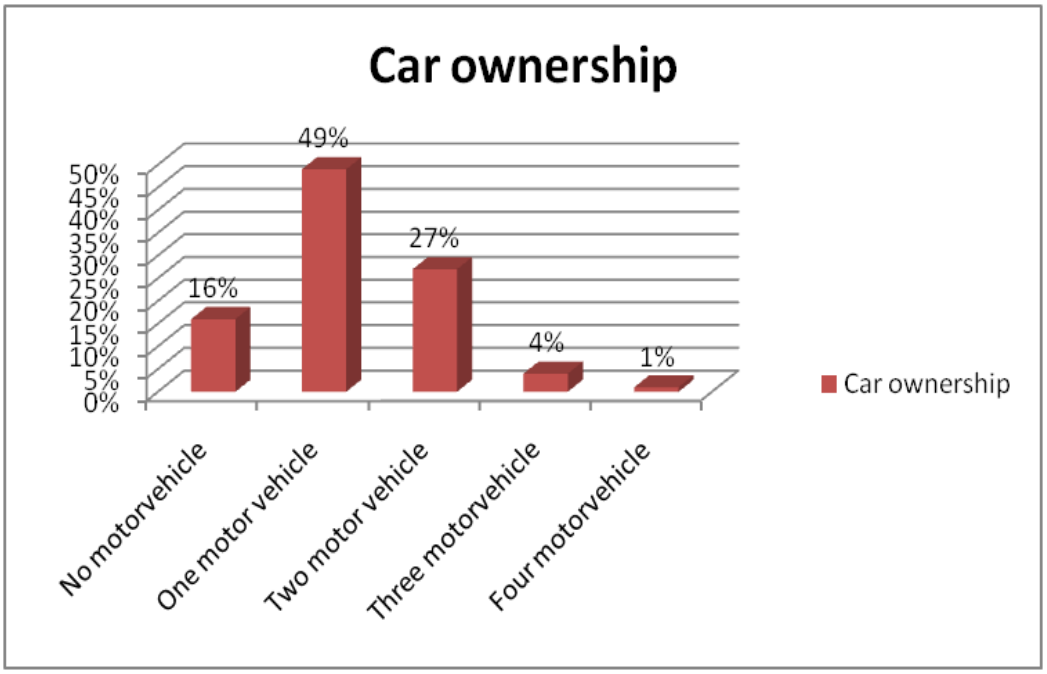


Figure12. Leichhardt LGA: Car Ownership, Source: 2006 ABS Census

Figure13 shows that in the subject area 35.4% of residents use active transport modes. This has the potential to increase with the availability of the new SLR service that provides a faster and more direct service to the City than current bus services.

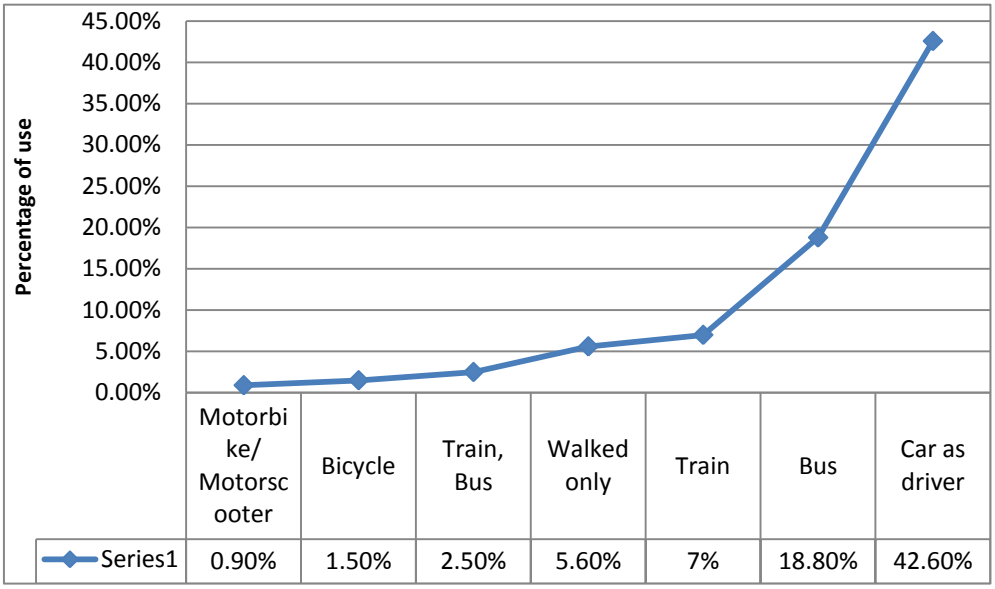


Figure13. Leichhardt LGA: Mode of Travel, Source SLR SIA 2010

5) Community Submissions

Department of Transport put the Sydney Light Rail project EA and Social Impact Assessment on public exhibition in 2010. A total of 197 submissions were received during the exhibition period. These comprised 178 submissions from community members, 10 submissions from non–government stakeholders and nine from government authorities and agencies.

The submissions indicated:

1) There was no opposition to the SLR project
2) There was strong support for the extension of the Greenway to the CBD; and
3) The community was vitally interested in ecological and biodiversity issues.

5.1) Detailed Issues

Table 8 categorises all community and non–government stakeholder submissions according to key issues and specific issues raised. Government submissions have been dealt with separately to community and non– government stakeholder submissions due to the number of specific, technical issues that were raised and it has not been considered in this report.

Generally, community submissions raised issues relating to ‘alternative schemes’, ‘project design’, ‘visual, landscaping and urban design’, ‘traffic and transport’, ‘noise and vibration’ and ‘ecology and biodiversity’. In all, 27% of all community submissions expressed concerns for project support. Submissions in relation to the Greenway were the most common (71%), indicating strong community interest in the issue. Some of the important submissions are:

Key Issues	Percentage of issue raised by community submissions	Sub-issues
Greenway	71%	Proposed green shared path and alternative schemes
Visual impact, landscaping and urban design	31%	public safety and privacy/amenity
Project design	30%	the route of the Greenway shared path - route, stops - construction and design, and general concerns regarding stops
Project support	27%	
Traffic and transport	24%	parking for the light rail and operational traffic congestion
Noise and Vibration	22%	light rail operation noise impacts and Greenway shared path operation noise impacts
Ecology and biodiversity	16%	vegetation clearing and bushcare management

Table 8, NGOs & Community Submissions, Source: Submissions Report, SLR Extension, TNSW

5.2) Greenway Shared User Path (SUP) – Routes

"Issues relating to the Greenway shared path route were raised in 19 community submissions and seven non-government stakeholder submissions. Of these, both the community and non-government submissions expressed support for extending the Greenway shared path as a cycling route to the CBD (eight and five submissions respectively). Additionally, 11 community

submissions and four non-government submissions expressed support for extending the Greenway SUP route over the Cooks River" (Submission Reports, Department of Transport).

5.3) Vegetation clearing, Bushcare management & Threatened species management

"Concerns about vegetation clearing along the corridor were the most commonly raised ecology and biodiversity sub-issue in community submissions. Concerns about bushcare management were the second most commonly raised ecology and biodiversity sub-issue in community submissions. The concerns were primarily related to the long term management of bushcare sites and the project's impact on flora and fauna. Concern about the management of threatened species and communities during the construction and operation of the project was the third most commonly raised ecology and biodiversity sub-issue in community submissions" (Submission Reports, Department of Transport).

6) Land uses

6.1) Current Land Uses in the Subject Area

The proposed Leichhardt North stop is situated on land owned by Rail Corp at the intersection of Darley Road and Francis Street. It is next to a vacant warehouse (Figure 14). The stop sits on the southern side of the entrance to the 300 metre tunnel that runs under the City West Road Link. To access Norton Street that leads to the restaurant and entertainment heart of Leichhardt, it is necessary to cross busy Darley Street at traffic lights to the south of the City West Road Link.

Figure.14 Old warehouse, Proposed Leichhardt North Stop, Source: E Riazifar 2011

Most of the 800 metre area around the Light Rail stop (Figure 15) is occupied by traditional low density semi detached houses. The area was originally working class but has now become gentrified. The predominantly low- density urban landscape is now dotted with medium density developments as a result of more recent property investment. There are mixed residential and commercial developments along the northern end of Norton Street.

Figure 15, 800m precinct of the Leichhardt North Stop, Source: Google Earth map

The north eastern edge of the area comprises the extensive former Callan Park Hospital site. It is presently the home of several community health services, the Sydney College of the Arts and the Writers Centre. There are large areas of parkland and sporting fields that stretch down to Iron Cove to the north of the proposed Light Rail stop.

The Hawthorne Canal that flows into Iron Cove is situated due west of the proposed Leichhardt North stop. On the Western side of the Hawthorne canal stretches the garden suburb of Haberfield that forms the western boundary of the 800 metre subject area. There one finds large fully detached houses in leafy streets.

Figure 16, Proposed Leichhardt Stop, Source: Indicative Design Guideline

The proposed Leichhardt North stop is connected to Hawthorne Canal Reserve via the rail and access road off Darley road that runs parallel with the City West Link. On the Western side of the access road lies Blackmore Oval and beside it there is a large industrial site occupied by a film studio, workshops and warehouses. Hawthorne Canal Reserve is popular with dog owners, walkers and joggers.

Leichhardt bus depot and the underutilized Pioneer Park form the eastern extremity of the 800 metres subject area. On east of these major land uses between Lilyfield Rd and the start of the City West Link, south of the Eastern Park, lies the extensive disused Rozelle Freight Yard. The surrounding area comprises low- density semi detached houses with a smattering of higher density residential developments. Along Balmain road lie a number of small -scale industrial uses such as smash repairs textile warehouses or auto-mechanic businesses. At Lilyfield in Balmain Road opposite Callan Park there a few small commercial uses together with a public school and a pub. The light rail will give Sydneysiders access to the amenities of the area.

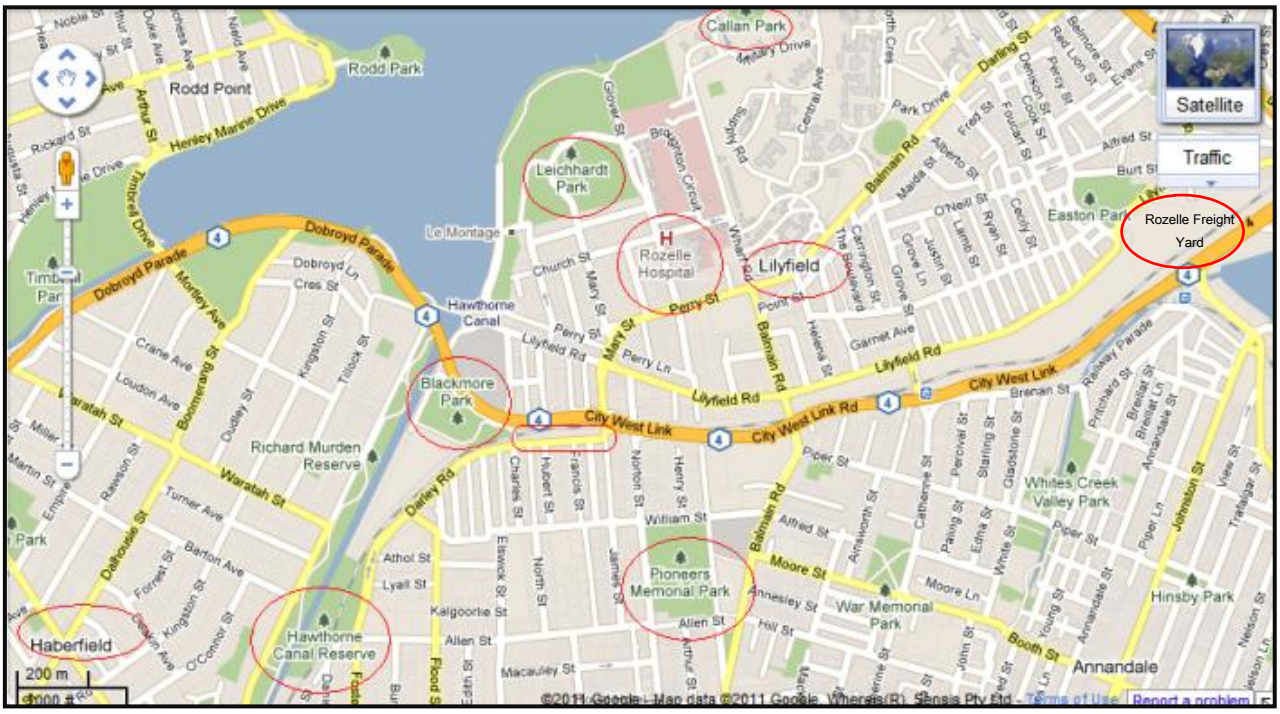


Figure17, Neighboured Suburbs & Important Land-uses around Leichhardt , Source: Google maps: http://maps.google.com.au/

6.2) Land uses and facilities

There many restaurants, cafes and hair dressers in the 800m precinct area but most of them are located in Norton Street. Thus, there is a need to increase the number of some facilities in other parts of the precinct in order to increase amenity for the local residents and improving the immediate site of the stop (Table 9) (Source: Google earth & Yellow pages).

Services & Facilities	Number (in 800m precinct)
Restaurant	17
Hair Dresser	9
Church	3
School	2
Childcare, Pre- School, School, College, Community Centre, Nursing Home, Retail shop, Gym, Art Gallery	1(of each)
Pool, News Agent, Post office, Library, Pet shop, shopping centre	0

Table9. Services & facilities in 800m precinct

Source: Yellow Pages

7) Relevance of Leichhardt Local Environmental Plan 2000 (LEP)

Leichhardt Local Environmental Plan 2000 states that the general objective for transport and access in this plan is to encourage the integration of the residential and non-residential land uses with public and private transport and improve access to:

(a) reduce the need for car travel and subsequent pressure on the existing road networks, and
(b) maximise utilisation of existing and future public transport facilities, and
(c) maximise the opportunity for pedestrian and cycle links, and
(d) identify and ameliorate adverse impacts of all transport modes on the environment, and
(e) improve road safety for all users, particularly pedestrians and cyclists.
(Clause 13 (3) amended by LEP 2000 Amendment No.11. Gov. Gaz. No.69 of 2.4.04)

Clauses 27 of Leichhardt LEP 2000 states that " the objectives of the Plan in relation to community uses are to facilitate the equitable provision and improve the range, quality and distribution of community and cultural facilities and services to meet the needs of residents, workers and visitors" (Amendment No.11. Gov. Gaz. No.69 of 2.4.04).

PART TWO

POTENTIAL LAND-USES

1) Integrating Transit and Land Uses

The Public Transport Authority Advisory (1997) has evaluated light rail systems in America and northern European cities as follows:

Country	City	Strengths
North America		• "no-frills" technological solution • Unused rail passenger or freight corridors • Pedestrian mall operations • An emphasis on downtown revitalisation • Metropolitan growth directed to light rail-served areas • Light rail is part of the multi-modal regional public transport strategy
France	Nantes	• Link residential and employment centre • Design concept: LR fit into the historic urban environment
	Grenoble	• Integration with pedestrian precinct • Changing street environment, heighten the amenity of the area • Introduction of new traffic management regimes favouring LR and other public transport operation
	Paris	• Link several metro lines • High urban design standard • Excellent connectivity between the light rail and metro and commuter rail system
	Strasbourg	• Meticulous attention to urban design • Inner city pedestrianised • Fully integrated with existing bus operations
Germany	Karslsruhe	• Innovative and low cost approach • High level of public transport service • 2.5 km long pedestrian mall

Table 10

Light Rail Case Studies,

Source: Public Transport Advisory Council, 1997

Beatley (2000) cites several case studies in Northern European cities where 'transit investments complement and are co-ordinated with major land use decisions' (112). The author identifies 'a concerted effort to place major activities adjacent to or in close proximity to public transit stops' (112). His book *Green Urbanism; Learning from European Cities* also paints a rosy picture of successful strategies to integrate different modes of active transport in Dutch, German and Danish cities:

> In these European cities, transit modes are generally integrated to an impressive degree, which means coordination of investments so that transit modes complement one another. In most of the cities studied, for example, regional and national train systems are fully integrated within local transit routes and it is easy to shift from one mode to another (Beatley 2000: 113).

Based on these case studies, we consider that the planning objectives of the proposed Leichhardt North light rail stop should:

1) Integrate the transit stop with other modes of transport

2) Integrate the transit stop with current and potential land uses in the 800 metre subject area: and

3) Improve socioeconomic and ecological outcomes in the local area and contribute to regional sustainability

The key to achieving all these objectives is connectivity. Connectivity in a planning sense is about creating proximity in time and space between different land uses and modes of transport. If this proximity can be achieved, the transport, socioeconomic and ecological systems of a district or region will work more efficiently and effectively and be 'sustainable'.

