CONNOR
HOLMES

BUCKLAND PARK MAJOR DEVELOPMENT

PLANNING REPORT

Prepared for
Walker Corporation Pty Ltd
and
Daycorp Pty Ltd

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1. INTRODUCTION

On 4 January 2007, the Minister for Urban Development and Planning declared the Buckland Park proposal would be assessed as a Major Development in accordance with Section 46 of the Development Act 1993.

A Development Application was submitted for the proposal on 25 May 2007. The proponent is Walker Corporation Pty Ltd and Daycorp Pty Ltd.

In August 2007, the Development Assessment Commission (DAC) acting independently determined Environmental Impact Statement (EIS) was required and issued a Guidelines document specifying what the statement should address.

The requirement for an EIS is part of a rigorous assessment process under the major development provisions of the Development Act, 1993.

The Major Development Declaration was revised on 18 June 2008 after a request from the proponent that the site be expanded from 1,000 hectares to 1,308 hectares to allow better management of flood issue, provide opportunities for employment and provide a connection to Port Wakefield Road.

An amended EIS Guidelines document was subsequently released in August 2008.

The Guidelines require the proponent to address more than 100 environmental issues including:

- potential flooding issues;
- infrastructure issues (water, sewerage, stormwater, transport);
- water use issues (supply, impacts on groundwater, water reuse and harvesting);
- possible construction and ongoing impacts on the local environment, including waterways;
- effects on and from adjacent industries; and
- demands on community services.

The site is shown on the plan in Appendix 1 entitled ‘Major Development Declaration Area’.

This planning report is provided in support of the EIS and is intended to assist the Minister with his assessment of the merits of the proposal. It also provides further information sought by the DAC as detailed within the Guidelines

2. DESCRIPTION OF THE PROPOSAL

2.1 Underlying Rationale

Buckland Park's environmental context has changed over recent years, to an extent that is now appropriate to consider the area for urban purposes. The changed circumstances included the following:

- Instigation of flood mitigation works associated with the Gawler River, which are anticipated to reduce flood risks in the area;
- Relocation of the 7RAR Battalion with 1,200 personnel from its current location in Darwin to new facilities within the Edinburgh Defence Precinct, including the construction of over $620 million of new facilities at Edinburgh. This in turn creates a significant demand for housing;
- Construction of the Northern Expressway (NExy), a major piece of road infrastructure. It will improve accessibility to the northern suburbs of Adelaide as will the northern connector and consequently the regions ability to attract employment and support new urban areas; and
- A decline in Metropolitan Adelaide's land stocks and housing affordability over the last 3 years. The Government has recently announced it is undertaking a Growth Investigation Areas project to identify a 25-year rolling land supply. Buckland Park is included in that project (Minister for Urban Development and Planning Nov 08).

Appendix 2 contains a Locality Plan.

2.2 Proposal Overview

A site and proposal of this scale, in the control of a single proponent, will allow efficient planning and implementation of the proposal. Government resources are minimised in this process, with the proponent funding planning resources.

The Buckland Park proposal will be a comprehensively planned community designed to accommodate 12,000 new allotments with a projected population of 33,000 people (Connor Holmes 2008).

The proposal is master planned to include a hierarchy of centres commensurate with its scale. The centres will provide local employment opportunities, and shops, commercial offices, service trades, medical facilities, community and library facilities, and schools (Connor Holmes 2008).

An internal road network, new interchange with Port Wakefield Road and a public transport network to accommodate buses is proposed (Parsons Brinkerhoff 2008).

Buckland Park's facilities and services will be available to residents of Virginia and Two Wells, expanding the limited range of services and facilities currently available to those communities.

The district centre will be the community focal point including a transportation hub.

Neighbourhoods will be designed so all residents are within reasonable proximity to a neighbourhood centre. These are located to coincide with local recreation reserves creating neighbourhood focal points. B-7 schools are anticipated in association with the neighbourhood centres.

The Master Plan facilitates a high level of self sufficiency by incorporating access to retail, commercial and community facilities within its boundaries.

Housing will be predominantly detached dwellings on separate allotments of various sizes in a typical range of around 300 m^2 to 800 m^2. Medium density housing is intended to be strategically provided around the District Centre, the neighbourhood centres, abutting local recreation areas and taking advantage of views to the extensive areas of open space.

The proposal will meet the Government's target of 15% Affordable Housing by delivering small allotments at a price point capable of accommodating affordable small dwellings and new housing concepts. This target is supported by changes to legislation (*Statutes Amendment Affordable Housing Act 2007*). The implementation of the 15% is centred on Government land, Declared Major Developments, significant rezoning or change in use to residential from non-residential uses, together with the creation of opportunities for housing associations and cooperatives and the involvement of Housing SA.

The Master Plan includes an open space network to protect biodiversity assets, accommodate flood management facilities, create permanent water bodies, provide for sport and recreation, pedestrian links and cycle-ways and present a landscaped outlook for a large part of the community.

Accessibility and service provision for new residents at the outset of residential occupation is an important component of the proposal and therefore the proposal includes:

- A community bus service;
- A community worker; and
- Neighbourhood Centre within Stage 1.

2.3 Master Plan

The Buckland Park Master Plan includes the following key features:

- Approximately 12,000 dwellings, including some 3,885 medium density dwellings and a range of affordable housing options;
- A District Centre, four neighbourhood centres incorporating a range of commercial and community facilities;
- Employment areas, including a mixed use, commercial and retail precinct adjoining Port Wakefield Road, and service/light industry precincts adjoining horticulture land to the south;
- Open space networks, significantly increasing regional open space;
- Four primary schools and two secondary schools;
- Appropriate separation distances to nearby rural activities; and
- A structure based on distinct neighbourhoods.

The Master Plan (Version 6) the Buckland Park proposal appears in Appendix 3 and provides an appreciation of the form of the proposal and its various components.

2.4 Staging

The proponent has a staging strategy for the project delivery over 25 years. Accordingly, Buckland Park has been considered and planned incrementally in 5 stages.

In the first five years of construction, 2010 to 2016, the requirements for early access to facilities and commitment to infrastructure will be addressed.

During the first five years:

- 1660 allotments will be created;
- Stage 1 will be completed, including the neighbourhood centre's first phase including a 1,500 m2 supermarket and 600 m2 of specialty shops, with the ability to double in size as more houses are occupied;
- A community bus network will be established to provide bus service for the first residents to connect with Route 900, and provide access to the region's shopping facilities, community services and schools;
- The storm and flood water management channel system will be commenced;
- Open space, parks and public domain landscaping, particularly in the neighbourhood centre, will be provided;
- A primary school will be established, by either the public or private sector.

Subsequent stages will comprise the following elements to support the overall population of 33,000 people.

Between 2017 and 2021

- 3080 additional allotments created;
- establishment of two primary schools, public and private;
- completion of the neighbourhood centre within Stage 1;
- construction of a second neighbourhood centre;
- employment area 1 partially developed.

Between 2022 and 2026

- 3200 additional allotments created;
- establishment of two new schools, public B-12 and private secondary school;
- Employment Area 1 fully developed;
- District Centre commenced;
- construction of a third neighbourhood centre.

Between 2027 and 2031

- 3200 additional allotments created;
- establishment of fourth primary school and another secondary school;
- ongoing creation of mixed use zone and district centre;
- Employment Area 2 partially developed;
- construction of a fourth neighbourhood centre;
- decommissioning of the Stage 1 Neighbourhood Centre.

Between 2032 and 2035

- 860 additional allotments created;
- ongoing development of district centre, mixed use zone and employment area 2.

The above staging sequence is illustrated in the Staging Plan at Appendix 4.

2.5 Neighbourhood Design

2.5.1 Design Parameters

The Master Plan has evolved having regard to three key spatial influences:

- the accommodation of flood mitigation facilities associated with the Gawler River;
- the protection and enhancement of remnant woodland areas; and
- urban form based on 'new urbanism' principles, notably permeability of the street network, a 'walkable' neighbourhood structure which accommodates pedestrian movement and community / public transport, ease of access to services and facilities, a mix of housing opportunities, a high quality public realm and commitment to sustainability.

2.5.2 Design Themes

More particularly, the Master Plan is based on three broad themes:

A relaxed lifestyle:

- open spaces;
- rural pursuits; and
- recreation trails.

The above lifestyle elements are characteristic of the masterplanned approach being taken at Buckland Park, which cannot necessarily be achieved in the small incremental divisions undertaken in most new and growing suburbs.

Water:

- large permanent water bodies;
- intermittent creek systems;
- flood plain identification and management;
- Gawler River management and flood mitigation works;
- use of recycled water for non- potable purposes;
- microclimate modification (through vegetation and water); and
- irrigation, revegetation and greening.

The need to reduce the use of potable water and manage stormwater and flooding on the site creates opportunities to re-use storm and flood water for irrigation and the creation of water features throughout the site.

Environmental principles:

- sustainable quality of life;
- pollution minimization;
- resource conservation;
- implementing WSUD techniques; and
- biodiversity conservation.

2.6 Sustainability

It is widely accepted that sustainability entails meeting the social, environmental and economic objectives of the current generation, while balancing the needs of future generations.

Sustainability seeks to achieve resource conservation, prevent pollution, maintain biodiversity and improve community well-being. Sustainability in Buckland Park will not be solely limited to the environment, but it is intended to create a community which provides people with a feeling of general safety, security, and a sense of community, with opportunities for employment, relaxation and learning.

Sustainability is an important Government consideration and is paramount within the objectives in South Australia's Strategic Plan. The Buckland Park proposal will embrace the drive and direction provided by the Strategic Plan, and sustainability will be a key focus in the development's planning, delivery and management of ongoing operations.

In particular the following Objective and Targets found within South Australia's Strategic Plan are applicable:

Objective 3: Attaining Sustainability (2007)

- Biodiversity – (T3.1);
- Energy consumption – dwellings (T3.14);
- Greenhouse emissions (T3.5);
- Land biodiversity (T3.2);
- Water (T3.9);
- Use of public transport (T3.6);
- Ecological footprint (T3.7, T3.8).

A significant element of the Buckland Park proposal is efficient water management and flood mitigation achieved through the use of wetland and creek systems, use of recycled treated water from Bolivar which will be pumped to the site, and integration with the Gawler River management and flood mitigation work.

Measures aimed at climate change and the environment, including sustainable energy practices through passive building design, use of solar and wind energy, dual water supply systems, and extensive tree planting and environment restoration and management have been investigated and reported on independently.

Social, economic and environmental sustainability initiatives are continuing to be investigated for delivery at all stages of the proposal.

For "Ecologically Sustainable Development" (ESD) and climate change initiatives to be successful they must be practical, commercially viable and easily replicated. They will be applied during the planning, implementation and operation phases. The context of Buckland Park and its characteristics will see initiatives tailored to suit.

Buckland Park's scale offers an opportunity to implement a comprehensive strategy for ESD. Such a strategy seeks to address the following:

- sustainable quality of life – open space, transport, amenity, socio-economic well-being and safety;
- pollution minimisation – noise, air, ground and water;
- resource conservation –water, energy, soils, construction materials and land; and
- biodiversity conservation – eco-systems, flora and fauna.

Parsons Brinckerhoff has undertaken a *Sustainability and Climate Change Assessment* as part of the EIS approval process. As part of that assessment Parsons Brinckerhoff refer to a number of sustainability principles which will influence Buckland Park's built form and community including:

- equity within and between generations;
- ecological integrity;
- polluter pays;
- precautionary behavior; and
- community involvement.

A supporting design philosophy for Buckland Park has been applied and reflects the emphasis of the sustainability vision and above principles. It achieves sustainability outcomes with respect to:

- Community;
- Energy;
- Transport;
- Water use;
- Biodiversity;
- Resources; and
- Pollution.

To assist Buckland Parks' future residents and businesses, designers and builders, a set of Sustainability Guidelines have been drafted by Parsons Brinckerhoff (2008). The Guidelines provide confidence that sustainability requirements will be incorporated into Buckland Park's buildings. These guidelines are intended to be responsive to climate change adaptation and long term sustainability. Currently the Guidelines are principles only and will be detailed and finalized when the proposal receives the Governor's approval.

The Master Plan layout guides residential and commercial locations, ensuring the ESD principles are considered early within the design of each future stage. Appropriate master planning can positively impact on energy efficiency ratings, resource conservation, urban design and the residential amenity ultimately achieved.

Suitable parameters for open space and garden design, plant species selections and sustainable horticultural practices applicable to South Australian environment together with effective, efficient and appropriate water use have been incorporated into the design of open space and landscaped components. These will be further refined as the design process becomes more focused on detail.

The processes of 'place design', 'place development' and 'place management' will be applied to the future detailed design of urban spaces and focal points to create a sustainable public domain that is attractive, functional and viable.

3. EXISTING ENVIRONMENT AND LOCALITY

3.1 The Site

The site is located on the northern Adelaide Plains at Buckland Park, approximately 32 kilometres by road from the centre of Adelaide. It is located on the western side of Port Wakefield Road (Highway 1), 2.4 kilometres east of Virginia (refer to the locality plan in Appendix 2).

By comparison, Gawler Town Centre is 41 km from Adelaide by road, Mt Barker is 35km, Seaford Rise is 36km and Sellicks Beach is 53km.

The site is within the Metropolitan Adelaide boundary and approximately 9 kilometres outside of metropolitan Adelaide's current Urban Growth Boundary. It is in proximity to key transport routes and is within reasonable commuting distance to metropolitan employment hubs, services and facilities.

The site is 1,308 hectares and comprises 39 separate Certificates of Title. The site has boundaries that follow cadastral boundaries. The Gawler River forms the northern boundary, Cheetham salt pans adjoin to the south west, and portion of the site abuts the Port Wakefield Road to the east. A site plan in at Appendix 5.

The site is not uniform in shape, as it is composed of numerous contiguous allotments.

The site is extremely flat and characteristically low-lying, generally being between three and six metres above sea level. The locality contains a large flood plain and has historically been the subject of varying inundation due to flooding from the Gawler River.

Tracts of remnant native vegetation (River Red Gums and Black Box) are located in the northern portion of the site, generally adjacent to the Gawler River. The site also contains areas of Samphire shrub land. Other parts of the site are host to habitat of varying types including several bird and bat species.

The site is largely devoid of structures. Only part of the site has been used intensively in recent years for agricultural purposes. There are dilapidated greenhouses located on the south west corner of Legoe and Tippets Bridge Road. Much of the site is used for grazing.

The site has limited connection to mains water, and no connection to sewer. It does, however, have access to the Virginia Pipeline, which provides treated water from Bolivar for use by agricultural producers located on the northern Adelaide Plains.

The site abuts an 11Kv overhead power line on Legoe Road and overhead power lines along Park Road enter the southern portion of the site.

The site is conveniently accessed from Port Wakefield Road via Reedy Road, Legoe Road (portion sealed), Park Road (portion sealed) and Thompson Road (constructed but unsealed).

3.2 The Locality

The towns of Virginia, Two Wells and Angle Vale are in the site's region. These towns service a dispersed rural population of approximately 8,000 people. Virginia, the smallest of the three towns, lies 3-4 kilometres to the east of the site.

Despite these towns' relatively close proximity to the Adelaide metropolitan area, each is set in a rural context and retain an identity distinct from that of greater metropolitan area. Angle Vale is the township closest to the suburbs of Elizabeth and Smithfield and also has the largest population. Typically its residents rely significantly on employment outside the region, and therefore include a large proportion of commuters. Virginia and Two Wells play an important support role to the horticultural and agricultural industries surrounding the townships. Virginia is experiencing some growth with new residential allotments being released immediately to the south of the town.

Buckland Park is situated approximately some 32km by road from the Central Business District (CBD), Elizabeth and Salisbury are approximately 18km and 15km away respectively and contain significant economic activity nodes and public transport interchanges.

Key regional features include:

- Port Wakefield Road (Highway 1) which connects interstate destinations with Adelaide, Gawler via Angle Vale Road and the northern suburbs of metropolitan Adelaide;
- The Australia Rail Track Corporation's Adelaide-Darwin railway line;
- The Northern Expressway;
- The proposed Northern Connector;
- The Edinburgh RAAF base and adjacent Edinburgh Parks Precinct which provide considerable employment growth potential;
- Key service centres at Munno Para, Elizabeth, Salisbury and Mawson Lakes; and
- Industrial precincts emerging at Gillman.

Buckland Park's regional position is shown on the Regional Context Plan found in Appendix 6.

The area around Virginia is characterised by longstanding horticultural activities which are intensifying with increased use of sheds and greenhouses particularly east of Port Wakefield Road. The horticulture industry is important to the South Australian economy and the area's excellent access to the Port Wakefield Road is an essential element in this success.

Horticultural uses also exist on the western side of Port Wakefield Road, but to a lesser extent. Vines and olives have become popular, taking their place alongside the more traditional market gardens and greenhouses.

The Virginia Pipeline, completed in 1999, provides a dependable source of non-potable water from the Bolivar Treatment Works. It has the potential to allow significant expansion of horticulture and agricultural uses in the region, particularly as access to potable water becomes scarcer and less economical.

3.3 Adelaide Plains Horticulture Industry

Development of Horticulture Industries on the Adelaide Plains – A Blueprint for 2030 prepared by the Lucas Group and released in July 2007 suggests a vision for the Horticulture Industry on the Adelaide Plains, to assist long term strategic planning, efficient use of land and resources.

The study identified the Adelaide Plains Horticulture Industry as being concentrated in the area around Virginia and Angle Vale, with expansion occurring into the area around Two Wells.

The study culminated in a Vision for the Plains, which conceptually shows "lower value land to west of Port Wakefield Road could be utlised for hydroponic greenhouse production". The site's eastern portion is included in this category as are large areas to the south and north. Most of the site is not nominated for any purpose in the Vision.

3.4 Buckland Park's Strategic Context

Buckland Park is within the Metropolitan Adelaide region as described in the Planning Strategy and is 9 kilometers from the Urban Growth boundary.

The location of Buckland Park to Adelaide's other new and growing suburbs, including those that are either commenced, committed, proposed or under investigation, has been reviewed. Buckland Park is currently being investigated as a new growth location in the Growth Investigation Areas project initiated by the Minister for Urban Development and Planning on 5th November 2008.

Table 1 contains a comparison of 8 different new or growing areas with Buckland Park:

- Golden Grove;
- Concordia;
- Hewett;
- Sellicks Beach;
- Bowering Hill;
- Mt Barker;
- Dry Creek; and
- Roseworthy.

Table 1 **Buckland Park's Strategic Context**

Urban Area	Size (ha)	Type	Within Metro Area	Distances to Key Services / Facilities (km by vehicle)						
				CBD	Regional centre	Major rail interchange	Major hospital	TAFE College	University	Major employment lands
Buckland Park	**1300**	**Proposed**	**Y**	**30**	**18**	**15**	**20 (LM)**	**15 (Salisbury)**	**30 (City)**	**9 (Edinburgh Parks)**
Golden Grove	1240	Completed	Y	22	9	9	9 (M)	9 (Modbury)	22 (City)	10 (Parafield)
Concordia	500	Committed	N	45	20	20	24 (LM)	3 (Gawler) 17 (Elizabeth)	45 (City)	20 (Edinburgh Parks)
Hewett		Completed	N	45	20	20	24 (LM)	3 (Gawler) 17 (Elizabeth)	45 (City) 33 (Levels)	20 (Edinburgh Parks)
Sellicks Beach		Completed	Y	53	26	26	42 (F)	26 (Noarlunga)	43 (Flinders)	26 (Noarlunga Centre) 32 (Lonsdale)
Bowering Hill	397	Committed	Y	43	14	14	30 (F)	26 (Noarlunga)	31 (Flinders)	14 (Noarlunga Centre) 20 (Lonsdale)
Mt Barker		Expanding	N	35	38 (Marion)	35	35 (F)	Mt Barker	35 (City) (Flinders)	38 (Marion) 45 (Mawson Lakes) 45 (Gillman)
Dry Creek		Under Investigation	Y	12	9	10	12 (RA)	12 (Pt Adelaide)	12 (City) 5 (Levels)	3 (Gillman) 5 (Mawson Lakes)
Roseworthy		Under investigation	N	49	24	25	28 (LM)	Roseworthy 8 (Gawler) 25 (Elizabeth)	49 (City) 37 (Levels)	25 (Edinburgh Parks)
No. of location indicators inferior to BP			**4**	**6**	**5**	**5**	**6**		**6**	**6**

Key

LM – Lyell Mcewin Hospital
F - -Flinders Hospital
RA – Royal Adelaide Hospital
Levels – The University of SA Levels Campus
BP – proposed Buckland Park major development area

Areas selected include consideration of some of the areas identified within the Minister's News Release "Growth Investigation Areas" dated 5 November 08.

The new and growing areas have been analysed against the following 8 location indicators:

- location within Metropolitan Adelaide Area as described in the Planning Strategy;
- distance by road to:
  - Adelaide CBD;
  - Regional centres;
  - Major employment areas;
  - Major rail interchanges;
  - Major hospitals;
  - TAFE colleges; and
  - Universities.

It was found that Buckland Park's relationship to these key urban facilities was:

- Superior to 6 of the 8 comparable growth areas, on at least 5 of the 8 location indicators; and
- Superior to 2 of the 4 comparable growth areas within the Metropolitan Adelaide Area on at least 5 of the 8 location indicators.

Buckland Park is better placed than the majority of comparable growth areas, including others within Metropolitan Adelaide, often by a considerable margin.

To appreciate the geographic extent of the proximity of the areas to key strategic sites Appendix 7 contains a Strategic Context map showing the 8 new or growing areas mentioned above relative to strategic sites identified in the Planning Strategy 2007 including:

- Economic growth areas;
- Key industry sites;
- Defence industry and technology;
- Significant employment nodes;
- Regional centres (activity nodes);
- District (activity nodes).

Buckland Park relative to other areas is well placed as it is within the Metropolitan Adelaide Area defined within the Planning Strategy and it is in close proximity to the greater proportion of Adelaide's economic growth areas and significant employment nodes (including key industry, Defence and technology sites). It is also in close proximity to rail interchange facilities at Salisbury and Elizabeth, tertiary education and major medical services.

4. LEGISLATIVE AND ASSESSMENT PROCESSES

Purpose and Description of the EIS Process

4.1 Purpose

An EIS, as defined in Section 46B of the *Development Act, 1993*, includes a description and analysis of issues relevant to the proposal and the means by which those issues can be addressed.

An EIS details the likely environmental, social and economic effects of the proposal. An EIS considers the degree to which the likely effects of the proposal are consistent with the provisions of the Development Plan and the Planning Strategy. Where relevant, it describes how the objects of the *River Murray Act, 2003*, the objects and objectives of the *Adelaide Dolphin Sanctuary Act, 2005* and the duty of care under those acts, and any matter prescribed by the Regulations under the *Development Act, 1993* will be accounted for.

An EIS states the proponents' commitments to meet conditions (if any) placed on any approval to avoid, mitigate or satisfactorily control and manage any potential adverse impacts of the proposal on the environment.

Additionally, an EIS will address any further information required by the Minister.

4.2 Process Summary

The EIS process is prescribed in the Development Regulations 2008. The Development Assessment Commission determines the nature and extent of the investigations required to satisfactorily address possible issues of concern.

On 17 September 2008 the Commission made available to the public a set of Amended Guidelines for the preparation of the EIS which advise:

- *an EIS must be prepared by the proponent in accordance with the Guidelines;*
- *the EIS will then be referred to any prescribed authority or body under the Development Act, 1993, and to other relevant authorities or bodies for comment;*
- *public exhibition of the EIS document will occur by advertisement;*
- *Planning SA will hold a public meeting in the locality of the proposed development to provide information on the development, to explain the EIS document and processes, and to assist interested persons to make submissions under the Development Act, 1993;*
- *copies of any submissions received from the public and other relevant agencies will be given to the proponent closely following the cessation of the public consultation period; and*
- *the proponent must then prepare a "Response Document" covering the matters raised by the Minister, any prescribed or specified authority, body and the public.*

Following this the Minister will prepare an Assessment Report taking into account any submissions and the proponents' subsequent written response. Comments from any other authority or body may be considered at the Minister's discretion.

The Assessment Report and the Response Document will be made available to the public in accordance with the legislative requirements of the process.

The Governor must have regard to the following matters when arriving at a decision:

- provisions of the appropriate Development Plan and Regulations;
- the Building Rules, if relevant;
- the Planning Strategy;
- the EIS and Assessment Report;
- the *Environment Protection Act, 1993,* if relevant;
- the objects of the *River Murray Act, 2003* including any obligations under the Murray-Darling Basin Agreement; and
- the objects and objectives of the *Adelaide Dolphin Sanctuary Act, 2005,* if relevant.

The Governor can determine at any time, and prior to completion of the assessment process, that the proposal will not be granted authorisation. This would occur where it is clear the proposal is inappropriate or cannot be managed properly.

5. LAND USE IMPLICATIONS

5.1 Surrounding Land Uses

The Buckland Park site being 1,308 hectares shares borders with a number of properties. Consequently it has interrelationships with various land uses.

Of particular note are a number of key land uses:

- Horticulture – both open land, irrigated and within greenhouses;
- Viticulture – east of Port Wakefield Road adjoining Virginia township;
- Extractive industry – Cheetham salt crystallisation ponds to the west of the site;
- Organics waste treatment and demonstration farm – operated by Jeffries Garden Soils adjoining to the south of the site;
- State Shooting Park – located to the south east of the site;
- Plant nursery activities;
- Rural living, generally in association with a horticulture land use;
- The Gawler River and Buckland Park Lake to the north and west.

The site has frontage to Port Wakefield Road, a major freight route, and Virginia township lies to the east.

A site plan, showing its context is at Appendix 5.

The site's context introduces issues of noise, odour, stormwater control and traffic. These potential impacts have been considered in separate consultant reports. Both the impacts on the proposal, and the impacts associated with the proposal on adjoining activities have been assessed.

There is sufficient ability to manage the impacts of both existing and proposed land use by way of engineered responses, separation strategies, environmental compliance and planning controls.

6. STATUTORY PLANNING

6.1 South Australia's Strategic Plan 2007

Within the South Australian Strategic Plan, the Government of South Australia has presented its blue print for developing economic and community strength by establishing a direction for the next decade and beyond. The plan is based on six interrelated objectives:

(1) Growing prosperity
(2) Improving well being
(3) Attaining sustainability
(4) Fostering creativity & innovation
(5) Building communities
(6) Expanding opportunities

The plans, programs and budgets of all Government agencies will align with the Plan's key directions and strategies.

Key targets from the State Strategic Plan include:

- *Increase South Australia's population to 2 million by 2050, with an interim target of 1.64 million by 2014 (T1.22);*
- *Improve the quality of life of all South Australians through maintenance of a healthy work/life balance (T2.12);*
- *Increase environmental flows by 500 GL in the River Murray by 2009 as a first step towards improving sustainability in the Murray-Darling Basin, with a longer term target to reach 1500 GL by 2018 (T3.10)*
- *Achieve the Kyoto target by limiting the state's greenhouse gas emissions to 108% of 1990 levels during 2008-2012, as a first step towards reducing emissions by 60% (to 40% of 1990 levels) by 2050 (T3.5);*
- *Reduce South Australia's ecological footprint by 30% by 2050 (T3.7)*
- *Increase affordable home purchase and rental opportunities by 5 percentage points by 2014 (T6.7); and*
- *Halve the number of South Australians experiencing housing stress by 2014 (T6.8).*

Objective 1: Growing Prosperity, the proposal will generate both construction jobs and on-going employment in its service and maintenance areas, equating to directly and indirectly 2,229 FTEs of employment per annum over 25 years (*Hudson Howells – Economic Assessment October 2008*). This will contribute to achievement as the T1.10 Jobs, T1.11 Unemployment and T1.12 Employment Participation targets. This is particularly important in the northern suburbs, which historically have experienced high unemployment levels.

The proposal will contribute to economic growth and can be expected to involve investment of more than $4,287million over 25 years (*Hudson Howells – Economic Assessment October 2008*) in the construction of external infrastructure, internal infrastructure, housing and other elements. It will thus contribute to achieving the T1.1 Economic Growth and T1.5 Business Investment targets.

Most significantly, the proposal is likely to contribute to Adelaide's competitive business climate by assisting in keeping land costs and, housing costs down. This will be complemented by the inclusion of affordable housing and increase in competition with other projects in the northern Adelaide area. The proposal will therefore contribute to achieving the T1.2 Competitive Business Climate target.

By maintaining or improving Adelaide's attractiveness as a low cost centre, the proposal has an indirect potential to influence T1.23 Interstate Migration and T1.22 Total Population.

The Buckland Park proposal has the ability to deliver many of the outcomes sought under **Objective 3: Attaining Sustainability**. The proposed approach to energy conservation through correct design of housing, encouragement of solar panels for each dwelling and exceeding a five star energy rating for dwellings can contribute towards the achievement of the T3.12 Renewable Energy, T 3.14 Energy Efficiency - Dwellings and T3.7 Ecological Footprint targets and in doing so, contribute to the T3.5 Greenhouse Gas Emissions Reduction target. The use of alternate technologies, such as gas fired air conditioning will assist.

The proposal has the potential to create a biodiversity corridor along the Gawler River and provide a significant component in the link between the Gulf St Vincent and the upper reaches of the Gawler River and its tributaries, the North Para River and the South Para River. This could, in fact, represent one of the five biodiversity corridors sought under the T3.2 Land Biodiversity target.

Substantial positive impact upon native vegetation is possible through the protection of, and care for, the river red gum woodland along the Gawler River and the samphire shrubland in the south of the site (T3.1 and T3.2). Biodiversity benefits can flow from the use of indigenous plantings in the public domain, while a contribution to the reduction of our ecological footprint can be made through extension of the One Million Trees program to the site.

These areas will be rehabilitated and revegetated, as will new areas within the site.

Under **Objective 6 : Expanding Opportunity**, Buckland Park can make a meaningful contribution to the provision of affordable housing (T6.7) and, indirectly, contribute to the decline in the number of South Australians experiencing housing stress (T6.8). The proposal can achieve the 15% affordable housing component sought by the State Housing Plan.

6.2 Planning Strategy for Metropolitan Adelaide

In December 2007, the State Government released a revised Planning Strategy for Metropolitan Adelaide. The Planning Strategy provides a physical and policy framework for reaching the various targets outlined in the *South Australia's Strategic Plan* (2007). There are three volumes in the Planning Strategy. Buckland Park is within the Metropolitan Adelaide volume which:

- provides a framework for development based on principles of ecologically sustainable development and management of the Adelaide metropolitan area; and
- creates an environment of certainty for investors, state agencies, local government and the community by providing a clear indication of the State Government's policy directions for the physical development of the metropolitan area.

The Strategy includes an Urban Growth Boundary which seeks to :

- protect valuable agricultural production areas from urban development;
- facilitate the efficient provision and use of infrastructure and services inside the boundary;

- facilitate the clustering of activities;
- reduce the social disadvantage which can be caused through distance;
- reduce travel time and costs to and from employment;
- provide certainty to investors.

Buckland Park is outside the current UGB, however, the proposal is consistent with the intent of the Planning Strategy.

The Government has identified there will be a need for new suburbs outside the current UGB to accommodate part of Adelaide's growth over the next 30 years (Connor Holmes 2008). A Growth Investigation Areas project has been initiated to review of land supply and prepare a 25 year rolling supply of broadacre land. Buckland Park is one area under consideration.

Projected increases Adelaide's in population demonstrate the urgent need to resolve land supply, before scarcity begins to affect affordability.

The Urban Growth Boundary can only be considered a planning tool which must be regularly reviewed in response to Adelaide's changing demographics and economy.

Buckland Park specifically displays the following positive attributes and can be seen to achieve the intention of the Urban Growth Boundary:

- *it does not involve the conversion of "valuable" agricultural production areas, instead utilises land that has been identified as being of "lower value land" (VHC 2007);*
- *it will facilitate the provision and use of infrastructure and services to a new master planned community, in addition to which the adjacent towns of Virginia and Two Wells will benefit from improved infrastructure and new services;*
- *it will achieve a clustering of activities through an orderly and economic master planning approach;*
- *it will include strategies and resources to alleviate social disadvantage to the new community, whilst providing an indirect benefit for those already residing in the surrounding area by way of new services;*
- *significant employment precincts will be created within Buckland Park which will provide an estimated 10,687 jobs by 2036 (Connor Holmes 2008) and indirectly an additional 15,268 jobs (Hudson Howells 2008). It is expected that many of these job opportunities will be filled by residents from within Buckland Park;*
- *the master planned approach and coordinated release, construction and occupation of the proposal provides certainty to investors.*

The proposal will contribute to a range of environmental, development and community initiatives within the Planning Strategy, including:

Water Resources

Policy 1: efficient use of water
Policy 2: water sensitive urban design
Policy 3: integrate the management, protection and use of water resources
Policy 4: coordination of multi-objective management of stormwater
Policy 5: development of alternate water re-use schemes

Biodiversity

Policy 1:	integrate the protection of biodiversity and ecosystem processes into urban development
Policy 2:	increase the integrity and viability of areas of biological significance
Policy 3:	increase the viability of areas of biological significance by creating linkages between such areas

Open Space, Recreation and Sport

Policy 1:	create strategic open space
Policy 2:	ensure that biodiversity assets are protected
Policy 4:	provide a network of accessible recreation facilities

Land Use and Transport Integration

Policy 1:	integrate transport and land use planning decisions
Policy 3:	maximise accessibility to, and the use of, the public transport system
Policy 4:	encourage people of walk and cycle to destinations
Policy 9:	ensure integrated transport and land use supports quality of life outcomes

Energy Efficiency

Policy 1:	reduce energy requirements for transportation and buildings

Integrated Waste Management

Policy 1:	develop waste treatment and resource recovery facilities
Policy 3:	ensure urban design and buildings incorporate space, facilities, access and construction methods to manage waste

Coastal, Estuarine and Marine Environments

Policy 1:	maintain public access to the coast and waterways
Policy 2:	protect coastal, estuarine and marine habitats
Policy 3:	minimise the discharge of stormwater, pollution and nutrients to coastal and marine environments
Policy 4:	avoid, prevent or reduce coastal hazards such as flooding, erosion or acid sulphate soils
Policy 5:	minimise the adverse impacts of development on coastal, marine and estuarine environments

Education Facilities

Policy 1:	provide access to a range of education and care facilities
Policy 2:	locate education and care facilities so that access to them is equitable and convenient
Policy 4:	ensure education and care facilities and services demonstrate sustainable practice
Policy 5:	ensure education and care facilities and services are adaptable and responsive to changing needs and demoghraphics

Health and Community Services

Policy 1: create living environments with services and facilities to support healthy lifestyles and active communities

Policy 2: match location and delivery of health and community services and facilities with the needs of the community

Hazard Avoidance, Minimisation and Management

Policy 1: minimise risk of flood damage to persons and property

Policy 3: ensure development does not mobilise, and is protected from, acid sulphate soils

Activity Centres

Policy 2: support a range of activity centres that are complimentary and meet community needs

Policy 3: encourage an appropriate mix of uses to create multifunctional activity centres

Policy 4: actively encourage people to walk, cycle and use public transport to access activity centres

Policy 5: improve the transit focus of activity centres through greater integration with public transport facilities

Policy 7: encourage attractive, functional and vibrant activity centres

Residential Neighbourhoods and Housing

Policy 1: facilitate and support a variety of affordable housing development options

Policy 2: increase the diversity of activities within walking distance of housing

Policy 5: develop transit-focused neighbourhoods to provide opportunities for people to walk to public transport and other services and facilities

Policy 6: create safe, convenient and pleasant environments for walking, cycling and public transport use

Policy 9: provide a network of parks and recreation areas within neighbourhoods

Policy 10: design and develop neighbourhoods in an ecologically sustainable manner

Policy 11: integrate ecologically sensitive design principles into housing development

Policy 12: accommodate a range of facilities in neighbourhoods

Policy 13: facilitate and support a variety of affordable housing development options

Policy 14: encourage a broad distribution of social housing

Urban Design

Policy 1: enhance elements that contribute to the overall character of the metropolitan area

Policy 2: create well designed and inspiring urban environments and public spaces

Policy 3: promote the principles and practice of good urban design

Primary Industry

Policy 1: identify and protect areas of primary production significance

Policy 2: encourage the establishment of enterprises that value add to primary production

Policy 4: identify and plan for future viable and sustainable industry

Policy 6: manage the interface between primary industry and urban/rural areas

Employment and Business Focus Areas

Policy 1:	create a diverse range of business and employment opportunities
Policy 2	ensure the provision of an adequate supply of land for business and employment purposes
Policy 3:	promote the development of 'green' businesses

Commercial Uses

Policy 1: locate commercial uses in suitable areas in activity centres

The Planning Strategy aims to protect key areas of primary production, including the northern Adelaide plains (page 15, 2007).

Part of the area identified as an "area of strategic interest for primary production", affects a small portion of the site. This is illustrated at Appendix 8.

This component of the Planning Strategy must be considered within its overall context.

The part of the site considered of strategic interest for primary production is small, 177.6 hectares. This is not significant given the total size of the area of strategic interest.

VHC found that this area has limited value as agricultural land (2007).

The area is strategically important to the creation of Buckland Park, as it enjoys the best access to Port Wakefield Road, a major piece of transport infrastructure.

The exclusion of this area will effect the viability of the proposal which will contribute to the state's economic health (Hudson Howells 2008).

There need for viable new suburbs to serve Adelaide's economic and population growth in strategic locations.

It is appropriate to consider the best and most economic use for this land.

In this circumstance, it is considered the land of strategic interest is most appropriately used for urban purposes.

In summary, the most relevant provisions of the Planning Strategy to this proposal seek to:

- ensure there is an adequate and appropriate supply of land for residential purposes (with the Government initiating a "Growth Investigation Areas" project to identify broad acre land to provide a 25 year rolling supply for Adelaide);
- concentrate new housing into areas that have employment, infrastructure and services;
- achieve sustainability targets, particularly reducing our ecological footprint to reduce the impact of human settlements and activities;
- ensure proposals to change the economic use of land to housing include an assessment of the implications of that change on economic activity;
- prepare development strategies for surplus and under-used sites, including treatment of contamination, upgrading of physical infrastructure and community issues; and
- develop higher residential densities in strategic locations around centres and transport nodes and interchanges to provide housing choice and support public transport use.

Coupled with the current Planning Strategy direction is the Government's recently announced *Directions for Creating a New Plan for Greater Adelaide* representing the current and emerging thinking with respect to a vision for the future growth of Greater Adelaide. That document states there is a focus on creating:

- *a city which will undergo urban regeneration and revitalisation in many existing areas (while sensibly protecting valued heritage and character), with vibrant new higher-density neighbourhoods created in and near the CBD and along designated transit corridors to the west, north and south;*
- *a city that embraces well-planned fringe growth with new population centres closely connected to transport infrastructure and employment opportunities;*
- *a city that encourages the sustainable growth of near country towns and townships, while protecting our most valuable environmental, agricultural and tourism assets;*
- *a city that will see the provision of high speed mass transport linked to the growth in residential housing and jobs. The government will spend nearly $2billion over the next 10 years to modernise our public transport system.*

Revised population projections indicate that up to 600,000 additional people could be living in SA by 2036. The majority of this population growth is anticipated to occur in Greater metropolitan Adelaide. This represents a 40% increase on the existing population, presenting considerable growth management questions for the Government.

Consequently, high population growth and an ageing profile could create a demand for almost 250,000 additional dwellings in the Greater Adelaide area over the next three decades.

The Government has therefore committed to a Plan that incorporates the following:

- within the next 30 years Greater Adelaide can house 500,000 more people, nearly 250,000 new dwellings and 160,000 new jobs;
- new housing will move over time from a 50:50 split between existing suburbs and new suburbs, to a 70:30 split;
- well located and functioning Transit Oriented Developments;
- a 25 year supply of broadacre land identified, and a 15 supply of land zoned for urban use at all times.

The Buckland Park proposal is consistent with the intent of the Planning Strategy and can be viewed as being orderly and economic in this regard. Whilst outside of the current Urban Growth Boundary the proposal is within Metropolitan Adelaide. In addition to which it supports emerging Government policy, particularly the *Plan for Greater Adelaide*.

6.3 Development Plan

The site land is located within the Horticulture West Zone and the MOSS (Recreation) Zone of the Playford (City) Development Plan, authorised 7 August 2008.

Appendix 9 contains a plan showing the existing zoning applying to the site.

6.3.1 Horticulture West Zone

The key objectives for the Horticulture West Zone accommodate a broad range of horticultural activities, with residential occupation and other forms of urban development specifically discouraged.

The zone recognises the importance of the Northern Adelaide horticultural area in terms of economic benefit to the state. This is highlighted by Objectives 1-6, which are reproduced below in italics.

Objective 1: *Retention of land for horticultural purposes.*

The Northern Adelaide horticulture area provides significant economic benefit to the State and region. The location and seasonal advantages of the horticulture area including proximity to the produce markets, major transport routes, labour supply and extended growing periods are unique within the South Australian context. The Zone is also strategically located to take advantages created by the Adelaide to Darwin railway.

It is envisaged that, in association with packaging sheds and irrigated horticulture, there will be demand for modern greenhouses including hydroponics on allotments. Such developments are promoted within the Zone.

A threat to the long-term economic viability of the Zone is the conversion of horticultural land to residential/rural living activities. These activities are incompatible with horticulture production (eg due to noise, spray drift etc) and often raise the cost of production for those remaining in production.

Objective 2: *A zone characterised by open rural areas, market gardens, greenhouses, hydroponics, vineyards, orchards and pasture.*

Objective 3: *Education and extensive employment opportunities in horticulture and related industries.*

Objective 4: *Horticultural activities supported by horticultural related industrial and commercial activities such as packing sheds, cold storage facilities and small-scale processing facilities.*

Objective 5: *Intensive horticulture in appropriate locations supported by adequate infrastructure and environmental management techniques.*

Objective 6: *Horticultural activities that are protected from the encroachment of residential and rural living development.*

The zone objectives identify the rural character and scenic qualities of the area are to be preserve and enhanced, and ensuring that the flow of flood water from the Gawler River is not impeded or that the pattern of movement of flood waters are not changed (Objectives 8 and 9). The EIS considers the proposal's potential impacts on the hydrology of the locality.

The zone provides for value adding uses such as packaging sheds and whilst there may be a demand for irrigated horticulture, there could also be demand for modern greenhouses including hydroponic growing sheds.

The Development Plan considers the conversion of horticultural land to residential/rural living activities can pose a threat to the long-term economic viability of the Zone. These activities have the potential to be incompatible with horticulture production (eg due to noise, spray drift etc). The consequence of this can be the cost of production rises for those remaining in production. The impacts on existing horticulture production can be accounted for with new development providing adequate measures to alleviate potential impact. An assessment of the impact of the proposal on surrounding land uses has been undertaken with respect to the implications of noise, odour and spray drift as part of the EIS.

The objectives of the zone are supported by more detailed principles of development control. In addition to emphasising development should principally be for horticultural purposes, the principles also provide guidance in relation to the provision of physical infrastructure, vehicle access, impact management, stormwater and waste disposal, land division, water courses and flooding.

It is recognised the proposal is inconsistent with the intent of the Horticultural West Zone. However, it is important to appreciate that the site represents some 13% of the total area of land zoned for horticultural use within the City of Playford, and therefore the proposal will have a negligible impact on attainment of the Development Plan's key objectives.

Part of that area allows for industrial or employment opportunities where value adding enterprises aligned to the horticulture industry could be established.

The suitability of the site for horticultural purposes needs to be carefully considered, with the quality of the land for horticultural purposes being of lesser productive value on the western side the Port Wakefield Road.

Taking aside the issue of land use, the proposal is considered to have the propensity to achieve general compliance with most other provisions of the Horticultural West Zone, primarily the environmental and sustainability outcomes sought.

The proposal will not be fatal to the attainment of the overall intent of the zone. Importantly it should be recognised that the vast majority of the site currently is not used for horticultural production and is largely grazed.

Should the Buckland Park proposal be approved, it would be prudent for the subject land to be rezoned to provide a detailed and specific policy direction particularly in terms of land use, built form, sustainability and stormwater management. Appreciably the current zoning is not suitable to address such policy matters.

6.3.2 MOSS (Recreation) Zone

The northern portion of the site adjoining the Gawler River is affected by the MOSS (Recreation) Zone. This zone extends for 100m from the centreline of the Gawler River into the Buckland Park site for the entire length of Gawler River which forms the northern boundary.

The pertinent objectives of the zone as far as they are applicable to the proposal seek:

- the establishment of a regional open space network which is integrated and linked to adjoining areas;
- linear open space for a range of public and private activities;
- maintenance of stormwater capacity and flood mitigation measures for adjoining areas;
- provision for cycling and walking paths;
- protection of the Gawler River riparian zone;
- presentation and enhancement of the attributes of the Gawler River;
- provision of public access to and along the length of the Gawler River; and
- protection of the Gawler River 100-year ARI Flood Plain from development that may impede the flow of floodwaters.

This is highlighted by Objectives 1-5, 7-10 and 12-13 which are reproduced below.

Objective 1:	*Establishment of a regional open space network.*
Objective 2:	*A zone that provides a linear open space for a range of public and private activities, including passive and active recreational land uses in an open and natural landscaped setting as part of the Metropolitan Open Space System, within a well landscaped setting.*
Objective 3:	*Protection of items of Aboriginal and European heritage significance and areas of scientific, archaeological or cultural importance.*
Objective 4:	*The maintenance of stormwater capacity and flood mitigation measures for adjoining areas, and the protection of recharge of underground aquifers.*
Objective 5:	*Provision of cycle and walking paths within an integrated system of open spaces linking adjoining land uses.*
Objective 7:	*Protection of the Gawler River, Little Para River and Smith Creek riparian zones through the conservation and enhancement of existing locally indigenous vegetation and the creation of a wildlife corridor.*
Objective 8:	*Preservation and enhancement of the character, scenic beauty and amenity of the Gawler River, Little Para River, Smith Creek, Hills Face and coastline.*
Objective 9:	*Provision of public access to and along the length of the Gawler River, Little Para River, Smith Creek, Hills Face and coastline.*
Objective 10:	*Land kept free of buildings and structures along the Gawler River.*
Objective 12:	*The Gawler River 100-year Average Return Interval Flood Plain kept free of development which could impede the flow of floodwaters.* *Buildings, solid fences and increases in the level of land all have the potential to impede the flow of floodwaters or change the pattern of the movement of floodwaters. This in turn may increase the depth, velocity or spread to floodwaters in other parts of the floodplain, resulting in an increase in damage or inconvenience in that location.*
Objective 13:	*Development of the Gawler River Flood Plain which recognises varying degrees of flood hazard.*

The intent of the zone will be strengthen by the proposal. The area of land dedicated as MOSS is to be significantly increased with the inclusion of native woodland to the north adjoining the Gawler River, comprehensive flood mitigation works, creation of a linear reserve and wetland system to the south of the site all of which are linked and will be publicly accessible.

Rehabilitation works and new planting within the MOSS zone will incrementally improve its ecological quality and useability of the open space system.

The zone also contains principles of development control which underpin the achievement of the objectives. The proposal will be able to achieve the attainment of those principles so far as they may be applicable to the proposal.

6.3.3 Council Wide

Given the proposal is intended to facilitate the establishment of new urban areas, a significant number of provisions of the Development Plan are directly relevant to the proposal, with an equally significant number relevant in a contextual sense given the intended future use of the allotments to be created as part of the proposal.

Those provisions of the Development Plan considered relevant to an assessment of the proposal are as follows:

Form of Development

Objectives (Obj): 1, 2, 3, 5 and 6

Principles of Development Control (PDC): 1, 2, 3, 4, 5 and 8

The above provisions are considered relevant as they generally seek orderly and economic development, based on the proper distribution and segregation of land uses and the capability and servicing of land. The provisions also seek to ensure that development does not lead to a potential hazard in the event of a major flood. The proposal holds these provisions in high regard. The proposal is certainly orderly and economic. Its proximity to major employment lands, public transport interchanges, key activity centres, major health and education institutions is considered more favourable than a number of recently released residential growth areas.

Its scale, single entity control and Master Plan facilitates it orderly creation over 25 years.

Land Division

Obj: 7

PDC: 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18

These provisions seek to ensure that the allotments created are generally suitable for their intended use in terms of area and configuration. In addition, these provisions seek to ensure that land which is to be divided is appropriately serviced. Further policy direction is also provided to ensure potential flooding issues are addressed. The proposal can achieve compliance with these provisions.

Transportation (Movement of People and Goods)

Obj: 8, 9, 10, 11, 12, 14 and 15

PDC: 19, 20, 21, 24, 25, 26, 27 and 30

A compatible relationship between land uses and the transport system, and achieving an appropriate hierarchy of roads to ensure safe and efficient traffic flows is sought by these provisions. The provisions also seek to ensure that pedestrian, bicycle and bus routes are provided by new development. The assessment undertaken by Parsons Brinckerhoff (2008) with respect to traffic impact and road hierarchy has confirmed the proposal identified within the Master Plan can be delivered to meet best practice standards, and the provision of bus, pedestrian and bicycle links therefore satisfying the Development Plan.

Public Utilities

Obj: 16

Objective 16 states '*Economy in the provision of public services'.* This objective seeks to ensure that development occurs in appropriate locations where public services can be provided in an economic manner. The proponent will be responsible for facilitating planning for the orderly provision of new services and the necessary utilities required to service the needs of the proposal. The wider benefit of this is Virginia and its surrounding areas, which are currently greatly under serviced, will have access to a new level of infrastructure that would not ordinarily be provided. The proposal's scale facilitates the efficient delivery of infrastructure, which will serve a large population.

Land Use

It is appropriate to have regard to the provisions of the Development Plan which relate to the future intended use of the land. Given the proposal will establish an urban area a wide range of land uses will be needed to service the needs of the future resident population.

Residential Development

Obj: 17, 18, 19, 20, 21, 22 and 23

The Development Plan does not presently recognise the site as being a future residential opportunity, but focuses on regeneration and renewal opportunities that make efficient use of infrastructure. However the broad residential objectives do seek:

- sustainable residential environments;
- variety of housing forms and choice; and
- new residential development which is integrated and cohesive and where timely provision is made for services convenient to the population they serve.

The proposal will create sustainable residential environments, provide for a variety of housing forms and choice in line with changing demographics, and will form a completely integrated and cohesive development. This provision of the Development Plan is intended to defer creation of new estates, which are not contiguous with existing areas. In the case of Buckland Park, these provisions do not necessarily apply.

Land Division (Residential)

PDC 34-70

These principles are detailed design matters concerning neighbourhood planning, allotment and road layout, public open space, stormwater management and water quality management. The division of the site will accord with the trust of these provisions.

