Client

Alinta Asset Management (3) Pty Ltd

Project

Rosehill Recycled Water Scheme
Social impact assessment

Date

11 July 2008

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Date	11 July 2008
Job number	06/391
Document name	Rosehill RWS Final Report 11 July 08
Version	Final Report

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1 Introduction

1.1 Background

For most of its settled history, Sydney has relied on water supplies from its extensive dam network. The storage capacity of the dam network is 2,600 billion litres. Sydney stores more water per head of population than most other cities of the world.

In recent times, however, water has become an increasingly scarce resource. A shift in community attitudes has seen governments more accepting of recycling strategies. Principles of sustainability are increasingly driving infrastructure policy and water recycling projects have gained importance.

Faced with water becoming one of Australia's major issues, the NSW Government released the Metropolitan Water Plan aimed directly at meeting Sydney's water needs into the future. The Plan states clearly that recycled water can deliver multiple benefits and has an important role to play in the suite of strategies aimed at protecting Sydney's water supply.

Implementation of the Metropolitan Water Plan to meet the challenge of securing Sydney's water supply in the long term and in drought requires innovation, resources, partnership approaches and new ways of managing and delivering supplies.

Participation of the private sector in water projects has been advanced through the Government's Water Savings Fund. The Government called for private companies to propose recycled water services in the Camellia area in order to identify the most imaginative, cost-effective and sustainable options available to reduce demand on Sydney's potable water.

AquaNet Sydney Pty Ltd, a joint venture between Singapore Power International Pty Ltd and Babcock and Brown (the Joint Venture) together with Alinta Asset Management (3) Pty Ltd (Alinta) and Veolia Water Australia, is the preferred tenderer by Sydney Water Corporation to design, build and operate the first privately owned recycled water treatment system in NSW, the Rosehill Recycled Water Scheme. Veolia would construct and operate a water recycling facility. Alinta would construct and operate the reticulation network for the recycled water. The project would deliver a cost effective recycled water scheme that reduces demand on Sydney's potable water through the supply of recycled water to industrial customers for non-potable use.

This report assesses the potential social impacts of the proposed Rosehill Recycled Water Scheme to accompany an Environmental Assessment under Part 3A of the Environmental Planning and Assessment Act.

The study area includes approximately 20 km of pipeline and considers the impacts to the communities of Parramatta, Holroyd, Fairfield and Bankstown, located along the pipeline route.

This social impact assessment outlines the likely effects, both beneficial and adverse, on the community and businesses within the study area. It draws on information from various technical studies undertaken during the investigations process, such as traffic and transport, noise, vibration and heritage assessments, as well as existing information and the results of community consultation.

1.2 Project objectives

In 2006, Sydney Water called for tenders for the development of a recycled water system using treated effluent from the Liverpool to Ashfield Pipeline (LAP) in Sydney's west. The project will deliver a recycled water scheme that reduces demand on Sydney's potable water through the supply of recycled water to industrial customers for non-potable use. The project is consistent with the need to supplement sources of Sydney's drinking water, in line with the Metropolitan Water Plan.

The Rosehill Recycled Water Scheme has the potential to deliver the innovation required by the Metropolitan Water Plan. The project will involve the design and construction of a recycled water treatment facility, pipelines, service reservoirs, pumping stations and other ancillary works.

The scheme would be one of the first privately owned recycled water distribution networks in Australia and represents a unique approach to a complex issue. The project can claim a number of 'firsts':

- Utilities and corporate customers will partner to deliver a significant recycling project
- It will be the largest privately owned water recycling project in NSW
- It will use best practice engagement techniques to involve the community and stakeholders from the outset.

1.3 Project description

The project involves construction of a reverse osmosis recycled water treatment plant (RWTP) at Fairfield designed for an initial water output of 20ML/day (7 billion litres per year) with capacity to

expand to an output of 25ML/day to meet expected future demand for recycled water.

It would also involve the construction of three above ground reservoirs for storage of recycled water and pumping stations at two locations along a 20 km pipeline route.

The plant will take secondary treated effluent from the LAP and, through a process of 'polishing' via reverse osmosis, produce recycled water. Recycled water would be stored onsite and pumped via a network of pipes towards the demand centres of Rosehill/Camellia and Yennora/Smithfield.

Thirteen industrial customer/water users have been identified in the Rosehill/Camellia and Yennora/ Smithfield areas to be provided with recycled water for the replacement of their drinking water usage. This recycled water would be used for industrial and irrigation purposes. In addition, another 26 potential customers have been identified that could be supplied recycled water with future network expansion.

Key components of the proposed Rosehill Recycled Water Scheme are shown on Figure 1 and include:

- Construction of a reverse osmosis recycled water treatment plant (RWTP) including reservoirs and a pumping station at the corner of North Street and East Parade, Fairfield in a parcel of vacant land owned by Sydney Water. The 1.2 ha site is adjacent to the Sydney Water Corporation's Fairfield Storm Sewage Treatment Plant (SSTP). The RWTP would have a peak output of 20ML/day of recycled water.

- Connection to the Liverpool to Ashfield sewage Pipeline, from which secondary effluent as feedstock for the RWTP would be sourced

- Rosehill Reservoir and pumping station proposed to be located in industrial land on the corner of Durham Street and Grand Avenue, Rosehill. The reservoir would comprise two storage tanks of approximately 25m in diameter and 6m in height and a pumping station

- Woodville Reservoir comprising a single storage tank of approximately 16m in diameter and 3.6m in height elevated 6m above the ground surface to be located on the north side of Barbers Road in South Granville, at the southern boundary of Woodville Golf Course between the maintenance building and the water supply pipeline.

- Approximately 20 kilometres of pipeline to be layed in trenches along public roads and public reserves to carry primary recycled water. The pipeline, which includes roughly five kilometres of isolated gas mains, would extend from Camellia, to the west of the City of Parramatta, through Granville, Guildford, branching off Woodville Road to an area adjacent to Prospect Creek and the Cumberland Highway. Another branch crosses The Horsley Drive, Prospect Creek and Fairfield Park to terminate to the east of the Railway alignment.

Alinta and its construction contractor(s) would use a range of techniques for laying sections of pipeline for the proposed Rosehill Recycled Water Scheme to reduce potential environmental impacts and disruptions to the community. Pipeline construction methods, shown in Table 1 overleaf, would include trenching, horizontal directional drilling, pipe bursting and re-use of an existing isolated gas main for five kms along Woodville Road between Fairfield East and Granville.

The scheme would initially supply recycled water to thirteen customers between Smithfield and Camellia, but would have sufficient capacity for possible future extensions to the Liverpool, Wetherill Park and Parramatta/Westmead areas. At customer locations, off-takes from the water main would allow access to the recycled water.

If approved, it is envisaged that project construction would commence in early 2009 following completion of regulatory approvals and notification to residents and stakeholders. Construction of the project would take about two years with completion scheduled for June 2010 or 2011. Its capital cost is estimated to be $100 million.

Table 1 – Construction method – pipe laying methods

Pipe laying method	Description	Location
Trenching	Standard pipeline laying method involving excavation of a trench, laying of pipe and backfilling.	Default pipeline laying method for non-sensitive areas
Horizontal directional drilling (HDD)	A trenchless technique that involves drilling a small diameter pilot hole using a drill head and drill rod launched from a drilling rig. The pilot hole is enlarged to a sufficient size to accommodate the recycled water pipe. HDD involves the use of a drilling fluid, usually bentonite slurry, as a lubricant and to flush out cuttings to the surface for treatment.	Waterway crossings including Prospect Creek in Fairfield Park, Burns Creek (two locations) and Duck Creek.
Thrust boring	A trenchless technique that involves installing pipe sections with an augur head to create a void and to remove spoil.	Arterial road crossings including Woodville Road, Fairfield Road and Parramatta Road. Railway line crossing at Yennora Railway Station. Duck River
Pipe bursting	A trenchless technique that involves splitting an existing (isolated) 12-inch Alinta gas pipeline with a hydraulic or pneumatic nose cone to create a void into which the new pipe is inserted.	Woodville Road, Fairfield East to Granville
Pipe lining	Lining of an existing gas pipeline (isolated) to facilitate water reticulation.	Underneath the railway corridor at Clyde Railway Station
Pipe bridge	A section of elevated pipeline that is not buried.	Locations where the proposed pipeline intersects with water supply pipelines on Woodville Road and Barbers Road in Guildford and at crossings of some drainage channels.

Source: Parsons Brinckerhoff, January 2008.

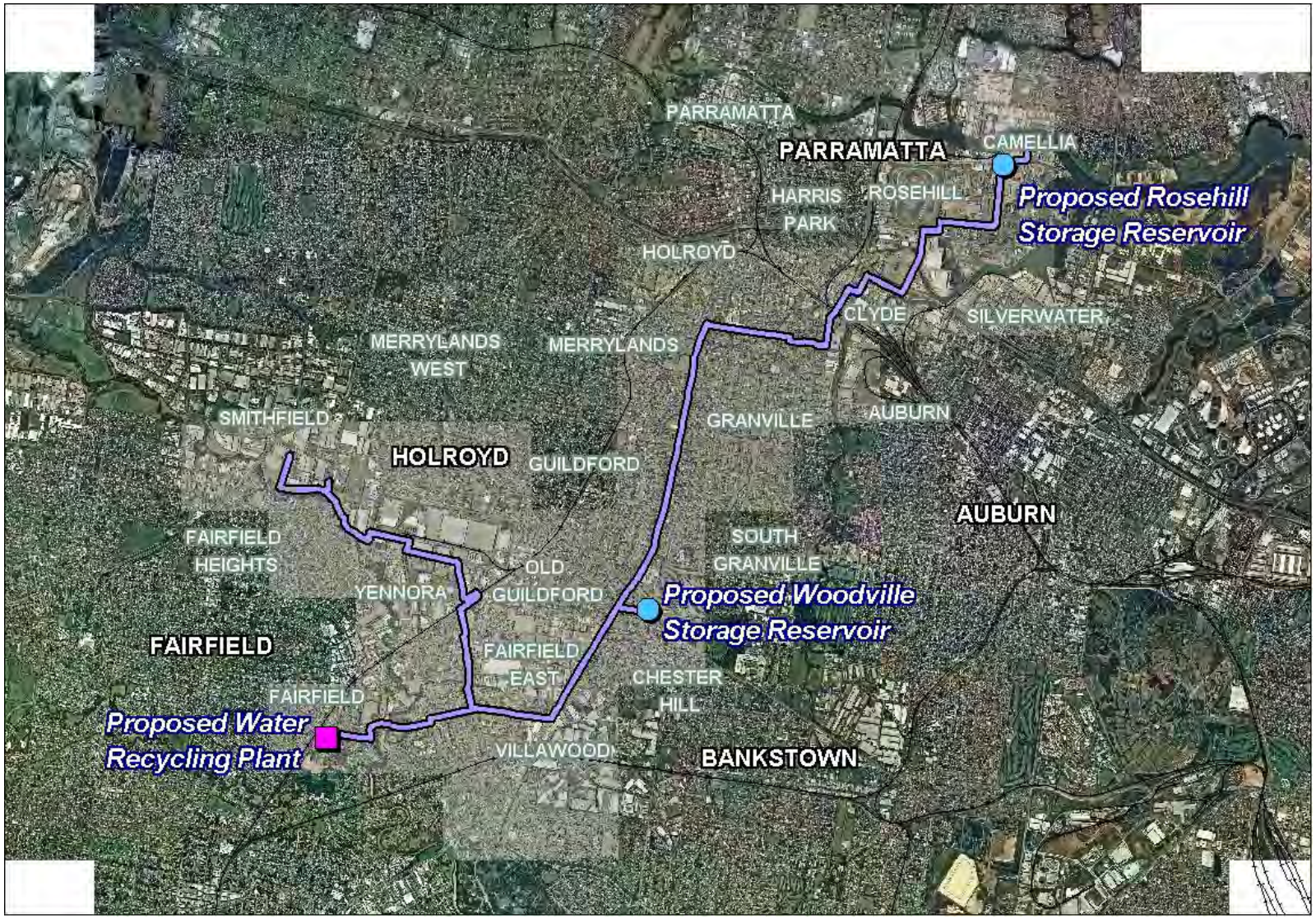

Figure 1 – Route of the proposed pipeline and location of reservoirs and pumping stations

1.4 Study approach

Social impacts are commonly defined as being "[E]vents experienced by people as positive and negative changes in:

- Their way of life – the way people live, work play and relate to one another, organise to meet their needs and generally participate as members of society
- Their culture – beliefs, customs and values
- Their community – its cohesion, character, services and facilities." (Armour, 1992).

Social Impact Assessment (SIA) is most beneficial when undertaken during the project development phase, to ensure that greater certainty pertaining to social impacts of a proposal up front will allow adaptive responses in project design and development.

This study adopts the methodology for SIA consistent with the NSW Cabinet Office *Guidelines for Assessing Social Impacts* (1997) and the Ministry of Urban Infrastructure Management (MIUM) 1998, *Guidelines for Assessing the Social Impacts of Infrastructure Projects DRAFT* which remain the most current NSW government guidelines on the assessment of social impacts.

The SIA process involved:

- Discussions with members of the project team and review of project information
- Collation and analysis of 2006 Census data
- Review of planning policies applicable to the area
- Discussions with Councils' Social Planners
- Integration with consultation process, including attendance at Community Information and Feedback Session and review of feedback information
- Review of technical consultancy reports for the project
- Summary of information provided and analysis of likely social issues and impacts arising from the proposal
- Development of measures to mitigate identified adverse impacts.

2 Existing social environment

2.1 Strategic overview

The Rosehill Recycled Water Scheme is consistent with the directions of key NSW Government legislative and policy drivers relating to sustainable growth and development within Sydney, as well as conserving water resources. The project seeks to implement the objectives of the NSW Water Management Act as well as the resource conservation outcomes of the Sydney Metropolitan Strategy and the Metropolitan Water Plan, as outlined in Section 2 and 3 of this Environmental Assessment.

A summary of relevant regional and local strategic planning directions is provided below.

2.1.1 Metropolitan context

Metropolitan Water Strategy

The 2006 Metropolitan Water Strategy sets out a range of measures to provide a secure water supply to meet Sydney's future water needs. It outlines ways in which the NSW government aims to:

- Provide a secure water supply to meet the long term needs of Sydney
- Ensure that water supplies are adequate during drought
- Minimise costs to the community and the environment.

In the past, Sydney has relied heavily on capturing and storing rainwater through its system of dams and water catchments. However, an increasing focus on sustainability of water use including demand management and recycling opportunities will be used to better balance future demand and supply.

The *Metropolitan Water Strategy* identifies an important role for recycled water in industry, agriculture and for non-potable uses in new homes. "Recycling can reduce the demand for drinking water, deliver benefits to river health by decreasing the level of nutrients discharged by sewage treatment plans and diversify the system with a supply source not relying on rainfall" (p. v).

The Strategy aims to save 145 billion litres of water per year by 2015, through a combination of initiatives including, reducing demand, BASIX and improving access to recycled water supplies. Almost half of this saving is expected to be achieved through recycling initiatives.

The Rosehill Recycled Water Scheme is a core deliverable of the Metropolitan Water Plan (p.43). It aims to provide up to 6 billion litres of recycled water every year to industrial and open space users through sewer mining and provision of a recycled water connection for a number of large industrial users in western Sydney. Treated wastewater can be sourced from Liverpool Sewage Treatment Plant, retrieved through sewer mining and is then delivered to customers with a large demand. This sewer proposal is the subject of this social impact assessment.

Water Industry Competition Act 2006

The objective of this Act "is to encourage competition for the supply of water and provision of sewerage services and to facilitate the development of infrastructure for the production and reticulation of recycled water" (PEA, p. 12). Under this Act, "the Minister can grant a network operator's licence that authorises the licensee to construct, maintain and operate water industry infrastructure." (PEA, p.12). A licensed network operator can then carry out any work in or under a public road or public reserve"... after notifying the local council or roads authority and allowing 40 days for submissions.

The proponents of this project will apply for a network operator's licence under this Act to carry out the construction works.

Energy and Utilities Administration Act 1987

In 2005, this Act was amended to require large water users to prepare Water Savings Action Plans.

Seven customers proposed for this project are required to prepare Water Savings Action Plans. Participation in this project will assist them in reducing demands for potable water.

Council Social Plans

Council social plans identify and prioritise the main social needs and high needs groups within each LGA. Although there is great variety in the household characteristics and social needs across the study area and within individually local government areas, the key social issues of relevance to this proposal broadly include:

- Areas of rich cultural heritage and diversity in backgrounds and languages and the need to

target services to the needs, cultural practices and languages of these groups, especially in areas of rapid growth and change. High proportion of persons born overseas that do not speak English well or at all

- Meeting the needs of large proportions of the local population from culturally and linguistically diverse (CALD) groups including Somalian, Ethiopian and Kurdish communities, refugees, those on temporary protection visas and other immigrant groups
- Concentrations of multiple social disadvantage, especially amongst newly arrived migrants and refugees
- Poor community health including emerging health issues for children
- Need for support services for children, older persons, youth populations, people with a disability, homeless people and refugees
- Uneven provision of support services and limitations to accessing the services available. Need for specialist health resources, such as torture, trauma counselling for refugee community and mental health facilities. Constrained and inadequate council social and cultural infrastructure and reliance on non-profit/community sector.
- Community harmony with emerging marginal groups and changing social needs
- Need for improved public transport service and accessibility for youth, elderly and disabled or less mobile persons.
- Housing issues for single and recently divorced men
- Areas with high levels of indigenous and/or youth unemployment. Need for employment programs and skills development and support for young people
- Areas of major and petty crime and poor perceptions of actual levels of public safety
- Strength through social capital.

The social plans confirm many of the demographic characteristics described in the community profile below which have direct impacts on the quality of life and needs of residents of the past of western Sydney. In particular, community needs through the area impacted by the proposed pipeline relate to the needs of new immigrant groups, issues arising from unemployment, family, child and youth support services, community health, education needs, recreational activities and housing affordability, transport accessibility and crime and safety.

While this information on community needs and priorities provides a background to considering potential social impacts, it is unlikely the project would directly impact on many of these issues critical to local communities.

2.2 Community Profile

2.2.1 Background

The pipeline extends through the Local Government Areas (LGAs) of Parramatta, Holroyd, Fairfield and Bankstown and along the border of Auburn LGA. The length of the pipeline is approximately 20km. Given the expanse of the study area, the community profile has been prepared at an LGA wide level. A summary of the key demographic characteristics of each of the LGAs is provided in Table 4.1.

2.2.2 Characteristics of the study area

Table 4.1 provides a summary of population, housing and labour force statistics for the LGAs of Parramatta, Holroyd, Fairfield, Bankstown and Auburn, compared with the Sydney Statistical Division and NSW overall. Key characteristics include:

Country of origin and languages

All suburbs have a significantly high proportion of persons born overseas, when compared to both the Sydney and NSW figures. Fairfield and Auburn LGAs have a particularly high proportion of persons born overseas (58.5% and 53.2% respectively). This is substantially higher than the Sydney average of 39.6%.

This data correlates with high rates of languages other than English spoken in the home. Auburn (77.9%) and Fairfield (72.5%) LGAs demonstrated especially high proportions of persons speaking a language other than English in the home, double the Sydney average of 36.1% and almost three times the proportion for NSW overall (26%). Arabic, Cantonese and Vietnamese are the most commonly spoken languages other than English.

Household size

Household sizes are generally higher in these LGAs than the Sydney and NSW averages. Parramatta has a similar average household size to that of Sydney SD (both 2.7 persons per household), however Fairfield and Auburn have a significantly

Table 2 – Regional population and employment characteristics

Population characteristic	Parramatta LGA	Holroyd LGA	Fairfield LGA	Bankstown LGA	Auburn LGA	Sydney SD	NSW
Population 2006	148,324	89,766	179,891	170,489	64,958	4,119,191	6,549,178
Population growth 2001-2006	3.6%	5.3%	-0.9%	9.4%	16.2%	4.5%	3.7%
Indigenous persons	0.8%	0.8%	0.6%	0.7%	0.7%	1.1%	2.1%
Male	50.1%	50.5%	49.5%	49.3%	52.1%	49.3%	49.3%
Female	49.9%	49.5%	50.5%	50.7%	47.9%	50.7%	50.7%
Median age	34 years	34 years	34 years	35 years	31 years	35 years	37 years
Persons aged under 15 years	19.1%	20.6%	21.6%	21.9%	21.0%	19.5%	19.8%
Persons aged over 65 years	12.3%	12.2%	11.2%	14.0%	9.0%	12.3%	13.8%
Born overseas	48.3%	46.9%	58.5%	43.3%	53.2%	39.6%	30.9%
Speaks a language other than English at home	51.3%	51.4%	72.5%	56.5%	77.9%	36.1%	26%
Average household size	2.7 persons	2.8 persons	3.2 persons	2.9 persons	3.1 persons	2.7 persons	2.6 persons
Dominant family type	Couples with children 15+ years	Couples with children 15+ years	Couples with children 15+ years	Couples with children 15+ years	Couples with children 15+ years	Couples with children 15+ years	Couples with children 15+ years
Lone person households	9.4%	8.4%	4.9%	7.1%	6.2%	8.9%	9.5%
Proportion of fully owned dwellings	27.9%	31.7%	33.4%	36.5%	27.5%	31.9%	34.8%
Proportion of dwellings being rented	38.3%	35.5%	30.1%	28.9%	39.5%	31.3%	29.5%
Median weekly household income	$1,043	$998	$873	$926	$906	$1,154	$1,036
Main employment industries	Health care & social assistance (10.8%)	Manufacturing (12.5%)	Manufacturing (20.2%)	Manufacturing (13.5%)	Manufacturing (13.8%)	Retail trade (10.5%)	Retail trade (11.1%)
Occupational structure	Professional (23.2%)	Clerical & administrative (19%)	Technicians & trade workers (16.9%)	Clerical & administrative (18.5%)	Professional (18.3%)	Professional (23.8%)	Professional (21.2%)
Unemployment rate	6.7%	6.9%	10.5%	7.4%	9.1%	5.3%	5.9%
Full-time employment	62.9%	64.1%	60.2%	59.6%	61.1%	63.1%	60.8%
Part-time employment	24.3%	22.8%	22.1%	24.5%	23.0%	25.7%	27.2%
Labour force participation	57.4%	57.6%	51.9%	53.1%	49.6%	60.7%	58.9%
Post school qualifications	42.1%	36.7%	25.6%	32.2%	31.4%	42.9%	40.7%

Source: Australian Bureau of Statistics, 2006 Census of Population and Housing

higher average household sizes at 3.2 persons and 3.1 persons respectively.

Income and employment characteristics

Fairfield and Auburn LGAs have significantly lower median weekly household incomes ($873 and $906 respectively) than the Sydney median ($1154). These areas therefore have a relatively high proportion of larger households living on relatively low incomes.

All LGAs along the pipeline route experience higher levels of unemployment than the Sydney SD (5.3%) and NSW overall (5.9%). The unemployment rate in Fairfield is roughly double that of the Sydney SD at 10.5% in 2006. This figure is closely followed by Auburn LGA at 9.1% and Bankstown (7.4%), Holroyd (6.9%) and Parramatta (6.7%).

The proportion of the labour force in full time employment is comparable to the Sydney and NSW figures within Parramatta, Holroyd and Fairfield LGAs, at between 60-64%. Bankstown is lower than the Sydney SD and NSW figures, with 59.6% of persons employed on a full time basis in Fairfield, compared to 63.1% in Sydney and 60.8% in NSW.

Labour force participation rates are notably lower in Auburn, Fairfield and Bankstown LGAs. Participation rates are lowest in Fairfield and Bankstown, where rates are 51.9% and 53.1% respectively. All of these LGAs have lower levels of female participation in the workforce with 42.4% in Auburn, 42.9% in Fairfield and 44.8% in Bankstown, compared with Sydney where 54.5% of females participate in the labour force. Manufacturing represents the principal employment industry for residents of all LGAs in the study area other than Parramatta. Manufacturing represents 20.2% of employment in Fairfield, 13.8% in Auburn, 13.5% in Bankstown and 12.5% in Holroyd.

Educational attainment

With the exception of Parramatta, attainment of post school qualifications for residents of the study area is on average lower than for Sydney (42.9%) and NSW (40.7%). In Fairfield, despite technicians and trades being the largest occupational grouping, only 25.6% of the population has completed a post school qualification. Auburn, Bankstown and Holroyd LGAs indicate higher levels of post school qualifications at 31.4% 32.2%, and 36.6% respectively.

Family and household characteristics

Couples with children are the dominant family type across all LGAs. Of these families, couples with non-dependent children were most highly represented.

There are a higher proportion of children and young persons under 15 years in Bankstown and Fairfield LGAs at 21.9% and 21.6% respectively. This is slightly higher than the Sydney and NSW figures of 19.5% and 19.8%.

Auburn LGA has a significantly lower median age of 31 years than adjoining LGAs and both Sydney and NSW medians of 35 and 37 years respectively. At 14%, Bankstown has a proportionately higher percentage of persons aged over 65 years than Parramatta, Holroyd, Fairfield and Sydney SD, which are around 11 to 12%. Auburn has the lowest proportion of persons aged over 65 years, at only 9%, which is well below Sydney and NSW figures.

Housing tenure

The proportion of fully owned homes is highest within Bankstown (36.5%) and Fairfield (33.4%) LGAs and these proportions are higher than that of Sydney SD (31.8%). This is likely to reflect a combination of factors including traditionally higher levels of housing affordability. By contrast, Auburn has lower levels of home ownership (27.5% of dwellings fully owned) and higher levels of renting (almost 40%) which is well above the Sydney SD and NSW figures of around 30%. This may be indicative of both a younger population and lower incomes.

2.2.3 Implications of demographic indicators

The demographic profile identifies a number of key considerations specific to the community located along the course of the pipeline, which will need to be addressed by the proposal. These key issues and implications are summarised below.

- With 51-78% of persons speaking a language other than English at home, communications and consultation exercises will need to be cognisant of reaching a broad community. This may require specialist translation services and engagement methods, with particular focus on the Arabic, Cantonese and Vietnamese languages. Communications materials produced and disseminated within the community must be clear and concise, with directions for seeking translation services for explanations of project material.

- Labour force participation rates in the suburbs located along the pipeline are below that of

Sydney and NSW, particularly in the suburbs of Bankstown, Fairfield and Auburn. There are also relatively lower participation rates for women. There may therefore be a higher proportion of people home during the day across this study area, which will be important in considering construction arrangements, noise impacts and changes to road conditions resulting from the tunnelling exercise and construction.

- Given the relatively lower levels of education and high numbers of non-English-speaking households, it will be necessary to ensure that information circulated about the project is clear, concise and easily accessible. Great care should be taken to avoid technical jargon and assumptions that residents are familiar with the planning process or strategic justification for a water recycling scheme.

- The main employment industry across Holroyd, Fairfield, Bankstown and Fairfield LGAs is manufacturing, consistent with a higher concentrations of industrial development in these locations. Residents may be employed at one of the many manufacturing sites which will use recycled water or may have an understanding of processes where the water will be used.

2.3 Route survey

A background assessment of potential social issues arising from the project was undertaken in conjunction with the route survey in November 2007. The route survey attempted to identify stakeholders who may be impacted by the project through the study area and get an 'on the ground' feel for the types of issues which might arise as a result of this project. The route survey helped identify sites such as schools, nursing homes, shopping areas, busy intersections, community facilities and other sensitive land uses.

2.3.1 Sensitive land uses

Sensitive uses which could be affected by this proposal include:

- Cuddly Bear pre-school, North Street, Fairfield
- Villawood North Public School, Tangerine Street
- Bimbo Kindergarten, Tangerine Street
- Villawood Aged Care Facility
- Dr David Chan, surgery
- Yennora Primary School, Yennora
- Verona School, Yennora
- Full Gospel Churches of Australia, Yennora
- Rosary Village Nursing Home, Yennora
- Many churches, schools, pre-schools along Woodville Road
- A child care centre on Barbers Road, Old Guildford
- Schools, pre-school, TAFE and churches along Elizabeth, New York and Third Streets, Granville.

Consideration will be given to the sensitive nature and operating conditions of these activities when assessing potential construction and operating impacts of the proposal. For example, in some areas, night works would be considered to minimise social, as discussed in section 5.

2.3.2 Businesses, industrial, commercial and distribution centres

Commercial centres along the route include:

- Corner of The Horsley Drive and Tangerine Street (6-7 small businesses) and a small industrial complex containing Bunnings
- Small businesses at intersection of Crown Street and Fairfield Parade
- Seville Business Park - A large industrial estate in Fairfield East bounded by Fairfield, Lisbon, Seville and Mandarin Streets could have access disrupted at Lisbon and Seville Streets during construction
- Heavy industrial area and small businesses on Nelson Road, Yennora
- Major industrial area and major distribution centre, Nelson Road, Norrie Street and Loftus, Pine and Dursley Roads, Yennora
- Numerous businesses and shopping villages along Woodville Road. Very large industrial estate bounded by Malta Street, Woodville Road and Orchardleigh Street.
- A turf business on Barbers Road to the south of Woodville Golf Course
- Small and large businesses along Elizabeth, New York, Third Streets and Factory Streets, Granville, including the International Mail Centre

- Around 20 small to large business would be impacted along eastern side of Berry Street, Parramatta, known as 'auto alley' but also including Duck River Estate Shopping village, food production, interiors, insurance companies, a café and car repairs.