2) Importance of Mixed Land Uses

The influential urban planner and writer Jane Jacobs (1961) who is credited with founding 'new urbanism' movement sums up her philosophy to planning as follows:

> The intricate order [of cities] - a manifestation of the freedom of countless number of people to make and carry out countless plans is – in many ways a great wonder. We ought not be reluctant to make this living collection of interdependent uses, this freedom, this life, more understandable for what it is (510).

Jacobs (1961) is highly critical of the fundamental premise of traditional zoning regulations that seek to segregate land uses:

> [Zoning regulations] have helped and rationalized city rebuilding into the sterile regimented empty thing it is. They stand in the way that could deliberately encourage spontaneous diversity by providing the conditions necessary to its growth
> (Jacobs 1961:220)

In *The Death and Life of Great American Cities* Jacobs argues that zoning should be about encouraging diversity not uniformity to achieve a diversified range of styles and ages of buildings. Zoning regulation should preserve old buildings where possible. To ensure that new buildings are not 'overwhelmingly of one kind' (331) height regulations should not be too prescriptive but aim to facilitate gradual replacement of lower density development with higher density buildings when demand signals it.

Another important function of zoning regulations is to control the 'scale' of land uses so they fit in with the streetscape:

> [T]he problem is *size* of use rather than *kind* of use. On certain streets, any disproportionately large occupant of street frontage is visually a street disintegrator and desolator, although exactly the same *kinds* of uses, at small scale, do no harm and are indeed an asset (Jacobs 1961:306)

Professor of Architecture and Urban Planning at the University of Michigan, Douglas Kelbaugh (2008) argues that typography can 'promote a richer and more understandable urban order than zoning, which singles out and isolates land uses as if it is unable to juggle more than one variable at a time' (45).

Figure18,

Mixed land Uses

Source: Kelbaugh 2008

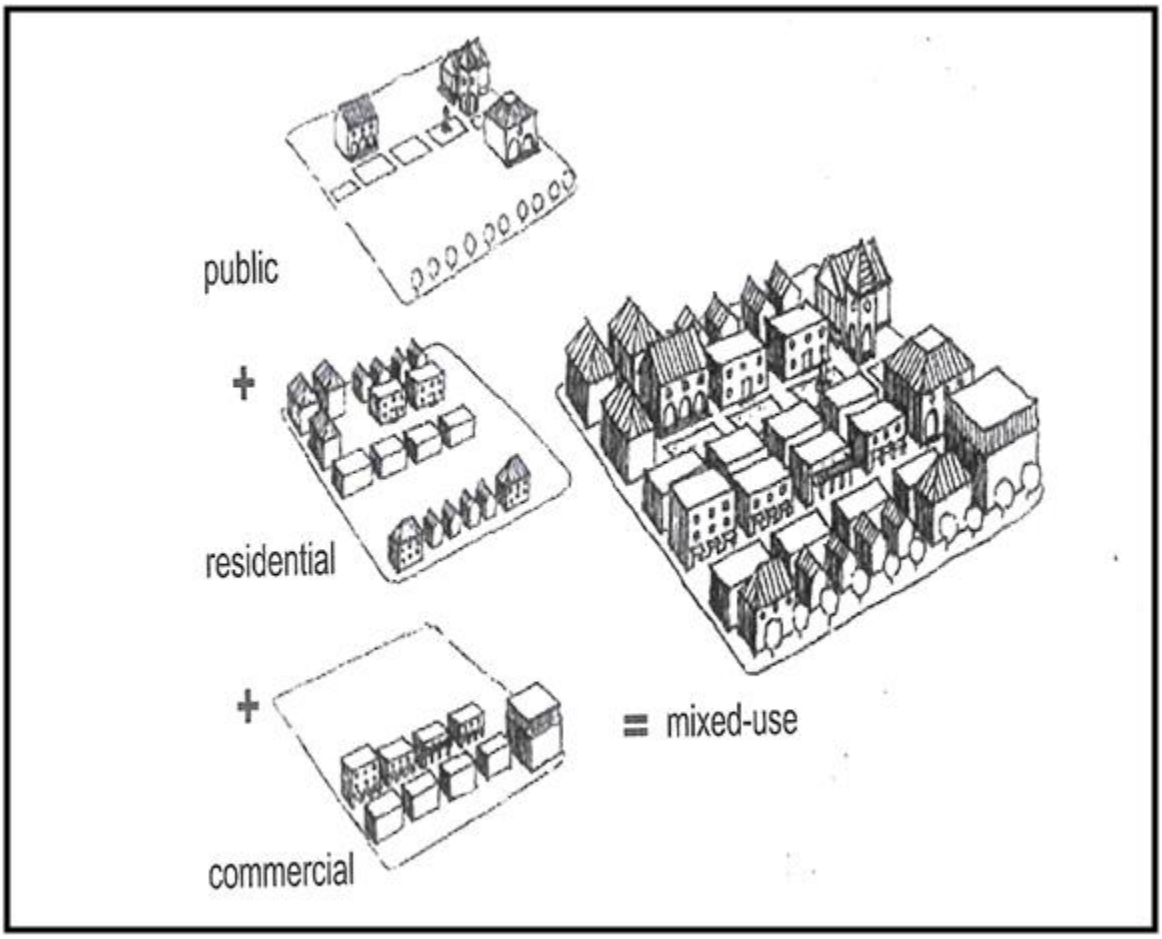


Figure 18 shows a typographical layout that would place public buildings or uses in the foreground and commercial/residential uses in the background.

In this regard Jacobs (1961) argues that public buildings form an important socio- economic function besides their literal one. Such buildings act as 'public primers' that stimulate diversity and vitality in a neighbourhood or district. To maximise this effect the public primers should be well mixed in with commercial/ residential uses as shown in figure 18.

Owing to their crucial socio-economic function when mixed with other uses, Jacobs (1961) maintains that public primers should be retained even when there is intense market pressure to sell them. To do this would be to kill the goose that lays the golden egg because it is precisely the fact that a public building is so different from its surrounding uses that creates the viability that drives land prices.

3) The Conceptual Basis for New Urbanism

Shane (2008) argues that new urbanism is a 'recombinant mixture of Jane Jacob's *Death and Life of Great American Cities* (1961) and the early green/ ecological movement of Rachel Carson's *Silent Spring* (1962)' [130].

In the former book, Jacobs explains the conceptual framework for new urbanism as a problem of 'organised complexity'. This contrasts to traditional modernist and technocratic approaches to planning that assume the issue is one of 'disorganized complexity' that can be dealt with in terms of statistical averages. Such thinking Jacobs (1961) argues is a 'top down' approach that seeks to place and 'artificial' order on the 'natural' socio-economic functioning of the city. This approach is doomed to failure as the great modernist planning experiments of the twentieth century show.

The new urbanism movement borrows its methodology from the life sciences and takes a 'bottom up' approach that is based on inductive rather than deductive reasoning. The new urbanism planner seeks to discover how a local neighbourhood community works and how it fits in with the functioning of the city as a whole. In this regard, 'unaverage' observations provide vital clues to the workings of the urban system and insights as to what will actually work from a planning perspective. This empowers local communities rather than experts, because the former are best placed to provide the necessary insights that will determine whether a land use plan will succeed or fail. To access the valuable local knowledge of communities it is necessary for planners to implement a 'process' and this community participation process is essential to achieve sustainable planning outcomes.

4) New Urbanism Planning Principles

Modern planning principles look upon the urban environment as a 'complex multipurpose social organism' (Duany & Plater-Zyberk 2008:65). In this regard the urban built and social environment is analogous to a natural ecosystem (Jacobs 1992). The planner Peter Hall (2008) argues that urban densities should ensure that shops are within walking distance of residences and there is good access to transit.

The Death and Life of Great American Cities by Jane Jacobs (1961), has become almost a bible for new urbanism planners. She writes at page 315:

> The main responsibility of city planning and design should be to develop-insofar as public policy can do so-cities that are congenial places for places this great range of unofficial plans, ideas and opportunities to flourish, along with the flourishing of the public enterprises

Jacob lays down four key practical planning principles to achieve this objective:

1. Planners should ensure that there are multi-purpose and diverse uses in the subject area that ensure street activity in the evening as well as the day;

2. Planners should ensure that the layout of developments incorporate frequent streets and short blocks that create a fabric of intricate cross-use;

3. Planners should preserve old buildings that are fully depreciated and therefore have an economical yield that will allow diverse commercial and affordable residential uses to flourish; and

4. Planners should plan for higher densities that create vitality and demand in an area and can absorb a high population growth. In this regard high density does not equate with overcrowding that is defined as more than 1.5 persons per room. High density means a high number of dwellings per acre. If there are many dwellings in a given area this does not lead to overcrowding and many thriving high -income areas are high -density.

The Australian new urbanism planner Peter Newman (2008) identifies six key variables that are consistent with Jane Jacobs (1961) as follows:

- Permeability (the number of street intersections per hectare)
- Density of residents (population per hectare);
- Density of jobs (jobs per hectare, which is a way of measuring mixed use);
- A combination of these two called " activity intensity" (number of people and jobs per hectare);
- Distance from the central business district (CBD) (in Kilometres); and
- Transit activity (a measure of how much of a local government/ suburb has public transport services that are at least every fifteen minutes and where evening and weekend services exist) (Newman 2008,186).

Newman (2008) argues that above parameters “emerge as the fundamental context for reducing automobiles dependence” (188). Application of these variables result in a “compact city” that he argues is necessary for “sustainability”.

Cervero (2008) cites American case studies that show that residents will buy into neighbourhoods near transit stops because they want to shed one or more cars and free up money for other purposes.

4.1) Detailed Aspects of New Urbanism

Over the last 10 years new urbanism has established itself as maybe the most influential movement in contemporary urbanism (Marcus 2008). The following aspects of new urbanism have been taken from the US- based on “New Urbanism” website (See references):

4.1.1) Walkability

-Most things within a 10-minute walk of home and work
-Pedestrian friendly street design (buildings close to street; porches, windows & doors; tree-lined streets; on street parking; hidden parking lots; garages in rear lane; narrow, slow speed streets)
-Pedestrian streets free of cars in special cases

4.1.2) Connectivity

-Interconnected street grid network disperses traffic & eases walking
-A hierarchy of narrow streets, boulevards, and alleys
-High quality pedestrian network and public realm makes walking pleasurable

4.1.3) Mixed-Use & Diversity

-A mix of shops, offices, apartments, and homes on site. Mixed-use within neighborhoods, within blocks, and within buildings

-Diversity of people - of ages, income levels, cultures, and races

4.1.4) Mixed Housing

A range of types, sizes and prices in closer proximity

4.1.5) Quality Architecture & Urban Design

Emphasis is on beauty, aesthetics, human comfort, and creating a sense of place; Special placement of civic uses and sites within community. Human scale architecture & beautiful surroundings nourish the human spirit.

4.1.6) Traditional Neighborhood Structure

-Discernable centre and edge

-Public space at centre

-Importance of quality public realm; public open space designed as civic art

-Contains a range of uses and densities within 10-minute walk

-Transect planning: Highest densities at town centre; progressively less dense towards the edge. The transect is an analytical system that conceptualizes mutually reinforcing elements, creating a series of specific natural habitats and/or urban lifestyle settings. The Transect integrates environmental methodology for habitat assessment with zoning methodology for community design. The professional boundary between the natural and man-made disappears,

enabling environmentalists to assess the design of the human habitat and the urbanists to support the viability of nature. This urban-to-rural transect hierarchy has appropriate building and street types for each area along the continuum.

4.1.7) Increased Density

-More buildings, residences, shops, and services closer together for ease of walking, to enable a more efficient use of services and resources, and to create a more convenient, enjoyable place to live.
-New Urbanism design principles are applied at the full range of densities from small towns, to large cities

4.1.8) Smart Transportation

-A network of high-quality trains connecting cities, towns, and neighborhoods together
-Pedestrian-friendly design that encourages a greater use of bicycles, rollerblades, scooters, and walking as daily transportation

4.1.9) Sustainability

-Minimal environmental impact of development and its operations
-Eco-friendly technologies, respect for ecology and value of natural systems
-Energy efficiency
-Less use of finite fuels
-More local production
-More walking, less driving

4.1.10) Quality of Life

Taken together these add up to a high quality of life well worth living, and create places that enrich, uplift, and inspire the human spirit.

5) Relevance of New Urbanism to Local Land-use Planning

Table11 Compares 'new urbanism' zoning principles with the typical Local Environmental Plan (LEP) of which the Leichhardt LEP is an example.

LEP	New Urbanism Principles
Segregated land uses	Mixed land uses
Rigid height restrictions	Flexible height
Similar land uses	Diverse land uses
Low density favored	High density favored
No restriction on scale	Restriction on scale

Table11, LEP vs New Urbanism Zoning Principles Source: E. Riazifar & AC Fraser

The criticism of traditional LEP is that they:

1) Restrict mixed-uses that create vitality in an area

2) Impose rigid height regulations that prevent a high enough concentration of people to sustain that vitality; and

3) Permit large-scale land uses that ‘crowd out’ a multitude of socially- desirable small scale uses such as local businesses and affordable housing.

From a strategic planning point of view, the ‘new urbanism’ zoning principles with their emphasis on higher densities provide a solution to accommodating the needs of a growing urban population.

The zoning map for the Leichhardt LGA shown in Figure 19 and Figure 20 does not generally comply with new urbanism zoning principles. Areas are generally zoned single use low density residential and there are height restrictions that would preclude the higher density developments that new urbanism advocates.