Centres and Shops

Obj: 24, 25, 26 and 27

PDC: 136, 137, 138, 139, 140, 141, 143 and 144

These provisions seek to ensure that shopping, administrative, cultural, community, entertainment, educational, religious and recreational facilities are located in integrated centres within a hierarchy based on function. Further, the policies outline desired design outcomes concerning management of interface issues, car parking provision, built form and signage. These elements will be incorporated into Buckland Park's future stages and neighbourhoods.

The design of these elements will be guided by the Master Plan to ensure a well planned community.

Community Facilities

Obj: 30, 31 and 32

The above objectives seek to ensure appropriate community facilities are provided to serve the community and that the provision of such facilities occurs in a timely manner, early in the development of the new communities. This includes the provision of public transport.

Buckland Park will deliver community facilities commensurate with the staging releases as detailed within Section 2.4. The proponent is acutely aware of the need to ensure the early provisions of community support and adequate facilities and has made commitments in this regard.

Rural Development

Obj: 44, 45, 46, and 47

PDC: 194

These provisions seek to ensure rural areas are retained for agricultural and pastoral purposes. These provisions however need to be applied based on an appraisal of the capability of the land for such purposes. The land in question has been identified as having a lower horticultural value than land to the east of Port Wakefield Road and agricultural land north of the Gawler River. A balanced approach needs to be taken in reviewing the appropriateness of new urban development, within Adelaide's Metropolitan area against the loss of lower quality productive land.

In this case, it is considered the most orderly and efficient use of the site most is for urban purposes, given its strategic context, and the value of the agricultural land it replaces.

Country Townships

Obj: 50 and 51

Objective 50 seeks to ensure that development of an urban character located outside of the metropolitan urban area, is contained within country townships. The proposal is consistent with the thrust of this objective as it will be self sufficient in terms of the provision of centres and services and its relationship to its natural environment.

Objective 51 seeks to ensure that there is minimal conflict between township uses and the adjacent horticulture zone. Given the site's scale, the proposal can be readily planned and designed in order to achieve this intent and to minimise impact on any adjacent horticultural activity. Investigations undertaken by Connell Wagner with regard to Environmental Noise and Air Quality have established the proposal and surrounding existing uses can co-exist.

Environmental

Catchment Water Management

Obj: 54-64

PDC: 222-234

These provisions seek to ensure that development does not impact upon surface and underground water resources and watercourse environs. Site planning and engineering design detail can effectively respond to these provisions. Investigations undertaken as part of the rigor of the EIS process have considered the potential impacts of surface and ground water and confirm that measures and practices can be implemented to mitigate the likely affects of the proposal.

Stormwater Management

PDC: 235-248

These provisions relate to the management and treatment of stormwater. Given the sensitivity of the potential for inundation or flooding from the Gawler River, stormwater management is of paramount importance. Engineering assessment undertaken by Wallbridge and Gilbert in response to the EIS Guidelines confirms a flood mitigation and stormwater strategy is available to control and manage the potential for inundation, with those findings being key elements driving the layout of the significant open space corridors within the Master Plan. Design detail typical of any major proposal will be provided as part of any future application process.

Conservation

Obj: 65, 70, 72 and 73

PDC: 257-258

The protection of attractive areas and native vegetation are key outcomes sought by these provisions. The proponent has recognised this and the proposal has been designed to take advantage of key natural features of the site particularly the Gawler River environment. Accordingly strategies which enhance sustainable environmental outcomes form part of the proposal.

Public Open Space

Obj: 79, 80, 81, 82 and 83

PDC: 291

These provisions generally seek the provision of adequate public parks and recreation areas. The proposal incorporates vast tracts of open space networks to provide amenity, pedestrian and bicycle linkages, water management and recreational opportunities for the future resident population. This land is to be incorporated in to the MOSS (Recreation) Zone.

Coastal Areas

Obj: 84, 85, 86, 89, 90, 91, 92, 93

PDC: 301, 302, 303, 304, 305, 306, 308, 310, 312, 316, 317, 321, 333, 334 and 335

The above provisions are applicable to coastal areas and in general seek to control development such that its affects on coastal areas are suitably minimised, and coastal processes do not impact on the proposal.

Many of the provisions relate directly to development proposed within coastal areas or coastal reserves and as such are not applicable to the proposal given its separation from the coast. It is noted that Buckland Park is located between 2km and 3km from the coast with the closest future residential area some 2.7km from the coast. The broader provisions which seek to mitigate the potential impact of stormwater (quantity and quality) or risk minimisation provisions such as protecting development from the effects of climate change and sea level rise are pertinent to the Buckland Park proposal.

The importance of the coastal area as an environmental asset has not been overlooked in the planning of Buckland Park. A comprehensive stormwater management strategy has been devised which seeks to capture, treat and re-use stormwater and minimise disposal to the coast. An aquatic ecology assessment has been prepared.

It is not envisaged that the proposal will impact on coastal processes or cause erosion, nor will it interfere with the environmentally important features of the coastal area.

The proposal has observed the need to incorporate into its design allowance for sea level rise due to land subsidence and climate change over the period to 2050. Beyond this date it is accepted the impacts of sea level rise are unpredictable. In doing so mean sea level, tidal levels, storm interaction and land subsidence have all been factored in to the design of the Buckland Park proposal. It is considered such a risk minimisation strategy will satisfy the relevant provisions of the Development Plan.

In summary it can be seen there are a significant number of Council wide provisions which can be applied to the Buckland Park proposal, which we are of the opinion the proponent can adequately satisfy. As part of the major development process the proponent intends to satisfy all design requirements placed on the proposal.

6.4 Development Plan Amendment

The site is located within the Horticulture West Zone and the MOSS (Recreation) Zone of the City of Playford Development Plan. The changes that would need to be made to the zoning affecting Buckland Park would entail:

- rezoning of the Horticulture West Zone so far as it applies to the subject land, to a combination of zones reflecting the intended use of the land as outlined in the Master Plan **(**found in Appendix 3) to provide consistent policy with zones of a similar nature located elsewhere within the City of Playford;
- inclusion of specific principles that would apply broadly to protect existing land uses from the potential impacts of the proposal, thereby strengthening the ability for coexistence with minimal adverse impact; and
- the creation of new policies for each of the zones depicted on the plan found in Appendix 10.

The proposed zoning plan found in Appendix 10 shows one approach to set out separate zones within the site area, for example Residential, Neighbourhood Centre, District Centre, Mixed Use and Employment zones similar to the existing provisions within the Development Plan and expansion of those base principles to reflect the nuances of the proposal and its context. An alternative approach could be to establish a Buckland Park Zone containing overarching provisions with a number of policy areas accounting for the various distinct land uses ie Residential, Centres, Industry/Employment etc.

The MOSS (Recreation) Zone will be retained in its entirety and will be extended to include substantial tracts of land within the proposal area.

The final outcome will be determined following appropriate investigations as part of the Development Plan Amendment process and would include elements drawn from the Better Development Plan Program.

It would be prudent in any rezoning exercise to extend the investigations to consider the appropriateness of adjoining land to Buckland Park, however that is a decision to be made by Council and the Government.

7. CONSISTENCY WITH LEGISLATION AND POLICIES

In arriving at a decision, the Governor must have regard to:

- provisions of the appropriate Development Plan and Regulations;
- if relevant, the Building Rules;
- The Planning Strategy;
- EIS and Assessment Report;
- if relevant, the *Environment Protection Act, 1993;*
- if relevant, the objects of the *River Murray Act, 2003* and any obligations;
- under the Murray-Darling Basin Agreement;
- if relevant, the objects and objectives of the *Adelaide Dolphin Sanctuary Act, 2005.*

While the Governor must have regard to those matters set out in Section 48(5), the Governor is not bound by the relevant provisions of the appropriate Development Plan or the Planning Strategy when making the decision.

If the Governor approves the Buckland Park proposal a Development Plan Amendment report for the site should be undertaken in order to create a framework that can properly control design, planning and construction of the proposal over 25 years.

7.1 Planning Strategy for Metropolitan Adelaide, 2007

The proposal represents an integrated approach to planning by establishing a new urban area, which in many respects will be self sufficient, but also will have good road linkages to regional facilities, employment and the CBD.

There is clear support for the proposal within the Planning Strategy particularly with respect to a raft of sustainability measures proposed. These sustainability measures include flood mitigation strategies, high levels of infrastructure and service self sufficiency and the adoption of Water Sensitive Urban Design (WSUD) principles.

The proposal delivers the additional benefits of relevance to the Planning Strategy, including:

- an opportunity to create a substantial supply of residential allotments within a self contained urban environment (as opposed to incremental expansion at the fringe of the Urban Growth Boundary), which will make a substantial contribution to meeting Adelaide's requirements for residential land over the next 30 years;
- the provision of a range of allotment types to assist in achieving housing diversity and affordability, which is essential to accommodate the changing nature of household formation and household demand;
- providing enhanced lifestyle choice within a unique masterplanned community; and
- the provision of land for essential community facilities to support the new urban area, including a 'District Centre', comprising educational facilities, recreational facilities and open space.

The only apparent inconsistencies of the proposal with the Planning Strategy relate to:

- concentration of population in an area not presently serviced by public transport. The proposal is planned to include business and employment opportunities and social facilities which reduce the need for travel. The proposal makes provision for public transport needs; and
- the need to augment infrastructure services to meet the requirements of the incoming population. The proposal will reduce some demand through sustainable energy and water strategies, however it should be recognised that 12,000 new allotments cannot be provided anywhere in the Metropolitan area without the need to augment infrastructure.

With the above in mind, the proposal will facilitate a critical mass that will give rise to a substantiated demand for public transport, improved community services and access to new infrastructure which the existing community of Virginia and its surrounds does not currently enjoy.

The site is included within portion of the "areas of strategic interest for primary production" as identified on Figure 1 Adelaide Metropolitan Spatial Framework, Figure 11 Employment and Business Focus Areas and Figure 12 Industry. However, as stated earlier in this report, the site falls within the primary production area identified within the *Development of Horticulture Industries on the Adelaide Plains – A Blueprint for 2030* as lower value and therefore lower priority with an emphasis toward the land being suited to hydroponic greenhouse production. The portion of the site of strategic interest is negligible in the context of the large part of northern Adelaide which is of strategic interest.

7.2 City of Playford Development Plan

The proposal achieves a high degree of consistency with the broader directions of the Development Plan, as it relates to the desirable attributes of urban development. However, it is at odds with the current land use intent prescribed for the locality by the Horticulture West Zone. Whilst this is the case, it is not considered to be fatal to the intent of the Development Plan, particularly given the discussion above.

The proposal is exceptional in its intended adoption of sustainability principles and exceeds the expectations of the Development Plan in these matters.

An amendment to the current Development Plan to create a specific policy framework to guide the future development of Buckland Park will be required.

7.3 Development Act, 1993 and Development Regulations, 2008

The proposal will not create any inconsistencies with the Development Act, 1993 or the Development Regulations, 2008. There are detailed processes and procedures that will be followed as part of the Major Development process. The legislation also provides for the next steps i.e. rezoning of the land to reflect the intended use.

7.4 Building Rules

The proposal as submitted seeks to include *development associated with the establishment and operation of a shopping centre of up to 8,000m^2 of gross leasable floor area and associated community uses, including any related ancillary development, including signage.* In addition the proposal also contemplates *development of a Display Village including any related ancillary development, including signage.*

Should the proposal be approved by the Governor any works requiring assessment against the Building Code of Australia will be reserved for subsequent consideration. Early indications suggest there will not be any matters which would not fully comply with the relevant Building legislative requirements.

If the Governor grants Development Authorisation, it would be anticipated a condition of approval stipulating no works may be undertaken on the site unless and until an authorised officer of Council or private certifier has issued the necessary consent(s). This will assist in ensuring safety (including fire safety) and stability of construction.

7.5 Environment Protection Act, 1993

The Buckland Park proposal comprises activities of environmental significance as stated in the *Environment Protection Act 1993* (EP Act).

The objects of the EP Act are:

- to promote principles of ecologically sustainable development;
- to ensure that all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment having regard to the principles of ecologically sustainable development, and to prevent, reduce, minimise and, where practicable, eliminate harm to the environment.

Furthermore, proper weight should be given to both long and short term economic, environmental, social and equity considerations in deciding all matters relating to environmental protection, restoration and enhancement. The EPA is required to undertake an assessment of risk of environmental harm and ensure that all aspects of environmental quality affected by pollution and waste are considered in decisions relating to the environment.

7.6 River Murray Act, 2003

The Buckland Park proposal embraces the Objects of the *River Murray Act 2003* and has a strong commitment to the principles of ecologically sustainable development. The proposal seeks to ensure the use, development and protection of the environment is managed in a way, and at a rate, that will enable people and communities to provide for their economic, social and physical well-being and for their health and safety.

7.7 Dolphin Sanctuary Act, 2005

The objects of this Act are:

(a) to protect the dolphin population of the Port Adelaide River estuary and Barker Inlet; and

(b) to protect the natural habitat of that population.

The proposed development of Buckland Park is separated by other land from the sensitive coastal environment. It is however a potential source of impact as a result of the introduction of a resident population and the elements that are associated with that i.e. stormwater run-off, pollution and human interaction.

Accordingly the objectives if the Dolphin Sanctuary Act 2005 have been considered in the masterplan approach taken by the proponent, including the manner with which stormwater and flood mitigation is to be managed such that it does not diminish but sustains the ecological processes, environmental values and productive capacity of the Port Adelaide River estuary and Barker Inlet.

8. CONCLUSION AND RECOMMENDATION

The proposal seeks to create an entirely masterplanned, sustainable urban area at Buckland Park.

Detailed investigation on the range of matters identified in the EIS guidelines has been prepared by the proponent and the findings of those investigations support the creation of the urban area.

Community development, retail, trade and commercial facilities, employment, infrastructure provision, road network and transport planning, public transport, ecological and environmental management, stormwater management, affordable housing, open space design, land use controls and interface issues can be adequately addressed as evidenced by relevant specialists, the findings of which form separate reports to the EIS.

Buckland Park compared to other areas is very well placed being within the current metropolitan Adelaide boundary, it is in close proximity to the greater proportion of economic growth areas of Adelaide and therefore significant employment nodes (including key industry, Defence and technology sites), it is in close proximity to rail interchange facilities at Salisbury and Elizabeth, tertiary education and major medical services. We are of the opinion Buckland Park is better positioned than the majority of comparable growth areas (that are quite isolated) identified in Section 3.4, even those within metropolitan Adelaide, often by a considerable margin.

These issues are, however, representative of those routinely investigated during urban management processes currently applied to urban fringe expansion and large scale land division, for example, at Playford North / Blakeview, at Seaford Meadows and at Mt Barker.

Sections 6 and 7 assessed the proposal against the provisions of the Playford Development Plan, Planning Strategy and South Australia's Strategic Plan and comments with respect to consistency between the proposal and the various Plans. It was found Buckland Park will be generally consistent with a wide range of over-arching policies and provisions seeking high quality, sustainable development outcomes. Nonetheless, the proposal is at odds with the specific content of the Horticulture West Zone, but not fatal to the overall intent of the Development Plan.

It is not anticipated environmental impacts will arise from the proposal that cannot be limited or mitigated with the application of the best available design and implementation techniques. In particular the impacts of noise, odour and spray drift have been fully assessed with neither the existing land uses in the area or those proposed as part of the development likely to be affected.

The achievement of sustainability goals and the management of environmental, social and economic effects will be facilitated by the ongoing involvement of the proponent in all phases of the Buckland Park proposal's planning and implementation. The Master Plan will guide detailed 'stage' planning incorporating the preparation of implementation strategies and programmes for each such stage.

The proponent will prepare Design Guidelines for future dwellings and buildings. It is intended that some of the key facilities will be built by the proponent to ensure the timely delivery of such facilities to early residents, for example, the initial Neighbourhood Centre and community services building. They will also be responsible for managing the construction of civil and landscaping works.

9. REFERENCES

Connor Holmes *Demographic Analysis* 2008

SA Government *South Australia's Strategic Plan*

SA Government *Planning Strategy for Metropolitan Adelaide* December 2007

Parsons Brinkerhoff Buckland Park *Traffic and Transport* 2008

Minister Holloway – *Press Release* November 2008

Virginia Horticultural Centre (VHC) *Development of Horticulture Industries on the Adelaide Plains – A Blueprint for 2030*, 2007

Hudson Howells, *Buckland Park Economic Assessment*, December 2008

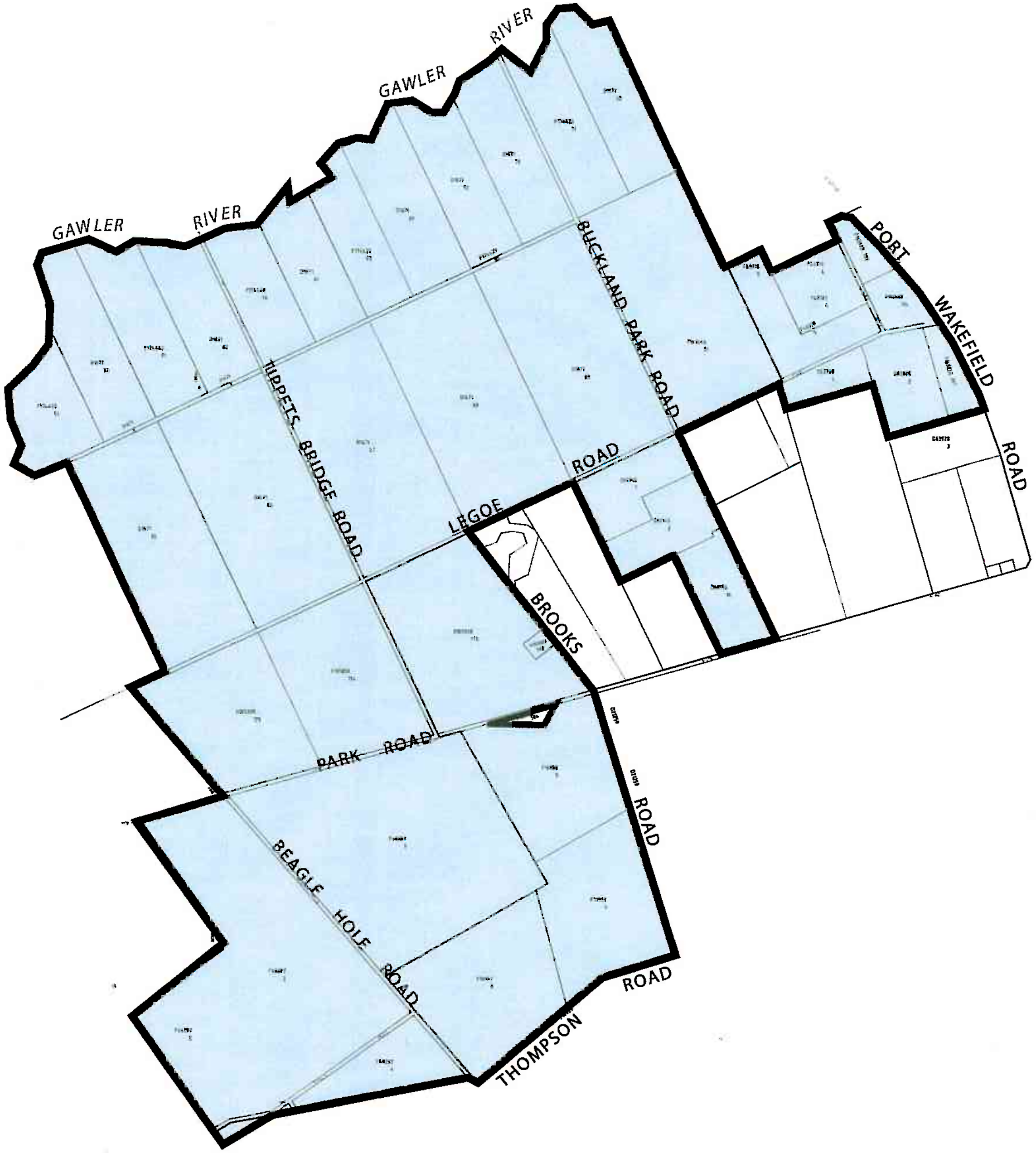
Parsons Brinckerhoff – *Sustainability and Climate Change Assessment Report 2008*

Statutes Amendment Affordable Housing Act 2007

Connor Holmes *Land Supply and Demand Analysis* 2008

APPENDIX 1

MAJOR DEVELOPMENT DECLARATION AREA PLAN



Major Development Declaration Area

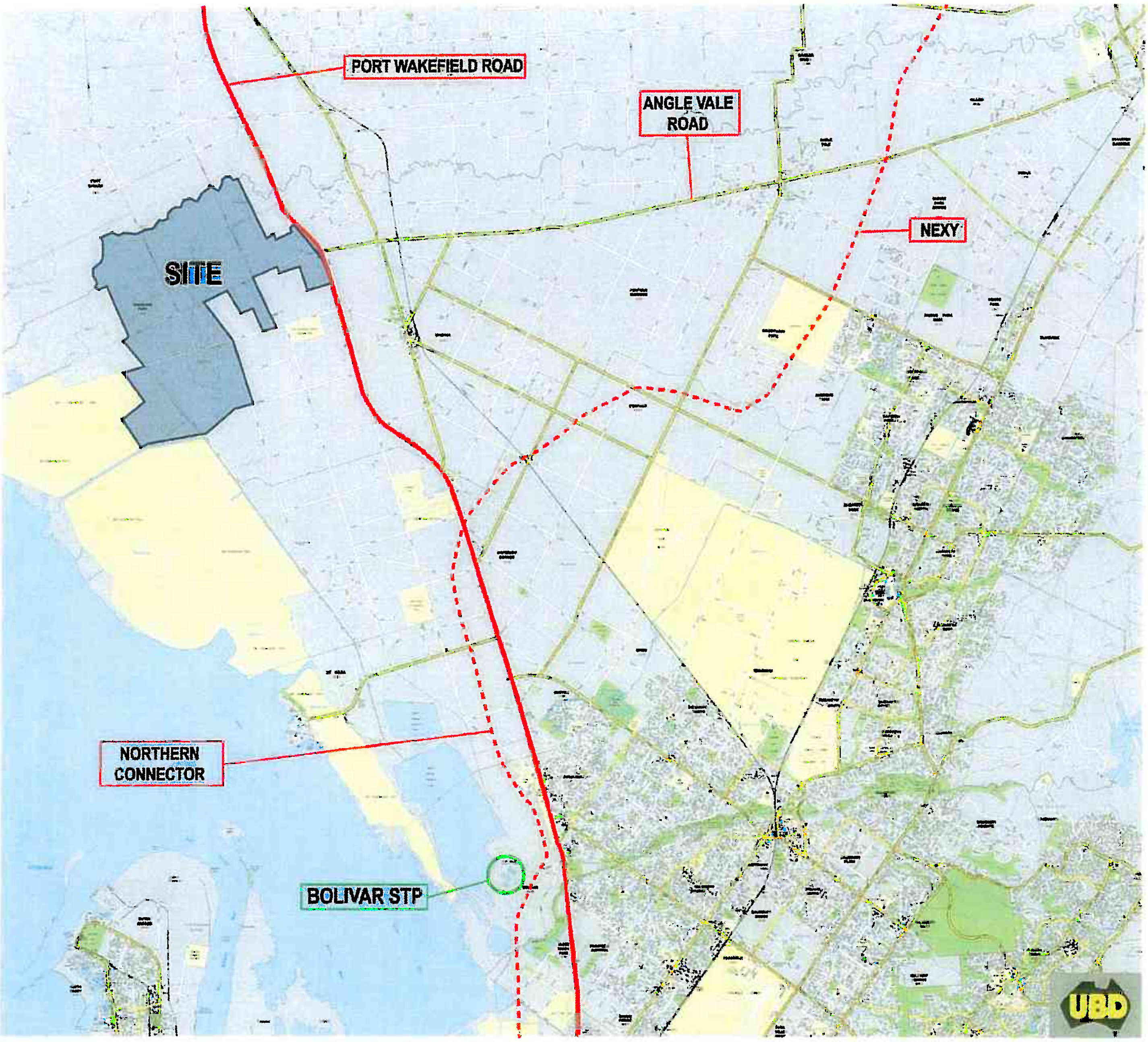
KEY

Current Major Declaration Area - gazetted 12 June 2008

November 2008

APPENDIX 2

LOCALITY PLAN



Walker

BUCKLAND PARK

OCTOBER 2008

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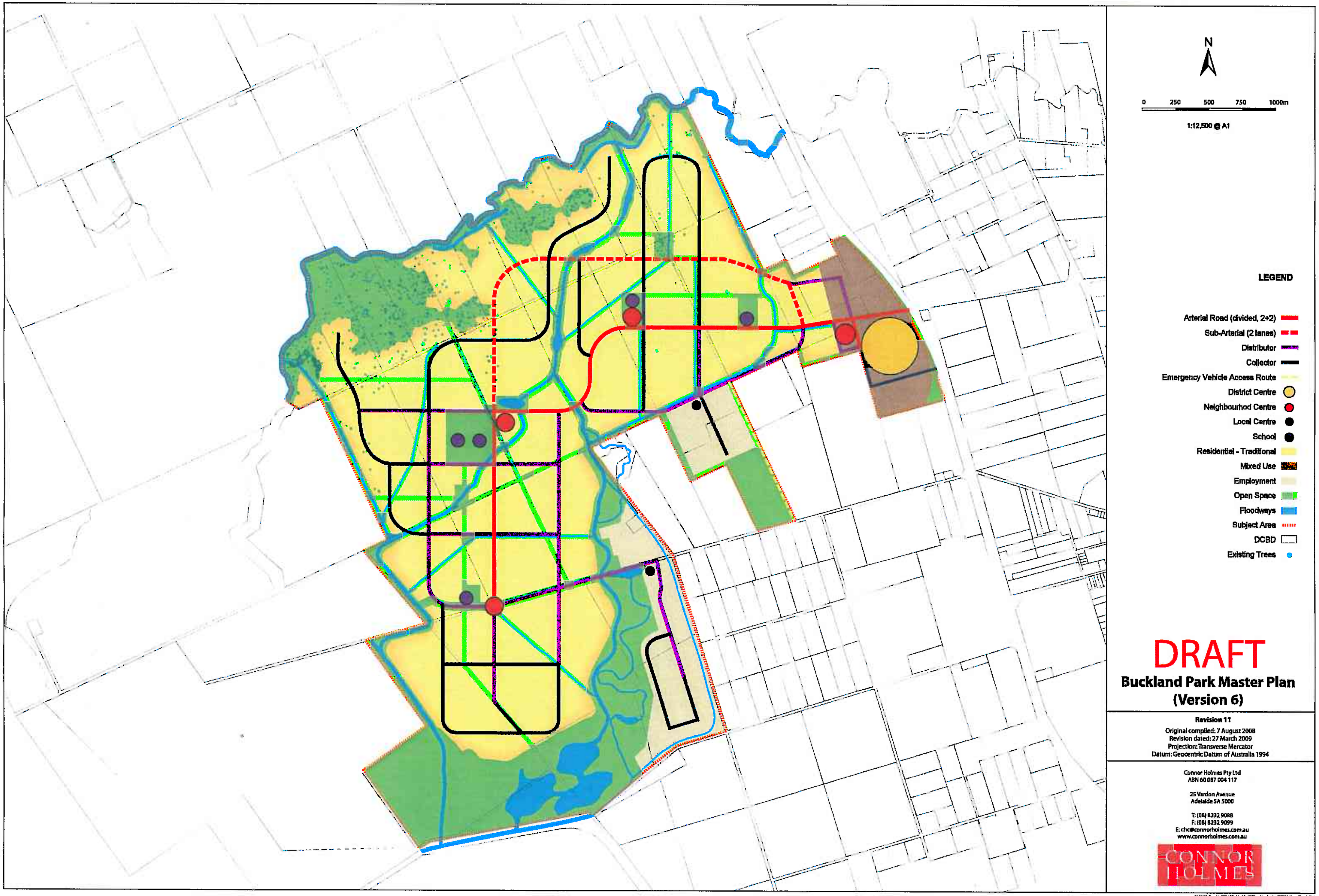
APPENDIX 3

MASTER PLAN


N
0 250 500 750 1000m
1:12,500 @ A1
LEGEND
Arterial Road (divided, 2+2)
Sub-Arterial (2 lanes)
Distributor
Collector
Emergency Vehicle Access Route
District Centre
Neighbourhod Centre
Local Centre
School
Residential - Traditional
Mixed Use
Employment
Open Space
Floodways
Subject Area
DCBD
Existing Trees
DRAFT
Buckland Park Master Plan
(Version 6)
Revision 11
Original compiled: 7 August 2008
Revision dated: 27 March 2009
Projection: Transverse Mercator
Datum: Geocentric Datum of Australia 1994
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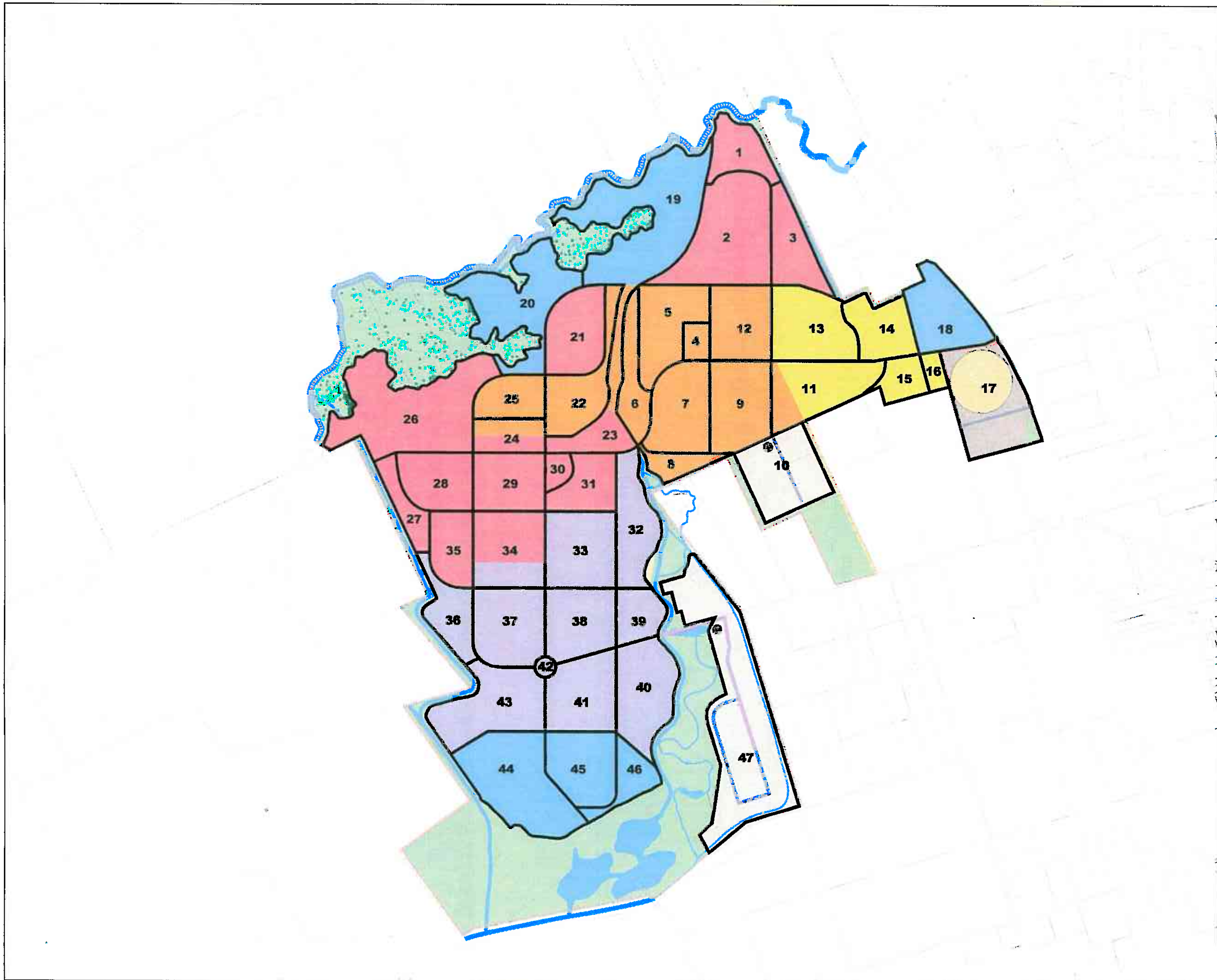
APPENDIX 4

STAGING PLAN



LEGEND

Staging

- 2010 - 2016
- 2017 - 2021
- 2022 - 2026
- 2027 - 2031
- 2032 - 2036
- Precinct Boundary
- Non Residential Precincts

DRAFT

Buckland Park Residential Staging

Revision 11

Original compiled: 7 August 2008
Revision dated: 27 March 2009
Projection: Transverse Mercator
Datum: Geocentric Datum of Australia 1994

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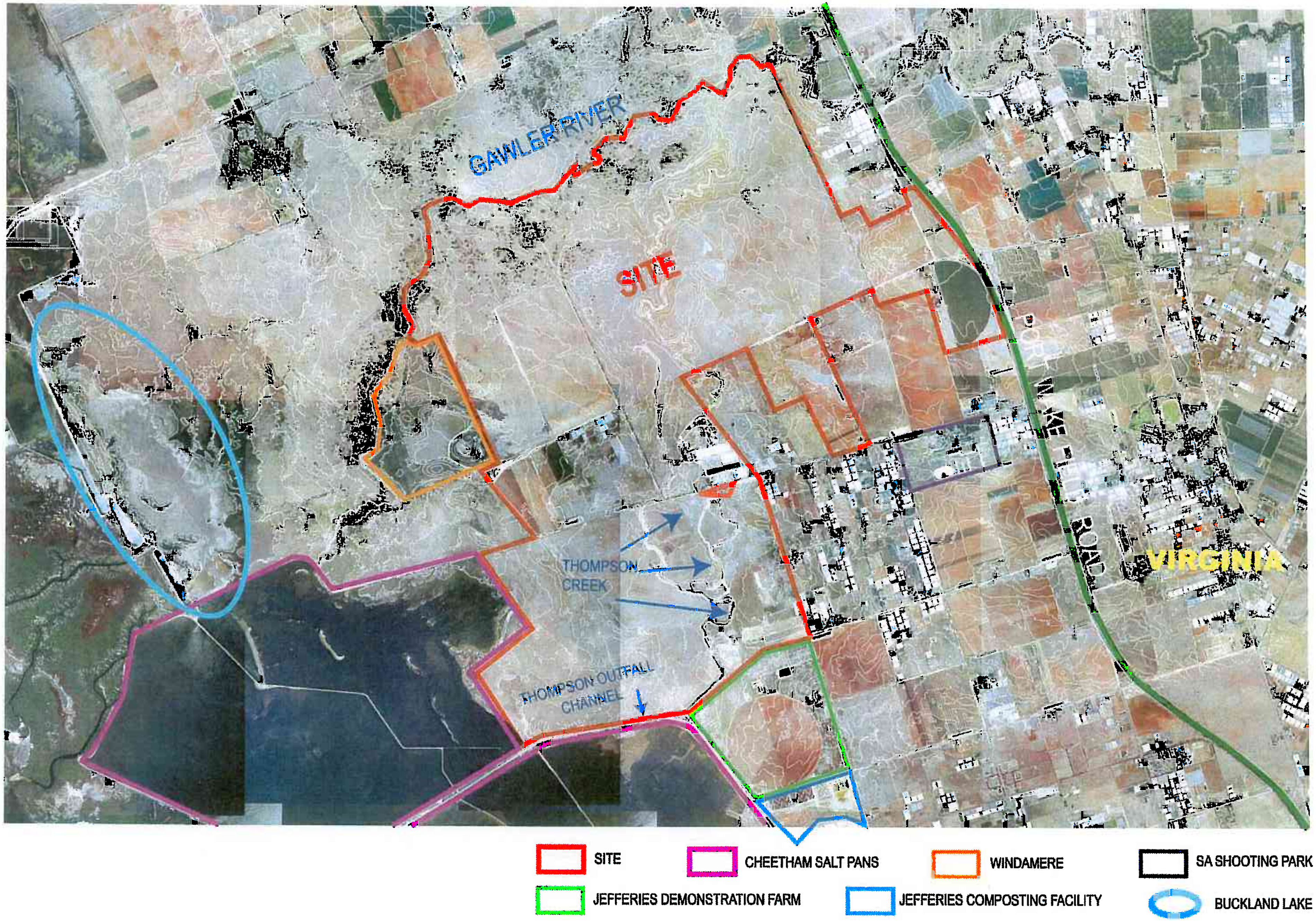
APPENDIX 5

SITE PLAN


GAWLER RIVER
SITE
PORT WAKEFIELD ROAD
VIRGINIA
THOMPSON CREEK
THOMPSON OUTFALL CHANNEL
SITE
CHEETHAM SALT PANS
WINDAMERE
SA SHOOTING PARK
JEFFERIES DEMONSTRATION FARM
JEFFERIES COMPOSTING FACILITY
BUCKLAND LAKE

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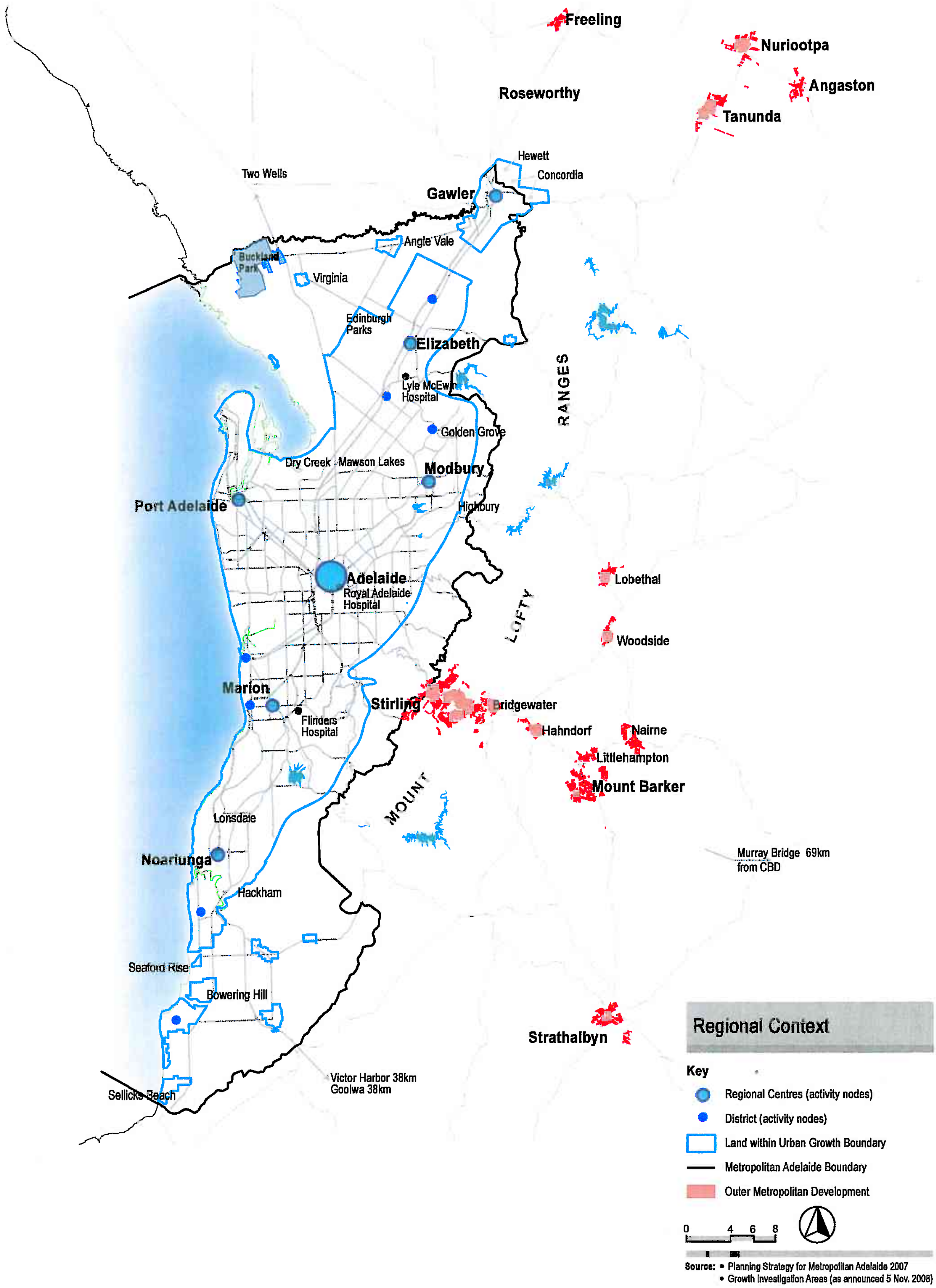
APPENDIX 6

REGIONAL CONTEXT PLAN


Freeling
Nuriootpa
Angaston
Roseworthy
Tanunda
Hewett
Concordia
Two Wells
Gawler
Angle Vale
Buckland Park
Virginia
Edinburgh Parks
Elizabeth
Lyle McEwin Hospital
RANGES
Golden Grove
Dry Creek
Mawson Lakes
Modbury
Port Adelaide
Highbury
Adelaide
Royal Adelaide Hospital
Lobethal
LOFTY
Woodside
Marion
Stirling
Bridgewater
Flinders Hospital
Hahndorf
Nairne
Littlehampton
Mount Barker
MOUNT
Lonsdale
Murray Bridge 69km from CBD
Noarlunga
Hackham
Seaford Rise
Bowering Hill
Strathalbyn
Regional Context
Key
Regional Centres (activity nodes)
District (activity nodes)
Land within Urban Growth Boundary
Metropolitan Adelaide Boundary
Outer Metropolitan Development
Victor Harbor 38km
Goolwa 38km
Sellicks Beach
0 4 6 8
Source: • Planning Strategy for Metropolitan Adelaide 2007
• Growth Investigation Areas (as announced 5 Nov. 2008)

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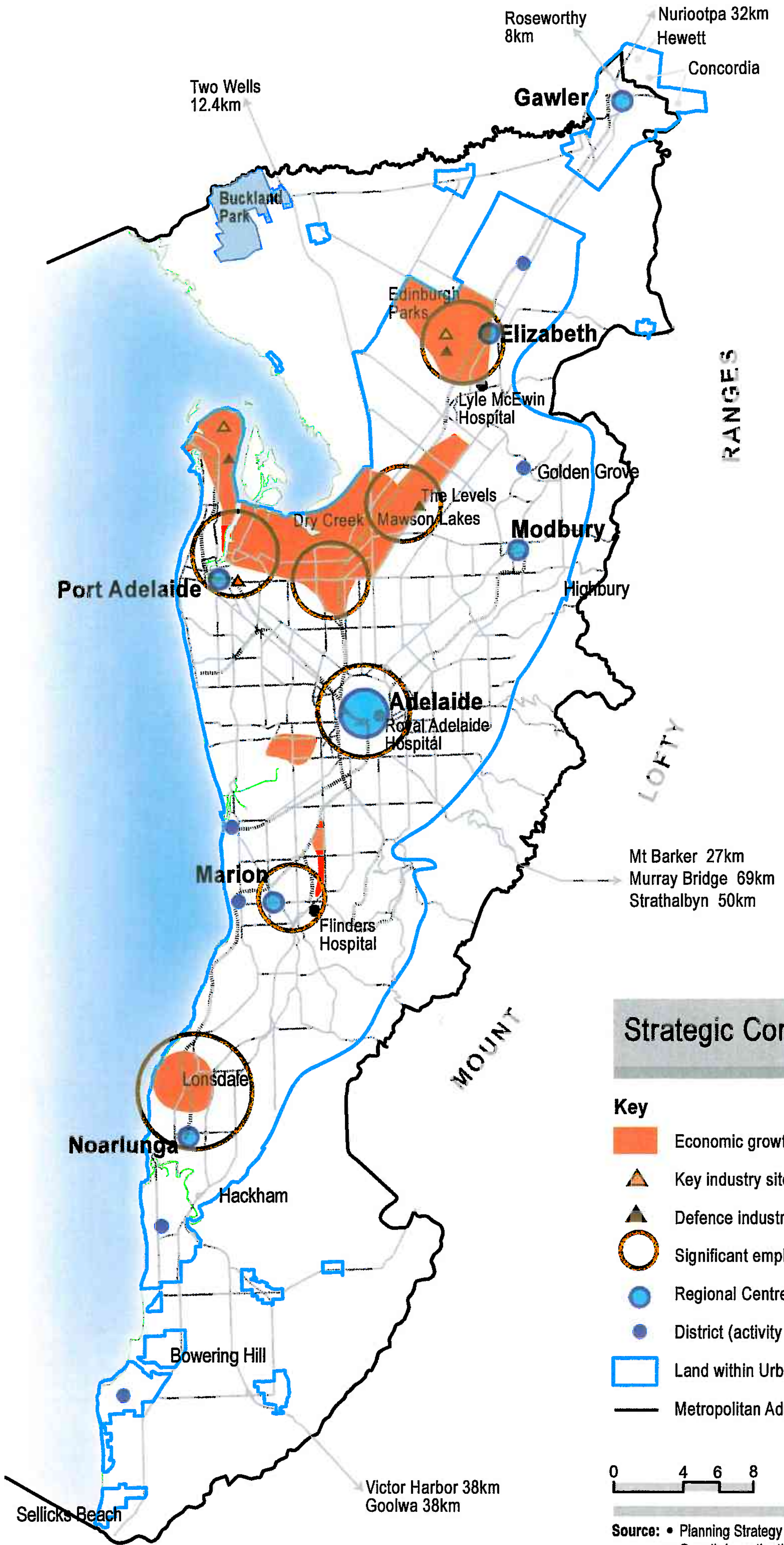
APPENDIX 7

STRATEGIC CONTEXT PLAN



Strategic Context

Key

- Economic growth areas
- Key industry sites
- Defence industry and technology
- Significant employment nodes
- Regional Centres (activity nodes)
- District (activity nodes)
- Land within Urban Growth Boundary
- Metropolitan Adelaide Boundary

Source:
- Planning Strategy for Metropolitan Adelaide 2007
- Growth Investigation Areas (as announced 5 Nov. 2008)

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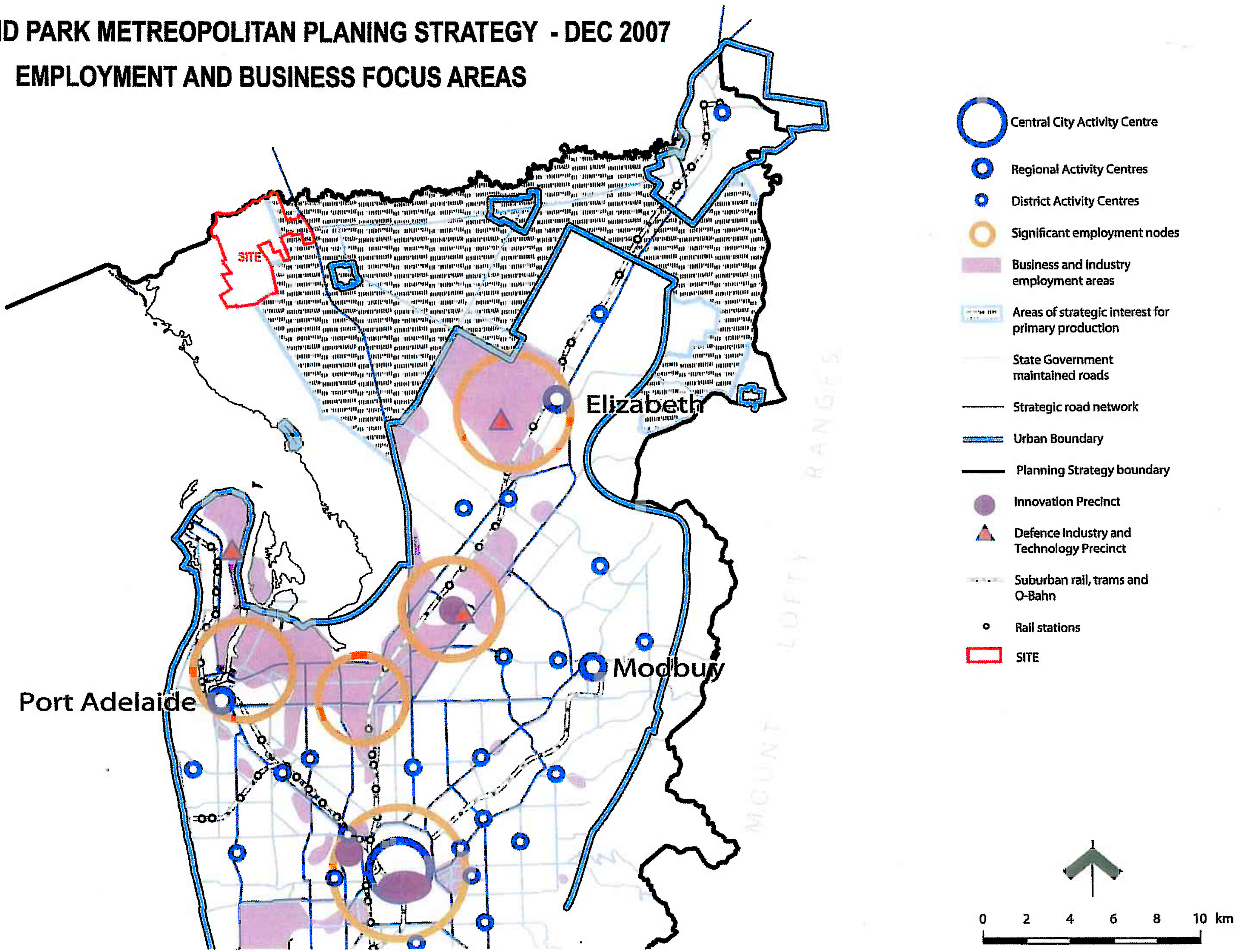
APPENDIX 8