- Industrial areas along Shirley, Unwin, Colquhoun, Devon and Durham Streets, Rosehil and Grand Avenue and Thackeray Streets Camellia.

Key issues identified through this spatial analysis are discussed in Sections 3 and 4 below.

2.4 Community issues

The concerns and feedback of communities and businesses within the study area and the types of issues that are likely to be raised in response to the proposal were identified through a range of sources, including the community consultation program and discussions with local government.

2.4.1 Community consultation

The Consultation Strategy for this project included the following elements:

- Stakeholder analysis

- Key stakeholder workshops including a risk analysis workshop and workshop with local government representatives

- Letters to local members of parliament, council general managers, government agencies and residents nearest the proposed plant

- Distribution of a community newsletter

- 1800 number as a project 'hotline'

- Community information and feedback sessions in three locations – Fairfield, Granville and Guildford

- Dedicated project website.

Where possible, information provided was also available in community languages, given the high proportion of non-English speakers across the study area.

2.4.2 Local government workshops

A workshop attended by representatives of the four local councils (Parramatta, Fairfield, Holroyd and Bankstown) was held in December 2007 to brief attendees on the project and seek their feedback. The key workshop objectives were to:

- Advise each council of the project and seek comment during the environmental assessment stage to identify concerns and or/opportunities that councils may have

- Identify key issues and concerns that the project team need to be aware of for planning for the construction of this important project

- Discuss the scope and impact of the proposal, the proposed consultation activities and ensure the communications approach is appropriate for local target audiences.

Attendees raised the following social issues relevant to this assessment:

- A limited sense of community in areas of housing along Woodville Road. Many of the premises are rented.

- Concern about disruption to industrial/ commercial premises in Camellia and the need to avoid disruptions to business access as far as possible

- Low levels of access to a computer or the internet by residents in some areas of Fairfield.

- Expected cultural and educational barriers to the dissemination and interpretation of technical project information. This would indicate a need for innovative communication and engagement with the public eg through pictures/diagrams and a model of the project and by targeting community members through existing community organisations, community leaders and established links with the community. Information will need to be provided in community languages and at places where the community congregates.

- Expected barriers to articulation of community concerns and interests.

2.4.3 Community information and feedback sessions

Community consultation has been a core component of the Rosehill Recycled Water Scheme. Local community members have important local knowledge that can assist in identifying constraints to route options.

Community information sessions were held on:

- Saturday 29 March, at Fairfield Community Centre, 25 Barbara Street, Fairfield

- Thursday evening 3 April, at Granville Youth and Community Recreation Centre, 3A Memorial Drive, Granville

- Saturday 5 April, at Guildford Community Centre, 90 O'Neill Street, Guildford

The sessions were open house meetings where members of the public were invited to view the route maps, ask questions and make comments to members of the project team. The sessions presented information about the scheme and the outcomes of the environmental assessment on 21 A0 storyboards. Attendees were also encouraged to complete a feedback form at the session or via a reply paid post. Further details are provided in the Consultation Outcomes report (Section 4 and Appendix D).

The main issues raised by the 23 attendees and 8 feedback forms are summarised in Table 3. Key concerns were as follows:

- Impacts on flora and fauna, particularly in the area surrounding the Fairfield SSTP
- Noise and vibration issues during construction and operation
- Property depreciation and visual amenity impacts
- Safety impacts during construction, especially the bike path in North Street and East Parade.

In general, consultations identified support for the overall aim supplying recycled water for industrial and irrigation use to help reduce the pressure on Sydney's drinking water supply. Attendees expressed a mixed response as to whether private sector involvement and competition in the water industry would lead to better provision of water services.

The majority of attendees felt that their knowledge and understanding of the environmental and social impacts associated with the proposal had improved though attending the community information and feedback session. All participants were either residents or property owners and felt that the construction and operation of the scheme would have either a medium to low impact on their daily life.

Given the small response to the community information and feedback sessions, Alinta will ensure that proactive community relations activities, during construction, are undertaken to establish open working relationships with the community and keep them informed as the project progresses (see section 5).

Table 3 - Summary of issues identified through community information and feedback sessions

Issue	Details of issue	Section addressed
Noise and vibration	• Concern expressed regarding noise from trucks and machinery during construction • Clarification sought regarding the duration of construction time on North Street • Suggestion to work within reasonable hours such as 8.00am to 4.00pm, Monday to Friday only	Section 3 and 4 of SIA Section 8.2 of EA
Flora and fauna	• Concern conveyed regarding the impact on birdlife, such as Kookaburra's, Galahs, Parrots and Cockatoos in North Street/East Parade/East Pole land • General feeling conveyed that bird life in the land surrounding the Fairfield Sewage Treatment Plant has increased since the land has been vacant • Suggestion to use recycled water in parks and the golf course to plant trees/shrubs/flowers in order to attract native fauna to the area • General statement that there would be little impact on the flora and fauna as the area is already urban and industrial • Request not to disturb the colony of Bellbirds living in the trees near the Fairfield Sewage Treatment Plant • Concern conveyed that the scheme would reduce healthy vegetation and birdlife in the area • Unease expressed regarding possible subsidence in soft soils near Prospect Creek	Section 3 and 4 of SIA Section 8.3 of EA
Traffic, transport and access	• Strong concern expressed regarding potential traffic disruption • Suggestion to control traffic in North Street and Orchard Road, Fairfield as there are only two exit/entries points • Concern conveyed regarding possible disruption at Yennora railway station • Interest expressed regarding rerouting traffic on Woodville Road • Concern expressed regarding blocking driveways with trucks and equipment and disturbing access	Section 3 and 4 of SIA Section 8.1 of EA
Visual and odour	• Request to plant more trees in front of water tanks to make them less visible. Further suggestion to build them underground • Concern expressed regarding the sightliness of the water tanks and request to further shield them from view	Section 3 and 4 of SIA Section 8.7 of EA
Water quality	• Request to undertake constant quality control of treated water for coliforms	Section 4 of SIA Section 8.5 of EA
Property depreciation	• North Street resident expressed concern regarding property depreciation	Section 4 of SIA Section 8.8 of EA
Health and safety	• Suggestion to address safety issues associated with construction on North Street and East Parade – a lot of children and adults use the bike path	Section 3 of SIA Section 8.6 of EA
Miscellaneous	• General point raised that local residents will find it difficult to understand the aims and methodology of the project • Suggestion to be careful of overhead powerlines • Enthusiasm for the scheme and the aim of the project, to reduce pressure on Sydney's drinking water • Clarification sought as to whether water rates will decrease • One resident strongly opposed the project and expressed a lack of trust in the Government • Clarification sought as to whether the scheme would expand to supply residential properties in the future • Suggestion to include more local newspaper advertisements and highly visible street signage. Further suggestion to do a letter box drop when construction commences.	Sections 3,4 and 5 of SIA Various sections of EA

3 Construction impacts on the social environment

The above range of information sources has highlighted the key social issues and potential impacts likely to arise from construction of the proposed recycled water scheme. In addition, a range of technical consultancy reports prepared for this proposal were reviewed to identify potential social impacts which would arise from construction and/or operation of this proposal. Key construction issues and impacts are assessed in this section and operational impacts are assessed in section 4.

3.1 Construction method and timing

The major impacts likely to arise from this proposal will occur during its construction, due to its extensive (20km) coverage. The proposed pipeline route will pass through roads and areas open space in 15 suburbs in the Fairfield, Bankstown, Holroyd and Parramatta local government areas of western Sydney. New infrastructure will also be built in two areas currently used as open space.

Prior to construction a detailed construction methodology and a Construction Environmental Management Plan would be developed, containing measures to manage and minimise construction impacts (PEA, p.9). The plan would aim to minimise disruption to:

- Environmentally sensitive areas
- Residents and businesses along the route
- The general public.

As part of the Construction Management Plan, the construction route would be divided into zones with work sites established at the reservoir and pumping station sites and other temporary sites identified at suitable locations on road verges along the route. In some cases sites would also occupy one laneway of the road. Larger sites would be surrounded by hoardings or fencing.

Construction works for the supply pipeline would occur on a block-by-block basis with each block being partially or fully closed to traffic and detours implemented. Pipes would be installed underground along suburban streets, under footpaths and nature strips, under major roads and through areas of open space. Trenches would be dug by an excavator or trenching machine. In most locations, trenching, laying of the pipeline and backfilling of the trench would occur all on the same day so that local residents of the affected block would have vehicular access to their properties outside of construction work hours (PEA p. 9).

Work crews operating from smaller work sites, would establish and dismantle these every few days as pipe laying proceeds along the route. Pipeline construction is expected to occur at an average lay rate of approximately 30 metres per day. Actual lay rates for each section would vary from a few metres per day to almost 75 metres per day depending on the construction method and environmental constraints. Information for local residents would be provided through a range of mediums, as discussed in the section 5.

Construction methods are summarised in Table 1 and would include:

- Open trenching in new sections along local roads
- Inserting pipes directly into disused gas mains or ‘pipe bursting’ where there are exist pipes (along Woodville Road between Fairfield East and Granville and underneath the railway corridor at Granville)
- Boring where the pipeline crosses arterial roads
- Horizontal directional drilling across waterways.

Where trenching of the pipeline is proposed on a section of the alignment adjoining industrial, business or educational land uses, night-time or weekend works and works during school holiday periods would be planned to minimise disruption to these land uses (PEA p. 9).

Along Woodville Road, the pipeline would use a disused gas main and a process known as ‘pipe bursting’ would be used to enable a larger pipe to be inserted. This involves creating a bell hole every 90 metres through which a nose cone is inserted, which is then pulled though the pipeline, up to the next bell hole.

Construction hours would be governed by planning approval conditions. It is anticipated that in some areas construction would occur between 7am and 6pm Monday to Friday and 8am to 1pm Saturday. However, along major roads and other areas of heavy traffic, such as along Woodville Road and in the vicinity of Yennora Railway Station, for example, construction could be scheduled for night times to minimise traffic disruptions. It is

anticipated that there would be no work on Sundays or public holidays.

Subject to all approvals being received, construction would be expected to commence in late 2008 and continue for approximately two years. The system would be operational, delivering recycled water to industrial and irrigation customers by early 2011.

3.2 Traffic, public transport and cycleway impacts

Traffic and public transport issues were among the most frequently identified community impacts from the proposal, as shown in Table 3 and summarised below:

- Strong concern expressed regarding potential traffic disruption
- Suggestion to control traffic in North Street and Orchard Road, Fairfield as there are only two exit/entries points
- Concern conveyed regarding possible disruption at Yennora railway station
- Interest expressed regarding rerouting traffic on Woodville Road
- Concern expressed regarding blocking driveways with trucks and equipment and disturbing access.

During construction, traffic and access will be temporarily restricted for vehicles, bicycles and pedestrians. The Parsons Brinckerhoff *Traffic and Transport Study* for the proposed Rosehill Recycled Water Scheme (May 2008) identifies, on a street by street basis, the extensive spread of neighbourhoods likely to experience short-term impacts to properties and business. It proposes construction methods or scheduling of works to reduce impacts on properties

Residents in some areas, such as North Street, Latty Street, McIntosh Street and Orchard Road, Fairfield, may be particularly sensitive as they have recently experienced disturbances to access, noise and disruptions from construction of the Liverpool to Ashfield pipeline (LAP) through their local neighbourhood. The potential for community concerns as a result of the cumulative impacts of these two projects should not be overlooked.

Potential traffic impacts during construction of the proposal include:

- Reduction in road capacity and subsequent congestion on principal traffic routes due to lane/road closures
- Delays and loss of vehicular access to business, residential and other properties
- Loss of access for service vehicles and amenities (e.g. maintenance, garbage collections)
- Potential delays to public transport services
- Road user safety risks with moving traffic around construction work sites and compounds
- Disruptions to pedestrians in the vicinity of construction work sites
- Traffic and safety implications of construction vehicles (especially heavy vehicles) for pedestrians and light vehicles.

From a traffic management perspective, the greatest areas of potential impact are likely to occur:

- From trenching across the intersection of Fairfield Street, Crown Street and Ellis Parade, Fairfield East, where local and through traffic movements, two schools and Yennora railway station access will need to be accommodated
- At Railway Street, the northern access to Yennora railway station, where pedestrian access and traffic access will need to be maintained
- Along Woodville Road as this is a major arterial road estimated to carry almost 55,000 vehicles per day and providing connections between three motorways and other arterial routes. The affected section of Woodville Road between Tangerine Street and Elizabeth Street) contains 12 signalised intersections. Much of the construction planned for this section of the route will be scheduled for night times to minimise traffic and occupational and traffic safety impacts
- From trenching under Parramatta Road, where there would be major impacts on road capacity as well as occupational and traffic safety impacts
- At Wentworth Street, Granville, where trenching could impact on local and through traffic movements between Rosehill and Granville

However, traffic disruptions will occur along most parts of the pipeline route during the construction period. Key intersections and roads where impacts will need to be carefully managed include:

- Gordon Street roundabout, Fairfield

- The Horsley Drive and Tangerine Street, Fairfield East
- Tangerine Street and Woodville Road, Villawood
- Normanby Street, Fairfield East to Crown Street and Ellis Parade, Yennora
- Fairfield Street, a sub-arterial collector route
- Trenching along Nelson Road and Railway Street, Yennora with major disruptions to traffic and temporary removal of railway station parking.
- Nelson Road, Norrie Street and Loftus, Pine and Dursley Roads, Yennora – this heavy industrial area and distribution centre generate large numbers of heavy vehicle movements. Access to some properties, truck routes and on-street industrial parking will be impacted during trenching works.
- Woodville Road, Old Guildford, Guildford, Merrylands and Granville. Night work is proposed to minimise traffic disruption through this critical north-south traffic route, which contains 12 signalised intersections, on-street parking and industrial parking. However, many of the commercial activities present , including fast food outlets, service stations, supermarket, liquor supply and a 24 hour vet, would operate in the evenings and at night and these businesses could be impacted by night time construction.
- Elizabeth, New York, Third, Factory and Berry Streets, Granville. Berry Street is particularly congested with truck and car movements and nearby Clyde Railway Station
- Parramatta Road, Parramatta between Berry and Kendall Streets. This major arterial road carries very high traffic volumes.
- Martha Street, Granville, especially in vicinity of Wentworth Street, which is a busy road and truck route passing under James Ruse Drive. Denlehy Street
- The industrial areas and heavy vehicle routes along Shirley, Unwin, Colquhoun, Devon and Durham Streets, Rosehill
- Heavily trafficked industrial areas of Grand Avenue and Thackeray Street, Camellia.

Access to public transport is also likely to be disrupted for a time in the vicinity of Yennora and Clyde railway stations. Construction impacts will include changed access arrangements. Every effort will be made to ensure access changes are clearly marked and free of obstructions. Close communications with the State Rail Authority (SRA) will need to be established and information communicated effectively to passengers.

The following cycleways will also need to be crossed:

- A shared pathway along the western side of Yennora Railway Station
- A shared pathway along the northern site of Martha Street in Granville
- A shared pathway around the perimeter of the proposed RWTP site along East Parade and North Street to Lyndon Street, Fairfield.

Measures for managing traffic and minimising delays and inconvenience to affected properties and the local community will need to be carefully developed in consultation with affected owners and stakeholder groups (eg public transport users, pedestrian council) for incorporation into the Construction Traffic Management Plan. Implementation of the Plan will then need to be sensitively managed and include regular consultation and updates for those likely to be adversely affected or inconvenienced, as outlined in section 5.

3.3 Vehicle access to properties

During construction hours there would be temporary restrictions on access to properties inside the construction zone. Driveway access would be restricted to most properties along the route and many streets at some time during construction, although in many cases access would be restored at the end of the each day. In addition, there may be loss of kerbside parking and temporary relocation of bus stops and pedestrian access to footpaths in the following locations:

- Taylor and North Streets, Fairfield (approximately 40 houses and a pre-school)
- Northern footpath of Gordon Street, Tangerine Street, Fairfield East and Villawood (approximately 152 houses, and 74 apartments in addition to small businesses, industrial areas, community facilities and playing fields)
- Normanby Street, Fairfield East to Crown Street and Ellis Parade, Yennora (western footpaths to approximately 107 residential properties, 2 schools, around 10 small businesses and a large industrial estate)
- Vicinity of Yennora Railway Station – trenching will disrupt parking, access to bus stop north of

station entrance, hence requiring its temporary relocation, and pedestrian access to railway station (approximately 10 residences, church, schools and nursing home)

- On-street parking, vehicle access and parking on Nelson Road, Yennora (approximately 10 small and large businesses)
- Barbers Road, Old Guildford (approximately 50 houses and 17 residential units)
- On-street parking, bus stop, cycleway and access to properties, Elizabeth Street, Granville (approximately 60 houses and 71 apartments, TAFE college, 2 child care centres and a church)
- Driveway access, on-street parking and bus stop will be affected on New York Street and Third Street, Granville (approximately 30 houses, 30 apartments, 1 small business and the post office, 2 schools, a pre-school, 2 churches)
- Driveway access and on-street parking restrictions along Factory Street, Granville (approximately 30 houses, businesses including the International Mail centre, a pre-school
- On-street parking along Berry Street, Granville (around 20 businesses, including some major traffic generators)
- Bus stop on Parramatta Road, Parramatta and possible access restrictions
- Temporary access and on-street parking restrictions for around 13 mostly industrial businesses along Kendall Street, Parramatta
- Disruptions to on-street parking, a bicycle path, pedestrian access and access to businesses and Raceway/Sportsground along Martha and Denley Streets, Granville (around 15 small businesses, a motorcycle training centre and access to two racecourses and Granville Showground and Granville Sports Ground)
- Access to industrial and business properties, footpaths and parking through the Rosehill Industrial Estate, Shirley Street, Unwin Street , Rosehill, Colquhoun, Devon and Durham Streets Granville and Grande Parade and Thackeray Street, Camellia, which currently experience high demands for on-street parking and form a heavy vehicle route.

As outlined above, mitigation measures to minimise delays and inconvenience to residents during construction will need to be developed in consultation with affected property owners and residents and incorporated into the Construction Traffic Management Plan. In general, construction will be limited to one side of the street. Residents of these properties will be notified by mail and in person several days in advance to ensure particular access requirements are understood. In exceptional circumstances, special access arrangements will need to be provided for.

Once trenching is complete, generally within one working day, driveway access will be restored and pavements resealed. Further details are provided in section 5.

3.4 Impacts on businesses, industrial, commercial and distribution centres

Construction of the pipeline may have some short term impacts to small and medium commercial businesses, particularly smaller businesses and neighbourhood shops located along the pipeline route due to changes in road conditions such as detours, or fencing that limits pedestrian access to the shopfront. In some instances, the proposal may bring short-term benefits, such as through use of local food outlets by work crews. Overall, pipeline construction is expected to have minor and very short-term adverse impacts for businesses along the route.

Commercial centres along the route which could be impacted are listed in Section 2.3.2 above.

Regular communication with these businesses prior to and during construction should be undertaken to ensure they are fully aware of potential for disturbance to access and trade. Further measures to minimise adverse impacts are given in section 5.

3.5 Construction noise and vibration

Feedback from the community consultation summarised in Table 3 indicated concerns about:

- Noise from trucks and machinery during construction
- Hours of operation
- The duration of construction along individual sections of the route, such as along North Street.

Construction and operation of the RWTP and associated pipeline system will have some noise and vibration impacts, as reported in the Noise and Vibration Assessment (Parsons Brinckerhoff, February 2008). Along the pipeline route, most disturbance from construction-related noise and

vibration is likely to be of only one or two days' duration at any one location.

Pipeline Route

Noise and vibration from laying of the pipeline will be dependent on the particular method to be used in each area (see Table 1). Noise will be generated by excavation works, trenching, horizontal directional drilling and thrust boring. Initial excavation works to break up the road surface, break ground and excavate a shallow pit will require use of saw cutting equipment. This is considered to be the dominant noise source, creating the greatest noise, but would last for short periods of around 3 hours. Thereafter, noise levels at the lower predicted range would be expected to occur. Two sensitive receivers were identified in the Noise report as being Villawood Primary School on Tangerine Street and the South Western Sydney Institute Granville College on Elizabeth Street.

During construction of the pipeline, noise levels at the nearest affected properties are likely to exceed Environmental Noise Control Manual (ENCM) guidelines using worst case assumptions at many locations along the route, with peak noise levels occurring over a one day period and then moving through the local area. Exceedances depend on the intensity of saw cutting and the proximity of the nearest property to the excavation pit. In many cases, nearest properties are 12 metres from the noise source. Large exceedances of noise guidelines are therefore predicted to occur for short periods.

Pipe bursting activities are proposed for a distance of five kms along Woodville Road. This work is proposed to be undertaken during the evenings (6pm to 10pm) and at night (10pm to 5pm) to minimise traffic disruptions. The majority of works associated with pipe bursting along Woodville Road will occur immediately adjacent to the entry and exit pits, to be located at intervals of approximately 90 metres. However, pipe bursting construction methods will exceed noise guidelines for a distance of 100 metres from the excavation pit and could impact on up to 20 properties with a mix of single dwelling and medium density residences and businesses. It is therefore likely to result in significant disturbance to occupants of adjacent properties over a period of one to two nights. Advice from Council indicates that some of these residential properties may be unoccupied and awaiting redevelopment (Parsons Brinckerhoff, February 2008).

To limit potential disturbance to nearby residents from pipe bursting, it is expected that the noisiest works, associated with road cutting and pit excavation, would be planned for the evening period before midnight each night. Communication of this and other construction information to residents and businesses will need to be carefully managed and sensitively conveyed.

Pipeline installation by trenching will result in some exceedances from use of compactors and excavators in proximity to residential properties. Approximately 10-15 properties are likely to be affected at any one time. Horizontal directional drilling and thrust boring are expected to comply with noise guidelines.

Noise and vibration have the potential to disturb sleep and cause anxiety in those exposed to it, even when for short periods of time. As stated above, construction noise and vibration along the pipeline route is expected to be for a short period only. However, it is likely to disturb some residents at night and if this interferes with sleep patterns it could be expected to create annoyance. All efforts should be made to ensure residents are warned of impending works and their concerns addressed through measures discussed in Section 5.

Pumping station and reservoir sites

Noise impacts from construction at the sites of the RWTP, pumping stations and reservoirs will occur throughout the duration of the construction period. These noise levels are also predicted to exceed ENCM guidelines for short periods at North Street and Barbers Road properties, under a worst case scenario where all plant is in operation at the same time. Noise could be reduced substantially where a grader is not used or with construction of an earth embankment (RWTP), a wall (Woodville Road) or where buildings act as a shield (Parsons Brinckerhoff, February 2008). Other large noise sources include cement mixers and cranes during building works. It would be unlikely that all noise sources would be operating simultaneously, and typical noise levels during construction are more likely to comply with noise guidelines. Truck movements during construction were assessed as being unlikely to increase ambient noise levels during daytime (7:00am to 6:00pm) construction hours.

Most construction at the pumping station and reservoir sites is expected to be carried out during the daytime, when sleep disturbance is expected to be less of an issue for nearby residents. Nevertheless, there will be a need to liaise with those living close to these sites to inform them of the likely timing and nature of noise disturbances, as discussed in Section 5.

Vibration

There is also the potential for noise and vibration impacts to land uses adjoining transient construction work sites and compounds. Although the construction sequence and intensive activities would be staged to limit emissions, potential night

time and weekend construction works may be required. Potential vibration impacts at most locations are also expected to be of one days duration, but will not exceed structural vibration levels.

A range of Best Management Practice and Best Available Technology Economically Achievable are proposed to ensure that feasible and reasonable measures are undertaken to reduce received noise levels. A Construction Noise Management Plan will be prepared, incorporating mitigation measures such as screening around work sites, construction plant with lowest sound power levels and establishment of a solid boundary fence at the proposed Fairfield RWTP site.

3.6 Safety during construction

Safety during construction was raised in several comments from the community in relation to:

- Safety on North Street and East parade where children and adults use the bicycle path
- Taking care to avoid overhead power lines.

As described above, the Construction Management Plan to be prepared by the contractor will detail measures to ensure community safety around work sites. Typical layouts will involve water filled safety barriers arranged around equipment and trenches to prevent unauthorised access.

Fixed facilities will be fenced and secured. Equipment left in road corridors during network construction and work areas will be provided with appropriate security to ensure public safety and discourage vandalism or theft.

Safety of workers is another important consideration in design of traffic management measures for this proposal, especially where road works are proposed for night times or along busy routes during the day. The Traffic and Transport identifies areas where particular caution should be taken.

3.7 Impacts on Open Space

Concerns about impacts on areas of open space relate to a range of aspects including restrictions on access during construction, construction of infrastructure in areas of open space and ongoing visual and ecological impacts to areas of habitat. Some of these concerns were expressed during consultations (see Table 3):

- Concern conveyed regarding the impact on birdlife, such as kookaburras, galahs, parrots, cockatoos and a colony of bellbirds living in trees near the Fairfield Sewage Treatment Plant at North Street and East Parade. There is a general feeling that bird life in this open area has increased since the land has been vacant
- Suggestion to use recycled water in parks and the golf course to plant trees, shrubs or flowers to attract native fauna
- General statement that there would be little impact on the flora and fauna as the area is already urban and industrial
- Concern conveyed that the scheme would reduce healthy vegetation and birdlife in the area
- Unease expressed regarding possible subsidence in soft soils near Prospect Creek
- Concern expressed regarding the sightliness of the water tanks. Requests to shield them from view, plant more trees to make them less visible or build them underground.

3.7.1 Construction impacts

Existing areas of open space have been identified as sites for the RWTP, a reservoir and for parts of the pipeline route.

North Street

It is proposed that the RWTP be located in an area of open space at Fairfield bounded by Symons Street, East Parade, North Street and the Fairfield Storm Sewage Treatment Plant (SSTP). The site is owned by Sydney Water and zoned for water infrastructure use. However, it has been accessible to the public and lies adjacent to a residential area across North Street, Fairfield. Residents of the area use this site for dog walking, cycling and other recreational activities. Construction will also result in changes in the visual quality of the area.

At this site, construction of the RWTP will involve removal of some vegetation and erecting of a number of enclosed tanks, buildings, a service road and fencing. For the nearest residents across North Street, the major impacts will be likely to involve construction noise and vibration, changes to the visual character of the area, construction traffic. Once operational, the impacts will be predominantly associated with the loss of this area of informal open space (see below), the presence of 3 large (17-23 metre) tanks screened by vegetation and set back 20 metres from the North Street boundary, and low levels of traffic from service vehicles accessing the plant.

Fairfield Park

Near Fairfield Park, construction could temporarily impact on sporting facilities and activities such as

the Fairfield Baseball Club, tennis courts, Cobreloa Soccer Club and the Fairfield Community Health Centre on McIntosh Street and the many athletics, sporting and recreational activities which take place in the park.

Recreational areas through Fairfield Road Park and Prospect Creek, Yennora, Guildford West Sportsground, Guilford West and Long Street Park Recreational Reserve, Smithfield are likely to be impacted during construction. Other potentially affected areas of open space include:

- Granville Park sporting, recreational and picnic area with access off Woodville Road to the west
- Access to Woodville Golf Course via Rawson Road to the east of Woodville Road.

Woodville Golf Course

Construction of an above ground reservoir on the southern part of Woodville Golf Course would require removal of 17 trees and create visual impacts. However, it is planned to retain three large fig trees which will provide some visual screening to nearby residents.

Rosehill Racecourse vicinity

There could also be temporary access impacts to the large areas of open space at Rosehill Racecourse, Parramatta City Raceway and Granville Showground and Sportsground.

Once construction has finished, all areas of open space along the pipeline route will be reinstated to their former condition and revegetated and there will be no further restrictions on access.

At the RWTP site, however, security fencing will be installed and the area quarantined from future use as open space. There remains a large area of open space in the vicinity of this site which can continue to be used for walking and cycling. However, the quality of this area as an informal area of recreational open space or passive enjoyment will be permanently lost for adjacent residents.

3.7.2 Ecological impacts

Many of the community issues raised concerns about potential impacts on the birdlife around the proposed site for the RWTP.

Ecological impacts were examined in the Rosehill Recycled Water Scheme Biodiversity Assessment (Parsons Brinckerhoff, January 2008). The report concludes that, in general, the proposal would occur in a highly modified urban environment. However, there are a few limited areas of native vegetation and habitat such as at the proposed RWTP site. At this location the proposal could result in:

- Clearing of native vegetation to construct the Fairfield RWTP. This would involve removal of medium size Eucalyptus trees from the park bounded by North and Taylor Streets, Fairfield. In addition, approximately 15 non-native trees would need to be removed, including 7 over 10 metres in height.
- Removal of some native trees in Fairfield Park.

Removing native and non-native trees was expected to have only minor impacts on native fauna habitats. Moreover, existing large trees and shrubs will be retained to screen houses on the opposite side of North Street. Once construction is complete, trees will be replanted to maintain habitat. It is expected that the variety of valued birdlife will continue to be attracted to the area, due to the large areas of open space nearby.

3.7.3 Changes to visual character

The changes outlined above from construction in areas of open space are also likely to affect the visual characteristics of the open space areas, which impact on community values attaching to the natural environment. “Removal of native and non-native trees would have visual impacts for local residents and those currently using the park...” (Parsons Brinckerhoff, January 2008). However, as stated above, large existing trees will be retained where possible and new trees planted on completion, to provide a screen from neighbours across North Street.