Figure 19, Catchment Area in Relation to Zoning Map, Source: Leichhardt LGA LEP

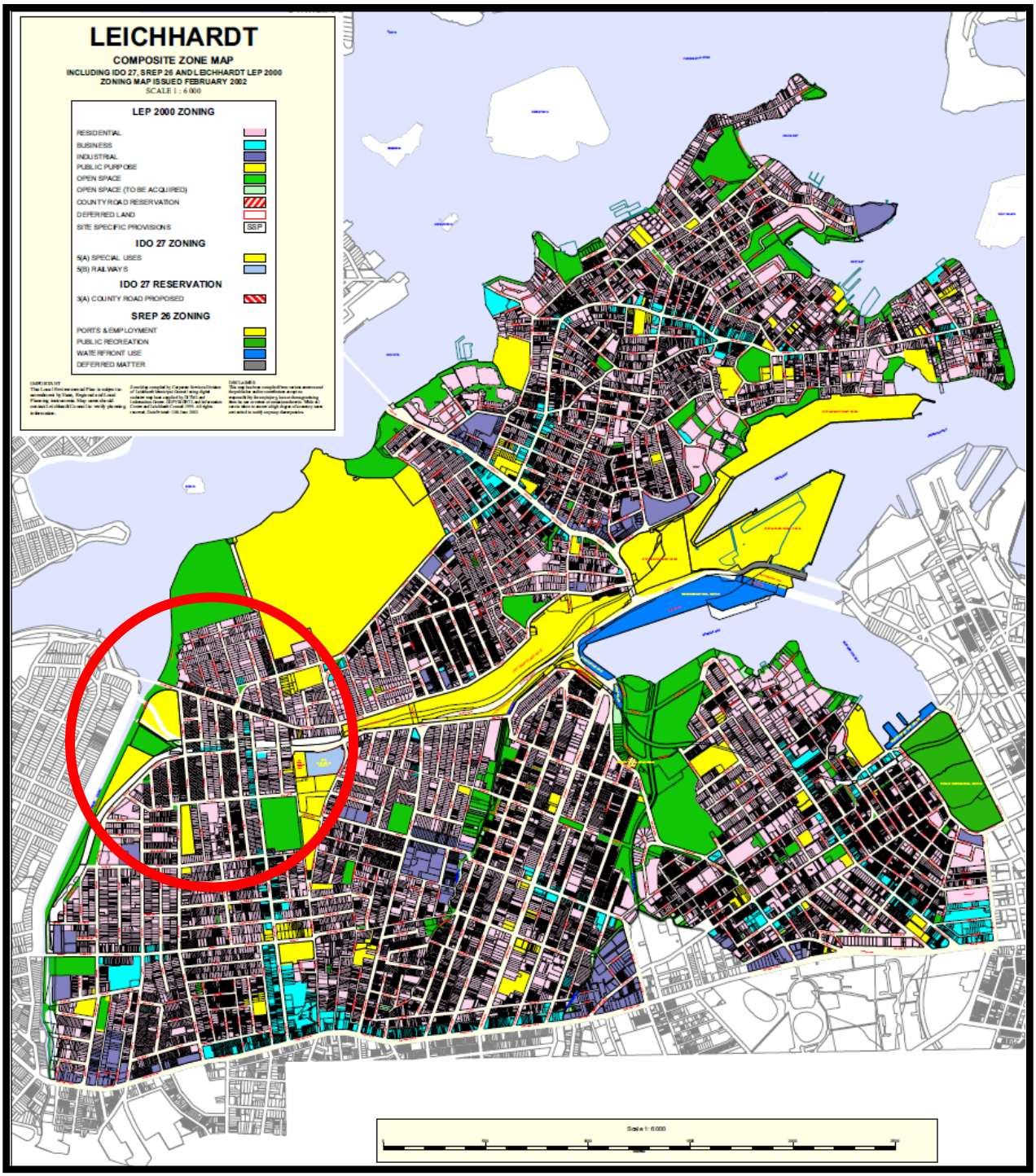
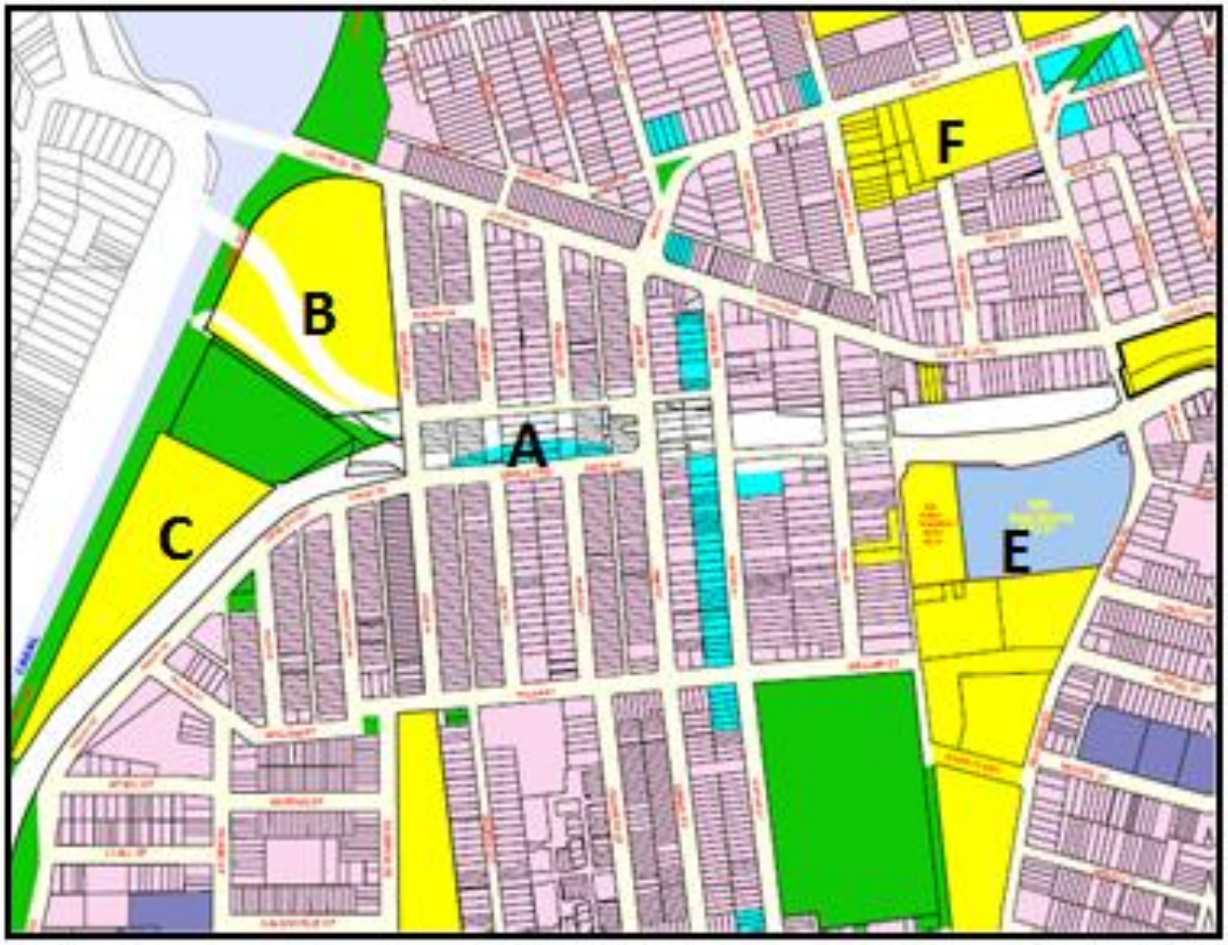
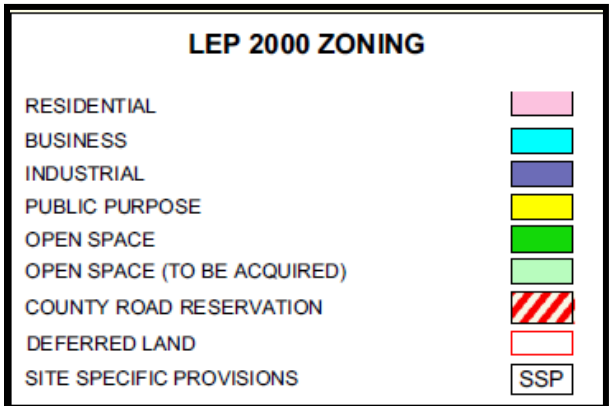


Figure 20: LEP Zoning Near Transit Stop, Source: Leichhardt LGA LEP





In Figure 20 which shows an enlarged area of the red circle in Figure 19, A is the proposed transit stop, B are the old warehouses, C is the film studio/ warehouses, E is the Leichhardt bus depot and F is the Orange Grove public school. These areas are currently zoned single use and to facilitate new urbanism planning principles they should be rezoned mixed use.

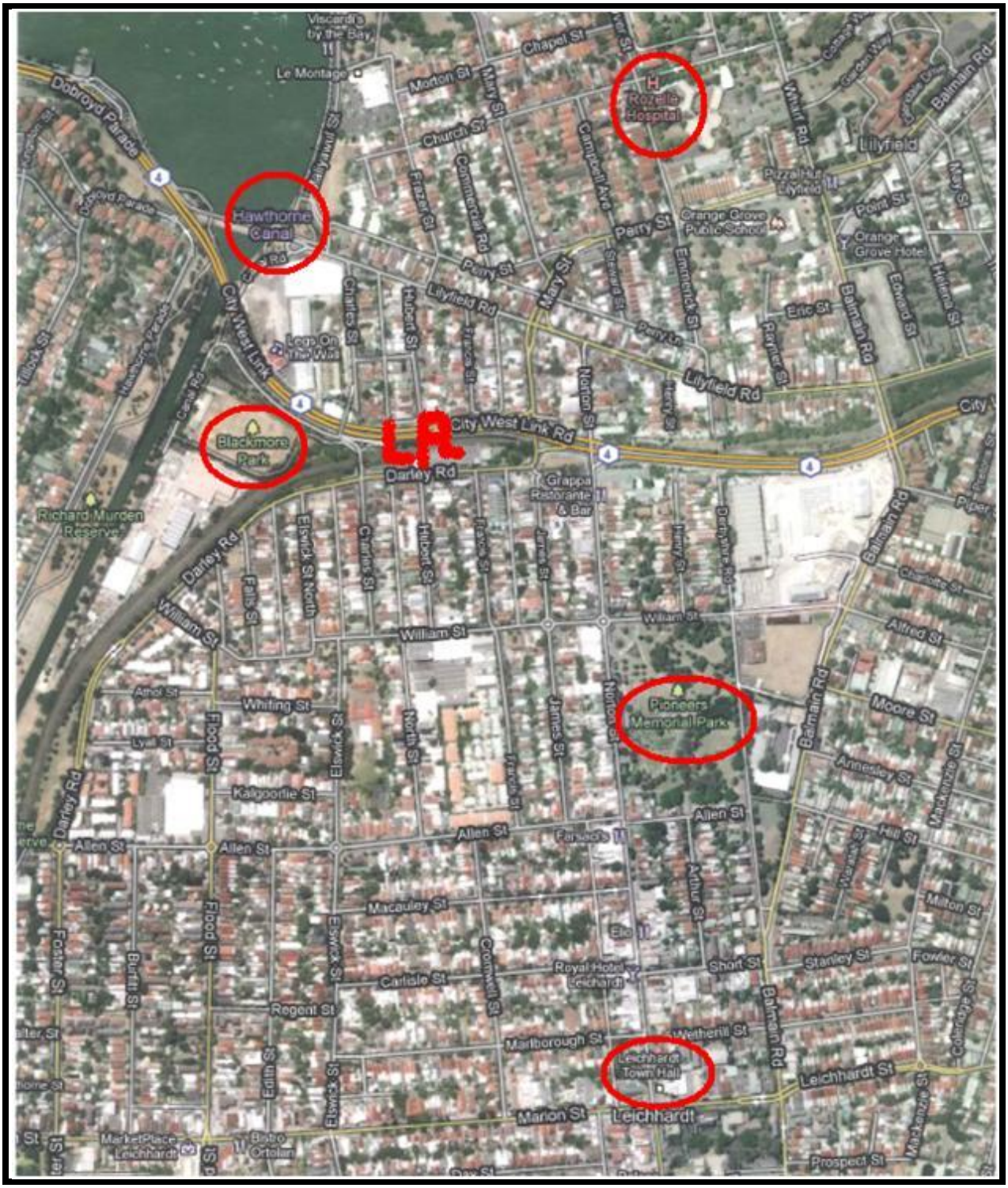
The Leichhardt North subject area in Figure 21 shows public uses at the boundaries (foreground) and commercial/ residential uses sits within these public markers. These markers are Hawthorne Reserve to the West, Rozelle Hospital to the north, Pioneer Park to the east and Leichhardt Town Hall to the south. Mixed residential and commercial uses comprise the background within these public use features.

According to Jacobs (1961) the public uses aesthetically serve to clarify and illuminate the order that can be found in the natural diversity of a city if one has eyes to see. Like multiple bonfires defining the pattern of darkness, these public primers form centres of brightness and vitality in otherwise grey areas of the city. By looking at a precinct through the lens of public uses in the foreground, the background commercial or residential uses (like the night murk) take on a typographical order.

Public primers such as buildings, small parks and bridges can also be seen as ‘landmarks’ that break up the duplication of uses around them and therefore promote diversity. However, it is important that such visual streetscape interruptions not be ‘dead ends’ and that there should always be a way around or through the landmark (Jacobs 1961: 499).

Figure 21, Public Use Boundary Markers

Source: Google Earth map, http://maps.google.com.au/



6) Ecologically Sustainable Development (ESD Principles)

The standard ESD definition lays down four dynamic principles for the integration of economic, environmental and intergenerational equity considerations in land use planning:

- The precautionary principle
- Inter-generational equity
- Conservation of biological diversity and ecological integrity; and
- The polluter pays principle (Farrier & Stein 2006)

In 2006, the Land and Environment Court in *Telstra Corporation Ltd v. Hornsby Shire Council* [2006] NSWLEC reviewed all of the abovementioned ESD principles. Preston CJ held that a consent authority had 'to have regard to the principles of ecologically sustainable development in cases where issues relevant to those principles arise' (supra Paragraph 124). Bates 2006 argues in *Environmental Law in Australia* that ESD constitutes an integrated decision-making construct and is thus *always* relevant to development approvals (Bates 2006 Ch.5).

The precautionary, inter-generational and polluters pays principles would require planners to reduce greenhouse gases emissions, save on water use and use renewable energy sources in the built environment.

The third principle deals with the natural environment. It requires planners to maintain or improve biodiversity and preserve the ecological integrity of an area. The Harvard ecologist and urban planner Richard Forman (2008) argues that the natural environment should be managed to:

- Increase habitat diversity
- Create ecological corridors between green spaces

- Control invasive species
- Protect keystone species; and
- Restore natural wetlands that mitigate flooding, filter out pollutants and create a bio-diverse habitat.

PART THREE

INTEGRATED TRANSPORT INFRASTRUCTURE PLAN

1) Improving Connectivity at Leichhardt North Site

The urban morphology surrounding the proposed Leichhardt North transit stop at Francis Street and Darley streets is presently inimical to good connectivity from a transport, socioeconomic and ecological perspective.

There are five major obstacles to good connectivity in the area as follows:

1. The City-West Link and the disused rail corridor creates a major barrier between the land uses to the North and South of that line.

2. The rail tunnel and cutting under the City West-Link forms an obstacle to extending the Greenway from Iron Cove in an easterly direction towards the City.

3. The Hawthorne Canal hinders direct East West access for pedestrians and cyclists from the Leichhardt North stop to the residential area of Haberfield.

4. Pedestrians and cyclists have to wait at traffic lights to cross Darley Road in an easterly direction to access Norton Street with its lively entertainment and restaurant precinct.

5. In a westerly direction a stormwater drain with a safety fence together with a road hinder pedestrian and cyclist access to Blackmore Oval together with the film studio and workshop site adjacent to it.

1.1) The North- South Barrier

The Design guidelines state that a focus group approved the name of the stop. The stop name indicates that its main purpose is to access land uses in North Leichhardt. North Leichhardt may be naturally defined as the area north of the City-West Link. However the purpose of the Leichhardt North stop does not presently live up to its name because of the impediment to good north-south connectivity caused by the City-West Link.

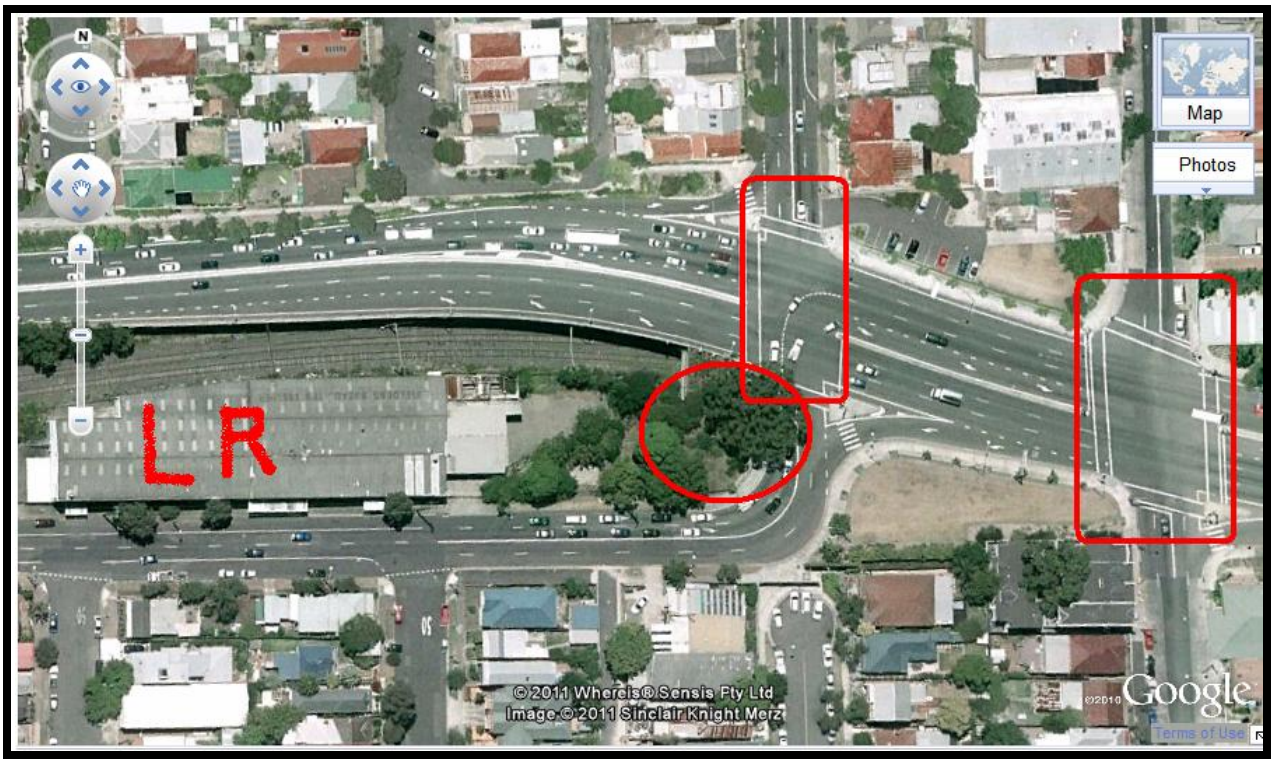


Figure 22, Transit Stop in Relation To City West Link, Source: Google Earth maps, http://maps.google.com.au/

At present there is a pedestrian bridge and traffic lights across the City West Link but site observations indicate that these linkages are inadequate to fully integrate the proposed Leichhardt North stop with the uses to the north and south of this barrier.