PLANNING STRATEGY – EMPLOYMENT & BUSINESS FOCUS AREAS PLAN

BUCKLAND PARK METREOPOLITAN PLANING STRATEGY - DEC 2007

MAP 11 EMPLOYMENT AND BUSINESS FOCUS AREAS



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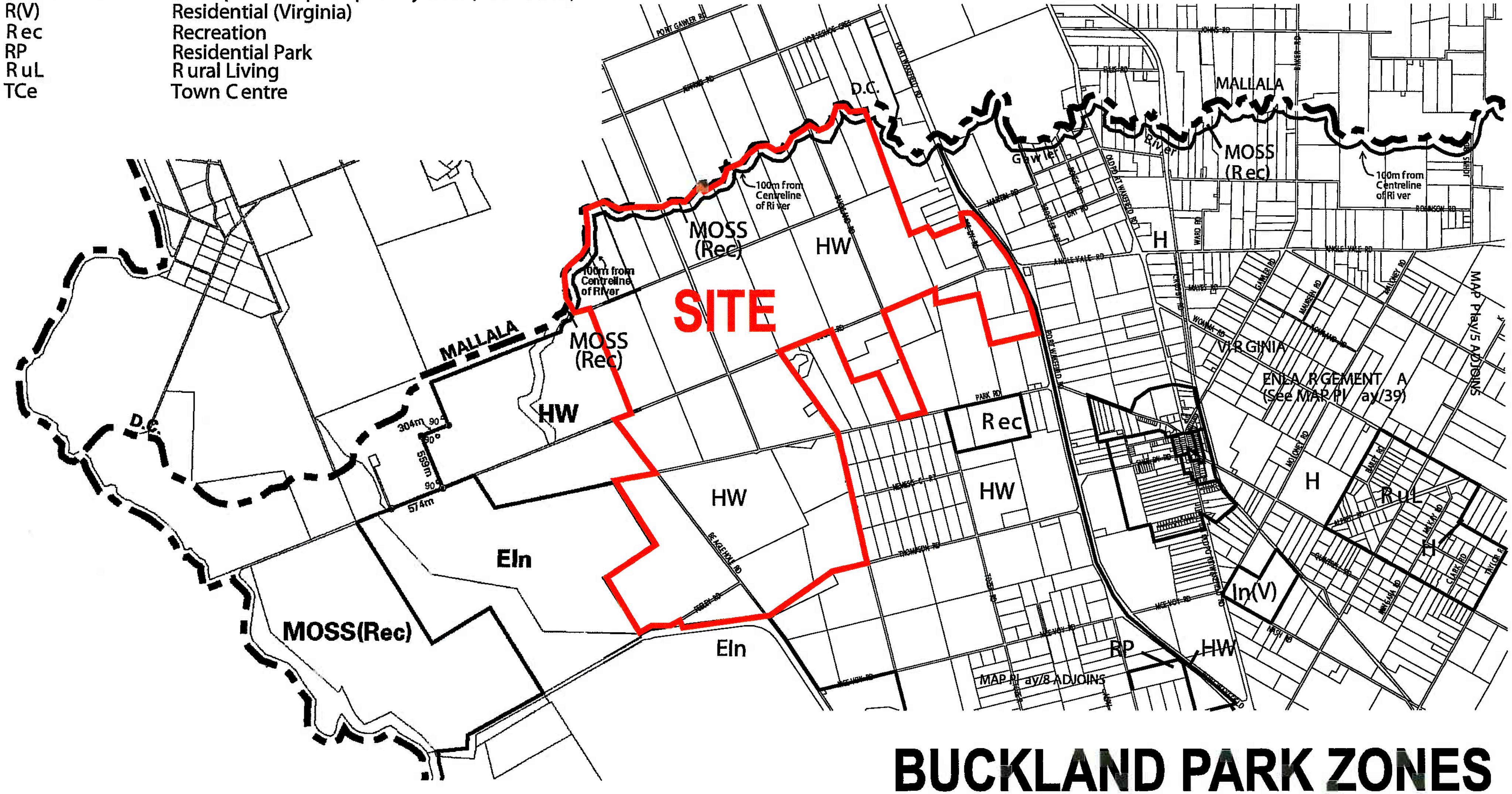
APPENDIX 9

EXISTING ZONES PLAN

C(V)	Commercial (Virginia)
EIn	Extractive Industry
F(V)	Flood Plain (Virginia)
H	Horticulture
HW	Horticulture West
In(V)	Industry (Virginia)
MOSS(Rec)	Metropolitan Open Space System (Recreation)
R(V)	Residential (Virginia)
Rec	Recreation
RP	Residential Park
RuL	Rural Living
TCe	Town Centre



BUCKLAND PARK ZONES

Zone Boundary
Development Plan Boundary

0 2km
Scale 1:50000

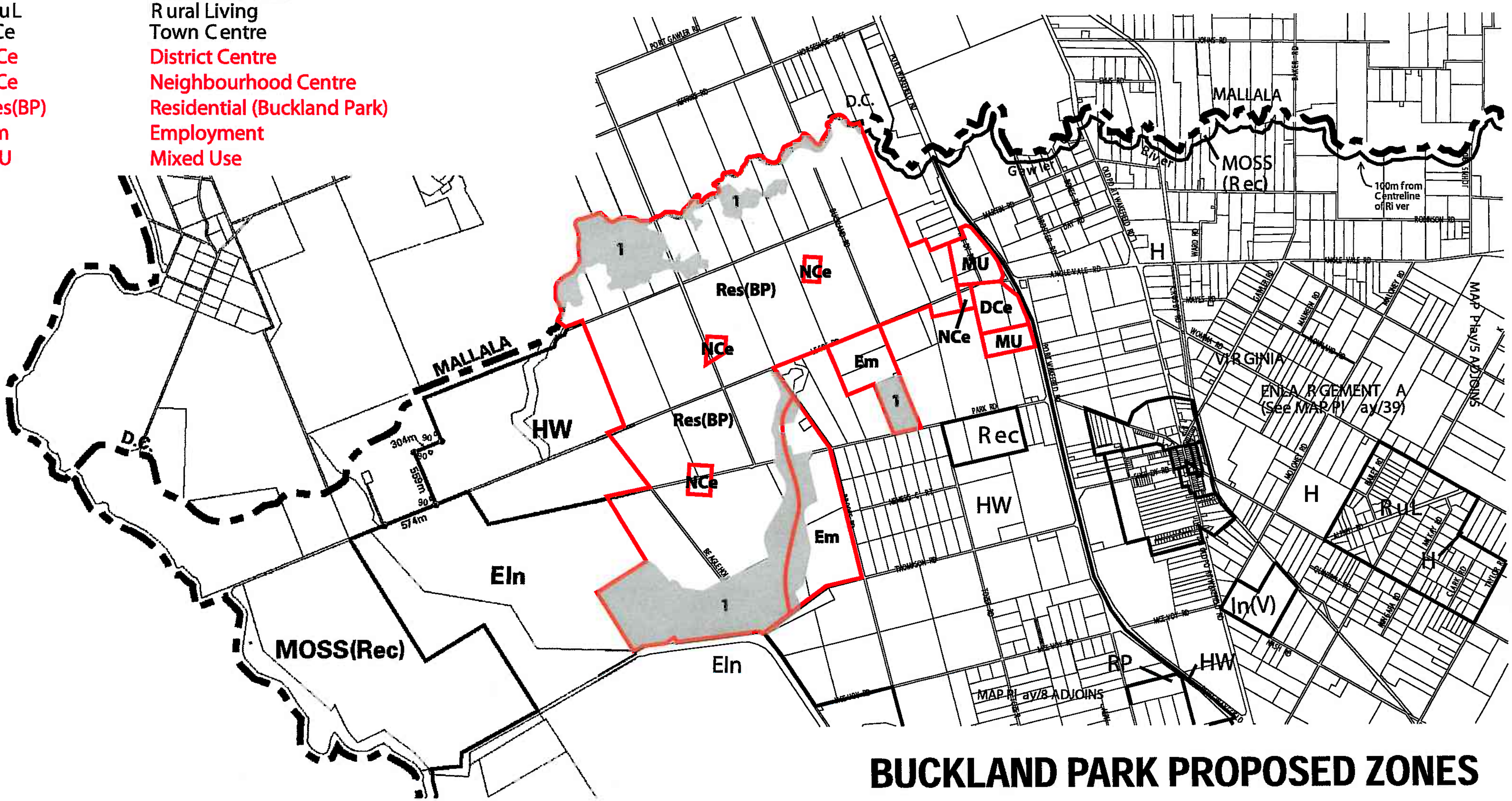
APPENDIX 10

PROPOSED ZONES PLAN

C(V)	Commercial (Virginia)
EIn	Extractive Industry
F(V)	Flood Plain (Virginia)
H	Horticulture
HW	Horticulture West
In(V)	Industry (Virginia)
MOSS(Rec)	Metropolitan Open Space System (Recreation)
R(V)	Residential (Virginia)
Rec	Recreation
RP	Residential Park
RuL	Rural Living
TCe	Town Centre
DCe	District Centre
NCe	Neighbourhood Centre
Res(BP)	Residential (Buckland Park)
Em	Employment
MU	Mixed Use

Policy Area

1 Open Space / Recreation Policy Area



BUCKLAND PARK PROPOSED ZONES

Zone Boundary

Development Plan Boundary

0 2km

Scale 1:50000

CONNOR HOLMES

BUCKLAND PARK URBAN AREA

LAND SUPPLY AND DEMAND ANALYSIS

Prepared for
WALKER CORPORATION & DAYCORP

March 2009

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1. INTRODUCTION

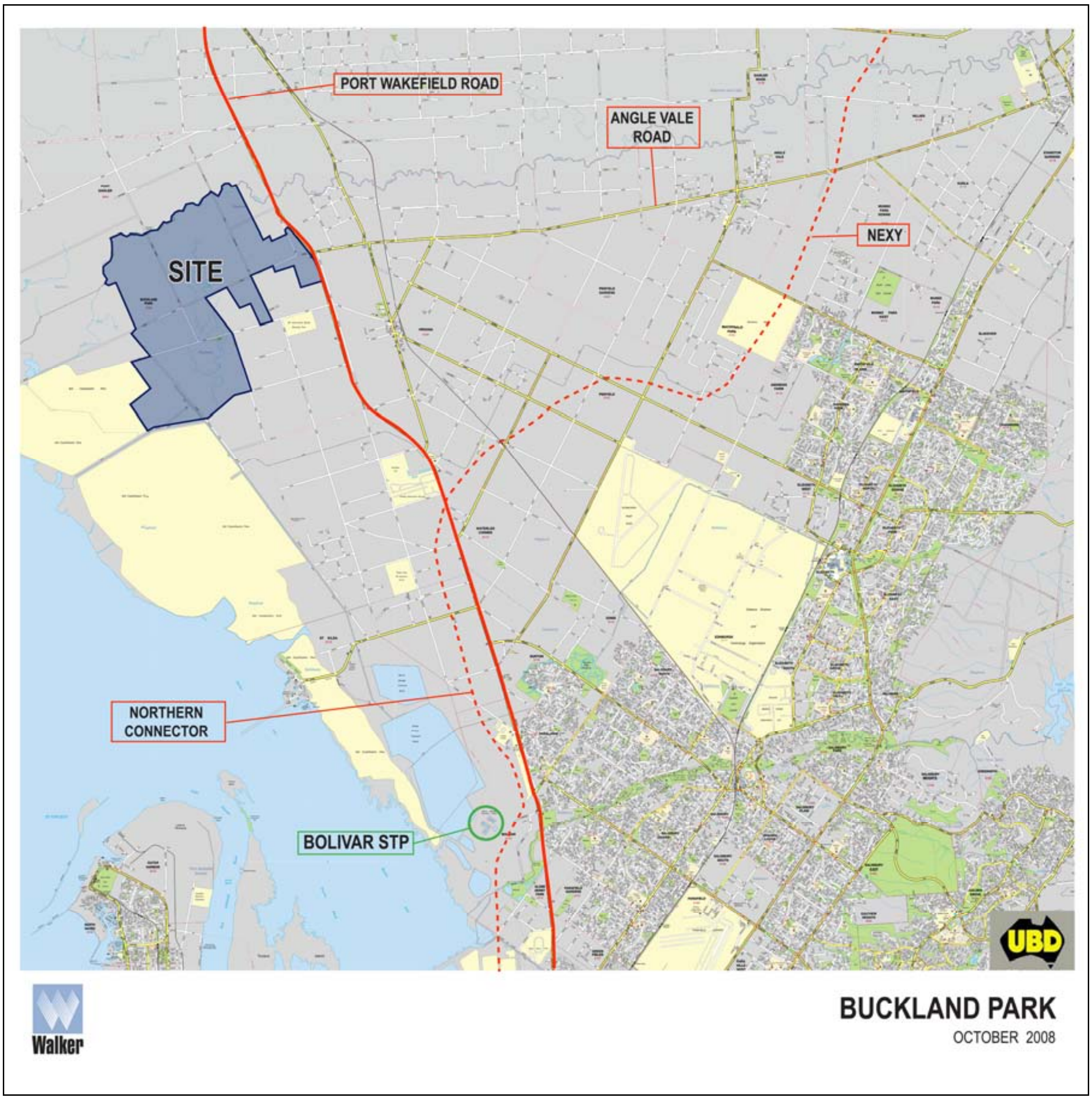
1.1 The Site

This report considers the demand for housing in Adelaide, and the way Buckland Park will supply that housing.

The proposal is a joint venture of Walker Corporation and Daycorp.

Buckland Park is located on Port Wakefield Road within the City of Playford, west of Virginia. It is around 32 kilometres north of the Adelaide CBD and 14 kilometres west of Elizabeth.

Figure 1.1: Buckland Park Locality Map



Buckland Park is located within Metropolitan Adelaide's northern region, as defined in the Planning Strategy (SA Government 2007).

Figure 1.2: Buckland Park in Metropolitan Adelaide

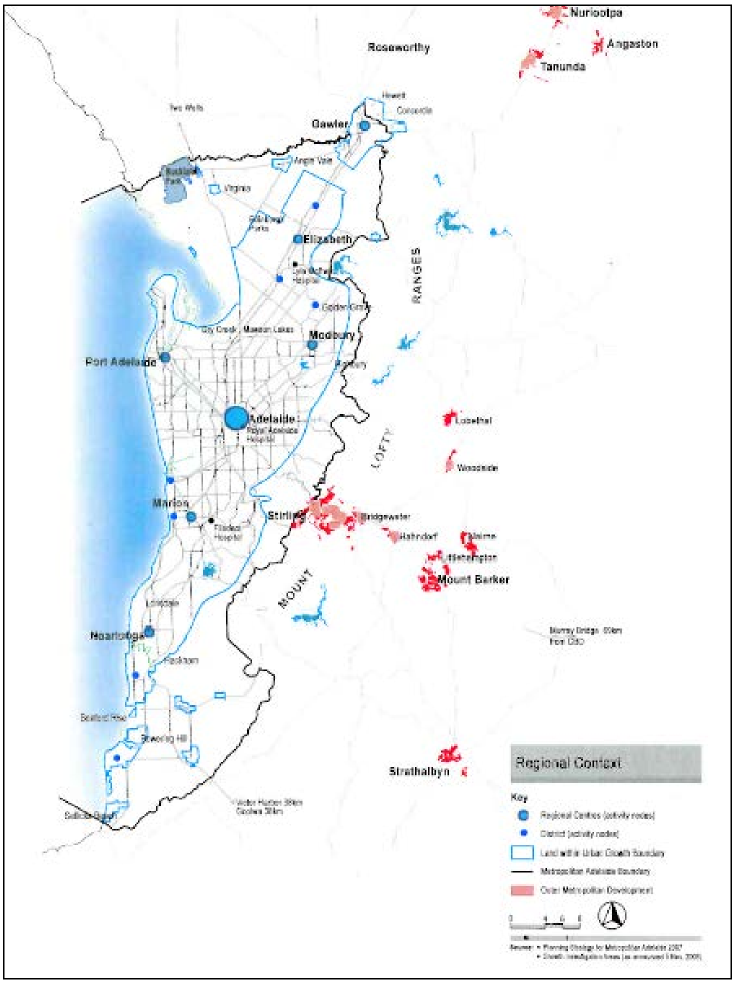
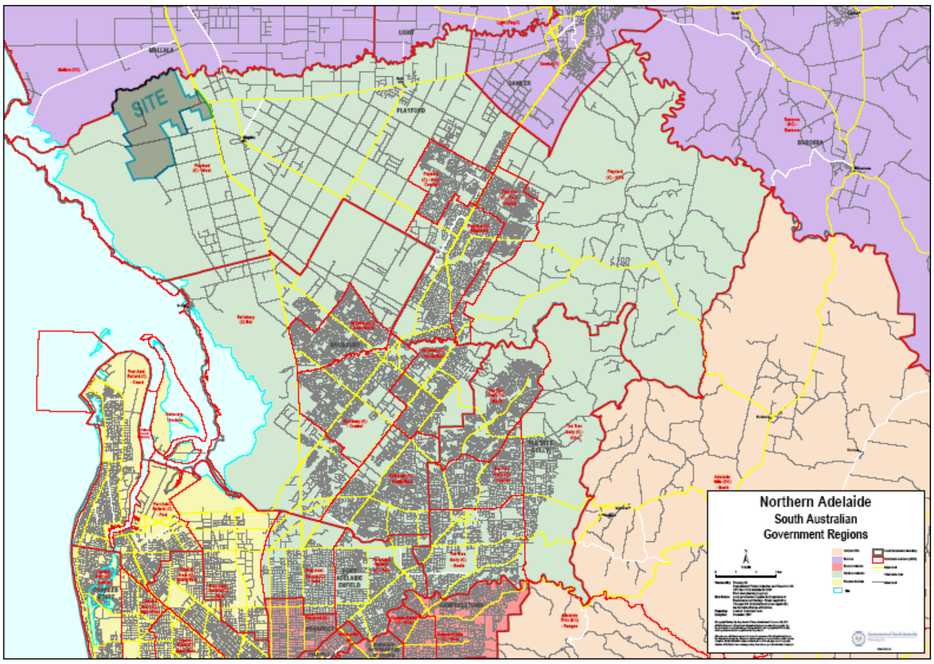
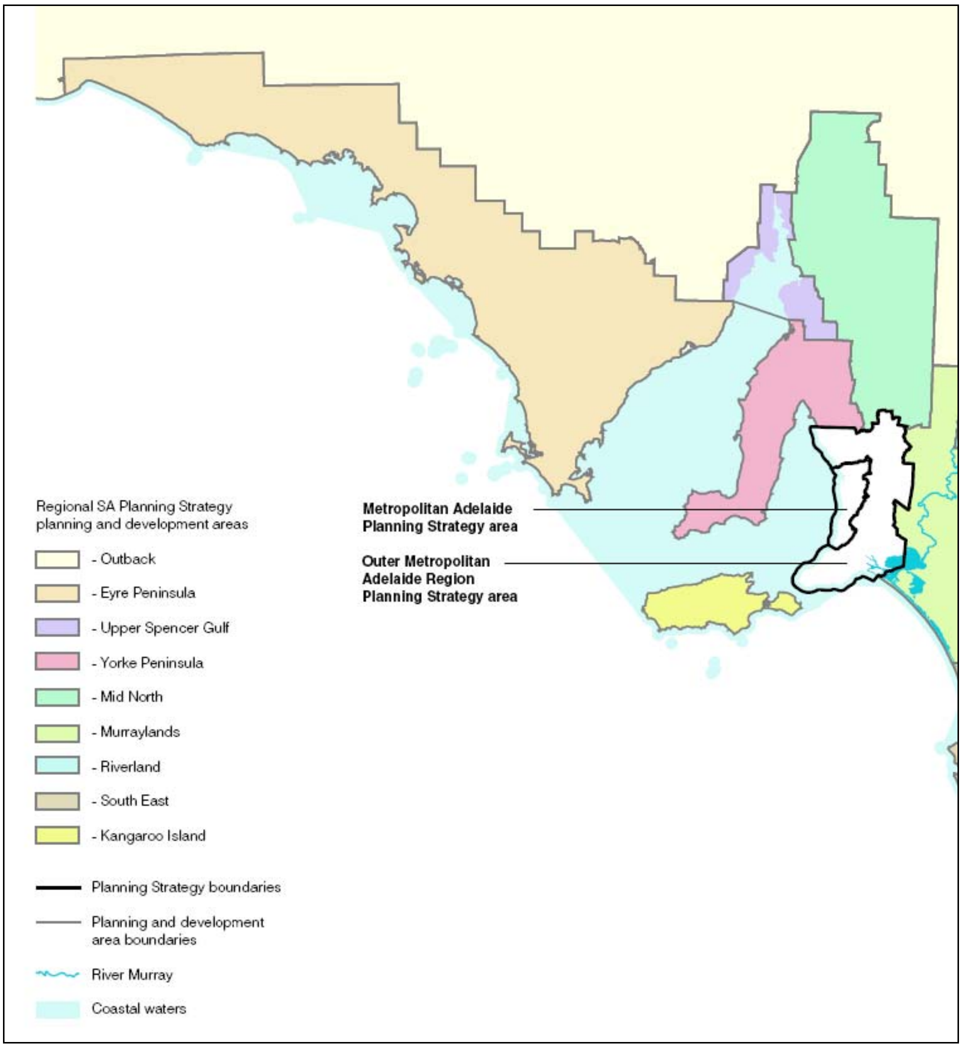


Figure 1.3: Buckland Park in Metropolitan Adelaide's Northern Region



Greater Metropolitan Adelaide includes Metropolitan Adelaide, and Outer Metropolitan Adelaide.

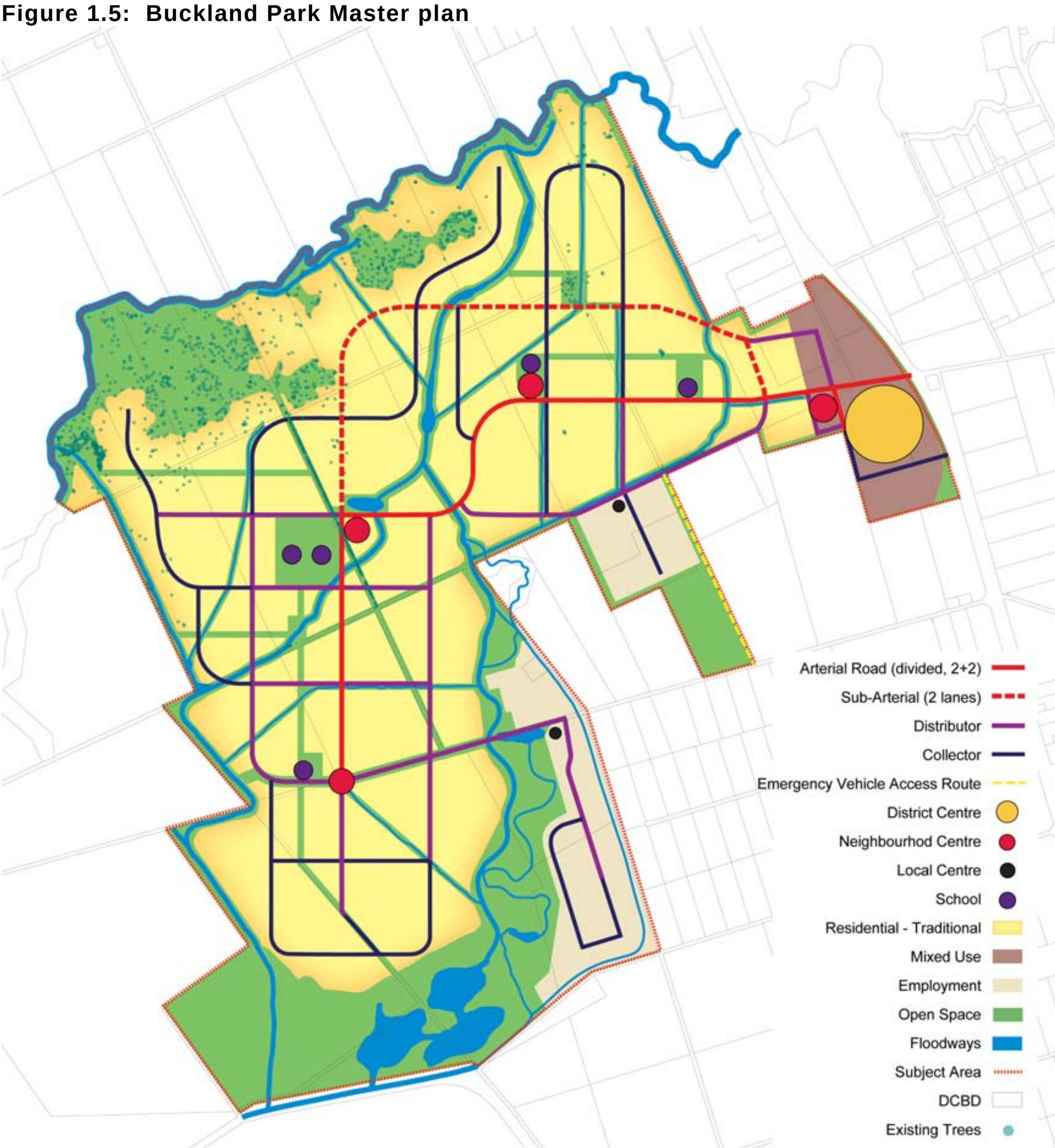
Figure 1.4: The Greater Metropolitan Area



1.2 The Proposal

Buckland Park is planned to accommodate residential areas, supported by open space, recreation and biodiversity areas, employment precincts and centres. The arrangement of land uses is described in the Masterplan.

Figure 1.5: Buckland Park Master plan

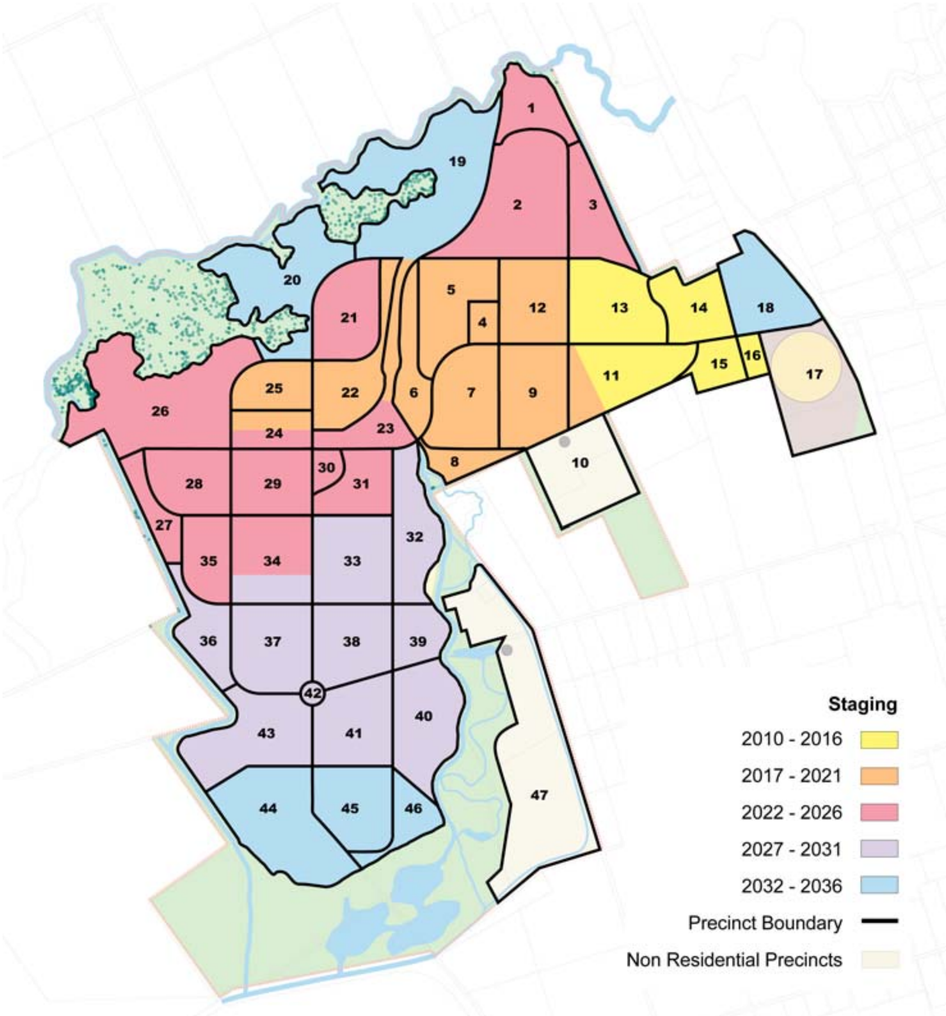


The proposal will be implemented in stages over a period of 25 years, Stage 1 is planned for 2010 to 2016, as illustrated in the staging plan. The first residents are expected in 2013.

It is anticipated Buckland Park will be fully constructed and occupied by 2036, when it will accommodate 12,000 residential allotments, with an average size of 500m^2, supported with multiple purpose open space, and commercial, retail, community and employment uses.

By 2036, a total population of 33,000 is anticipated, with a workforce of 10,687 people. (Connor Holmes, 2008).

Figure 1.6: Proposal Staging



1.3 The Study Purpose

This report addresses the guidelines for Buckland Park's Environmental Impact Statement (EIS) issued by the Development Assessment Commission in August 2008.

In particular, guideline 4.1.2 is addressed:

Outline current and predicted supply and demand for a range of residential development in the region; including affordable housing, aged housing and high needs housing.

2. SUPPLY AND DEMAND ANALYSIS

2.1 State, Metropolitan and Regional Growth Context

Since emerging from the early-mid 1990s' recession, demand for housing in Adelaide has steadily increased. Today, demand has reached a point where it cannot be met by the development industry, which is limited by a lack of available, suitably zoned land, and limits on the ability to construct housing.

Some short term relief to land supply is expected from Land Management Corporation (LMC) releases, and in the medium term from the recent inclusion of an additional 2,000 hectares within the Urban Growth Boundary (UGB), which will, over time, be rezoned and developed for urban purposes.

However, the process of creating new suburbs on this land will be complicated, and for some areas, appears highly problematic. For example, some areas are highly fragmented in ownership (Hackham), some areas are politically sensitive (Bowering Hill) and some face environmental remediation (Highbury). In this context, the delivery of Buckland Park in a timely manner remains crucial to the uninterrupted supply of residential land to the Adelaide market.

Constraints on the construction of housing are likely to remain, even if land supply issues can be overcome. South Australia's labour shortages in key trades will continue as there is strong competing demand for skilled labour from a range of expanding industries.

The following statistics show historical trends in housing construction, immigration levels and population growth. These statistics provide an important reference point for the prediction of future growth levels in Metropolitan Adelaide and, indeed, Greater Metropolitan Adelaide.

Table 1: SA Population and Migration

June Quarter	Estimated Resident Population	Overseas Migration	Interstate Migration	Net Migration	Overall Population Change
1997	1,481,357	3,106	-3,318	-212	7,104
1998	1,489,552	3,160	-1,996	1,164	8,195
1999	1,497,819	2,682	-1,631	1,051	8,267
2000	1,505,038	3,829	-3,531	298	7,219
2001	1,511,728	2,765	-2,418	347	6,690
2002	1,521,119	2,798	-1,335	1,463	9,391
2003	1,531,259	3,904	-1,218	2,686	10,140
2004	1,540,399	4,305	-2,936	1,369	9,140
2005	1,552,523	7,020	-3,250	3,770	12,124
2006	1,568,204	9,813	-2,591	7,222	15,681
2007	1,584,513	13,146	-3,563	9,583	16,309
2008	1,601,821	14,186	-4,355	9,831	17,308

Source: ABS Catalogue No. 3101.0

Figure 2.1: SA Population Annual Growth, 1983-2008

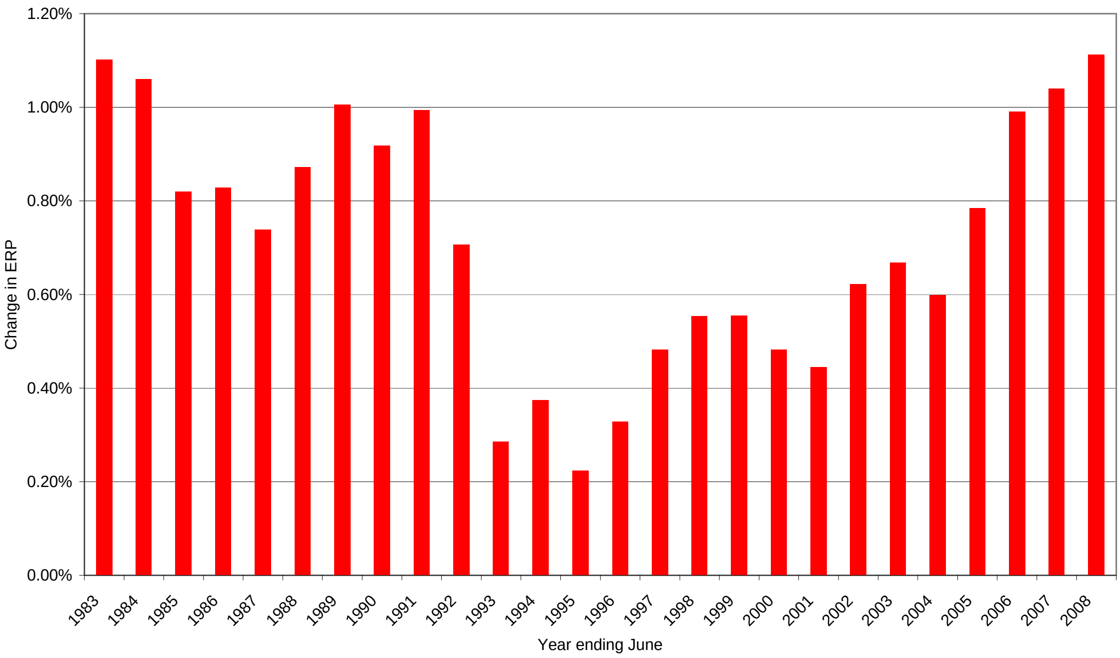


Figure 2.2: Australian Net Overseas Migration, 1982-2008

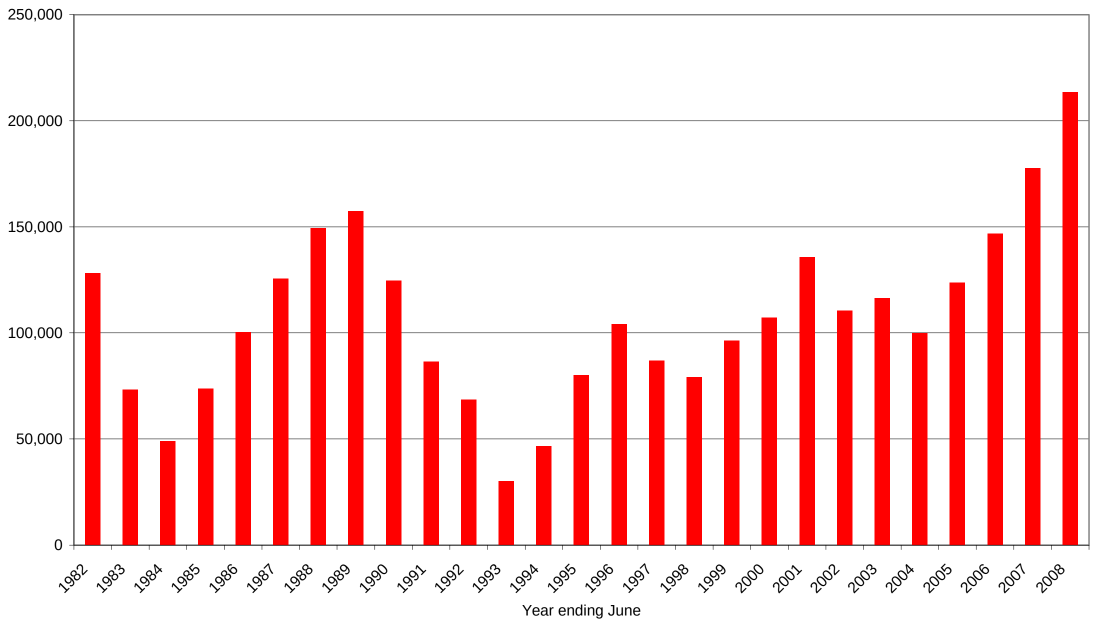
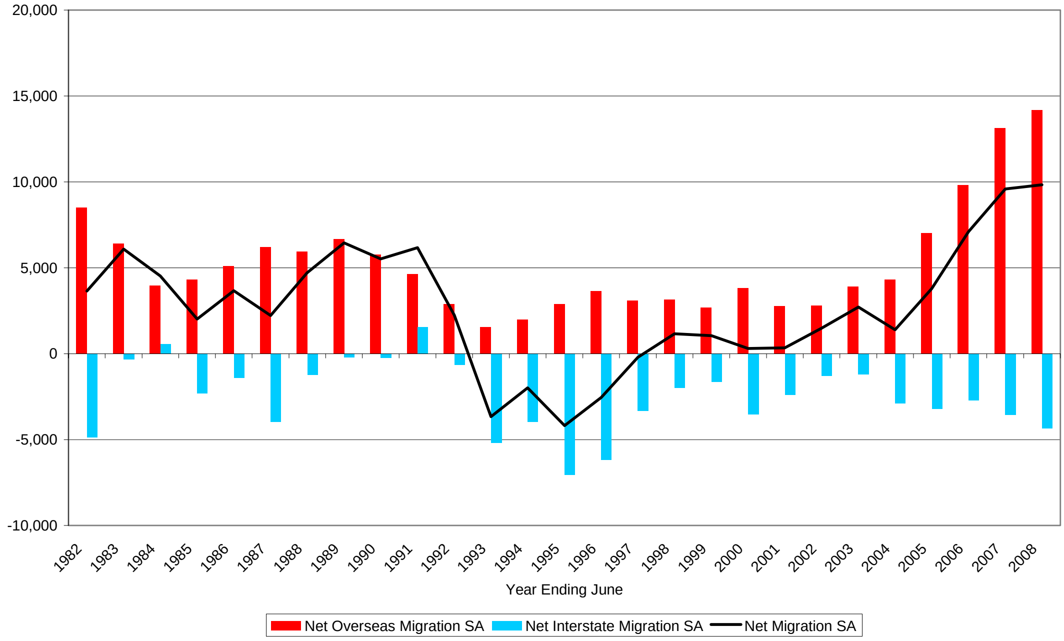


Figure 2.3: SA Total Net Migration, Net Overseas Migration and Net Interstate Migration, 1982-2008



As illustrated above, overseas immigration to South Australia has substantially increased over the last few years. With fairly stable interstate migration and natural increase, this has resulted in an increase in the State's rate of population growth from 0.2% per annum in the 1990s, to 1.1% per annum in 2008.

In 2008, population was growing at a rate 2-3 times faster than in the 1990s.

While the long term continuation of growth at these levels cannot be assumed, the anticipated performance of the State in terms of the mining, defence and education sectors, suggests that growth levels could actually rise in the medium term.

The State Government has recently endorsed population and dwelling projections for South Australia and Greater Metropolitan Adelaide to inform 30 year state plans currently being prepared. (DPLG, 2008; Minister for Urban Development and Planning, 2008).

These growth projections anticipate the State's population will grow from 1.6 million in 2008, to 2 million by 2027. Greater Metropolitan Adelaide is projected to grow by 547,000 people and 255,000 dwellings in the 30 years from 2006 to 2036, excluding Murray Bridge.

To support this level of population growth, an average of 8,500 additional dwellings will be required in Greater Metropolitan Adelaide each year, for the next 30 years.

The Government endorsed projections for South Australia's population growth to 2031 are given in Table 2. Table 3 shows Greater Metropolitan Adelaide's population and dwelling projections to 2036, excluding Murray Bridge.

Table 2: Population Projections for South Australia, 2006 to 2031

Year	High
2006	1,568,204
2011	1,662,609
2016	1,764,609
2021	1,873,917
2026	1,985,875
2031	2,095,806

Table 3: Greater Adelaide's Forecast Population, 2006 to 2036

Year	Estimated Resident Population	Dwellings	Occupancy Rate
2006	1,270,592	535,861	2.37
2011	1,347,251	575,677	2.34
2016	1,435,083	617,728	2.32
2021	1,529,480	661,208	2.31
2026	1,626,688	704,322	2.31
2031	1,722,888	747,547	2.30
2036	1,817,007	791,155	2.30

In a regional context, growth in Metropolitan Adelaide's northern region and the Barossa LGA are expected to be strong and substantially above Greater Metropolitan Adelaide's overall growth rates.

While the Government endorsed population projections have not yet been disaggregated into regions, the Department of Planning and Local Government (DPLG) have prepared population forecasts for the Metropolitan Adelaide's northern region and the Barossa LGA for 2007-2021. These are shown in Table 4.

Table 4: Forecast Population of Metropolitan Adelaide's Northern Region and Barossa LGA, 2007-2021

Year	Northern Adelaide	Barossa LGA
2007	350,857	63,167
2011	371,807	71,625
2016	400,490	83,793
2021	429,967	96,771

These projections show increasing growth in the absolute size of the population in each of these regions over the period of projection, reflecting their future role providing land for housing.

The following table records dwelling approvals in LGAs within the Metropolitan Adelaide's northern region and the Barossa LGA over the last 7 years. Significant growth is evident, with total activity levels rising by some 50% over the 4 years from 2003-2004 to 2007-2008.

Table 5: Dwelling Approvals by LGA

	Playford	Gawler	Salisbury	Barossa	Light	Mallala	Total
2001-2002	502	140	1,143	204	247	68	2,304
2002-2003	537	201	979	194	178	72	2,161
2003-2004	442	211	831	260	190	78	2,012
2004-2005	485	236	1,084	404	208	87	2,504
2005-2006	552	348	1,190	207	119	54	2,470
2006-2007	811	177	1,037	205	123	47	2,400
2007-2008	1,111	218	1,443	204	134	35	3,145

Source: ABS Catalogue No. 8731.0

Between 2001-2002 there was a 150% increase in the annual number of dwelling approvals in the Playford LGA. This reflects a possible increase in the creation of new residential areas in the LGA, and also a general upsurge in Adelaide's residential market.

It is reasonable to conclude the Playford LGA is experiencing a surge in new housing construction.

Growth in the Outer Metropolitan LGAs of Barossa and Light is also likely to occur with the Northern Expressway's opening, which will improve these LGAs' accessibility to Metropolitan Adelaide. They will be within 30 minutes driving time of most of the major employment precincts north of Grand Junction Road.

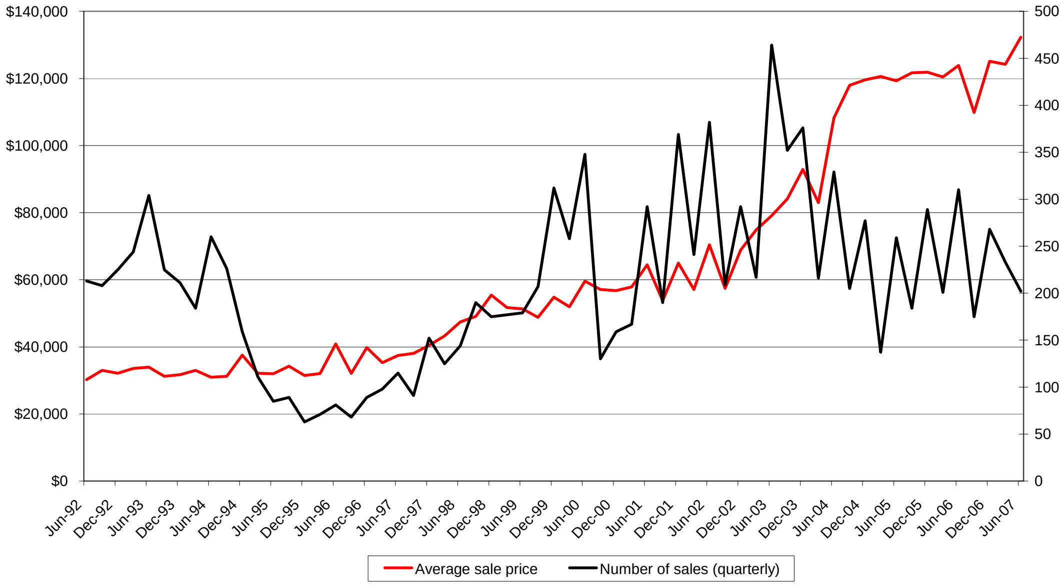
2.2 Land and Housing Prices

While land prices are influenced by a range of factors, the strength of demand coupled with restricted supply have contributed to a rapid escalation in prices.

Therefore, strong land price increases can at least be partially addressed by a substantive increase in the supply of land.

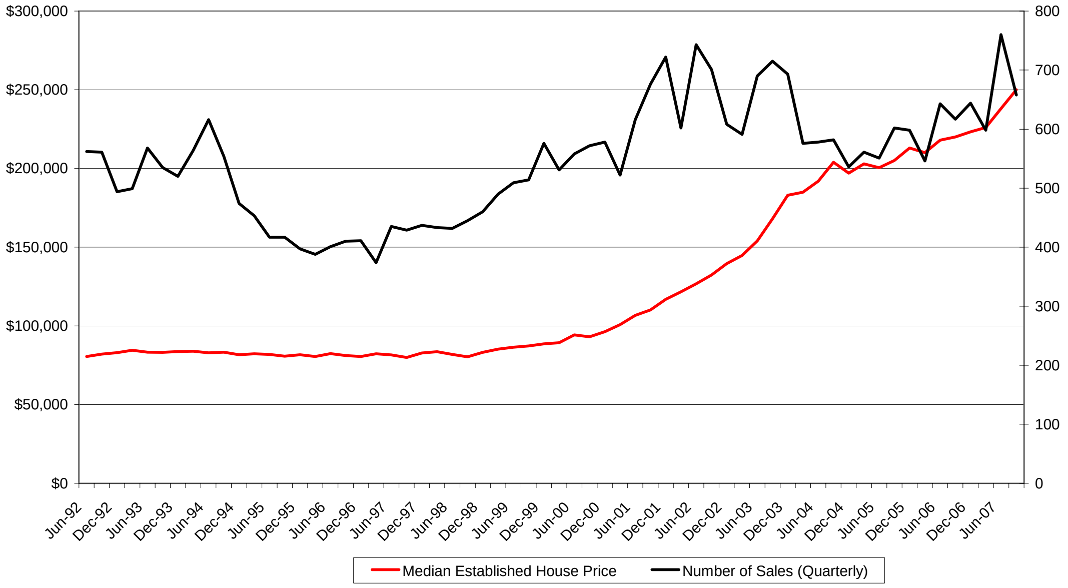
Land and house price increases in the Metropolitan Adelaide's northern LGAs of Salisbury, Playford and Gawler are summarised in the following graphs.