In the longer term it will be possible to screen much of the visual impact from the three most visible tanks and reservoirs with vegetation. This will serve to provide a well-landscaped environment and some habitat to attract birdlife. However, it is unlikely that tree planting alone will fully obscure the tanks along the North Street frontage or the reservoir proposed on Woodville Golf Course.

3.8 Impacts on Aboriginal and historic cultural heritage

Aboriginal and historic cultural heritage issues were examined to identify potential constraints to the proposal (AMBS, March 2008). The analysis was based on background research only and did not involve consultations with Aboriginal stakeholders. Its findings are therefore considered to be only a preliminary constraints analysis and are “not intended to reflect any potential cultural significance to the Aboriginal community.”

The report notes that areas where the proposed pipeline crosses parklands or creeks

> "have the potential to contain physical evidence of Aboriginal activity and occupation... sites and objects of archaeological significance and areas of Aboriginal cultural significance. These areas require archaeological ground-survey and evaluation by relevant Aboriginal community representatives in order to determine their level of significance. Consultation with Aboriginal community groups is required as an assessment of Aboriginal cultural heritage values can only be made by representatives of local Aboriginal communities." (p. 40).

Along the pipeline route, one site, a Potential Archaeological Deposit (PAD) and an isolated artefact site, is listed in the Aboriginal Heritage Information Management System (AHIMS) database. Also in the vicinity is an area currently the subject of a Native Title Claim. Both the site and area of Native Title Claim are located to the south of Fairfield Park between Prospect Creek and Honour Avenue, Fairfield, and could therefore be directly impacted by the pipeline. Another six locations are identified as having low to medium levels of archaeological potential, although the cultural significance of each of these sites to Aboriginal people is unknown at this stage and "may only be determined through site assessment and consultation with representatives of the relevant Aboriginal community groups." (p. 36).

The report recommends detailed assessments, consultations and ground surveys to be carried out in the presence of Aboriginal stakeholders in accordance with Department of Environment and Climate Change (DECC) Guidelines and heritage best practice and the requirements of the Native Title Act 1993. Further consultation with Aboriginal groups has commenced in accordance with the recommendations.

The study also identified a range of heritage sites from the area's early settlement and industrial past. A number of changes to the location of the pipeline were recommended to minimise impacts on identified historic heritage areas and avoid visual and aesthetic impacts in local parklands.

Pipeline construction therefore has the potential to impact on sites and objects of archaeological significance and areas of Aboriginal cultural significance. Mitigation measures are covered in section 5.

4 Operational impacts on the social environment

Once operational, the proposal is likely to have many social benefits and relatively few adverse social impacts. Key concerns raised by residents and businesses and the likelihood of impacts are discussed below.

4.1 Benefits of recycled water use

The proposal will provide benefits to industries in western Sydney and residents of Sydney as a whole will benefit through reductions in demand for potable water.

Recycled water will be supplied to businesses at a reduced tariff relative to the price of potable water. This will offset costs of installing dual reticulation systems where required and provide for long tern cost savings. The quality of the recycled water can also provide process benefits for some industries as it can e better for some industrial applications than potable water.

The project will be one of the first of its kind where a private company invests in a recycled water supply scheme for industrial and irrigation purposes. Foundation customers include:

- Rosehill Gardens
- Bassell Australia
- Boral
- James Hardie
- Visy Paper
- Marubeni Australia Paper Services

As such, it will have social benefits through reducing demand for potable water of up to 6 billion litres of water per year (NSW Government 2006) and broaden the sources of supply for industrial use.

The industrial users in the study area are also likely to be employers of some of the residents impacted by this proposal.

The project is expected to have a positive impact for some businesses along the pipeline route, by providing opportunities for large industrial users of water to connect to the recycled water network. This will be particularly beneficial for industrial users at Smithfield, Rosehill and Camellia.

4.2 Health and safety

Some residents have raised issues about the safety of the proposal, including the need for quality control of treated water to detect faecal coliforms.

The proposal is for use of recycled water in industrial processes and landscape irrigation only. All water will be treated to tertiary standards and safe for these purposes. No water from this project will be for human consumption.

Recycled water mains will be coloured lilac in accordance with appropriate codes, to distinguish them from potable water mains.

4.3 Operational noise and vibration impacts

The proposed plant will operate on demand, with pumping occurring intermittently to meet customer need. The proposed Fairfield RWTP and associated reservoirs and pumping stations have been designed to minimise ongoing operational noise. Noise assessment (Parsons Brinckerhoff, February 2008) indicates noise levels at the nearest properties to the proposed Woodville Golf Course and Rosehill sites would be within NSW Industrial Noise Policy (INP) noise goals.

Ongoing operational noise impacts may affect some residents in North Street, Fairfield. The system is designed for 24 hour operation and there is likely to be demand for pumping at night (between 10pm and 7am). Water pumps at Fairfield RWTP have been identified as a major operational noise source and under worst case scenario assumptions of all three pumps operating simultaneously, noise goals would be exceeded at the nearest property on North Street. The report recommends use of quieter water pumps or other structural barriers to ensure noise guidelines are met.

In addition, there will be noise from heavy vehicles during operation.

Mitigation of operation noise sources is discussed in detail in the Noise and Vibration Assessment Report (Parsons Brinckerhoff, February 2008) and summarised in section 5.

4.4 Traffic and transport

Once the RWTP system is operating, there will be only minor ongoing traffic impacts. A small number

of traffic movements per day would be generated by maintenance, monitoring and servicing vehicles at:

- Fairfield RWTP and pumping station in East Parade, Fairfield
- Woodville Reservoir in Barbers Street, Chester Hill
- Rosehill Reservoir and Pumping Station in Durham Street, Rosehill.

At this level, traffic impacts are not considered to be significant and no ongoing adverse social impacts are anticipated.

4.5 Visual impacts

Visual impacts arising from operation are mainly related to the presence of new structures (such as the three reservoirs and two pumping stations) and changes in the vegetation in these areas. As discussed in Section 3,7,1 above, the proposal will result in permanent structures set back about 20 metres along North Street and within the Woodville Public Golf Course. The third reservoir, at Rosehill, will be within an industrial zone and have fewer visual impacts and no immediate residential neighbours.

Provided that every effort is made to ensure there is adequate screening of tanks and structures with appropriate vegetation, visual impacts will be minimised. Consultation with neighbours, Councils and other relevant stakeholders should take place in reaching decisions about appropriate vegetation treatments.

4.6 Lighting

The RWTP site boundary will be lit at night with lighting similar to street lighting. The administration and process buildings at the southern end of the site will have lighting around access points. There will also be floodlights in specific locations to be used in the event of an after hours call-out. The precise location of this lighting will not be finalised until detailed design.

Normally the external lighting is set up to allow the option of manual mode or sensor mode. Street lighting and low level lighting around the buildings and other areas would normally be selected in sensor mode. The high level lighting (floodlights) are normally left in manual mode and only used if required.
It is likely that the requirement for lighting would be greater for the administration building at the south western corner of the site and at the southern side of the RWTP, at the unloading area. This should provide a degree of screening for the residents along North Street, Fairfield.

One lighting option is to provide minimal external lighting at night, but to provide a switch at the main entrance gate to activate the street lighting and external building lights when required. This arrangement is used effectively at a similar site. However, it would be subject to an assessment of the potential for vandalism.

4.7 Odour impacts

Odours are not anticipated during operation of the RWTP at Fairfield or at reservoirs or pumping stations along the route.

The water accessed from the LAP will not be raw sewage but instead will have been treated to a secondary standard with most of the impurities removed so it will not smell. The RWTP will then ‘polish’ this water through treatment processes including chemical coagulation, membrane filtration (ultrafiltration and reverse osmosis), pH correction and disinfection, resulting in water suitable for use in industrial processes and irrigation. Tanks will be roofed or sealed. No odours will therefore be released from the RWTP, reservoirs or pumping stations.

4.8 Property depreciation

Concern was expressed by one North Street resident about the potential for depreciation in the value of their property with the facility opposite.

The main ongoing impact for residents of North Street will be visual impacts associated with the presence of three large tanks on the Sydney Water property and background noise arising from plant operations.

Visual impacts of the tanks will be screened with established trees and additional landscape treatments to minimise visibility of the tanks. Nevertheless, residents are likely to be exposed to intermittent noise from the plant’s operation.

The presence of the new RWTP could result in some impacts to property values in North Street as a result of this development. However, the site has been zoned for water infrastructure and is so indicated on Council’s zoning maps. It is adjacent to the existing Fairfield Storm Sewage Treatment Plant and as such is consistent with the types of use present nearby. Moreover, all efforts will be made as part of this proposal, to ensure vegetation screens the site from views of residents across North Street. On-going consultation and the provision of an opportunity for involvement of local residents in the landscape planning could assist in addressing some of their immediate concerns.

5 Management of social impacts

In order to address the potentially adverse social impacts identified in sections 3 and 4, a number of specific measures will need to be undertaken as part of the proposal.

5.1 Traffic, transport and access impacts

Construction of the proposal involves laying of a pipeline along approximately 20km of suburban and arterial roadways and through parklands, as described in section 3. Construction activities will therefore impact on residents and businesses across the study area, albeit mostly for short periods of time.

Measures for managing traffic, access and public transport changes to minimise delays and inconvenience to affected properties and the local community are outlined in the Traffic and Transport Report (Parsons Brinckerhoff, May 2008). Details will need to be carefully developed in consultation with affected owners, including sensitive uses along the route, and stakeholder groups (eg public transport users, local Councils, Roads and Traffic Authority, State Rail Authority) for incorporation into the Construction Traffic Management Plan. Implementation of the Plan will then need to be sensitively managed and include regular consultation and updates for those likely to be adversely affected or inconvenienced. The particular demographic characteristics of the area will influence the methods of communication.

Typical measures to minimise adverse traffic and transport impacts include:

- Considering the access needs of adjoining land uses when scheduling trenching works
- Discussing construction access arrangements with the owners of properties with specific property access requirements
- Works within industrial areas may be undertaken at night to ensure vehicular access is maintained to adjoining businesses during normal business hours
- Trenches should be backfilled or plated at the end of each construction day or night, so that vehicular access is maintained when construction sites are unattended. This would ensure that local residents have morning and evening access to their properties during construction.
- Liaising with local councils to allow them to integrate planned works with road works for this project (eg. Fairfield Council has a landscaping and road rehabilitation programme planned for the area).

5.2 Noise and vibration impacts

5.2.1 Construction noise

The proposal will create substantial noise impacts at times during its construction, particularly with pipeline construction. Amongst the greatest social impacts will be the tradeoffs associated with reducing traffic congestion along Woodville Road by undertaking night works. Night-time pipe bursting is proposed for a 5km stretch of Woodville Road through Old Guildford, Guildford, South Granville, Granville and Merrylands.

Construction planning and management for this section of the route will require a great deal of careful planning and sensitive interaction with residents, whose sleep patterns will be disturbed for 1-2 nights at a time. Although only a short period in total and at intervals of around 90 metres, there are nevertheless many properties along this section of the route which will be exposed to loud noise at night times and potential for sleep disturbance. Wherever practical, it may be preferable to undertake this work at a time of minimal disturbance, such as during school holidays or in January when overall traffic levels are lower and there may be less disturbance to residents.

Again, careful consultation with impacted residents and businesses should be undertaken according to a well-defined consultation strategy which is sympathetic to the particular characteristics of the local areas and populations through which it will pass. This will need to include information in a range of languages, cooperation with local councils and recognition that workers and family members may have routines which reflect the variety of cultural and socio-economic backgrounds present in the area. Examples include the possibility of large numbers of shift workers and relatively high proportions of residents at home during the daytime, compared with other parts of Sydney.

Other noise control measures will include machinery with low sound power levels and noise screening when appropriate. The Noise and Vibration Impact Assessment Report (Parsons Brinckerhoff, February 2008) includes a list of mitigation measures which should be incorporated into the Noise Management Plan and

Communication Strategies. A key aspect of the success of this project will be its ability to ensure sensitive receivers along the route (child care and aged care facilities, schools and pre-schools etc), as identified in Section 2.3.1, or large traffic generators (Yennora Station, Yennora Distribution Park, Woodville Road etc) are consulted in advance and activities planned in such a way as to minimise adverse impacts on access, sleep patterns and anxiety for impacted residents and businesses.

5.2.2 Operational noise

On-going operational noise from the RWTP at North Street Fairfield will need careful consideration in the detailed design and operations phases to ensure effects on nearest sensitive receivers are minimised, and if possible, meet operational noise criteria. Mitigation measures considered to date include:

- Locating pumps as far as possible from sensitive receivers such as adjacent residents
- Installing solid noise barriers and screens around pumps and enclosing plant and equipment
- Using best available pumps and machinery with the lowest possible sound power levels

Close liaison with residents of North Street, Fairfield and Barber Street, Old Guildford, should be established prior to construction to brief them on likely impacts, on-going issues and establishing a contacts and grievances procedure should there be complaints.

5.2.3 Vibration impacts

Although vibration is not expected to create any issues during construction, a preconstruction survey of construction zones would be undertaken and any vibration related impacts from construction machinery will be identified. Property owners along the route will then be able to report issues to construction contractors.

5.3 Cumulative social impacts

Road works associated with other major projects including the Liverpool to Ashfield pipeline (LAP) have recently affected many residents through the study area, as outlined in section 3.2. To impose further disturbance through construction of another major infrastructure project could antagonise members of the community. Construction contractors should be aware of the potential for this project to be seen as yet another inconvenience to a local population.

Making available information to the local community about the specific project, its benefits, timeframe and expected disturbances, will assist in maintaining good community relations.

5.4 Aboriginal cultural heritage

As outlined in section 3.8, there are a number of areas with the potential for physical evidence of Aboriginal occupation or site and objects of significance to Aboriginal people. Further detailed assessments and ground surveys will be required in the presence of Aboriginal stakeholders in accordance with DECC Guidelines. Care will also need to be taken during the detailed design and pipeline construction phases of the project to ensure sites or objects are not disturbed.

5.5 Communication with a diverse population

The culturally and socio-economically diverse community living and working along the pipeline route and in the vicinity of new infrastructure sites presents unique and challenging issues in communicating information about the project, both during the construction phase and through its operational life.

Where interaction with members of the community is required, issues such as understanding individual and community expectations and concerns, potential impacts of this project and the presentation of information will need to be carefully developed to ensure clear communication and understanding.

Information from local Councils and other agencies who have previously been involved in presentation of information to the public in this area indicates that project information would need to be presented in a variety of formats (diagrammatic and 3D models, visual, written, oral etc). Our experience gained during the community engagement for this phase highlighted difficulties in attracting interest or conveying information about the proposal. The particular community structure and mix of backgrounds has created a different mix of attitudes and responses to those encountered on other major infrastructure projects. In general, members of the community in this area have so far expressed only minimal interest in the specifics or rationale for the project. There is little indication, for example, that residents are concerned about the pipeline or its potential effects on individual properties or daily activities. These considerations will need to be factored into future community engagement processes and efforts should be made to ensure material about the project is effectively communicated and freely available in a range of languages and formats. It is considered important

that residents and businesses are fully aware of the types and extent of impacts that will occur as the pipeline is being layed or infrastructure built. This interest may not arise until construction is underway in their local area.

As such, a series of recommendations have been developed as part of the Community Engagement Outcomes Report to assist future engagement around the proposal. They include:

- Community relations management plan - Closer to construction, a community relations management plan will be developed to outline activities that will ensure that the community is kept well informed throughout the construction process. This community relations plan will provide the framework, policy and procedures that will direct all communications and interfaces with customers and key stakeholders including residents and property owners for the Rosehill recycled water scheme.

- Community relations principles - The principles of the community relations activities will be to:

  - Build and maintain a positive interface with the community
  - Develop flexible information delivery systems that are able to work ahead of and respond to changes in the construction schedule
  - Provide timely, relevant and targeted information
  - Identify and report community issues and special needs so as to build solutions into the construction schedule in advance where possible
  - Respond in an effective manner to individual concerns
  - Record community relations activities in a data management system *(Consultation Manager)*
  - Measure and assess community relations activities for effectiveness and relevance.

- Community pre-construction surveys with property owners along the route, including industrial and commercial stakeholders such as Parramatta City Raceway, Mitsubishi, TAFE and Shell

- Public announcements via local newspapers

- Fact sheets

- Newsletters

- Free call 1800 community contact enquiry line

- Translation and interpreter services

- One-on-one meetings with key stakeholders and interest groups, such as migrant and cultural organisations, small businesses, schools and other community services and organisations likely to be affected by or have an interest in the project

- Website with up-to-date information about the project

- Notifications prior to and post construction

- Weekly construction updates to key project stakeholders (councils, emergency services, bus operators etc)

- Community, business and stakeholder satisfaction surveys.

In implementing the community relations activities, it will be essential to ensure staff are comfortable working and communicating changes and impacts to communities with diverse language and ethnic backgrounds. It is recommended that a dedicated 'neighbourhood liaison' worker with specialist cultural and language skills be appointed to be present before and during construction and be available to answer questions as they arise. Background information relevant to the needs of ethnically diverse neighbourhoods could be obtained from liaising with migrant information centres and councils across the route.

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Technical paper 7

Indigenous heritage

BIOSIS
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Pty. Ltd.

Rosehill Recycled Water Scheme: Aboriginal Archaeological and Cultural Heritage Assessment

Report for Jemena Asset Management Pty Ltd

October 2008

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DOCUMENT CONTROL SHEET

PROJECT	Rosehill Recycled Water Scheme

BIOSIS RESEARCH PTY. LTD. PROJECT NO.	s5096

REPORT TO	Jemena Asset Management Pty. Ltd.

REPORT TITLE:	Rosehill Recycled Water Scheme

AUTHOR(S):	Dominic Brady

REVISION	*PREPARED*	*INTERNAL REVIEW*	*EXTERNAL REVIEW*	*AMENDED*
Draft report	DPB	JR		DPB

REVISION	*ISSUED*	*NAME*	*SIGNED*

ACKNOWLEDGMENTS

Biosis Research Pty. Ltd. acknowledges the contribution of the following people and organisations in preparing this report:

- Kevin Cavanagh, and Steve Randall (Deerubbin Local Aboriginal Land Council);
- Mark 'Jack' Johnson, Alfred Sang, Ian Edwards, and Keira Edwards (Gandangara Local Aboriginal Land Council);
- Sandra Lee, Terry Lee, and John Riley;
- Dave Gordon and Sharlene Freeburn (NSW Department of Environment and Climate Change);
- Wendy Hopley (Cumberland Classifieds); and
- John Fisher (Jemena Asset Management Pty. Ltd.).

ABBREVIATIONS

AHC	Australian Heritage Council
AHILA	Aboriginal Heritage Information Licence Agreement
AHIMS	Aboriginal Heritage Information Management System
ATSIC	Aboriginal and Torres Strait Islander Commission
CHL	Commonwealth Heritage List
CHMP	Cultural Heritage Management Plan
DECC	Department of Environment and Climate Change
DoP	NSW Department of Planning
DLALC	Deerubbin Local Aboriginal Land Council
GLALC	Gandangara Local Aboriginal Land Council
DTAC	Darug Tribal Aboriginal Corporation
EA	Environmental Assessment
EP&A	Environmental Protection and Assessment
EPBC	Environment Protection and Biodiversity Conservation
GIS	Geographic Information Systems
GSV	Ground Surface Visibility

ICOMOS	International Council on Monuments and Sites
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
MGA	Map Grid of Australia – unless otherwise specified, all coordinates are in MGA
NHL	National Heritage List
NNTT	National Native Title Tribunal
NPWS	National Parks and Wildlife Service (now part of DECC)
REP	Regional Environment Plan
RNE	Register of the National Estate
SHI	State Heritage Inventory
SHR	State Heritage Register

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EXECUTIVE SUMMARY

Biosis Research Pty. Ltd. was commissioned by Jemena Asset Management Pty. Ltd. to undertake an Aboriginal archaeological and cultural assessment for the Rosehill Recycled Water Scheme.

The overall aims of the assessment were as follows: to identify any known or potential Aboriginal heritage sites and/or values associated with the project area; to identify any impacts associated with the proposed development to any sites and values identified; and to provide recommendations for the management of any such sites and values.

A search of statutory and non-statutory heritage registers identified one Aboriginal site, an open site and associated PAD (site name: PC1; site identification number: 45-5-3272) located in the immediate vicinity of the project area (see Figures 2 and 6).

Archaeological and cultural field surveys of the project area that involved Biosis Research Pty. Ltd, Gandangara Local Aboriginal Land Council, Deerubbin Local Aboriginal Land Council, and Darug Tribal Aboriginal Corporation were conducted on 9, 10, 12, and 19 September 2008.

During the surveys, no Aboriginal heritage sites unregistered on statutory and non-statutory heritage registers and databases were identified within, overlapping, or in the immediate vicinity of the project area.

No archaeological materials were relocated at the location of the open site and associated PAD (site name: PC1; site identification number: 45-5-3272) (see Figures 2 and 6).

A zone encompassing parts of Fairfield Park, Fairfield, and open space adjacent to Vine Street, Fairfield and Bland Street, Carramar, within which parts of the proposed reticulated network would be located, was identified as an area of high Aboriginal archaeological sensitivity (see Figure 6). There is a high likelihood that Aboriginal archaeological materials will be present throughout the undisturbed parts of this zone, or parts that have only been subjected to minor disturbances, such as vegetation clearance.

The overall effective survey coverage of the project area is considered to be poor due to low ground surface visibility and a low amount of exposures within the study area. This was expected as the project area is located in a highly developed urban environment: most of the surface of the project area has been extensively disturbed by impacts from urban development, and, consequently, in general, any potential Aboriginal archaeological materials within or overlapping the study area are likely to have been subject to similar levels of disturbance.

In summary, this assessment identified Aboriginal heritage issues associated with the project area:

- There is one Aboriginal site, an open site and associated PAD (site name: PC1; site identification number: 45-5-3272) located in the immediate vicinity of the project area (see Figures 2 and 6); and

- A zone encompassing parts of Fairfield Park, Fairfield, and open space adjacent to Vine Street, Fairfield and Bland Street, Carramar, within which parts of the proposed reticulated network would be located, was identified as an area of high Aboriginal archaeological sensitivity (see Figure 6).

Recommendations for the management of any known or potential Aboriginal heritage sites and values associated with the project area are outlined below.

Prior to any impacts occurring within the project area, the following is recommended:

Aboriginal heritage sites and zones of Aboriginal archaeological sensitivity

Recommendation 1

It is recommended that Jemena Asset Management Pty. Ltd. continue to liaise with the identified Aboriginal registered stakeholders (GLALC, DLALC, and DTAC) with reference to the management and mitigation of impacts to Aboriginal cultural heritage sites and values associated with the proposed development.

Recommendation 2: *The development of a Cultural Heritage Management Plan (CHMP) to conduct sub-surface testing of the zone of high Aboriginal archaeological sensitivity identified in this report*

It is recommended that, prior to any impacts to the zone of high Aboriginal sensitivity identified in this report (Figure 3), a CHMP is developed to conduct sub-surface testing of any parts of this zone that will be impacted by the proposed development in order to determine if any potential Aboriginal heritage sites will be impacted. It is important to note that this area *encompasses* the location and immediate vicinity of an Aboriginal heritage site, an open site and associated PAD (site name: PC1; site identification: 45-5-3272).

The CHMP should also include provisions for the management and storage of any archaeological materials recovered during the sub-surface testing program.

Recommendation 3: *Stop work provision for any potential Aboriginal heritage sites identified during construction*

It is recommended that the CHMP includes the requirement and procedures for managing any previously unidentified Aboriginal objects or places identified during any phase of the proposed development. It is recommended that, if any previously unidentified Aboriginal objects or places are identified during any phase of the proposed development, all works cease in the vicinity of the find, and the following bodies notified:

- DECC; and
- Registered Aboriginal stakeholders: Deerubbin Local Aboriginal Land Council (DLALC); Gandangara Local Aboriginal Land Council (GLALC); and Darug Tribal Corporation.

1.0 INTRODUCTION

Heritage refers to objects or places from the past that are valued by a community or communities. Legislation protecting Aboriginal and historical heritage applies in New South Wales. There is evidence of up to 50,000 years of occupation of New South Wales by Aboriginal people.

Heritage can provide us with important information about past lifestyles and cultural change. Preserving and enhancing these important and non-renewable resources is encouraged.

It is an offence under sections of legislation to damage or destroy heritage sites without a permit or consent from the appropriate body (see Appendix 2 for a discussion of the relevant heritage legislation and constraints).

When a project or new development is proposed, it must be established if any heritage sites are in the area and how they might be affected by the project. Often it is possible to minimise the impact of development or find an alternative to damaging or destroying a heritage site. Therefore, preliminary research and field survey to identify heritage sites is a fundamental part of the background study for most developments.

Consequently, the first stage of an archaeological assessment usually involves conducting background research about the land relevant to the proposed development footprint, the study area. A second stage often involves a field survey of this area.

Possibly the most important part of the study involves assessing the cultural significance of any heritage sites within the study area. Understanding the significance of a heritage site is essential for formulating management recommendations and making decisions.

1.1 Project Background

Jemena Asset Management Pty. Ltd. has applied to the NSW Minister for Planning for project approval under Part 3A of the *Environmental Planning and Assessment Act* 1979 for the Rosehill Recycled Water Scheme (previously named, 'Camellia Recycled Water Project'). This application was supported by a preliminary Environmental Assessment Report, prepared by Parsons Brinckerhoff Australia Pty Ltd (2007), which provided information about the proposal and its potential environmental impacts.

The NSW Department of Planning responded with the requirements of the Director-General for the preparation of a detailed Environmental Assessment. Although cultural heritage was not identified as a key issue in the Director-General's requirements, potential Aboriginal cultural heritage impacts associated with the proposed development were identified in a preliminary cultural heritage assessment prepared by AMBS (2008).

Consequently, Biosis Research Pty. Ltd. was commissioned by Jemena Asset Management Pty. Ltd. to prepare an Aboriginal cultural heritage impact assessment for the proposed development.

1.2 Study Area

As outlined by Jemena Asset Management Pty. Ltd., the study area, i.e., the proposed development footprint, traverses the Local Government Areas (LGAs) of Parramatta, Holroyd, Fairfield, and Bankstown. See Figure 1 for a map of the study area.

1.3 Proposal

Jemena Asset Management Pty. Ltd. proposes to construct the following:

- A reverse osmosis water recycling plant;
- Approximately 20 kilometres of an underground reticulated network; and
- Two water storage reservoirs (one of which is elevated), two pumping stations, a storage tank, and associated infrastructure along the network.

The water recycling plant, a pumping station, and a storage tank would be located within vacant land at North Street, Fairfield, adjacent to the Fairfield Storm Sewerage Treatment Plant. The underground reticulated network would traverse the local government areas of Fairfield, Holroyd, Bankstown and Parramatta and would be mainly located within road reserves or open space. A pumping station and a water storage reservoir would be located at the intersection of Durham Street and Grand Parade, Rosehill. The elevated storage reservoir would be constructed on the southeastern boundary of Woodville Golf Course, Guildford.

1.4 Planning Approvals

This project will be assessed under the following legislation:

- *Environmental Planning and Assessment Act* 1979 (NSW);

1.5 Aims

The following is a summary of the major objectives of this report:

- To search statutory and non-statutory heritage registers and registers for any known Aboriginal heritage sites within the study area and to list and describe any sites identified;

- To research environmental factors that are relevant to an archaeological assessment of the study area.
- To review regional and local archaeological and/or heritage studies that are relevant to the study area;
- To formulate a predictive model for locating areas of archaeological potential within the study area;
- To consult with stakeholders that were identified through the consultation process in accordance with the DECC endorsed guideline document, *National Parks and Wildlife Act 1974: Part 6 Approvals Interim Community Consultation Requirements for Applicants*;
- To conduct an appropriate archaeological and cultural field survey of the study area to identify, record, and assess the condition of any Aboriginal heritage sites not listed on heritage registers and databases within or overlapping the study area, and to relocate and update the condition of any registered Aboriginal heritage sites;
- To assess the archaeological significance of any known Aboriginal heritage sites and values within, overlapping, or in the immediate vicinity of the study area;
- To identify the impacts of the proposed development on any known or potential Aboriginal heritage sites and values within, overlapping, or in the immediate vicinity the study area;
- To provide recommendations to mitigate impacts to any known or potential Aboriginal heritage sites and values within, overlapping, or in the immediate vicinity the study area;
- To provide recommendations to manage any known or potential Aboriginal heritage sites and values within, overlapping, or in the immediate vicinity the study area.
- To map any known Aboriginal heritage sites and values and zones of archaeological sensitivity within, overlapping, or in the immediate vicinity of the study area.

The preparation of a report that complies with the guidelines provided by the Department of Environment and Climate Change (DECC) and the Heritage Branch, Department of Planning (DoP). The respective overarching heritage guidelines of these Government departments are the *Aboriginal Cultural Heritage: Standards and Guidelines Kit* and *NSW Heritage Manual*.

1.6 Consultation

Community consultation for the Rosehill Recycled Water Scheme was conducted in compliance with the DECC endorsed guideline document, National Parks and Wildlife Act 1974: Part 6 Approvals Interim Community Consultation Requirements for Applicants, which is a necessary requirement for the preparation of an Aboriginal cultural heritage assessment as prescribed by the DECC's DRAFT Guidelines For Aboriginal Cultural Heritage Impact Assessment and Community Consultation July 2005.