To the north of the Link there are important public current land uses such as Leichhardt Oval and Aquatic Centre, the western edge of Callan Park and Orange Grove public school. There is also considerable potential to revitalise the area if appropriate potential uses could be found for the disused Heritage Rozelle Hospital site, the underutilized Orange Grove public school and the ex-Brownfield site between Canal Road and Charles Street.

To the south lies the important recreational area along the Hawthorne canal and the major entertainment and restaurant precinct in Norton Street. The Potential Land-use Plan contains our recommendations to improve the socioeconomic and ecological sustainability of these areas.

Possible solutions to the north-south connectivity issue are detailed in the Integrated Transport Plan.

1.2) The Rail Tunnel and Cutting Barrier

The Greenway with its cyclist and pedestrian paths and ecological corridor extends from Iron Cove along a narrow ‘green’ salient north of the City West Link and stops abruptly at a small reserve that overlooks the start of the rail tunnel below near Emmerick St. The high drop off to tracks below and the narrowness of the rail cutting at this point presents a significant barrier to extending the Greenway to Lilyfield stop where there is considerable open space. This latter space near the former Rozelle freight yards offers much potential for sustainable redevelopment. A possible solution to connecting the Greenway with this open space is contained in the Integrated Transport Infrastructure Plan.

Figure 23 shows the narrow rail cutting as it approaches the rail tunnel under the City West Link. A gently ascending ramp with an SUP on top, starting at Lilyfield Stop could bring walkers and cyclists up to the Lilyfield Rd level at Balmain Rd Bridge. The SUP could then proceed west under the bridge via a path that would need to excavated into the northern rock face at Lilyfield Rd level. Proceeding further west , the path could then link with the Greenway salient at the small reserve near Emmerick St.

Figure 23

Rail Cutting & Balmain Rd Bridge Looking West Towards Rail Tunnel

1.3) Access to the Haberfield Residential Area

A possible solution to this issue is contained in the proposed Transport Infrastructure Plan.

1.4) Access to the Norton Street Entertainment Precinct

A way of improving this connection is contained in the Integrated Land Use Plan.

1.5) Access to Blackmore Oval

Ways of improving this presently underutilized space and reconfiguring its use are contained in the Integrated Land Use Plan.

2) Overseas Best Practice

As argued above, European case studies (Beatley 2000, PTAC 2001) indicate the Light Rail Stop at North Leichhardt needs to be well connected to important land uses in the 800metre subject area to achieve socioeconomic and ecological sustainability. Priority needs to be given not only to improve the travel times on main roads but also to maintain fast, intermodal and reliable public transport, by providing walkable access for pedestrians, facilitating recreational transport and improving infrastructure for cyclists.

At the same time improved active transport infrastructure reduces greenhouse gas emissions and enhances biodiversity. It achieves these goals through encouraging more low carbon active transport use creating platforms for ecological corridors that 'green' the grey urban environment. The light rail corridor can add to biodiversity values if it is planted with native or endemic species and managed to conform to those values.

The Department of Transport with its new integrated planning powers for road and active transport (public transport, cycling and walking as defined in the Metropolitan Transport Plan 2005) is in a unique position to provide a sustainable transport solution for the subject area that will also contribute to regional sustainability. Moreover, it is consistent with the planning objectives of the Leichhardt LEP 2000.

2.1) Objectives of the Integrated Transport Plan

- Improve travel times on the City West Link
- Encourage active transport use and thereby reduce GHG emissions and realise the health benefits from exercise
- Create platforms for ecological corridors: and
- Improve connectivity for pedestrians, cyclists and motorists within the 800 metre subject area
- Attract people to make use of the assets of the North Leichhardt precinct

The following integrated transport solution is designed to achieve these objectives.

3) Integrated Transport Infrastructure plan

Our Integrated Transport Infrastructure Plan is designed to meet the following objectives:

1. *Increase connectivity of the north precinct of the stop over the City West Link*

Up to three combined road, cyclist, pedestrian and ecological bridges over the City West Link providing north-south access.

2. *Increase connectivity for bikes to the Greenway*

A low rising ramp from Lilyfield stop that will bring pedestrians and cyclists up to the road level along the northern end of the rail cutting, proceed under Balmain road and then link up with the Greenway salient at the eastern end of the rail tunnel. Between Balmain Road and the tunnel the pedestrian/cyclist shared user path would have to be excavated into the rock face on a level with Lilyfield Road.

3. *Increase intermodal active transport*

Provide a large bike parking or bike hiring area in the open space at Lilyfield stop.

4. *Increase connectivity within precinct*

Establish an environmentally friendly shuttle bus service that would connect with trams every 15 minutes at Leichhardt North stop and link key land uses in the 800 metres subject area.

5. *Relocate the bus depot to a more appropriate site*

With the construction of the transit stop only 300 metres away; the existing bus depot on Balmain Road could be located to the large area of vacant land at Rozelle freight yard near Eastern Park on Lilyfield Road in order to free the former site for higher value land uses

6. *Increase connectivity to West*

Build a bridge over the Hawthorne canal near Blackmore Oval so residents of Haberfield can access the SLR transit stop.

3.1) Multi-Purpose Bridges Across City West Link

Figure 24 shows the site of the proposed SLR rail stop.

Figure 25 shows an artist's impression of a design for a bridge across the City-West Link at James Street near the site of the proposed SLR Leichhardt North SLR stop.

Figure.24 Leichhardt North Stop Site

Source: Indicative Design Guidelines,2010

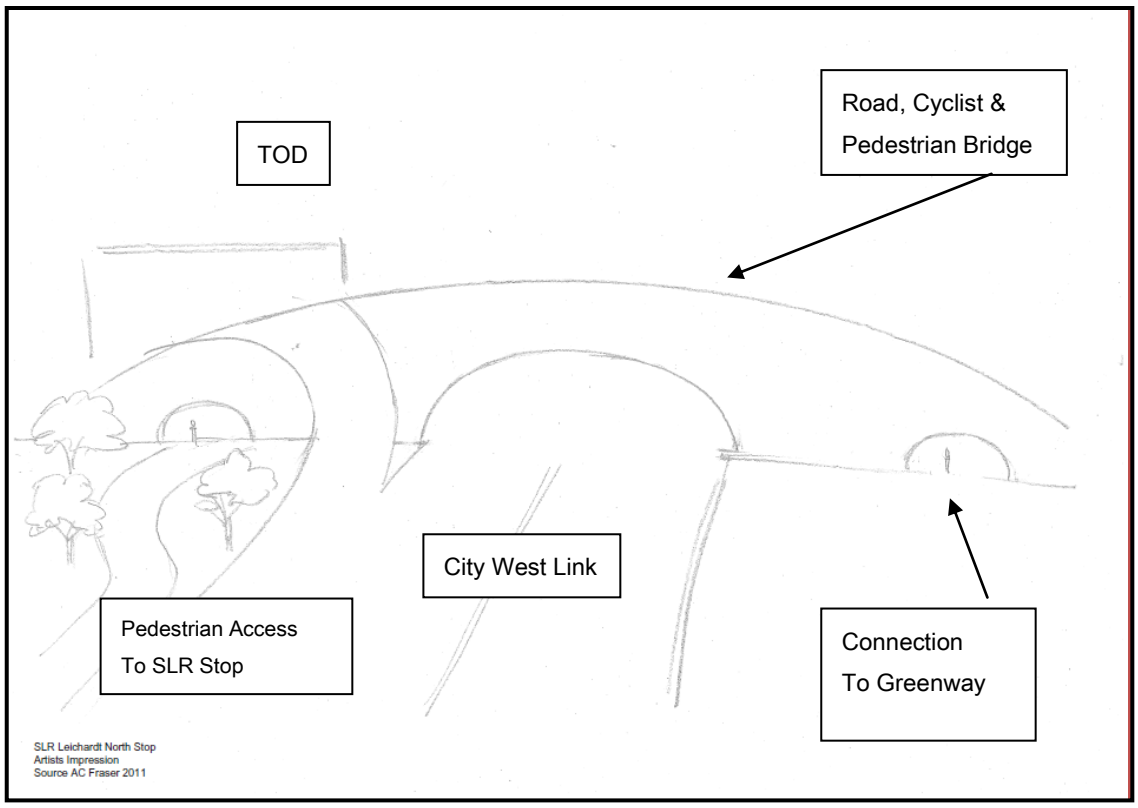


Figure 25, Artist's Impression of Bridge across City West Link at Leichhardt North Stop
Source: AC Fraser 2011

The bridge is designed to:

- Enable City West traffic to pass freely under the bridge without stopping at traffic lights as is the case now.

- Carry north-south pedestrians and cyclists over the City-West Link without needing to wait at traffic lights.

- Provide a platform for an ecological corridor across the City West link that is presently almost impenetrable to flora and fauna. The ecological corridor would start at the proposed

Blackmore Park bio-diverse area, cross Darley Road via a wildlife tunnel, proceed north-east up the right hand side of Darley Road, cross the right hand side of the proposed multi-purpose bridge and then link up with the Greenway on the other side of the City West Link.

- Include a shared user path for pedestrians and cyclists (SUP) on its left hand side that could be accessed by a lift from the Leichhardt North stop at the lower level. The SUP could also be accessed by a cycle path and a footpath on the left hand side of Darley Road.

- Incorporate underpasses on either side of the City-West Link so pedestrians & cyclists can safely access respectively the Greenway salient behind the noise barrier on the northern side and the SLR Leichhardt North stop on the southern side. This saves pedestrians and cyclists from having to negotiate traffic along James Street and Darley Road to access these important land uses.

- Provide an aesthetic landmark feature similar in design to Gladesville Bridge (albeit on a much smaller scale) to offset the monotonous City West Link morphology.

- Improve access to the light rail for the low density residential Leichhardt North precinct to higher density mixed land uses that will bring life to the area and provide housing and employment for future population growth (see Integrated Land Use Plan);and

- Create a transit boulevard along Darley Road to facilitate future planning for densification that the market will signal along the transit corridor once the latter comes into operation.

Similar bridges could also be constructed to cross the City West Link at Norton Street and Balmain Road resulting in like benefits at those points. If multiple bridges were built there would be economies in design and construction costs. Frank & Bernanke (2007) show that “increasing returns to scale or economies of scale ‘(387) results from larger scale projects. Application of this key economic principle means that the average cost of each bridge would be significantly

less than if only one bridge was built. The construction for each bridge could be done in separate stages reducing risks by allowing for progressive drawdown of funds after approval of each stage.

Three bridges have the potential to significantly improve travel times along the City West Link through removal of three traffic bottlenecks at Balmain Road, Norton Street and Darley Road respectively. This links from these streets could be retained through ramps for left turning traffic incorporated in the design of the bridge (see Figure 22).A faster City West Link opens up employment and business opportunities in Western Sydney because of the more efficient transport link to the CBD and may attract federal funding from Infrastructure Australia.

Right turning traffic from Darley Rd / James St, Norton St and Balmain Rd could be diverted via Lilyfield Rd to the traffic lights at Catherine St and City West Link. Lilyfield Rd is a wide street that is currently lightly utilized and could sustain more local traffic. Roundabouts at the intersections along Lilyfield Rd would facilitate efficient flow of traffic to the City West Link. A pedestrian/ cyclist underpass at the intersection of Catherine Street and City West Link would improve connectivity and reduce travel times for motorists on the Link.

This solution is consistent with clause 13(f) and 13(g) of the Leichhardt LEP 2000 which emphasis on providing adequate access and linkages to public open space (e.g. Blackmore Oval and Pioneers Memorial Park), and accommodating the existing and future needs of the locality concerned.

3.2) Extension of Greenway to Lilyfield Stop

The extension of the Greenway to Lilyfield would be very popular with the Leichhardt LGA community based on the large number of submissions signalling their interest in this issue. Benefits would include:

- Improved health benefits by encouraging people to walk or cycle to work or as leisure activity. A PricewaterhouseCoopers Cost Benefit Analysis (PwC CBA 2010) indicates that the quantified health benefits resulting from the HarbourLink SUP has a net present value of$182.02 million and that benefit alone was enough to justify the high capital cost of the project.

- Encouragement of intermodal active transport by providing the means whereby large numbers of people could cycle along the Greenway to Lilyfield Stop, leave their bikes in the large bike park that could be provided there. The design guidelines provide for limited bike parking at the other proposed SLR stops and take the SLR tram to work in the City. Beatley (2000) shows that this type of intermodal active transport has been highly successful in European countries such as Denmark and Netherlands.

- Provision of bike hiring station with automatic machinery e.g. Lyon

- The provision of a continuous ecological corridor from Iron Cove to Lilyfield Stop and beyond that would enhance biodiversity. The SLR line could also be ‘greened’ by planting vegetation between the light rail tracks as is done in Europe (Beatley2000) (Figure 26 & 27).

- Pedestrian and cyclist linkages from the Greenway to the proposed bridges across the City West Link would improve north- south connectivity for these stakeholders.

Figure 26
Planting Vegetation Between LR Tracks, Madrid, Spain

Source: Google Images

Figure 27
Planting Vegetation Between LR Tracks, Madrid, Spain

Source: Google Images

- Opening up tourism and leisure opportunities in addition to those associated with the existing Greenway; attracting people to use light rail/ bike combination to access water/ park etc in the precinct.

- Improving the value of property along the Greenway sending a market signal for higher density housing that could be used to accommodate population growth. However, this development would need to be developed in a way that stepped back from the Greenway so the tunnel of the development did not block out the Greenway from sun light and views.

- Provision of an iconic positive externality that would attract people and foster community pride in the area.

Figure 28, Shared Pedestrian & Bike Path, Source: Indicative Design Guidelines, 2010

Based on the Greenway submissions and the local demographical data, the good community support that such an extension is likely to enjoy would facilitate progress of the project.

A rigorous Benefit/ Cost Evaluation like the one carried out by Price-Waterhouse for the HarbourLink project for North Sydney Council (see below) could identify the benefits argued above and be used to inform a decision on the proposal.

3.2.1) Relevance of HarbourLink Analysis

The HarbourLink project is a proposal to build a 3km stretch of shared off-road pedestrian and bike pathway that will stretch from the Harbour Bridge to Naremburn and has much in common with the extension of the Greenway proposal. Macquarie University recently considered the Benefit /Cost Analysis that Price-Waterhouse Coopers carried out for HarbourLink.

The problem to be analyzed for both these projects is one of Private Car Travel versus Active Transport. In terms of the Metropolitan Transport Strategy (NSW Government 2005), 'active transport' comprises public transport, walking and cycling.

3.2.1.1) Private Car Travel versus Active Transport

The following analysis relates to the HarbourLink project that is similar to the Greenway SUP.

In economic terms active transport is a positive 'externality' or 'public good' because it generates 'benefits that accrue to people not directly involved in those activities' (Frank & Bernanke 2007p347) and left to the market these benefits would not be produced or produced in sufficient quantity from a social point of view. Examples of positive externalities include amenity and sense of place as well as leisure, retail and tourism opportunities. These benefits have not been measured in the PwC CBA owing to methodological issues. However the analysis indicates the project is viable on the 'internal' benefits. The health benefits alone have a Net Present Value of up to $182.02 million compared to an upfront capital cost for the project

of $85 million. Under the optimistic scenario the total Benefit Cost Ratio is 4.95:1 compared to 2.3:1 for the average road project (Price-Waterhouse Coopers 2010).

It is considered that the optimistic scenario is appropriate when one considers the unmeasured positive externalities. Since the PricewaterhouseCoopers report does not measure these externalities, the numbers understate the economic efficiency of the project from a social point of view

Private car travel in heavily built up areas such as North Sydney or Leichhardt LGA must generally be seen as a 'public bad'. This is because petrol prices are growing exponentially due to Peak Oil, parking space is limited and traffic congestion is a growing problem. Ten years ago the EU estimated the direct, social and environmental costs of private car travel at $300 billion (Beatley 2000). These days the costs are likely to be higher when one considers the environmental cost because road transport is the 'fastest-growing contributor to greenhouse emissions in Australia, and in most Western countries' (Low et al 2005: 134).