Figure 2. 4: City of Salisbury Land Sales



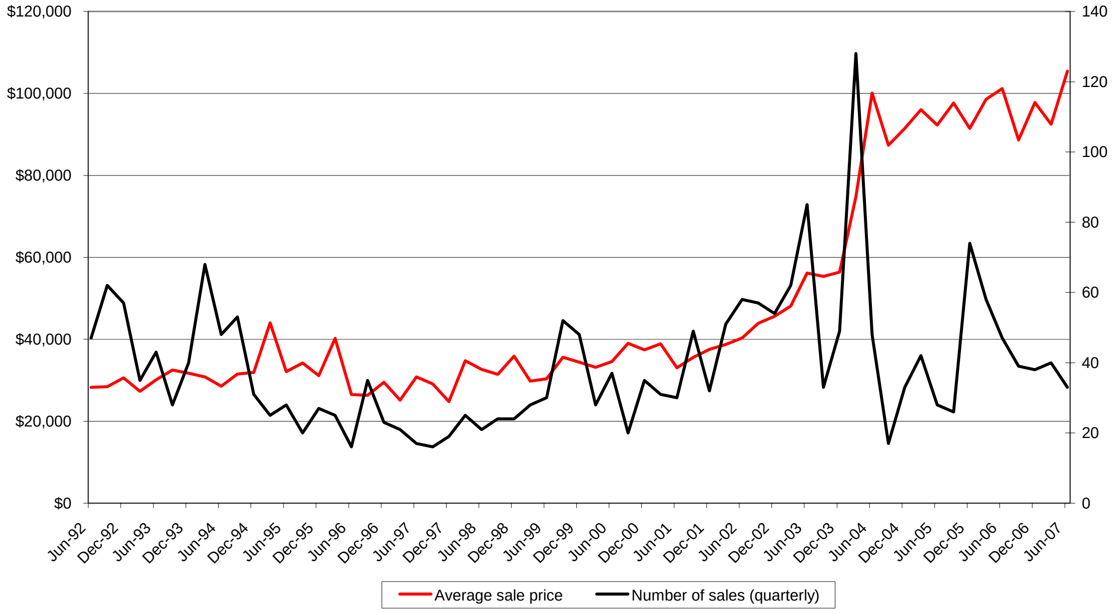
Source: Valuer General; RP Data

Figure 2.5: Salisbury House Sales



Source: Valuer General; RP Data

Figure 2.6: Town of Gawler Land Sales



Source: Valuer General; RP Data

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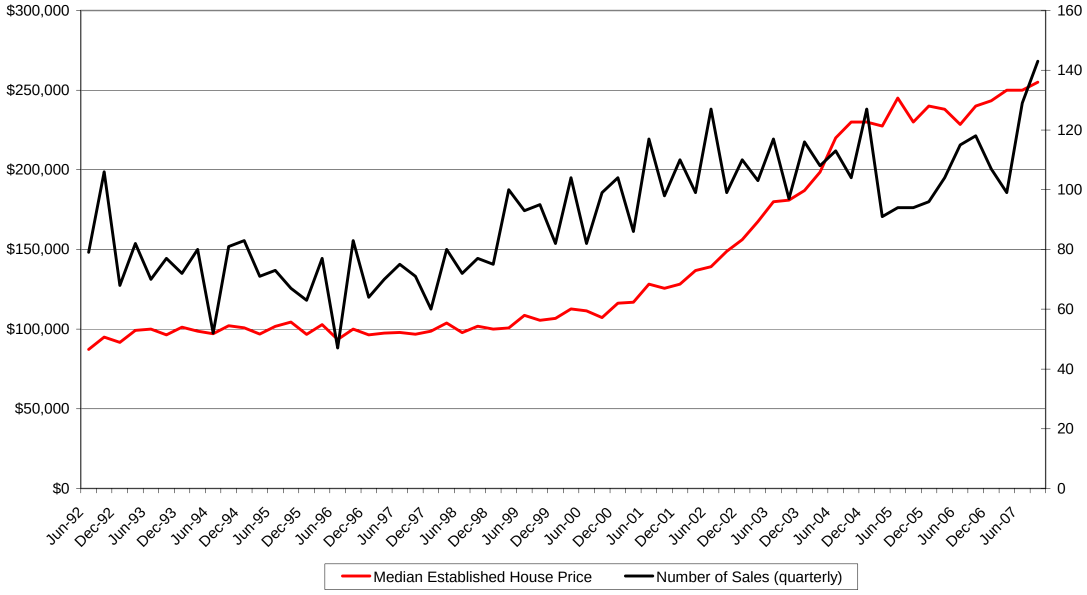
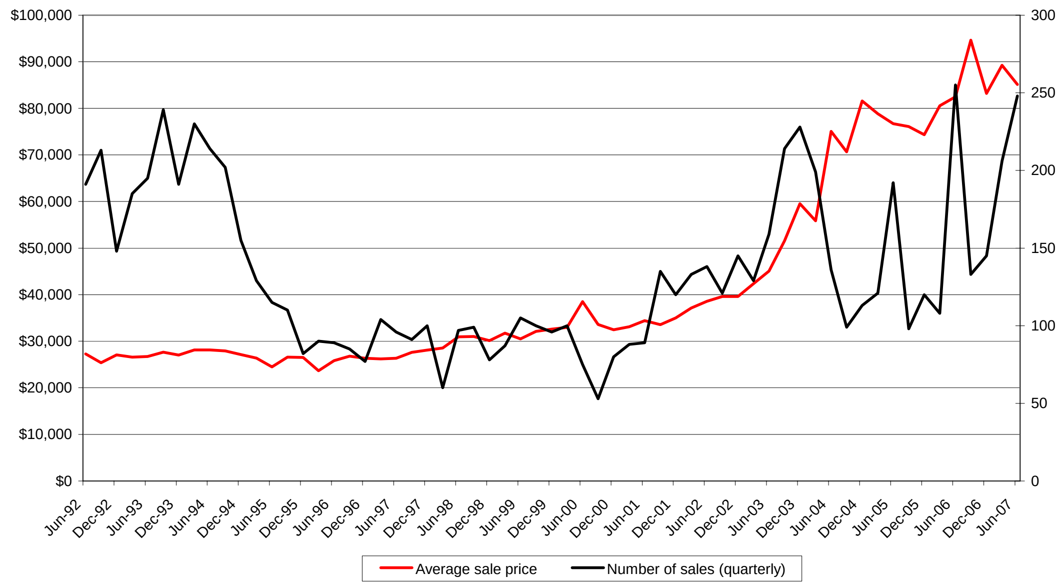
Figure 2.7: Gawler House Sales



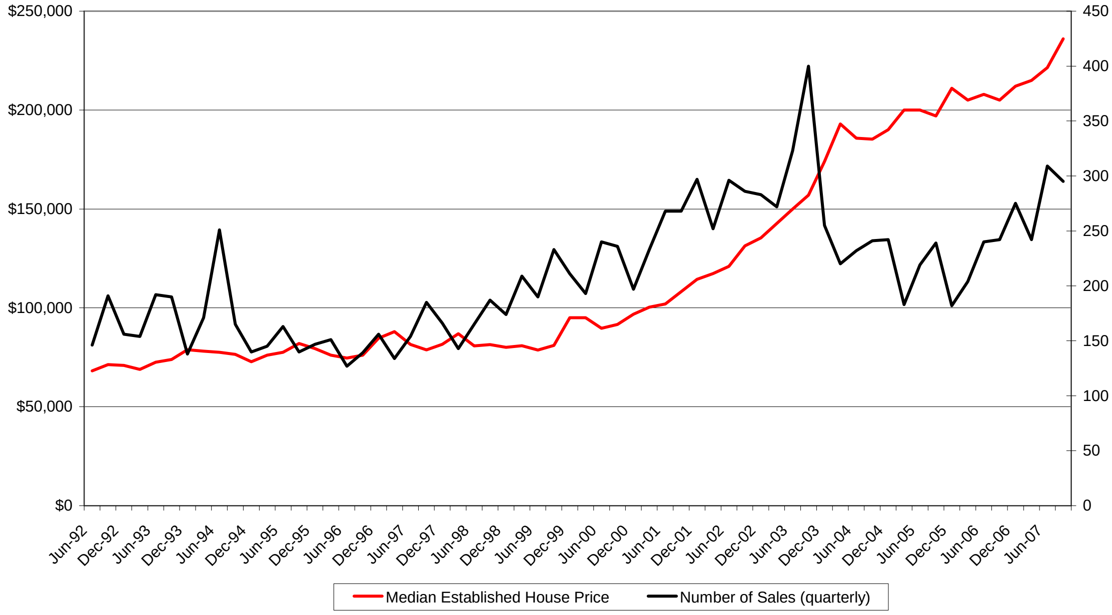
Source: Valuer General; RP Data

Figure 2.8: City of Playford Land Sales



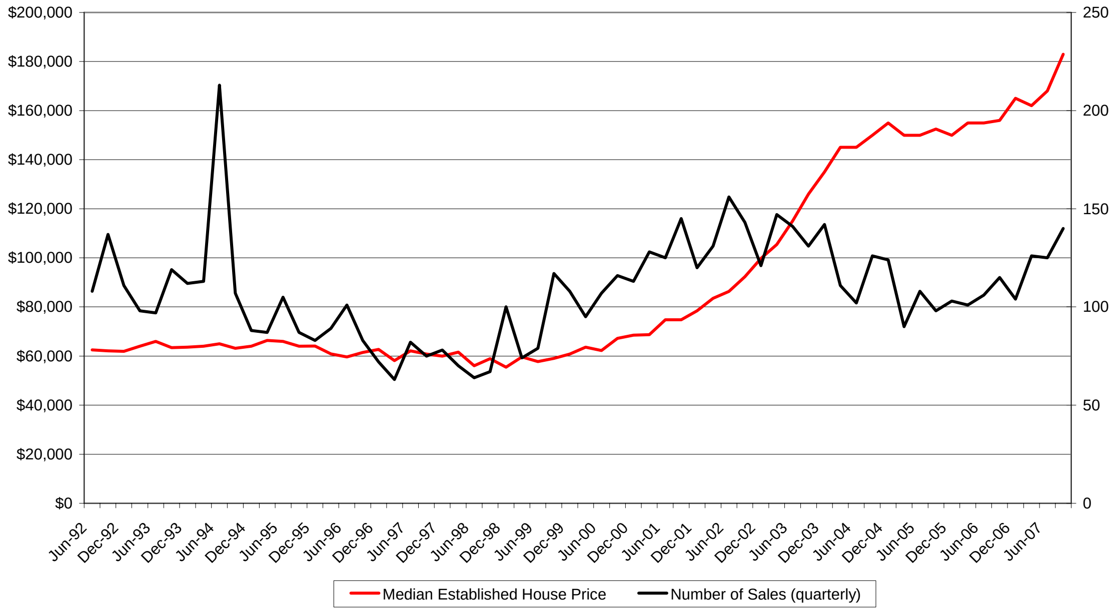
Source: Valuer General; RP Data

Figure 2.9: Playford 1 (Munno Para) House Sales



Source: Valuer General; RP Data

Figure 2.10: Playford 2 (Elizabeth) House Sales



Source: Valuer General; RP Data

These figures demonstrate a strong consistency across these LGAs, with all having:

- Fairly stable prices during the 1990s;
- A rise in prices commencing in 1999;
- Rapid price rises between 2002 and 2004;
- A tapering off in price rises during 2005-2006;
- A recommencement of accelerated price rises in 2007.

While many factors contribute to price rises, it can be expected increased land supply and competition between new residential areas will assist in avoiding supply induced price escalation.

The supply of housing land and competition in the residential market provided by Buckland Park will therefore contribute to restraining house prices in Adelaide.

3. DEMAND FOR BUCKLAND PARK'S RESIDENTIAL LAND

3.1 Context

DPLG's population and dwelling projections for Greater Metropolitan Adelaide and South Australia form the basis for predicting the demand for Buckland Park's residential land. As discussed above, these projections do not reflect the Government's endorsed 30 Year planning projections.

The SA Government has identified locations within Metropolitan and Outer Metropolitan Adelaide for consideration as potential urban growth areas in its Planning Review reference?

Buckland Park's role in supplying land and satisfying demand is considered within this framework.

3.2 Demand For Residential Land

As previously discussed, DPLG predicts an average of 8,500 additional dwellings per annum will be required between 2006-2036 to supply the houses needed to accommodate Greater Metropolitan Adelaide's population growth in the same period.

Based on continuation of the levels of construction activity recorded in Outer Metropolitan LGAs over the last decade, it is assumed approximately 1,350 dwellings per annum will be provided in towns located in Outer Metropolitan Adelaide, (eg. Mt Barker, Barossa towns, Strathalbyn, Victor Harbor, Goolwa etc.)

There will therefore be a demand for approximately 7,150 dwellings per annum in Metropolitan Adelaide.

As an outcome of the Planning Review, the SA Government wants 70% of the new housing needed by 2036 to be provided in infill sites in established suburbs, with 30% provided in new suburbs.

The ratio of growth accommodated in new suburbs, and growth accommodated in Adelaide's established suburbs has varied over Adelaide's history. Up until the 1990s, new suburbs accommodated most of Adelaide's growth.

Between the 1990s and 2003/04, infill and brownfield sites in Adelaide's central region have emerged as a substantial supplier of new residential land. Adelaide's changing demographic, lifestyle aspirations and industrial sector have facilitated this trend.

Since 2003/04, Adelaide's central region has waned slightly relative to new suburbs, possibly as a result of a dwindling number of sites, rapidly escalating prices, increased complexity of planning policies, particularly in character areas, and increasing community resistance.

It is doubtful Adelaide's central sector can continue to supply sites as in the past. There is a lack of sites with potential equivalent to Northfield, Cheltenham and Port Adelaide.

The Planning Review predicates achievement of the 70:30 ratio of infill to new suburbs on the creation of Transit Oriented Development (TOD), which will see increases in residential densities around upgraded fixed transport nodes.

Nevertheless, it is considered 70% of new housing in established suburbs is an ambitious target. However, it may be possible to maintain the level of supply from infill sites in established areas at 50%, given there will be some supply of medium to high housing land from antiquated centrally located industrial sites.

The proportion of supply from infill sites in established suburbs could be raised to 60% if renewal of antiquated industrial sites continues, combined with the creation of TODs.

Renewal of infill sites is likely to be focused in Adelaide's northern established suburbs as this area has better access to employment and services.

It is likely the 30% of housing to be provided in new suburbs will be focused in Metropolitan Adelaide's northern region rather than the southern region. The northern region has more suitable, available land and considerably better access to employment, infrastructure, and future infrastructure (Connor Holmes 2008a)

As new suburbs are established in the northern region, they will draw in more infrastructure, employment and services, providing a catalyst for the creation of additional suburbs.

Towns in Outer Metropolitan Adelaide's south and south east will continue to expand, facilitated by the following factors:

- Accessibility to central Adelaide provided by the South Eastern Freeway;
- The limited availability and cost of land in Metropolitan Adelaide's southern and central regions;
- The growing number of retiring baby boomers seeking a lifestyle change.

It is predicted the direction of Greater Metropolitan Adelaide's growth to 2036 will be influenced by the following:

- Growth from infill areas increasing to 60% - 70%, depending on the success of Government policy, and availability of sites;
- An increasing role for Metropolitan Adelaide's northern region in supplying land for the new suburbs accommodating 30%-40% of predicted growth. This may also include some locations contiguous to existing suburbs, but located in Outer Metropolitan Adelaide, for example, Barossa LGA;
- Declining availability of land in Metropolitan Adelaide's southern region;
- Moderate growth in towns within Outer Metropolitan Adelaide's south eastern region, for example, Mt Barker, Littlehampton, Nairne, Callington or Murray Bridge;
- Continuing town growth in Outer Metropolitan Adelaide and further a field in the state.

Clearly, the land needed to support the 30% of Adelaide's growth to be provided in new suburbs is not available within the current Urban Growth Boundary (UGB).

Locations for new suburbs must be identified and the current UGB adjusted to facilitate planning for those areas.

Therefore, the rate of land supply from Buckland Park identified later in this report assumes the current UGB is adjusted and locations for new suburbs identified. If this does not occur, the rate of demand for Buckland Park would be increased, as land supply from within the current UGB would be inadequate to satisfy demand generated from Adelaide's projected growth. This affect would be more pronounced at the end of Buckland Park's construction and occupation programme, as other land supply locations become exhausted.

3.3 Regional Demand Analysis

Table 6 shows predicted demand for dwellings in Greater Metropolitan Adelaide's infill and new suburbs. Table 7 shows predicted demand for dwellings in Metropolitan Adelaide's northern and southern regions, and at Buckland Park within that context. The figures for the northern region also include the Barossa LGA.

Table 6: Demand for New Dwellings in Greater Metropolitan Adelaide 2006-2036

Year	Ratio of Infill to New Suburbs	Infill	New Suburbs	Towns	Total
2006	50:50	3575	3575	1350	**8500**
2007	50:50	3575	3575	1350	**8500**
2008	51:49	3645	3505	1350	**8500**
2009	52:48	3720	3430	1350	**8500**
2010	52:48	3720	3430	1350	**8500**
2011	53:47	3790	3360	1350	**8500**
2012	54:46	3860	3290	1350	**8500**
2013	54:46	3860	3290	1350	**8500**
2014	55:45	3930	3220	1350	**8500**
2015	56:44	4005	3145	1350	**8500**
2016	56:44	4005	3145	1350	**8500**
2017	57:43	4075	3075	1350	**8500**
2018	58:42	4145	3005	1350	**8500**
2019	58:42	4145	3005	1350	**8500**
2020	59:41	4220	2930	1350	**8500**
2021	60:40	4290	2860	1350	**8500**
2022	60:40	4290	2860	1350	**8500**
2023	61:39	4360	2790	1350	**8500**
2024	62:38	4435	2715	1350	**8500**
2025	62:38	4435	2715	1350	**8500**
2026	63:37	4505	2645	1350	**8500**
2027	64:36	4575	2575	1350	**8500**
2028	64:36	4575	2575	1350	**8500**
2029	65:35	4645	2505	1350	**8500**
2030	66:34	4720	2430	1350	**8500**
2031	66:34	4720	2430	1350	**8500**
2032	67:33	4790	2360	1350	**8500**
2033	68:32	4860	2290	1350	**8500**
2034	68:32	4860	2290	1350	**8500**
2035	69:31	4935	2215	1350	**8500**
2036	70:30	5005	2145	1350	**8500**

Table 7: Demand for New Dwellings in Metropolitan Adelaide's Northern and Southern Regions 2006-2036

Year	Location			Total
	Buckland Park	Northern Region (excl. Buckland Park & incl. Barossa LGA)	Southern Region	
2006	-	2475	1100	**3575**
2007	-	2475	1100	**3575**
2008	-	2505	1000	**3505**
2009	-	2430	1000	**3430**
2010	-	2430	1000	**3430**
2011	-	2460	900	**3360**
2012	120	2270	900	**3290**
2013	160	2330	800	**3290**
2014	200	2220	800	**3220**
2015	300	2145	700	**3145**
2016	400	2045	700	**3145**
2017	480	1995	600	**3075**
2018	600	1805	600	**3005**
2019	600	1905	500	**3005**
2020	600	1830	500	**2930**
2021	640	1820	400	**2860**
2022	640	1820	400	**2860**
2023	640	1850	300	**2790**
2024	640	1775	300	**2715**
2025	640	1875	200	**2715**
2026	640	1855	200	**2645**
2027	640	1835	100	**2575**
2028	640	1835	100	**2575**
2029	640	1865	-	**2505**
2030	640	1790	-	**2430**
2031	640	1790	-	**2430**
2032	640	1720	-	**2360**
2033	640	1650	-	**2290**
2034	220	2070	-	**2290**
2035	-	2215	-	**2215**
2036	-	2145	-	**2145**

For the period 2006-2036, demand for housing at Buckland Park is predicted to be approximately 13% of total dwellings required in the northern region and Barossa LGA, with a peak demand of approximately 25% per annum.

Golden Grove is the only new residential area in Adelaide's history of a similar scale to Buckland Park. Significantly, the demand predicted for dwellings at Buckland is smaller than actually experienced at Golden Grove.

At Golden Grove's peak, nearly 1,100 lots were produced in a single year, and approximately 1,000 lots per annum were produced over a number of years. This was 30-40% of the lots demanded by the northern region's market.

Demand for lots at Buckland Park is expected to be only 13% of the lots required by the northern region's market.

Therefore it is not expected Buckland Park will artificially distort the residential land market by providing more lots than the market demands.

3.4 Impact on Blakeview, Playford North and Penfield

The government is planning for residential growth in Blakeview, Playford North and Penfield, including the provision of services and infrastructure. A slowing of growth in those areas, to levels below the planned levels, could result in unused infrastructure and services, or delays in their provision, potentially wasting government resources, or leaving residents without services.

However, given the high demand for new housing anticipated in Metropolitan Adelaide's northern region, it is considered Buckland Park can be absorbed into the residential land market without impacting on the demand for residential land in Blakeview, Playford North and Penfield.

These projects can therefore be expected to proceed as planned.

3.5 Impact on Virginia and Angle Vale

As the nearest town, Virginia will be most influenced by Buckland Park. In its early stages, Buckland Park's new residents may draw on Virginia's services and facilities. The availability of residential land may impact on Virginia's residential market.

Connor Holmes' centres and social analyses considered the influence Buckland Park may Virginia's Neighbourhood Centre and human services (Connor Holmes 2008b and 2008c).

Land within Virginia's town boundary is held in relatively small allotments, by many different owners. This restricts the ability to subdivide the land to create new residential properties, and limits the viability of small scale residential projects. Site amalgamations would be required to create sites suitable for housing projects. This is a difficult process, made harder by the need to coordinate several owners.

Residential growth in Virginia is therefore likely to be slow, irrespective of Buckland Park.

Angle Vale originally comprised large farming sections, which could be feasibly divided into large residential allotments, of generally 1,800 m^2.

Only a few farming sections of a scale suitable for division into residential allotments remain.

Accordingly, it is concluded Buckland Park will not slow or hamper the creation of new residential land at Angle Vale.

Furthermore, Angle Vale's residential character is created by its large residential lots. Buckland Park will have a totally different character, therefore the two markets will be independent of each other, and one will not impinge on the other.

4. HOUSING SUPPLY FROM BUCKLAND PARK

4.1 Yield

Buckland Park has an area of 1,340 hectares. Excluding land needed for roads, non-residential uses and environmental constraints, there will be approximately 600 hectares of residential land, capable of accommodating 12,000 dwellings.

Detailed planning of future stages will confirm yields, but at this stage in the design process, these figures have been adopted for planning purposes.

This yield is generated from the neighbourhood types and densities described in Table 8.

Table 8: Dwelling Types and Yields

Location	**Net Area (hectares)**	**Net Residential Density (dwellings per hectare)**	**Total Dwellings**
Low Density Residential Neighbourhoods	77	10	700
Residential Neighbourhoods	449	20	8,580
Medium Density Neighbourhoods	61	40	2,320
Mixed Use Precincts	13	40	400
Total Dwelling Yield	**600**		**12,000**

Source: Connor Holmes 2008

4.2 Staging of Construction and Occupation

This proposal does not include construction of dwellings, but only production of allotments. It is anticipated construction and occupation of the allotments and dwellings will occur over a 25 year time frame. There will be a two year lag between commencing construction of the allotment and occupation of the dwelling.

An average of 480 dwellings are expected to be constructed per annum, and this figure has been used to inform transport, centres and services planning. However, the actual rate achieved will be influenced by a combination of factors including:

- The strength of demand Metropolitan Adelaide's northern region's residential market
- The suitability of Buckland Park's allotments to that market, in respect of timing and housing types available. It is expected Buckland Park will be able to provide a range of housing types simultaneously because of its large scale.
- The timing and scale of competing residential land releases in the northern region.
- The time delay between commencement of subdivision construction and building houses.

This rate of production is considered reasonable, but will be subject to variation over time as a result of market conditions for example.

Also production tends to be slower in the early years as an area becomes established, faster in the middle years as production and marketing are in full swing, and slower in the later years as the availability of allotments shrinks.

This affect is likely to be seen over the proposal's 25-year construction and occupation time frame, and on a smaller scale, within each of the proposal's stages.

It is considered however, a figure of 480 dwellings per year is a reasonable average for planning purposes.

Table 9: Dwelling Numbers at Buckland Park over the Life of the Project

Year	Number of Dwellings	
	Occupied During Year	Cumulative Total
2010	0	0
2011	0	0
2012	0	0
2013	120	120
2014	160	280
2015	200	480
2016	300	780
2017	400	1,180
2018	480	1,660
2019	600	2,260
2020	600	2,860
2021	600	3,460
2022	640	4,100
2023	640	4,740
2024	640	5,380
2025	640	6,020
2026	640	6,660
2027	640	7,300
2028	640	7,940
2029	640	8,580
2030	640	9,220
2031	640	9,860
2032	640	10,500
2033	640	11,140
2034	640	11,780
2035	220	12,000

Source: Connor Holmes

These figures differ from those contained in the tables in Table 7 by one year, reflecting the time between dwelling commencement and dwelling occupation.

4.3 Housing Types

With a planned yield of 12,000 dwellings, accommodating 33,000 residents, Buckland Park will comprise approximately 3% of Metropolitan Adelaide's population.

Buckland Park therefore needs provide housing which suits a range of people and households in different age and income brackets.

The housing mix planned for Buckland Park is summarised in Table 10. This mix has been prepared to assist planning. Detailed design of future stages will undoubtedly include changes and refinements, but will be guided by the Masterplan.

Table 10: Housing Type by Household Type

Land and Housing Package	Size		Component of total yield	Household Type
	Site Area	Frontage		
Acreage	2000 m^2+	40 m+	<1%	Families
Premium	800-1000 m^2	22 m+	5%	Families
Traditional	540-700 m^2	18-22 m	25%	Families
Courtyard	420-480 m^2	14-16 m	20%	Families, Older Couples
Four Packs	360-450 m^2	12-15 m	2%	Families, Older Couples
Villa - large	375 m^2	12.5 m	10%	Families, Older Couples, Older Singles, Couples, Single Parent Families, Low Income Groups
Villa - small	300-330 m^2	10-11 m	10%	Families, Older Couples, Older Singles, Couples, Single Parent Families, Low Income Groups
Cottage	300-350 m^2	14-15 m	5%	Families, Older Couples, Older Singles, Couples, Single Parent Families, Low Income Groups
Gatehouse	150-300 m^2	10-14 m	5%	Older Couples, Older Singles, Couples, Single Parent Families, Low Income Groups
Terraces / Row Dwellings	125-300 m^2	5-10 m	5%	Singles, Couples, Older Couples
Rear Loaded Dwellings	125-200 m^2	5-8 m	5%	Singles, Couples Older Couples
Mews Dwelling	25-40 m^2	na	1%	Singles, Couples, Low Income Groups
Apartments	70-100 m^2	na	3%	Singles, Couples, Low Income Groups
Mansions	200-300 m^2	18-22 m	<1%	Singles, Couples, Small Families
Shop Top / Soho	70-100 m^2	na	<1%	Singles, Couples
Retirement - lifestyle	300-400 m^2	na	2%	Active Retirees
Retirement - aged care	250-350 m^2	na	2%	Supported, Retirees, Low Income Groups

Source: Connor Holmes

The above mix includes 87% (10,440) of dwellings provided as allotments, and 13% (1,560) as part of future residential projects, for example medium density housing. There will be a similar breakdown between detached, and attached dwellings.

Table 11 compares Buckland Park's mix of housing types, to the mix in other parts of the Adelaide Metropolitan area.

Table 11: Detached and Attached Housing

Location	% Detached	% Attached
Metropolitan Adelaide	77%	23%
Metropolitan Adelaide's northern region	86%	14%
Playford LGA	81%	19%
Buckland Park	87%	13%

Source: ABS Catalogue No. 2001.0 / Connor Holmes

The allotment and dwelling types planned for Buckland Park are defined in Table 12.

Table 12: Definitions of Allotment and Dwelling Types

Allotment or Dwelling Type	Definition	Location
Acreage	Large allotments greater than 2,000m^2 but including allotments of up to 2 hectares	Areas incorporating significant natural vegetation, stormwater channels or buffers to adjoining land uses
Premium	Large suburban allotments providing scope for grand residences	Adjacent to woodland areas and in exclusive culs-de-sac precincts separated from other neighbourhoods.
Traditional	Standard suburban allotments providing scope for most project home designs including 'triple fronted dwellings'	Throughout the site.
Courtyard	Allotments providing dimensions suitable for specific courtyard products and most 'double fronted dwellings'	Throughout the site.
Four Packs	Sites for four dwellings served by a common central driveway, typically of courtyard dimensions	On main road frontages and on reserve frontages where no road access is provided to the lots fronting the main road or reserve
Villa - large	Allotments providing dimensions suitable for large villa homes, typically single fronted plus double garage	Throughout the e site.
Villa - small	Allotments providing dimensions suitable for compact villa homes, typically single fronted plus single garage	Throughout the site.
Cottage	Shallow allotments that provide for a smaller, more affordable housing product	Throughout the site.
Gatehouse	Small lots, often at the rear of larger properties providing an affordable housing product	Facing onto laneways and minor streets
Terraces / Row Dwellings	Attached dwellings built in rows of three or more which take advantage of zero side setbacks	Mixed use precincts, centres, near centres and where definition of the street environment is required. Corner sites permit vehicular access to the rear of the site

Allotment or Dwelling Type	Definition	Location
Rear Loaded Dwellings	Detached dwellings on small allotments with zero side setbacks and with vehicular access provided from a rear lane, avoiding garaging onto key streets	On main road frontages and on reserve frontages where no access is available from the main road or reserve, and in precincts near the centres
Mews Dwelling	Single bedroom dwellings or bedsits located over garaging	Facing onto laneways and minor streets
Apartments	Multi-level attached dwellings at medium densities	In and around centres and mixed use precincts
Mansions	Two or three apartments on corner sites with separate vehicle access for each dwelling and taking on the appearance of a very large dwelling	At key intersections to define the scale of development of the area
Shop Top / Soho	Multi-level attached dwellings located over ground level commercial floorspace, sometimes with ownership links between residential and commercial space	In centres, mixed use zones and along major road frontages
Retirement - lifestyle	Integrated villages, usually single storey, providing a range of recreation and lifestyle services to active retirees	Reasonable proximity to shops, public transport and medical services
Retirement - aged care	Low care and high care accommodation for older age groups, by way of independent living units and assisted care in hostels and nursing homes. May be multi-storeyed	Close proximity to shops, public transport and medical services

Source: Connor Holmes

This housing mix provides for a wide cross-section of the community, and reflects the ability of Buckland Park to accommodate a wide range of housing types, at different prices, as a result of its significant scale.

The following parts of the community are likely to seek housing at Buckland Park:

- Young singles and couples leaving their family home;
- Young families purchasing their first home;
- Middle families upgrading to a larger home;
- Older parents following their children;
- Families seeking larger allotments or access to open space;
- Families and people on low or fixed incomes seeking affordable housing;
- Local Virginia and Two Wells area residents seeking better housing;
- Workers in the Virginia and Two Wells area seeking housing close to work;
- Defence Housing Authority tenants;
- Families and singles with employment in Metropolitan Adelaide's northern region, including Greater Edinburgh Park.

This cross-section of the community is likely to be drawn predominantly from the second, third and fourth income quintiles, but very often including double income families with moderate to high capacity for mortgage repayments. It is expected to include some professionals and managers, a large administrative and clerical base and substantial numbers of tradespersons and skilled workers.

Table 13 shows household incomes in locations where the majority of Buckland Park's new residents are expected to be drawn from, and which provide an indication of the household incomes expected in Buckland Park.

Table 13: Household Income Levels for Selected Areas

Locality	Median Annual Household Income (2006)
Metropolitan Adelaide	$48,048
Playford LGA	$37,388
Salisbury LGA	$45,500
Gawler LGA	$43,368
Tea Tree Gully LGA	$55,900
Hewett (suburb)	$78,000
Blakeview (suburb)	$52,472
Andrews Farm (suburb)	$55,224
Burton (suburb)	$51,792
Craigmore (suburb)	$55,276
Angle Vale (township)	$65,572

Source: ABS Catalogue No. 2001.0 / Connor Holmes

The median annual household incomes in the Playford LGA are particularly low. However within Playford LGA, the new suburbs of Blakeview, Andrews Farm and Craigmore, have median household incomes which are 9-15% higher than the metropolitan median, as there are many double income families in those suburbs.

Hewett, which is a new large lot estate, is attracting higher income households to Metropolitan Adelaide's northern region. Its median income is 62% higher than Metropolitan Adelaide.

Angle Vale, which has also has large lot estates, has a median household income approximately 36% higher than Metropolitan Adelaide.

These figures are sourced from the 2006 Census, it is expected the incomes listed would have increased since the census.

4.4 Affordable Housing

15% of Buckland Park's housing is planned as Affordable Housing. These dwellings include a cross-section of housing types and locations, and will include sites suitable for not for profit housing providers, investment housing for affordable rental, and low cost allotments and housing types.

The breakdown of affordable land and housing types is anticipated as follows:

Table 14: Affordable Housing Mix

Component	Number of Units	% of Total Yield	% of House Or Allotment Types
Acreage	-	-	-
Premium	-	-	-
Traditional	-	-	-
Courtyard	-	-	-
Four Packs	-	-	-
Villa - large	12	<0.1%	1%
Villa - small	470	4.0%	40%
Cottage	360	3.0%	60%
Gatehouse	610	5.0%	100%
Terraces / Row Dwellings	-	-	-
Rear Loaded Dwellings	-	-	-
Mews Dwelling	120	1.0%	100%
Apartments	180	1.5%	50%
Mansions	-	-	-
Shop Top / Soho	-	-	-
Retirement - lifestyle	-	-	-
Retirement - aged care	48	0.5%	25%
Total	**1800**	**15.0%**	**15%**

Source: Connor Holmes

Allotments will be made available on commercial terms to various affordable housing providers as shown in Table 15.:

Table 15: Anticipated Affordable Housing Recipients

Affordable Housing Recipient	Number of Units	% of Total Supply
Government Welfare providers	607	4.0%
Community housing groups	152	1.0%
Not for Profit Aged Care providers	76	0.5%
Low income purchasers	1137	7.5%
Investors (providing affordable rental housing)	303	2.0%
Total	**2275**	**15.0%**

Source: Connor Holmes

4.5 Delivery of Affordable Housing

The strategy for delivery of Affordable Housing is considered in a separate report (Connor Holmes 2008d).

4.6 Staging

The provision of various housing and allotment types will not be uniform over the 25 year construction and occupation period. In the early stages, it is likely there will be a larger proportion of traditional low density allotments, suitable for accommodating detached dwellings.

As Buckland Park's centres and services become more established, more medium density housing, and high needs housing, such as aged care, will be provided.

The mix of each stage will be established during its detailed planning and design, however this process will be guided by the Masterplan.

4.7 Non-Residential Facilities

The availability of non-residential facilities will improve Buckland Park's attractiveness to potential residents.

Buckland Park will provide a wide range of facilities and services to provide for the social and employment needs of its new residents. These may include the following:

- Education
  > Pre-school
  > Primary education
  > Secondary education
  > Private and Government schools
  > TAFE or University Campus (single discipline)

- Community Services
  > Child Care Centres
  > Library
  > Neighbourhood House
  > Meeting Rooms
  > Worship Centres
  > Aged Care Facilities

- Retailing
  > Local Centres
  > Neighbourhood Centres
  > District Centre
  > Bulky Goods Precinct
  > Growers Market

- Commercial Services
  > Sales Office / Display Centre (with community services / meetings capability)
  > Professional Services
  > Post Offices
  > Banks / Financial Institutions
  > Offices
  > Motel / short stay accommodation

- Recreation Facilities
  > Sports Clubs
  > Gymnasiums
  > Bowling
  > Squash
  > Recreation Centre

> Sports ovals
> Tennis courts
> Netball / basketball courts
> Informal recreation spaces
> Swimming Pool / wave pool / beach
> Boat Ramp upgrade (Port Gawler)

- Entertainment Facilities
  > Restaurants / cafes
  > Hotels / taverns
  > Nightclubs / bars
  > Auditorium
  > Cinema complex
  > Amusement hall

- Health Services
  > Medical Centres
  > Dental Services
  > Physiotherapists etc.
  > Community Health Facilities
  > Alternative Care

- Emergency Services
  > Ambulance
  > Fire
  > Police

- Transport Services
  > Bus network
  > Pedestrian / cycle network
  > Interchange / car parking

- Employment
  > Service provision (retail / commercial / community / education / recreation)
  > Office precinct
  > Business park
  > Mixed commercial precinct
  > Service trades / light industry precinct
  > Vocational training centre
  > Start-up enterprise centre

- Open Space
  > Walking trails / cycling trails
  > Active and passive recreation areas
  > Reafforestation
  > Carbon credits
  > Open woodland regeneration and habitat re-establishment
  > Wetland network
  > Ornamental lakes / permanent water bodies
  > Stormwater capture and reuse

- Infrastructure
  > Water recycling
  > Energy efficiency
  > Passive solar design

Some of these facilities will be provided in Stage 1, including:

- A small supermarket for convenience shopping. The proponent will negotiate suitable lease agreements with potential tenants, in the event a supermarket is not financially viable at opening;
- A community space equipped with office and meeting facilities – a community worker will be based in the space;
- Six specialty shops suitable for a café, private medical and dental surgeries and other small businesses;
- A sales and display centre;
- Landscaping, including an entry statement and children's playground.

The second phase will be constructed when demand for additional facilities is generated by new residents occupying Stage 1, or during later phases. It will include additional community space, additional supermarket space and four additional specialty shops.

Within the neighbourhood centre, an "extension area" has been included for other private facilities, for example, a childcare centre, recreation facilities, a hotel, offices, or housing.

5. CONCLUSION

Demand for housing in Adelaide has steadily increased, while the supply of suitable zoned land has been limited. Demand has been fuelled by a steadily increasing growth rate.

In 2008, population was growing at a rate 2-3 times faster than in the 1990s.

It is anticipated the State's population will grow from 1.6 million in 2008, to 2 million by 2027. Greater Metropolitan Adelaide is projected to grow by 547,000 people and 255,000 dwellings in the 30 years from 2006 to 2036.

To support this level of population growth, an average of 8,500 additional dwellings will be required in Greater Metropolitan Adelaide each year, for the next 30 years.

In a regional context, growth in the Metropolitan Adelaide’s northern region and the Barossa Region are expected to be strong and substantially above Greater Metropolitan Adelaide’s overall growth rates.

These areas have already seen a rise in housing approvals, and improvements to infrastructure will make the region more attractive.

While land prices are influenced by a range of factors, the strength of demand coupled with restricted supply have contributed to a rapid escalation in prices.

Therefore, strong land price increases can at least be partially addressed by a substantive increase in the supply of land.

The supply of housing land and competition in the residential market provided by Buckland Park will therefore contribute to restraining house prices in Adelaide.

Buckland Park’s role in supplying land and satisfying demand must be considered within the context of strategic growth in the Greater Adelaide Region.

As an outcome of the Planning Review, the SA Government is targeting 70% of the new housing needed by 2036 to be provided in infill sites in established suburbs, with 30% provided in new suburbs.

It is considered 70% of new housing in established suburbs is an ambitious target. However, it may be possible to improve the land supply from infill sites in established areas to beyond 60%, if appropriate renewal sites are found, and the creation of TODs is successful.

It is likely the 30% - 40% of housing to be provided in new suburbs will be focused in Metropolitan Adelaide’s northern region, which has more suitable, available land and considerably better access to employment, infrastructure, and future infrastructure.

As new suburbs are established in the northern region, they will draw in more infrastructure, employment and services, providing a catalyst for the creation of additional suburbs.

For the period 2006-2036, demand for housing at Buckland Park is predicted to be approximately 13% of total dwellings required in the Northern Adelaide and Barossa Regions, with a peak demand of approximately 25% per annum.

At its peak, Golden Grove provided 30-40% of the lots demanded by the northern region’s market.

Therefore it is not expected Buckland Park will artificially distort the residential land market by providing more lots than the market demands.

Given the high demand for new housing anticipated in Metropolitan Adelaide's northern region, it is considered Buckland Park can be absorbed into the residential land market without impacting on the demand for residential land in Blakeview, Playford North and Penfield.

Given its existing limited potential and the difficulties of creating new residential areas in Virginia, is anticipated residential growth in Virginia will be slow, irrespective of Buckland Park.

Angle Vale also has limited growth potential, but in any case as a predominately large lot residential area, it will not compete with Buckland Park, and vice versa.

Buckland Park has an area of 1,308 hectares. Excluding land needed for roads, non-residential uses and environmental constraints, there will be approximately 600 hectares of residential land, capable of accommodating 12,000 dwellings.

Detailed planning of future stages will confirm yields, but at this stage in the design process, these figures have been adopted for planning purposes.

Buckland Park will accommodate a range of neighbourhood and dwelling types, at different densities

An average of 480 dwellings are expected to be constructed per annum at Buckland Park, and this figure has been used to inform transport, centres and services planning. However, the actual rate achieved will be influenced by a combination of factors, including the strength of demand and the creation of other new suburbs.

Buckland Park will provide housing which suits a range of people and households in different age and income brackets, so a range of housing types is planned. Detailed design of future stages will undoubtedly include changes and refinements, however, will be guided by the Masterplan.

Housing and allotment types range from large detached housing, to attached housing, apartments and shop top housing. The proportion of detached to attached housing is similar to the mix achieved over Metropolitan Adelaide, with a slightly higher emphasis on detached housing.

The desired character of new neighbourhoods, and the accessibility to centres and public transport will inform the final mix of housing within each stage, however, this processes will be guided by the Masterplan.

The housing mix provides for a wide cross-section of the community, and reflects the ability of Buckland Park to accommodate a wide range of housing types, at different prices, as a result of its significant scale.

Medium density housing is more likely to be provided in later stages when Buckland Park's centres and services are more established.

In summary, Adelaide's Greater Metropolitan Area requires substantial quantities of new housing over the next 30 years. 30%- 40% will be provided in new suburbs.

Buckland Park will make a major contribution to the provision of the required housing.

6. REFERENCES

Connor Holmes *Buckland Park Demographics Report* 2008

Connor Holmes *Buckland Park Planning Report* 2008a

Connor Holmes *Buckland Park Centres Planning* 2008b

Connor Holmes *Buckland Park Social Analysis* 2008c

Connor Holmes *Buckland Park Affordable Housing* 2008d

South Australia Government *Planning Strategy for Metropolitan Adelaide* December 2007

Department of Planning and Local Government (DPLG) *Forecast Dwellings in Greater Adelaide by Statistical Local Area and State Government Region, 2007 to 2021*

Department of Planning and Local Government (DPLG) *Forecast Population and Dwellings for Greater Adelaide, 2006 to 2036*

Minister for Urban Development and Planning, *Directions for Creating a New Plan for Greater Adelaide, 2008*

RP Data – Valuer General, Residential and Vacant Allotment Sales

7. GLOSSARY

ERP Estimated Resident Population

LGA: Local Government Area

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European Heritage Assessment Report

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BUCKLAND PARK

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For Walker Corporation

Directed through:
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Cover: Early photograph of boats on the Gawler River (Courtesy of City of Playford Local History Service).

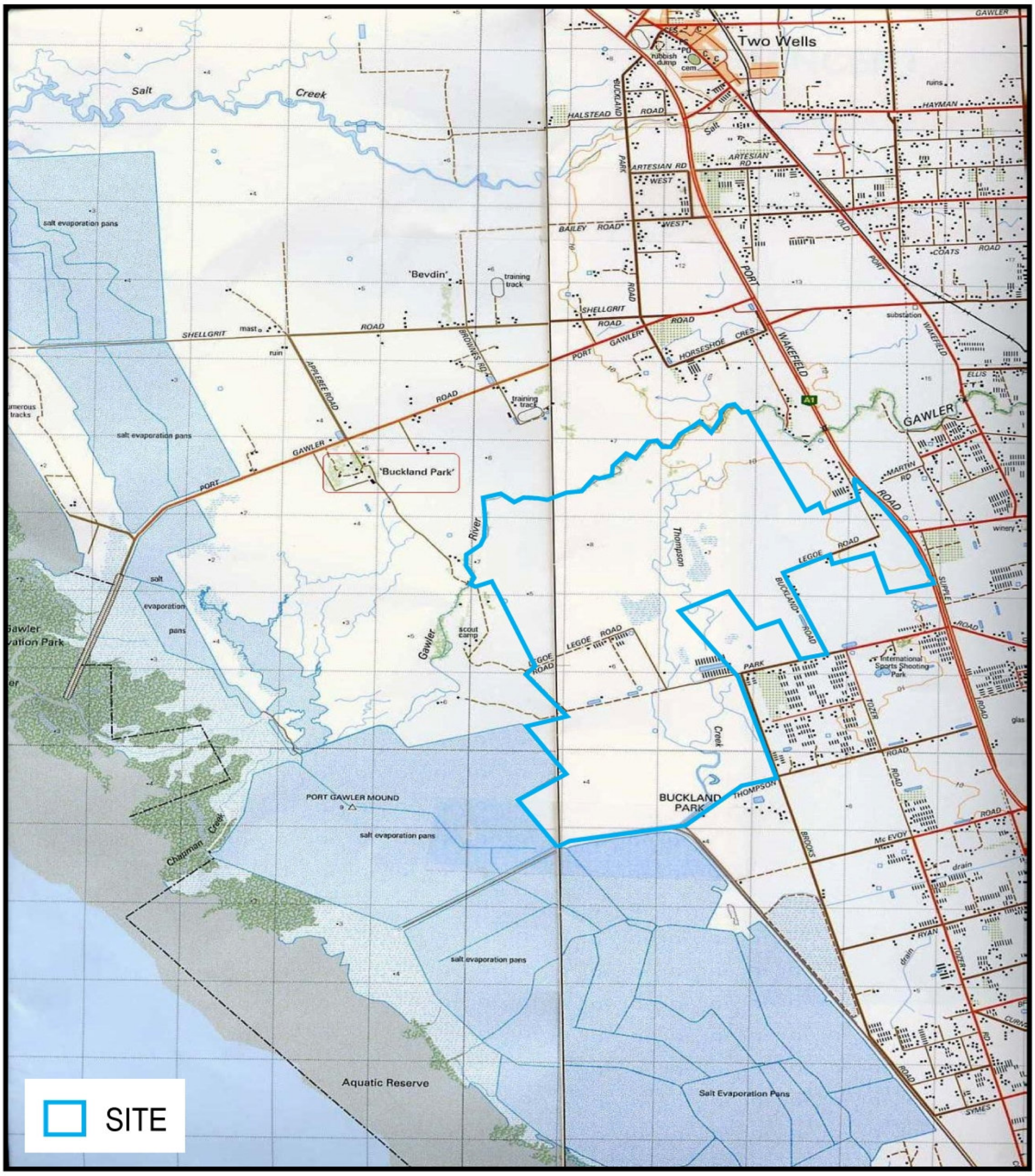
1. INTRODUCTION

1.1 Background

The history of the Buckland Park area subject to this study revolves largely around the Buckland Park homestead. Although the property lies outside of the boundaries of the site being situated off Port Gawler Road, it remains significant to the general area. The estate is located northwest of the Gawler River and since being subdivided some 15 years ago, its buildings are now sited on different properties under different ownership.

As it lies outside the site (refer map on next page), the Buckland Park homestead does not have any implications for the proposal; however, as the project derives its name from the homestead, and as it is the only site of European heritage interest west of the Port Wakefield Road, a discussion of its history is warranted in order to be able to address historical factors during the life of the development of the area.

This is undertaken first, followed by an assessment of the heritage significance of the general region, followed by conclusions of the relevant heritage issues.



Map 1: General locality showing the Buckland Park Homestead site outlined in red & the site outlined in blue.

2. METHODOLOGY

The methodology applied for the production of this report involved:

- A search of relevant archival material and published literature (as cited in the References at the conclusion of this report);
- A search of the relevant materials held by the City of Playford Council and the City of Playford library;
- A search of the National, State and local Heritage Registers;
- Telephone interviews with long-term resident of Virginia and knowledgeable local, Ms Raelene Besnard;
- Analysis of the data to identify any impacts on heritage issues as a result of the Township's creation, and
- Making recommendations regarding the European heritage of the study area.

3. BUCKLAND PARK HOMESTEAD

3.1 The land

The attractiveness of the Adelaide Plains for early settlers and agriculturalists lay not only in the lightly wooded countryside, but the land was generally 'level for the plough and a deep soil too' (Davenport 1843, cited in Williams 1974:128). Not only were the Plains suitable for growing crops, but also 'well suited for depasturing sheep' (Morphett 1837, cited in Williams 1974:128).

However the advantage of accessibility was offset by the heavy demand for wood for housing (largely framework and roofing shingles), fires and fencing, which with the burgeoning population soon created a timber cutting industry centred in the Mount Lofty Ranges where the preferred stringy bark was in supply (Williams 1974:130). Concern at the rapidity of deforestation led to the introduction of a licence, fees for which were increased to £20 by 1849. Felling was hard to police however and black marketeering developed in response to this heavy impost (Williams 1974:131).

This was the case to the north of Adelaide in the general region of the study area, where in the 1850s Daniel Parker of Virginia:

> …found that 400 acres that he had bought had "nothing left on the land but a host of stumps, being so completely stripped of timber". There was not enough wood for him to fence his land (Correspondence of the Surveyor General's Office 1116/1857, cited in Williams 1974:132).

The area of most impact from deforestation in the vicinity of the study area was at Peachy Belt, where a peppermint gum forest stretched 'between the Para River and north of Gawler, along the foothills zone', which had all but disappeared by 1880 (Williams 1974:133-134).

Nevertheless, despite the severity of the deforestation on the Adelaide Plains, the inferior quality of the majority of the other species of eucalypt for construction and indeed even fuel, such as river red gums and blue gums, led to the reprieve of some large stands of these species, as evidenced by the number of significant trees still extant along the banks of the Gawler River.

The land adjacent to the Gawler River was desirable for its rich soil which was brought about by its regular and severe inundation from flooding of the river. This flooding however posed a problem for the maintenance of agricultural pursuits. While Buckland Park homestead stands on a 'loamy rise immune from flood, about a mile from the river and two miles from the sea beach' (*Pastoral Homes of Australia* c.1927:14), the larger part of the estate was subject to flooding.

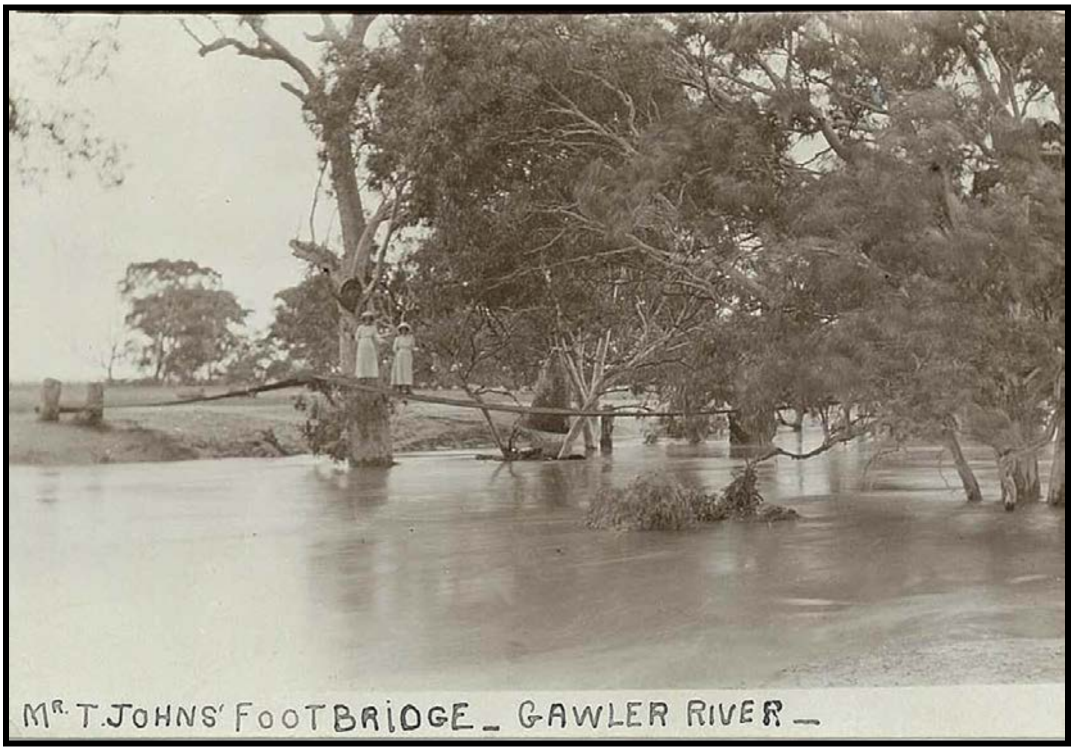


Figure 1
Mr. T Johns' Footbridge (c. 1890s) - Gawler River in flood
(Photo Courtesy of City of Playford Local History Service)

Figure 2
Gawler River in flood, Port Wakefield Road, 1992
(Photo Courtesy of City of Playford Local History Service)

3.2 The beginnings of Buckland Park Estate

Following the proclamation of the State of South Australia in 1836 the Government introduced a system of special surveys in which a settler would pay the Government to survey a large acreage and choose a portion of the surveyed land for his own use. This was the case for Buckland Park (Baker 1976:1, LH VIRI HI00001-00005), which was firstly called 'Milner Estate' by owner Mr G. Milner Stephen, a former Advocate General, Acting Governor, then Colonial Secretary[1]. This particular land, comprising 20,000 acres and 'extending from a frontage of 15 miles to St. Vincent's Gulf and back along the Gawler River to the vicinity of the townships of Two Wells and Virginia' (*Pastoral Homes of Australia*:11) was chosen by Stephen for its fertile river frontages.

[1] He was also a son-in-law of Captain Hindmarsh, the first Governor of South Australia (Allery and Trimboli 1999:15).

The property remained undeveloped, however, until it was purchased in 1838 by Captain John Ellis, a retired merchant seaman who had amassed a fortune transporting tea from the East to England and Captain William Allen of the East India Company, who later became a founder of St. Peter's College (LH VIRI BU00001-00055:70). It was Allen who renamed the property Buckland Park after its English counterpart, a coursing icon. Circumstances surrounding the transaction led to criminal proceedings against Stephens, but the details of this are unknown (Cockburn 1908).

As the story goes, Captain Ellis hoped to increase his wealth through farming in South Australia in order to buy back an English estate he had expected to inherit from an uncle who broke his promise and left it to his butler (LH VIRI BU00001-00055:70). He and Captain Allen met on the voyage to South Australia, where they agreed to enter into business partnership.