In accordance with the DECC endorsed guideline document, National Parks and Wildlife Act 1974: Part 6 Approvals Interim Community Consultation Requirements for Applicants, on 14 July 2008, Biosis Research Pty. Ltd. provided written notification of the Rosehill Recycled Water Scheme to the following bodies:

- Deerubbin Local Aboriginal Land Council (DLALC);
- Gandangara Local Aboriginal Land Council (GLALC);
- Registrar of Aboriginal Owners;
- NSW Native Title Services;
- NSW Department of Environment and Climate Change;
- Parramatta City Council;
- Holroyd City Council;
- Fairfield City Council; and
- Bankstown City Council.

Also, in accordance with the DECC endorsed guideline document, National Parks and Wildlife Act 1974: Part 6 Approvals Interim Community Consultation Requirements for Applicants, Biosis Research Pty. Ltd. advertised the Rosehill Recycled Water Scheme in the project local print media that provided distribution coverage of the Local Government Areas within which the project area extends. The advertisement provided information about the project and invited individuals and groups to express their interest in the project. The print media included the following local papers:

- Parramatta Advisor (advertisement published on 16 July 2008);
- Fairfield Advance (advertisement published on 16 July 2008); and
- Bankstown-Canterbury Express (published on 15 July 2008).

A register for interested stakeholder groups was opened on 16 July 2008, and registrations were received by Biosis Research Pty. Ltd. until close of business on 30 July 2008.

The following groups expressed their interest in the project (these groups are referred to as ‘registered stakeholders’):

- Gandangara Local Aboriginal Land Council (GLALC); and
- Deerubbin Local Aboriginal Land Council (DLALC).

On behalf of all members of Darug Tribal Aboriginal Corporation (DTAC) and their descendants, Angela Martin, Colin Rex Gale, and Gordon William Morton lodged a native title claim, which was entered on the register on 13/12/2000, that traverses part of the proposed development, a section of pipeline within Fairfield Park, near McIntosh Street.

Darug Tribal Aboriginal Corporation (DTAC) did not respond to the Rosehill Recycled Water Scheme advertisement. Consequently, Biosis Research Pty. Ltd, with due diligence, formally invited DTAC to register as an interested party for the Rosehill Recycled Water Scheme on 7 August 2008. DTAC expressed their interest in the project via phone on 7 August 2008.

In accordance with DECC's Part 6 Approvals – Interim Community Consultation Requirements for Applicants, the registered stakeholders were provided with a proposed methodology for the cultural and archaeological assessment and given a minimum of 21 days to review it and provide feedback. The comments of the registered stakeholders, GLALC, DLALC, and DTAC, on the draft methodology are provided in Appendix 1

1.7 Heritage Status and Planning Documents

1.8 Commonwealth Registers

1.8.1 National Heritage Registers

The Commonwealth Australian Heritage Commission Act was repealed in January 2004, and, in its place, amendments were made to the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

Under the EPBC Act Amendments (No 88, 2003), the National Heritage List and Commonwealth Heritage List were established. The National Heritage List provides protection to places of cultural significance to the nation of Australia. The Commonwealth Heritage List comprises natural, Aboriginal and historical heritage places owned and controlled by the Commonwealth and, therefore, mostly includes places associated with defence, communications, customs, and other federal government activities.

Nominations to these two lists are assessed by the Australian Heritage Council (AHC), who also compile the Register of the National Estate, a list of places identified as having national estate values. There are no management constraints associated with listing on the RNE unless a commonwealth agency owns the listed place or is the proponent.

APPLICATION TO THE STUDY AREA – NATIONAL HERITAGE REGISTERS
There were no Aboriginal places listed on the National Heritage List, Commonwealth Heritage List, or the Register of the National Estate within, overlapping, or in the immediate vicinity of the study area (search undertaken on 18 July 2008).

1.8.2 National Native Title Register

The Commonwealth *Native Title Act* 1993 establishes the principles and mechanisms for the preservation of Native Title for Aboriginal people.

Under Subdivision P of the Act, *Right to negotiate*, native title claimants can negotiate about some proposed developments over land and waters (known as 'Future Acts'), if they have the right to negotiate. Claimants gain the right to negotiate if their native title claimant application satisfies the registration test conditions.

The right to negotiate applies over some proposed developments or activities that may affect native title. Native title claimants only have the right to negotiate over certain types of future acts. The right to negotiate is not a right to stop projects going ahead — it is a right to have a say about how the development takes place. In some situations, the right to negotiate does not apply. In these circumstances, claimants may have the right to be notified, to be consulted, to object and to be heard by an independent umpire.

APPLICATION TO THE STUDY AREA – NATIONAL NATIVE TITLE REGISTER LISTINGS

A search of the National Native Title Register, the Register of Native Title Claims, and the Register of Indigenous Land Use Agreements identified a Native Title Claim (Federal Court Number NSD6061/98, NNTT Number NC97/8) by Darug Tribal Aboriginal Corporation (DTAC) that is traversed by the section of pipeline route near McIntosh Street and within Fairfield Park, Fairfield (search undertaken on 28 July 2008).

1.9 State Registers

1.9.1 National Parks and Wildlife Act Registers

The Department of Environment and Climate Change (DECC) maintains a database of Aboriginal heritage sites within NSW under the auspices of the NSW *National Parks and Wildlife Act 1974*. Aboriginal objects and places in NSW are legally required to be registered on the Aboriginal Heritage Information Management System (AHIMS) database. The AHIMS database lists all Aboriginal objects and places, and other Aboriginal heritage values in NSW that have been registered as required under the NSW *National Parks and Wildlife Act* 1974.

AHIMS - The area searched on the AHIMS database was larger than the study area because any Aboriginal heritage sites that are listed within the wider area can provide information about site patterning, which can be used as an indication of the possible location, types, and frequency of sites that may be expected in the local area encompassing the study area.

APPLICATION TO THE STUDY AREA – AHIMS DATABASE

A search of the AHIMS Database (search undertaken on 28 July 2008), identified 170 previously recorded Aboriginal heritage sites within a 1 km buffer of the study area boundaries (see Figures 2, 3, 4, and 5). One of these sites, an open site and associated PAD (site name: PC1, site identification number: 45-5-3272), is located within the immediate vicinity of the study area - approximately 8 m from a 5 m buffer of the study area (see Figures 2 and 6). The results of the AHIMS search are discussed further in Section 4.4.

1.9.2 Heritage Act Registers

The Heritage Branch of the Department of Planning maintains registers of heritage items that are of State or local significance to New South Wales.

The State Heritage Register (SHR) contains items that have been assessed as being of State Significance to New South Wales.

The State Heritage Inventory (SHI) is an amalgamated register of items listed on Local Environmental Plans (LEPs), Regional Environmental Plans (REPs), and/or on a State Government Agency's Section 170 registers; these items may have been identified as having State or local level significance, but are statutorily protected at a local level.

If a heritage item does not appear on either the SHR or SHI, this does not necessarily mean that the item does not have heritage significance; many heritage items within NSW have not been assessed to determine their heritage significance. An assessment is required for items that are 50 years or older. Items that appear on either the SHR or SHI have a defined level of statutory protection. This is discussed more fully in Appendix 2.

APPLICATION TO THE STUDY AREA – NSW STATE HERITAGE REGISTER LISTINGS
There were no Aboriginal heritage items listed on the State Heritage Register within, overlapping, or in the immediate vicinity of the study area (search undertaken on 18 July 2008).

APPLICATION TO THE STUDY AREA – NSW STATE HERITAGE INVENTORY LISTINGS
There were no Aboriginal heritage items listed on the State Heritage Inventory within, overlapping, or in the immediate vicinity of the study area (search undertaken on 18 July 2008).

S.170 provisions: Section 170 of the NSW *Heritage Act 1977* requires that culturally significant heritage items managed or owned by Government agencies be listed on departmental Conservation and Heritage Registers. Information in these Registers has been prepared according to NSW Heritage Office guidelines and should correspond with information in the State Heritage Inventory (though this is not always the case).

APPLICATION TO THE STUDY AREA – GOVERNMENT AUTHORITY S.170 REGISTER
There were no Aboriginal heritage items listed on the s.170 Heritage and Conservation Registers of government authorities within the study areas (search undertaken on 18 July 2008).

1.9.3 Environmental Planning and Assessment Act Registers

The *Environmental Planning and Assessment Act* 1979 includes provisions for local government authorities to consider environmental impacts in land-use planning and decision making. Such impacts are generally considered in relation to the planning provisions contained in the Local Environment Plan (LEP) or Regional Environment Plan (REP).

Local Environmental Plans: Each Local Council is required to create and maintain a Local Environment Plan (LEP) for their Local Government Area (LGA) that includes Aboriginal and historical heritage items. Local Councils identify Aboriginal or historical heritage items that are of significance within their LGA, and these items are listed on heritage schedules in the LEP and are protected under the EP&A Act 1979 and the *Heritage Act* 1977.

APPLICATION TO THE STUDY AREA – BANKSTOWN LOCAL ENVIRONMENT PLAN 2001
There were no Aboriginal heritage items listed on the Bankstown Local Environment Plan 2001 within, overlapping, or in the immediate vicinity of the study area (search undertaken on the 18 July 2008).

APPLICATION TO THE STUDY AREA – FAIRFIELD LOCAL ENVIRONMENT PLAN 1994
There were no Aboriginal heritage items listed on the Fairfield Local Environment Plan 1994 within, overlapping, or in the immediate vicinity of the study area (search undertaken on the 18 July 2008).

APPLICATION TO THE STUDY AREA – HOLROYD LOCAL ENVIRONMENT PLAN 1991
There were no Aboriginal heritage items listed on the Holroyd Local Environment Plan 1991 within, overlapping, or in the immediate vicinity of the study area (search undertaken on the 18 July 2008).

APPLICATION TO THE STUDY AREA – PARRAMATTA LOCAL ENVIRONMENT PLAN 2001; PARRAMATTA CITY CENTRE LOCAL ENVIRONMENT PLAN 2007; AND PARRAMATTA LOCAL ENVIRONMENT PLAN 1996 (HERITAGE AND CONSERVATION)
There were no Aboriginal heritage items listed on the Parramatta Local Environment Plan 2001, Parramatta City Local Environment Plan 2007, and Parramatta Local Environment Plan 1996 within, overlapping, or in the immediate vicinity of the study area (searches undertaken on the 18 July 2008).

1.10 Heritage Listings Summary

The listings of any Aboriginal heritage items listed on statutory and non-statutory heritage registers or databases within, overlapping, or in the immediate vicinity of the study area are summarised in Table 1 below.

	HERITAGE REGISTERS											
HERITAGE ITEM	NATIONAL HERITAGE LIST	COMMONWEALTH HERITAGE LIST	REGISTER OF THE NATIONAL ESTATE	AHIMS	STATE HERITAGE REGISTER	STATE HERITAGE INVENTORY	BANKSTOWN LEP 2001	FAIRFIELD LEP 1994	HOLROYD LEP 1991	PARRAMATTA LEP 2001	PARRAMATTA CITY CENTRE LEP 2007	PARRAMATTA LEP 1996 (HERITAGE AND CONSERVATION)
Open site and associated PAD (site name: PC1, site identification number: 45-5-3272)				√								

Table 1: A summary of any Aboriginal heritage items listed on statutory and non-statutory heritage registers and databases within, overlapping, or in the immediate vicinity of the study area.

2.0 ENVIRONMENTAL CONTEXT

It is important to consider the local environment of the study area in any archaeological assessment. Firstly, the environment can influence human land use and, consequently, the location, type, and frequency of archaeological material. Secondly, environmental processes can affect the preservation of archaeological materials to varying degrees, or even destroy them completely. In addition, environmental features can contribute to the cultural significance and attachments that people have to a place.

The following is a summary of environmental information relevant to an archaeological assessment of the study area.

2.1 Geomorphology

2.1.1 Geology and Topography

The study area is located within the Cumberland Plain, which consists of a low lying, gently undulating area of plains and low hills (Benson 1992:541,543; NPWS 2000:7; Tozer 2003:2). The Cumberland Plain is bounded by Parramatta to the east, the Hawkesbury-Nepean River to the west, Windsor to the north, and Camden to the south (NPWS 2000:7). Its general elevation ranges from 20 to 100 m above sea level (Benson 1992:541,543).

The Cumberland Plain is underlain by Hawkesbury Sandstone (Standard 1969:406-7), which is overlaid by the Wianamatta Group (Lovering and McElroy 1969:419). The Wianamatta Group is comprised of the Liverpool and Camden Sub-Groups (Lovering and McElroy 1969:419). The Liverpool Sub-Group is the relevant sub-group for the study area, and it consists of the following units: Bringelly Shale; Minchinbury Sandstone; Ashfield Shale; and the Mittagong Formation (Lovering and McElroy 1969:419).

The main rocks that outcrop or underlie the soils within the study area belong to the Bringelly Shale and Ashfield Shale units. In addition, alluvial terraces that are considered to be of Pleistocene age (Jones and Clarke 1991:53) also occur within the study area

Bringelly Shale has an average thickness of 60 m (Lovering and McElroy 1969:419) and is characterised by claystone and siltstone, laminate, sandstone, coal, highly carbonaceous claystone, and tuff (Jones and Clarke 1991:24-5).

The Ashfield Shale unit is characterised by a “lower sequence of dark-grey to black, sideritic claystone – siltstone which grades upwards into a fine sandstone – siltstone laminite” (Jones and Clarke 1991:17), with an average thickness of 60 m (Lovering and McElroy 1969:419-20).

Alluvial terraces occur along St Georges River and its tributaries (Jones and Clarke 1991:53), and they are characterised by medium-grained sand, clay, and silt (Jones and Clarke 1991).

2.1.2 Soil Geomorphology

Since Aboriginal occupation of the local area encompassing the study area, the geomorphic processes that formed and continue to form the landforms over which the study area extends are likely to have significantly affected the likelihood that any potential Aboriginal archaeological materials are preserved, remain in situ, and are exposed as surface expressions. These processes can be broadly categorised as aggrading, stable, or eroding (Burke and Smith 2004:80).

Here the geomorphic processes associated with soil landscapes identified within or overlapping the study area are described.

Soil landscapes refer to areas of land that "have recognisable and specifiable topographies and soils, that are capable of presentation on maps, and can be described by concise statements" (Northcote 1978). The identification of soil landscapes are largely determined by the dominant geomorphic processes associated with the formation of landforms and underlying geology (Bannerman and Hazelton 1990:7),

The soil landscapes that occur within the study area are derived from the Wianamatta Group geological formation, and Quaternary and Tertiary alluvium. In general, Wianamatta Group derived soils are characterised by high soil acidicity (Benson 1992:543; Tozer 2003:3), and quaternary alluvial deposits occur along the major watercourses (Bannerman and Hazelton 1990:3; Tozer 2003:3). The dominant geomorphic processes associated with the soil landscapes over which the study area extends can be broadly described as aggrading, and, more specifically, described, as fluvial and residual (see Bannerman and Hazelton 1990:19; see Chapman and Murphy 1989:16).

Soil landscapes associated with fluvial geomorphic processes

As classified by the Soil Conservation Service of NSW (Bannerman and Hazelton 1990:19; Chapman and Murphy 1989:16), soil landscapes associated with fluvial geomorphic processes over which the study area extends include the Richmond, Berkshire Park, South Creek, and Birrong landscapes (see Bannerman and Hazelton 1990:19; Chapman and Murphy 1989:16).

Any potential Aboriginal archaeological materials within or overlapping the parts of these landscapes over which the study area extends are likely to have been incorporated into sediment deposited by the past overbanking of Prospect Creek, Duck Creek, and Burns Creek, or scoured and possibly shifted by water movement associated with these creeks. These landscapes are described in further detail below:

Berkshire Park

The Berkshire Park soil landscape occurs "on flat terrace tops dissected by small drainage channels and narrow drainage lines" (Bannerman and Hazelton 1990:82). The landscape is generally characterised by the following: soil erodability that ranges from low to high; slightly reactive to stable subsoils; strongly acidic soils; and a low to moderate erosional hazard for non-concentrated flows and a high erosional hazard for concentrated flows (Bannerman and Hazelton 1990).

South Creek

The South Creek soil landscape occurs on flat to gently sloping alluvial plains (Bannerman and Hazelton 1990:68). The landscape, an active floodplain, is generally characterised by the following: highly erodible soils; moderately reactive subsoils and stable surface soils; moderately acidic soils; and a very high to extreme erosional hazard due to frequent flooding. Stream bank, gully, and sheet erosion are commonly caused by concentrated flows (Bannerman and Hazelton 1990:69,70). Furthermore, there are many areas of deposition (Bannerman and Hazelton 1990:69).

Birrong

The Birrong soil landscape occurs on "level to gently undulating alluvial floodplains with local relief" (Chapman and Murphy 1989:82). The landscape is generally characterised by the following: highly erodible soils; moderately to slightly reactive soils; saline soils; and a low to moderate erosional hazard for non-concentrated flows (Chapman and Murphy 1989).

Richmond

The Richmond soil landscape occurs on mostly flat terrace tops (Bannerman and Hazelton 1990:75). The landscape is generally characterised by the following: moderately erodible surface soils and highly erodible subsoils; slightly to moderately reactive subsoils; highly acidic soils; a low erosion hazard for non-concentrated flows and a moderate to high one for concentrated flows.

Soil landscapes associated with residual geomorphic processes

As classified by the Soil Conservation Service of NSW (Bannerman and Hazelton 1990:19; Chapman and Murphy 1989:16), soil landscapes associated with residual geomorphic processes are comprised of remnant material from the decomposition of rocks (Bates and Jackson 1974). Soil landscapes associated with fluvial geomorphic processes over which the study area extends are limited to the Blacktown landscape (see Bannerman and Hazelton 1990:19; Chapman and Murphy 1989:16).

Any potential archaeological materials within or overlapping the parts of this landscape over which the study area extends are likely to have been incorporated into sediment. The Blacktown landscape is described in further detail below:

Blacktown

The Blacktown soil landscape occurs on gently undulating rises on Wianamatta Group shales (Bannerman and Hazelton 1990:28). The landscape is generally characterised by the following: moderately erodible soils; moderately reactive highly plastic subsoils; strongly acidic soils; poor soil drainage; and a slight to moderate erosion hazard for non-concentrated flows and moderate to high one for concentrated flows (Bannerman and Hazelton 1990).

Soil landscapes identified as disturbed

Disturbed soil landscapes are characterised by areas that have been extensively disturbed by human activity "including the complete disturbance, removal, or burial of soil" (Chapman and Murphy 1989:132). The characteristics of these landscapes are particular to the nature and extent of the disturbance.

2.1.3 Geological Cultural Resources

There are a number of outcrops or more relatively recent deposits that include rocks and/or minerals suitable for tool manufacture within the Cumberland Plain. These include the following: St Marys Formation; Rickabys Creek Gravel; Maroota Sands; Agnes Banks Sand; Cranebrook Formation; Lowlands Formation; and Holocene alluvium.

The St Marys Formation, which formed during the Tertiary Period, outcrops in small channels of the Wianamatta Group, as "isolated localities within the valleys of Mulgoa Creek and the South Creek – Eastern Creek system", and may have been identified at Moorebank (Jones and Clarke 1991:29,32). Stone materials suitable for stone tool manufacture (see Holdaway and Stern 2004:22-4) within this geological unit include silcrete gravels, including boulder-size silcrete (Jones and Clarke 1991:30). More specifically, there are silcrete sources that are part of the St Marys Formation at Plumpton Ridge, Marsden Park, and Riverstone. Also, silcrete boulders have been noted by McDonald (1998) at Second Ponds Creek, near Parklea.

Rickabys Creek Gravel, which was deposited during the Tertiary Period, outcrops in the Londonderry area and on the Blue Mountains Plateau (Jones and Clarke 1991:32). Stone materials suitable for stone tool manufacture (see Holdaway and Stern 2004:22-4) within this geological unit include quartz, quartzite, silcrete (which sometimes occurs as boulders) chert, porphyry, minor granite, and hornfels gravels (Jones and Clarke 1991:33,35).

The Maroota Sands Formation, which formed during the Tertiary Period, outcrops in northwest Sydney (Corkhill 1999:56-8). Stone materials suitable for stone tool manufacture (see Holdaway and Stern 2004:22-4) within this geological unit include silcrete, silicified wood, quartzite, quartz, porphyry, hornfels, and tuff (Attenbrow 2002:43-4).

The Cranebrook Formation, which formed during the Pleistocene, outcrops adjacent to the Nepean River between Mulgoa and Castlereagh (Jones and Clarke 1991:43). Stone materials suitable for stone tool manufacture (see Holdaway and Stern 2004:22-4) within this geological unit include quartz, quartzite, porphyry, chert, granite, hornfels, and silcrete

gravels (Jones and Clarke 1991:44-45). Also a large silcrete boulder (1 m x 1 m x 0.9 m) was found at the base of this unit at Emu Plains (Jones and Clarke 1991:47).

The Lowlands Formation, which formed during the Pleistocene, consists of alluvium along the Hawkesbury River, between Castlereagh and Pitt Town (Jones and Clarke 1991:49). Stone materials suitable for stone tool manufacture (see Holdaway and Stern 2004:22-4) within this geological unit include quartz, quartzite, porphyry, chert, basalt, and granite gravels (Jones and Clarke 1991:49)

Holocene alluvium occurs along the Nepean-Hawkesbury River. Stone materials suitable for stone tool manufacture (see Holdaway and Stern 2004:22-4) within this geological unit include quartz, quartzite, porphyry, chert, granite, and hornfels gravels (Jones and Clarke 1991:54). Large silcrete boulders have also been found in the river (Jones and Clarke 1991:55).

While the geological background indicates that rocks and minerals within the Cumberland Plain suitable for tool manufacture occur outside the study area, they remain relevant to the study area because they may have been procured through trading networks or travel, depending on the cultural boundaries that existed at the time.

It is important to note that, due to gaps in geological knowledge, there will be degrees of uncertainty regarding the occurrence of rocks and minerals at specific locations within the Cumberland Plain that have not been subject a geological survey or sub-surface testing.

2.2 Climate

Climate statistics for the study area have been collected from the closest weather stations near the study area <http://www.bom.gov.au/climate/averages/>: Liverpool (Whitlam Centre); Prospect Reservoir; Parramatta; and Bankstown Airport. These weather stations help to provide an indication of the annual climate of the local area encompassing the study area.

- Prospect Reservoir, located approximately northwest of the study area, receives an average annual rainfall of 872.2 mm, and has an average annual maximum temperature of 23.0 ºC and an average annual minimum temperature of 12.2 ºC.

- Liverpool (Whitlam Centre), located approximately south of the study area, receives an average annual rainfall of 867.7 mm, and has an average annual maximum temperature of 23.2 ºC and an average annual minimum temperature of 11.6 ºC.

- Parramatta located approximately north of the study area, receives an average annual rainfall of 921.2 mm, and has an average annual maximum temperature of 23.1 ºC and an average annual minimum temperature of 10.9 ºC.

- Bankstown Airport AWS, located approximately south of the study area, receives an average annual rainfall of 872.3 mm, and has an average annual maximum temperature of 23.1 ºC and an average annual minimum temperature of 11.9 ºC.

The climate throughout the study area was extrapolated from an average of these statistics. The study area has a total average annual rainfall of 883.35 mm, an average annual maximum temperature of 23.1 ºC, and an average annual minimum temperature of 11.7 ºC.

Such generally mild conditions would have been suitable for year-round habitation by Aboriginal people.

2.3 Hydrology

Prospect Creek, a tributary of Georges River, is traversed by parts of the study area located within Fairfield Park, Fairfield. In addition, parts of the study area within Fairfield Park, Fairfield, Fairfield Road Park, Yennora, and the Long Street Park Recreation Reserve, Yennora and Smithfield, are in the immediate vicinity of Prospect Creek.

Duck Creek, a tributary of Duck River, is traversed by parts of the study area located as follows:

- Approximately between Parramatta/Granville Sportsground, Granville, and the road reserve associated with Shirley Street, Granville; and

- Approximately within the road reserve associated with Elizabeth Street, Granville.

In addition, parts of the study area located approximately within the road reserve associated with the intersection of Woodville Road and Elizabeth Street, Merrylands, are in the immediate vicinity of Duck Creek.

Burns Creek, a tributary of Prospect Creek, is traversed by parts of the study area located as follows:

- Within the road reserve associated with Tangerine Street, Fairfield East; and

- Within the road reserve associated Normanby Street, Fairfield East.

The watercourses within the study areas would have provided food resources and transport for Aboriginal people and might have Aboriginal cultural value.

2.4 Flora

Natural vegetation can generally be associated with soil landscapes (Bannerman and Hazelton 1990), which, in turn, are largely determined by the underlying geology (Benson 1992:541).

The Cumberland Plain was the focus of agricultural activity in the early development of the New South Wales colony because of its relatively fertile soils, and, consequently, the landscape has undergone massive timber clearances, which gained further early momentum with the demand for railway sleepers with the introduction of railways to NSW in the mid 19th century (Proudfoot 1987:31). This has resulted in the reduction of native vegetation to approximately 13% of the pre-European extent (Tozer 2003:1). According to Benson and Redpath (1997), remnant native vegetation types of eastern Australia are similar to those present at the time of European settlement.

The National Parks and Wildlife Services (2002) have classified, described, and mapped 17 contemporary plant communities, "assemblages of plants that often grow together" (Keith 2004:15), located within the Cumberland Plain based on the description of floral assemblages formulated from quantitative survey data. Their classifications are highly consistent with the previous qualitative classifications by Benson (1992), as well as later studies such as Tozer (2003).

There are seven identified remaining native plant communities, as defined by NPWS (2002), within, overlapping, or in the immediate vicinity of the study area: Shale Plains Woodland; Alluvial Woodland; Cooks River; Castlereagh Ironbark Forest; Castlereagh Swamp Woodland; Shale Gravel Transitional Forest; and Mangrove/Saltmarsh Complex <http://www.environment.nsw.gov.au/surveys/GetHoldOfMapsDataAndReports.htm>. These communities provide a partial indication of the plants that may have existed within the local area encompassing the study area prior to the European occupation of NSW and been utilised by Aboriginal people. A complete list of the plant species characteristic of this community are summarised in Table 2 below.

Shale Plains Woodland

Shale Plains Woodland occurs mainly on soils derived from Wianamatta Shale. The tree stratum is dominated by *Eucalyptus moluccana* and *E. tereticornis* (NPWS 2002:53). The shrub stratum is dominated by *Bursaria spinosa* (NPWS 2002:53). The ground stratum commonly includes *Dichondra repens*, *Aristida vagans*, *Microlaena stipoides var stipoides*, *Themada australis*, *Brunoniella australis*, *Desmodium varians*, *Opercularia diphylla*, *Wahlenbergia gracilis* and *Dichelachne micrantha* (NPWS 2002:53). A complete list of the plant species characteristic of this community are summarised in Table 2 below.

Alluvial Woodland

Alluvial Woodland occurs "exclusively along, or in close proximity to minor watercourses draining soils derived from Wianamatta Shale" (NPWS 2002:42). The tree stratum is dominated by *Eucalyptus amplifolia*, *E. tereticornis*, and *Angophora floribunda* (NPWS 2002:42). The small tree stratum frequently includes "*Acacia parramattensis subsp. parramattensis*, and less frequently *Casuarina glauca*, and sometimes *Angophora floribunda*, and *Melaleuca linariifolia"* (NPWS 2002:42). The shrub stratum is often sparse and

dominated by *Bursaria spinosa* (NPWS 2002:42). The ground stratum is dense and dominated by *Oplismenus aemulus, Microlaena stipodes var. stipoides, Entolasia marginata, Echinopogon ovatus* and herb species, such as *Solanum prinophyllum, Pratia purpurascens,* and *Commelina cyanea,* frequently occur (NPWS 2002:42). A complete list of the plant species characteristic of this community are summarised in Table 2 below.

Cooks River/Castlereagh Ironbark Forest

Cooks River/Castlereagh Ironbark Forest occurs on clay soils derived from, or on shale soils adjacent to, Tertiary alluvium (NPWS 2002:27). The tree stratum is dominated by *Eucalyptus fibrosa* and *Melaleuca decora* with *E. longifolia* occurring less frequently (NPWS 2002:27). The small tree stratum is dominated by the same species (NPWS 2002:27). The shrub stratum is usually relatively dense and dominated by *M. nodosa, Lissanthe strigosa,* and *M. decora* (NPWS 2002:27), whereas *Acacia pubescens, Dillwynia tenuifolia, Daviesia ulicifolia, Pultenea villosa,* and *Grevillea juniperina* occur less frequently (NPWS 2002:27). The ground stratum, which is relatively sparse, commonly includes *Entolasia stricta, Lepidosperma laterale, Opercularia diphylla, Dianella revoluta subsp. revoluta, Themeda australis, Microlaena stipoides var. stipoides,* and *Pratia purpurascens* (NPWS 2002:27). A complete list of the plant species characteristic of this community are summarised in Table 2 below.

Castlereagh Swamp Woodland

Castlereagh Swamp Woodland occurs on soils derived from Tertiary alluvium or soils strongly influenced by Tertiary alluvium (NPWS 2002:33). The tree stratum is dominated by *Melaleuca decora* (NPWS 2002:33). In the tree and small tree strata, *Eucalyptus parramattensis subsp parramattensis* frequently occurs and *Eucalyptus fibrosa, Angophora subvelutina,* and *Melaleuca linariifolia* occur less frequently (NPWS 2002:33). The ground stratum, which is often dense, includes *Goodenia paniculata, Schoenus apogen, Centella asiatica,* and *Juncus usitatus.* A complete list of the plant species characteristic of this community are summarised in Table 2 below.