Even if one assumes that carbon emissions can be addressed by powering cars from renewable energy sources, the problem of traffic congestion in built up areas remains. Each active transport trip takes up to thirty times less road space than a private trip (Engwicht 1992) Thus substituting private car travel with active transport is an effective way to reduce traffic congestion and achieve consistent travel times, that are stated aims of traffic authorities (RTA Corporate Plan 2008-10) .

3.2.2) The Carrot and Stick Approach

Northern European countries have been able to achieve very high rates of substitution of active transport for private car travel by using a 'carrot and stick' approach (Beatley 2000p186) Many

Dutch cities have increased the bicycle share of the modal split to over 40% for short distances (Beatley 2000p167). In Copenhagen about 50% of train commuters ride their bicycle to the station where ample bike parking is provided (Beatley 2000 p167).

The carrot and stick approach involves simultaneously increasing the supply of active transport infrastructure while at the same time reducing the demand for private car travel. The following economic model illustrates the mechanism.

In Figure 29 an increase in the supply of active transport infrastructure shifts the supply curve from SS to S1S1. A higher equilibrium quantity and lower price of active transport infrastructure is reached at point X.

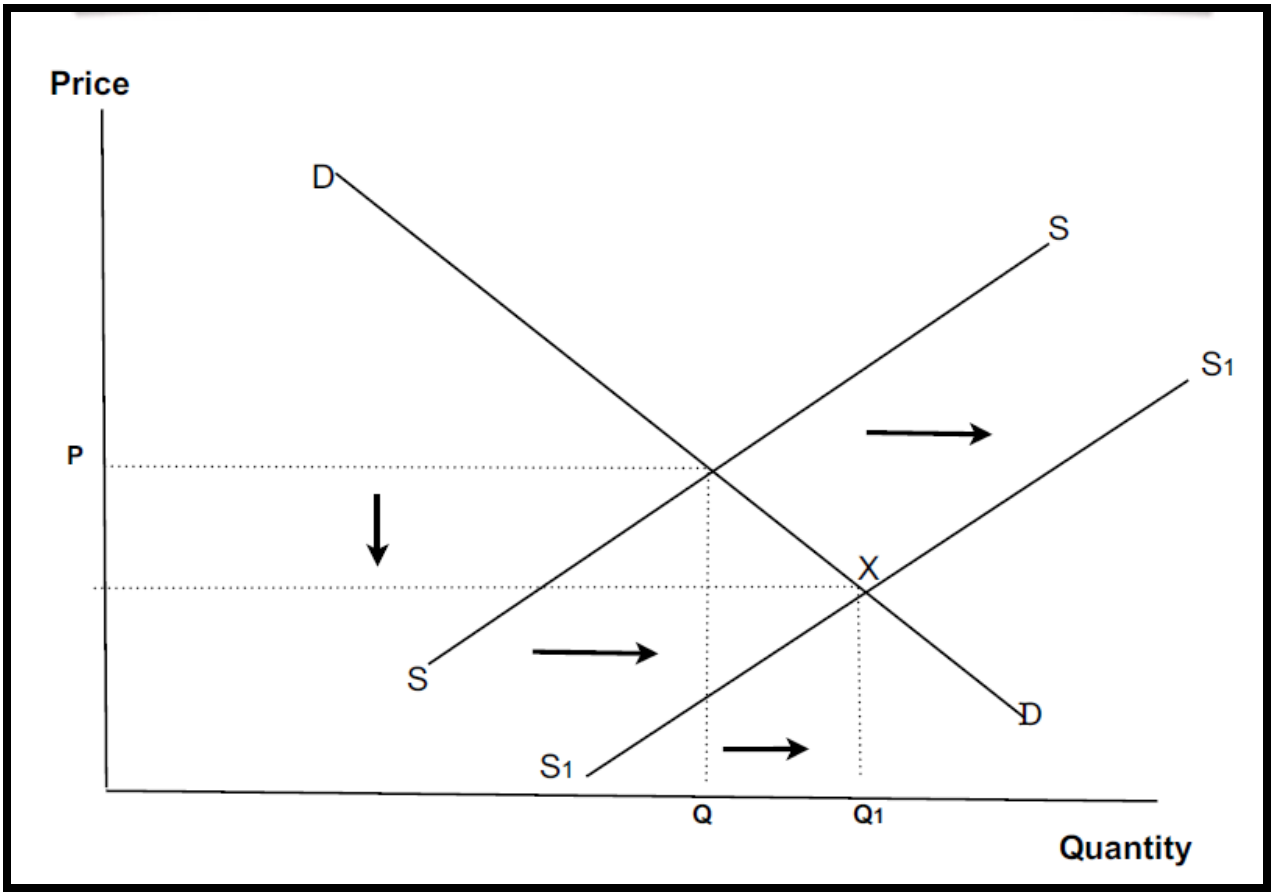


Figure 29, Active Transport Source: AC Fraser, BEcon, PGCert EnvEco

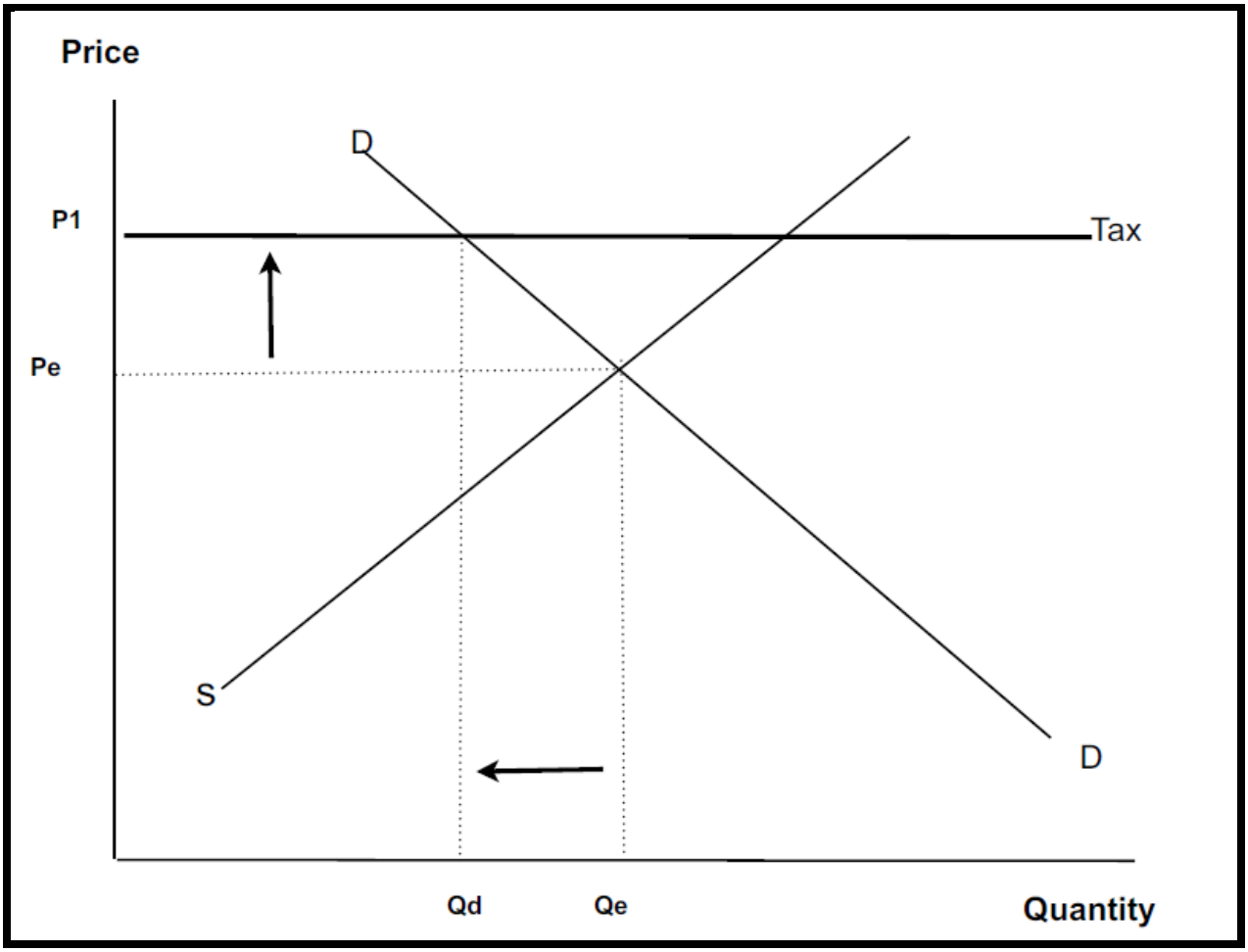


Figure 30, Private Car Travel

Source: AC Fraser, BEcon, PGCert EnvEco

At the same time in Figure 30, congestion taxes, tolls and higher parking charges cause the price of private car travel to rise to P1 and a lower quantity (Qd) of private car travel is demanded at that price.

The combined effect of Figures 29 and 30 is that active transport infrastructure supply rises and the quantity of private car travel demanded falls which is the socially desired outcome.

Figure 31 Source: Google Earth map, http://maps.google.com.au/

Figure 31 above shows the potential Greenway extension from Iron Cove to Lilyfield SLR stop. There is a wide SUP that extends along the Hawthorne Canal to Iron Cove. From Iron Cove there is a narrow salient that runs along the edge of City West link behind the sound barrier then stops at small reserve near Emmerick St.

At that point further connection east is hindered by a steep drop to the disused rail line below where it enters the tunnel under the City West Link. However, various plant species grow along the rock walls of the rail cutting. As one progresses east the land-form becomes steeper and narrower and finally opens up into the extensive open space at ground level at the Lilyfield stop.

3.3) Bike Parking/ Hiring along Greenway

If ample bike parking were included in the open space at Lilyfield this would add considerable value to an extension of the Greenway. This could be part of a business plan to provide a bike hiring service between North Leichhardt and Lilyfield Stop as well as other stops along the SLR extension. Vast bike parking areas are a feature at railway stations and other transport nodes in Europe [Beatley (2000)]. The combination of the Greenway and ample bike parking at Lilyfield Stop is likely to encourage Light Rail traffic there that is presently underutilized, especially at night, creating a security hazard.

A 'bike home' at Lilyfield stop would provide passive surveillance and increase peoples' sense of security. Various bike plans are designed to improve urban connectivity and recreational amenity (Figure 32 & 33). Smaller bike parking areas at other Light Rail stops as provided for in the SLR Extension Design Guidelines would facilitate inter-modal active transport along the length of the Greenway.

According to the Leichhardt LEP 2000, 'the purpose of the Bicycle Strategy 2007 is to identify a strategic direction for promoting cycling in and through the Leichhardt Council area and provide a framework in which Leichhardt Council, either alone or in conjunction with other authorities and organisations, such as the RTA, Health Authorities, NSW Police Service, local schools, and bicycle user groups, can work towards making cycling safer and easier for more people'.

The principal goal of the Cycle Promotion Plan (Chapter 5 of Leichhardt Bicycle Strategy 2007) is 'to encourage more people to take up cycling, especially for local trips which tend to create more pollution, use valuable road space for parking and generate traffic congestion in our area'.

Figure 32 Bike Hiring , Lyon, Source: http://en.wikipedia.org/wiki/Bicycle_sharing_system:

Figure 33
Open Space at Lilyfield Stop
Source: AC Fraser 2011

3.3.1) Bike Catchment Area

The catchment area of the proposed SLR Leichhardt North stop may be represented by Figure 34 below:

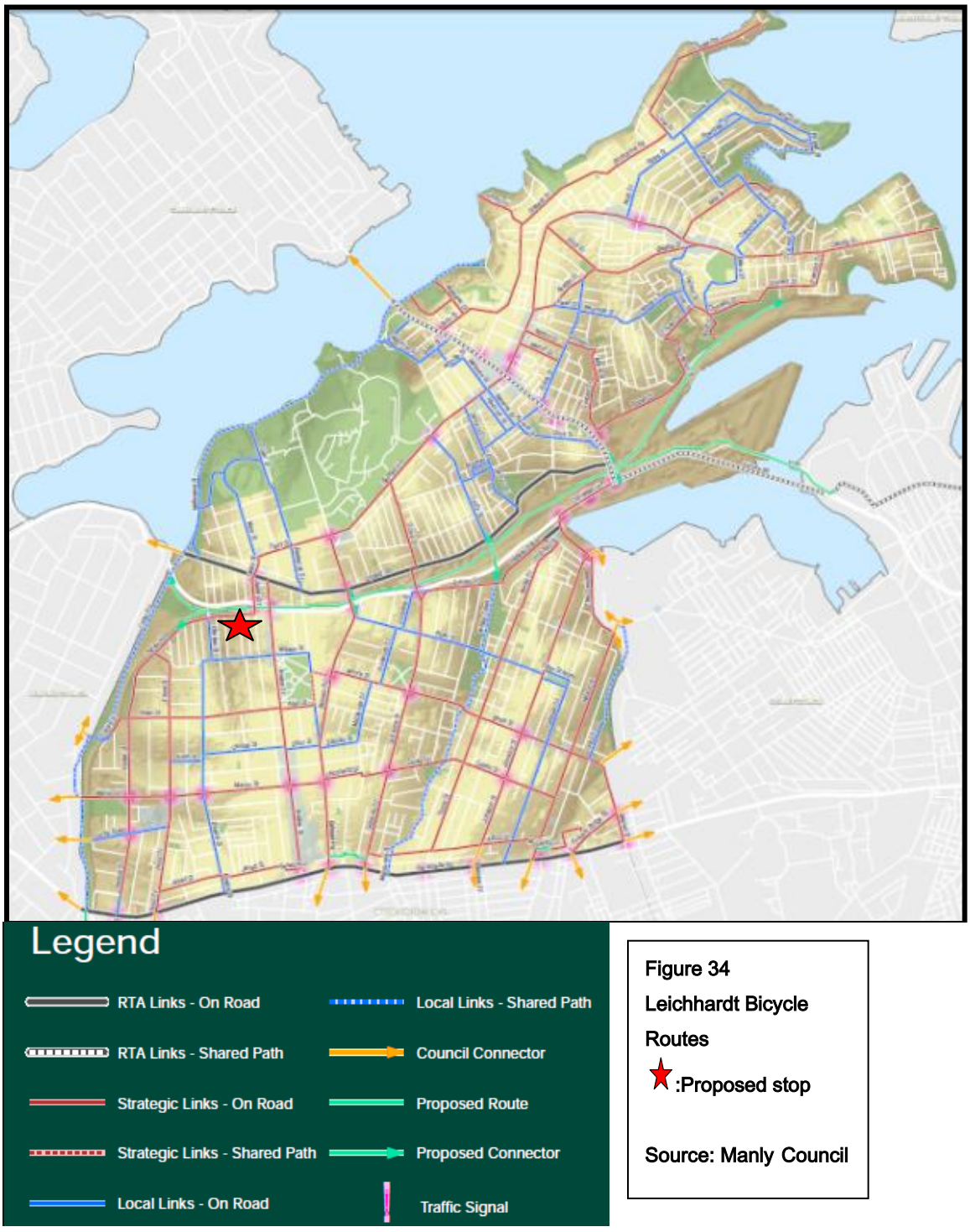


Figure 34
Leichhardt Bicycle Routes
:Proposed stop

Source: Manly Council

RTA figures indicate that the most bike trips are 5kms or less (Fraser & Amati 2011). This would indicate that the intermodal bike/ LR catchment area is around 5kms that corresponds roughly to the 5.6km length of the SLR Extension. If two large bike parking areas were places at either end of the LR line (Lilyfield & Dulwich Hill) this would enable cyclists to cycle their 5kms average trip along the Greenway, park their bike at these bike parks and then return by light rail.

3.4) Shuttle Bus Loop

At present, virtually no bus service exists in the vicinity of Darley Road at the proposed Leichhardt North Stop (Figure 35).