The first residence was a brick dwelling built on the hill above the present Buckland Park house on the Gawler River. The bricks used in its construction were imported as ballast in Captain Ellis' ships and some of the bricks which were used to build dams in the river may still be in situ (Pastoral Pioneers of South Australia, LH VIRI BU00009:70). The homestead proper was built in 1842 and 'beautiful gardens and a deer park were laid out by Ellis' in 1855 (Allery and Trimboli 1999:15; Buckland Park: Report of the National Estate LH VIRI BU000010:166). The deer park later became known as a 'kangaroo and deer farm' and was located at the entrance to the property.

In 1856 the property was sold to brothers Dr William John Browne and Dr John Harris Browne, who became prominent figures in the pastoral industry (Allery and Trimboli 1999:15, *Pastoral Homes of Australia* n.d.:11). Indeed they were among the largest and most successful pastoralists in South Australia and used the Buckland Park estate to fatten stock for their properties located further in the north of the State. In the 1870s Buckland Park was also acting as a stud farm for Clydesdale and Suffolk horses and besides many thousands of sheep, was reported to run 150 Clydesdale and 11 Suffolk mares (*The Register* 9 September 1873, p.14, col.B). William Browne's son Leonard Gilbert Browne acquired Buckland Park in 1885 and passed it over to his cousin, attorney Tom Landsdowne Browne three years later when he moved to England to live.

While the township of Virginia had become established around the stately Virginia Park homestead, built in 1860 (Zeigler 1927:164), it soon became a centre for agriculture. Its first major product was hay, as horsepower was used to a large extent in Adelaide, particularly by the Tramways Trust, horse-drawn trams being the major means of public transport for many years (Farming and Early Settlement [in the Virginia Area] n.d. LH VIR1 AG00001). By 1874, the produce of the area had expanded to include vegetables and the Virginia Show was a noted event. As reported in the *Observer* (6 August 1874) the agricultural show that year:

> …(t)aking all things into consideration, … might be pronounced a success, for although competition in some departments was not so lively as could be desired, the exhibits were in most cases of a superior character and the visitors were in general highly pleased with what came under their view.

In 1901 the Duke and Duchess of York (later King George V and Queen Mary) visited Buckland Park to shoot peacocks (Baker 1976:3, Buckland Park: Report on the National Estate LH VIRI BU00010:166). People of the staging post of Virginia, which serviced the Stage Coach route between Adelaide and Port Wakefield, lined the streets waving flags (Baker 1976:3). The presence of the royal carriage escorted by police troopers on horseback would have constituted a landmark occasion for the region.

Buckland Park as a suburb was formally subdivided into allotments in 1905, but not developed immediately (*see:* Figure 6 Subdivision Plan at the end of this report – Buckland Park Estate Subdivision Sale 1905, City of Playford Library Map 329).

In 1910 the Buckland Park estate left the ownership of the Browne family after 54 years when it was sold to Edmund Brookes and his father George (Allery and Trimboli 1999:15). This ushered in a new era for the development of the Buckland Park estate, which was also impacted by the coming of the railway to Virginia in 1914 and the bitumising of the Port Wakefield Road in 1922 (Baker 1976:3).

3.3 Buckland Park under the Brooks family

George Brooks had a life-long association with the pastoral industry and owned many pastoral properties in South Australia. On his death in 1926 ownership of Buckland

Park was retained solely by his son Edmund. Edmund was born in Inkerman, South Australia in 1877 and married Freda Bretag of Victoria, owner of Wootoona Station near Quorn, S.A. (*Pastoral Homes of Australia* c.1927:21).

The present red brick homestead appears to have been added to since its first construction and again at the time that the Brooks took over the property. The complex includes station hands' and manager's houses, shearing sheds, coach houses (dating from approximately the 1880s) and an old school (Heritage Survey Identification Sheet (Item Reference No. 30, Department for Environment and Heritage).

Edmund Brooks studied and experimented with flood tolerant fodder grasses and using 'hundreds of tons of concrete and sheet lead' (*Pastoral Homes of Australia* c.1927:12), erected flood gates to prevent the inundation of the larger part of his pasturage. This allowed the control of flooding, such that soil quality could be maintained by opening the floodgates to water and closing them while raising crops and grazing, hence elevating productivity. The property was naturally fertilized by the organically rich silt deposited by the Gawler River in those times in which it did flood across the low lying lands of the region (*cf.* Garden and Field June/July 1910:V111).

Brooks was also responsible for the planting of 'thousands of native trees' (*Pastoral Homes of Australia* c.1927:14), and Buckland Park was noted for its majestic river red gums, beneath the shade of which Mr and Mrs Brooks 'entertained members of the Empire Press Delegation in 1925 in a large marquee erected on the spot' (*Pastoral Homes of Australia* c.1927:14).

By the late 1920s Buckland Park had also become noted for hunting and shooting as the '"red coats" derive great pleasure in running the fox to earth and securing the coveted brush' (*Pastoral Homes of Australia* c.1927:14). At this time some 2000 head of cattle and 12,000 sheep were run on the property.

Brooks was also responsible for developing a breed of sheep that could withstand footrot, the major adverse effect of flooding on livestock. He did this by crossing Suffolk rams with Polwarth ewes. These sheep produce a fleece with a similar count to Merino and therefore of high quality (*Pastoral Homes of Australia* c.1927:18).

Buckland Park remained in the Brooks family until well into the 20th Century. By the 1960s it was reduced from the original 20,000 to 12,000 acres, but was still running deer, as an article in *The Advertiser* reported that:

> … with the full support of Buckland Park managing director, Mr. Malcolm Brooks', patrols from the Sporting Shooters Association of Australia were mobilising to protect the 'unique herd of deer' being shot out by poachers (LH VIRI BU00011).

Figure 3
Buckland Park Homestead
(Photo Courtesy of City of Playford Local History Service)

Figure 4
Buckland Park Homestead
(Photo Courtesy of City of Playford Local History Service)

Figure 5
Buckland Park Coachhouse
(Photo Courtesy of City of Playford Local History Service)

3.4 More recent times

By the 1960s considerable investment had been made in capital improvements for market gardening in the region, which held 6,500 of the State's 10,000 glasshouses and which produced tomatoes to the value of £1,000,000 (Capital Outlay on Buildings in the Virginia Area. n.d. - LH VIRI AG00008). By the 1970s produce was being exported to the United Kingdom (*The Advertiser* 17 July 1970 - LH VIRI AG00011) and a Virginia-based company had developed its own onion harvester (Chronicle 30 March 1973 - LH VIRI AG00012). By the early 1980s Virginia was such an important centre for market gardening that the Agriculture Department set up a permanent office there (*News Review* 25 November 1981 and 28 April 1982). Virginia and its surrounding districts today remains a renowned centre for market garden produce, which is what much of the Buckland Park Township project area has been utilised for over considerable time.

By the 1960s water was becoming an issue, due to an increase in the number of bores having been drilled by landowners to access the lower aquifer for irrigation. This led to the enactment of the *Underground Waters Preservation Act* 1969 by the Government in an attempt to control the use of water. In addition, a reclaimed water project was set up to experiment in the levels of salinity tolerable by crops (Virginia Experimental Gardening and Pasture Plots - LH BOL1 IR00036).

Crops at this time included potatoes, onions, root crops, celery, cabbage and cauliflower, lettuce, tomatoes, melons, pumpkin and flowers.

In 1967 Elders-GM advertised the auction on Friday 6 October of 'Historical Freehold Pastoral Property Buckland Park', representing 17,431 acres suitable for 'grazing, cereal growing, fat lambs, market gardening with the potential for further development and subdivision' (*Stock Journal,* 24 August 1967 - LH BUC1 NC0000). The sale did not occur however, the Brooks family continued to retain ownership into the 1990s (*pers. Comm*. Tom Gara). It was also announced that the Buckland Park beach frontage was to be purchased by the South Australian Government to be managed by local councils, which included Gawler, Elizabeth, Mallala, Mudla Wirra, Barossa and Munno Para (*News Review*, 4 October 1967).

According to long-standing resident Mr R. Sanders, who was interviewed in 1972 (City of Playford Library), the main families in the district at that time were the Ryans, Bradys, Sheedys, Maloneys, Taylors, Johns and Rohans, all of whom were represented in Virginia in the 1970s.

By the 1970s the Bolivar sewage treatment works were also causing some controversy. Effluent from the works was being fed into the ocean and affecting the St. Kilda coastline and large areas of sea grass and mangroves were noted to be disappearing (*Sunday* Mail, 20 June 1976 and *News Review*, 16 March 1977). Possibly as a result of this and the over-exploitation of underground water sources, the Minister of Works announced in 1977 that water from the Bolivar works would be made available for use on the Northern Plains (*The Advertiser,* 21 December 1977 - LH BOL1 IR00045). The proposal seems to have generated some controversy however, with the Munno Para District Council branding the proposal as 'impractical and too expensive', due to the need to lay separate pipes from the Bolivar Effluent Channel to vegetable gardens in the area (*New Review,* 15 February 1978 - LH BOL1 IR00045).

Despite this the Bolivar works continued to discharge effluent into the ocean, which according to local fishermen had ruined the fishing industry at St. Kilda (*News Review,* 31 May 1978 - LH BOL1 IR00045).

Market gardening continued in the region over the decades until in 1994 consideration was given to rezoning the land of 'the historic Buckland Park property near Virginia' (*News Review,* 21 June 1994, p.1 - LH BUC1 NC0000). Munno Para Council gave its blessing to the idea of rezoning Buckland Park for rural/residential living, opening the way for the subdivision of approximately 1600 hectares into about 1,000 hobby farms. The estate was noted as 'the largest tract of privately owned country left for development in metropolitan Adelaide'. Later in the same year the naming of the suburb of Buckland Park was proposed (*The Bunyip,* 14 December 1994 - LH BUC1 NC0000), the last in the Munno Para Council area to be named (*The Bunyip,* 21 December 1996 - LH BUC1 NC0000).

The hobby farm idea did not reach fruition, as in 1996 the Buckland Park property was offered for sale in seven lots, four of which sold. It was noted in the sales material that the Buckland Park buildings and scenic areas along the Gawler River had been used as settings to make a number of movies, although exactly which ones was not specified (*The Bunyip,* 25 September 1996, p.2 - LH BUC1 NC0000).

In 1997 it was proposed to convert the double-storey shearers' quarters into quarters for a farm camp for school children, where they could get a taste of farm life (*The Bunyip,* 12 February 1997, p.7 - LH BUC1 NC0000). This appears to have been deferred however, as later in the year a mushroom farm was developed on the property. The farm grew Agurigus mushrooms for export and for domestic use and was seen at the time to be something of a tourist attraction (*The Bunyip,* 17 December 1997, p.33 - LH BUC1 NC0000). The mushroom farm was not popular with the locals however and was shut down a year later due to various objections (*The Bunyip,* 2 December 1998, p.2 - LH BUC1 NC0000).

In March 1997 the Buckland Park homestead was put on the market. The property's use at the time was described as 'a private home', and as having been built in 1870 (*The Bunyip,* 26 March 1997, p.43 - LH BUC1 NC0000), but this date probably reflects the nature of additions to the original dwelling.

Buckland Park homestead was originally situated within the council area of Munno Para until that council merged with Playford in 1997 to form the City of Playford, under which auspices it has remained since that time.

Notably in 2001 Jackie Billie Kochergen, director of Seabreeze Farms, pleaded guilty to clearing native vegetation – six river red gums – at Buckland Park in 1999, which were more than 200 years old (*The Advertiser,* 15 February 2001, p.49 - LH BUC1 NC0000).

Despite various attempts at mitigation in earlier times flooding of the property remained a problem. A flood occurred in September 2001 and emergency services workers worked to plug a two metre hole in a Gawler River levee in order to save the 'historic' Buckland Park homestead (*The Advertiser,* 11 September 2001, p.14; *The Bunyip,* 12 September 2001, p.10 - LH BUC1 NC0000).

4. HERITAGE REGISTERS

4.1 The National Estate

The Buckland Park homestead still exists and is owner-occupied. The property was subdivided 15 years ago. Despite its rich heritage, the homestead is not considered of such architectural or cultural value to warrant its registration on the National Estate (*pers. comm*. Sarah Lawrence, Department for Environment and Heritage, Natural and Cultural Heritage). Nevertheless, it was considered to have been of sufficient heritage value to be listed on the Register of the National Estate at some point, as it is listed as one of the South Australian sites 'sent to Canberra for registration with the National Heritage Commission' in 1977 (*News Review,* 13 May 1977 - LH MPG1 NC00026).

4.2 State and local heritage

In 1982 the homestead was recommended for placement on the State Heritage Register but no action was taken as it was deemed that the homestead did not meet the criteria for the State Register. Even though it is considered architecturally interesting, there are many other places already on the Register like it and considered to be of greater heritage value. A new Act is due to come into force yet according to the Department of Environment and Heritage it remains unlikely that the Buckland Park Homestead would meet the criteria of the new Act either (*pers. comm*. Sarah Lawrence).

Similarly the homestead does not feature in any local heritage reviews (in particular in McDougal & Vines' City of Playford Heritage Review, December 2001), nor does it rate mention in Pikusa's *The Adelaide House* (1986).

My research has included a phone conversation with Ms Raelene Besnard by myself in the first instance and then by my colleague, Dr Suzi Hutchings. Ms Besnard, a long-term resident of Virginia and knowledgeable local, has failed to identify any sites of European heritage significance within the boundaries of the Buckland Park Township site.

Ms Besnard remembers with fondness the Adelaide Hunt Club located at Buckland Park in the late 1950s when the property was still owned by the Brooks family. She also remembers that one of the old homes on the original property was named Ilya. It had workers cottages in close proximity and a feature of the building was a large ballroom. In more recent times the old home has been used as recreation refuge for members of the disabled community.

4.2 Other registered sites in the vicinity of the study area

All other sites of European heritage significance are located on the eastern side of Port Wakefield Road and relate to the area around Virginia. They represent 15 places of local heritage value identified by the Department of Environment and Natural Resources South Australia *City of Munno Para Heritage Survey* (Laurence & Weidenhofer 1996), namely:

- Homestead, 'Virginia Park', Broster Road.
- Farmhouse, Section 7578, Johns Road.
- Our Lady of the Assumption Catholic Church, Leach Street, cnr. Penfield Road.
- Former Railway Cottages, Leach Street, cnr. Brady Street.
- Virginia Institute, Old Port Wakefield Road.
- Virginia Post Office, Old Port Wakefield Road.
- Wheatsheaf Hotel, Old Port Wakefield Road.
- Virginia Oval, Old Port Wakefield Road.
- Farmhouse, Section 7569, Old Port Wakefield Road.
- House, Section 3035, Penfield Road.
- Virginia Methodist Church (former Bible Christian Chapel), Phineas Street.
- Virginia Uniting Church (former Methodist Church), Phineas Street.
- House, Ridgeway Road.
- House, 'Almond Grove', Section 3009, Robert Road, cnr. Maloney Road.
- House, 'Calvin Grove', Section 3083, Taylors Road (Laurence and Weidenhofer 1996:289-290).

5. CONCLUSIONS

Extensive research failed to identify any existing sites of European heritage significance within the boundaries of the site.

As noted, the nearest and most relevant site is Buckland Park homestead, which is situated outside of the site. Given its prominence in the State's early history and in the pastoral industry, it is disappointing that it is not considered of sufficient value to be included in any of the local, State or National Registers of heritage places.

The absence of places of European heritage indicates therefore that there are no impediments to the proposal in this regard.

Appended to this report is a list of names that have arisen out of the research which may be considered when naming places within the development.

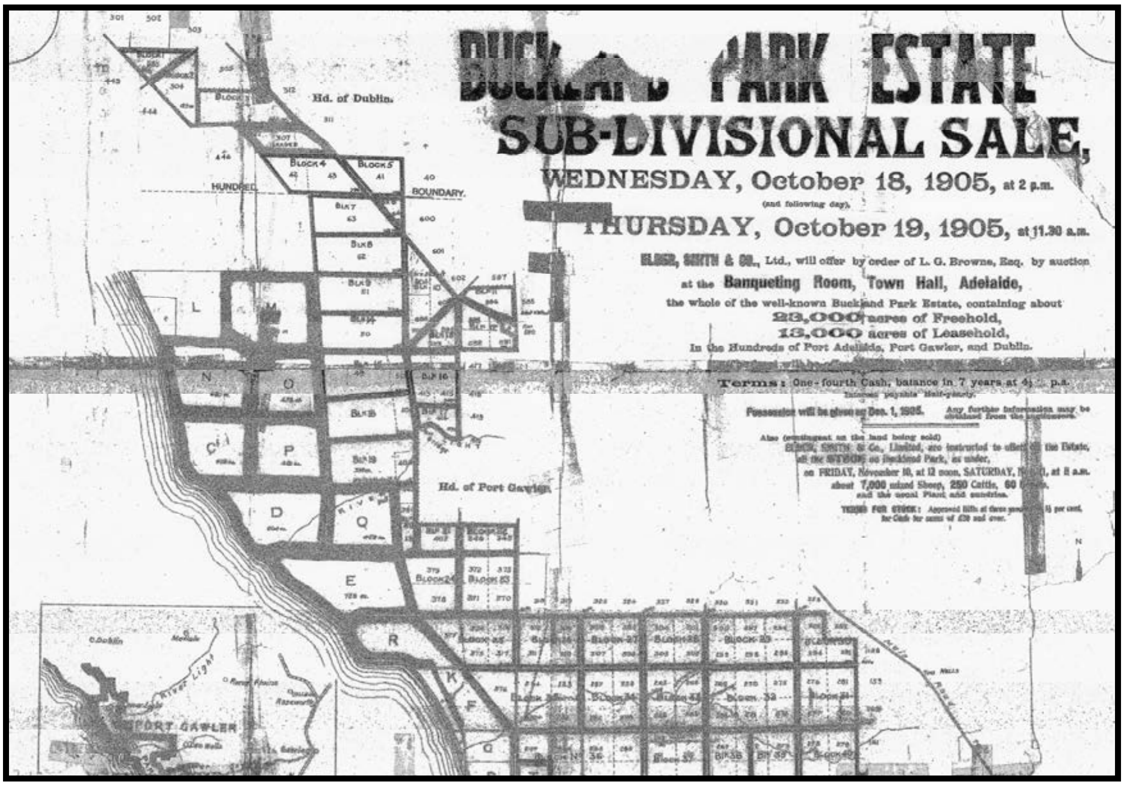


Figure 6
Buckland Park Estate Sub-Division Sale Map, 1905
City of Playford Library, Map 329

6. APPENDIX 1: NAMES ARISING FROM RESEARCH

Early names:

Milner Estate

G. Milner Stephen

Captain John Ellis

Captain William Allen

Dr William John Browne

Dr John Harris Browne

Leonard Gilbert Browne

Tom Landsdowne Browne

Mr Fisher

George Brooks

Edmund A. Brooks

Freda Bretag

Later:

Malcolm Brooks

Hector Brooks

Chris Brooks

Ryans

Bradys

Sheedys

Malonehys

Taylors

Rohans

7. REFERENCES

Allery, Linda and Trimboli, Grace. 1999. *City of Playford A Brief History*. City of Playford.

Baker, R.K. (Donated by). LH VIRI HI00001-00005. City of Playford Library. 1976. History of Virginia. Ms presented by Mrs. J. E. Reed. Librarian's note: Probable Author Mr Albert Hatcher, father-in-law of Mrs Reed, Salisbury.

Buckland Park: Report on the National Estate. n.d. LH VIRI BU00010. City of Playford Library.

Capital Outlay on Buildings in the Virginia Area. n.d. LH VIRI AG00008. City of Playford Library.

Chronicle. 30 March 1973. Locally-developed onion harvester. LH VIRI AG00012. City of Playford Library.

Cockburn, Rodney. 1908. *Nomenclature of South Australia*. Adelaide : W.K. Thomas & Co., Printers, 1908

Farming and Early Settlement [in the Virginia District]. n.d. LH VIRI AG00001. City of Playford Library.

Garden and Field, June 1909; July 1909 & May 1910, Publication held in the South Australian Collection at the State Library of South Australia.

Heritage Survey Identification Sheet (Item Reference No. 30) under the SA Heritage Act 1978-80. Department for Environment and Heritage.

Laurence, S. and Weidenhofer, T. 1996. City of Munno Para Heritage Survey. City of Munno Para/Department of Environment and Natural Resources.

McDougall and Vines. December 2001. City of Playford Heritage Review. Unpublished report for the City of Playford.

News Review. 4 October 1967 p.3. LH BUC1 NC0000. City of Playford Library.

News Review. 16 March 1977. Marine researcher Mr Chris Illert this week supported fears for the St. Kilda coastline because of effluent from Bolivar.

News Review. 15 February 1978. LH BOL1 IR00045. City of Playford Library.

News Review. 31 May 1978. LH BOL1 IR00045. City of Playford Library.

News Review. 25 November 1981. Agriculture Department at Virginia. LH VIRI AG00019. City of Playford Library.

News Review. 28 April 1982. Agriculture office for Virginia. LH VIRI AG00019. City of Playford Library.

Pastoral Homes of Australia. c.1927. The Pastoral Review, Sydney and Melbourne.

Pastoral Pioneers of South Australia. n.d. LH VIRI BU 0009. City of Playford Library.

Pikusa, S. 1986. *The Adelaide House*. Wakefield Press, Netley SA.

Reddin, B. 1985. *My Mother Said: An anecdotal history concerning South Australia from 1838 to 1910.*

Stock Journal. 24 August 1967. LH BUC1 NC0000. City of Playford Library.

Sunday Mail. 20 June 1976. The coastline around where water from the Bolivar sewage treatment works flows into St. Vincent Gulf is changing.

The Advertiser. 17 July 1970. Celery a U.K. hit. LH VIRI AG00011. City of Playford Library.

The Advertiser. 21 December 1977. Bolivar effluent water to be made available for use on the Northern Plains. LH BOL1 IR00045. City of Playford Library.

The Advertiser. 11 September 2001, p.14. LH BUC1 NC0000. City of Playford Library.

The Advertiser. 15 December 2001, p.49. LH BUC1 NC0000. City of Playford Library.

The Bunyip. 14 December 1994, p.4. LH BUC1 NC0000. City of Playford Library.

The Bunyip. 21 December 1994, p.23. LH BUC1 NC0000. City of Playford Library.

The Bunyip. 12 February 1997, p.7. LH BUC1 NC0000. City of Playford Library.

The Bunyip. 17 December 1997, p.33. LH BUC1 NC0000. City of Playford Library.

The Bunyip. 26 March 1997, p.43. LH BUC1 NC0000. City of Playford Library.

The Bunyip. 2 December 1998, p.2. LH BUC1 NC0000. City of Playford Library.

The Bunyip. 12 September 2001, p.10. LH BUC1 NC0000. City of Playford Library.

The Observer. 6 August 1874. 'Virginia Show August 1874'. LH VIR 1 HI 00005. City of Playford Library.

The Register. 9 September 1873. P.14, col. B. 'Mr Fisher's stud at Buckland Park'.

Whitelock, D. 1989. *Gawler: Colonel Light's country town. A history of Gawler and its regions – the Hills, the Plains and the Barossa Valley*. Corporation of the Town of Gawler.

Virginia Experimental Gardening and Pasture Plots. n.d. LH BOL1 IR00036. City of Playford Library.

Williams, Michael. 1974. *The Making of the South Australian Landscape*. Academic Press, London.

Williams, B. 1991. *Two Wells: Then and Now*. A History of the Hundred of Port Gawler. Les Williams, Salisbury Plan.

Zeigler. 1927. *Review of the Lower North*. LH VIRI BU00024. City of Playford Library.

CONNOR HOLMES

BUCKLAND PARK PROPOSAL

DEMOGRAPHIC ANALYSIS

Prepared for
WALKER CORPORATION
& DAYCORP

March 2009

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1. INTRODUCTION

This report contains a demographic profile for the Buckland Park proposal. Specifically this report provides the following information:

- Dwelling types and densities;
- Dwelling occupation schedule;
- Population growth 2010-2036;
- Household size;
- Age profile;
- Car ownership;
- Household income;
- Employment profile of Buckland Park residents;
- Employment profile within Buckland Park.

This report considers demographic changes over the proposal's 25 year construction and occupation time frame. It is anticipated construction will commence in 2010, with the final dwelling occupied by 2036.

After 2036 the community will be established, although it will go through the demographic changes experienced in all urban areas.

The purpose of this study is to provide the demographic information required to plan for the progressive provision of community services and transport, water, sewerage and electricity infrastructure over the 25 year construction and occupation process.

2. METHODOLOGY

To create a profile of Buckland Park's future population, consideration has been given to the characteristics of the Adelaide Statistical Division (ASD), the Playford Local Government Area (LGA) and six suburbs also located in northern Adelaide with new or growing residential estates, specifically:

- Andrews Farm;
- Blakeview;
- Burton;
- Craigmore;
- Hewett;
- Mawson Lakes.

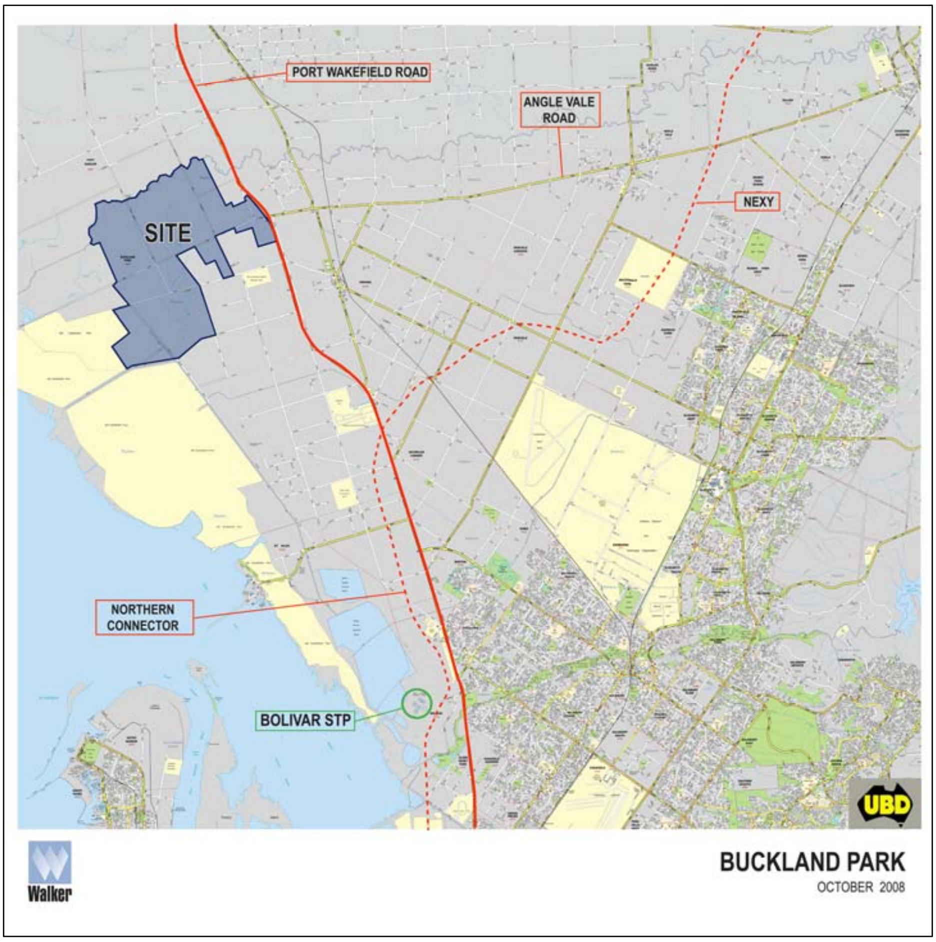
Australian Bureau of Statistics (ABS Census 2006) data provides the basis for the investigations contained in this report.

ASD data provides information on metropolitan demographic trends. Playford LGA provides a picture of the site's regional context.

The other suburbs considered provide an understanding of the demographics in new and growing suburbs in northern Adelaide. They have been used in this study to create a demographic profile of Buckland Park's future community.

Figure 2.1 shows the site's location relative to northern Adelaide.

Figure 2.1 Locality Plan



3. PROPOSAL OVERVIEW

The Buckland Park Master Plan is shown at Figure 3.1.

Figure 3.1 Buckland Park Master Plan

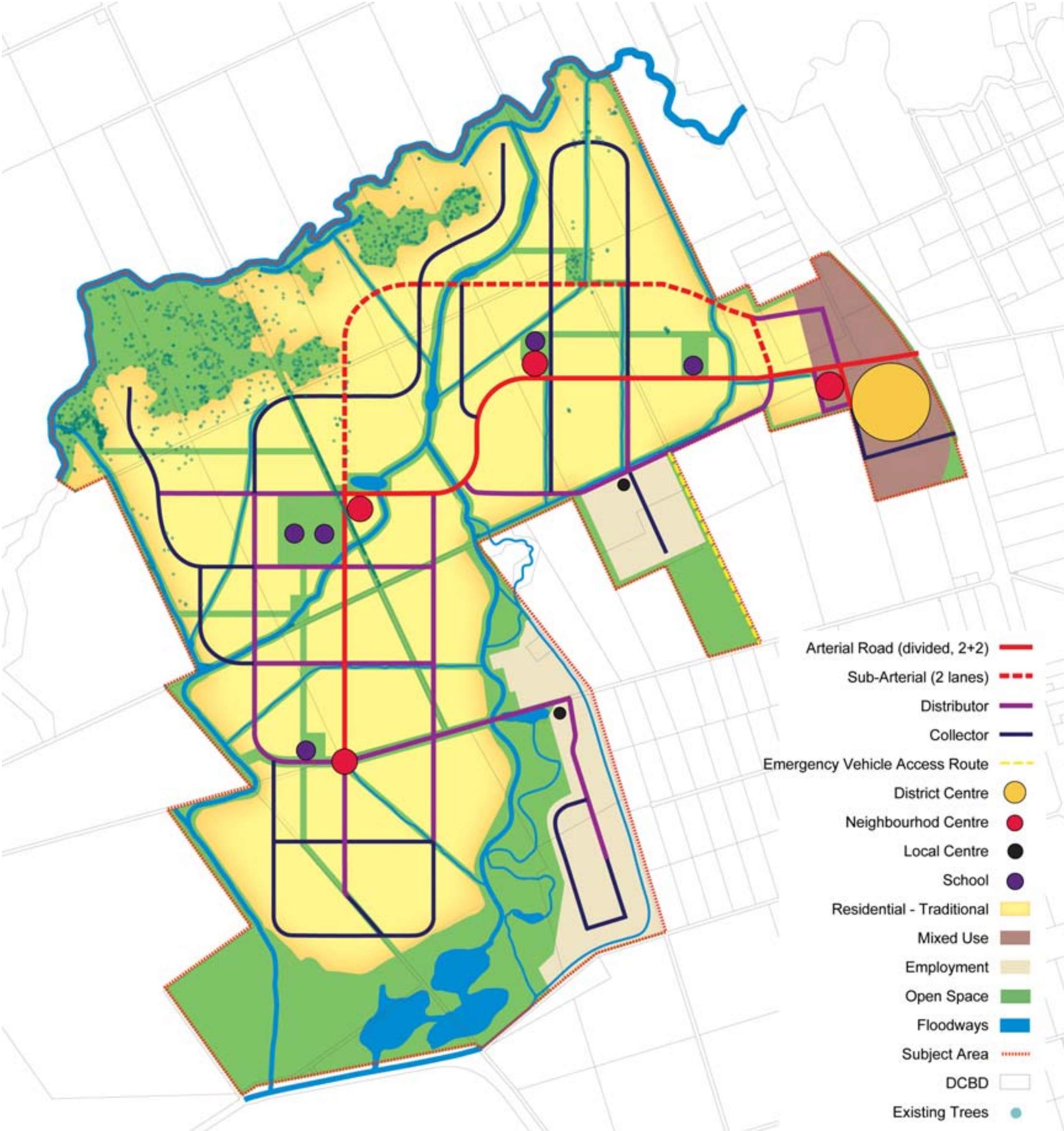


Table 3.1 below contains a summary of the planned residential precincts and densities. Higher density residential areas will be focused around centres and public transport routes, while lower density areas will be located where natural features, such as mature Eucalyptus trees near the Gawler River, must be accommodated in the master plan design.

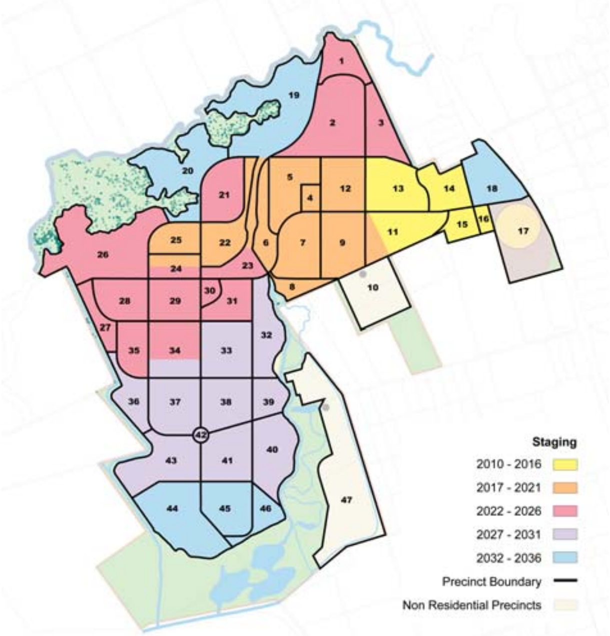
Table 3.1 **Dwelling Yields**

Location	Net Area Available	Net Density	Total Dwellings
Low Density Residential Villages	77ha	10	700
Traditional Density Residential Villages	449ha	20	8,580
Medium Density Clusters	61ha	40	2,320
Mixed Use Precinct	13ha	40	400
Total Dwelling Yield	600ha	22	12,000

Source: Connor Holmes

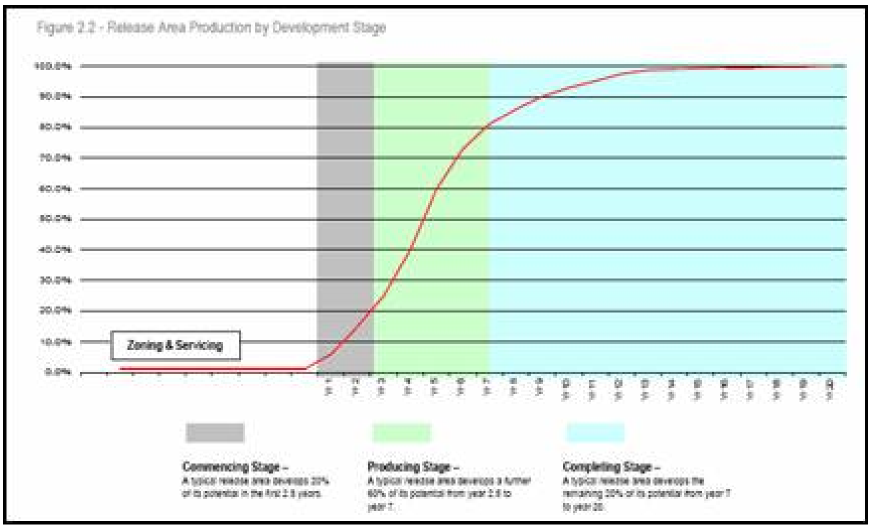
Construction and occupation of Buckland Park will occur over an anticipated 25 year time frame. Figure 3.2 illustrates the staging process.

Figure 3.3 Buckland Park Staging Plan



The normal rate of lot production for large land releases is slow in the early years, increasing as sales and production get into full swing, and slower at the end of the process as the final lots are sold. This is demonstrated in Figure 3.4.

Figure 3.4 Release Area Production by Development Stage



Source: NSW Dept. of Planning *Metropolitan Development Programme Update – 2007*.

This pattern of production has been applied at Buckland Park to determine the rate of the future population's growth, as demonstrated in Table 3.2 and Figure 3.5.

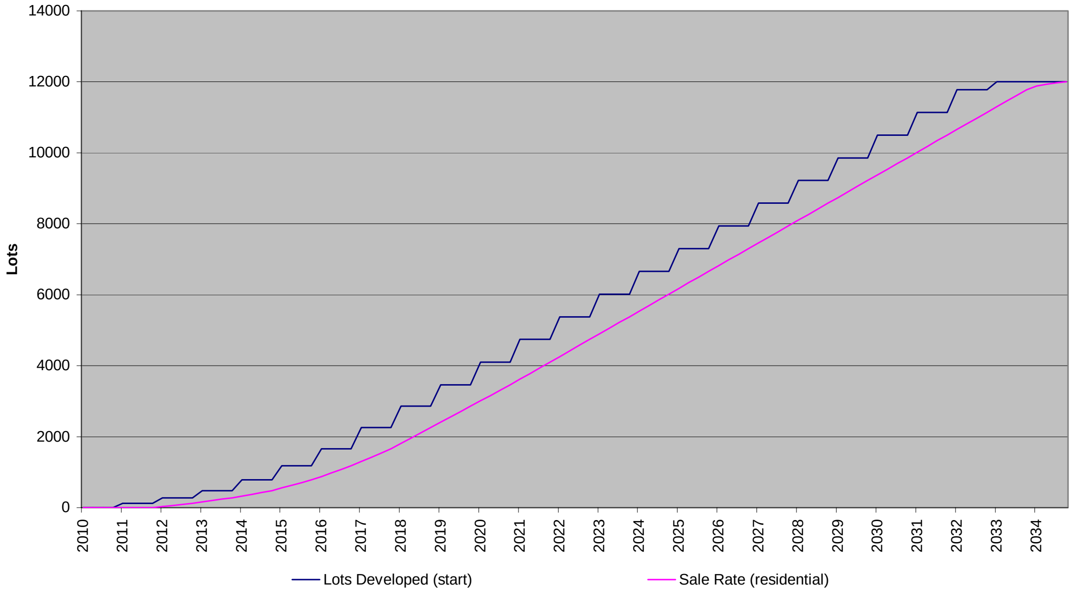
Table 3.2 below contains a summary of the projected number of lots created and dwellings occupied within Buckland Park from 2010 to 2036. It is expected that construction will commence in 2010 and the first dwelling will be occupied in 2013. Buckland Park is anticipated to be complete with a total of 12,000 dwellings by 2036.

Table 3.2 Construction and Occupation

Date	Lots Created	Lots Created Cumulative Total	Dwellings Occupied	Dwellings Occupied Cumulative Total
2010	0	0	0	0
2011	120	120	0	0
2012	160	280	0	0
2013	200	480	120	120
2014	300	780	160	280
2015	400	1,180	200	480
2016	480	1,660	300	780
2017	600	2,260	400	1,180
2018	600	2,860	480	1,660
2019	600	3,460	600	2,260
2020	640	4,100	600	2,860
2021	640	4,740	600	3,460
2022	640	5,380	640	4,100
2023	640	6,020	640	4,740
2024	640	6,660	640	5,380
2025	640	7,300	640	6,020
2026	640	7,940	640	6,660
2027	640	8,580	640	7,300
2028	640	9,220	640	7,940
2029	640	9,860	640	8,580
2030	640	10,500	640	9,220
2031	640	11,140	640	9,860
2032	640	11,780	640	10,500
2033	220	12,000	640	11,140
2034	0	12,000	640	11,780
2035	0	12,000	220	12,000

Source: Connor Holmes

Figure 3.5 Construction and Occupation



4. OCCUPANCY RATE

Table 4.1 compares occupancy rates by dwelling type across the comparison areas. Overall occupancy rates are significantly higher in new residential areas in northern Adelaide than the ASD. It is also noted that the Playford LGA has a higher overall occupancy rate than the ASD.

Detached dwellings have a higher occupancy rate than attached dwellings. The suburbs have detached dwelling occupancy rates in the range of 2.9-3.3 persons per dwelling, while the rates for the ASD and Playford are somewhat lower, 2.6 and 2.7 persons respectively.

In comparison, the occupancy rates for attached dwellings in the ASD and Playford are 53% and 35% lower than detached dwellings in each area respectively.

Occupancy rates for attached dwellings in the comparison suburbs should be treated with caution as they generally represent very small numbers of dwellings. However, in broad terms they affirm the ASD and Playford LGA trend of a lower occupancy rate than detached dwellings.

Table 4.1 Occupancy Rate by Dwelling Type: 2006 Census Data

Locality	Detached Dwelling	Attached Dwelling	All Dwellings
Adelaide SD	2.6	1.7	2.4
Playford LGA	2.7	2.0	2.6
Andrews Farm	3.0	-	3.1
Blakeview	2.9	1.3	2.9
Burton	3.0	2.2	3.0
Craigmore	2.9	1.5	2.9
Hewett	3.3	-	3.3
Mawson Lakes	2.8	2.1	2.7

Source: ABS Catalogue No. 2001.0

Based on the occupancy rates contained in Table 4.1 it is reasonable to expect an overall occupancy rate of around 3 persons per dwelling within Buckland Park. There are, however, two key factors which may reduce this figure.

With the exception of Mawson Lakes, new residential estates in the comparison suburbs generally comprise very high proportions of detached dwellings, so the detached house and overall occupancy rates are the same.

Buckland Park will offer a greater diversity of dwelling types, around 12% of housing is anticipated to be attached dwellings, and some 23% of housing is anticipated to be medium densities. This is expected to result in a lower overall occupancy rate than other new residential estates and therefore an occupancy rate of 2.75 persons per household has been adopted for Buckland Park's planning.

Secondly, occupancy rates may not remain fixed over the 25 year period. Household size has been in decline for some time, reflecting a number of social trends including:

- decreased fertility levels;
- decreased marriage rates;
- increased divorce rates;
- population ageing;
- increasing second home ownership.

Buckland Park's average occupancy rate could therefore be expected to decline by around 5% before it is completely occupied. This may be offset by the lower density residential precincts in the later stages of development. Consequently, it is expected that the average occupancy rate within Buckland Park will remain close to 2.75 persons per dwelling.

Table 4.2 provides the occupancy rate for Buckland Park at five year intervals.

Table 4.2 Dwelling Occupancy Rate

Year	Dwellings	Population	Occupancy Rate
2016	780	2,145	2.75
2021	3,460	9,475	2.74
2026	6,660	18,416	2.77
2031	9,860	27,158	2.75
2036	12,000	33,000	2.75

Source: Connor Holmes

5. CAR OWNERSHIP

Table 5.1 summarises car ownership per household in the comparison areas. In both the ASD and Playford LGA around half of all households own one or no vehicles, though the ASD has a slightly higher average ownership.

In the suburbs of Andrews Farm, Blakeview, Burton, Craigmore, and, in particular, Hewett, two vehicle households are most common and average car ownership is correspondingly higher than the ASD or Playford LGA. This reflects the location of these suburbs, the availability of public transport and the high proportion of two income families which can afford more than one car.

Mawson Lakes has a different car ownership profile to the other comparison suburbs, with an average car ownership lower than the ASD. This may be partially attributed to the lower household size in Mawson Lakes, which in turn is influenced by the provision of attached housing as well as the University Campus and associated student population.

Table 5.1 Car Ownership Comparison Areas 2006

Locality	No vehicles	1 vehicle	2 vehicles	3 or more vehicles	Average
Adelaide SD	10.9%	40.0%	35.6%	13.5%	1.58 vehicles
Playford LGA	13.9%	41.2%	31.7%	13.2%	1.50 vehicles
Andrews Farm	3.1%	35.0%	44.7%	17.1%	1.82 vehicles
Blakeview	3.6%	37.3%	44.4%	14.8%	1.77 vehicles
Burton	4.4%	33.8%	45.5%	16.3%	1.81 vehicles
Craigmore	3.1%	35.9%	45.0%	16.0%	1.76 vehicles
Hewett	0%	16.4%	63.8%	19.8%	2.09 vehicles
Mawson Lakes	2.7%	31.7%	51.6%	10.8%	1.50 vehicles

Source: ABS Catalogue No. 2001.0

Based on occupied private dwellings; households who did not state number of vehicles have been excluded.

Projections of car ownership per household in Buckland Park have been based on a similar rate to the suburbs. An overall car ownership rate of 1.75 has been nominated. This is the lower end of ownership rates in comparison suburbs, as it is anticipated that Buckland Park will have a higher proportion of attached dwellings and lower occupancy rate. Table 5.2. provides a summary of car ownership rates for Buckland Park.

Table 5.2 Car Ownership Buckland Park

Dwelling Type	Vehicles per Household
Detached dwellings	1.8
Attached dwellings	1.4
All dwellings	1.75

Source: Connor Holmes

It is difficult to project changes to car ownership over the construction and occupation period. Trends which may impact on car ownership rates within Buckland Park include:

- Fuel pricing and availability;
- Declining household size;
- Population ageing; and
- Public transport availability.

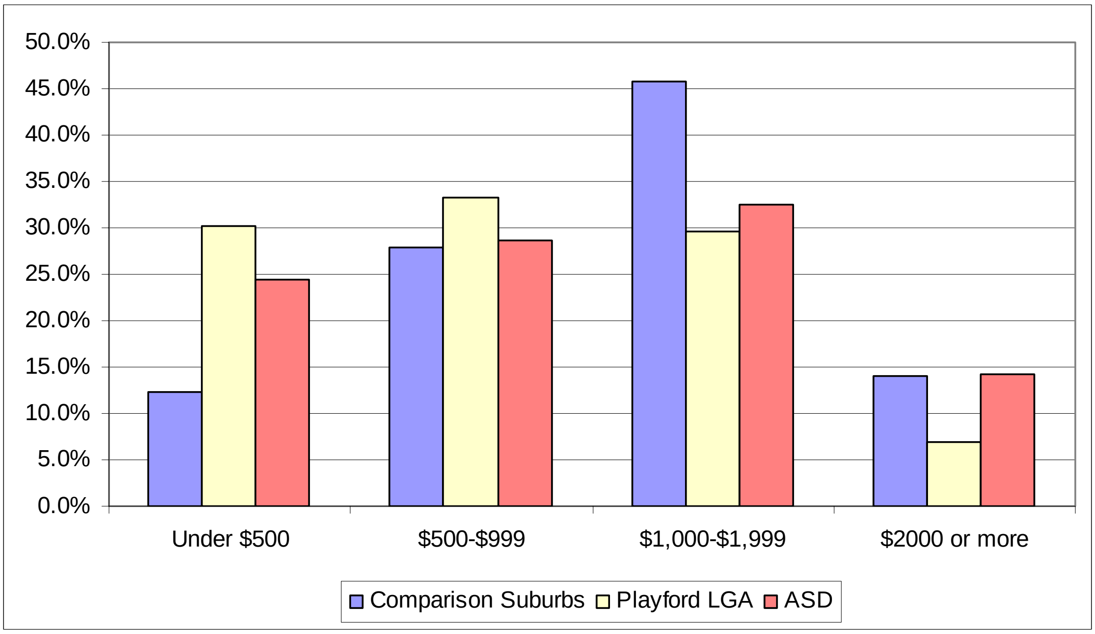
It is anticipated these trends will result in lower car ownership rates over time. However, it is considered the projected ownership rates given in Table 5.2 are suitable averages to be applied over the proposal's construction and occupation phase.

It is also noted macro environmental and economic factors, such as world oil prices and increasing concern over global warming, as well as new innovations in transport, may result in significant transportation changes to 2036 and beyond. It is not possible to accurately predict the nature of extent of such changes and they have not been considered in the Buckland Park projections.

6. HOUSEHOLD INCOME

Figure 6.1 shows household income levels in the comparison suburbs of Andrews Farm, Blakeview, Burton, Craigmore, Hewett and Mawson Lakes. Household income levels in these suburbs are generally higher than both the ASD and the Playford LGA.

Figure 6.1 Weekly Household Income Comparison Areas 2006



Source: ABS Catalogue No. 2001.0

Notably, there is less variation in income levels in comparison suburbs. Less than 15% of households have a weekly income of less than $500, similarly less than 15% of households have a weekly income of $2,000 or more. However some of the comparison suburbs have average income levels significantly higher than others. As shown in Table 6.1, Mawson Lakes and Hewett have average household incomes in excess of $80,000 per annum, whereas Burton and Andrews Farm have average household incomes of less than $60,000 per annum.

Table 6.1 Weekly Household Income Comparison Suburbs

	Andrews Farm	Blakeview	Burton	Craigmore	Hewett	Mawson Lakes
Under $500	11.6%	12.5%	16.6%	15.0%	4.3%	7.4%
$500-$999	32.2%	30.5%	33.4%	30.1%	16.6%	19.0%
$1,000-$1,999	48.7%	45.7%	42.4%	44.3%	54.4%	46.1%
$2000 or more	7.4%	11.3%	7.6%	10.7%	24.8%	27.5%

Source: ABS Catalogue No. 2001.0

Higher household income levels in comparison suburbs are also reflected in their tenure profile. Specifically, the majority of households in these suburbs are purchasing their home (e.g. 80% households within Hewett) and require sufficient income levels to service a mortgage. This compares with around 35% of households in the ASD in the process of purchasing a home.

In Buckland Park it is expected that income levels will vary considerably, reflecting the mix of house types (including affordable housing) and tenure types to be provided. Based on the above analysis and consideration of likely price points for different house types, average household income within Buckland Park is projected to be in the order of $70,000-$75,000 per annum.

7. AGE PROFILE

The age profile of an area has significant implications for dwelling types as well as the demand for human services such as schools, aged care facilities, open space and sporting facilities and medical services.