Shale Gravel Transitional Forest

Shale Gravel Transitional Forest occurs mainly "in areas where shallow deposits of Tertiary alluvium overlie shale soils (NPWS 2002:30). The tree stratum is dominated by *Eucalyptus fibrosa* (NPWS 2002:30), with *E. moluccana* and *E. tereticornis* occurring less frequently (NPWS 2002:30). The shrub stratum is sparse and commonly includes *Bursaria spinosa, Daviesia ulicifolia,* and *Lissanthe strigosa* (NPWS 2002:30). The ground stratum commonly includes *Microlaena stipoides* subsp. *stipoides, Cheilanthes sieberi* subsp. *sieberi, Themeda australis, Opercularia diphylla, Lomandra multiflora* subsp. *multiflora, Arista vagans, Pratia*

purpurascens, and *Wahlenbergia gracilis* (NPWS 2002:30). A complete list of the plant species characteristic of this community are summarised in Table 2 below.

Mangrove/Saltmarsh Complex

Mangrove/Saltmarsh Complex could not be adequetely characterised by NPWS (2002) due to a low number of samples. However, NPWS (2002) noted that the following species were identified more than once: *Avicennia marina var. australasica, Aegiceras corniculatum,* and *Sarcocornia quinqu.* A complete list of the plant species characteristic of this community are summarised in Table 2 below.

STRATUM	PLANT COMMUNITY	PLANTS CHARACTERISTIC OF PLANT COMMUNITY
TREES	Shale Plains Woodland	*Eucalyptus moluccana*; *Eucalyptus tereticornis*; *Eucalyptus crebra*; *Eucalyptus eugenioides*; *Eucalyptus fibrosa*; *Angophora floribunda*; *Angophora subvelutina; Corymbia maculata*; *Eucalyptus amplifolia*; *Eucalyptus punctata*; *Eucalyptus baueriana*; *Eucalyptus globoidea Eucalyptus longifolia*; *Eucalyptus paniculata*; *Exocarpus cupressiformis*; *Acacia parramattensis supsp. Parramattensis*; *and Acacia decurrens.*
	Shale Gravel Transitional Forest	*Eucalyptus fibrosa*; *Melaleuca decora*; *Eucalyptus moluccana*; *Eucalyptus tereticornis*; *Eucalyptus crebra*; *Eucalyptus eugenioides*; *Eucalyptus globoidea*; *Angophora floribunda*; *Eucalyptus punctata*; *Eucalyptus sclerophylla*; *Angophora bakeri*; *Angophora subvelutina*; *Corymbia maculata*; *Eucalyptus sparsifolia*; *and Syncarpia glomulifera*
	Alluvial Woodland	*Acacia parramattensis*; *Casuarina cunninghamiana* subsp. *Cunninghamiana*; *Eucalyptus deanei*; *Eucalyptus amplifolia*; *Eucalyptus tereticornis*; *Angophora floribunda*; *Casuarina glauca*; *Eucalyptus eugenioides*; *Angophora subvelutina*; *Eucalyptus moluccana*; *Eucalyptus globoidea*; *Eucalyptus punctata*; *Eucalyptus baueriana*; *Corymbia maculata*; *Eucalyptus elata*; *Eucalyptus piperita* subsp. *Piperita*; *and Eucalyptus sclerophylla*
	Cooks River/ Castlereagh Ironbark Forest	*Melaleuca decora*; *Eucalyptus fibrosa*; *Eucalyptus longifolia*; *Angophora floribunda*; *Eucalyptus eugenioides*; *Eucalyptus globoidea*; *Eucalyptus moluccana*; *Eucalyptus sclerophylla*; *Eucalyptus tereticornis*; *Syncarpia glomulifera*; *Angophora bakeri*; *Angophora subvelutina*; *Eucalyptus crebra*; *Eucalyptus oblonga*; *Eucalyptus parramattensis* subsp. *Parramattensis*; *Eucalyptus resinifera*; *and Eucalyptus sideroxylon.*
	Castlereagh Swamp Woodland	*Melaleuca decora*; *Eucalyptus parramattensis*; *Parramattensis*; *Angophora subvelutina*; *Eucalyptus amplifolia*; *Eucalyptus fibrosa*; *Eucalyptus tereticornis*; *Angophora floribunda*; *Eucalyptus eugenioides*; *Eucalyptus sclerophylla*; *Eucalyptus sideroxylon*
	Mangrove/Saltmarsh Complex	*Avicennia marina* var. *australasica*; *Aegiceras corniculatum*; *and Casuarina glauca*
SHRUBS	Shale Plains Woodland	*Bursaria spinosa*
	Shale Gravel Transitional Forest	*Daviesia ulicifolia*; *Lissanthe strigosa*; *and Bursaria spinosa*
	Alluvial Woodland	*Bursaria spinosa*
	Cooks River/ Castlereagh Ironbark Forest	*Melaleuca nodosa*; *Lissanthe strigosa*; *Dodonaea falcata*; *Acacia echinula*; *Pultenaea villifera*; *and Bursaria spinosa.*
	Castlereagh Swamp Woodland	*Bursaria spinosa*
	Mangrove/Saltmarsh Complex	*Bursaria spinosa*
GRASSES AND GRASS-LIKE PLANTS	Shale Plains Woodland	*Dichondra repens*; *Aristida vagans*; *Brunoniella australis*; *Desmodium varians*; *Opercularia diphylla*; *Wahlenbergia gracilis*; *Dichelachne micrantha*; *Paspalidium distans*; *Eragrostis leptostachya*; *Lomandra filiformis* subsp. *Filiformis*; *Dianella longifolia*; *Oxalis perennans*; *Lomandra multiflora* subsp. *Multiflora*; *Gnaphalium sphaericum*; *Goodenia hederacea* subsp. *Hederacea*; *Aristida ramosa*; *Arthropodium milleflorum*; *Danthonia tenuior*; *Cymbopogon refractus*; *Echinopogon caespitosus* var. *caespitosus*; *Dichopogon strictus*; *Ranunculus lappaceus*; *Brachycome multifida*; *Calandrinia pickeringii*; *Danthonia setacea*; *Pimelea curviflora* var. *subglabrata*; *Rorippa laciniata*; *Wurmbea biglandulosa*; *Dipodium punctatum*; *Entolasia stricta*; *Cheilanthes sieberi* subsp. *sieberi*; *Microlaena stipoides* var. *stipoides*; *Themeda australis*; *Glycine tabacina*; *and Glycine clandestina.*
	Shale Gravel Transitional Forest	*Opercularia diphylla*; *Lomandra multiflora* subsp. *multiflora*; *Aristida vagans*; *Pratia purpurascens*; *Wahlenbergia gracilis*; *Poranthera microphylla*; *Desmodium varians*; *Dichelachne micrantha*; *Goodenia hederacea* subsp. *hederacea*; *Lomandra filiformis* subsp. *filiformis*; *Brunoniella australis*; *Dianella revoluta* var. *revoluta*; *Hypericum gramineum*; *Lepidosperma laterale*; *Oxalis perennans*; *Panicum simile*; *Danthonia tenuior*; *Dianella longifolia*; *Echinopogon ovatus*; *Laxmannia gracilis*; *Pomax umbellata*; *Tricoryne elatior*; *Vernonia cinerea* var. *cinerea*; *Microtis parviflora*; *Microlaena stipoides* var. *stipoides*; *Cheilanthes sieberi* subsp. *sieberi*; *Themeda australis*; *Entolasia stricta*; *Dichondra repens*; *Glycine clandestina*; *Opercularia diphylla*; *Lomandra multiflora* subsp. *multiflora*; *Aristida vagans*; *and Pratia purpurascens*
	Alluvial Woodland	*Oplismenus aemulus*; *Entolasia marginata*; *Echinopogon ovatus*; *Solanum prinophyllum*; *Pratia purpurascens*; *Commelina cyanea*; *Desmodium varians*; *Lomandra longifolia*; *Oxalis perennans*; *Brunoniella australis*; *Alisma plantago-aquatica*; *Samolus valerandi*; *Bolboschoenus caldwellii*; *Centipeda cunninghamii*; *Cyperus trinervis*; *Fimbristylis velata*; *Myriophyllum variifolium*; *Persicaria subsessilis*; *Scutellaria mollis*; *Themeda australis*; *Aristida vagans*; *Lomandra multiflora* subsp. *multiflora*; *Entolasia stricta*; *Dichondra repens*; *Microlaena stipoides* var. *stipoides*; *Cheilanthes sieberi* subsp. *sieberi*; *Glycine tabacina*; *and Glycine clandestina*
	Cooks River/ Castlereagh Ironbark Forest	*Entolasia stricta*; *Lepidosperma laterale*; *Opercularia diphylla*; *Dianella revoluta* var. *revoluta*; *Pratia purpurascens*; *Aristida vagans*; *Danthonia tenuior*; *Goodenia hederacea* subsp. *hederacea*; *Panicum simile*; *Laxmannia gracilis*; *Eragrostis brownii*; *Vernonia cinerea* var. *cinerea*; *Deyeuxia quadriseta*; *Dichondra repens*; *Microlaena stipoides* var. *stipoides*; *Cheilanthes sieberi* subsp. *sieberi*; *Lomandra multiflora* subsp. *multiflora*; *Themeda australis*; *Dendrophthoe vitellina*; *Billardiera scandens*; *and Cuscuta australis.*
	Castlereagh Swamp Woodland	*Goodenia paniculata*; *Schoenus apogon*; *Centella asiatica*; *Juncus usitatus*; *Opercularia diphylla*; *Pratia purpurascens*; *Agrostis avenacea* var. *avenacea*; *Gratiola pedunculata*; *Hydrocotyle peduncularis*; *Hypericum gramineum*; *Poranthera microphylla*; *Eragrostis brownii*; *Fimbristylis dichotoma*; *Hypoxis hygrometrica*; *Lomandra longifolia*; *Cyperus flaccidus*; *Cyperus sanguinolentus*; *Eleocharis dietrichiana*; *Juncus australis*; *Juncus fockei*; *Lipocarpha microcephala*; *Nymphoides geminata*; *Potamogeton tricarinatus*; *Pratia surrepens*;

Mangrove/Saltmarsh Complex	*Cheilanthes sieberi* subsp. *sieberi*; *Microlaena stipoides* var. *stipoides*; *Themeda australis*; *Dichondra repens*; *Lomandra multiflora* subsp. *multiflora*; *Entolasia stricta* *Sarcocornia quinqueflora* subsp. *quinqueflora*; *Apium prostratum*; *Juncus kraussii*; *Samolus repens*; *Sporobolus virginicus* var. *minor*; *Suaeda australis*; *Microlaena stipoides* var. *stipoides*; *Cheilanthes sieberi* subsp. *sieberi*; *Dichondra repens*; *Entolasia stricta*; *Lomandra multiflora* subsp. *multiflora*; *Themeda australis*

Table 2*:* List of the plants characteristic of the plant communities within, overlapping, or in the immediate vicinity of the study area.

2.4.1 General Plant Use

Plants were used by Aboriginal people for a wide range of purposes (see Clarke 2007). Plants were an important source of food. Plants were also a source of drink and could be used as seasoning. According to Attenbrow (2002), the vegetation communities of Greater Sydney have over 200 species with edible parts. They were a source of drugs for personal use, narcotics, hallucinogenics, medicines, or stimulants. They were used as a poison for fishing - the resin of certain plant species can be used to paralyse fish. They were used to manufacture a wide range of items including: personal decoration; clothing; tools (digging sticks, weapons, shields, containers); art (paint fixatives); watercraft (canoes and rafts); and traps. They were used in the construction of shelters. They also featured in local mythologies, and some were considered sacred and/or had ritual uses.

Wood, bark, fibres, and resin are all examples of useful materials derived from plants: wood could be used to manufacture items such as boomerangs, clubs, or shields; bark could also be used to manufacture shields, clothing, canoes, or dishes; fibres could be used to manufacture string, baskets, or mats; and resin could be used as an adhesive in tool manufacture and decoration, or to seal leaks in canoes.

2.4.2 Specific Plant Use

Table 3 provides a summary of examples of known cultural uses of plants characteristic of Shale Plains Woodland, Alluvial Woodland, Cooks River/Castlereagh Ironbark Forest, Castlereagh Swamp Woodland, Shale Gravel Transitional Forest, and Mangrove/Saltmarsh Complex, as defined by NPWS (2002).

The below examples of Aboriginal plant usage are not necessarily from within the Cumberland Plain. Others do not directly reference Aboriginal usage (though many do), but general known usage of the relevant plants. Nonetheless, such examples demonstrate how plants within the study area may have been utilised by Aboriginal people. This summary is an indication, not a complete list (which would be exhaustive), of specific plant usage that may have occurred within the local area encompassing the study area.

PLANTS	ECOLOGICAL COMMUNITIES, AS DEFINED BY NPWS (2002)	EXAMPLES OF KNOWN USES
Acacia decurrens	• Shale Plains Woodland	Used by Aboriginal people as a food relish (Robinson 1991:64; Bunce (1859:71) cited in Clarke (2007:80).
Eragrostis genus	• Cooks River/Castlereagh Ironbark Forest	According to Robinson (1991:271), the grain of some species was used by Aboriginal people in Central Australia to make flour.
Aegiceras corniculatum	• Mangrove/Saltmarsh Complex	The leaves were used by Aboriginal people in Northern Queensland to remedy earache (Low 1990:185,277).
Arthropodium milleflorum	• Shale Plains Woodland	This plant has edible tubers and roots (Cherikoff 1993:126;151,194; Clarke 2007:73).
Avicennia marina var. *australasica*	• Mangrove/Saltmarsh Complex	The fruits of this plant were roasted and eaten by the Aborigines in Northern Australia (Robinson 1991:392).
Casuarina glauca	• Alluvial Woodland • Mangrove/Saltmarsh Complex	According to Robinson (1991:152), this is probably the plant from which Surgeon Worgan, in 1788, observed Port Jackson Aborigines removing "whole cylinders to make canoe hulls".
Centella asiatica	• Castlereagh Swampland	This plant can be used to heal wounds (Low 1990:56,228)
Centipeda cunninghamii	• Alluvial Woodland	According to Robinson (1991:414), Aboriginal people "from inland areas" would place this plant around the head to alleviate colds. In addition, the leaves and stem of this plant were used as a narcotic by Aboriginal people in Central Australia (Clarke 2007:97).
Eucalyptus and Angophora species	• Shale Plains Woodland • Alluvial Woodland • Cooks River/Castlereagh Ironbark Forest • Castlereagh Swampland • Shale Gravel and Transitional Forest	The kino, i.e., catechu-like gum, from these species was used by Aboriginal people as a remedy for diarrhoea (Low 1990:140,228).
Exocarpus cupressiformis	• Shale Plains Woodland	This plant has edible fruit (Cherikoff 1993:195,200; Low 1990:33), and its stalks were eaten by Aboriginal people in the Sydney region (Robinson 1991:208).
Dianella revoluta	• Shale Plains Woodland • Cooks River/Castlereagh Ironbark Forest	Most *Dianella* species have edible seeds and fruits (Stewart and Percival 1997:17,24; Cherikoff 1993:189,195), and some species have roots that are edible after processing (Stewart and Percival 1997:17; Clarke 2007:73). Clarke notes that the roots of this species were eaten by Aboriginal people (Clarke 2007:73) .
Dichopogon strictus	• Shale Plains Woodland	This plant has edible tubers (Cherikoff 1993:195).
Dipodium punctatum	• Shale Plains Woodland	This plant has edible tubers (Cherikoff 1993:195).
Grevillea species	• Cooks River/Castlereagh Ironbark Forest	The nectar of this plant is potable (Cherikoff 1993:195)
Lomandra longifolia	• Alluvial Woodland • Castlereagh Swampland	This plant has edible flowers and leaf bases (Stewart and Percival 1997:35; Cherikoff 1993:190;200), and its leaves were used by Aboriginal people to make baskets and mats (Clarke 2007:120; Stewart and Percival 1997:35)

Lomandra multiflora ssp. *Multiflora*	• Shale Plains Woodland • Alluvial Woodland • Cooks River/Castlereagh Ironbark Forest • Castlereagh Swampland • Shale Gravel and Transitional Forest • Mangrove/Saltmarsh Complex	This plant has edible flowers and leaf bases (Cherikoff 1993:195), and its leaves, which are strong and fiberous, were used by Aboriginal people to make 'net bags' (Robinson 1991:277)
Hypoxis hygrometrica	• Castlereagh Swampland	This plant has edible tubers (Cherikoff 1993:195).
Melaleuca species	• Cooks River/Castlereagh Ironbark Forest • Castlereagh Swampland • Shale Gravel and Transitional Forest	This plant has edible nectar (Cherikoff 1993:195).
Microtis species	• Shale Gravel Transitional Forest	This species has edible tubers (Cherikoff 1993:196).
Sarcocornia quinqueflora	• Mangrove/Saltmarsh Complex	This plant has an edible stem (Cherikoff 1993:196)
Suaeda australis	• Mangrove/Saltmarsh Complex	This plant has an edible 'greens' (Cherikoff 1993:197).
Themada australis	• Shale Plains Woodland • Alluvial Woodland • Cooks River/Castlereagh Ironbark Forest • Castlereagh Swampland • Shale Gravel and Transitional Forest • Mangrove/Saltmarsh Complex	This plant has edible seeds (Cherikoff 1993:191) and was also a source of string fibre for Aboriginal people in southeastern Australia (Clarke 2007:120).

Table 3: A summary of examples of known uses of plants diagnostic of the ecological communities (as defined by NPWS 2002) relevant to the study area.

2.5 Fauna

The plant communities discussed previously would have supported a range of fauna that would have been utilised by Aboriginal people. Animals were not only used for food, but also contributed to the cultural aspects of Aboriginal life. They provided materials for technologies, played a role in local mythologies, and some were considered sacred and/or had ritual uses.

Terrestrial mammals would presumably have been an abundant and reliable source of food for the Aboriginal occupants of the study areas. Kangaroos, wallabies, wombats, possums, bandicoots, potoroos and other marsupials would all have been exploited for food (Turbet 2001). Most Australian land mammals are non-migratory and would have been present all year round (Attenbrow 2002). Animals such as snakes, lizards, and grubs, as well as eels, fish, and shellfish from the watercourses, would have also been eaten (Turbet 2001:66-7).

As well as providing food resources, animals also provided materials for the technologies of Aboriginal people. For example: skins were used as clothing, such as possum skin cloaks, while sinews, bone points, or awls were used for sewing; animal teeth, bones, and sinews were used in tool manufacture; and animal products, such as feathers, fishbones, and teeth were used as decoration (Turbet 2001:12).

2.6 Resource Statement Summary

In conclusion, the local environment of the study area would have provided ideal conditions for Aboriginal occupation.

3.0 ABORIGINAL CONTEXT

3.1 Ethnohistory

It is generally accepted that people have inhabited the Australian landmass for the last 50,000 years (Allen and O'Connell 2003). Dates of the earliest occupation of the continent by Aboriginal people are subject to continued revision as more research is undertaken.

The timing for the human occupation of the Sydney Basin is still uncertain. Whilst there is some possible evidence for occupation of the region around 40,000 years ago, the earliest undisputed radiocarbon date from the region comes from a rock shelter site north of Penrith on the Nepean River, known as Shaws Creek K2, which has been dated to 14,700 +/- 250 BP (Attenbrow 2002:20).

The earliest known evidence of campsites within the Cumberland Plain is from approximately 7,000 years ago. Archaeological evidence of Aboriginal occupation of the Cumberland Plains indicates that the area was intensively occupied from approximately 4000 years BP (Dallas 1982). Such 'young' dates are probably more a reflection of the conditions associated with the preservation of archaeological sites and the areas that have been subject to surface and sub-surface archaeological investigations, rather than actual evidence of the Aboriginal hunter-gatherer population prior to this time.

Our knowledge of Aboriginal people and their land-use patterns and lifestyles prior to European contact is mainly reliant on documents written by non-Aboriginal people. These documents are affected by the inherent bias of the class and cultures of their authors, who were also often describing a culture that they did not fully understand – a culture that was in a heightened state of disruption given the arrival of settlers and disease. Early written records can, however, be used in conjunction with archaeological information and surviving oral histories from members of the Aboriginal community in order to gain a picture of Aboriginal life in the region.

Despite a proliferation of Aboriginal heritage sites there is considerable ongoing debate about the nature, territory and range of pre-contact Aboriginal language groups in the greater Sydney region. These debates have arisen largely because, by the time colonial diarists, missionaries and proto-anthropologists began making detailed records of Aboriginal people in the late 19th century, pre-European Aboriginal groups had been broken up and reconfigured by European settlement activity. The following information relating to Aboriginal people on the Cumberland Plains is based on such early records.

The first recorded people known to have an association with this landscape were people of the Darug language group. Darug was first described as a language (or dialectic group) by pioneer surveyor, anthropologist and linguist R. H. Mathews in the early 20th century. He described the *Dharruk* speaking people as extending along the coast to the Hawkesbury River, and inland to Windsor, Penrith and Campbelltown (Mathews 1901).

Since then, most historic and linguistic research has suggested that the Darug were principally an 'inland' group, associated with the Cumberland Plain and distinct from the Aboriginal groups of Coastal Sydney (Ross 1990). A separate language group, known as the Guringai, is thought to have lived along the coast of Port Jackson and Broken Bay (Ross in Powell and Banks 2000), although the extent of their territory continues to be debated (Attenbrow 2002). Attenbrow has identified the Darug language as one of the four main language groupings of the greater Sydney region (Attenbrow 2002). It is suggested that the hinterland Darug dialect covered the Cumberland Plain from Appin in the south to the Hawkesbury River in the north, and west of the Georges River, Parramatta, the Lane Cove River and Berowra Creek. These areas are considered to be indicative only, and would have changed through time, and possibly also changed depending on circumstances.

Since the arrival of European settlers, the movement of Aboriginal hunter-gatherers began to be increasingly restricted. European expansion along the Cumberland Plain was swift and soon there had been considerable loss of Darug land to agriculture. This led to violence and conflict between Europeans and Aboriginal people as both groups sought to compete for the same resources (Brooks et al 2003:16). At the same time, diseases such as small pox were having a devastating affect on the Aboriginal population. Death, starvation and disease were some of the disrupting factors that led to a reorganisation of the social practices of Aboriginal communities after European contact. The formation of new social groups and alliances were made as Aboriginal people sought to retain some semblance of their previous lifestyle.

3.2 Regional Overview

Numerous archaeological surveys have been undertaken along the Cumberland Plain - most of which have been site specific impact driven survey assessments. Rhoads and Dunnett (1985), Kohen (1986), and Smith (1989) provide a synthesis of much of the earlier work in the area. The Cumberland Plain has seen an increasing focus on archaeological investigations in response to the rapid urban and economical development in the region. More recent archaeological work continues to inform on the archaeological record of the region.

McDonald (1997) conducted a regional analysis of Aboriginal occupation of the Cumberland Plain and formulated a broad predictive model, which was based on data from 666 sites registered on the then NPWS Site Register. The model, summarised in McDonald (1998), concluded the following:

- Throughout the Cumberland Plain, sites were identified on all 'landscapes'. The most commonly identified site type was that of the open site, which accounted for 89% of sites (McDonald 1998:13), followed by scarred trees, which accounted for 2.1% of sites. Shelter or axe-grinding groove sites were predominantly identified "around the peripheries of the Plain" on Hawkesbury Sandstone (McDonald 1998:13).

- The frequency and density of Aboriginal heritage sites located in the headwaters of upper tributaries (first order watercourses) is likely to be low, and such sites are likely to represent a background scatter (McDonald 1998:15).

- The frequency and density of Aboriginal heritage sites located in the middle reaches of minor tributaries (second order watercourses) is likely to be low, and such sites are likely to represent single events, such as one-off camping locations or knapping episodes (McDonald 1998:15).

- The frequency and density of Aboriginal heritage sites located in the lower reaches of tributary creeks (third order watercourses) is likely to be greater, and such sites are likely to represent repeated occupation, knapping events, and more concentrated activities (McDonald 1998:15).

- The frequency and density of Aboriginal heritage sites located on major creek lines is likely to be greater, and such sites are likely to represent repeated or more permanent occupation and, consequently, will be more complex (McDonald 1998:15).

- The junctions of creeks may have been a focus of Aboriginal activity (McDonald 1998:15).

- The frequency and density of Aboriginal heritage sites located on ridgetops between drainage lines is likely to be low, and such sites are likely to represent single events (McDonald 1998:15).

- Outcrops of silcrete would have been exploited if known (McDonald 1998:15).

- In general, the size of stone artefacts is likely to decrease the further they are located from the quarry from which they were obtained. Similarly, the presence of cortex on artefacts is less likely to be present, or occur as smaller percentages, the further artefacts are located from the quarry from which they were obtained due to the continued reduction sequence (McDonald 1998:15).

- Sandstone overhangs may be the focus of camping and art production, and sandstone platforms may be the focus of axe production/sharpening (McDonald 1998:15-16).

This broad predictive model was further informed by the Rouse Hill Test Excavation Program undertaken by McDonald and Rich (1993) and McDonald, Rich, and Barton (1994). This project remains the largest archaeological sub-surface investigation within the Cumberland Plain. From this project, McDonald (1998:13-14) concluded the following:

- Most areas contained sub-surface Aboriginal archaeological deposits;

- Ploughing generally only disturbs soil approximately 30 cm deep; and

- Predictive models based only on Aboriginal heritage sites that are visible from the surface are "inadequate to describe either the characteristics of sites on the Cumberland Plain or to predict site location and/or variability" (also see McDonald 1996).

Specific to the study area, the broad predictive model for Aboriginal heritage sites within the Cumberland Plain formulated by McDonald (1997; see 1998:15) would suggest the following:

- The frequency and density of any potential Aboriginal heritage sites located along Duck River and Prospect Creek, both third order watercourses, is likely to be greater than that of a second order watercourse, and such sites are likely to represent repeated occupation, knapping events, and more concentrated activities.

- The frequency and density of any potential Aboriginal heritage sites located along Duck Creek and Burns Creek - both second order watercourses - is likely to be low, and such sites are likely to represent single events, such as one-off camping locations or knapping episodes.

3.3 Local Overview

As discussed previously, a number of archaeological studies have been undertaken within the Cumberland Plain. Those within or overlapping a 1 km buffer of the study area from which Aboriginal heritage sites were registered have been summarised below. It is important to note that at the time this report was produced, AHIMS was in the process of digitising all archaeological reports lodged with DECC. Consequently, a number of archaeological reports relevant to the study area were not available at the time of report production: Byrne (1994); Cole *et al* (1988); Comber (1990a); Comber (1990b); Comber (1991a); Comber (1991b); Jo McDonald Cultural Heritage Management Pty. Ltd. (2005); Haglund & Associates Pty. Ltd, Heritage Consultants, Tuck, and Rawson (2007); Knight & Kohen (2003); McDonald (1986); Navin (1992); and Rawson (2002). The unavailability of these reports is not a limitation to the assessment presented.

Dallas (1982) conducted an Aboriginal archaeological assessment of a number of areas that, combined, extend across the suburbs of Riverstone, Schofields, and Quakers Hill, NSW, for the NSW Land Commission. The survey focused on undisturbed and relatively undisturbed areas. The general ground surface visibility of these areas ranged from 'reasonable' to 'good'. The survey identified seven open artefact scatters, two of which had associated PADS, and four isolated artefacts. The sites were mainly identified near watercourses, including creek beds, banks, and a creek confluence, and elevated areas, including ridges and hills. The stone artefacts identified were predominantly composed of silcrete, followed by quartz, and chert, and a small number of chalcedony and silicified wood. All of the sites had been disturbed to a degree, four of which had been heavily disturbed.

McIntyre-Tamwoy (2003) conducted an archaeological assessment of an area of land in the suburb of Holroyd for Transgrid. No Aboriginal heritage sites were identified.

Mary Dallas Consulting Archaeologists (2003) conducted an Aboriginal heritage study of the Parramatta Local Government Area for Parramatta City Council. The overall aim of the study was to provide a planning and management strategy for Aboriginal heritage. The study identified and mapped the following: registered Aboriginal heritage sites; unregistered Aboriginal heritage sites identified through consultation with Aboriginal groups; and, using classifications, the relative Aboriginal archaeological sensitivity within the Parramatta LGA.

The majority of the study area extends over areas considered to have low Aboriginal archaeological sensitivity, as identified by (Mary Dallas Consulting Archaeologists 2003:119-20), in which there is a low likelihood for Aboriginal heritage sites to occur due to the "largely disturbed" nature of these areas. Mary Dallas Consulting Archaeologists (2003:121-124) recommended no further action for these areas.

However, parts of the study area - in particular, the proposed elevated storage reservoir – extend over an area of moderate sensitivity, as identified by Mary Dallas Consulting Archaeologists (2003: 119-20), in which there is moderate likelihood for Aboriginal heritage sites to occur due to the "partially disturbed" nature of the area. Mary Dallas Consulting Archaeologists (2003:123) recommended that this area is subject to an archaeological survey.

The zones of Aboriginal archaeological sensitivity within Parramatta LGA identified by Mary Dallas Consulting Archaeologist's (2003) are a preliminary indication only and, according to Mary Dallas Consulting Archaeologists (2003), should be reassessed/updated as further information becomes available.

Haglund & Associates Pty. Ltd. (2006) conducted an Aboriginal archaeological assessment of the eastern part of the Parramatta Health Services Area (PHSA), Marsden Street, Parramatta, which was to be informed by excavations approved under an s.87 permit. This assessment was further informed by Aboriginal artefacts identified by the historical excavation of the area, which was conducted simultaneously by Casey and Lowe.