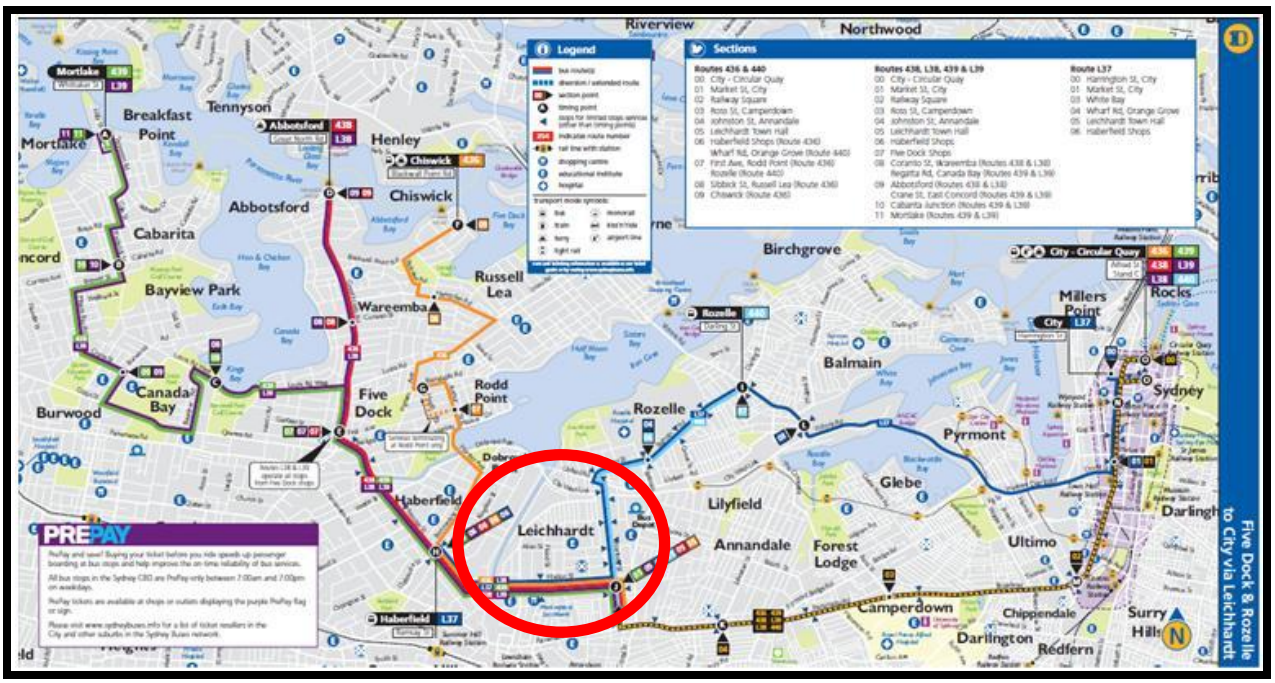


Figure 35, Bus routes from Five Dock to City Via Leichhardt, Source: Sydney Bus http://www.sydneybuses.info/routes/timetables-route-maps

To add value to the SLR service and enhance connectivity a shuttle bus could circulate around the main land uses in the local area and meet the trams every 15 minutes that they operate (figure 36).

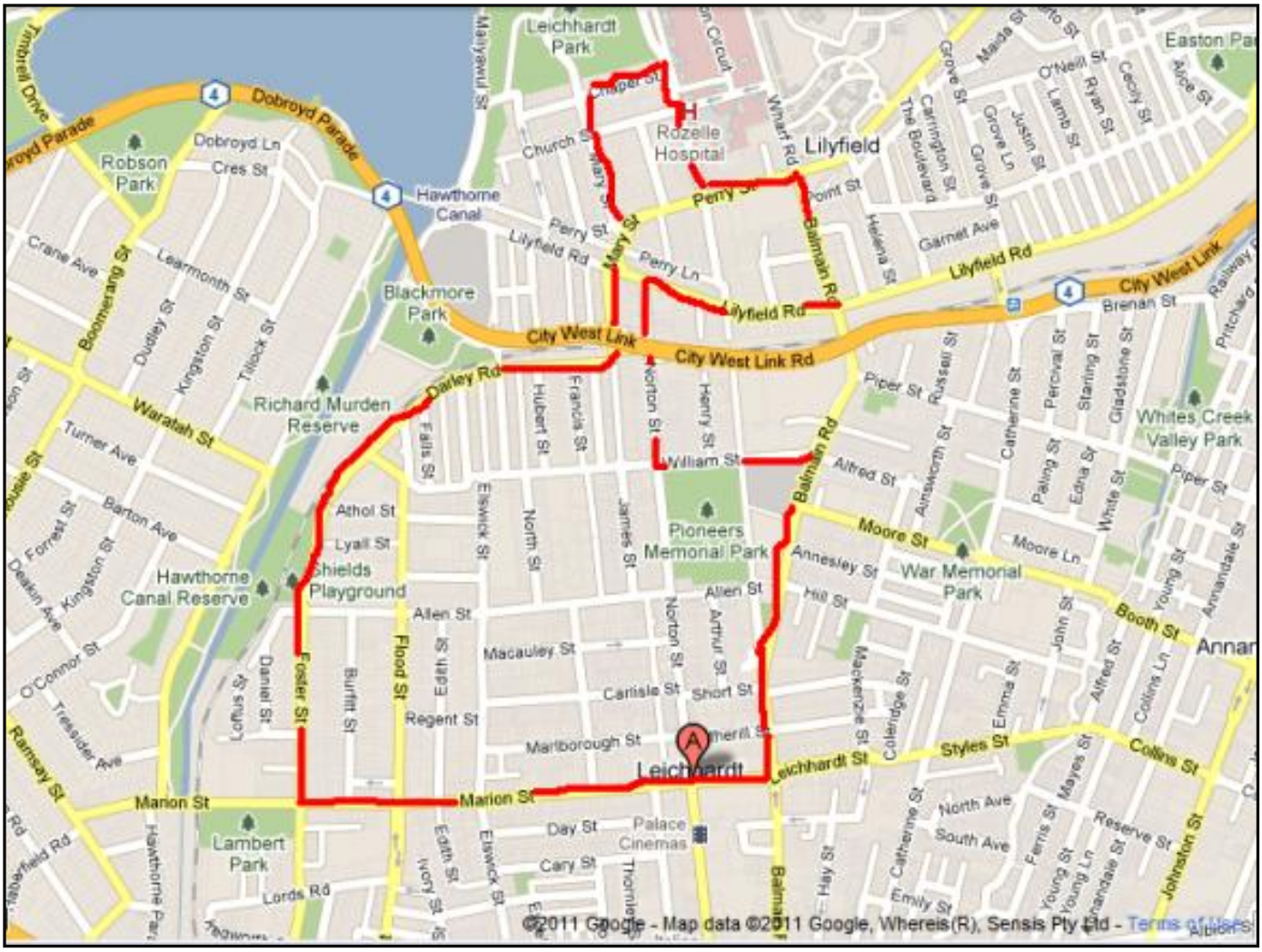


Figure 36, Possible Shuttle Bus Route, Source: E Riazifar & AC Fraser

Google map, http://maps.google.com.au

Other benefits of the service include:

- Economical and efficient operation through mini-vans. Manly Council runs such a service that has proved very successful and shuttle buses are commonly used in the USA at airports.

- Routes and stopping points could be flexible, responding to community demand.

- Vans could be powered by ecologically sustainable bio—diesel

- Disabled and elderly people could become more mobile with the service, and

- The service could be privatized and/or funded by the local Council

3.4.1) Key lessons from Manly Council Shuttle Service

The 'Hop, Skip and Jump' bus is a free public service in Manly area which can be used as an example of having a shuttle bus service.

This service is 7 days per week, from 7.00am to 7.00pm and operates in three routes. A total of 383,704 passengers used the HSJ service during the 2009/2010 financial year, and 1,391,160 passengers to date since HSJ commenced (5 years ago) (Manly Council).

Estimated annual running cost for this service is $550,000 pa including over head costs (e.g. 5.5 casual staff). Estimated leasing cost is $150,000 pa and it includes cost of diesel, and insurances. There are 4 buses operating in this service and estimated cost of drivers is $350,000 pa. Drivers are paid $28 per hour and double amount on weekends (Barnett 2011).

‘The Hop, Skip & Jump Bus runs on biodiesel fuel, which reduces exhaust emissions of carbon monoxide by approximately 50 per cent and carbon dioxide by 78 per cent because the carbon in biodiesel emissions is recycled from carbon that was already in the atmosphere, rather than being new carbon from petroleum that was sequestered in the earth's crust’ (Manly Council).

Service is operated by Manly Council; however Council accepts donations from commuters and also sponsorship from local businesses (Barnett 2011).

According to Dr Peter Macdonald (former Mayor of Manly) by using the Hop, Skip & Jump community bus, patrons are contributing to a cleaner, healthier and happier future for all Manly residents and making a significant improvement to our environment (Manly Council).

“Some of the benefits include a healthier, more active community and less vehicle traffic in the area, particularly at shopping centre and popular places like our beaches” (Manly Council Website 2011).

3.5) Relocation of Bus Depot

The bus depot on Balmain Road is an uneconomical use of potentially valuable land close to the Norton Street entertainment precinct (Figure 37 & 38). This proximity, combined with the addition of the proposed SLR Leichhardt North Stop within easy walking distance, means that the market will signal demand to use the site for higher value community, commercial and residential uses. Cervero (2008) cites a hedonic pricing study that parcels of land within a quarter of a mile a Light Rail stop result in an overall land value premium of 28%. The present bus depot is within that radius.

Figure 37, Bus Depot, Source: Google Images

The southern derelict part of the site could be sold to a private developer and the proceeds used to build a better facility at a more appropriate location geared to industrial uses and vehicular rather than transit access.

Figure.38, Bus Depot (blue line), Source: Google Earth map

Although the existing depot buildings are relatively new and undepreciated, sunk costs are irrelevant from a planning and economic point of view (Frank &Bernanke 2007). In any case it is likely that the proceeds from the sale of part of the land to a private developer would recoup those costs and realize enough to fund a bigger and better facility. However, the old buildings on the site should be retained if possible under 'new urbanism' planning principles.

Infrastructure from existing bus depot could be dismantled and reassembled on the new site and the building material could be recycled. Part of the existing structure could form part of the fabric of the new sports stadium of modest capacity proposed for the northern part of the site.

An appropriate relocation site could be the disused Rozelle rail yard near Easton Park on Lilyfield Road in the same LGA. Now that the Rozelle Metro project has been cancelled, the

land is free for another use. The area is flat, owned by Railcorp, larger than that of the present bus depot, closer to the city and the site can be accessed both from Lilyfield Road on the western side and the start of the City West Link on the eastern side. As the site is near the present depot, the bus services operating out of that site could be relocated to the new site with minimum disruption.

It is likely that relocation of the bus depot would be popular with the local community who would benefit from site being used for mixed community, residential and commercial uses that would add value and vitality to the area.

A Benefit Cost Analysis may be appropriate to quantitatively test the above argument.

3.6) Connectivity to Haberfield

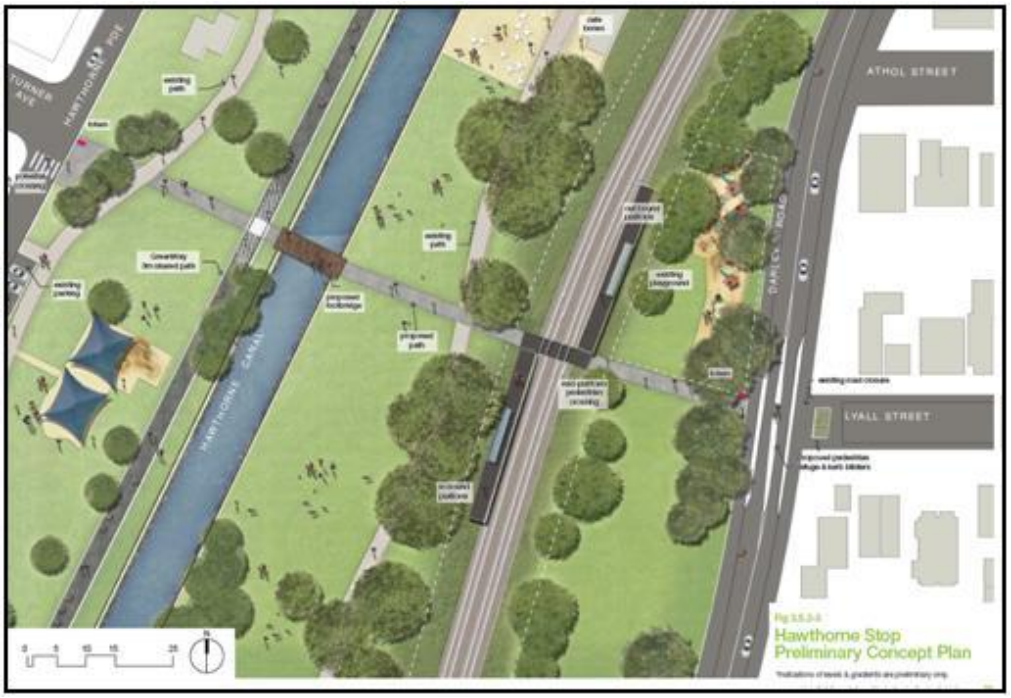
Although the eastern part of Haberfield is within the 800 metre catchment area for the SLR Leichhardt North Stop, there is presently no pedestrian and cyclist access to the northern end of that precinct.

A pedestrian and cyclist bridge over the Hawthorne canal near Blackmore Oval would have a relatively low capital cost and would provide walkable access to the transit stop for Haberfield residents on the western side of the Canal (Figure 39).

Figure 39

Bridge over the Hawthorne Canal near the Hawthorne Stop

Source: Indicative Design Guidelines



PART FOUR

INTEGRATED LAND-USES PLAN

1) Potential Land Uses in the Integrated Plan

Public authorities such as Department of Transport and local councils can integrate land uses planning by selling publicly-owned land to private developers subject to new urbanism planning principles, revitalizing existing public buildings or uses with new investment or by changing zoning laws to achieve better integrated land use outcomes.

Our recommended potential land uses are the considered outcome of many site inspections and application of the 'new urbanism' planning principles outlined in the previous section, as well as ESD principles. They are as follows:

1) *Leichhardt North Stop Site*

A five-story high-density 'transit-oriented development' (TOD) to incorporate mixed residential/commercial uses, environmentally friendly design and a sense of place.

2) *Present Bus Depot & Adjoining Derelict Site*

The southern derelict part of Leichhardt Bus Depot could be sold for private redevelopment that would include offices, shops and residences to realize proceeds for relocation of the bus depot. The part of the site presently used for bus parking could be retained in public hands and used for a new multi-purpose sports stadium of modest capacity.

3) *Blackmore Park*

A reconfiguration of Blackmore Park as an ecological park, incorporating a small wetland, grey water recycling facility for local residents and small amphitheatre to stage concerts and plays.

4) *Film Studio & Warehouses near Blackmore Park*

A rezoning of the presently underutilized film studio and warehouse site opposite Blackmore Oval to allow for redevelopment as medium- density housing with provision for limited mixed commercial and light industrial uses.

5) *Warehouses between Charles Street and Canal Road*

Rezoning of the presently underutilized large ex -Brownfield site bounded by Charles Street and Canal Road on the northern side of the City-West Link to allow for mixed residential/commercial uses as well as the existing cultural uses.

6) *Rozelle Hospital*

Renovation of the disused Heritage buildings of Rozelle Hospital to use as a community mental health centre with provision to lease space to private consultants and associated health services.

7) *Orange Grove Public School*

Orange Grove public school could be rezoned to incorporate a Long Day Care centre on the presently underutilized site.

We recommend that community consultation take place around these land uses.

1.1) TOD at Leichhardt North Stop

At present an old warehouse (Figure 37) occupies the site and the issues arises as to whether that building should be retained and renovated or demolished for redevelopment.

Under Jane Jacob's (1961) third planning principle old buildings should be preserved where possible to provide a home for diverse small business uses and affordable housing. However, in this case the immediate proximity of the transit stop means the market will signal a high value land-use for the site and a *new* Transit Oriented Development (TOD) could be justified. New urbanism principles would militate for a high density mixed-use development, the scale of which does not oppress the local streetscape.

The TOD could be aesthetically designed in old world style with an atrium, a colonnade and archway entrances to enhance the local streetscape (Figures42 & 45). This complies with the new urbanism prescription detailed at 4.1.5 above.

Figure 40, Interior of Old Warehouse on Site

The small commercial uses on the ground and mezzanine floors should be appealing to local residents as well as visitors to the area. The residences on the upper floors would provide passive surveillance and vitality to the local area both in the day and at night. The building would be designed to include the latest energy efficient and ecologically sustainable features. The modest height will mean that building will not overshadow local residences or dominate the landscape.

The hatched space in Figure 38 represents the area available for the TOD that we show in the artist impression and the design diagram (Figures 38, 39 & 40) that follow.

Figure.41, Leichhardt North Stop, Source: Indicative Design Guideline

In Figures 41 and 42 there would be a small square adjoining the TOD that would include street furniture, a lift to the proposed bridge above and incorporate a landscaped area that would retain the existing trees on the site.