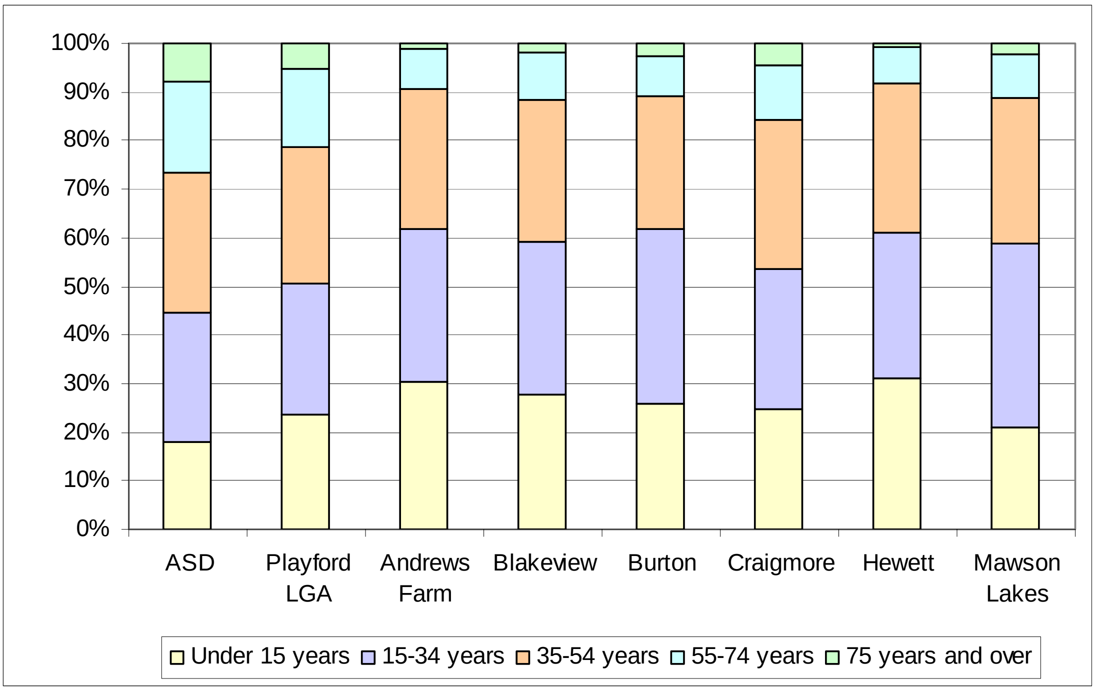
Table 7.1 and Figure 7.1 provide an age profile for comparison suburbs and demonstrate each has a younger age profile than the ASD. Playford LGA also has a greater proportion of children and smaller proportion of older people than the ASD. The suburbs of Hewett and Andrews Farm in particular have a very young age profile in comparison with the ASD, with over 30% of the population consisting of children aged less than 15 years and less than 10% consisting of persons aged 55 years and over. Other notable variations in age profiles include the lower proportion of children in Mawson Lakes (around 20%) and the higher proportion of older persons in Craigmore (around 15%).

Table 7.1 Age Profile Comparison Areas 2006

Age	ASD	Playford LGA	Andrews Farm	Blakeview	Burton	Craigmore	Hewett	Mawson Lakes
0-4	5.6%	7.4%	9.4%	8.6%	9.1%	7.5%	11.1%	8.7%
5-9	5.9%	7.9%	10.4%	9.6%	8.2%	8.5%	10.6%	6.7%
10-14	6.3%	8.2%	10.6%	9.6%	8.7%	8.9%	9.4%	5.6%
15-19	6.7%	7.5%	8.0%	7.5%	8.1%	7.9%	7.6%	6.4%
20-24	7.2%	7.2%	7.9%	6.6%	9.5%	7.2%	4.9%	8.7%
25-29	6.2%	6.2%	8.3%	7.9%	10.0%	6.3%	6.2%	11.2%
30-34	6.6%	6.5%	7.3%	9.4%	8.3%	7.4%	11.3%	11.5%
35-39	7.1%	7.3%	10.0%	9.4%	7.6%	8.3%	10.2%	10.3%
40-44	7.3%	7.6%	8.0%	7.9%	8.4%	8.9%	9.7%	7.5%
45-49	7.4%	7.1%	7.0%	7.1%	6.8%	7.9%	7.0%	6.7%
50-54	6.8%	5.8%	3.7%	4.9%	4.4%	5.5%	3.8%	5.4%
55-59	6.5%	5.1%	2.9%	3.4%	3.1%	4.1%	2.9%	4.2%
60-64	4.9%	4.0%	2.5%	2.5%	2.2%	2.9%	2.5%	2.6%
65-69	3.9%	3.6%	1.7%	2.0%	1.4%	2.6%	1.4%	1.3%
70-74	3.4%	3.3%	1.0%	1.9%	1.4%	1.7%	0.9%	1.0%
75 & over	8.0%	5.4%	1.2%	1.9%	2.7%	4.4%	0.7%	2.3%

Source: ABS Catalogue No. 2001.0

Figure 7.1 Age Profile Comparison Areas



Source: ABS Catalogue No. 2001.0

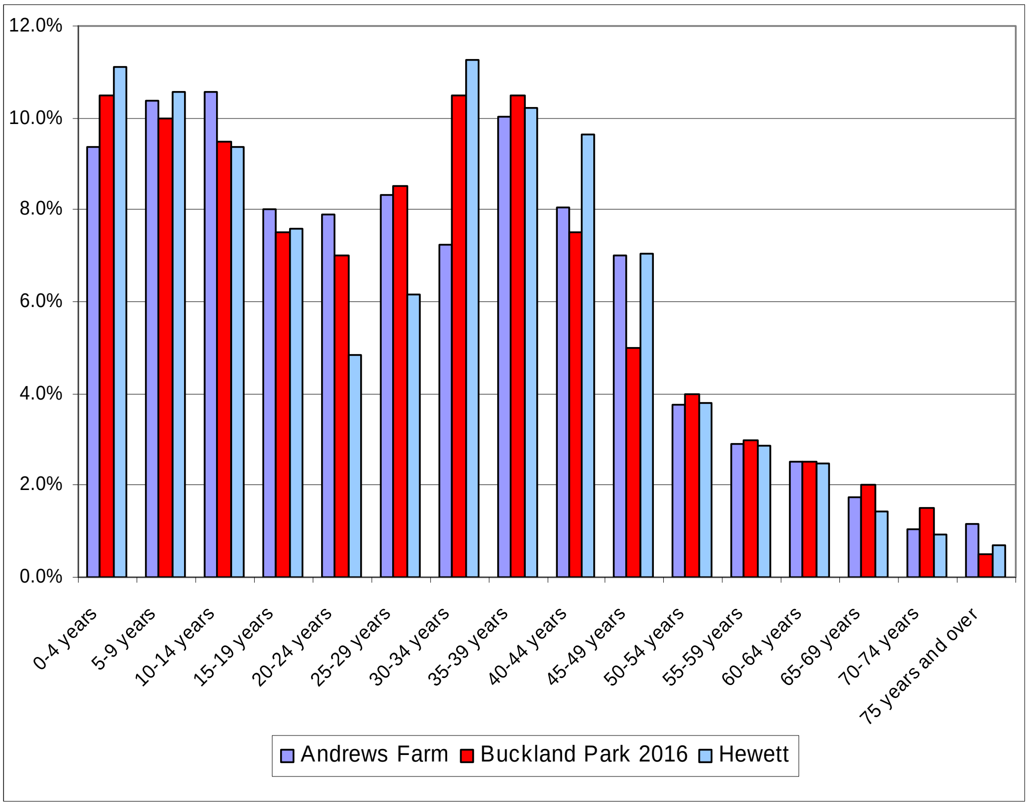
The age profile of Buckland Park is expected to be similar to Andrews Farm and Hewett, reflecting a similar buyer profile. Table 7.2 provides a projected age profile for Buckland Park at 2016. Figure 7.2 compares this with the age profiles of Hewett and Andrews Farm.

Table 7.2 Age Profile Buckland Park 2016

Age Group (Years)	% of Population	Number of Persons
0 – 4	10.0%	215
5 – 9	9.5%	204
10 - 14	9.0%	193
15 – 19	7.0%	150
20 – 24	6.5%	139
25 – 29	8.0%	172
30 – 34	10.0%	215
35 – 39	10.0%	215
40 – 44	8.0%	172
45 – 49	5.5%	118
50 – 54	4.5%	97
55 – 59	3.5%	75
60 – 64	3.0%	64
65 – 69	2.5%	54
70 – 74	2.0%	43
75+	1.0%	21
Total	**100.0%**	**2,145**

Source: Connor Holmes

Figure 7.2 Age Profile Buckland Park (2016), Andrews Farm and Hewett (2006)



Source: ABS Catalogue No. 2001.0; Connor Holmes

Tables 7.3-7.7 provide a projected age profile for Buckland Park at five year intervals over the construction and occupation period. Buckland Park's population is expected to steadily age over the period to 2036. This is illustrated in Figure 7.3 which compares the projected age profiles of Buckland Park in 2016 and 2036.

Table 7.3 Age Profile Buckland Park 2021

Age Group (Years)	% of Population	Number of Persons
0 – 4	9.5%	900
5 – 9	9.0%	853
10 - 14	8.5%	805
15 – 19	7.0%	663
20 – 24	6.5%	616
25 – 29	8.0%	758
30 – 34	9.0%	853
35 – 39	9.0%	853
40 – 44	8.0%	758
45 – 49	6.0%	569
50 – 54	5.0%	474
55 – 59	4.0%	379
60 – 64	3.5%	332
65 – 69	3.0%	284
70 – 74	2.5%	237
75+	1.5%	142
Total	**100.0%**	**9,475**

Source: Connor Holmes

Table 7.4 Age Profile Buckland Park 2026

Age Group (Years)	% of Population	Number of Persons
0 – 4	9.0%	1,657
5 – 9	8.5%	1,565
10 - 14	8.0%	1,473
15 – 19	7.5%	1,381
20 – 24	6.5%	1,197
25 – 29	7.5%	1,381
30 – 34	8.0%	1,473
35 – 39	7.5%	1,381
40 – 44	8.0%	1,473
45 – 49	6.5%	1,197
50 – 54	5.5%	1,013
55 – 59	4.5%	829
60 – 64	4.0%	737
65 – 69	3.5%	645
70 – 74	3.0%	552
75+	2.5%	460
Total	**100.0%**	**18,416**

Source: Connor Holmes

Table 7.5 Age Profile Buckland Park 2031

Age Group (Years)	% of Population	Number of Persons
0 – 4	8.0%	2,173
5 – 9	8.0%	2,173
10 - 14	7.5%	2,037
15 – 19	6.5%	1,765
20 – 24	6.5%	1,765
25 – 29	6.5%	1,765
30 – 34	7.0%	1,901
35 – 39	7.5%	2,037
40 – 44	8.0%	2,173
45 – 49	7.5%	2,037
50 – 54	6.0%	1,629
55 – 59	5.0%	1,358
60 – 64	4.5%	1,222
65 – 69	4.0%	1,086
70 – 74	3.5%	951
75+	4.0%	1,086
Total	**100.0%**	**27,158**

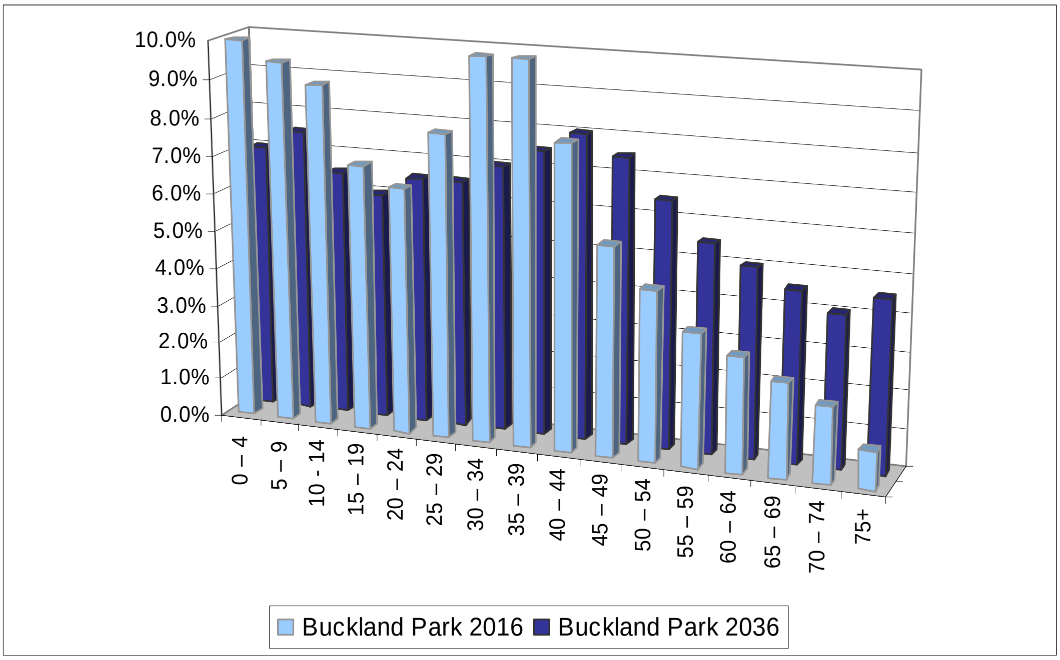
Source: Connor Holmes

Table 7.6 Age Profile Buckland Park 2036

Age Group (Years)	% of Population	Number of Persons
0 – 4	7.0%	2,310
5 – 9	7.5%	2,475
10 - 14	6.5%	2,145
15 – 19	6.0%	1,980
20 – 24	6.5%	2,145
25 – 29	6.5%	2,145
30 – 34	7.0%	2,310
35 – 39	7.5%	2,475
40 – 44	8.0%	2,640
45 – 49	7.5%	2,475
50 – 54	6.5%	2,145
55 – 59	5.5%	1,815
60 – 64	5.0%	1,650
65 – 69	4.5%	1,485
70 – 74	4.0%	1,320
75+	4.5%	1,485
Total	**100.0%**	**33,000**

Source: Connor Holmes

Figure 7.3 Buckland Park Age Profile 2016-2036



Source: Connor Holmes

8. EDUCATION

8.1 School Education

Choosing a school is a complex decision. Factors which influence this choice include:

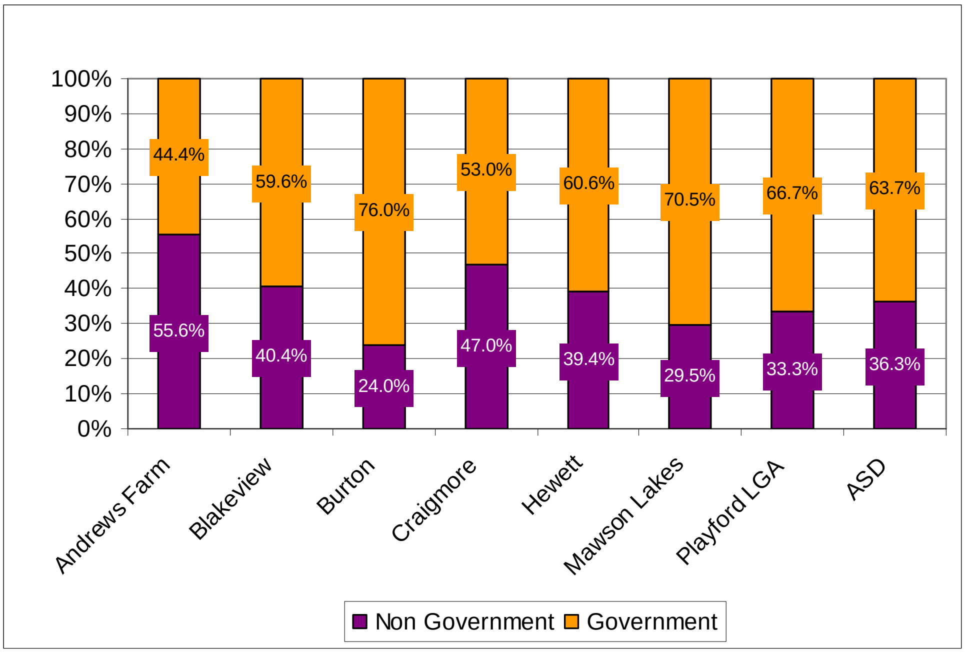
- Household income and fees of non-government schools;
- Distance and accessibility to government/non government schools;
- Religion;
- Comparative quality and facilities of schools;
- Government school zoning.

A relatively high proportion of school students attend non-government schools in the comparison suburbs, particularly at secondary school level. Overall rates of non-government school attendance in each of the comparison areas are as follows:

- Andrews Farm 58%;
- Hewett 53%;
- Craigmore 50%;
- Mawson Lakes 44%;
- Blakeview 43%;
- Burton 27%;
- Playford LGA 36%;
- ASD 40%.

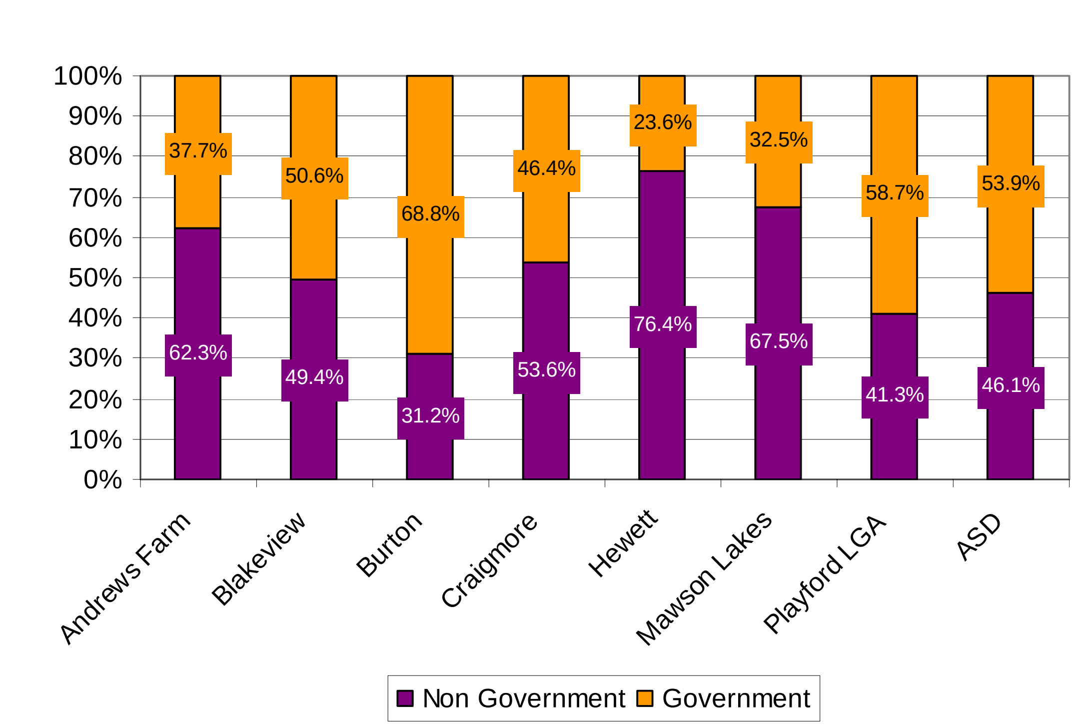
With the exception of Burton, all comparison suburbs have higher rates of non-government school enrolments than the ASD. Figures 8.1 and 8.2 show the proportion of primary and secondary school students attending government and non-government schools in the comparison areas. There are more non-government school enrolments at secondary school level than primary school in all comparison areas.

Figure 8.1 Primary School Enrolments Comparison Areas 2006



Source: ABS Catalogue No. 2001.0

Figure 8.2 Secondary School Enrolments Comparison Areas 2006



Source: ABS Catalogue No. 2001.0

The projected school age population of Buckland Park is sufficient to support the establishment of a number of schools within the proposal's master plan. Decisions regarding government schools' location, number and format (super schools, etc) will be made by the Department of Education and Children's Services (DECS).

Decisions by the non-government school sector are commercially based and depend on demand. However, early commitment to the establishment of schools may occur to secure market share.

The number of primary and secondary students projected to live in Buckland Park has been calculated based on the age profiles provided in Section 7. In terms of the split of enrolments between government and non-government schools, comparison area data indicates that non-government school attendance within Buckland Park may be relatively high. However, DECS have advised that basing Buckland Park school attendance rates on the high non-government school attendance rates experienced in comparison areas may be unrealistic. Accordingly, the following rates are based on the State average of 65% government school attendance. ABS data indicates that current government school attendance rates are higher at primary school level (67%) than secondary level (60%). These attendance rates have been applied to Buckland Park's school age population as shown in the following tables.

As the project progresses, there will be an opportunity to compare projected and actual population growth, age profile and attendance rates of government and non-government schools and plan the type and size of later schools.

Table 8.1 Government / Non-Government School Split 2016

School Type	All Schools		Government		Non Government	
	Students	Schools	Students	Schools	Students	Schools
Primary School (R-7)	320	-	214	-	106	-
Secondary School (8-12)	167	-	100	-	67	-

Source: Connor Holmes

Table 8.2 Government / Non-Government School Split 2021

School Type	All Schools		Government		Non Government	
	Students	Schools	Students	Schools	Students	Schools
Primary School (R-7)	1,336	2	895	1	441	1
Secondary School (8-12)	720	-	432	-	288	-

Source: Connor Holmes

Table 8.3 Government / Non-Government School Split 2026

School Type	All Schools		Government		Non Government	
	Students	Schools	Students	Schools	Students	Schools
Primary School (R-7)	2,449	3	1,641	2	808	1
Secondary School (8-12)	1,418	2	851	1	567	1

Source: Connor Holmes

Table 8.4 Government / Non-Government School Split 2031

School Type	All Schools		Government		Non Government	
	Students	Schools	Students	Schools	Students	Schools
Primary School (R-7)	3,395	4/5	2,275	2/3	1,120	2
Secondary School (8-12)	1,874	2	1,124	1	750	1

Source: Connor Holmes

Table 8.5 Government / Non-Government School Split 2036 (completed Project)

School Type	All Schools		Government		Non Government	
	Students	Schools	Students	Schools	Students	Schools
Primary School (R-7)	3,762	4/5	2,521	2/3	1,241	2
Secondary School (8-12)	2,046	2	1,228	1	818	1

Source: Connor Holmes

8.2 Child Care and Pre-School

The number of children in the child care age category is based on the projected 0-5 year old population. Beyond five years of age, the principle form of child care used is before and after school care which is typically provided on school sites and has therefore not been considered in these estimates.

In order to calculate the number of child care places required, information has been sourced from the ABS on the proportion of children in child care by year of age (Catalogue No. 4402.0). This has been applied to Buckland Park's projected 0-5 year old population. Of the total number of children in child care, an estimate of the proportion of children in different types of child care and the time spent in care has been applied, specifically:

- Occasional Child Care 10% 1 day per week;
- Long Day Care 70% 2.5 days per week;
- Family Day Care 20% 2 days per week.

Using these figures, the equivalent number of child care places required has been calculated. Finally, it is recognised that not all of these places will be provided within Buckland Park. Working parents may prefer a child care centre close to their place of work. Therefore, it has been assumed only 75% of the required child care places will be required within Buckland Park.

ABS data provides the proportion of the 3-5 year old population attending pre-school. Specifically, the following pre-school attendance rates have been applied to the projected 3-5 year old population in Buckland Park:

- 24% of three year olds;
- 56% of 4 year olds;
- 34% of five year olds.

ABS data indicates that the majority of children attending pre-school are enrolled for between 10 and 19 hours per week. It has therefore been assumed that children will, on average, attend pre-school 2.5 days per week.

Unlike child care placements, it is expected most children will attend pre-school close to home so sufficient pre-school places should be provided within Buckland Park to accommodate all of the projected pre-school enrolments.

Table 8.6 Buckland Park Child Care and Pre School Placements 2016

Facility	Estimated Number in Child Care/Pre-School	FTE Number of Places	Places within Buckland Park
Child Care	78	35	-
Pre-school	48	24	-

Source: Connor Holmes

Table 8.7 Buckland Park Child Care and Pre School Placements 2021

Facility	Estimated Number in Child Care/Pre-School	FTE Number of Places	Places within Buckland Park
Child Care	328	148	111
Pre-school	202	101	101

Source: Connor Holmes

Table 8.8 Buckland Park Child Care and Pre School Placements 2026

Facility	Estimated Number in Child Care/Pre-School	FTE Number of Places	Places within Buckland Park
Child Care	604	272	204
Pre-school	372	186	186

Source: Connor Holmes

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Table 8.9 Buckland Park Child Care and Pre School Placements 2031

Facility	Estimated Number in Child Care/Pre-School	FTE Number of Places	Places within Buckland Park
Child Care	794	357	268
Pre-school	495	248	248

Source: Connor Holmes

Table 8.10 Buckland Park Child Care and Pre School Placements 2036

Facility	Estimated Number in Child Care/Pre-School	FTE Number of Places	Places within Buckland Park
Child Care	847	381	286
Pre-school	538	269	269

Source: Connor Holmes

9. EMPLOYMENT

9.1 Workforce Participation

Table 9.1 provides the proportion of the population aged 15 years and over who are employed in full or part time work in comparison areas. The remainder of the over 15 year old population is either unemployed or not in the workforce by choice. These proportions exclude persons who did not state their labour force status.

Table 9.1 Proportion of Over 15 Year Olds Employed 2006 Comparison Areas

Location	Employed Persons
ASD	59.0%
Playford LGA	52.3%
Andrews Farm	68.5%
Blakeview	69.1%
Burton	61.6%
Craigmore	65.6%
Hewett	76.9%
Mawson Lakes	76.0%

Source: ABS Catalogue No. 2001.0

By 2036 it is projected 16,500 employed persons will live in Buckland Park. This is 63.3% of the over 15 year old population and 50% of the overall population. This is above current ASD and Playford LGA employment ratios, but significantly below those of comparison suburbs such as Hewett and Mawson Lakes.

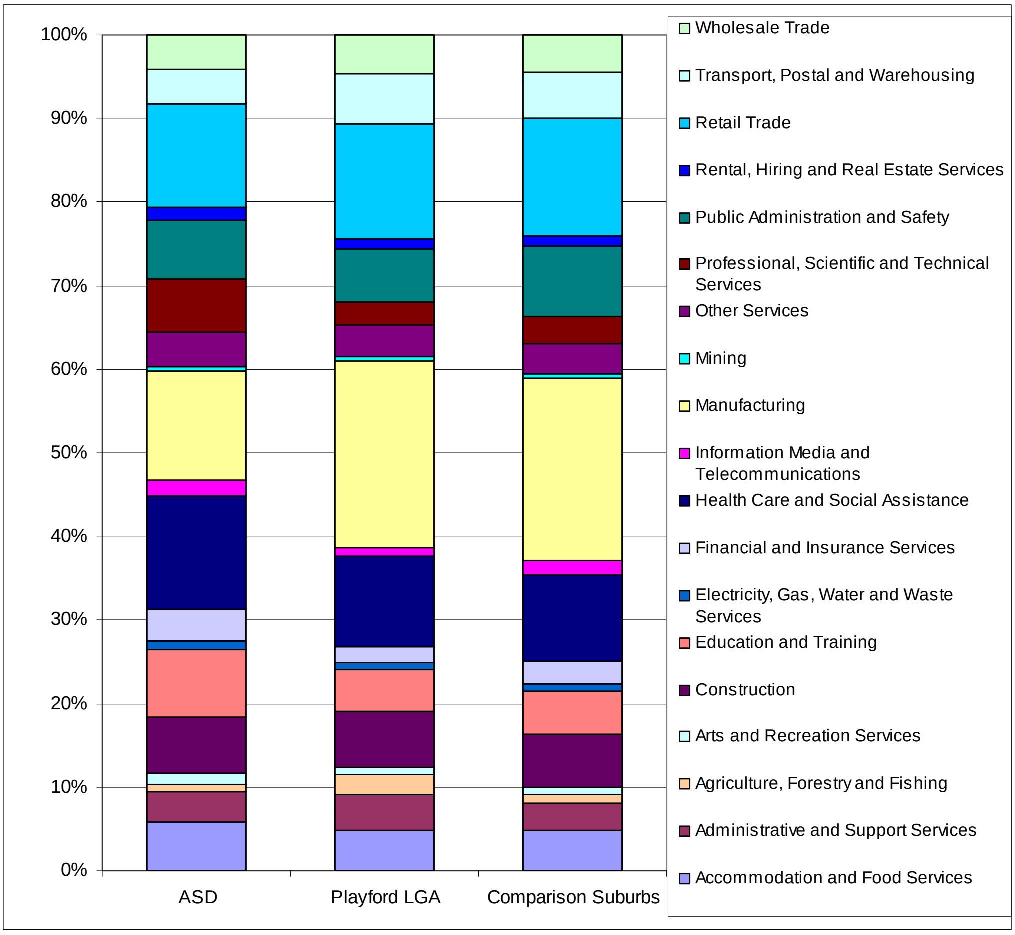
At 2006 these comparison suburbs had an over 65 year old population of less than 5%, whereas it is expected that the over 65 year old population in Buckland Park in 2036 will be around 13% and it anticipated the majority of people in this age bracket will not be in the workforce.

9.2 Industry of Employment

Figure 9.1 illustrates the employment profile of comparison areas. The employment profiles of Andrews Farm, Blakeview, Burton, Craigmore, Hewett and Mawson Lakes have been collated to assist with comparison. The employment profile of the comparison suburbs and Playford LGA are similar, whereas there are some notable differences between the comparison suburbs and the ASD, specifically:

- A lower proportion of manufacturing employees;
- A lower proportion of transport, postal and warehousing employees;
- A lower proportion of wholesale trade employees;
- A lower proportion of retail trade employees;
- A lower proportion of agriculture, forestry and fishing employees;
- A higher proportion of professional, scientific and technical services employees;
- A higher proportion of health care and social assistance employees;
- A higher proportion of financial and insurance services employees;
- A higher proportion of education and training employees.

Figure 9.1 Industry of Employment 2006 Comparison Areas



Source: ABS Catalogue No. 2001.0
Comparison suburbs – Andrews Farm, Blakeview, Burton, Craigmore, Hewett, Mawson Lakes

Table 9.2 contains 2036 projections for Buckland Park's employed residents, by their industry sector. The projections are based on information from the comparison suburbs, sourced from the ABS. It is expected Buckland Park and the comparison suburbs will have similar characteristics.

Adjustments have been made assuming the historical decline of the manufacturing industry in South Australia will continue into the future, and service industries will continue to generate employment growth.

Table 9.2 Buckland Park Residents 2036 Employment by Industry

Industry of Employment	% of Workers	Number of Workers
Accommodation & food services	4.9%	809
Administrative & support services	3.5%	578
Agriculture, forestry & fishing	3.3%	545
Arts & recreation services	0.8%	132
Construction	6.8%	1,122
Education & training	6.0%	990
Electricity, gas, water & waste services	0.9%	149
Financial & insurance services	2.7%	446
Health care & social assistance	11.0%	1,815
Information media & telecommunications	1.5%	248

Industry of Employment	% of Workers	Number of Workers
Manufacturing	18.0%	2,970
Mining	0.6%	99
Other services	3.4%	561
Professional, scientific & technical services	2.4%	396
Public administration & safety	8.0%	1,320
Rental, hiring & real estate services	1.2%	198
Retail trade	14.5%	2,393
Transport, postal & warehousing	6.1%	1,007
Wholesale trade	4.4%	726
Total	**100.0%**	**16,500**

Source: Connor Holmes

9.3 Location of Employment

A large proportion of employed Buckland Park residents are expected to have jobs within the Master Plan. The projected number of jobs expected to be created within Buckland Park is 10,687 by 2036. Employment within Buckland Park will be located within centre zones, mixed use and employment precincts. Table 9.3 provides a break down of the predicted uses, amount of floor space and number of workers within each of these precincts. Table 9.4 provides an indicative staging of employment within Buckland Park.

Table 9.3 Employment within Buckland Park by Precinct 2036

Use	Floor space m^2	Workers / 100 m^2	Total Workers
District Centre			
Core Retail	35,000	3.5	1,225
Bulky Goods	30,000	2.0	600
Community / Commercial	35,000	4.0	1,400
Total	**100,000**	**3.2**	**3,225**
Neighbourhood Centre (3 Centres)			
Retail	16,650	3.5	582
Community / Commercial	1,950	4.0	78
Total	**18,000**	**3.2**	**660**
Local Centre (6 Centres)			
Retail	900	3.5	31
Total	**900**	**3.5**	**31**
Mixed Use Precinct			
Light Industry	38,000	2.0	760
Commercial / Community	24,000	4.0	960
Total	**62,000**	**2.8**	**1,720**
Employment Precincts			
Industry / Services / Trades	222,400	2.0	4,448
Total	**222,400**	**2.0**	**4,448**
Schools			
Education	-	-	603
Total Buckland Park	**403,300***	**2.6**	**10,687**

Source: Connor Holmes

*excluding education floor space

Table 9.4 Employment Staging

Employment Type	2016	2021	2026	2031	2036
Retail	70	299	1,120	1,526	1,838
Bulky Goods	0	0	100	200	600
Education	0	142	384	547	603
Commercial, Office, Community	8	52	452	1,278	2,438
Light Industry, Industry, Services, Trades	0	815	1,630	3,339	5,208
Total	78	1,308	3,686	6,890	10,687

Source: Connor Holmes

10,687 jobs within Buckland Park, represent an employment self sufficiency rate of 65%. However, not all jobs within Buckland Park will be held by residents and employment self containment is estimated at 45%.

Consequently, 55% of the working population of Buckland Park is projected to travel outside the proposed urban area for employment. Current journey to work patterns within the City of Playford and major employment growth areas have been reviewed to determine likely work locations of Buckland Park residents.

Table 9.5 contains place of work data for the Playford LGA at the 2006 Census. The majority of working Playford residents are employed within metropolitan Adelaide's northern and north-western regions. A relatively small proportion of Playford residents are employed within the City of Adelaide (7.1%).

Table 9.5 Playford LGA Residents Place of Work 2006

LGA	Jobs	%
Playford	8,290	31.51%
Salisbury	4,706	17.89%
Port Adelaide Enfield	3,081	11.71%
Adelaide	1,863	7.08%
Charles Sturt	990	3.76%
Tea Tree Gully	782	2.97%
West Torrens	773	2.94%
Gawler	720	2.74%
Norwood, Payneham & St Peters	352	1.34%
Prospect	196	0.75%
Light	173	0.66%
Unley	172	0.65%
Burnside	166	0.63%
Campbelltown	149	0.57%
Mitcham	102	0.39%
Marion	81	0.31%
Walkerville	53	0.20%
Mallala	44	0.17%
Holdfast Bay	33	0.13%

LGA	Jobs	%
Adelaide Metro - undefined	30	0.11%
Onkaparinga	10	0.04%
Adelaide Hills (ASD portion)	7	0.03%
Rest of SA	1,895	7.20%
Rest of Australia	110	0.42%
Not Stated	1,529	5.81%
Total	**26,307**	**100.00%**

Source: ABS/Connor Holmes customised data

Within the Playford LGA a high proportion of jobs are in the manufacturing sector. The suburbs of Elizabeth West and Elizabeth South are manufacturing-based industrial areas, the latter including the Holden Factory. Elizabeth Regional Activity Centre and surrounds is an employment hub for education, retail and community service employment. There is also significant employment in primary production west and east of Port Wakefield Road including horticultural, agricultural and viticultural activities.

The Salisbury LGA contains the largest number of jobs in Adelaide's northern region. A significant proportion of these jobs are in the manufacturing sector and are located in Cavan, Burton, Direk and Pooraka. Edinburgh is a key employment precinct, comprising the RAAF base, the Defence Science and Technology Organisation (DSTO) and the Edinburgh Parks Industrial Estate. Mawson Lakes accommodates the University of South Australia Mawson Lakes Campus, Technology Park (around 2,000 employees) and the Mawson Lakes Town Centre. Parafield Airport has employment activities such as a bulky goods retail precinct as well as airport operations. Other significant employment locations include Bolivar Wastewater Plant and large retail centres such as Parabanks Shopping Centre and Hollywood Plaza and education facilities.

It is expected that in the future key employment growth areas in metropolitan Adelaide's northern/north-western region will include:

- Kingsford Regional Industrial Estate (Light Regional Council);
- Buckland Park (City of Playford);
- Greater Edinburgh Parks (Cities of Salisbury; Playford);

Kingsford Regional Industrial Estate comprises 170ha of zoned industrial land in Gawler Belt. A Development Plan Amendment (DPA) has been prepared to implement an area master plan. There is already some activity within this Estate, including the Amcor glass plant, which is a significant employer and is continuing to expand. This industrial area is likely to expand in the future to include land between the Kingsford Estate and Main North Road and link with the Industry (Roseworthy) zone bounded by Main North Road to the West and Roseworthy Road to the north. It is further suggested that an additional light industry zone north of the Kingsford estate would be appropriate to provide a buffer to the heavier industry including the Amcor plant. This would create a total employment area of around 517ha. Industrial and commercial employment within this area could be in the order of 18,000 jobs.

The Greater Edinburgh Parks area includes the RAAF base, DSTO site, Edinburgh Parks Industrial Estate, the recently approved Penfield Intermodal Terminal, as well as surrounding areas in the Salisbury and Playford LGA's. Additional future employment in this area could be in the vicinity of 38,000 jobs to 2027, with further expansion beyond that date providing for a possible doubling of employment opportunities in the longer term.

Port Adelaide has long been a key employment location. In the future significant infrastructure investment will reinforce its role. New infrastructure includes:

- Port River Expressway;
- Outer Harbour Channel Deepening;
- South Road Upgrade;
- Le Fevre Peninsula Transport Corridor;
- Northern Expressway;
- Northern Connector.

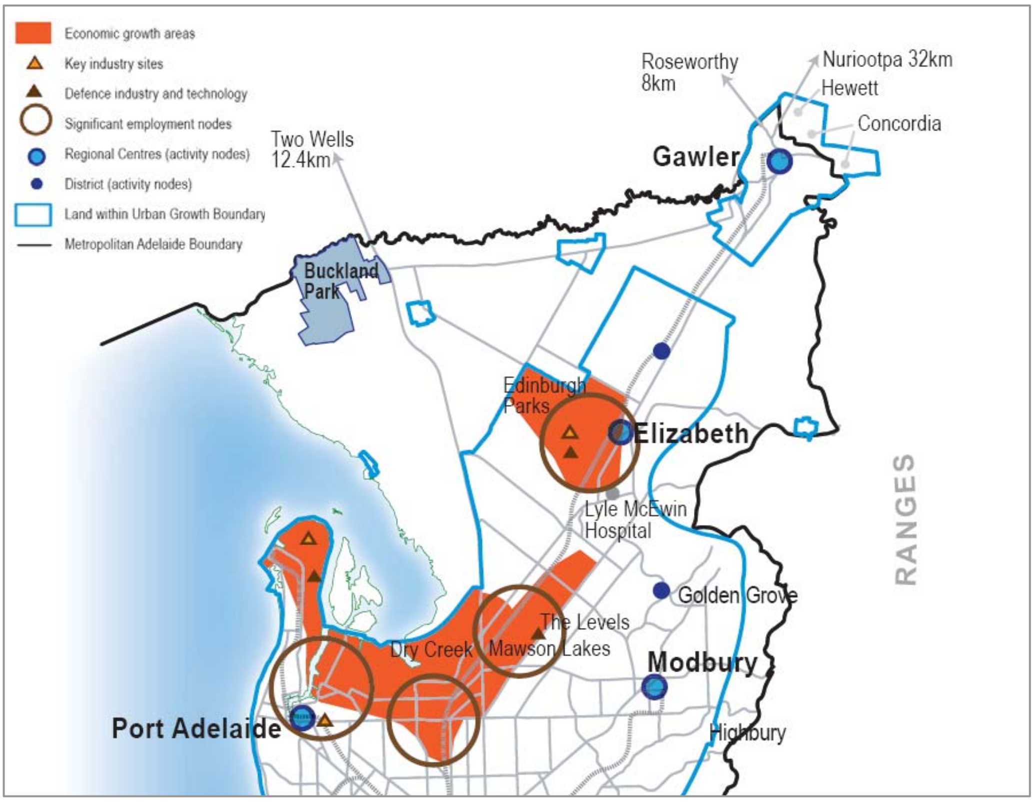
There is considerable capacity for additional employment uses within the Le Fevre Peninsula, Port Adelaide and Gillman. With the development of the Northern Expressway and Northern Connector, areas of Port Adelaide Enfield, north of Grand Junction Road will be within 15 minutes travel time of Buckland Park.

Additional sources of employment growth include:

- Expansion of employment within Mawson Lakes (further 2,000 jobs);
- Expansion of Activity Centres;
- Employment precincts within the new Playford North and Blakeview release areas;
- Employment within future growth areas such as Gawler East and Concordia when developed in future; and
- Infill within existing, underutilised industrial zones throughout Adelaide's northern region.

Adelaide's northern region is an area of strong population growth and can be expected to provide for major residential and employment expansion over coming decades. Figure 9.2 shows the relative location of key employment areas in Adelaide's northern region to Buckland Park.

Figure 9.2 Employment Locations



Major regional employment growth opportunities focusing on industry and related activities exist at Port Adelaide, Gillman, Cavan, LeFevre Peninsula, Edinburgh Parks and Kingsford Estate. Commercial, retail, office and high tech opportunities exist at Mawson Lakes and Technology Park. New employment precincts have also been planned for Playford North and Blakeview.

Based on the current and future employment growth areas discussed above, and the current work locations of Playford LGA's residents, a projection of Buckland Park employment locations has been prepared and is contained in Table 9.6. Notably, the proportion of residents employed within Playford LGA, including within Buckland Park, is expected to be higher as a result of the employment opportunities provided for in Buckland Park. Additionally, employment within the Adelaide's northern region has been scaled up from current patterns to reflect projected future employment growth in these areas.

Table 9.6 Projected Employment Locations for Buckland Park Residents

LGA	Jobs
Buckland Park	7,425
Playford	2,475
Salisbury	2,376
Port Adelaide Enfield	1,320
Adelaide	726
Charles Sturt	396
Tea Tree Gully	330
West Torrens	317
Gawler	330
Norwood, Payneham & St Peters	132
Prospect	66
Light	264
Unley	66
Burnside	66
Campbelltown	66
Mitcham	33
Marion	33
Walkerville	23
Mallala	23
Holdfast Bay	13
Onkaparinga	4
Other	16
Total	**16,500**

Source: Connor Holmes

10. SUMMARY

This study has established a demographic profile for Buckland Park. It has considered changes over the period from 2010 to 2036, when the proposal will be progressively staged and occupied. The following are key elements of those projections:

- A diversity of housing types and densities including 23% of housing at medium densities and 12% attached housing types;
- A dwelling occupation schedule and population growth rate which reflect rapid lot production and occupation in the middle years and slower growth in the early and later years of the project;
- An average household size of 2.75 persons;
- A generally younger age profile than the ASD average;
- A car ownership rate of 1.75 vehicles per household;
- An average household income in the order of $70,000-$75,000 per annum;
- A school age population of 5,808 by 2036, including 3,762 primary school age children and 2,046 secondary school age children;
- Child care and pre-school enrolments totaling 847 and 538 respectively by 2036;
- A working population of 16,500, representing 63% of the over 15 year old population by 2036;
- Overall employment provision of 10,687 jobs within Buckland Park, by 2036 of which 7,425 are expected to be held by Buckland Park residents.

11. REFERENCES

Australian Bureau of Statistics, 2006 *Census of Population & Housing*, Community Profile Series Catalogue No. 2001.0.

Australian Bureau of Statistics, *2006 Census of Population & Housing*, Customised Place of Work data.

Australian Bureau of Statistics, *Child Care Australia 2005*, Catalogue No. 4402.0

Australian Bureau of Statistics, *Schools Australia 2007*, Catalogue No. 4221.0

Australian Bureau of Statistics, *Schools Australia 2008*, Catalogue No. 4221.0

NSW Department of Planning *Metropolitan Development Programme Update – 2007*.

12. GLOSSARY

ABS: Australian Bureau of Statistics

ASD: Adelaide Statistical Division

FTE: Full Time Equivalent

LGA: Local Government Area

Net Residential Area: Area (hectares) available for residential development excluding non-residential uses such as open space, schools, centres and roads

Net Residential Density: Number of dwellings per hectare net residential area hudson howells

Buckland Park Proposal

Economic Assessment

Final Report

February 2009

hudson howells

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1. INTRODUCTION

1.1 Background

In November 2007, Hudson Howells was engaged by the Walker Corporation to undertake an economic assessment of the Buckland Park proposal.

This report details the findings of the economic assessment.

1.2 Study Objective

This study's principal objective is identification of economic costs and benefits associated with the Buckland Park proposal.

The assessment includes both a qualitative and quantitative analysis of the relevant costs and benefits. Data and information for the assessment has been sourced from previous studies, consultation with team members to identify costs associated with the construction of each stage, and primary research to identify regional and other data that inform the study tasks.

The study tasks are summarised by key areas of economic activity in the following table. They are based on the EIS Guidelines issued by the Development Assessment Commission in August 2008.

Task
Investment > How the township's construction and operation will support existing industrial, business and commercial activity in the northern Adelaide region, and attract and encourage growth in those sectors. > The opportunities for investment in the northern Adelaide region generated by the township's construction and operation. > The economic benefits/costs of the investment, both in the construction of the township and its operations, including consideration of the 'multiplier effect'.

Task
Employment
> The estimated employment opportunities created by the township's construction and operation, and available in the northern Adelaide region. > The suitability of those opportunities given the workforce characteristics of the township's anticipated population and the North Adelaide region. > The economic benefits/costs of the employment generated by the construction and operation of the township, including consideration of the 'multiplier effect'.
Agriculture
> The current agricultural production potential of the site, and the economic implications arising from the loss of that potential.

1.3 The Proposal

The Buckland Park proposal is a joint venture of Walker Corporation and Daycorp. The site has an area of 1,308 hectares.

It is located Adelaide's north western region, on Port Wakefield Road within the City of Playford, west of Virginia, and around 32 kilometres north of the Adelaide CBD and 14 kilometres from Elizabeth, see Figure 1.

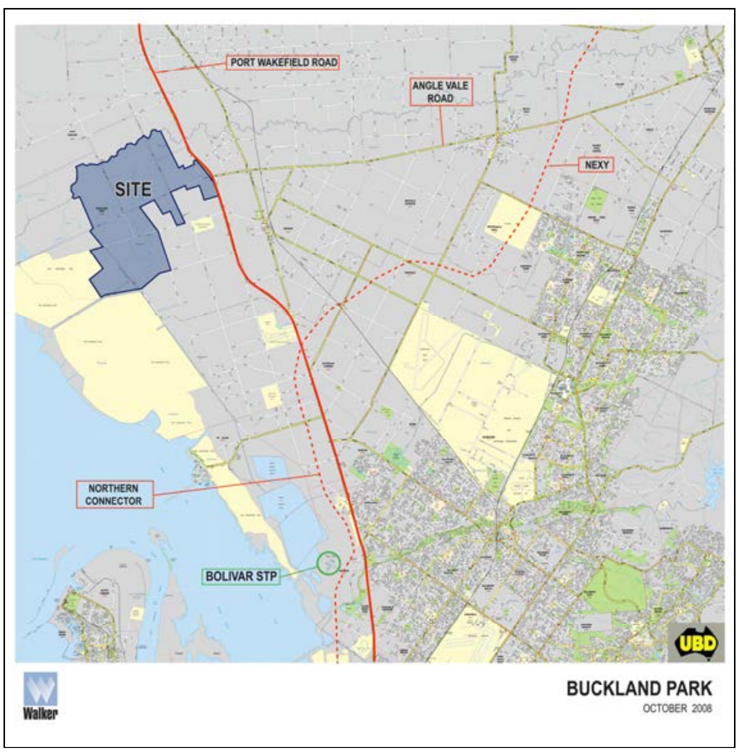

Figure 1: Buckland Park Locality Map

It is anticipated the proposal will comprise 12,000 residential allotments, with an average size of 500m², supported with multiple purpose open space, and commercial, retail, community and employment uses. The Proposal is illustrated in the Master plan.

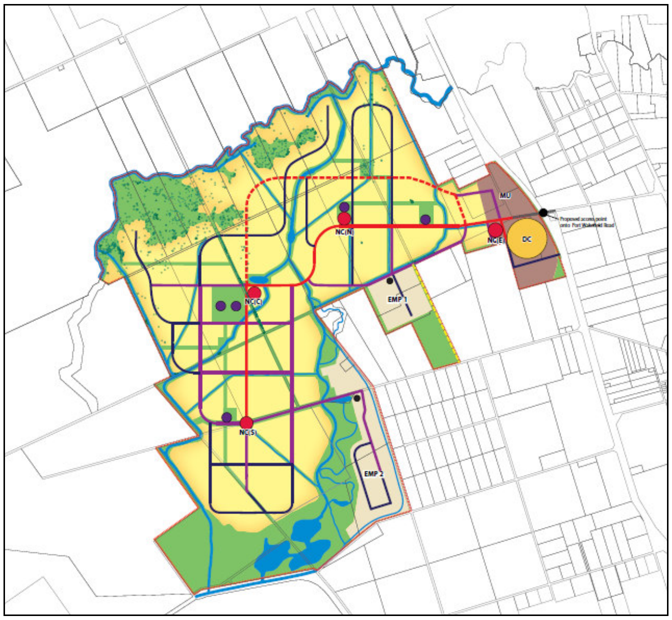

Figure 2: Master Plan of Buckland Park

The proposal will be implemented in stages over a period of 25 years. The first stage is planned for 2010 to 2016, as illustrated in the staging plan below in Figure 3. It is anticipated the proposal will be fully constructed and occupied by 2036.

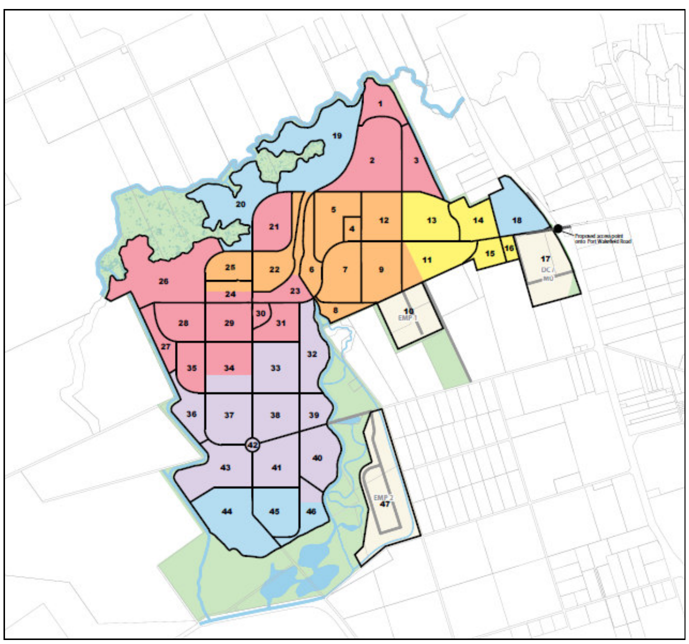

Figure 3: Proposal Staging

2. ECONOMIC IMPACT ASSESSMENT

2.1 Background

This section provides an assessment of the economic impact of the Buckland Park proposal and addresses the following.

Investment

> How the proposal's construction and operation will support existing industrial, business and commercial activity in the northern Adelaide region, and attract and encourage growth in those sectors.
> The opportunities for investment in the northern Adelaide region generated by the proposal's construction and operation.
> The economic benefits and costs of the investment, both in the construction of the proposal and its operations, including consideration of the 'multiplier effect'.