The study area was defined by a low ridge and ridge slope. The Aboriginal archaeological assessment conducted a subsurface investigation of three areas (see Haglund and Associates Pty. Ltd. 2006): the northern half of the study area (Stage 1) ; the western central and southern parts of the study area (Stage 2b); and an area immediately east of Stage 2b (Stage 2c). Thirty stone artefacts predominantly composed of silcrete were identified from Stage 1 (see Haglund and Associates Pty. Ltd. 2006). A few stone artefacts composed of silcrete were uncovered from Stage 2b (see Haglund and Associates Pty. Ltd. 2006). A total of 184 stone artefacts were identified from Stage 2c (see Haglund and Associates Pty. Ltd. 2006).

Navin Officer (2007) prepared a cultural heritage impact assessment for the development of a water treatment plant, pipeline, and associated infrastructure for Sydney Water, and the development extended across the Local Government Areas of Blacktown, Parramatta, Penrith,

and Baulkham Hills. The field survey for this assessment identified the following: four open artefact scatters, one of which had an associated PAD; three isolated finds, one of which had an associated PAD; and four additional PADS. All of the sites with identified artefacts were located on areas of exposure and on a range of landforms including upper slopes, mid slopes, basal slopes, and valley floors. The stone artefacts identified were predominantly composed of silcrete, with indurated mudstone, chert, and 'volcanic' artefacts occurring less frequently.

3.4 Results of the AHIMS Search

A search of the Aboriginal Heritage Information Management System (AHIMS), which is maintained by the Department of Environment and Climate Change (DECC), was undertaken on 28 July 2008. The search identified 170 registered Aboriginal heritage sites within a 1 km buffer of the study area (see Figures 2, 3, 4 and 5).

As previously discussed (see Section 1.9.1), there is one Aboriginal heritage site, an open site and associated PAD (site name: PC1; site identification number: 45-5-3272) located within the immediate vicinity of the study area – approximately 8 m from a 5 m buffer of the study area (see Figures 2 and 6). This site was initially recorded and registered with AHIMS by AMBS (date unknown).

Further information about this site was not available from AHIMS at the time of report production. The descriptive tag for the unavailable site information card indicates that the site consists of an open site (therefore, either an open artefact scatter or isolated artefact) with an associated potential archaeological deposit (PAD). As the site is located approximately 8 m from a 5 m buffer of the study area, the PAD may overlap the impact zone of the proposed development, although this is not clear without further information.

It is, however, important to note that the AHIMS database only includes Aboriginal heritage sites that have been registered with DECC. Large areas of NSW have not been subject to a systematic archaeological survey. The AHIMS listings are only representative of areas that have been subject to an archaeological survey; they should not be considered as a complete list of Aboriginal heritage sites within any given area.

Details of sites registered with AHIMS within a 1 km buffer of the study area are summarised in Table 4, and Figures 2, 3, 4, and 5 display a map of these sites.

SITE IDENTIFICATION NUMBER	SITE NAME	SITE TYPE	SMALL-SCALE LANDFORM	SITE DISTANCE FROM WATER
45-5-0257	Liverpool;Chipping Norton;	Scarred tree	Not stated	Not stated
45-5-0277	Cumberland Oval;Parramatta;	Scarred tree	River side	0 metres
45-5-0729	Orphan School Creek 6;	Scarred tree, open artefact scatter	Terrace	50 metres
45-5-0730	Orphan School Creek 5;	Open artefact scatter	Terrace	20 metres
45-5-0731	Orphan School Creek 4;	Open artefact scatter	Terrace	50 metres
45-5-0732	Orphan School Creek 3;	Scarred tree	Creek bank	22 metres
45-5-0734	Orphan School Creek 1;	Scarred tree	Terrace	50 metres
45-5-0740	Carawood Park Caramar.;	Isolated artefact	Creek bed	0 metres
45-5-0762	Parramatta park;	Open artefact scatter, scarred tree	Low ridge	75 metres
45-5-0791	Toongabbie creek;	Open artefact scatter	Creek bank	0 metres
45-5-0792	John Curtin Reserve, Northmead.;	Rock shelter with archaeological deposit	Cliff line	Not stated
45-5-0801	PB1;Prospect Reservoir;	Open artefact scatter	Watercourse bank	Not stated
45-5-0802	PB2;Prospect Reservoir;	INA	Not stated	Not stated
45-5-0803	PB3;Prospect Reservoir;	INA	Not stated	Not stated
45-5-0804	PB4;Prospect Reservoir;	Open artefact scatter	Spur	100 metres
45-5-0805	PA1;Prospect Reservoir;	INA	Watercourse edge	500 metres
45-5-0806	PA2;Prospect Reservoir;	Open artefact scatter	Low hill	500 metres
45-5-0824	Moxhams Road Cave;	Rock shelter with archaeological deposit	Ridgeside	Not stated
45-5-0835	Toongabbie Cave;Old Toongabbie;	Rock shelter with archaeological deposit	Creek bank	5 metres
45-5-0836	Prospect Tunnel;PT 1;	Open artefact scatter	Creek bank	5 metres
45-5-0841	Toongabbie Creek 4;Winston Hills;	Axe grinding groove	Creek bed	0 metres
45-5-0842	Toongabbie Creek 3;Old Toongabbie;	Open artefact scatter	Ridgetop	Not stated
45-5-0843	Finalysons Creek;Wenthworthville;	Axe grinding groove	Creek bed	0 metres
45-5-0864	Governors Bathhouse;	Open artefact scatter	Not stated	250 metres

45-5-0868	PP1;Prospect Reservoir;	Open artefact scatter	Low hill	20 metres
45-5-0869	PP2;Prospect Reservoir;	Open artefact scatter	Hill slope	500 metres
45-5-1065	Parra Park 3;PP 3;	Open artefact scatter	Ridgetop	6 metres
45-5-1081	CSIRO/ISF2;	Isolated artefact	Creek flat	5 metres
45-5-1082	CSIRO/ISF1;	Isolated artefact	Creek flat	4 metres
45-5-1083	CSIRO 1;	Scarred tree	Creek flat	4 metres
45-5-1094	Beresford Road Public School;	Open artefact scatter	Not stated	35 metres
45-5-1095	Pendle Hill Park;	Open artefact scatter	Ridgetop	100 metres
45-5-1096	Darling Street Park_1;	Open artefact scatter	High ground	Not stated
45-5-1097	Darling Street Park_2;	Open artefact scatter	High ground	20 metres
45-5-1099	Hume Highway;	Open artefact scatter	Not stated	40 metres
45-5-1109	Redbank;Northmead;	Open artefact scatter	High ground	30 metres
45-5-1110	Redbank;Northmead;	Axe grinding groove	Creek bed	0 metres
45-5-2295	Toongabbie 1;	Axe grinding groove	Creek Bank	0 metres
45-5-2296	Toongabbie 2;	Rock shelter with archaeological deposit	Creek terrace	15 metres
45-5-2297	Toongabbie 3;	Open shell midden	Spur	250 metres
45-5-2347	PRN1;	Open artefact scatter	Spur	INA
45-5-2361	EC 1(5);	Open artefact scatter	Not stated	Not stated
45-5-2405	CSIRO 2;	Open artefact scatter	Hill slope and creek flat	10-120
45-5-2447	Prospect Hill 1	Open artefact scatter and PAD	Toe slope	100 metres
45-5-2463	Parramatta Regional Park (IF1)	Isolated arfefact	Not stated	10 metres
45-5-2464	Parramatta Regional Park (IF2)	Isolated artefact	Not stated	15 metres
45-5-2465	Parramatta Regional Park (IF3)	Isolated arfefact	Terrace	80 metres
45-5-2522	CS-IF-1	Isolated arfefact	Not stated	300 metres
45-5-2523	OSC-IF-1	Isolated artefact	Creek terrace	15 metres
45-5-2524	OSC-IF-2	Isolated arfefact	Creek terrace	10 metres
45-5-2547	Prospect Hill 2,3,4	Open artefact scatter, scarred tree, and PAD	Ridge slope, crest	150 metres
45-5-2548	Prospect Hill 5	Open artefact scatter and PAD	Not stated	Not stated
45-5-2549	Prospect Hill 6	PAD	Drainage line	1 metres

45-5-2555	Prospect Hill 7	PAD	Toe slope	50-100 metres
45-5-2571	Prospect Hill	INA	INA	INA
45-5-2650	OSC-OS-1/PAD 3	INA	INA	INA
45-5-2745	PH3	Open artefact scatter, scarred tree, and PAD	Undulating, High ground	500 metres
45-5-2746	PH1	Open artefact scatter and PAD	Toe slope	100 metres
45-5-2811	OSC-OS-1	Open artefact scatter	creek bank	0 metres
45-5-2820	Fairfield GC	Open artefact scatter	High ground	30 metres
45-5-2856	Parramatta Park Macquarie Entrance PAD	INA	INA	INA
45-5-2866	Holroyd Substation PAD	INA	INA	INA
45-5-2891	site REL 1	Open artefact scatter	Lower slopes, drainage line	0 metres
45-5-2892	site REL 2	Open artefact scatter	Foot slopes	200 metres
45-5-2893	site REL 3	Open artefact scatter	Ridgeline	500 metres
45-5-2894	site REL 4	Open artefact scatter	Ridgeline	200 metres
45-5-2895	PAD2 Prospect	PAD	Flat, bank?	350 metres
45-5-2896	PAD3 Prospect	PAD	Flat, bank?	5-100 metres
45-5-2897	PAD4 Prospect	PAD	Flat, bank?	20 metres
45-5-2903	356 OWR	INA	INA	INA
45-5-2908	Mirambeena Regional Park 1	Open artefact scatter	Ridgetop	5 metres
45-5-2909	Mirambeena Regional Park 2	Open artefact scatter	Ridgetop	20 metres
45-5-2910	Mirambeena Regional Park 3	Open artefact scatter	Ridgetop	6 metres
45-5-2911	Clear Paddock Creek	Open artefact scatter	High flat ground	Not stated
45-5-2912	Brickmakers Creek	Open artefact scatter	High flat ground	Not stated
45-5-2970	Moxhams Road Bridge	Rock shelter with PAD	Hill slope	30 metres
45-5-2971	The Fernbanks	Rock shelter with PAD	Hill slope/ Creek bank	5 metres
45-5-2978	Archaeological Test Area 1	INA	INA	INA
45-5-2982	PAD 2 Stringbark Creek	PAD	Creek bank, hill slope	10 metres
45-5-3069	CSIRO 4	Open artefact scatter	Upper hill slopes	400 metres
45-5-3152	CSIRO 3	Open artefact scatter	Creek flat	0 metres
45-5-3153	CSIRO 2/3 Complex	Open artefact scatter	Creek flat, lower hill slopes	0-400 metres

45-5-3186	Marsden Street	stone artefacts (site type not stated)	Not stated	Not stated
45-5-3269	OSC 1	INA	INA	INA
45-5-3271	CC1	INA	INA	INA
45-5-3272	PC1	INA	INA	INA
45-5-3308	HE IF1	INA	INA	INA
45-5-3309	NBP1	INA	INA	INA
45-5-3323	Western Sydney PAD4	INA	INA	INA
45-5-3336	Quarry Branch 1	Rock shelter with PAD	Lower gully slopes	11 metres
45-5-3337	Quarry Branch 2	Rock shelter with PAD	Lower gully slopes	11 metres
45-5-3338	Quarry Branch 3	Rock shelter with PAD and artefact scatter	Upper gully slopes	35 metres
45-5-3339	Quarry Branch 4	Rock shelter with PAD	Upper gully slopes	30 metres
45-5-3340	Quarry Branch 5	Rock shelter with PAD	Upper gully slopes	50 metres
45-5-3341	Quarry Branch 6	Rock shelter with PAD	Lower gully slopes	6 metres
45-5-3342	Quarry Branch	Rock shelter with PAD	Mid gully slopes	17 metres
45-5-3343	Quarry Branch 8	Rock shelter with PAD and artefact scatter	Upper gully slopes	24 metres
45-5-3344	Quarry Branch 9	Rock shelter with PAD	Lower gully slopes	15 metres
45-5-3345	Quarry Branch 10	Rock shelter with PAD	Lower gully slopes	30 metres
45-5-3346	Quarry Branch 11	Waterhole	Creek line	0 metres
45-5-3347	Quarry Branch 12	Rock shelter with PAD	Lower gully slopes	30 metres
45-5-3348	Quarry Branch 13	Rock shelter with PAD	Lower gully slopes/creek bank	5 metres
45-5-3349	Quarry Branch 14	Isolated artefact and PAD	Lower gully slopes	30 metres
45-5-3350	Quarry Branch 15	Rock shelter with PAD	Lower gully slopes	30 metres
45-5-3428	CC 1	INA	INA	INA
45-6-0031	Ryde;Ryde Bridge;	Rock shelter with art	Not stated	46 metres
45-6-0534	Charity Point;Meadowbank Park;	Open shell midden and open stone artefact scatter	Ridgetop	250 metres
45-6-1156	Epping;Terrys Creek Cave;	Rock shelter with art	Not stated	Not stated
45-6-1432	Vineyard Creek 2;Telopea;	Rock shelter with archaeological deposit	Ridgeside, gully	15 metres
45-6-1449	Vineyard Creek 1;Telopea;	Rock shelter with archaeological deposit	Gully, hill side	10 metres
45-6-1523	George St Parramatta;Family Law Courts;	Open artefact scatter	Alluvial plain	150 metres

45-6-1781	Lake Parramatta Reserve Shelter.;	Rock shelter with art and archaeological deposit	Hill slope	5 metres
45-6-1886	William Place Shelters.;	Rock shelter with archaeological deposit	INA	Not stated
45-6-1894	Rivendell;	Rock engraving	River bank	Not stated
45-6-1937	Rocky Point;Concord West;	Open shell midden	Foreshore	Not stated
45-6-1961	Ermington 1;	Open shell midden and open stone artefact scatter	Not stated	60 metres
45-6-2036	Lake Parramatta 2;	Rock shelter with art	Ridgeside	Not stated
45-6-2098	Duck River 1;	Open artefact scatter	Hill slope	30 metres
45-6-2300	Rivendell 2;Concord West;	Open shell midden	Foreshore	Not stated
45-6-2309	Ermington PS;	Open artefact scatter	Hill slope	30 metres
45-6-2312	Subiaco Ck 1;	Open artefact scatter	High ground	Not stated
45-6-2313	Subiaco Ck 2;	Open artefact scatter	Flat	Not stated
45-6-2324	Yaralla Bay;Concord West Hospital;	Open shell midden	Foreshore	Not stated
45-6-2339	Haslams Ck 1	Open artefact scatter	High ground	53 metres
45-6-2344	Duck River 21;Granville South;	Open artefact scatter	Hill slope	9 metres
45-6-2347	Duck River 19;	Open artefact scatter	High ground	9 metres
45-6-2348	Duck River 20;	Open artefact scatter	High ground	Not stated
45-6-2349	Duck River 22;	Open artefact scatter	High ground	4 metres
45-6-2407	Acacia Park;	Open artefact scatter	Ridgetop	88 metres
45-6-2553	Lake Parra R1;LP R1;	Open artefact scatter	Ridgetop	30 metres
45-6-2554	Elizabeth Farmhouse	Open artefact scatter	Ridgetop	30 metres
45-6-2557	Waterview Street	Open shell midden and isolated stone artefact	Beach	30 metres
45-6-2559	Sydney Turf Club Carpark;STC Carpark;	Open artefact scatter	High ground	9 metres
45-6-2560	Lake Parra R2;LP R2;	Open artefact scatter	Ridgetop	6 metres
45-6-2569	Sturt Street	Open artefact scatter	High raised ground	2 metres
45-6-2570	Kissing Point Rd	Open artefact scatter	High ground	Not stated
45-6-2571	Substation;	Open artefact scatter	High ground	10 metres
45-6-2572	McKillop Place;	Open artefact scatter	High ground	10 metres
45-6-2573	Turpentines;	Open artefact scatter	Flat	7 metres
45-6-2578	Collett Park;	Open artefact scatter	Ridgetop	10-15 minutes

45-6-2591	Duck Creek;Guildford;	Open artefact scatter	Hill slope	15 metres
45-6-2627	HP-1	INA	INA	INA
45-6-2636	Ermington PAD	Not a site	n/a	n/a
45-6-2648	Charles/George 1	INA	INA	INA
45-6-2668	Argyle St	INA	INA	INA
45-6-2669	Kendall Street, Harris Park	INA	INA	INA
45-6-2673	RTA-G1	INA	INA	INA
45-6-2678	SSP1 (formerly Smith Street PAD)	INA	INA	INA
45-6-2679	Parramatta Children's Court	Open artefact scatter	Flat	150 metres
45-6-2682	Wanngal Woodland Axe-Marked Tree	Scarred tree	Hill crest	100-300 metres
45-6-2683	Wanngal Woodland IF1	Isolated artefact	Hill crest	100-300 metres
45-6-2684	Wanngal Woodland IF2	Isolated artefact	Hill slope	100-200 metres
45-6-2685	Wanngal Woodland IF3	Isolated artefact	Hill slope	100-200 metres
45-6-2686	Civic Place PAD	INA	INA	INA
45-6-2738	James Ruse Reserve Open Camp 1	Open artefact scatter	Alluvial terrace	50 metres
45-6-2739	PADUNknown	INA	INA	INA
45-6-2741	Parramatta Transport Interchange PAD	INA	INA	INA
45-6-2746	Old Hospital Site Parramatta Health SErvcies Precinct	INA	INA	INA
45-6-2751	Marsden St Carpark	INA	INA	INA
45-6-2756	Parramatta Rehabilitation Centre (formerly O'Connell St PAD)	INA	INA	INA
45-6-2758	Duck River 3	Open artefact scatter	High flat ground	7 metres
45-6-2759	Duck River 5	Open artefact scatter	Flat ground	55 metres
45-6-2760	Duck River 2	Open artefact scatter	High flat ground	6 metres
45-6-2761	Duck River 4	Open artefact scatter	High flat ground	4 metres
45-6-2785	Wanngal Woodland PAD2	PAD	Hill crest	100-300 metres
45-6-2786	Wanngal Woodland PAD1	PAD	Hill crest	100-300 metres
45-6-2795	150 Marsden Street Parramatta PAD	PAD	Slope	300 metres
45-6-2805	Lake Parramatta Playground 1	Open artefact scatter	Hill crest	30 metres
45-6-2863	Cumberland Press Site	INA	INA	INA

45-6-2864	George Kendall Ermington	INA	INA	INA

Table 4: Details of sites registered with AHIMS within a 1 km buffer of the study area.

3.4.1 Analysis of Sites Registered with AHIMS

A simple analysis of the registered Aboriginal heritage sites within a 1 km buffer of the study area was conducted. The analysis includes the following: the frequency of site types and small-scale landforms associated with sites; the distance of sites from water; and the raw materials used in tool manufacture as evidenced by artefact scatter and isolated artefact sites.

It is important to note that archaeologists describe sites differently with varying amounts of detail, and this is reflected by the information cards, termed 'site cards', for each site registered with AHIMS. The National Parks and Wildlife Services (NPWS) have attempted to limit this variation by providing site recording templates, which include checkbox fields. Although this has limited the variation of site descriptions, variation still exists. Furthermore, many of the site cards for the registered sites located within a 1 km buffer of the study area predate the new site card format.

Consequently, this makes it difficult to categorise sites associated with different landforms because the landform descriptions are often inconsistent in scale. In general, these inconsistencies are a minor hindrance; they do not prevent the identification of patterns.

It is important to note that, in an analysis, information about site cards can often be applied to more than one category in a field depending on the fields used. For example, a site could extend over two landforms. In addition, unless otherwise stated, the percentage figures presented do not include the 'Information not Available', 'Not a Site', and 'N/A' fields.

Site types

The frequency of site types are displayed in Table 5.

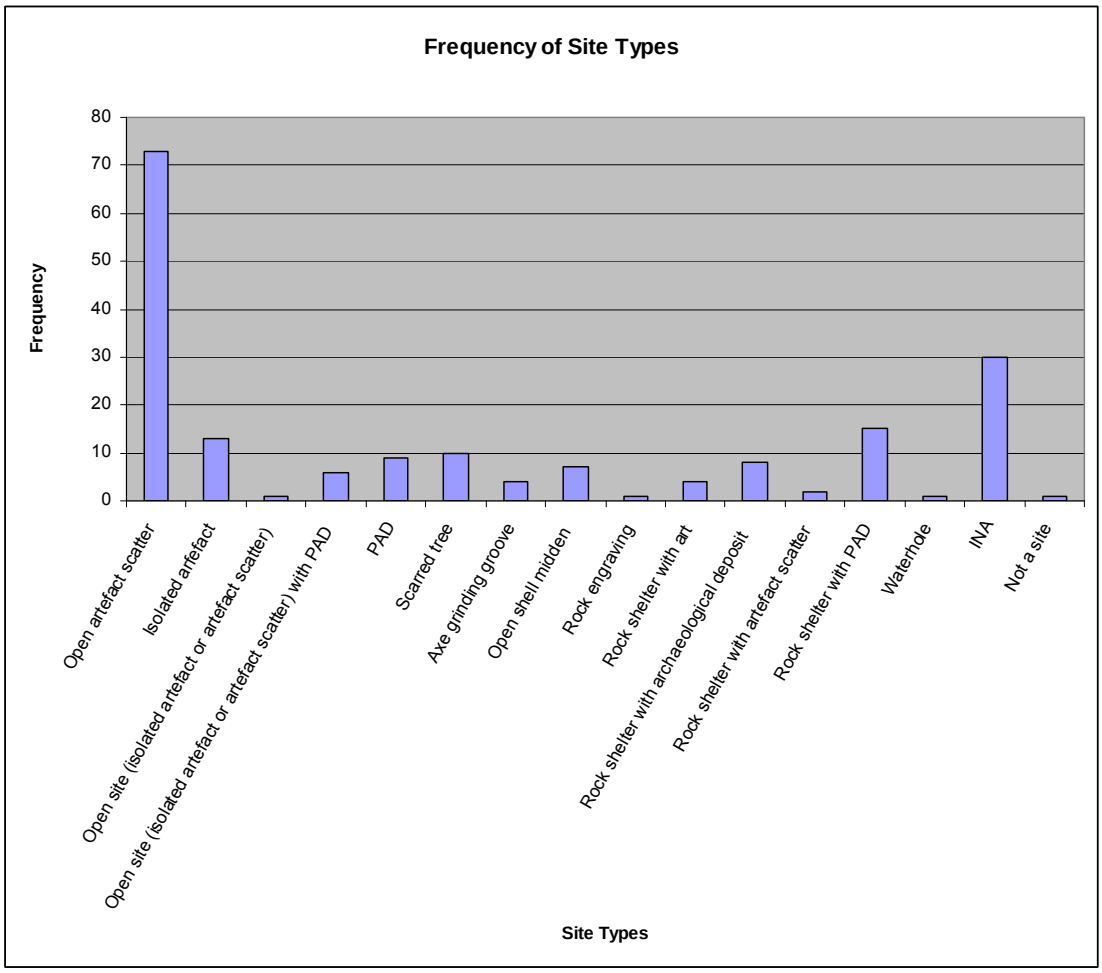

Table 5: The frequency of site types.

The most commonly identified sites types were open sites (artefact scatters and isolated artefacts), which represent 56% of sites. This is consistent with the general prediction that open sites are the most commonly identified site within the Cumberland Plain (see McDonald 1998:13; Dallas 1982). Sandstone rock shelters with art, artefact scatters, archaeological deposits, and/or potential artefact deposits, which represented 19% of sites, were frequently identified; however, the identification of these sites was confined outside the study area to the north on Hawkesbury Sandstone that outcrops within the periphery of the Cumberland Plain (see Figures 2, 3, 4, and 5).

Scarred trees, which represented 7% of sites, were less frequent and were all located within close proximity to watercourses (see Figures 2, 3, 4, and 5). Open shell middens, which represented 5% of sites, were all identified within close proximity to the Parramatta River. Similar to sandstone rock shelters, sandstone axe grinding grooves, which represented 3% of

sites, were identified outside the study area to the north on Hawkesbury Sandstone that outcrops within the periphery of the Cumberland Plain.

Landforms associated with sites

The frequency of landforms associated with identified sites are displayed in Table 6.

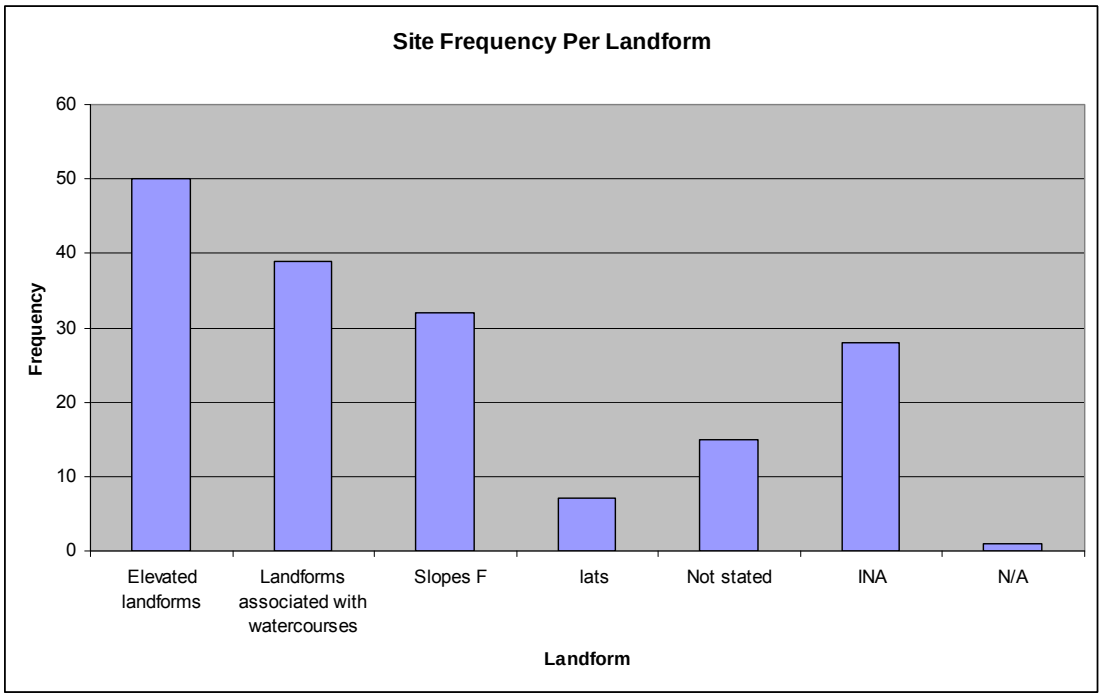

Table 6: Frequency of landforms associated with identified sites.

The most common landforms associated with the identified sites were as follows: elevated landforms (including high ground, crests, ridgetops, low ridges, ridge lines, ridge slopes, spur, cliff lines, hill crests, and low hills), which combined represented 39% of landforms; and watercourses (including gullies, creek flats, watercourse terraces, drainage lines, river sides, creek lines, watercourse edges, watercourse banks, watercourse beds, and beaches), which combined represented 31% of landforms. Sites identified on slopes, which represented 25% of landforms, were less frequent, and sites located on flats, which represented 6% of landforms, were considerably less frequent.

Site distance from water sources

The distances of identified sites from water sources are displayed in Table 7.

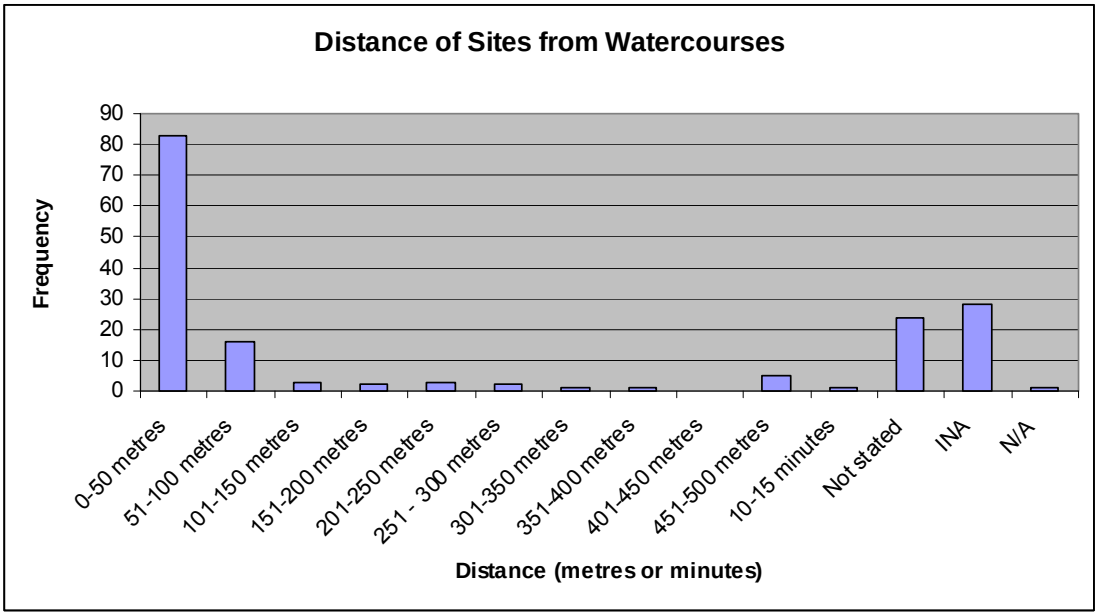

Table 7: Distance of sites from watercourses.