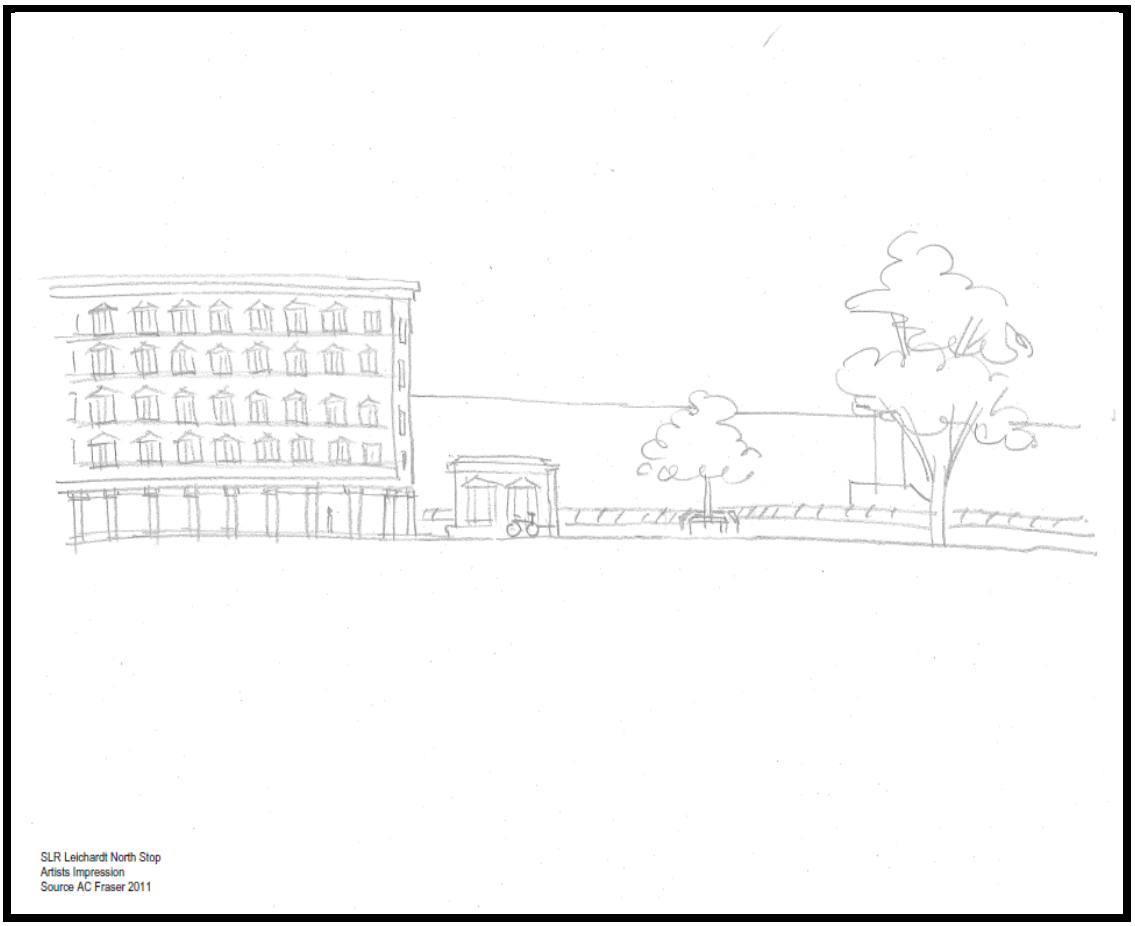


Figure 42, Artist's Impression of Leichhardt North Stop Building and surrounding area

Source: AC Fraser 2011

Figure 43, Public and Green Space Next to Leichhardt North SLR Stop

Source: Indicative Design Guideline 2010

A pedestrian passageway under Darley road (Figure 44) would connect the transit stop to a tree-lined walkway on the southern side of the City West Link to Norton Street and the proposed large-scale redevelopment of the bus depot. Both these destinations would be within easy walking distance of the Light Rail stop.

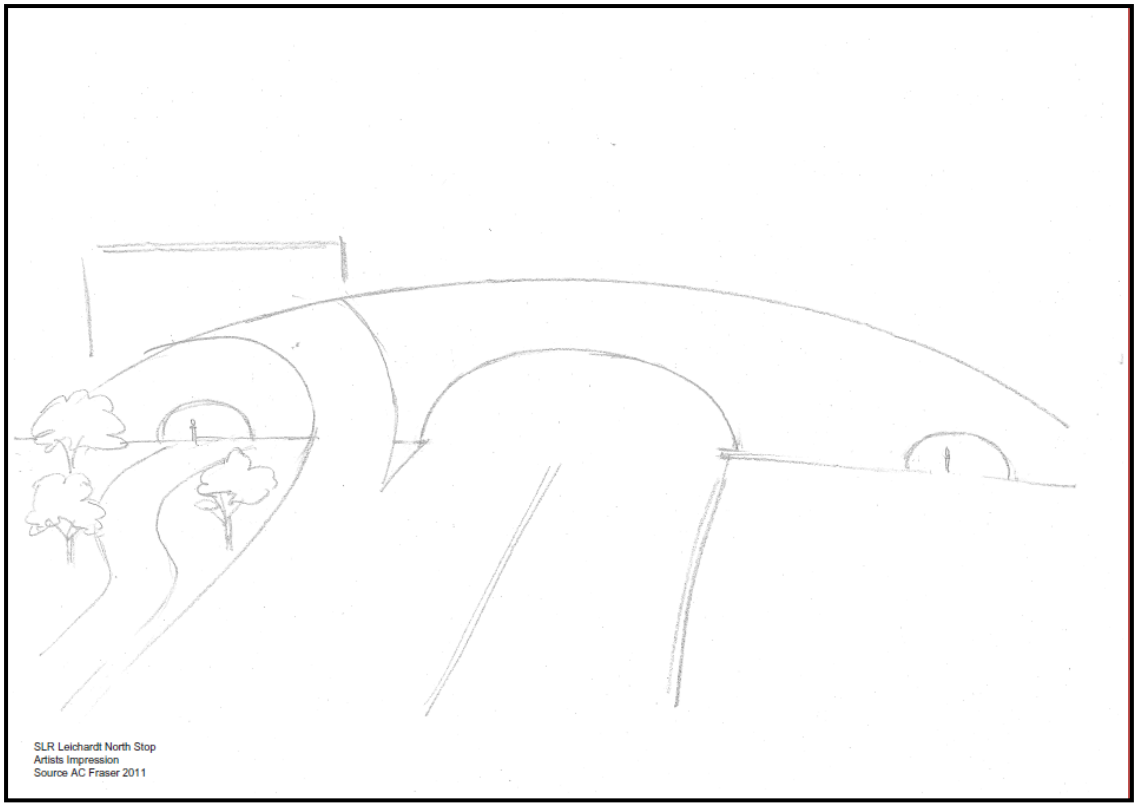


Figure 44, Artist's Impression of Bridge across City West Link at Leichhardt North Stop
Source: AC Fraser 2011

Figure 45 shows the design of the atrium that would reside in the centre of the development up to the mezzanine level where commercial uses cease.

Figure 45
Artist Impression of TOD Featuring Central Atrium
Source: AC Fraser 2011

The atrium would include a glass ceiling at the first floor level that would provide noise and privacy separation from the commercial lower level uses for residents on the three upper levels.

Figure 46

Photovoltaic Cells as Ceiling Fixture

Source: Woking Council

The glass-glass photovoltaic shading installed at the spectator gallery at Pool in the Park allows 40% light in with 60% shading. The benefit of this installation is that previously this area got extremely warm – now the panels not only give shading but also produce 9.1kWp of electrical power. Source: Woking Council

According to Leichhardt DCP (Part A10.2.4) building wall height is to be a maximum of 3.6m, but it can be 6.0m along Darley Road where there is potential for higher density. In addition, medium density development is allowed along the Darley road (Part A.10.2.2). Therefore, an exemption in LEP is required for the proposed building as 5 level building's height would be more than 6.0m (around 13 m) and medium density would not apply to that.

Many of the dwellings in the area are single story Victorian and Federation-style. Leichhardt DCP (Desired Future Character) has emphasis on preserving and enhancing the predominant scale and character of the area (Part A10.2.2). Therefore, there is a need to investigate the most appropriate design for the building and community consultation would be helpful in this case.

1.2) New Cultural / Sporting Stadium

Construction of a multi-purpose sports stadium of a similar capacity to Leichhardt Oval on the bus depot site could be justified because it is close both to the lively 'Little Italy' cultural precinct and the proposed Leichhardt north SLR stop.

The Norton St entertainment and restaurant precinct is a mecca for locals and tourists alike. During international soccer matches cafes and restaurants are full to capacity. However, the precinct lacks a multi-purpose sports stadium of modest capacity that could comprise a 'public primer' that would attract tourists on a more sustainable basis if it was used for appropriate events.

The existing bus depot site is only 300 metres from the proposed SLR Leichhardt North Stop providing easy access to potential users of a multipurpose stadium. As discussed above, the existing bus parking area could be relocated to a more appropriate site at the disused Rozelle freight yard with minimum disruption. Bus depot infrastructure could be dismantled and reassembled on the new site. The existing office building on the bus depot could be retained and used for sympathetic purposes consistent with the multi-purpose stadium.

The relocation of the bus depot could be financed by sale of the presently derelict land on the southern part of the site for commercial and residential redevelopment.

The proposed stadium would act as powerful demand driver for private investment in the vicinity and provide public surveillance for the underutilized Pioneer Park. The doyenne of the new urbanism movement, Jane Jacobs (1961) stipulates that parks will die if they are not adjacent to commercial and residential uses that sustain them. Much of the eastern side of Pioneer Park presently adjoins derelict buildings and wasteland and constitutes a security risk.

1.3) Ecological Park and Amphitheatre

Observations of Blackmore Park (Figure 47) that is designed for Rugby League matches showed that the Park was deserted even on a Saturday afternoon. By contrast nearby Hawthorne Reserve was alive with people jogging, cycling and walking their dogs. It may be appropriate to start a conversation with the local community about more ecologically sustainable use for Blackmore Oval than the currently underutilized sports field. The EA and Community submissions indicate strong interest in ecology and biodiversity.

Blackmore Park is a natural water catchment area bounded by riparian corridor that is presently occupied by a stormwater drain. The drain presently hinders access from the proposed transit stop to the east. The drain could be opened up and landscaped with a small wetland that would absorb storm-water, reduce flood hazard and create a bio-diverse habitat (Forman, 2008).

Figure 47, Blackmore Oval, Source: AC Fraser 2011

The grey water flowing into the storm water drain could be collected in the constructed wetland that filters out pollutants. The water could then be recycled in an underground plant and piped out for use by local residents. Such a system exists in Kolding, Denmark (Newman & Jennings 2008:113).

An opportunity exists to create a vegetated corridor along the dug-out storm water drain that follows a natural riparian corridor. There could be a wild-life movement route and walking path along this corridor that would link the transit stop and pedestrian bridge on the southern side the City West Link to the Hawthorne Reserve parkland in an ecologically sustainable fashion.

To ensure that ecologically reconfigured Blackmore Park is sustainable from a socioeconomic perspective it could also contain what Jane Jacobs (1961) calls a ‘demand driver’. These are uses that attract a ‘buzz’ in the area such as music, cultural events, sporting matches, shops etc. A ‘high -brow’ public primer such as a small amphitheatre where outdoor concerts and plays could be staged would suit the character of the precinct. Jacobs (1961) argues that such a demand driver should be situated at the borders of parks and in this case this would be where Blackmore Park adjoins Canal road.

1.4) Film Studio and Workshops

The large underutilized Brownfield site next to Blackmore Park is suitable for redevelopment for mixed residential/ commercial uses (Figure 48). The eastern part of the site adjoining an ecologically reconfigured Blackmore Park could be rezoned for medium-density housing that would attract a premium in the market because of the highly desirable location near the transit stop, proposed ecological park and Hawthorne Reserve.

However there is room on the site for affordable housing and commercial uses. Varied densities and residential types could be accommodated on the large site. Jane Jacobs (1961) observes that if varied housing types are not included in residential developments, high income childless couples and singles tend to crowd out families.

Under the permeability principles (Newman 2008, Jacobs 1961), such a redevelopment should be broken up into small blocks and several streets to form an intricate pattern of cross use. An extra road and access under the rail line to the site from Darley Road would facilitate breaking up the site into smaller blocks as well as greatly improving connectivity. This road should proceed diagonally north-east from Darley Road to Canal Road through the subdivision and

thus avoid a square grid pattern for new developments that new urbanism permeability principles discourage.

It may be appropriate to relocate the existing light industrial uses to the industrial precinct near Easton Park on Lilyfield Rd where the bus depot could be relocated. At that location there is ample public land to accommodate the former uses.

Figure 48, Film Studio, Source: AC Fraser 2011

1.5) Old Warehouses

The old warehouses on the northern side of the City West Link bounded by Charles Street and Canal Road that are presently underutilized for cultural and community uses. It may be desirable to rezone the site allow for mixed residential and commercial uses in order to promote socio-economic sustainability.

The warehouses look structurally sound and could be converted into affordable housing like that near Wentworth Park Ultimo (Figure 49). Car parking need not be provided because there would be easy access to the transit stop across the pedestrian bridge over the City-West Link, saving on development costs. In line with Jane Jacob's (1961) third planning principle, the old warehouses would be fully depreciated, and thus offer an economical yield for affordable housing and diverse small business uses that will bring life to the precinct.

Figure 49, Warehouse converted to residential use, Ultimo near Wentworth Park

Source: AC Fraser 2009

1.6) Renovation of Rozelle Hospital

Rozelle Hospital (Figure 50) is a Heritage site that currently stands unused. The Federal Government announced major new funding for Mental Health in the May Budget and some of this money could be used to convert the disused hospital into a community mental health centre.

A renovated metal community health centre would act as a 'public primer' for private health care services. There is ample space on the site and the excess capacity could be leased out for these privatised services. In line with Jane Jacob's third planning principle, the old buildings would offer an economical yield to private health care businesses.

Figure 50, Rozelle Hospital

Source: Flickr Website: http://www.flickr.com/photos/ghee/5363551456/in/photostream/

1.7) Orange Grove Public School/Day Care Centre

Orange Grove Public School (Figure 51) on Lilyfield Road is underutilized and has ample land. The demographic profile of the area indicates that there would be a demand for long day care services because of the high number of working women in high income households.

The Public School could act as a public primer for a long day care centre on the site. There would be economies that would arise from the convenience of a having like uses on the same site. There would also be opportunities for shared resources and facilities.

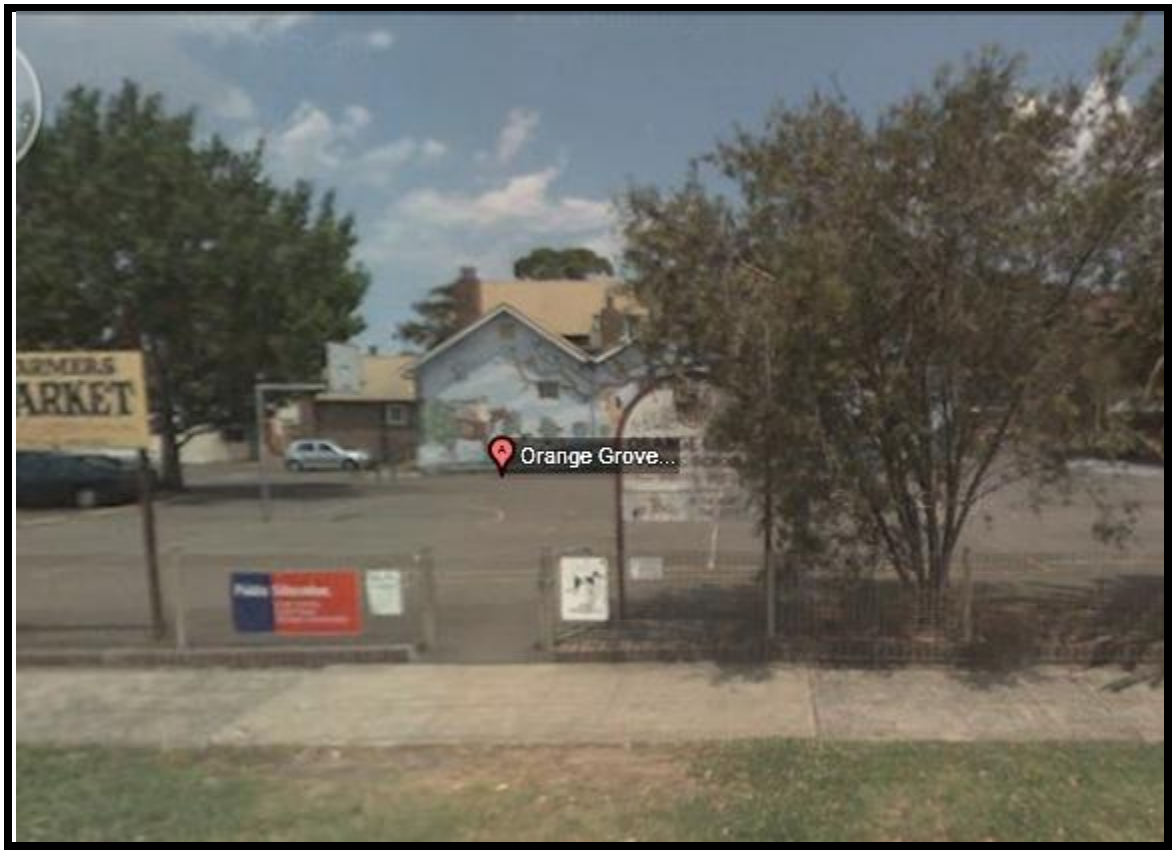


Figure 51, Orange Grove Public School, Perry Street, Leichhardt

Source: Google Map: http://maps.google.com.au/

2) Sustainable Design for Buildings

To save on energy usage and greenhouse gas emissions all new or renovated buildings in the subject area should be built to the highest energy efficiency standards for lighting, heating and cooling. Insulation and computerised systems should be employed to regulate temperature at about 20^{o} and rooftop photo-voltaic cells used to generate electricity. Green roofs, which absorb greenhouse gases, retain rainwater and provide significant habitat should be mandatory on all buildings. Green roofs have the advantage being natural, low maintenance and inexpensive. They also provide natural insulation.