Employment

> The estimated employment opportunities created by the proposal's construction and operation, and available in the northern Adelaide region.
> The suitability of those opportunities given the workforce characteristics of the proposal's anticipated population and the North Adelaide region.
> The economic benefits/costs of the employment generated by the construction and operation of the proposal, including consideration of the 'multiplier effect'.

Infrastructure

> The benefit and amenity improvements to townships in the North Adelaide region as a result of infrastructure changes associated with the proposal's creation.

2.2 Introduction and Methodology

The following section highlights the economic contribution the Buckland Park proposal will make by estimating its gross employment and income impacts on the South Australian economy. It does not factor in employment that might be displaced from other proposals.

Buckland Park's contribution to the economy is measured through an estimation of the construction costs associated with all aspects of the proposal's construction, such as internal and external infrastructure and housing. Economic modelling was then used to estimate the direct and indirect (multiplier) economic benefits attributable to this construction activity.

It is stressed this report is primarily based on desk research and estimations. No primary consultation or research was undertaken, other than a survey to determine the current value of primary agricultural production from the site. The findings are therefore estimates based on a range of assumptions and estimated costs and other data provided or sourced by Walker Corporation and Connor Holmes.

The costs of major infrastructure used are estimates only, and based on concepts. It has been assumed these costs will be distributed over the 25 year construction and occupation time frame.

For a proposal of this scale, with a long time frame for planning, construction and establishment, it is considered this type of assessment is adequate to identify the broad costs and benefits to the economy.

2.3 Study Objective

This study's principal objective is to identify the economic costs and benefits of the Buckland Park proposal. These costs and benefits have been estimated based on the use of an econometric model and have measured:

- Value added to the Gross State Product.
- Impacts on employment - both directly and indirectly.

This study's specific objective is to identify economic impacts associated with investment in the construction of Buckland Park's infrastructure, housing and commercial and retail infrastructure.

The economies of the region, metropolitan area and the state will be considered.

The implications of direct and indirect employment, incomes, and value added will be identified.

2.4 Estimated Economic Impacts – Establishment and Construction

This section provides an analysis of the level of economic activity associated with the proposal based on economic modelling.

Estimates are made of:

> The total jobs, wages paid and expenditure directly associated with the proposal's construction.
> Induced or multiplier, economic impacts indirectly generated by direct investment.

Economic benefits to the broader community and economy from investment in the proposal are considered in this study.

Conversely, a financial assessment would determine the returns to an investing party, and is therefore not relevant to this study.

Assumptions

A range of assumptions have been made to facilitate this economic impact assessment. Most of these are cost and timing assumptions are based on information provided by Walker Corporation. They have been used to populate a Microsoft Excel model for the proposal. These assumption included costs and timing for:

External Infrastructure

- External road upgrades
- Stormwater
- Potable water
- Sewer and recycled water
- Gas
- Electricity

Internal Infrastructure

- Roads
- Footpaths
- Power
- Water

> Sewer
> Stormwater
> Telecommunications

<u>Housing</u>

> Housing construction investment

<u>Other Town Investment</u>

> Retail establishments
> Bulky goods retail establishments
> Education facilities (schools etc)
> Commercial and community services
> Industry and trade services

While the costing detail is contained in the Excel model, the total estimated values of investment over 25 years are summarised below:

> External Infrastructure - $200.7 million
> Internal Infrastructure - $500 million
> Housing Investment - $2,500 million
> Other Town Investment - $1,087 million
> Total - $4,287.7 million (or an average of $171.5 million per annum)

Following is a summary of assumptions by investment category.

External Infrastructure

External infrastructure investment incorporates:

<u>External Road Upgrades</u>

> Port Wakefield Road & Angle Vale Road Intersection
> Port Wakefield Road & Park Road Intersection, if required
> Additional 2 lanes to Port Wakefield Road (7 kms), if required

<u>Stormwater & ASR</u>

> Land and construction of detention basins (15 ha)
> 450mm stormwater pipe to Council's wetland (10 kms)

Potable Water

> 600 mm potable water pipe (approx 20 kms)
> SA Water Plan Approvals fee ($1,232/lot + $4/linear metre)

Sewer & Recycled Water

> 450 mm sewer line to Bolivar STP (14 kms)
> 450 mm recycled water line from Bolivar STP (14 kms)
> SA Water Sewer Plan Approvals fee ($2,023/lot + $2/linear metre)
> SA Water Recycled Plan Approvals fee ($1,232/lot + $2/linear metre)

Gas

> Park Rd Gas Station up grade and connection into site under Pt Wakefield Rd (1.4 kms)

Electricity

> Upgrade Virginia substation
> New 66kV line from Virginia to Angle Vale substation
> Upgrade to 66kV line between Virginia & Bolivar substations
> New 66kV line from Virginia substation to Munno Para (future substation)
> 4 new 66kV line bays at Bolivar and Parafield Gardens West substations
> Upgrade to 66kV line between Virginia and Two Wells substations
> New 66kV line from Virginia substation into the site
> 2 new substations on site
> ETSA Augmentation contributions

Telecommunications

> Land dedication for exchange 60m^2

Internal Infrastructure

It is assumed internal infrastructure costs will be in the order of $40,000 per allotment, which will be constructed at a rate of 500 per annum, over the proposal's 25 year construction and occupation period.

Housing Investment

An average construction cost of $200,000 per dwelling has been assumed over the 25 year construction and establishment period.

Other Investment

Other investments estimated are based on the following assumptions related to the floor space to be constructed and per square metre costs by construction type.

Table 1: Total Floor Space Estimates

Employment Type	Floor Space
Retail	52,550m^2
Bulky Goods	30,000 m^2
Education[1]	46,500 m^2
Commercial/Office/Community	60,950m^2
Light Industry/Industry/Services/Trades	260,400m^2

Table 2: Estimated Construction Costs

Component	Establishment Costs (m^2)
Commercial office space – above ground	\$2,450/m^2
Bulky goods retailing/showrooms – include landscaping and car parking	\$1,050 /m^2
Industrial sheds– include landscaping and car parking	\$900/m^2
Factory units– include landscaping and car parking	\$1,050 /m^2
Primary schools (buildings only)	\$2,050/m^2
High schools (building only)	\$2,050/m^2
Retail shops (100m^2 each) in a small centre	\$1,650/m^2

Table 3 below indicates the industry ratios and multipliers used for the assessment of jobs and income outcomes, derived from State input/output tables[2].

Table 3: Ratios and Multipliers

	Construction
Value Added	1.083
Employment	13.0

[1] Based on 31 hectares with an average building site representing 15%

[2] Multipliers have been adjusted for inflation and for indicative estimates of productivity gains

Table 3 shows a $1 million of construction investment will support a value added component of $1,083,000 and 13.0 FTE directly and indirectly created jobs.

Gross Economic Impacts

Table 4 details the calculation of gross economic impacts associated with the proposal's infrastructure and housing construction. These are per annum based on estimated investment in the proposal over 25 years, that is, these are the jobs and incomes that are estimated to be sustained over 25 years of investment in constructing and establishing the proposal.

Table 4: Estimated Per Annum Job and Income Outcomes Over 25 Years

	External Infrastructure	**Internal Infrastructure**	**Housing Investment**	**Other Investment**	**Total**
Value Added ($ million)	$8.7 million	$21.7 million	$108.3 million	$47.1 million	$185.8 million
Employment (FTE jobs)	104 jobs	260 jobs	1,300 jobs	565 jobs	2,229 jobs

Based on the assumptions used, it is estimated infrastructure, housing and other construction associated with the proposal will directly and indirectly result in, on average, 2,229 FTE's of employment per annum over 25 years. It is estimated the associated incomes, or value added to the economy, generated by this activity will, on average, be $185.8 million per annum over 25 years.

2.5 Estimated Economic Impacts – Proposal Operations

Section 2.4 dealt with direct investment expenditure associated with the establishment of Buckland Park. However, Buckland Park will also attract investment in business activity, for example, commercial, retail, industry and services. This investment will generate its own economic impacts and multiplier consequences.

The construction elements of business activity were considered in Section 2.4, as a component of "establishment economic impacts".

The operational impacts are based on the following key estimates (Connor Holmes, 2008).

Table 5: Employment by Year

Employment by Year					
Employment Type	**2016**	**2021**	**2026**	**2031**	**2036**
Retail	70	299	1,120	1,526	1,838
Bulky Goods	0	0	100	200	600
Education	0	142	384	547	603
Commercial, Office, Community	8	52	452	1,278	2,438
Light Industry, Industry, Services, Trades	0	815	1,630	3,339	5,208
Total Direct Employment	**78**	**1,308**	**3,686**	**6,890**	**10,687**

These job estimates are based on Connor Holmes estimates of the number of jobs per square metre by industry. The following tables show the employment estimates used.

Table 6: Local Centres

Employment Type	Floor Space	Employees/100m²	Employees
Retail (6 centres x150m²)	900m²	3.5	31

Table 7: Neighbourhood Centres

Employment Type	Floor Space	Employees/100m²	Employees
Retail	16,650m²	3.5	582
Commercial/Community	1,950m²	4.0	78
Total	**18,600**	**3.4**	**660**

Table 8: District Centre

Employment Type	Floor Space	Employees/100m²	Employees
Core Retail	35,000m²	3.5	1,225
Bulky Goods	30,000m²	2.0	600
Commercial/Community	35,000m²	4.0	1,400
Total	**100,000**	**3.2**	**3,225**

Table 9: Schools

Employment Type	Enrolments	Employees
Primary School	3,762	312
Secondary School	2,046	207
Pre School	538 (269 FTE)	27
Child Care	847 (381 FTE)	57
Total	**7,193**	**603**

Table 10: Mixed Use Precinct

Employment Type	Floor Space	Employees/100m²	Employees
Commercial/Office/Community	24,000m²	4.0	960
Light Industry	38,000m²	2.0	760
Total	**62,000**	**2.8**	**1,720**

Table 11: Industry

Employment Type	Floor Space	Employees/100m²	Employees
Industry/Services/Trades	222,400m²	2.0	4,448

Based on the above estimates and input-output employment multipliers for the construction industry, the following direct and total employment estimates are made for proposal's operational period.

Table 12: Total Operational Employment Impacts

Employment Type	Direct Employment 2006	Employment Multiplier (Type 2)[3]	Total Employment Impact
Retail	1,838	1.38	2,536
Bulky Goods	600	1.38	828
Education	603	1.6	1,221
Commercial, Office, Community	2,438	2.25	5,486
Light Industry, Industry, Services, Trades	5,208	3.05	15,884
Total	**10,687**		**25,955**

[3] Type 2 multipliers include both the induced production and consumption effects of the initial employment generated and therefore may include some double counting

The 10,687 operational jobs based within Buckland Park by 2036 will generate an additional 15,268 jobs in the wider state economy. A total of 25,955 jobs per annum will be generated directly and indirectly. However, this total annual impact will not occur until 2036 when the proposal is constructed and occupied. Between commencement of construction and 2036, the multiplier impact will be generally proportional to the rate of direct employment growth within the site. This is described in Table 13.

Table 13: Total Employment Impact by Year

Total Employment by Year					
Employment Type	**2016**	**2021**	**2026**	**2031**	**2036**
Total Direct Employment	78	1,308	3,686	6,890	10,687
Total Indirect Employment	112	1,869	5,266	9,843	15,268
Total Employment	**190**	**3,177**	**8,952**	**16,733**	**25,955**

2.6 Summary and Conclusions

This study's principal objective was to identify the economic costs and benefits associated with Buckland Park.

The study findings and associated conclusions are detailed below by key task.

How Buckland Park's construction and operation will support existing industrial, business and commercial activity in the northern Adelaide region, and attract and encourage growth in those sectors. The economic benefit to townships in the North Adelaide region as a result of infrastructure changes associated with the township's creation.

Buckland Park's construction and operation will support existing businesses and generate new business activity throughout the State, greatly exceeding activity directly generated within Buckland Park.

While over 10,000 jobs will be generated at Buckland Park (Connor Holmes 2008), it is estimated that over 25,000 jobs will be created or supported throughout the State. This will encompass all industry sectors providing business and employment opportunities.

One of the major factors leading to this broader positive impact is spending 'leakage' from Buckland Park's businesses and residents.

Not all goods and services will be able to be procured from local, Buckland Park businesses. Suburbs and businesses in Adelaide's northern region will benefit from leaked spending, as will businesses in the region.

The opportunities for investment in the northern Adelaide region generated by the township's construction and operation.

Investment opportunities will emerge principally through support required for the construction and operation of Buckland Park's housing, retail, commercial, and industrial facilities, and the new community's demands for goods and services.

This investment may take place at Buckland Park, or elsewhere in Adelaide's north and north west region. Investment opportunities will arise in the following sectors:

- Construction
- Retail
- Commerce and Trade
- Industry
- Education and Training
- Community Services

All these industries are represented in the northern region and will benefit from investment generated from Buckland Park. For example, Connor Holmes (2008a) estimate by 2036, Buckland Park's residents will shop in the region's centres, directly contributing $17 million per annum into the region's economy.

Adelaide's north and north west are undergoing growth in the housing and employment sectors.

Historically, metropolitan Adelaide's industries located close to markets, labour and transport, concentrated in the inner metropolitan area.

However, the state's economy has grown, trade with interstate and overseas markets has expanded, and industries have changed in character. Small inner city sites are no longer suitable.

Simultaneously, inner industrial sites, with good access to the metropolitan transport, are becoming more valuable for housing, commercial or retail uses.

Industries are relocating to areas such as Adelaide's north and north west, which offer efficient gateway access between interstate and overseas air, sea, freight rail and road transport networks, and metropolitan rail and road networks, needed to access metropolitan markets.

Large sites are available in the region, which are more suitable for modern industry which focuses more on distribution, logistics, warehousing, and packaging, and less on small scale manufacturing. These businesses need inter-modal facilities, and room to accommodate large vehicles, large buildings and corporate headquarters.

This trend is expected to continue, and demand for new industrial land will be focused on the Adelaide's north and north west, where Buckland Park is located.

The South Australian government has responded by planning for more industrial land in Adelaide's north and north west, and commencing major infrastructure projects to support that planning, for example, the Playford Inter-modal Facility, NEXY and the Northern Connector. But more land and infrastructure will be required.

Buckland Park's contribution to this type of investment will be the creation of a market and workforce in the same region, which will progressively expand over the next 25 years, matching growth in business investments employment opportunities.

Continuing to support these trends will be essential to support Adelaide's and South Australia's economic well being.

Buckland Park will also contribute to economic growth by bringing infrastructure to this strategically important metropolitan region. Additionally, it will also make more economically efficient use of the infrastructure provided by government, by increasing the number of users, for example, infrastructure will be used by housing, as well as industry.

It is anticipated employment land provided in Buckland Park's Masterplan could be suitable for businesses relocating from more traditional Adelaide locations needing dedicated industrial precincts designed specifically to cater for their needs.

However, it is likely Buckland Park's employment land will be required for smaller service type industries, required to support the new community.

Buckland Park is within one of South Australia's major horticulture production regions. It is expected over time, there will be a shift towards value adding of horticulture produce. This will range from food packaging to food processing and these activities will require labour, land and supporting infrastructure, for example power, water and telecommunications.

Employment land at Buckland Park will supply all of these components, potentially accommodating horticultural based industry.

The economic benefits/costs of the investment, both in the construction of the township and its operations, including consideration of the 'multiplier effect'. The estimated employment opportunities created by the township's construction and operation, and available in the northern Adelaide region. The economic benefits/costs of the employment generated by the construction and operation of the township, including consideration of the 'multiplier effect'.

Buckland Park will generate significant economic benefits for the state.

Directly, the state will receive the financial benefits of collection of state taxes of approximately $2.6 million per year. The UDIA (SA) estimate $15,000 in state taxes is generated for every $million of activity in the construction industry. These taxes include land tax, stamp duty of the transfer of real property and the emergency services levy.

There will be $171.5 million worth of activity per annum associated with Buckland Park (see page 7). This will generate approximately $2.6 million in taxes per year.

This figure excludes Local Government rates, which will be collected by Playford City Council, and payroll taxes.

The government is targeting 245,000 new homes in Adelaide to support South Australia's economic growth (Department of Planning and Local Government 2008). A lot of this new growth will occur in the Adelaide's north and north west region.

Buckland Park will supply 12,000 house allotments, in a single well planned proposal. This is 5% of the target needed to support the state's economic growth.

Economic benefits flowing from Buckland Park are enhanced by:

- Economies of scale associated with a single, large scale project which facilitates the orderly and efficient provision of infrastructure.

- Land use and infrastructure planning funded by the proponents rather than state or local government.

- Buckland Park's location in the Adelaide's north west region, which provides opportunities for sharing infrastructure with other land releases, and creates a catalyst for more housing needed to reach the 245,000 target, with greater efficiencies for government.

- Smaller green field or infill projects demand more government resources for planning and infrastructure.

The following table summarises the value added and employment benefits of investment in the proposal's construction and establishment over 25 years.

Table 14: Estimated Per Annum Job and Income Outcomes Over 25 Years

	External Infrastructure	**Internal Infrastructure**	**Housing Investment**	**Other Investment**	**Total**
Value Added ($ million)	$8.7	$21.7	$108.3	$47.1	$185.8
Employment (FTE jobs)	104 jobs	260 jobs	1,300 jobs	565 jobs	2,229 jobs

It is estimated infrastructure, housing and other construction associated with the proposal will directly and indirectly, generate on average 2,229 FTEs of employment per annum over 25 years, including the flow through multiplier impact. It is estimated this activity will generate for the state's economy, on average, $185.8 million per annum over 25 years. This includes associated incomes or value added.

In addition, it is estimated Buckland Park's operational employment will be 10,687 by 2036. This will generate for the wider State economy a total of 25,955 jobs per annum, including 15,268 indirectly generated jobs. However, this total annual impact will not occur until 2036. Between 2010 and 2036 while Buckland Park is being progressively constructed and occupied, the multiplier impact will be generally proportional to the rate of direct employment growth as shown in the following table.

Table 15: Total Employment Impact by Year

Total Employment by Year					
Employment Type	**2016**	**2021**	**2026**	**2031**	**2036**
Total Direct Employment	78	1,308	3,686	6,890	10,687
Total Indirect Employment	112	1,869	5,266	9,843	15,268
Total Employment	**190**	**3,177**	**8,952**	**16,733**	**25,955**

The suitability of those opportunities given the workforce characteristics of the township's anticipated population and the North Adelaide region.

The employment opportunities identified in this report cover a broad spectrum of industries ranging from retailing, municipal and community services, and construction and manufacturing trades.

These industries will offer a range of employment opportunities within Adelaide's north west region, during the construction phase, and into the future. Connor Holmes (2008) considers this issue in more detail.

3. AGRICULTURE

This section addresses the site's agricultural production potential, and the economic implications arising from the loss of that potential.

Hudson Howell undertook a survey of all landowners within the site in August 2008 in order to determine the current farmgate value of agricultural production.

All landowners were contacted. Each was asked to provide the total value of agricultural production from their land for the 2007/08 financial year. They were also asked how many people they employed.

The total farmgate value of agricultural production generated from the site in the 2007/08 financial year was $786,000. This excludes Perpetual Holding's operation on Brooks Road, which will remain active on site, and has been incorporated into the Masterplan's employment areas.

This figure may vary from year to year. Some of the landowners noted they rotate crops, and therefore the value of production for the 2008/09 year might be lower or higher than the 2007/08 year.

Of the 13 land owners contacted:

- Five landowners advised they were intending to shift their agricultural production elsewhere should the proposal be approved.
- One landowner intended to stop farming altogether. The estimated value of his production is $6,000.
- Two were unsure what they will do.
- The remainder are not currently farming their land.

Therefore there are minimal economic implications associated with lost production. $780,000 of production will be directly lost. Less than a $1 million of indirect benefits, from multiplier effect on other forms of production and consumption, will be lost associated with the direct loss of $780,000 of production.

The Adelaide Plains' horticulture industry produces approximately 16% of South Australia's horticulture output, with a farm gate value of $92 million (Virginia Horticultural Centre 2007).

The total loss to Virginia's farm gate production resulting from the proposal's use of formerly agricultural land is $780,000 or less than 1% of the region's farm gate value.

This loss is considered negligible, and outweighed by the economic benefits associated with the proposal.

While it is estimated there will less than 10 jobs lost it is expected that most of these workers will find employment in metropolitan Adelaide's north, or the Adelaide Plains.

4. CONCLUSION

An economic assessment of the proposal has been undertaken. It considered the investment required to construct and establish infrastructure, housing and businesses within Buckland Park.

The economic costs and benefits flowing during the proposal's operation were also considered, including the loss of agricultural production and the benefits of employment, business activity and resident's spending.

The objective was identification of economic costs and benefits associated with the Buckland Park proposal.

The assessment included both a qualitative and quantitative analysis of the relevant costs and benefits. Data collect to identify costs was not primary information, rather it was based on the consultant and proponent's previous work and experience.

For a proposal of this scale, with a long time frame for planning, construction and establishment, it is considered this type of assessment is adequate to identify the broad costs and benefits to the economy.

The study found construction of Buckland Park's infrastructure, housing and other components will directly and indirectly have associated, on average, 2,229 FTE's of employment per annum over 25 years. It is estimated the associated incomes, or value added to the economy, generated by this activity will, on average, be $185.8 million per annum over 25 years.

It was found during Buckland Park's operation its 10,687 jobs by 2036 will generate an additional 15,268 jobs in the wider state economy. A total of 25,955 jobs per annum will be generated directly and indirectly. However, this total annual impact will not occur until 2036 when the proposal is constructed and occupied. Between commencement of construction and 2036, the multiplier impact will be generally proportional to the rate of direct employment growth within the site.

Buckland Park's construction and operation will support existing businesses and generate new business activity throughout the State, greatly exceeding activity directly generated within Buckland Park.

Suburbs and businesses in Adelaide's northern region will benefit from spending generated by activities related to Buckland Park, but leaked to businesses in the region.

Investment opportunities for the region will emerge principally through support required for the construction and operation of Buckland Park's housing, retail, commercial, and industrial facilities, and the new community's demands for goods and services.

Adelaide's north and north-west are undergoing growth in the housing and employment sectors. Industries are relocating there to take advantage of the large sites suitable for modern operations and efficient gateway access between interstate and overseas transport networks, and metropolitan transport networks, needed to access metropolitan markets.

Buck land Park will contribute to this trend by:

- Providing market and workforce in the same region, this will progressively expand over the next 25 years, matching growth in business investments employment opportunities.
- Bringing infrastructure to the region, and making economically efficient use of the infrastructure provided by government to support the region's growth.
- Providing some suitable employment land.

Buckland Park is within one of South Australia's major horticulture production regions. Buckland Park could contribute land for use by agricultural based business, such as food processing. It will also provide housing for workers and potentially its infrastructure could be shared by horticultural industries.

All the land owners within the site were contacted as part of this study and asked the value of their production and the number of employees involved.

It was found 10 jobs would be lost, and $780,000 of production. Less than a $1 million of indirect benefits, from multiplier effect on other forms of production and consumption, will be lost associated with the direct loss of $780,000 of production.

The Adelaide Plains' horticulture industry produces approximately 16% of South Australia's horticulture output, with a farm gate value of $92 million (Virginia Horticultural Centre 2007).

The total loss to the economy resulting from the proposal's use of formerly agricultural land is therefore $780,000 or less than 1% of the region's farm gate value.

Directly, the state will receive the financial benefits of collection of state property taxes of approximately $2.6 million per year.

Buckland Park will supply 12,000 house allotments, in a single well planned proposal. This is 5% of the target needed to support the state's economic growth.

Economic benefits flowing from Buckland Park are enhanced by:

- Economies of scale associated with a single, large scale project which facilitates the orderly and efficient provision of infrastructure.

- Land use and infrastructure planning funded by the proponents rather than state or local government.

- Buckland Park's location in the Adelaide's north west region, which provides opportunities for sharing infrastructure with other land releases, and creates a catalyst for more housing needed to reach the 245,000 target, with greater efficiencies for government.

- Smaller green field or infill projects demand more government resources for planning and infrastructure.

5. REFERENCES

Connor Holmes *Buckland Park Demographic Analysis* 2008

Connor Holmes *Buckland Park Centres Planning* 2008a

Department of Planning and Local Government website, accessed 15 December 2008

Urban Development Institute of Australia (SA)

Virginia Horticulture Centre *Development of Horticultural Industries on the Adelaide Plains – A Blueprint for 2030* 2007

6. GLOSSARY

FTE:	Full Time Equivalent job.
Econometric Model:	a model used to estimate the employment impacts as a result of investment in the proposal.
Gross State Product:	the state's economic output, measured as the sum of all value added by industries within the state.
Value added:	is the sum of wages and salaries, returns to capital and payment of taxes
UDIA:	Urban Development Institute of Australia

31 March 2009

DRAFT REPORT

PRELIMINARY GEOTECHNICAL INVESTIGATION, BUCKLAND PARK, SOUTH AUSTRALIA

Submitted to:
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REPORT

Report Number: 077662060 004 Rev4

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1.0 INTRODUCTION

This report presents the results of a preliminary geotechnical site investigation carried out by Golder Associates Pty Ltd (Golder) for the Buckland Park Proposal and Environmental Impact Statement (EIS). The location of the site is shown on in Appendix A, Tab 1.

The investigation was commissioned by Walker Corporation on 17 December 2007 (letter, Lewis/Proudman) and was carried out in general accordance with our proposal (reference P77662077b dated 28 November 2007).

The aim of the geotechnical investigations was to provide an understanding of the soil stratigraphy and existing site geotechnical conditions as part of the preliminary development information for the site.

The investigation included:

- a desktop study of geological and groundwater information;
- site walk over to inspect drains, cuttings and exposures in the Gawler River;
- intrusive site investigations and soil sample collection;
- field and laboratory testing for acid sulphate soils (outlined in our report *'Preliminary ASS Investigation, Buckland Park, South Australia'*, dated 30 September 2008, reference 077662060 008 Rev1);
- laboratory testing of soils for classification, CBR, Atterberg Limits and sodic and
- saline soils; and
- preparation of this report including the results of investigations, and discussion and
- recommendations.

As part of the desktop study an extract of SKM's baseline draft report for the site (provided as Appendix B), commenting on hydrogeology, was provided by Walker Corporation for reference.

2.0 DESKTOP ASSESSMENT

2.1 Site Description

Buckland Park is located 32 km north of the Adelaide CBD. The site is bounded by Port Wakefield Road, the Gawler River, Cheetham Salt Limited salt pans and horticultural activities. The Site location is shown in Appendix A. The site area is 1,308 hectares, the certificates of title are tabled as Tab 2 within Appendix A.

The proposal comprises 12,000 residential lots, to be created over a 25 year time frame. Stage 1, proposed to commence in late 2009, is indicated within Appendix A and encompasses portions of the east sector and north sector east shown in Appendix A.

The site is generally flat, and has been used for agricultural purposes, primarily low intensive grazing. In the north west and south west parts of the site there are areas of remnant native vegetation.

The site has been divided into environment "sectors" as shown in Appendix A. Table 1 below outlines the sector names with the investigation locations within those boundaries. The investigation locations were arranged in an approximate grid pattern placing a borehole or test pit approximately every 500 m over the site. Due to the release of land at different times and portions of the land being under crops, not all of the investigation locations fit exactly on the grid. A total of 75 locations were investigated yielding approximately 1 investigation location per 20 hectares of land.

Table 1: Summary of Investigation Locations within Each Environmental Sector

Sector Name	Borehole Identification	Test Pit Identification	No Investigation Locations
Central Sector	BH33, BH34, BH35	TP08, TP09	5
North Sector East	BH01 to BH15, BH54, BH55, BH59, BH60	TP01 to TP03, TP06, TP07	24
North Sector West	BH16 to BH21, BH43, BH56 to BH58	TP04, TP05	12
South Sector West	BH22 A/B to BH31, BH40, BH41, BH52,	TP11, TP13, TP14	17
South Sector East	BH45 to BH47		3
South Sector	BH32, BH36 to BH39, BH42, BH44	TP10, TP12	9
East Sector	BH48 to BH51, BH53		5

2.2 Published Site Soils and Geology

The "*Gawler*" geological mapsheet[1] provides information on the geology of the site for all but the western side of the site, which is not included on mapsheet. The mapsheet indicates that the eastern part of the site is underlain by Quaternary age 'alluvial clays and sands of the Adelaide Plains'. The mapsheet also shows tributaries of Thompson Creek flowing in generally a southerly direction across the site, with some swamp areas along these tributaries.

[1] Campana, B. Scale 1:63,360, Geological Survey of South Australia (1953)

The "*Vincent*" geological mapsheet[2] provides the following information on the western side of the site - the rest of the site is not included on the map-sheet;

- Most of the western side of the site is underlain by Quaternary age 'Pooraka formation: Red-brown sandy clay and micaceous, clayey sand. Late Pleistocene (30,000 to 20,000 years before present) fluvial and alluvial deposits and abandoned channels'.
- The far north-west of the site is underlain by 'Holocene alluvium: Micaceous, red-brown and grey, fine sand and silty clay. Recent floodplain deposits and abandoned channels.'
- The far south-west of the site is underlain by 'St Kilda Formation: (Holocene marine and coastal marine sediments)', including 'Supratidal flats. Gypseous clay.'
- There is possible faulting – including the 'Buckland Fault' – approximately two kilometres west and north of the site. The 'Redbanks Fault' may also pass close to or through the site.

Bulletin 46 of the Geological Survey of South Australia[3] indicates that the site is part of the Lower Outwash Plain of the Para Fault scarp. The topography of the Lower Outwash Plain is dominated by outwash fan deposits of the streams draining the hills to the east (these form the Para Fault scarp). There is evidence of levee development in the Lower Outwash plain associated with the streams. The stream courses appear to have varied over time so that buried creek channels (alluvial deposits of sand and gravel) are present within the Plain, generally overlain with clay. Often these will be associated with shallow surface depressions.

The Australian Soil Resource Information System (ASRIS) produced by the CSIRO and Atlas of South Australia Map produced by Planning SA provide reference maps to assess if a site has potential for acid sulphate soils. The maps do not indicate the potential for acid sulphate soils on the site (the mapping of the soil may have been limited due to private property boundaries), but indicates a high probability closer to the coast in St Kilda Formation and slightly inland of the coastline in Holocene Alluvium. Both of these soil formations are suspected to be on the site and therefore there is the potential for acid sulphate soils.

2.3 Hydrogeology

As discussed in an extract from SKM's draft report (Appendix B) the groundwater across the site varies between 1.38 mAHD in the south and 6.40 mAHD in the north of the site. Generally the groundwater flows westerly and south westerly, towards the coast. The measured groundwater level ranged from 0.88 m below ground level ('bgl') and 5.67 m bgl. For the majority of the site groundwater is considered to be less than 4 m bgl. Available data indicates that seasonal fluctuations in the groundwater table could be around 1 to 2 m.

As the site is in a coastal region, there is a possibility that groundwater is affected by tidal changes, however this is not expected to be influential and has not been measured as part of the EIS investigation.

[2] Belperio, B.P. Scale 1:50,000, Geological Survey of South Australia (1988)
[3] Taylor JK, Thomson BP and Shepherd RG, The soils and Geology of the Adelaide Area, Department of Mines (1974)

3.0 METHODS OF INVESTIGATION

3.1 Site Walkover

A site walkover was carried out on 16 January 2008 by a senior engineering geologist from Golder. This includes traverses of the Gawler River and the boundary to the site. Observations were also made of the open ground, minor creeks and in earthworks trenches excavated along Park Road.

3.2 Intrusive Investigations

Intrusive soil investigations were conducted between 21 January and 18 April 2008, and included:

- excavating fourteen (14) test pits (TP01 to TP14) using a backhoe to depths of between 2.3 m and 3.4 m; and
- drilling sixty-one (61) boreholes (BH01 to BH60, including BH22 A and B) using a 4WD mounted 'Rockmaster' drill-rig, including:
  - fifty (50) 'shallow' boreholes to depths of between 2.2 m and 3.9 m; and
  - eleven (11) 'deep' boreholes to depths of between 5.1 m and 6.0 m.

Intrusive soil investigations were performed in the presence of an engineer or scientist from Golder, who logged the materials recovered, performed field tests and recovered samples for laboratory testing.

Test locations were recorded using a hand-held GPS. The locations of the test pits and boreholes are shown on Figure 1.

The Reports of Test Pits and Boreholes are located in Appendix C, together with Notes and Abbreviations used in their preparation. Each test pit and borehole core tray was photographed during the investigation. These photos and other site photographs taken during fieldwork are presented in Appendix D on the attached CD-ROM.

3.3 Laboratory Testing

3.3.1 Geotechnical

We conducted the following geotechnical testing on samples from the test pits, taken between depths of 0.2 m and 2.8 m:

- Atterberg Limit and Particle Size Distribution on 12 Samples - TP01/01, TP04/01, TP07, TP08/02, TP09/02, TP10/01, TP11/01, TP12/02, TP13/01, TP14/01, TP14/02 and BH46.
- Soaked and Unsoaked CBR (compacted to 98% dry density ratio compared to Standard compaction and with 4.5 kg surcharge) including measurement of the compaction characteristics, for 6 Samples - TP01/01, TP04/01, TP07, TP11/01, TP10/01, TP13/01 and Soaked CBR only (compacted to 98% dry density ratio compared to Standard compaction and with 4.5 kg surcharge) for BH46.

The geotechnical soil testing was performed in accordance with the relevant Australian Standard methods at Golder Associates' Adelaide laboratory which is NATA accredited for the testing performed.

3.3.2 Chemical Testing - Sodic and Saline

We submitted sodic and saline chemical testing for 45 samples from the test pits and boreholes. Samples were taken between ground surface and a depth of 6.0 m. Sodic and saline testing included analysis for pH, electrical conductivity, sulphate, chloride, calcium, magnesium, sodium and potassium.

Chemical testing was performed by ALS Environmental's Sydney laboratory which is NATA accredited for the testing performed.

4.0 RESULTS

4.1 Geotechnical Site Walkover

A site walkover was carried out on 16 January 2008 by a senior engineering geologist from Golder.

Observations made during the site inspection suggest that most of the site is covered by topsoil either naturally or as ploughed fields for farming, or has been disturbed by housing and roads. Inspection of Gawler River and minor creeks and excavated channels provided some limited exposure of subsurface materials. The shallow subsurface profile to about 1 m was also observed in trenches excavated along Park Road.

From the available exposures we observed that there is generally a change in the surface soils from clayey soils in the eastern portion of the site to sandy soils in the western portion of the site. Clay and sandy clay soils were observed in service trenches along Park Road and in a corner of the site west of Brooks Road and north of Thompson Road.

Clayey soils were also observed in the creek channels which extend north east from Thompson Creek. Sandy soils were observed in the more westerly of the two channels, and in a borehole being drilled adjacent to these channels. We observed sand and clayey sand soils north of Beagle Hole Road in the excavated drains adjacent to the south west corner of the site.

There was limited geological exposure north of Park Road. Along the Gawler River we observed more variable clayey soils towards the eastern end of the river's intersection with the site boundary, and more sands towards the western end. Some sandy clay soils were also observed along the western portion of the Gawler River.

The observations made suggest sands and clayey sand soils are present near the surface west of Brooks Road and parallel to the coast with clays and sandy clays more prevalent towards Pt Wakefield Road. Interbedding of these two soils types is likely to occur with depth due to the typical onlapping of sediments caused by the interaction of coastal processes and alluvial outwash processes over time.

4.2 Summary of Subsurface Conditions

Groundwater was encountered at 25 of the investigation locations at depths between 1 m and 5.1 m, at the south western corner and north eastern corner of the site respectively. Shallow groundwater (less than 2.5 m below the surface) was recorded mainly in the south sector east and south sector, with the exception of BH16 and BH09 in the southern portions of the northern sectors.

The subsurface soil conditions encountered in the boreholes and test pits were generally consistent with the published geology.

The soil profile observed in the boreholes and test pits varied across the site.

At the time of our investigation we did not observe fill in the boreholes or test pits. The soil was logged from the existing ground level to depths up to 6m below ground level.

Generally the topsoil encountered was clayey sand or sandy clay with the exception of boreholes BH01, 05, 13, 15, 22A, 23, 34, 52 where the topsoil was sand and BH08 where it was clay. The plasticity of the fine fraction of the soil varied between low and high. The topsoil was generally brown or grey brown.

Below the topsoil we encountered clayey sand, sand clay, sand and clay. There was variation in the composition, thickness of material layers, the plasticity, depth, colour and proportion of calcareous materials in the soils across the site. Colour generally varied between brown, red brown and orange brown with mottled grey encountered in most boreholes and test pits (except 13 locations, generally in the northern sectors of the site) below between 1.15 m and 5.8 m. Calcareous material was encountered at most investigation locations - either disseminated in the soil, as calcrete gravels, or both.

Inferred calcrete was observed at TP04, BH25 and TP05, but did not cause refusal. No other rock strength material was encountered during the investigation. Push tube refusal on dense, and possibly cemented, sand was encountered at 3.7 m depth BH38 and refusal at 5.2 m depth in BH59 on an unknown material.

Some boreholes were reported to be predominantly sand however, these were scattered across different sectors of the site and did not indicate a geological pattern.

4.3 Laboratory Testing Results

4.3.1 Geotechnical

A summary of the laboratory geotechnical testing results is provided below in Table 2. The results of the geotechnical laboratory testing are presented in Appendix F. References to the testing procedures adopted are shown on the test certificates.

Table 2: Summary of Laboratory Geotechnical Testing Results

Sample Number	Sample Depth (m)	Soil Classification	Percentage Passing Sieve		Liquid Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	CBR Soaked (%)	CBR Unsoaked (%)
			2.36 mm	0.075 mm					
TP01/01	0.4 – 0.5	Sandy Clay (CI)	97	55	42	26	11	10	13
TP04/01	0.2 – 0.4	Sandy Clay (CL)	100	51	21	6	3	5	7
TP07	0.2 – 0.4	Clay (CI)	100	91	48	29	12	7	15
TP08/02	1.95 – 2.15	Clay (CH)	100	74	67	42	15	-	-
TP09/02	1.9 – 2.0	Sandy Clay (CL)	92	55	34	19	9	-	-
TP10/01	0.3 – 0.5	Clay (CI)	86	60	41	25	10	11	12
TP11/01	0.9 – 1.1	Clayey Sand (SC)	100	48	30	15	5	11	12
TP12/02	2.1 – 2.3	Clay (CH)	100	90	71	23	17	-	-
TP13/01	0.7 – 0.9	Sandy Clay (CL)	100	50	26	9	1	8	8
TP14/01	1.1 – 1.3	Clayey Sand (SC)	99	49	24	7	3	-	-
TP14/02	2.5 – 2.8	Sandy Clay	98	72	39	21	10	-	-

		(CI)							
BH46	0.5 – 0.65	Gravelly Clayey Sand (SC)	72	39	34	14	7	20	-

4.3.2 Chemical Testing - Sodic and Saline

Results of the chemical testing are summarised for each borehole and test pit in Appendix G. Table 3 below gives a range for pH, electrical conductivity (EC), chloride and sulphate levels as well as the sodium adsorption ratio (SAR) for each sector.

Table 3: Summary of Chemical Testing within Each Environmental Sector

Sector Name	pH	Electrical Conductivity	Chloride (mg/kg)	Sulphate (mg/kg)	Sodium Adsorption Ratio
Central Sector	8.6	1270	1450	380	28
North Sector East	6.8 - 10	<1 - 870	180 - 2130	70 - 980	3 - 97
North Sector West	8 - 10	100 - 1090	40 - 1250	40 - 360	5 - 47
South Sector West	7.9 – 9.7	289 - 2770	280 - 4630	50 - 1250	7 - 101
South Sector East	8 – 9.9	154 - 5950	50 - 1390	10 - 470	1 - 45
South Sector	9 – 9.4	811 - 1920	900 - 2470	140 - 460	41 - 93
East Sector	8.7 – 9.4	798 - 1810	610 - 1840	260 - 1830	11 - 79

Figures 3 to 6 indicate the pH level, Chloride and sulphate concentrations and SAR respectively, along with the depth the samples collected.

The results of the chemical testing are presented in Appendix H along with the chain of custody documentation.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 Design CBR

We recommend the design California Bearing Ratios (CBR) in Table 4 be adopted for the preliminary pavement design based on the laboratory and field testing. A CBR of 10 is recommended for Stage 1 of the proposal.

Table 4: Summary of Investigation Locations within Each Environmental Sector

Sector Name	Design CBR (%)
Central Sector	5
North Sector East	7
North Sector West	5
South Sector West	8
South Sector East	10
South Sector	11
East Sector	10

5.2 Soil Movements

The natural soils observed in the subsurface profile generally comprised sands, clayey sands, sandy clays and clays of low to high plasticity. These soils are expected to be reactive to seasonal and long-term moisture changes.

The structural footings should be designed to withstand the forces applied by the moisture related soil movements. The forces applied by swelling or shrinkage of the soil should be taken into account in the design.

We calculated characteristic movements (y_s) at various borehole and test pit locations based on the recommendations of AS2870-1996 "Residential slabs and footings - construction" estimating input parameters based on experience and published data.

The calculated y_s values varied across the site, ranging from 10 mm to 70 mm not taking into account tree effects. It is recommended for preliminary design that a median y_s value of 55 mm is assumed for the site with an uncertainty of plus or minus 15 mm.

When tree effects are considered the y_s value increases by around 20 mm for a single tree and 30 mm for a group of trees. However, we consider that there is sufficient uncertainty associated with predicting tree effects (size and number of trees and their proximity to the dwelling all affect the prediction) that it is unreasonable to account for these at this preliminary stage. We recommend that tree effects should be considered for individual cases across the site once further detailed investigations have been undertaken.

5.3 Footings Recommendations

We recommend that footings should be founded below any fill or topsoil, embedded around 0.2 m into natural material.

We consider that the bearing pressures applied by residential structures buildings, or single and double-storey commercial buildings are not likely to exceed the allowable pressure for the soils observed during the investigations on the site.

5.4 Implications of Sodic & Saline Soils

Chemical testing indicates a variance in pH, chloride concentration, sulphate concentration and sodium adsorption ratio (SAR).

As discussed in SKM's draft report (Appendix B) the measured groundwater salinity across the site varies between 3,765 mg/L and 79,950 mg/L. Generally the site groundwater is more saline in the west and fresher to the east. Available data indicates that seasonal fluctuations in the groundwater table could be between 1 m and 2 m. There has been speculation that sea levels may rise in the future. Groundwater levels are likely to rise as a consequence of constructing the proposal.

Saline water (greater than 5000 mg/L) within 4 m of the surface should be considered in the design and specification of asphaltic concrete pavements and in-ground structures with regard to the grade of concrete and reinforcement specifications. Landscaping and flora design should consider the SAR.

There are no disposal criteria for sodic and saline soils however saline groundwater can not have a percentage variance greater than 10 when disposed of to a fresh aquatic ecosystem, as outlined in the Environment Protection (Water Quality) Policy 2003.

5.5 Implications of PASS Material

The implications of PASS material on the design process and during construction are discussed in our report *"Draft Report, Preliminary Acid Sulphate Soil Investigation, Buckland Park, South Australia*" dated 3 November 2008 (reference 077662060 008 Rev 2). Generally PASS soils appear to be confined to small portions of the St Kilda Formation associated with former watercourse alignments (refer to figure 5). This material is concluded to be at low risk of being exposed unless excavation occurs below the water table or the water table is lowered.

The report recommends details ASS investigations and management planning prior to the commencement of works in locations where:

- Excavation below groundwater is proposed.
- Activities which would potentially lower ground water within water courses.
- Within areas identified as having a high to medium risk of ASS.

In areas where PASS material may be encountered, or there is potential for acid formation, this must be considered in design and specification of infrastructure.

5.6 Liquefaction

Seismic activity has been recorded through much of South Australia. Australian Standard 1170.4 – 2007 '*Earthquake actions in Australia'* includes information relevant to design for earthquakes.

Liquefaction of soils may be triggered by seismic activity. Liquefaction was recorded in the South East of South Australia in 1897, associated with South Australia's largest recorded earthquake (magnitude around 6.5, with estimated Modified Mercalli intensity VIII) which was centred offshore from Beachport.

Liquefaction is generally associated with seismic disturbance of saturated (ie below groundwater level) low density silt and silty sand or saturated soft and sensitive clays. While the St Kilda Formation could potentially contain such soils, on the basis of previous studies[4] of liquefaction risk elsewhere in the Adelaide metropolitan we conclude that there is a low liquefaction risk.

On that basis, we consider that the risk on the Buckland Park site is likely to be low and confined to the St Kilda Formation.

5.7 Excavation

The reports of Boreholes and Test Pits contained Appendix C provide information related to excavation and drilling resistance.

The natural soils at the site generally presented low to moderate resistance to excavation using a backhoe. We expect that generally the soil materials on the site will be able to be excavated with conventional earthmoving machinery (excavators, front end loaders etc) without a requirement for specialised rock excavation.

During excavation of test pits where groundwater was encountered, the soils immediately above and below the groundwater were observed to collapse as the material beneath it was removed. This should be considered during design and construction stages.

5.8 Suitability of On-Site Material for Re-Use During Construction

The sodic and saline chemical tests and ASS results need to be considered when planning the re-use of excavated materials on site. Subject to those considerations, we expect that onsite materials will generally be suitable for bulk earthworks and subgrade filling. Further investigations will be necessary to confirm that prior to their use.

Our investigations encountered many soils which we expect will be suitable for use in low-permeability liners (for instance in wetland or stormwater basin construction. As the soils vary across the site, further investigations will be required to confirm the suitability of the particular materials proposed for use at specific sites.

5.9 Further Investigations

This geotechnical investigation is an overview of the ground conditions and geology of the Site. Further investigation will be required the development (road layouts, stormwater management structures, etc) has been better defined.

5.10 Constraints & Management

The constraints that may affect the construction and operation of a township (including residential and commercial dwellings) identified in this investigation are the sodic and saline soil conditions.

[4] Poulos H.G, Love D.N. and Grounds R.W. (1996) "*Seismic Zonation of the Adelaide Area*", 7th Australia New Zealand Conference on Geomechanics, pps 331-342

6.0 LIMITATIONS OF THIS REPORT

This report has been prepared in accordance with the agreement between Walker Corporation and Golder Associates Pty Ltd. The services performed by Golder Associates have been conducted in a manner consistent with the level of quality and skill generally exercised by members of its profession and consulting practice. No warranty or guarantee of site conditions is intended.

This report is solely for the use of Walker Corporation and any reliance of this report by third parties shall be at such party's sole risk and may not contain sufficient information for purposes of other parties or for other uses. This report shall only be presented in full and may not be used to support any other objective than those set out in the report, except where written approval with comments are provided by Golder Associates.

The information on subsurface conditions in this report is considered to be accurate at the date of issue in accordance to the current conditions of the site. Subsurface conditions can vary across a particular site which cannot be explicitly defined by investigation. Therefore, it is unlikely that the results and estimations expressed in this report will represent the extremes of conditions within the site. Subsurface conditions including contaminant concentrations can change in a limited period of time. This should be considered if the report is used after a significant delay in time.

Attached as Appendix I is a document entitled "Important Information About Your Geotechnical Engineering Report" which should be read in conjunction with this report. We would be pleased to answer any questions about this important information.