85% of identified sites were located within 100 m of watercourses, and 100% of identified sites were located within 500 m of watercourses. This is consistent with the general prediction that Aboriginal heritage sites may be more likely to be identified along watercourses (see McDonald 1998:15).

Raw materials used in stone tool manufacture

The dominant raw material used in stone tool manufacture evidenced from open artefact scatter and isolated artefact sites was silcrete. In addition, quartz, chert, and indurated mudstone artefacts were evidenced frequently. Quartzite and basalt were also identified, but only occasionally.

3.5 Discussion and Predictive Model

A predictive model has been formulated based on the following:

- Site patterning within the regional and local area (discussed earlier in Sections 4.2 and 4.4);
- Environmental information (discussed earlier in Section 3.0) relevant to past Aboriginal land use and the preservation and detectability of archaeological material within or overlapping the study area;
- Previous archaeological and heritage studies (discussed earlier in Section 4.3).

The purpose of this model is to broadly predict the following: the location; type; and frequency of archaeological materials within or overlapping the study area; and the integrity and detectability of archaeological materials within or overlapping the study area. The model is outlined below.

4.5.1 Site Types

Open sites

Open artefact scatters and isolated artefacts are the sites most likely to occur within the study area.

Open artefact scatters can range from high density concentrations of artefacts to sparse, low-density 'background scatters'. These sites can be associated with a range of everyday activities, such as stone reduction, woodworking, and food preparation (Kohen 1986). Open artefact scatters may be potentially located anywhere within the study area; however, they may be more likely to be identified on elevated landforms, landforms associated with water, or slopes (see Section 4.4.1).

Isolated stone artefact occurrences are likely to represent discard or loss during transitory movement (Kohen 1986), or artefacts that have been shifted from their original context by geomorphic processes. Isolated artefacts may potentially be located anywhere within the study area.

Any potential stone artefacts that may occur within the study area are highly likely to be comprised of silcrete, quartz, chert, or indurated mudstone (see Section 4.4.1). Artefacts comprised of quartzite and basalt may also occur within the study area, but are less likely to do so (see Section 4.4.1).

Rock shelters with the following: art, open artefact scatters, isolated artefacts, and/or archaeological deposits

Rock shelters may occur within landscapes in which suitable geological features exist, such as shelving and overhangs that provide sufficient sheltered space.

The geological background of the study area indicates that rock shelters will not occur within the study area; the Hawkesbury Sandstone formation, which can provide outcrops suitable for rock shelters in the Sydney region, outcrops on the periphery of the Cumberland Plain (Jones and Clarke 1990:14), outside the study area.

Axe-grinding grooves.

Axe-grinding grooves are produced by rubbing a stone implement against a friable stone to produce a durable cutting edge. The resulting grooves are generally characterised by elongated, narrow depressions. They are usually found on sandstone outcrops near watercourses as water was used in the process to make the sandstone "more abrasive and to reduce dust" (State Government of Victoria 2008).

The geological background of the study area indicates that axe-grinding grooves are unlikely to occur within the study area: as previously mentioned, Hawkesbury Sandstone outcrops on the periphery of the Cumberland Plain (Jones and Clarke 1990:14), outside the study area. Axe grinding grooves may, however, occur within the study area on Hawkesbury Sandstone, which underlies the study area, that has been exposed by fluvial erosion associated with the watercourses that traverse the study area: Prospect Creek, Duck Creek, and Burns Creek.

Scarred trees

Scarred trees exhibit scars caused by the removal of bark or wood, which was used by Aboriginal people for a variety of purposes (see Section 3.4 for a summary). Such scars can be found on old growth trees that tend to be of a size from which a suitably sized piece of bark or wood for its intended purpose can be removed.

Scarred trees are unlikely to occur within the study area for three reasons:

- the lifespan of trees is relatively short as an archaeological unit;
- the practise of tree scarification has hugely diminished since the European invasion of the continent; and

- Since the European invasion, the Cumberland Plain has undergone massive timber clearances, which would have gained initial momentum with the establishment of farming and grazing lands (the earliest farming within the Cumberland Plain, and Australia, took place in the early 1790s at Parramatta), as well as that of the later timber industry in the mid 19th century.

Scarred trees may potentially be located anywhere within the study area; however, they may be more likely to be identified in close proximity to watercourses (see Section 4.4.1).

Burials

Aboriginal burial sites are generally situated within deep, soft sediments such as aeolian or alluvial deposits. Burials would only be detectable from the surface if they had been exposed by natural erosion, or cultural or animal disturbances to the landscape.

Burial sites may occur within the alluvium that forms the terraces that define the Richmond, Berkshire Park and Birrong soil landscapes and the floodplain that defines the South Creek soil landscape (see Section 3.1.3). Any potential burials are likely to have been further incorporated into sediment deposited by the past overbanking of Prospect Creek, Duck Creek, and Burns Creek, or scoured and possibly shifted by water movement associated with these creeks.

All of the soil landscapes over which the study area extends are characterised by either moderate or, in the majority of cases, high soil acidity, and this *ph* range accelerates bone decomposition. Therefore, any human bones within the study area are highly likely to have accelerated decomposition rates and disintegrated completely, or be of relatively recent origin.

Aboriginal stone quarries

Aboriginal stone quarries are outcrops of stone that were exploited by Aboriginal people for raw materials used in the manufacture of stone artefacts.

No previously identified quarries have been identified within or overlapping the study area. The geological background of the study area (see Section 3.1.4) indicates that it is unlikely that Aboriginal stone quarries will occur within, overlapping, or in the immediate vicinity of the study area.

Post-contact sites that relate to Aboriginal people

These are sites that relate to the shared history of Aboriginal and more recent settlers since the European invasion of the Australian continent in 1788. Many of these sites can hold special significance for Aboriginal people and may include places such as missions, massacre sites, post-contact camp sites, and buildings associated with post-contact Aboriginal use. This site type is usually known from historical records or knowledge preserved within the local community.

Post-contact sites are unlikely to occur within, overlapping, or in the immediate vicinity of the study area, which is predominantly located within existing road reserves.

Aboriginal places

Aboriginal places are places of cultural significance to Aboriginal people. Archaeological materials need not be present for the identification of an Aboriginal place. Often they are places tied to community history and may include natural features (such as swimming and fishing holes), places where Aboriginal historical political events commenced, or particular post-contact buildings.

Community consultation is required to determine the existence of Aboriginal places within the study area.

4.5.2 Detectability and Integrity of Archaeological Materials

The dominant geomorphic processes associated with the soil landscapes over which the study area extends can be broadly described as aggrading, and, more specifically, described, as fluvial and residual (see Bannerman and Hazelton 1990:19; see Chapman and Murphy 1989:16). The soil landscapes associated with fluvial and residual geomorphic processes over which the study area extends are described in Section 3.1.2.

Any potential Aboriginal archaeological materials within or overlapping the parts of the fluvial landscapes over which the study area extends are likely to have been incorporated into sediment deposited by the past overbanking of Prospect Creek, Duck Creek, and Burns Creek, or scoured and possibly shifted by water movement associated with these creeks.

Any potential Aboriginal archaeological materials within or overlapping the parts of the residual landscape over which the study area extends are likely to have been incorporated into sediment.

4.5.2.2 Desktop examination of disturbances due to impacts associated with visible historical land use

A street directory, SIX Viewer <http://imagery.maps.nsw.gov.au>, and aerial maps of the study area (see Parsons Brinckerhoff Australia Pty. Limited 2007) were examined as an indication of visible historical land use and associated disturbances within the study area.

The study area is located in an urban environment, and, overall, appears to have been extensively disturbed by impacts from urban development. Due to the large size of the study area, it has been divided into nine areas to assist in providing more specific information about visible historical land use and associated disturbances within the study area.

Road reserves

The parts of the road reserves within which the proposed reticulated network would be located are highly likely to have been disturbed by the following: vegetation clearance; revegetation; the construction of roads, driveways, footpaths, nature strips, car parks, telegraph poles/street lights, traffic lights, signs, drains, bus shelters, bridge crossings; and other facilities common to road reserves, such as telecommunication facilities.

Rail reserves

The parts of the rail reserves within which the proposed reticulated network would be located are highly likely to have been disturbed by the following: vegetation clearance; and construction of Yennora and Clyde railway stations, the railways, railway stations, and associated infrastructure, such as overhead wiring.

Recreational reserves

Fairfield Park, Fairfield

The parts of Fairfield Park within which the proposed reticulated network would be located appear to have been disturbed by the following: vegetation clearance; the construction of the adjacent McIntosh Street; an unnamed road extending from McIntosh Street,

Long Street Park Recreational Reserve, Smithfield and Yennora, and Fairfield Road Park, Yennora

The parts of Long Street Park Recreational Reserve and Fairfield Road Park within which the proposed reticulated network would be located appear to have been disturbed by the construction of a walking track, vegetation clearance, and, with reference to the Long Street Park Recreational Reserve, possibly the construction of the adjacent Smithfield Energy Facility and Sewerage Water Treatment Works.

Open space

Open space adjacent to North Street, Fairfield

The parts of this open space within which the proposed water recycling plant, pumping station, storage tank, and reticulated network would be located appear to be have been disturbed by vegetation clearance.

Parramatta/Granville Sportsground, Granville

The parts of the Parramatta/Granville Sportsground, Granville, within which the proposed reticulated network would be located appear to have been disturbed by vegetation clearance and the construction of the sports ground.

Smithfield Energy Facility and Smithfield Water Treatment Works, Smithfield

The parts of the Smithfield Energy Facility and Smithfield Water Treatment Works, Smithfield, within which the proposed reticulated network would be located appears to have been disturbed by vegetation clearance and may have been disturbed by construction of the adjacent Smithfield Energy Facility and Smithfield Water Treatment Works.

Woodville Public Golf Course, Guildford

The parts of the Woodville Public Golf Course within which proposed elevated storage reservoir would be located appear to have been disturbed by vegetation clearance and the construction of the golf course.

Shell Refinery, Rosehill

The parts of the Shell Refinery within which the proposed pumping station and storage tank would be located appear to have been disturbed by the construction of structures associated with the Shell Refinery.

Desktop observations of visible historical land use and associated disturbances appear to indicate that, overall, the study area has been extensively disturbed by impacts from urban developments. Consequently, in general, any potential Aboriginal archaeological materials within or overlapping the study area are likely to have been subject to similar levels of disturbance.

4.0 SURVEY

The overall aim of the survey was to identify, record, and assess the condition of any Aboriginal heritage sites not listed on heritage registers and databases within or overlapping the study area, and to relocate and update the condition of any registered Aboriginal heritage sites.

4.1 Areas Surveyed and Survey Teams

Archaeological and cultural field surveys of the study area were undertaken on 9, 10, 12, and 19 September 2008 under fine weather conditions.

- On 9 and 10 September, John Riley (DTAC) and Dominic Brady (Biosis Research Pty. Ltd.) surveyed the entire study area;
- On 12 September, Steve Randall (DLALC) and Dominic Brady (Biosis Research Pty. Ltd.) surveyed the parts of the study area within DLALC's boundaries (the parts of the study area north of Parramatta Road); and
- On 19 September, Ian Edwards (GLALC) and Dominic Brady (Biosis Research Pty. Ltd.) surveyed the parts of the study area within GLALC's boundaries (the parts of the study area south of Parramatta Road).

Due to restricted access, the survey teams were not able to survey the parts of the study area (with reference to GLALC and DLALC, within their respective boundaries) located within the following areas: Shell Refinery, Rosehill; Parramatta/Granville Sportsground, Granville; open space adjacent to the Smithfield Energy Facility and Smithfield Water Treatment Works, Smithfield; and Woodville Public Golf Course, Guildford. These areas were assessed from a distance.

4.2 Methodology

The methods used to survey the study area are described below.

Transect and windscreen survey

Dominic Brady (Biosis Research Pty. Ltd.) and John Riley (DTAC) walked, spaced apart, parallel transects across the study area.

In the draft methodology, it was proposed to undertake the entire survey by foot. However, in separate discussions between Dominic Brady (Biosis Research Pty. Ltd.) and both Steve

Randall (DLALC) and Ian Edwards (GLALC) during the field survey, it was agreed that, for the parts of the study area within road reserves *exhibiting a high level of disturbance*, it would be appropriate to drive a car through these areas and observe them through the car windows (otherwise known as a windscreen survey). It was also agreed that it would be appropriate to walk, spaced apart, parallel transects over the parts of the study area *outside* road reserves exhibiting a high level of disturbance.

Targeted survey

During the transect and windscreen surveys, any particular landforms, or features, such as old growth trees, within or on which Aboriginal archaeological materials were more likely to be identified were targeted. These areas and features were identified by the predictive model (see Section 4.5) formulated for the study area, as well as further information gained during the survey.

In general, attention was focused on areas of good ground surface visibility and exposures - areas in which any potential buried archaeological materials were more likely to have been exposed as surface expressions. In addition, the survey focused on any areas that were identified by Steve Randall (DLALC), Ian Edwards (GLALC), and John Riley (DTAC) as requiring more detailed investigation.

Aerial photographic maps of the proposed development provided by Jemena Asset Management Pty. Ltd. and a street directory were used to navigate the study area.

The information observed and/or recorded during the survey included the following:

- Ground surface visibility;
- The type and amount of exposures - areas in which any potentially buried archaeological materials are more likely to have been exposed as surface expressions;
- Disturbances to the landscape resulting from human or animal activities, which, with reference to human activities, includes identifiable past and present land-use impacts;
- Exploitable resources for Aboriginal people, including vegetation, stone suitable for knapping, and fresh water sources;
- The general landform and more specific landforms over which the study area extends; and
- Any Aboriginal heritage sites and zones of Aboriginal archaeological sensitivity within or overlapping the study area.

Information about ground surface visibility and the type and amount of exposures can further inform the predictive model with reference to the detectability of any potential Aboriginal archaeological materials.

Information about disturbances resulting from human and animal activities can further inform the predictive model with reference to the integrity of any potential Aboriginal archaeological materials.

Information about exploitable resources, the general landform and more specific landforms, and Aboriginal heritage sites over which the study area extends can further inform the predictive model with reference to the location, types, and frequency of any potential Aboriginal archaeological material within or overlapping the study area.

The team was equipped with the following: a hand-held GPS and aerial photographs for recording the location of any Aboriginal heritage sites and zone of Aboriginal archaeological sensitivity; and tailor-made recording forms and other equipment for recording site details and, more specifically, artefact attributes.

4.3 Limitations

There are several factors that can influence the effectiveness of a survey. A brief discussion of these factors is presented below.

Ground surface visibility and general visibility

Ground surface visibility (GSV), which is sometimes referred to as simply 'visibility' in archaeological reports and guidelines, is the amount of ground that is visible at the time of the survey. GSV is usually expressed as a percentage estimate of the average GSV for an area. In general, the primary factor that affects GSV is vegetation cover; however, modern cultural material, which can include landfill, structures, roads, and rubbish, can also significantly affect GSV, especially in an urban context.

Exposure

The term exposure usually refers to either the *probability* that, or an *area* in which any potentially buried archaeological materials are more likely to be exposed as surface expressions. It differs from GSV in that GSV does not see, nor gauge, the causal factors that can expose buried archaeological materials, but, rather, the probability of observing any artefacts *that have been exposed*. For example, an artefact may be exposed as a surface expression, but it may not necessarily be visible to the naked eye: it may be obscured by long grass. Similar to GSV, the amount of exposures within the area being surveyed is also expressed as a percentage estimate.

For a detailed discussion of the geomorphic processes that can affect the degree that any potential Aboriginal archaeological materials are exposed as surface expressions within or overlapping the study area, please see Sections 3.1.2 and 4.5.1.

Exposures can also be caused by disturbances resulting from human or animal activities, and these are usually much more immediate than those caused by geomorphic processes. These are described below.

Disturbances

Disturbances can expose buried archaeological materials; however, they can also compromise the integrity of archaeological sites, or destroy them completely. Disturbances can expose archaeological materials in their original context, or remove them from their original context.

Disturbances that can be attributed to animal activity generally affect a small area and include the scratching and burrowing of the soil by animals such as rabbits, foxes, wombats, and wallabies. Disturbances that can be attributed to human activity are predominantly the result of historical land-use and, in an urban environment, commonly includes vegetation clearance and the construction of roads and structures.

4.4 Survey Results

As previously discussed (see Sections 2.2 and 4.4), there is one Aboriginal heritage site, an open site and associated PAD (site name: PC1; site identification number: 45-5-3272), registered with AHIMS located within the immediate vicinity of the study area – approximately 8 m from a 5 m buffer of the study area (see Figures 2 and 6).

No Aboriginal heritage sites unregistered on heritage registers and databases were identified within or overlapping the study area during the survey.

4.4.1 Existing Condition of the Study Area

Due to the large size of the study area, it has been divided into twelve areas to assist in providing more specific information about the existing condition of the study area (see Table 8). The divisions used here are slightly different to those used for desktop observations of preliminary historical land use and associated disturbances (see Section 4.5.1.2).

Road reserves

The parts of the road reserves within which the proposed reticulated network would be located have been disturbed by the following: vegetation clearance; revegetation; the construction of roads, driveways, footpaths, nature strips, car parks, telegraph poles/street lights, traffic lights, signs, drains, bus shelters, underground and exposed pipelines, and bridge crossings located along both Tangerine Street and Normanby Street, Fairfield East, and Barbers Roads, Chester Hill and Guildford. In addition, the study area may also have been disturbed by the construction of adjacent roads, fences, and buildings.

Overall ground visibility was poor (approximately <5%) and, in general, was mainly limited to patches within the nature strip, at the base of a number of planted native and non-native trees, and along the base of a number of fences. A low amount of exposure was identified (approximately <2%); areas of evident exposure were limited to the bases of a number of telegraph poles/street lights and recently planted trees or shrubs.

Plate 1: Section of Woodville Road, Chester Hill.
View faces southwest.

Plate 2: Section of Unwin Street, Rosehill.
View faces west.

Plate 3: Section of Tangerine Street, Fairfield East.
View faces southwest.

Plate 4: Bridge crossing over Prospect Creek between Normanby Street and Crown Street. Fairfield East.
View faces southwest.

Rail reserves

The parts of the rail reserves within which the proposed reticulated network would be located have been disturbed by the following: vegetation clearance; and the construction of Yennora and Clyde railway stations, railways, and associated infrastructure, e.g., overhead wiring. Overall ground visibility was non-existent (0%) and no areas of exposure (0%) were identified.

Plate 5: View of Clyde Railway Station. View faces northeast.

Plate 6: View of Yennora Railway Station. View faces northeast.

Recreational reserves

Fairfield Park, Fairfield

The parts of Fairfield Park, Fairfield, within which the proposed reticulated network would be located have been disturbed by the following: vegetation clearance; a sealed road, unsealed road, footpath, and car park; design landscaping; and a section along the terrace of Prospect Creek appears to have been excavated for an unknown purpose. In addition, the study area may also have been disturbed by the construction of the adjacent McIntosh Street.

Overall ground visibility was poor (approximately <10%). A low amount of exposure was identified (approximately <5%); areas of evident exposure were limited to a low number of patches on the raised terraces along Prospect Creek.

Plate 7: Fairfield Park, Fairfield.
View faces southwest.

Plate 8: Fairfield Park, overlooking Prospect Creek, Fairfield.
View faces southwest.

Plate 9: Footpath, design landscaping, and road (back of the photograph) within Fairfield Park, Fairfield.
View faces west.

Plate 10: Car park and design landscaping within Fairfield Park, Fairfield.
View faces west.

Long Street Park Recreational Reserve, Yennora and Smithfield

The parts of Long Street Park Recreational Reserve, Yennora and Smithfield, within which the proposed reticulated network would be located have been disturbed by the following: vegetation clearance; and the construction of a footpath, telegraph pole, and underground piping.

Overall ground visibility was poor (approximately <5%); however, there were a number of patches with good visibility (approximately <70%). A low amount of exposure was identified (<5%); areas of evident exposure were limited to the disturbed base of a telegraph pole. In addition, the study area may have been disturbed by the construction of the adjacent Smithfield Energy Facility.

Plate 11: Long Street Park Re creational Reserve, Smithfield.
View faces east.

Plate 12: Long Street Park Re creational Reserve, Smithfield.
View faces west.

Fairfield Road Park, Yennora

The parts of Fairfield Road Park, Yennora, within which the proposed reticulated network would be located have been disturbed by the following: vegetation clearance; and the construction of a soccer field and footpath. In addition, the study area may have also been disturbed by the construction of adjacent public toilets.

Overall ground visibility was poor (approximately <5%). No areas of exposure (0%) were identified.

Plate 13: Fairfield Road Park, Yennora. View faces northwest.

Plate 14: Fairfield Road Park, Yennora. View faces northwest.

Open Space

Open space adjacent to North Street, Fairfield

The parts of this open space within which the proposed water recycling plant, pumping station, storage tank, and reticulated network would be located have been disturbed by vegetation clearance. In addition, the study area may have also been disturbed by the construction of the adjacent East Parade, Fairfield.

Overall ground visibility was non-existent (0%) and no areas of exposure (0%) were identified.

Plate 15: Open space adjacent to North Street, Fairfield. View faces east.

Open space between Fairfield Park, Fairfield and both Vine Street, Fairfield, and Bland Street, Carramar

The parts of this open space within which the proposed reticulated network would be located have been disturbed by the following: minor vegetation clearance; and the construction of a channel for a drainage pipe and fencing. In addition, the study area may have been disturbed by the construction of the adjacent Vine Street, Fairfield, and Bland Street, Carramar.

Overall ground visibility was poor (approximately <5%). No areas of exposure (0%) were identified.

Plate 16: Open space between Fairfield Park, Fairfield, and both Vine Street, Fairfield, and Bland Street, Carramar.

Open space adjacent to Elizabeth Street, Granville

The parts of this open space within which the proposed reticulated network would be located have been disturbed by the following: vegetation clearance; and the construction of a drainage channel, bridge crossing, footpath, and fencing.

Overall ground visibility was poor (approximately <5%). however, there were areas with good visibility (approximately <70%) adjacent to the drainage channel. A low amount of exposure was identified (approximately <15%); areas of evident exposure were located adjacent to the drainage channel.

Plate 17: Open space adjacent to Elizabeth Street, Granville.
View faces east.

Plate 18: Open space adjacent to Elizabeth Street, Granville.
View faces southwest.

Area between Deniehy Street and Shirley Street, Granville, outside the road reserves

The area between Deniehy Street and Shirley Street, Granville outside the road reserves, within which the proposed reticulated network would be located has been disturbed by the construction of a pipeline. Overall ground visibility was non-existent (0%). There were no areas of exposure (0%).

Plate 19: Area between Deniehy Street and Shirley Street, Granville. View faces east.

Parramatta/Granville Sportsground, Granville

The parts of the Parramatta/Granville Sportsground, Granville, within which the proposed reticulated network would be located have been disturbed by the following: vegetation clearance; the construction of an unsealed road; and vehicle movement. In addition, the study area may have been disturbed by the construction of the adjacent Parramatta/Granville Sportsground.

As previously discussed, at the time of the survey, the survey teams were unable to access this area, and it was viewed from a distance instead. Overall ground visibility appeared to be good (approximately <80%). There appeared to be no areas of exposures (0%).

Plate 20: Parramatta/Granville Sportsground. View faces northeast.

Smithfield Energy Facility and Smithfield Water Treatment Works, Smithfield

The parts of Smithfield Energy Facility and Smithfield Water Treatment Works, Smithfield, within which the proposed reticulated network would be located have been disturbed by the following: vegetation clearance; and the construction of telegraph poles and fencing. In addition, the study area may have been disturbed by the construction of the adjacent Smithfield Energy Facility and Smithfield Water Treatment Works.

As previously discussed, at the time of the survey, the survey teams were unable to access this area, and it was viewed from a distance instead. Overall ground visibility appeared to be poor (approximately <5%). There appeared to be no areas of exposure (0%).

Plate 21: Open space adjacent to the Smithfield Energy Facility and Smithfield Water Treatment Works, Smithfield. View faces north.

Plate 22: Open space adjacent to the Smithfield Energy Facility, Smithfield. View faces north.

Woodville Public Golf Course, Guildford

The parts of Woodville Public Golf Course, Guildford, within which the proposed elevated storage reservoir would be located have been disturbed by the following: vegetation clearance; and the construction of a golf course and fencing.

As previously discussed, at the time of the survey, the survey teams were unable to access this area, and it was viewed from a distance instead. Overall ground visibility appeared to be non-existent (0%). There appeared to be no areas of exposures (0%).

Shell Refinery, Rosehill

The parts of the Shell Refinery, Rosehill, within which the proposed pumping station and storage tank would be located have been disturbed by the following: vegetation clearance; and the construction of an industrial railway, shed, and fencing. In addition, the study area may have been disturbed by the construction of the adjacent Durham Street.

As previously discussed, at the time of the survey, the survey teams were unable to access this area, and it was viewed from a distance instead. Overall ground visibility appeared to be poor (approximately <5%). There appeared to be no areas of exposure (0%).

Plate 23: Shell Refinery, Rosehill.
View faces south.

Plate 24: Shell Refinery, Rosehill.
View faces southeast.

The information recorded during the survey is summarised in Table 8 below.

TOTAL AREA (Ha)	SURVEY EFFORT (m^2)	GROUND VISIBILITY (%)	EXPOSURE (%) AND EXPOSURE TYPES IDENTIFIED	EFFECTIVE SURVEY COVERAGE (ha and %)	DISTURBANCES	GENERAL LANDUSE	SITES
Road reserves							
Approximately 17.9987 ha	Approximately 17.9987 ha	c. <5%	c. >2%; areas of evident exposure were limited to the bases of a number of telegraph poles/street lights and recently planted trees or shrubs.	0.0179 ha	Disturbances include the following: vegetation clearance; revegetation; the construction of roads, driveways, footpaths, nature strips, car parks, telegraph poles/street lights, traffic lights, signs, drains, bus shelters, underground and exposed pipelines, and bridge crossings. In addition, the study area may also have been disturbed by the construction of adjacent roads, fences, and buildings.	Transport corridor	None
Rail reserves							
Approximately 0.1569 ha	Approximately 0.1569 ha	0%	0%	0 ha	Disturbances include the following: vegetation clearance; and the construction of Yennora and Clyde railway stations, railways, and associated infrastructure, e.g., overhead wiring.	Transport corridor	None
Fairfield Park, Fairfield							
Approximately 0.3334	Approximately 0.3334 Ha	c. <10%	<5%; areas of evident exposure were limited to a low number of patches on the raised terraces along Prospect Creek	0.001 ha	Disturbances include the following: vegetation clearance; a sealed road, unsealed road, footpath, and car park; design landscaping; and a section along the terrace of Prospect Creek appears to have been excavated for an unknown purpose. In addition, the study area may also have been disturbed by the construction of the adjacent McIntosh Street.	Recreational reserve	An open site and associated PAD (site name: PC1; site identification number: 45-5-3272)
Long Street Park Recreational Reserve, Smithfield and Yennora							
Approximately 1.2893 ha	Approximately 1.2893 Ha	c. <5%; however, there were a number of patches with good visibility (c. <70%).	c. 5%; areas of evident exposure were limited to the disturbed base of a telegraph pole.	0.003 ha	Disturbances include the following: vegetation clearance; and the construction of a footpath, telegraph pole, and underground piping. In addition, the study area may have been disturbed by the construction of the adjacent Smithfield Energy Facility.	Recreational reserve	None
Fairfield Road Park, Fairfield							
Approximately 0.2475 ha	Approximately 0.2475 Ha	c. <5%	0 %	0.012 ha	Disturbances include the following: vegetation clearance; and the construction of a soccer field and footpath. In addition, the study area may have also been disturbed by the construction of adjacent public toilets.	Recreational reserve	None

Open space adjacent to North Road, Fairfield							
Approximately 1.6876 ha	Approximately 1.6876 Ha	0%	0 %	0 ha	Disturbances include vegetation clearance. In addition, the study area may have also been disturbed by the construction of the adjacent East Parade, Fairfield.	Open space	None
Open space between Fairfield Park, Fairfield and both Vine Street, Fairfield, and Bland Street, Carramar							
Approximately 0.1061 ha	Approximately 0.1061 ha	c. <5%	0 %	0.0053 ha	Disturbances include the following: minor vegetation clearance; and the construction of a channel for a drainage pipe and fencing. In addition, the study area may have been disturbed by the construction of the adjacent Vine Street, Fairfield, and Bland Street, Carramar.	Open space	None
Open space adjacent to Elizabeth Street, Granville							
Approximately 0.0875 ha	Approximately 0.0875 Ha	c. <5%; however there were areas with good visibility (c. <70%) adjacent to the drainage channel.	c.15%; areas of evident exposure were located adjacent to the drainage channel.	0.0006 ha	Disturbances include the following: vegetation clearance; and the construction of a drainage channel, bridge crossing, footpath, and fencing.	Open space	None
Area between Deniehy Street and Shirley Street, outside the road reserves, Granville							
Approximately 0.1315 ha	Approximately 0.1315 Ha	0%	0%	0 ha	Disturbances include the construction of a pipeline.	Area	None
Parramatta/Granville Sportsground, Granville							
Approximately 0.0223 ha	0 ha	c. <80%.	0%	0 ha	Disturbances include the following: vegetation clearance; the construction of an unsealed road; and vehicle movement. In addition, the study area may have been disturbed by the construction of the adjacent Parramatta/Granville Sportsground.	Private	None
Smithfield Energy Facility and Smithfield Water Treatment Works, Smithfield							
Approximately 0.4718 ha	0 ha	c. <5%	0%	0 ha	Disturbances include the following: vegetation clearance; and the construction of telegraph poles and fencing. In addition, the study area may have been disturbed by the construction of the adjacent Smithfield Energy Facility and Smithfield Water Treatment Works.	Private	None
Woodville Public Golf Course, Guildford							
Approximately 0.2925 ha	0 ha	0%	0%	0 ha	Disturbances include the following: vegetation clearance; and the construction of a golf course and fencing.	Private	None
Shell Refinery, Rosehill							
Approximately 0.7242 ha	0 ha	c. <5%.	0%	0 ha	Disturbances include the following: vegetation clearance; and the construction of an industrial railway, shed, and fencing. In addition, the study area may have been disturbed by the construction of the adjacent Durham Street	Private	None

Table 8: Information recorded during the field survey.