Energy for the precinct could come from “green transformers’ that are being implemented by the City of Sydney. Green Transformers are central plants which convert waste to energy, produce low-carbon energy and recycled water. Through cogeneration, heat is captured as the product of energy generation. This heat is then used for heating, hot water and can even be used to chill water that is then used to cool buildings. (City of Sydney 2009)

A major opportunity exists to design the proposed redevelopments as a ‘closed loop’ systems. Rainwater could be collected at ground level and recycled for toilet flushing. Both the green and open space areas of the site could form the catchment area. The built open space such as the proposed public square at the transit stop could be made of permeable bricks so water passes through the surface and is collected below. Grass would grow in the cracks around the bricks so the surface connects with the green spaces.

Sewerage and other biodegradable wastes could be recycled to produce biogas which together with the energy generated by rooftop photovoltaic cells, could not only meet the energy needs of the site users but produce a surplus that could be sold on the electricity grid. The residual biodegradable wastes could be converted to fertiliser for use on the green spaces and green roofs. The whole system would be carbon neutral or carbon negative so that there are no net greenhouse gas emissions.

Figure 52, Green Roof, Sydney

Source: Water Sensitive Urban Design, http://www.greenroofs.org/index.php/grhccommittees/287?task=view

Figure 53, Green Roof, Beijing

Source: Treehugger, http://www.treehugger.com/files/2006/07/chinas_learning.php

Figure 54, Green Roof, New York

Source: Solaire Building, http://www.greenroofs.org/index.php/grhccommittees/287?task=view

One of the objectives of Leichhardt LEP 2000, is ‘to encourage the incorporation of the principles of ecologically sustainable development in the design and management of the built and natural environment’ to preserve natural resources, minimise the negative impacts of urban development on environment and also to enhance the quality of life (Cl13, General Objectives).

In order to do that, principles of Leichhardt LEP including DCPs need to be folowed. As an instanse, Leichhardt Council is promoting greater energy efficiency and environmental sustainability by the careful choice of building materials. As part of its Environment Strategy, several lists of suitable building materials has been prepared including specified plantation and regrowth timbers for use in Leichhardt, and timber not recommended for use in Leichhardt (Part B, Appendix 2, Residential DCP).

According to Part C of Leichhardt DCP (LEP2000) following design elements need to be considered in a development; site drainage and storm-water control, energy efficient siting and lay out, thermal mass and material, external window shading, external and internal lighting, insulation, ventilation, space heating and cooling and using solar energy.

Therefore, the proposed mixed- use redevelopments for the Leichhardt North Stop site, the derelict site near the existing bus depot and the Film Studio site should incorporate the latest features in ecologically sustainable design.

Some of the recommended methods include the usage of thermal matts, double glazed windows, external shading devices, energy efficient fluorescent lighting and low flow taps. In addition, design of the building in a way that increase the natural flow of the air will improve free cooling system and reduce electric load of air conditioning system. Also, design of the windows is important due to maximize the usage of day light (Leichhardt LEP2000, Taleb & Sharples, 2011). All of these methods play a role in conservation of natural resources, increasing social amenity and also will positively affect on economic directly and indirectly.

A heat recovery system within the drain system can recover as much as 70% of the heat from drained hot water and recycles back for immediate use (Inviroharvest Inc. 2011).

Using recycled water or grey-water as an alternative water source is one of the way to conserve high quality water for drinking and other personal uses. Grey-water can be used untreated, or it can be treated to varying degrees. Untreated grey-water can be used for garden irrigation and treated grey-water can be used for toilet flushing and washing machines (Department of Health, Victoria 2011).

One of the possible designs for new building and also City West Link wall in the proposed stop is Vertical Garden design in which recycled water can be used.

Figure 55, Vertical Garden, Source:

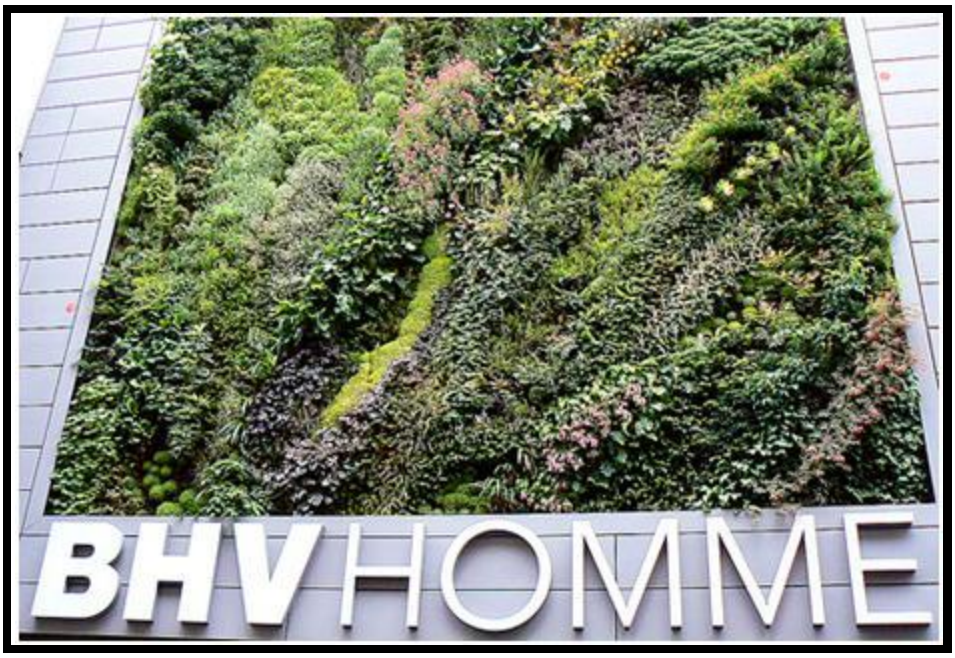


Figure 56, Vertical Garden

Source: The Grow Spot, http://www.thegrowspot.com/know/f5/vertical-gardens-living-walls-53838.html

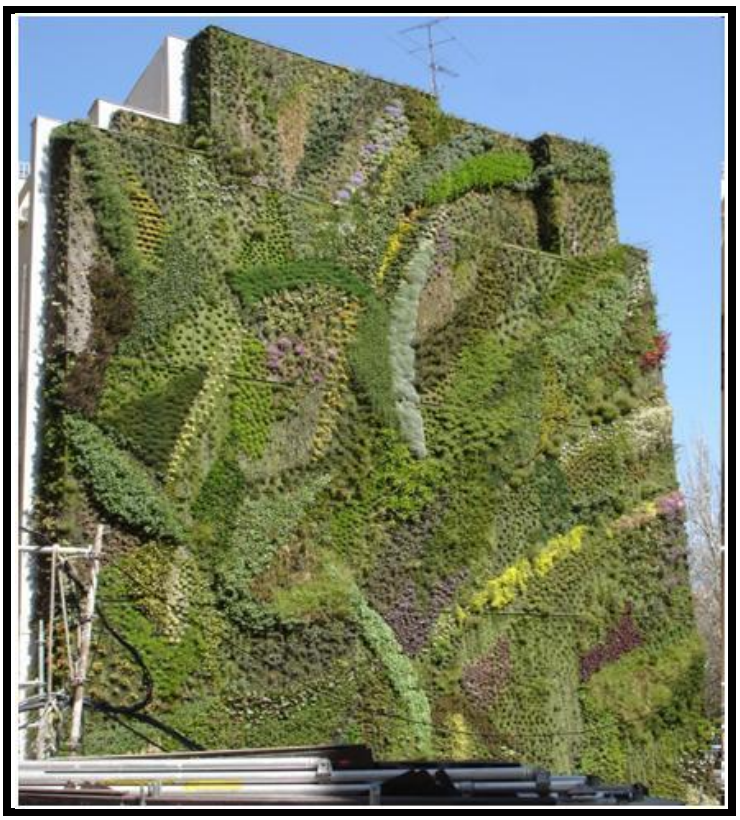


Figure: 57

Vertical garden by Patrick Blanc in Madrid, Spain.

Source: Adaptiveruse Via Green Roof Australia
http://greenroofs.wordpress.com/page/2/

Figure 58, ACROS Fukuoka building, Japan

Source: Greenroofs.com: http://www.metaefficient.com/?s=ACROS+Fukuoka+building

Figure 59, Building Design, Vertical Garden By Patrick Blanc

Source: The Grow Spot: http://www.thegrowspot.com/know/f5/vertical-gardens-living-walls-53838.html

Using a solar power is also useful in two ways: environmentally and financially. Some the benefits include:

- Reducing carbon emissions by using renewable energy source
- Low maintenance cost for a clean and reliable energy source which will produce energy for long time
- Reducing residential power bills (Solaray 2011)

Figure60, Solar Powers, Source: Woking Borough Council

Figure 61
Hybrolight
Source: Woking Council

The Hybrolight in Old Woking uses a combination of solar photovoltaic panels and a vertical wind turbine to power a street lighting column.

Appendix

Table 2

Leichhardt LGA: Age Distribution by Sex

Source: 2006 ABS Census

Age	Male	Female	Total
0 - 4 years	1,804	1,631	3,435
5 - 18 years	2,478	2,407	4,885
19 - 40 years	9,628	10,954	20,582
41 - 64 years	7,361	7,852	15,213
65 - 84 years	1,897	2,232	4,129
85 years and over	173	361	534

Table 3

Leichhardt LGA: Work Type by Sex

Source: 2006 ABS Census

	Female	Male
Working full-time (more than 35hrs/w)	**4,634**	**7,090**
Working part-time (less than 35hrs/w)	**3,514**	**1,713**
Total	**8,148**	**8,803**

	Low Density	Medium Density	Total
Owner Occupied	9,914	1,392	11,306
Tenanted	4,379	3,723	8,102
Total	14,293	5,115	19,408

Tabale 4 Leichhardt LGA: Housing Density, Source: 2006 ABS Census

Table 5, Leichhardt LGA: Household Income

Source: 2006 ABS Census

Level of Income	Gross Annually Income	Owner Occupied	Tenant	Total Households
Low	$40,999 or less	816	498	1,314
Middle	$41,000 - $155,999	3,443	2,204	3,647
High	$156,000 or more	2,497	844	3,341

Table 6

Leichhardt LGA: Language Spoken at Home

Source: 2006 ABS Census

Language	Persons
English	38,112
Italian	1,653
Greek	720
Chinese	743
Spanish	437
German	326
Arabic	198
Portuguese	140
Hindi	86

Table 7

Leichhardt LGA: Incidence of Crime in 5 year Period

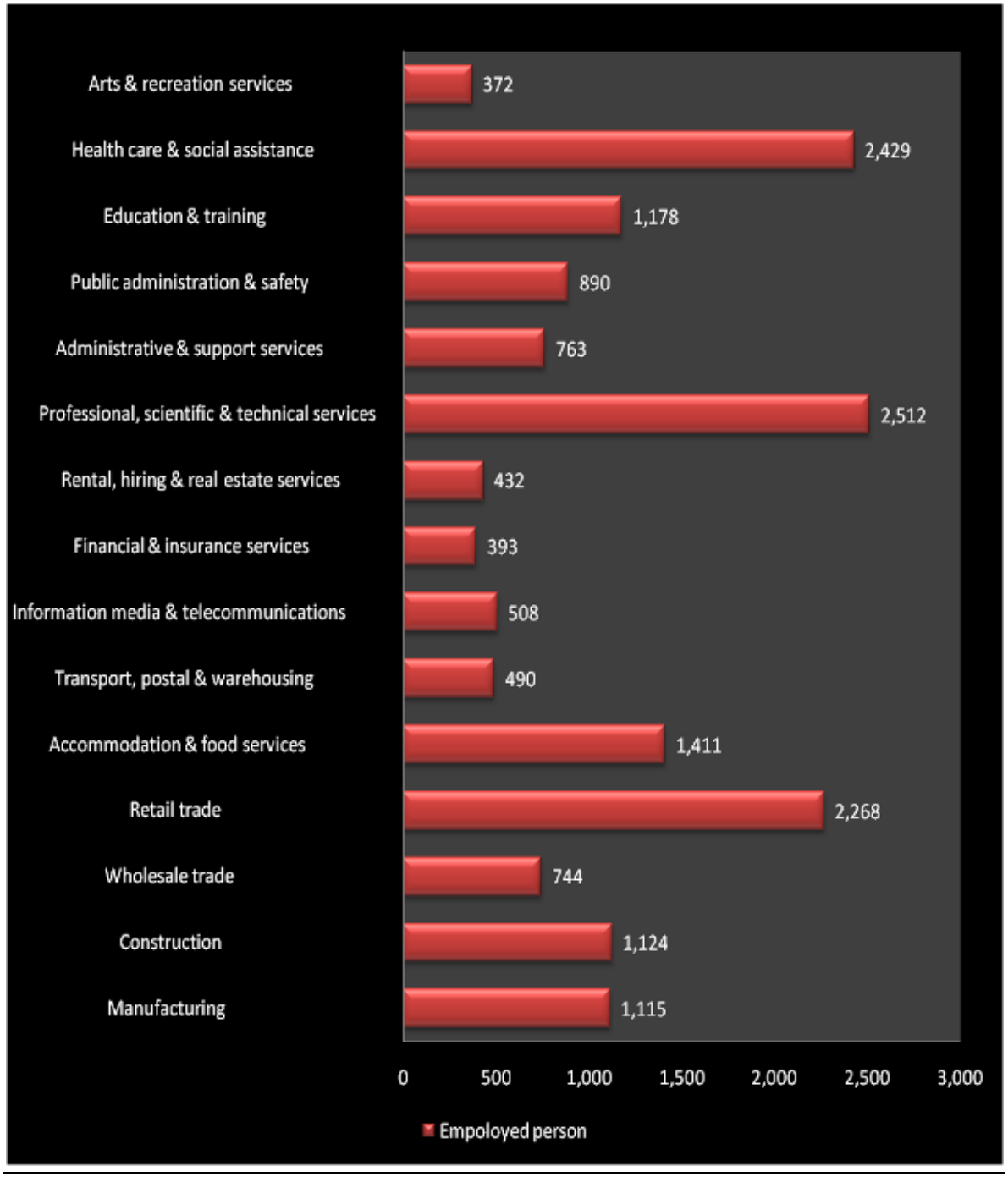
Source: 2006 ABS Census

Offence Type	Number of incident between 2005-2009	Rate per 100,000 population between 2005-2009	5 year trend
Domestic	586	222.6	Stable
Non-domestic	1,341	529.6	Stable
Sexual offence	214	81.2	Stable
Rubbery	3,113	1,189	Stable
Theft	6,975	2,656.6	Decreased
Fraud	1,315	3,603	Stable
Vandalism	3,775	1,436.6	Stable

Figure 11

Leichhardt LGA: Employment Industry, 15 Years & Over

Source: 2006 ABS Census



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