4.4.1.1 Existing Conditions Summary

The parts of the study area (with the exception of the parts of the study area within the road reserve associated with Tangerine Street, Fairfield East) that traverse Prospect Creek, Fairfield, Burns Creek, Fairfield East, and Duck Creek, Granville, have been visibly disturbed by fluvial erosion.

The study area is located within an urban environment, and the landscape has been extensively disturbed by impacts from urban development. Only the disturbances that were visible during the survey are discussed here.

The visible disturbances include the following: vegetation clearance; revegetation; and the construction of roads (sealed and unsealed), driveways, footpaths, nature strips, car parks, telegraph poles/street lights, traffic lights, signs, drains, bus shelters, bridge crossings, underground and exposed pipelines and drainage channels, railway stations, railways, and railway infrastructure.

More specifically, the study area has also been visibly disturbed by the following: design landscaping and the excavation of a section along the terrace of Prospect Creek, Fairfield Park; and the construction of the following: a soccer field, Yennora; Woodville Public Golf Course, Guildford; and private industrial railway and shed, Rosehill.

In addition, the study area may have been disturbed by the construction of the following: adjacent roads, fences, and buildings, and, more specifically, the adjacent Smithfield Energy Facility and Smithfield Water Treatment Works, Smithfield; Parramatta/Granville Sportsground, Granville; adjacent public toilets, Yennora.

Most of the native vegetation that would have existed within the study area has been cleared. For example, within road reserves, the remaining native vegetation identified was limited to isolated trees located within the nature strip. In general, the remaining native vegetation identified was significantly more frequent within the parts of the study area within Fairfield Park, Fairfield, and the open space between Fairfield Park, Fairfield, and both Vine Street, Fairfield, and Bland Street, Carramar, and the only remaining old growth trees identified during the survey were a low number located in these areas.

4.4.2 Effective Survey Coverage

As mentioned previously, the overall effectiveness of the survey - the likelihood of finding any potential archaeological sites - is based on the ground surface visibility and amount of exposures within the study area.

Ground Surface Visibility

The overall GSV of the study area was low due to either urban development or vegetation cover.

Exposure

Overall, a low amount of exposure was identified within the study area. Areas of exposure within the study area were located at the following locations: a low number of patches on the raised terraces of Prospect Creek, Fairfield Park, Fairfield; the area adjacent to the drainage channel adjacent to Elizabeth Street, Granville; and the disturbed bases of both a number of telegraph poles/street lights and more recently planted trees or shrubs, which were predominantly within road reserves.

Effective Survey Coverage Summary

As expected in a highly developed urban environment, the overall effective survey coverage of the study area is considered to be poor due to low ground surface visibility and a low amount of exposures within the study area.

A quantative *indication* of the effectiveness of the survey can be calculated by multiplying the area covered in the survey by the percentage estimates of average ground surface visibility and the amount of exposures within the study area, and the resulting figure refers to the amount of the study area that has been effectively surveyed. The effective survey coverage of the study area is summarised in Table 8.

4.4.3 Aboriginal Heritage Sites Registered on Heritage Registers and Databases

As previously discussed, there is one Aboriginal heritage site, an open site and associated PAD registered with AHIMS located within the immediate vicinity of the study area – approximately 8 m from a 5 m buffer of the study area (see Figures 2 and 6). As previously discussed, the site card for this site was not available from AHIMS at the time of report production. The only available information about the location of the site was limited to map grid coordinates provided by AHIMS. No Aboriginal archaeological material was relocated at this location during the survey.

The following is a description of the site.

Site Name: PC1***; Site Identification Number:*** 45-5-3272***; Site Description:*** Open site and associated potential artefact deposit (PAD)***; Map Grid Coordinates:*** MGA 311160E 6249391N)

Location

The open site and associated PAD (see Plate 25) appear to be located adjacent to a sealed road within Fairfield Park, Fairfield.

Plate 25: Fairfield Park, Fairfield.
View faces east.

Extent

The extent of the open site is unclear without the site information card, and the extent of the associated PAD is unknown.

Disturbances

The location of the site based on map grid coordinates provided by AHIMS has been disturbed by the vegetation clearance. Although the extent of the open site is unclear without the site information card, and the extent of the associated PAD is unknown, the site may have been disturbed by designer landscaping and the construction of a sealed road and fences located within the immediate vicinity of this location.

4.4.4 Aboriginal Heritage Sites Unregistered on Heritage Registers or Databases

There were no Aboriginal heritage sites unregistered with heritage registers or databases identified within or overlapping the study area during the survey.

4.4.5 Zones of Aboriginal Archaeological Sensitivity

A zone encompassing parts of Fairfield Park, Fairfield, and open space adjacent to Vine Street, Fairfield and Bland Street, Carramar, within which parts of the proposed reticulated network would be located, was identified as an area of high Aboriginal archaeological sensitivity (see Figure 6).

The zone is in the immediate vicinity of Prospect Creek, and includes many raised areas overlooking the creek. It was predicted that open sites would be more likely to be identified on areas that are elevated and in close proximity to water (see Section 4.4.1).

Consequently, there is a high likelihood that Aboriginal archaeological materials will be present throughout the undisturbed parts of this zone, or parts that have only been subject to minor disturbances, such as vegetation clearance.

4.5 Results Summary and Discussion

There is one Aboriginal heritage site registered with AHIMS, an open site and associated PAD (site name: PC1; site identification number: 45-5-3272), located within the immediate vicinity of the study area (see Figures 2 and 6). No Aboriginal archaeological material was relocated at this location during the survey.

No Aboriginal heritage sites unregistered on heritage registers or databases were identified within or overlapping the study area during the survey.

A zone encompassing parts of Fairfield Park, Fairfield, and open space adjacent to Vine Street, Fairfield and Bland Street, Carramar, within which parts of the proposed reticulated network would be located, was identified as an area of high Aboriginal archaeological sensitivity (see Figure 6).

The study area traverses Prospect Creek, Fairfield, Burns Creek, Fairfield East, and Duck Creek, Granville. Any potential archaeological material within or overlapping the parts of the study area along the banks or terraces of any of these watercourses are likely to have been further incorporated into sediment deposited by the past overbanking of these creeks, or scoured and possibly shifted by water movement associated with these creeks.

As expected in a highly developed urban environment, the overall effective survey coverage of the study area is considered to be poor due to both a low overall surface visibility and amount of exposure identified during the survey. Overall, the study area has been extensively disturbed by impacts from urban development.

When assessing the impact of disturbances to the study area, it is important to distinguish the likelihood that disturbances may have impacted any potential Aboriginal archaeological materials exposed as surface expressions or buried. Most of the surface of the study area has been extensively disturbed by impacts from urban development. Furthermore, many of these disturbances are likely to have impacted depths associated with the dates of Aboriginal occupation, and, of these, many are likely to further extend to depths that predate Aboriginal occupation. Consequently, in general, any potential Aboriginal archaeological materials within or overlapping the study area are likely to have been subject to similar levels of disturbance.

Due to extensive clearance of native vegetation within and overlapping the study area, the only remaining old growth trees identified during the survey were a low number within Fairfield Park, Fairfield, and open space between Fairfield Park, Fairfield, and both Vine

Street, Fairfield, and Bland Street, Carramar, and they displayed no signs of being modified by Aboriginal people. It was predicted that, in general, scarred trees would be unlikely to remain within or overlapping the study area.

5.0 SIGNIFICANCE ASSESSMENT

5.1 Introduction to the Assessment Process

Heritage assessment criteria in NSW fall broadly within the significance values outlined in the Australia ICOMOS Burra Charter (Australia ICOMOS 1999). This approach to heritage has been adopted by cultural heritage managers and government agencies as the set of guidelines for best practice heritage management in Australia. These values include:

- **Historical** significance (evolution and association) refers to historical values and encompasses the history of aesthetics, science and society, and, therefore, to a large extent underlies all of the terms set out in this section. A place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may also have historic value as the site of an important event. For any given place, the significance will be greater where evidence of the association or event survives in situ, or where the settings are substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment.

- **Aesthetic** significance (Scenic/architectural qualities, creative accomplishment) refers to the sensory, scenic, architectural and creative aspects of the place. It is often closely linked with social values and may include consideration of form, scale, colour, texture, and material of the fabric or landscape, and visuals, smells, and sounds associated with the place and its use.

- **Social** significance (contemporary community esteem) refers to the spiritual, traditional, historical or contemporary associations and attachment that the place has for the present-day community. Places of social significance have associations with contemporary community identity. These places can have associations with tragic or warmly remembered experiences, periods or events. Communities can experience a sense of loss should a place of social significance be damaged or destroyed. These aspects of heritage significance can only be determined through consultative processes with local communities.

- **Scientific** significance (archaeological, industrial, educational, research potential and scientific significance values) refers to the importance of a landscape, area, place or object because of its archaeological and/or other technical aspects. Assessment of scientific value is often based on the likely research potential of the area, place or object and will consider the importance of the data involved, its rarity, quality or representativeness, and the degree to which it may contribute further substantial information.

The assessment of the significance of Aboriginal and historical sites will be based on the significance values outlined above. As well as the ICOMOS Burra Charter significance values

guidelines, various government agencies have developed formal criteria and guidelines that have application when assessing the significance of heritage places within NSW. Of primary interest are the guidelines prepared by the NSW Department of Environment and Climate Change (DECC), the NSW Heritage Office and the Commonwealth Department of Environment and Heritage (DEH). The relevant sections of these guidelines are presented below.

5.2 Aboriginal Heritage Sites – Assessment of Significance

The following Aboriginal significance assessment is based on Part 1 of the *DECC Guidelines for Aboriginal Heritage Impact Assessment* (1997). These guidelines state that an area may contain evidence and associations which demonstrate one or any combination of the ICOMOS Burra Charter significance values outlined above in reference to Aboriginal heritage. Reference to each of the values will be made when evaluating Aboriginal significance for sites and places.

In addition to the previously outlined heritage values, the *DECC Guidelines* also specify the importance of considering cultural landscapes when determining and assessing Aboriginal heritage values. The principle behind a cultural landscape is that 'the significance of individual features is derived from their inter-relatedness within the cultural landscape'. This means that sites or places cannot be 'assessed in isolation' but must be considered as parts of the wider cultural landscape. Hence the site or place will possibly have values derived from its association with other sites and places. By investigating the associations between sites, places, and (for example) natural resources in the cultural landscape, the stories behind the features can be told. The context of the cultural landscape can unlock a 'better understanding of the cultural meaning and importance' of sites and places.

The two main values that are likely to be addressed in a consideration of Aboriginal heritage sites are as follows: cultural/social significance to Aboriginal people; and the archaeological or scientific significance to archaeologists. Other values, however, such as educational or tourism values, may also be considered. It is considered best practise that archaeologists understand that archaeological scientific assessments of Aboriginal heritage sites are part of a larger picture.

The determinations of Aboriginal significance for sites and places are expressed as *statements of significance* that preface a concise discussion of the contributing factors to Aboriginal cultural heritage significance. Nomination of the level of value, i.e., high, moderate, low or not applicable, for each relevant category are also proposed and presented in a summary table.

5.2.1 Aboriginal Community or Cultural Values

The NSW DECC recognises that the 'Aboriginal community are the primary determinants of the significance of their heritage' (NSW DEC 2004). Biosis Research Pty. Ltd. recognises that our role in the cultural heritage assessment process is to provide specialist skills, particularly in regard to archaeological and heritage management expertise. These specialist skills can be articulated and enhanced through consultation with the Aboriginal community, with the aim of providing a comprehensive assessment of cultural heritage significance.

The heritage assessment criteria outlined above that relate to community or cultural values include social, historic and aesthetic value. Social and aesthetic values are often closely related. Social value refers to the spiritual, traditional, historical or contemporary associations and attachment that the place or area has for the present-day Aboriginal community. Aesthetic values are related to Aboriginal heritage sites that may contain particular sensory, scenic, architectural and creative values, and meaning to Aboriginal people. Historic value refers to the associations of a place with a person, event, phase or activity of importance to the history of an Aboriginal community. Gaining a sufficient understanding of this aspect of significance will often require the collection of oral histories and archival or documentary research, as well as field documentation. Places of post-contact Aboriginal history have generally been poorly recognised in investigations of Aboriginal heritage, and the Aboriginal involvement and contribution to important regional historical themes is often missing from accepted historical narratives.

These aspects of heritage significance can only be determined through consultative processes with one or more Aboriginal communities. In terms of Aboriginal communities, heritage places – including those that are otherwise defined as 'archaeological sites' – will always attract differing values. These may include custodianship obligations, education, family or ancestral links, identity, and symbolic representation. History and traditions are important: this generation has an obligation to future generations to retain certain things as they are currently seen and understood. This includes retaining alternative understandings to those that come through scientific assessments. Heritage places are often more complex than is identified through the scientific determination of value. Cultural and social values can be complex and rich - the past is a vital component of cultural identity. Feelings of belonging and identity are reinforced by knowledge of the existence of a past, and this is further reinforced and maintained in the protection of cultural heritage.

5.2.2 Statement of Community and/or Cultural Significance (Social Significance)

Any known or potential Aboriginal objects or places within or overlapping the study area might be significant to communities or cultural groups.

It is, therefore, very important that the representatives of the registered stakeholders, DLALC, GLALC, and DTAC, are provided with the opportunity to comment on the values of any known or potential Aboriginal objects or places within or overlapping the study area, as well as the broader local area encompassing the study area.

Dominic Brady (Biosis Research Pty. Ltd.) met with Mark 'Jack' Johnson (GLALC), Sandra and Terry Lee (DTAC), and Steve Randall (DLALC) to listen to their comments. A report of their comments, which they have reviewed and approved for inclusion in this report in the below format, is provided below:

Meeting with Mark 'Jack' Johnson (CEO) (GLALC)

Dominic Brady (Biosis Research Pty. Ltd.) and John 'Jack' Johnson (CEO of GLALC) met on 7 October 2008.

John 'Jack' Johnson indicated the following:

- The link between Aboriginal people and the land/country is people, not culture; it is people who create and reinforce this link.

- Aboriginal values cannot be simply associated with the Local Aboriginal Land Councils. Aboriginal values transcend these bodies, which were established by NSW legislation. Aboriginal values are, instead, directly associated with people.

- Aboriginal values associated within the study area and the wider local area undoubtedly existed in the past, the present, and will continue to exist into the future. It is important to note that the way of life and associated values of Aboriginal people is, like all other cultures, dynamic, not static.

- There are many examples of fluid movement of Aboriginal people throughout the boundaries of the Darug language group and of long distance family ties within the Darug language group.

- One example of a past Aboriginal values within the study area and the wider local area were sources of fresh water. Fresh water was generally in short supply throughout the Cumberland Plain, especially during the dry times. Areas in close proximity to these resources were considered special and/or sacred and were protected because water was necessary for life.

- Conflict ensued between the European invaders and Aboriginal people when the Europeans violated traditional law of the Aboriginal people (under traditional law, they were always welcome). One example of these breaches was in reference to their treatment of the fresh water supplies: the hoofed animals, such as cattle, that were introduced by the Europeans would defecate in freshwater sources, and with reference to fresh watercourses, trample the banks. These were not actions typically associated with terrestrial native animals.

John 'Jack' Johnson is not aware of any other known Aboriginal heritage sites within, overlapping, or within the immediate vicinity of the study area other than those already registered with AHIMS. He indicated that other sites undoubtedly exist within the study area and the wider local area.

John ‘Jack’ Johnson indicated that, due to the upheaval of the Aboriginal way of life and displacement of Aboriginal people since the European invasion, there are large gaps in Aboriginal local knowledge of the Cumberland Plain, including the local area encompassing the study area. He believes a current study that focuses on the Cumberland Plain by John Lennis, Hawkesbury Nepean Catchment Management Authority, will provide a valuable contribution to the current knowledge-base about Aboriginal people within the Cumberland Plain.

Meeting with Sandra and Terry Lee (DTAC)

Dominic Brady (Biosis Research Pty. Ltd.) and Sandra and Terry Lee (DTAC) met on 8 October 2008.

Sandra and Terry Lee indicated the following:

- The Aboriginal people had and continue to have a strong spiritual link to Darug country. The link to country is a fundamental part of the identity of Aboriginal people.

- Due to the massive upheaval of the Aboriginal way of life and displacement of Aboriginal people since the European invasion, there are large gaps in Aboriginal local knowledge of the Cumberland Plain. For example, one of the most valuable surviving records of the Darug language is widely considered to be the notes of William Dawes, an English marine officer. In addition, local Aboriginal knowledge further diminished with the establishment of the missions and reserves, such as the Hawkesbury Aborigines Reserve and Mission established in 1889. To help to avoid being taken to the missions and reserves, or other forms of discrimination, it was often necessary for Aboriginal people to repress any information that might indicate their Aboriginality or strong links to their culture. Even European names that were to later become associated with Aboriginal families were changed to avoid unwanted attention.

- When the mullet would spawn at the head of Parramatta River, the clans of the Darug language group would meet at this location. The gathering of such a large amount of people was possible due to the large quantities of food provided by the mullet, which were caught with nets. During this time, there was trade and intermarriage between the clans. Consequently, many Aboriginal heritage sites have been identified around the head of the Parramatta River due to this past concentration of people.

- Sources of fresh water were an important life resources for the Aboriginal people. In addition, Aboriginal people would hunt animals that came to the water to drink. Consequently, campsites were likely to be located near areas in close proximity to sources of water.

- There is a known clan associated with Duck Creek, which is referred to as the Duck Creek Clan, one of its descendents is Kerry Kentu.

Sandra and Terry Lee indicated that they are not aware of any other known Aboriginal heritage sites within, overlapping, or within the immediate vicinity of the study area other than those already registered with AHIMS. They indicated that other sites undoubtedly exist within the study area and the wider local area.

Sandra and Terry Lee indicated that all Darug people, regardless of their clan's location, are associated with Darug country due to the intermarriage between clans, which resulted in family links and, consequently, relatively fluid movement within Darug country.

Meeting with Steve Randall (DLALC)

Dominic Brady (Biosis Research Pty. Ltd.) and Steve Randall (DLALC) spoke on the phone on 27 October 2008.

Steve Randall indicated the following:

- Parramatta River and its tributaries were 'lifeways' for Aboriginal people; they were important sources of water and food, and, consequently, were considered to be special areas.

Steve Randall indicated that he is not aware of any other known Aboriginal heritage sites within, overlapping, or within the immediate vicinity of the study area other than those already registered with AHIMS. He indicated that other sites undoubtedly exist within the study area and the wider local area.

5.2.3 Archaeological (Scientific) Significance

Archaeological significance (also called scientific significance) refers to the value of archaeological objects or sites as they relate to research questions that are of importance to the archaeological community, including indigenous communities, heritage managers and academic archaeologists. Generally the value of this type of significance will be determined on the basis of the potential for sites and objects to provide information regarding the past lifestyles of people (Burke and Smith 2004: 249, NPWS 1997). For this reason, the NSW NPWS summarises the situation as 'while various criteria for archaeological significance assessment have been advanced over the years, most of them fall under the heading of archaeological research potential' (NPWS 1997: 26). The NPWS criteria for archaeological significance assessment are based largely on the Register of the National Estate Criteria, and under the heading of 'research potential', include the following aspects and definitions (NPWS 1997):

General site considerations, which include factors such as:

- *Site intactness or integrity:* This includes the state of preservation of archaeological objects, as well as the stratigraphic integrity of the site, the taphonomic processes acting on the site, and the impact of past artefact collections made at the site.

- *The connectedness* of the site to other sites – when considered as part of a larger assemblage or landscape, the site may have greater research potential than if it was simply considered in isolation.

- *Chronological potential* refers to the potential of a site to provide a dateable framework extending back into the past. The potential antiquity of a site is also an important consideration, as older sites are relatively less common than younger sites. In many cases, stratified, dateable artefact bearing deposits are sufficiently rare to be a very valuable resource.

Representativeness

- *Representativeness* refers to the ability of a site or object to serve as a representative example of sites in the same class. This aspect of value is only meaningful when considered in conjunction with a conservation goal, and must be determined against the archaeological record at various scales of consideration - local, regional and continental for example. It takes into account site and object variability, connectedness and a consideration of what is already, and likely to be, conserved. Burke and Smith (2004: 247) define representativeness as 'an assessment of whether or not a place is a good example of its type, illustrating clearly the attributes of its significance.'

Rarity

- *Rarity* is, of course, closely related to representativeness (if a site is rare, it is likely to have high representative value), and will include a consideration of those issues discussed under general site considerations. In many ways, the determination of rarity is a summation of exceptional research potential, or a representative of a small class of sites or objects. Burke and Smith (2004:247) further describe rarity as "an assessment of whether the place represents a rare, endangered or unusual aspect of our history or cultural environment that has few parallels elsewhere".

In addition to the research potential related value factors, the NSW NPWS (1997: 32) also discuss *Educational Potential* and *Aesthetic Significance*, as items that may be included in scientific significance. The NPWS general advice is that archaeologists should give careful consideration prior to attempting to determine educational and aesthetic values (NPWS 1997: 32). We make no attempt to determine educational potential of sites under scientific assessment, but do consider educational value as a contributing factor that may be included in an assessment of social significance by the Aboriginal community.

Aesthetic values

There is a diverse yet accessible literature regarding identifying aesthetic values and determining aesthetic significance (Burke and Smith 2004: 248-9, Kerr 1996: 15-16, Pearson and Sullivan 1999: 134-8). It is generally agreed that aesthetic values are an important part of cultural heritage significance; however, they are dependent on an individual's sensory response, which means determining aesthetic value is fraught with difficulty, and should be applied on a case-by-case basis as it is not always a value applicable to archaeological sites (Burke and Smith 2004: 248). However, when dealing with shelter and rock art sites aesthetic values and landscape context are an important consideration. The question 'does the place have a relationship between its parts and the setting which reinforces the quality of both', while originally proposed in an architectural context (Kerr 1996: 15), is relevant also for rock art and shelter sites in a bushland setting where there is often an important relationship between the cultural site and natural environment.

5.2.4 Statements of Archaeological (Scientific Significance) for Known Aboriginal Heritage Sites within, overlapping, or in the Immediate Vicinity of the Study Area

Site Name: PC1; **Site Identification Number:** 45-5-3272; **Site Description:** Open site and associated potential artefact deposit (PAD); **Map Grid Coordinates:** MGA 311160E 6249391N)

As previously discussed, the site information card for this site was not available from AHIMS at the time of report production. The only available information about the location of the site was limited to map grid coordinates provided by AHIMS. No Aboriginal archaeological material was relocated at this location during the survey.

General

The location of the site based on map grid coordinates provided by AHIMS has been disturbed by vegetation clearance. Although the extent of the open site is unclear without the site information card, and the extent of the associated PAD is unknown, the site may have been disturbed by designer landscaping and the construction of a sealed road and fences located within in the immediate vicinity of this location.

No connection between this site and other Aboriginal heritage sites has been established; at the time of report production, no other Aboriginal heritage sites were located near this site.

Representativeness

The representative value of this site is unknown.

Rarity

The site is classed as one of the most common site types in the local and regional area, the open site. The nature of the artefacts that compose the site is unknown.

Aesthetic

The surrounding landscape of the location of the site based on map grid coordinates provided by AHIMS includes evidence of post-contact land use. The site is in close proximity of public toilets, a sealed road, fences, designer landscaping, and a baseball field. The site does not overlook Prospect Creek, which is in the immediate vicinity.

SIGNIFICANCE: LOW

5.2.5 Aboriginal Heritage Sites – Significance Summary

A summary of the significance assessment for known Aboriginal heritage sites within, overlapping, or in the immediate vicinity of the study area is provided below in Table 9.

ABORIGINAL HERITAGE SITES	COMMUNITY AND/OR CULTURAL SIGNIFICANCE	ARCHAEOLOGICAL (SCIENTIFIC) SIGNIFICANCE
Site name: PC1; site identification number: 45-5-3272	HIGH	LOW

Table 9: Summary of the significance assessment for any known Aboriginal heritage sites within, overlapping, or in the immediate vicinity of the study area.

6.0 IMPACT ASSESSMENT

6.1 Potential Impacts

As previously outlined, Jemena Asset Management Pty. Ltd. propose to construct the following:

- A reverse osmosis water recycling plant;
- Approximately 20 km of an underground reticulated network; and
- Two water storage reservoirs (one of which is elevated), two pumping stations, a storage tank, and associated infrastructure along the network.

The proposed development will result in significant disturbances to the present landscape of the study area. These disturbances might include direct impacts to any potential Aboriginal heritage sites within, overlapping, or in the immediate vicinity of the proposed development footprint, as well as indirect impacts to those outside of the development footprint.

The potential impacts of the proposed development to any known Aboriginal heritage sites registered or unregistered on heritage registers or databases within or overlapping the study area are described below.

Site Name: PC1***; Site Identification Number:*** 45-5-3272***; Site Description:*** Open site and associated potential artefact deposit (PAD)***; Map Grid Coordinates:*** MGA 311160E 6249391N)

The location of the site based on map coordinates provided by AHIMS for this site, which consists of an open site and associated PAD, is within the immediate vicinity of the study area - approximately 8 m from a 5 m buffer of the proposed development. As both the extent of the open site is not clear without the site information card and the extent of the associated PAD is unknown, the site may overlap with the impact zone of the proposed development.

6.2 Impact summary

The potential impacts of the proposed development to any known Aboriginal heritage sites registered or unregistered on heritage registers or databases within or overlapping the study area, alongside their identified archaeological (scientific) significance are summarised in Table 10 below.

ABORIGINAL HERITAGE SITES	SIGNIFICANCE (ARCHAEOLOGICAL)	POTENTIAL IMPACT
Site name: PC1; site identification number: 45-5-3272	LOW	YES

Table 10: Summary of impacts to Aboriginal heritage sites within, overlapping, or in the immediate vicinity of the study area.

7.0 RECOMMENDATIONS

7.1 Introduction

Cultural heritage places provide us with evidence of past human activity. They may be confined to a small area, or represented by a complex of features, including a cultural landscape. Places of human activity in the past are affected by the actions of the present, particularly urban expansion and agriculture. This means cultural heritage places are a diminishing resource.

Cultural heritage places are valuable, not only for the scientific records of the past they provide, but also for their social significance. Many Aboriginal places, for example, have a special significance to Aboriginal communities as places where traditional life has continued and places that may have sacred or symbolic significance.

Many heritage places may also be outstanding examples of artistic and creative achievement. Heritage places are valuable to Australians, as they not only provide a link with a culturally rich past, but they can contribute to current recreational and community life.

Heritage places may also have economic potential (Pearson & Sullivan 1995:15). These values should, where possible, be protected and handed on to future generations. We all have some degree of social, spiritual, ethical - and legal - obligation to see that this happens.

7.2 Management Recommendations

Prior to any impacts occurring within the study area, the following is recommended:

7.2.1 Aboriginal Heritage Sites and Zones of Aboriginal Archaeological Sensitivity

Recommendation 1

It is recommended that Jemena Asset Management Pty. Ltd. continue to liaise with the identified Aboriginal registered stakeholders (GLALC, DLALC, and DTAC) with reference to the management and mitigation of impacts to Aboriginal cultural heritage sites and values associated with the proposed development.

Recommendation 2: *The development of a Cultural Heritage Management Plan (CHMP) to conduct sub-surface testing of the zone of high Aboriginal archaeological sensitivity identified in this report*

It is recommended that, prior to any impacts to the zone of high Aboriginal sensitivity identified in this report (Figure 3), a CHMP is developed to conduct sub-surface testing of any parts of this zone that will be impacted by the proposed development in order to determine if any potential Aboriginal heritage sites will be impacted. It is important to note that this area

encompasses the location and immediate vicinity of an Aboriginal heritage site, an open site and associated PAD (site name: PC1; site identification: 45-5-3272).

The CHMP should also include provisions for the management and storage of any archaeological materials recovered during the sub-surface testing program.

Recommendation 3: *Stop work provision for any potential Aboriginal heritage sites identified during construction*

It is recommended that the CHMP includes the requirement and procedures for managing any previously unidentified Aboriginal objects or places identified during any phase of the proposed development. It is recommended that, if any previously unidentified Aboriginal objects or places are identified during any phase of the proposed development, all works cease in the vicinity of the find, and the following bodies notified:

- DECC; and
- Registered Aboriginal stakeholders: Deerubbin Local Aboriginal Land Council (DLALC); Gandangara Local Aboriginal Land Council (GLALC); and Darug Tribal Corporation.