Report Signature Page

GOLDER ASSOCIATES PTY LTD

Sarah Young
Geotechnical Engineer

Aaron O'Malley
Geotechnical Team Leader

SY;AO/LJS/cf

A.B.N. 64 006 107 857

j:\2007\geo\077662060 - buckland park\outgoing\077662060 004 r rev3 - geotechnical invest.doc

FIGURES

Figure 1 – Investigation Locations
Figure 2 – Geotechnical & ASS Testing Locations
Figure 3 – Soil pH Levels
Figure 4 – Soil Chloride Levels
Figure 5 – Soil Sulphate Levels
Figure 6 – Sodium Adsorption Ratio

BUCKLAND PARK PROPOSAL

Legend

- Borehole Location
- Test Pit Location
- Site Boundary
- Road

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0 500 1,000
Scale in metres

N

SCALE 1:22,500

DATUM GDA 1994
PROJECTION MGA Zone 54

Project:	077662060	Figure No:	F0002
Drawn:	KB	Date:	05.05.2008
Checked:		Date:	05.05.2008

Golder Associates
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FIGURE 1

J:\2007\Geo\077662060 - Buckland Park\GIS\Project\077662060_TMP_R_F0002_Rev0.mxd

BUCKLAND PARK PROPOSAL

GEOTECHNICAL AND PASS TESTING LOCATIONS

Legend

- Particle Size Distribution, Atterberg Limits and Calafornia Bearing Ratio
- Particle Size Distribution and Atterberg Limits
- Potential Acid Sulphate Soils
- Site Boundary
- Road

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Scale in metres

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SCALE 1:22,500

DATUM GDA 1994
PROJECTION MGA Zone 54

Project:	077662060	Figure No:	F0003_Rev1
Drawn:	KB	Date:	23.05.2008
Checked:		Date:	23.05.2008

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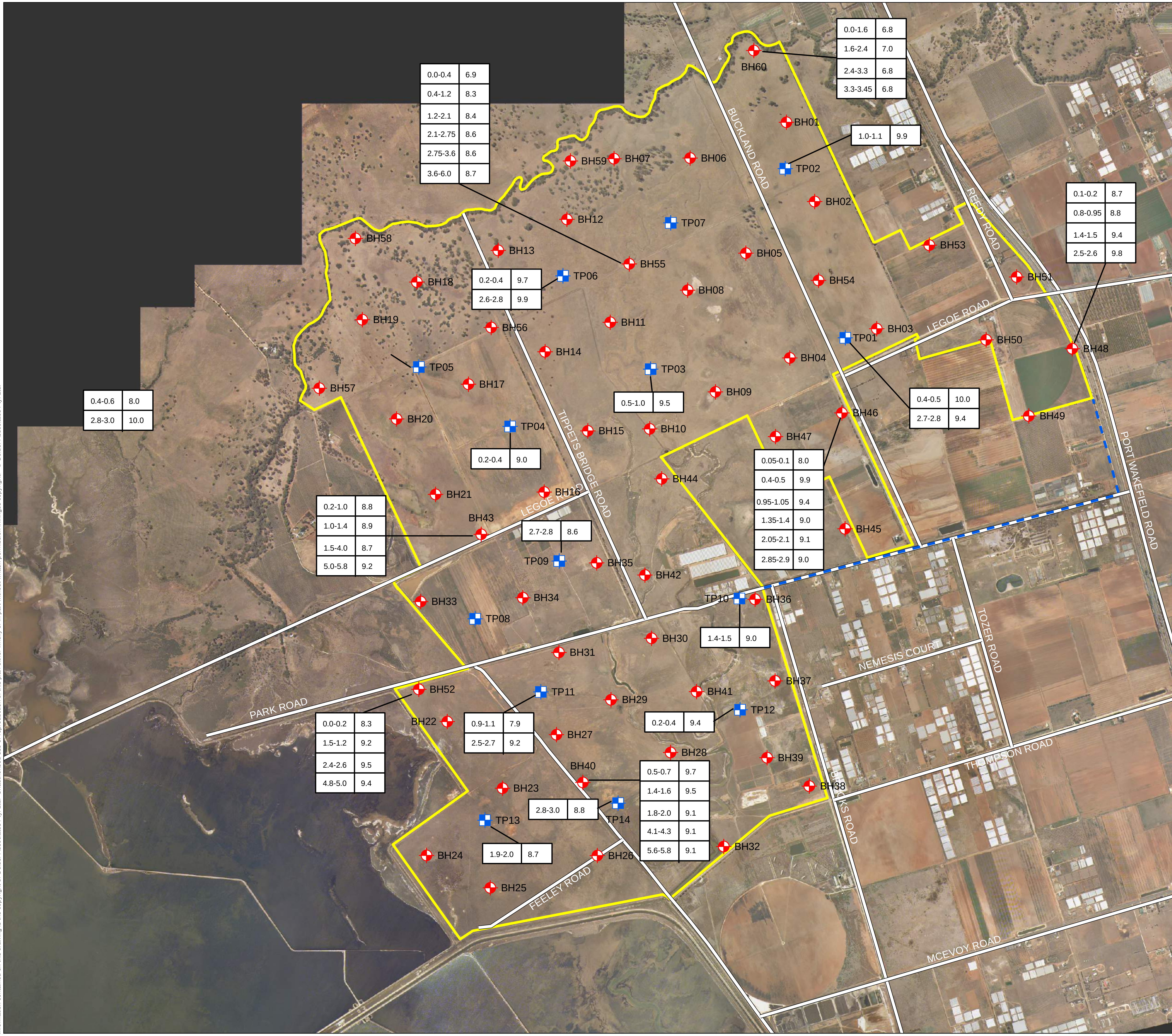
FIGURE 2



BUCKLAND PARK PROPOSAL

SOILS - PH LEVELS

Legend

- Borehole Location
- Test Pit Location
- Site Boundary
- Road

Depth (m)	pH units
0.4-0.5	10.0
2.7-2.8	9.4

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0 500 1,000
Scale in metres

N

SCALE 1:22,500

DATUM GDA 1994
PROJECTION MGA Zone 54

Project: 077662060 Figure No: F0004_Rev1
Drawn: KB Date: 23.05.2008
Checked: Date: 23.05.2008

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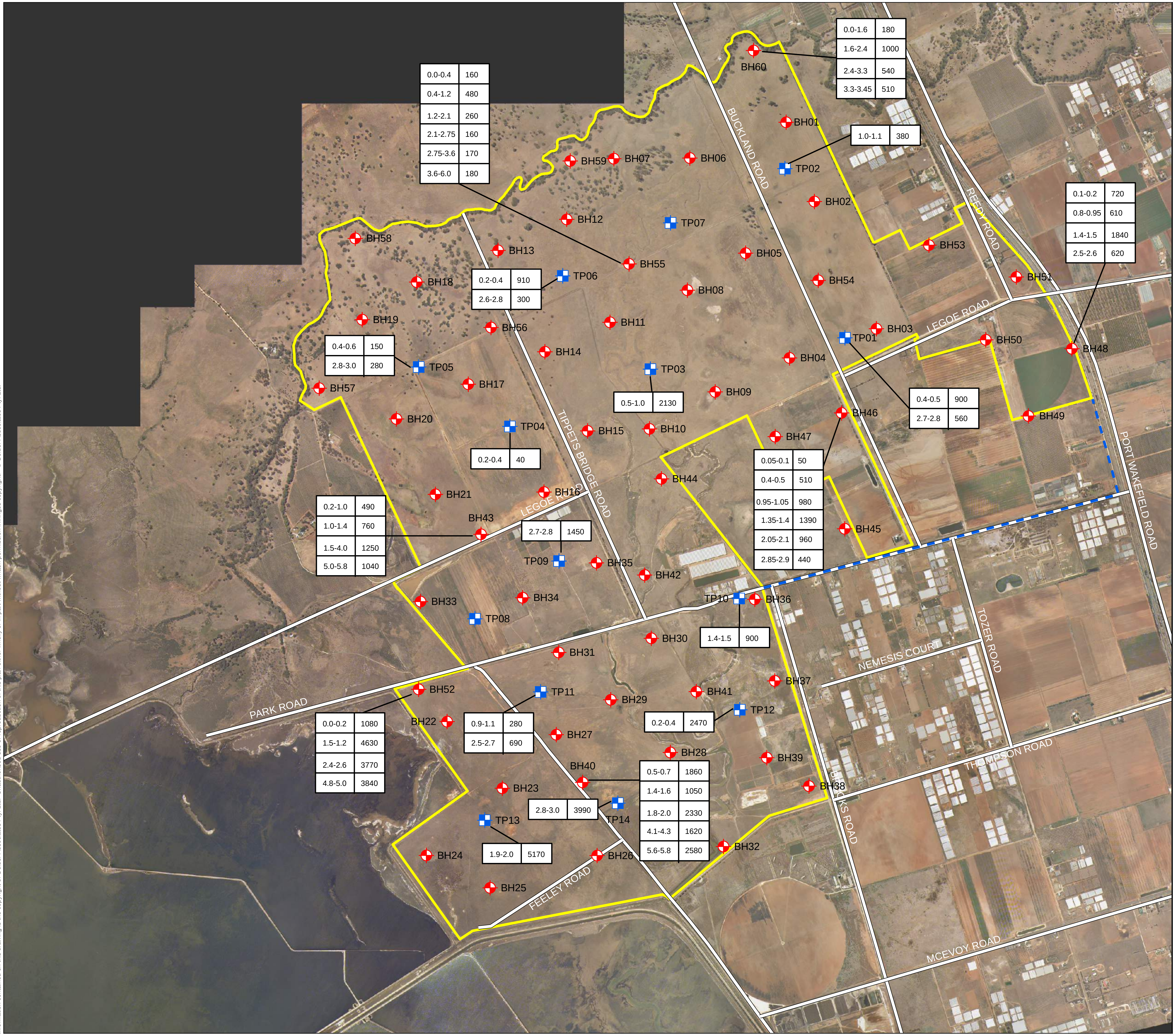
FIGURE 3

J:\2007\Geo\077662060 - Buckland Park\GIS\Project\077662060_TMP_R_F0004_Rev1.mxd



BUCKLAND PARK PROPOSAL

SOILS - CHLORIDE LEVELS

Legend

- Borehole Location
- Test Pit Location
- Site Boundary
- Road

Depth (m)	mg/kg
0.4-0.5	900
2.7-2.8	560

DRAFT

0 500 1,000
Scale in metres

N

SCALE 1:22,500

DATUM GDA 1994
PROJECTION MGA Zone 54

Project:	077662060	Figure No:	F0005_Rev1
Drawn:	KB	Date:	23.05.2008
Checked:		Date:	23.05.2008

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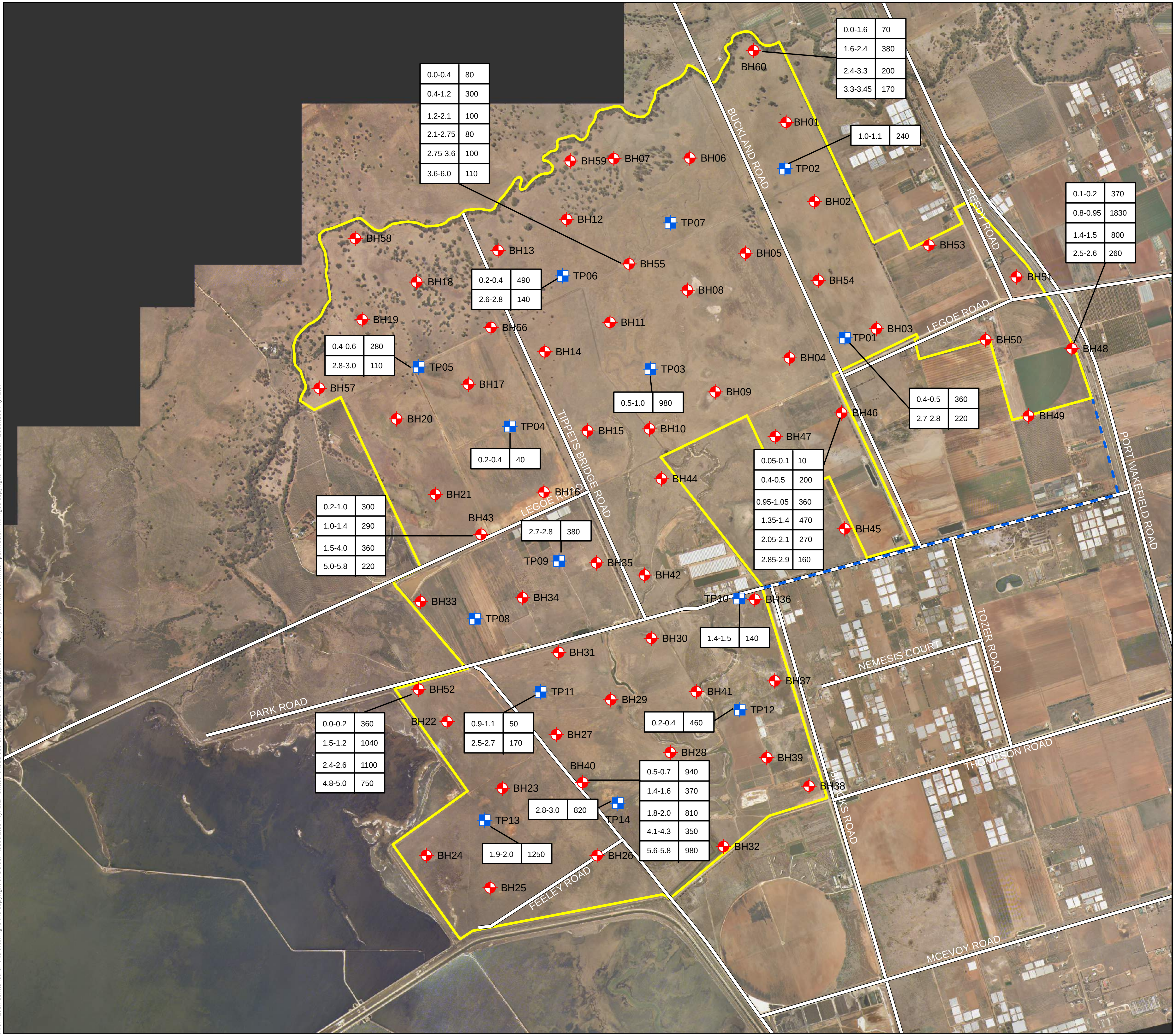
FIGURE 4



BUCKLAND PARK PROPOSAL

SOILS - SULPHATE LEVELS

Legend

Borehole Location

Test Pit Location

Site Boundary

Road

Depth (m)	mg/kg
0.4-0.5	360
2.7-2.8	220

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0 500 1,000

Scale in metres

N

SCALE 1:22,500

DATUM GDA 1994
PROJECTION MGA Zone 54

Project: 077662060
Drawn: KB
Checked:

Figure No: F0006_Rev1
Date: 23.05.2008
Date: 23.05.2008

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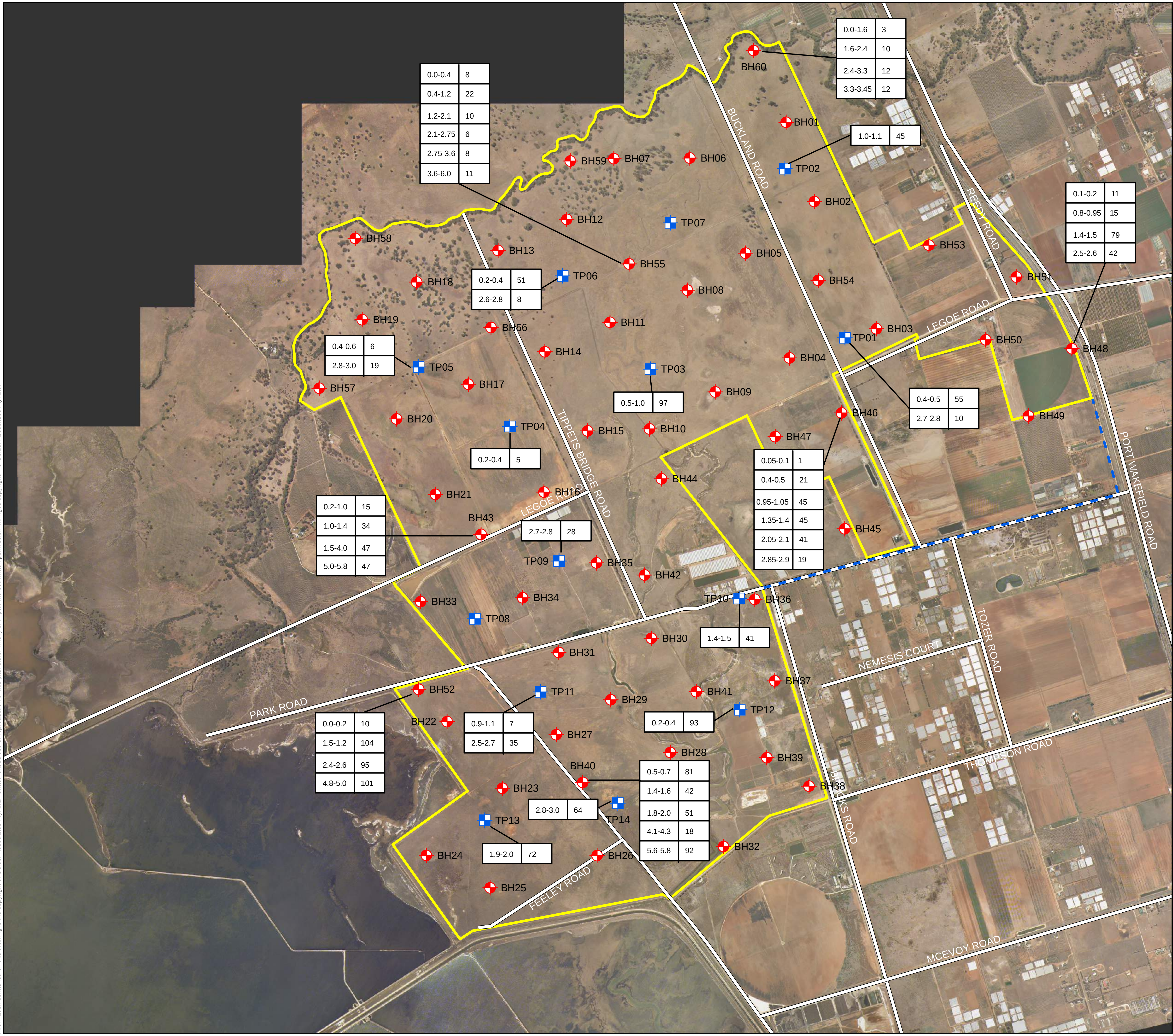
FIGURE 5

J:\2007\Geo\077662060 - Buckland Park\GIS\Project\077662060_TMP_R_F0006_Rev1.mxd



BUCKLAND PARK PROPOSAL

SOILS - SODIUM ADSORPTION RATIO

Legend

Borehole Location

Test Pit Location

Site Boundary

Road

Depth (m)	Ratio
0.4-0.5	55
2.7-2.8	10

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0 500 1,000
Scale in metres

N

SCALE 1:22,500

DATUM GDA 1994
PROJECTION MGA Zone 54

Project: 077662060
Drawn: KB
Checked:

Figure No: F0007_Rev1
Date: 23.05.2008
Date: 23.05.2008

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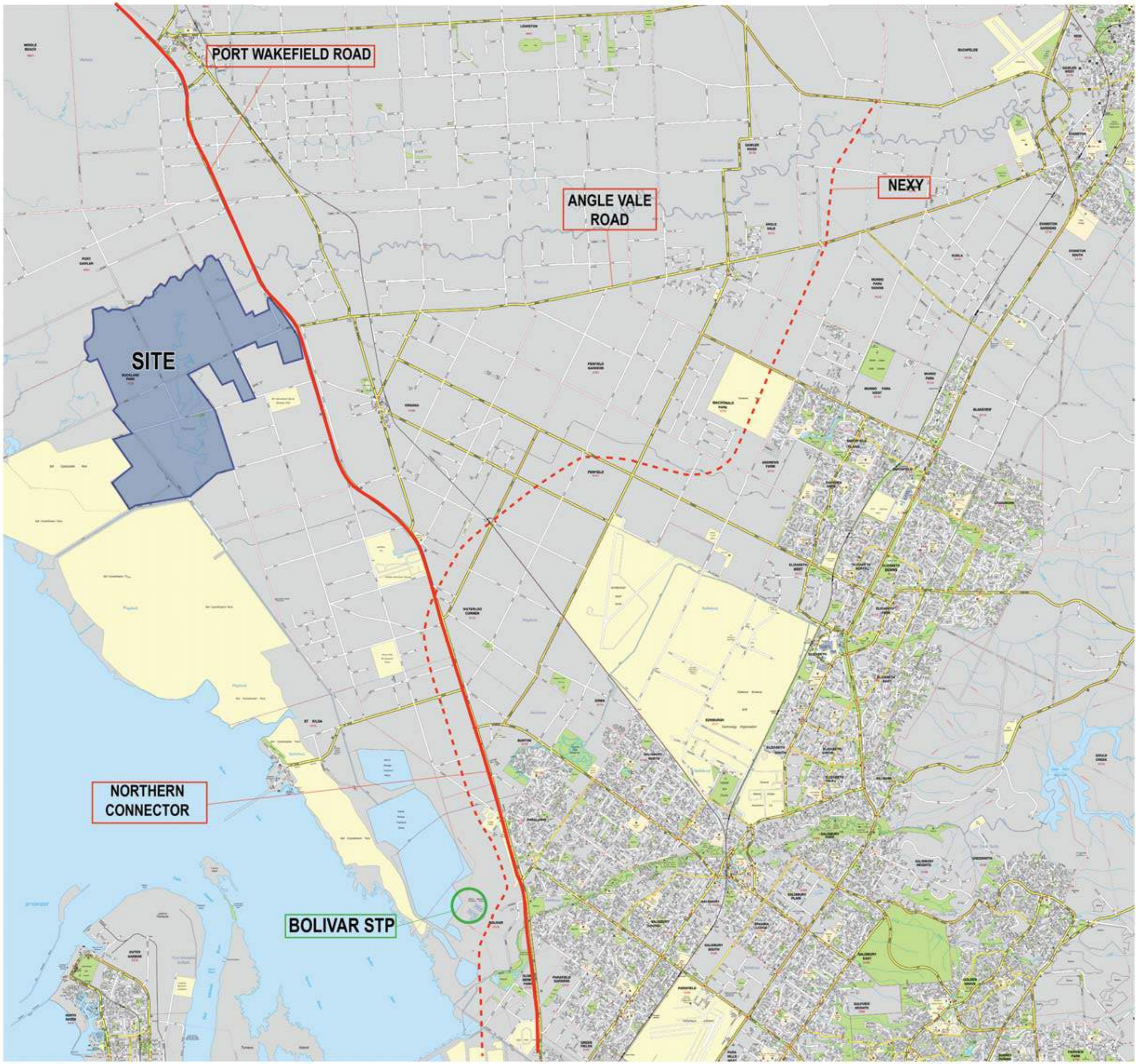
FIGURE 6

APPENDIX A

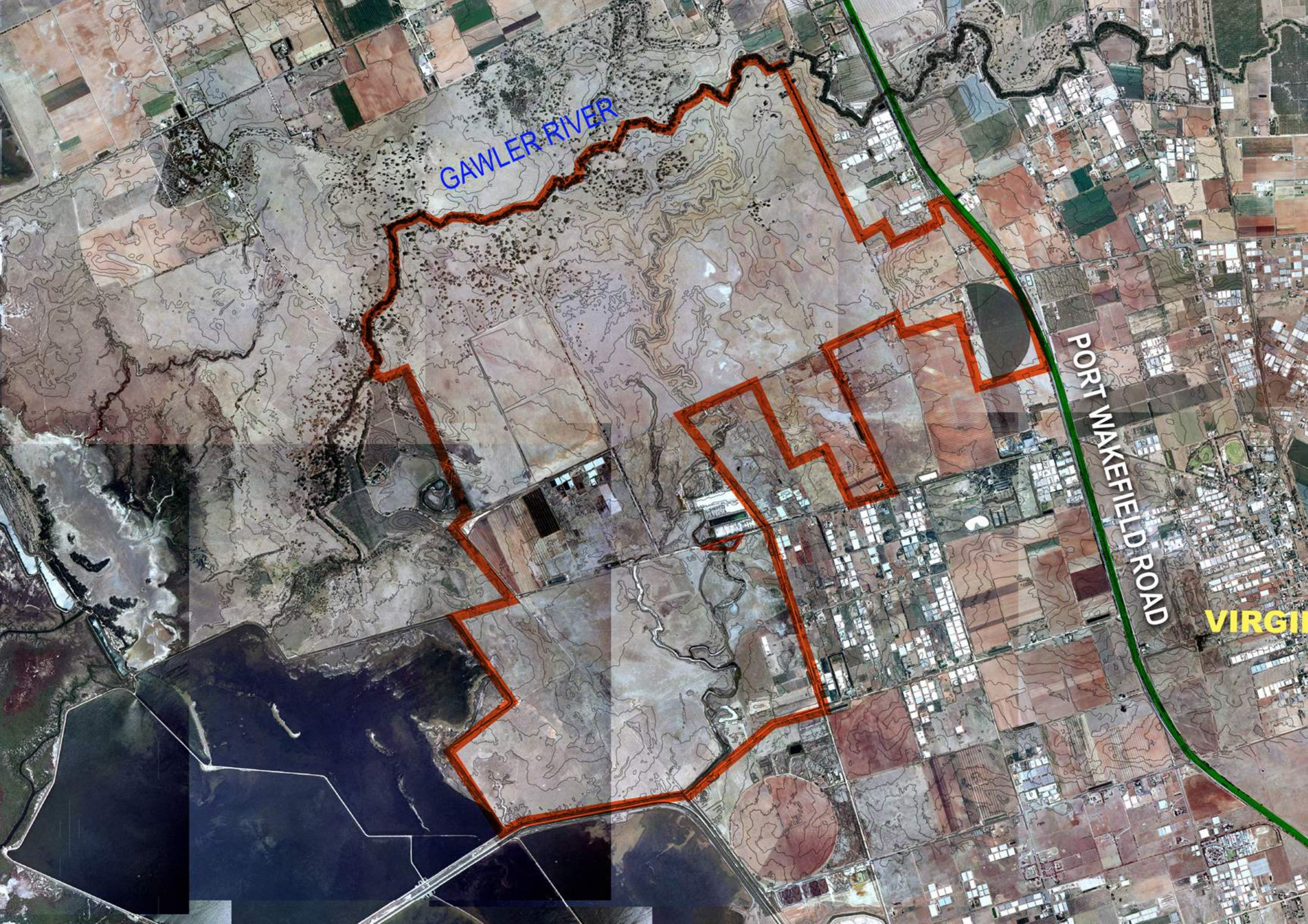
Figures Provided by Walker Corporation



Walker

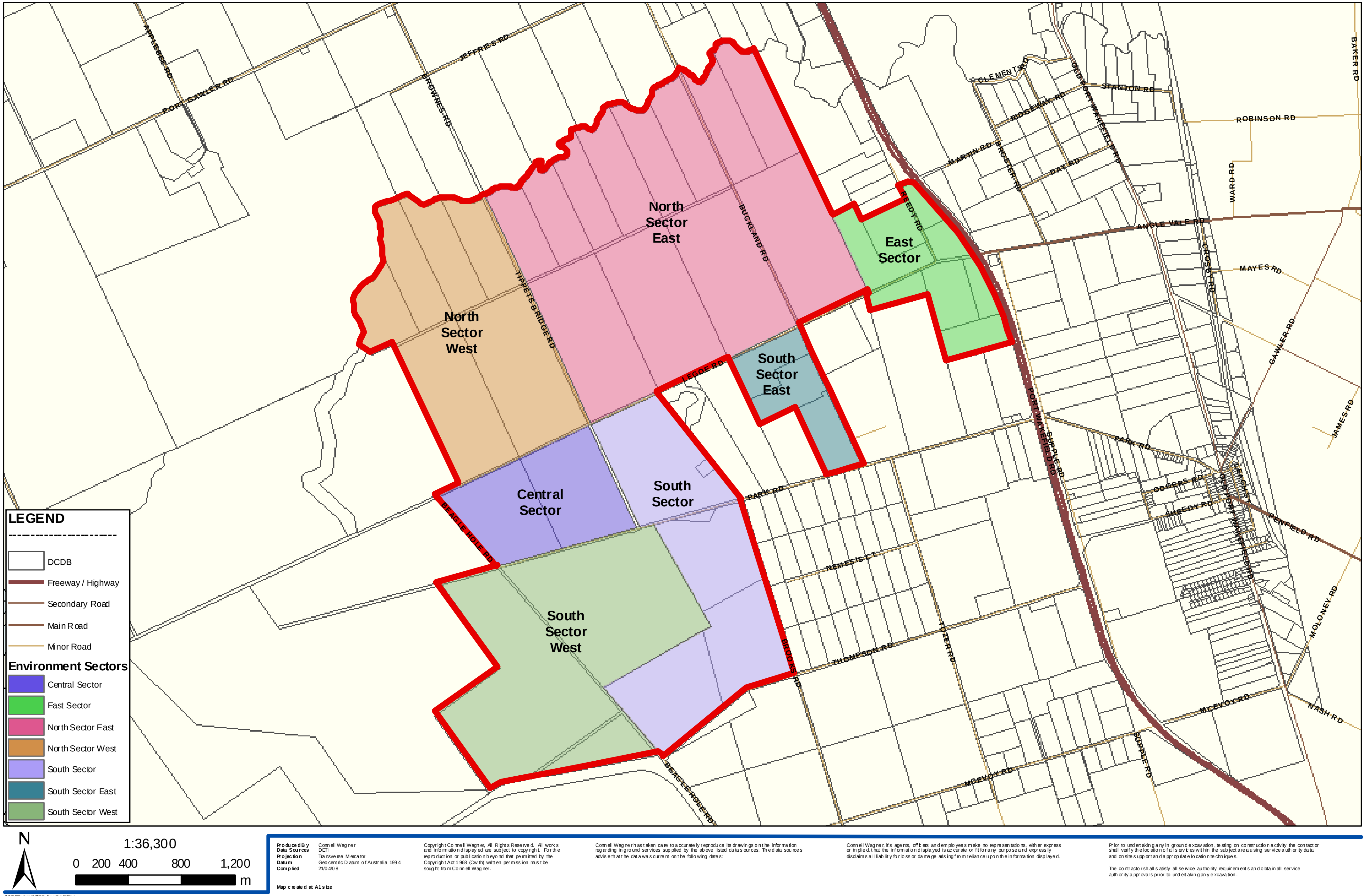
BUCKLAND PARK

OCTOBER 2008


GAWLER RIVER
PORT WAKEFIELD ROAD
VIRGI

Connell Wagner

BUCKLAND PARK



Produced By	Connell Wagner
Data Sources	DETI
Projection	Transverse Mercator
Datum	Geocentric Datum of Australia 1994
Complied	21/04/08

Map created at A1 size

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Prior to undertaking any in ground excavation, testing on construction activity the contactor shall verify the location of all services within the subject area using service authority data and on site support and appropriate location techniques.

The contractor shall satisfy all service authority requirements and obtain all service authority approvals prior to undertaking any excavation.

TAB 2

BUCKLAND PARK COUNTRY TOWNSHIP

DESCRIPTION OF THE SITE
2 MAY 2008

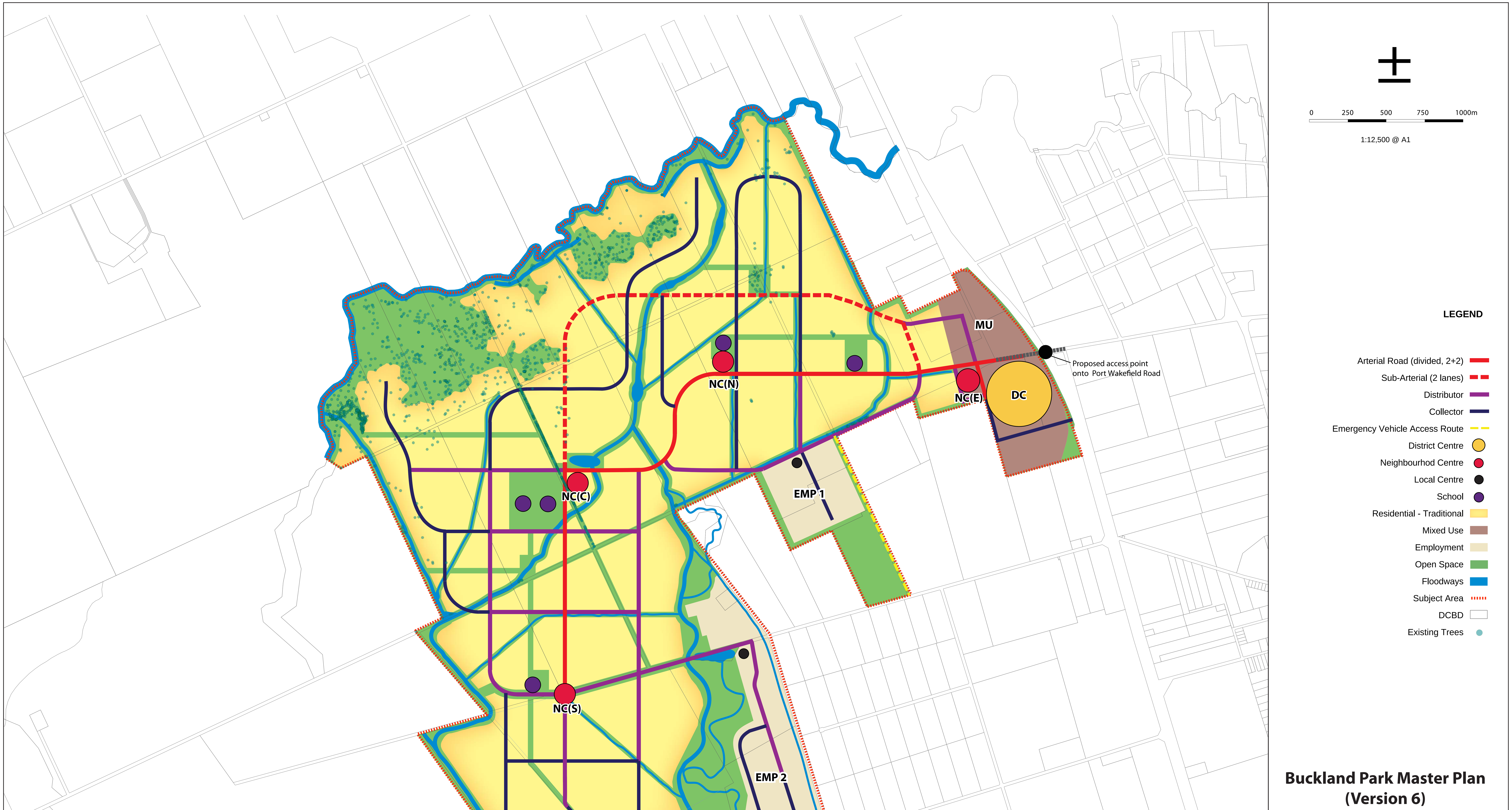
CERTIFICATE OF TITLE	LOT	DP/FP	AREA
5447/585	6	16853	44.780
5447/581	4	16853	39.660
5447/579	5	16853	38.970
5909/380	Sec 503	H105800	1.189
5909/379	Sec 173	H105800	57.870
5883/977	1	60145	15.400
5883/978	2	60145	15.240
5883/980	18	60145	15.490
5916/59	1	63928	7.487
5916/61	3	63928	12.220
5916/60	2	63928	15.460
5303/891	267	FP163235	6.737
5755/199	134	FP162483	6.611
5763/970	133	FP162482	4.937
5228/167	4	40170	12.600
5424/348	5	40170	17.300
5868/766	68	1671	65.330
5868/767	67	1671	65.190
5868/768	69	1671	65.300
5868/769	91	163644	66.580
5868/770	59	1671	25.500
5868/771	93	174427	17.600
5868/772	65	1671	57.150
5868/773	91	174403	19.700
5868/774	91	174425	24.000
5868/775	95	174429	3.440

TAB 2

BUCKLAND PARK COUNTRY TOWNSHIP

DESCRIPTION OF THE SITE
2 MAY 2008

CERTIFICATE OF TITLE	LOT	DP/FP	AREA
5868/776	94	174428	19.900
5868/777	62	1671	21.900
5868/778	66	1671	65.460
5868/779	91	174402	25.600
5868/780	92	174426	24.300
5868/781	S	1671	2.157
5868/782	60	1671	27.700
5868/783	61	1671	20.200
5868/784	63	1671	26.600
5868/785	58	1671	26.600
5875/910	1, 2, 3 & 4	40207	240.300
5399/95	179	105800	40.000
5399/96	174	105800	44.900
TOTAL HECTARES			**1,307.358**



Buckland Park Master Plan (Version 6)

Revision 10

Original compiled: 7 August 2008
Revision dated: 19 February 2009
Projection: Transverse Mercator
Datum: Geocentric Datum of Australia 1994

Connor Holmes Pty Ltd
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www.connorholmes.com.au

CONNOR HOLMES

N:\data\My Documents\Word\Buckland Park\992\working drawings\090219_Master Plan v6 r10.ai

	Dwelling Count
Premium	288
Courtyard	175
Large Villa	91
Small Villa	32
Gatehouse	30
	616 TOTAL

1 : 2,000 @ A1

25 50 75 100m

Buckland Park Stage 1 Residential Allotment Mix

Revision: D
Date compiled: 16 March 2009

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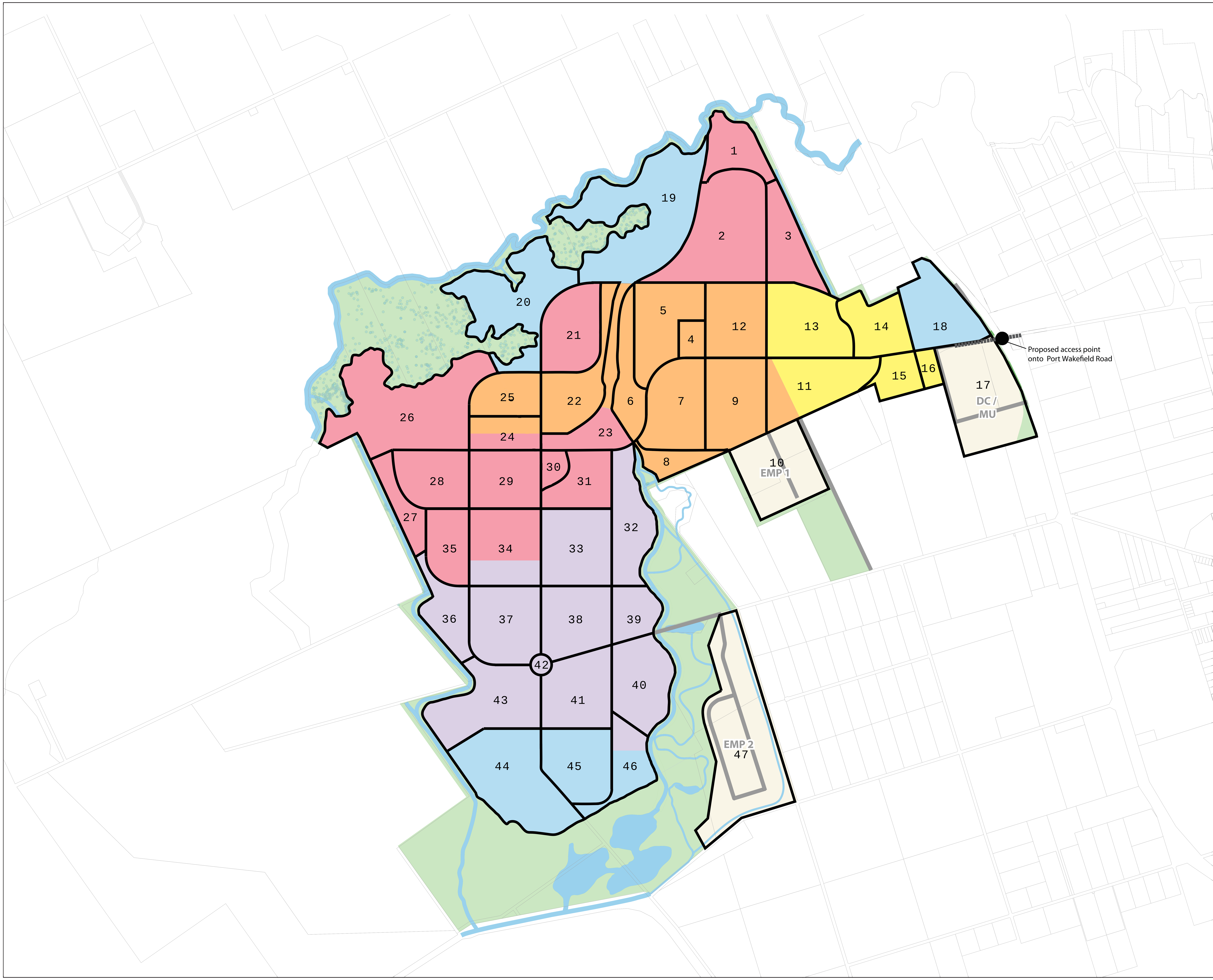

0 250 500 750 1000m

1:12,500 @ A1

LEGEND

Staging

2010 - 2016

2017 - 2021

2022 - 2026

2027 - 2031

2032 - 2036

Precinct Boundary

Non Residential Precincts

Buckland Park Residential Staging

Revision 1

Original compiled: 17 September 2008
Projection: Transverse Mercator
Datum: Geocentric Datum of Australia 1994

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APPENDIX B

Extract Provided from SKM Draft Report

1 DATA REVIEW

1.1 Site Description

The site proposed for development at Buckland Park is situated to the west of Port Wakefield Road about 32 km north of Adelaide (Figure 1.1). The site covers around 1500 hectares immediately south of the Gawler River.

Current land use in the area includes agricultural land (grazing and horticulture) with smaller portions of residential development and the Cheetham Salt salt evaporation ponds immediately to the west and south of the site.

The landscape is characterised as low lying and low relief coastal plain, as illustrated by the ground surface topography presented in Figure 2.1. Two natural watercourses (Gawler River and Thomson Creek) provide the majority of natural drainage. Prior to alteration, the drainage systems of the Gawler River (being the larger of the two watercourses) would have ended in a raised coastal delta formation within the mangroves and tidal flats which remain along the coast on the western boundary of the study area.

An overview of the physical characteristics of the land across the study area has been provided by Rural Solutions (2007). The higher land on the margin of north sector east, which sits at around 10-12 m AHD, is the tail end of a very gently inclined plain with sand to sandy loam topsoils over clayey subsoils. The system is underlain by alluvial sediments deposited by the Gawler River as it meandered across the plain. The sediments are mantled by aeolian carbonates. As the land drops below 10 m towards north sector west, saline groundwater tables begin to influence soil profiles and productivity potential. As the land further drops away to the low lying coastal flats and associated with saline water courses the soils become poorly drained and the watertable is shallow and saline. In these areas the presence of land salinisation is recognisable either as saline subsoils or as surface seepage and the presence of salt tolerant vegetation.

1.2 Climate

The Adelaide coastal plain is characterised by a Mediterranean climate, with hot, dry summers and relatively cool, wet winters.

Local climate data has been sourced from the Bureau of Meteorology for the weather station on Sheedy Rd in Virginia, located approximately 2 km east of the Buckland Park site. This station was in operation during the period from 1889 through to 2005 and although it has now been closed, the data represent a long term climate record, spanning more than 100 years, that is situated very close to the present site. Annual rainfall totals and cumulative deviation from average annual rainfall are presented for the period of record in Figure 2.2 and mean monthly rainfall has been compared with mean monthly pan evaporation in Figure 2.3.

The average annual rainfall of 442mm occurs mostly in the winter months with average monthly rainfall between June and August around 53mm, in contrast to the months December to February with mean monthly rainfall around 22mm.

The average annual pan evaporation of 1860 mm exceeds average annual rainfall by more than four times. On average during the winter months evaporation is approximately equal to rainfall, while during summer evaporation exceeds rainfall by around 12 times.

The record of cumulative deviation from the average annual rainfall (Figure 2.1) shows that there have been a number of wetter and drier cycles over the last 100 years, with the most recent wet periods occurring in 2000 and then back in the mid 70's and again in the mid 50's. These wet periods correspond to years of above average rainfall.

1.3 Hydrology

The surface water hydrology of the Buckland Park area is largely controlled by the Gawler River situated immediately north of the site. The Gawler River extends across the northern and western boundary of the site. The ephemeral water course of the Gawler River can have large flows and flooding during the winter wet season but is largely dry, with only stagnant pools, during the drier summer months. The river channel has been incised below ground level by three to four metres. When flood flows break from the channel, flood waters will spill away from the channel towards lower lying areas. These flows generally do not re-enter the Gawler River channel.

Extending through the North Sector East and South Sector, Thompson Creek is a shallow intermittent ephemeral watercourse that channels surface flows during the wet season and periods of flooding when the Gawler River overflows. It is likely that this watercourse also acts as a shallow groundwater drain when the shallow watertable is elevated above the creek bed as a result of direct recharge during the wet season.

The two salt lakes present immediately to the southwest of the site are currently operated by Cheetham Salt. A representative of Cheetham Salt, Mr. Kevin Taylor (*pers. comm*., 22/2/2008), could not provide exact operational details for the lakes, but indicated that the northern of the two lakes is held at a level of about 2.85 m AHD and the southern lake is held at about 3.25 m AHD. Mr Taylor also indicated that the network of surface drains surrounding the lakes are intended to provide some management of the ingress of salt water onto the surrounding land. Survey data relating to the levels or inverts of the drains was not available, but Mr. Taylor did indicate that to the north the drains discharge via pumping into the Gawler River channel. Flow gradients in the area are very low and Mr. Taylor suggested that not a lot of flow occurs in the drains and that the primary out flux was probably by evaporation.

1.4 Soils and Geology

In "Natural History of the Adelaide Region" (Royal Society of SA, 1976) Northcote describes the dominant soils of the study area as permeable, alkaline, red brown soils/calcareous red pedal clays with a moderate to high bearing capacity and deficiencies in nitrogen, phosphorous and zinc.

Reference to the Geologic Survey of South Australia – Adelaide 1:250,000 map sheet (DME, 1969) indicates the near surface stratigraphy of the study area comprises the Quaternary sediments of the Pooraka Formation, across the majority of the site, and the St Kilda and Glanville Formations towards the coast. The Pooraka Formation is described as mottled clay and silt inter-bedded with sand, gravel and thin sandstone layers. The St Kilda formation is characterised by estuarine muds, sands, peats and shelly beds and often contains lenses of highly permeable sand layers.

The Late Quaternary sediments on the Northern Adelaide Plains overlie the older sediments of the Hindmarsh Clay, which is described as a layered sequence of mottled red-brown sandy clay and sand and gravel lenses. In a hydrogeological context together these units can be collectively described as clays containing lenses and discontinuous layers of silts, sands and gravels.

Interpretation of available lithological logs and drillers logs from the state Drillhole Enquiry System (DES) (locations shown on Figure 2.4) indicates that the near surface sediments comprise discontinuous beds and lenses of clay, silt and sand. In a similar fashion to the site specific data, presented below, there is a high degree of variability in the logged sediments both laterally across the area, and vertically through the profile. However, it also became evident that interpretation of the data is confounded by a lack of detail in the near surface interval in many of the logs. A geological cross-section, based on the logs from DES (Figure 2.5) illustrates the variability from west to east across the site (location shown on Figure 2.4), but also seems to indicate a relatively consistent clay layer sitting at a depth of around 20 metres across the site.

1.5 Shallow Aquifer Sequence

The uppermost groundwater aquifers across the study area occur in the sand and gravel lenses of the Pooraka, St Kilda and Hindmarsh Clay Formations. While it appears that these thin shallow aquifers are often discontinuous it has also been suggested (REM, 2002) that the top Quaternary aquifer (Q1) is hydraulically connected with aquifers within the marine sediments of the St Kilda Formation forming a somewhat continuous aquifer system (and pathway) across the study area.

According to Martin and Hodgkin (2005), a shallow Quaternary aquifer is present in the area between Virginia and Gawler River. Wells to monitor this perched aquifer have been drilled to depths of between 2.5 and 9.5 m, but most commonly wells are completed at 4-6 m depth (Rural Solutions, 2007). According to AGT (2004), pumping test results for two sites close to Buckland Park showed that this perched aquifer can be hydraulically connected to the underlying Q1 aquifer, while the Q1 aquifer and underlying Q2 aquifer had almost no hydraulic connection. Three Quaternary aquifers (Q1 to Q3) are generally recognised in the Northern Adelaide Plains region with thicknesses ranging from about 3 to 15 m. They can be quite discontinuous with lateral extents of less than 2,000 m. Overall, the thickness of the Hindmarsh Clay diminishes northwards and can be as little as 20 to 30 m near the northern limit of the Northern Adelaide Plains PWA . Clay generally underlies the Q3 aquifer and forms a confining bed, although there are localised occurrences where the Q3 aquifer is in hydraulic continuity with the underlying aquifer.

A report produced by Rural Solutions SA (Rural Solutions, 2007) covering the nearby Virginia area provides information on aquifer delineation within the Quaternary sequence. According to that report, the unconfined Q1 aquifer, uppermost in a series of sandy layers in the Hindmarsh Clay, comprises thin layers of silt and sand at depths of around 5 to 10 m, although wells have been drilled to depths of up to 17 m to delineate the Q1 aquifer. To delineate the Q2 aquifer wells have been drilled to depths of between 13 and 28 m.

1.6 Groundwater Levels and Trends

Available existing data on groundwater levels in the watertable aquifer were obtained from the DWLBC database. These data, also assessed by REM (2003) showed that water levels are typically quite shallow, at between around 1 to 6 m bgl. Shallow groundwater occurs particularly in low lying areas and where clay layers cause perching. There was generally a decreasing trend in groundwater levels from the higher land to the north east towards the coast in the southwest. The available historical data was rather sparse, but some time series information was found. The locations of the few wells with time series data are shown in Figure 2.6. The data from these wells has been plotted up and an example is presented in Figure 2.7. Plots of the data from all the wells are attached in Appendix A. This information shows what appears to be a seasonal fluctuation in water levels, indicating diffuse rainfall recharge of the shallow aquifer. However, with rainfall amounts being quite variable in this region the seasonal fluctuations are somewhat less than regular. Seasonal watertable fluctuations appear to be in the order of around 1 to 2 m, obviously depending on the amount of seasonal rainfall.

1.7 Groundwater Salinity

The shallow groundwater is generally quite saline, but according to existing information assessed by REM (2003), salinity can range widely from almost potable (1,280 mg/L) to around that of sea water (30,000 mg/L). Typically fresh groundwater occurs where localised recharge has occurred from a surface water source such as river losses or excess irrigation water. Groundwater in much of the area is quite shallow and, particularly in low lying areas, evaporative processes are active in concentrating salts in the shallow watertable aquifer.

1.8 Data Gaps and Project Approach

The availability of hydrogeological information within the Buckland Park study area was limited prior to the field investigation programs undertaken as part of this project. The nearby Virginia area has been much more intensively investigated in the past due to the high level of activity there, but to the west of the Port Wakefield Road there has been much less activity and available stratigraphic and hydrogeological information is scattered and sparse.

The geological layering in the project area, particularly in the Quaternary sediments, appears to be highly variable. Soil type varies widely both spatially and with depth through the profile and as a result it does not appear to be possible to construct an obvious ‘layer cake’ of the profile that clearly represents the sequence of aquifers and aquitards beneath the area.

A field investigation program has been undertaken to support the analysis and provide additional information with which to understand the subsurface conditions. Lithological information and groundwater level and groundwater quality information were obtained from the drilling and installation of 11 groundwater monitoring wells by REM. Additional soil information was obtained from site investigations undertaken by Golder Associates and Connell Wagner as part of the EIS-related investigations, and groundwater level data were obtained from the 15 wells installed by Connell-Wagner.

While some historical groundwater level monitoring data was found for a few wells on or near some parts of the study area, the distribution and extent of the available time series information was not sufficient to warrant the development of a transient state groundwater flow model for the site. Rather it was considered more useful within the project framework to focus on the development of a steady state groundwater flow model and achieve model calibration using available existing information combined with newly generated groundwater level information. This model can still be used to assess relative potential changes to groundwater conditions at the site from a range of scenarios associated with the development.

A qualitative analysis of the likely transient behaviour of the groundwater system has been included in this assessment from interpretation of the few available water level hydrographs.

2 SITE INVESTIGATION RESULTS

2.1 Site Soils and Geology

Drilling logs were produced by REM from the installation of 11 groundwater monitoring wells to depths ranging from about 10 metres near the Gawler River to about 3.5 metres in the lower lying areas in South Sector West. In addition, logs were obtained from Golder Associates, covering depths of 3 to 6 metres, and from Connell Wagner, covering depths of 6 to 9 metres. Existing information from the Department of Water Land and Biodiversity Conservation (DWLBC) online Drillhole Enquiry System (DES) was also incorporated in this assessment.

This lithological information indicates a near surface geology that is highly variable both across the study area and with depth through the profile. Sediment composition included sand, silt and clay in varying proportions, but in general an abundance of clay and clayey sediments were identified across the site. Sand and silt appeared to be present in lenses and pockets that were not spatially continuous across the site. In the majority of holes an appreciable thickness of clay was present at or near the surface. In order to illustrate the spatial distribution of clay across the site, and the relative levels at which it occurs, a map of depth to clay (Figure 4.1) was produced from all available lithological logs. This interpretation shows that clay is likely to be present in the upper 4 m of the soil profile across nearly the entire site, and there are large areas where clay is at the ground surface. The few areas where clay is deeper than 4 m are isolated and mostly associated with only one or two data points.

The data shows that subsurface clays occur extensively throughout the study area at depths of less than 4 m bgl. These clays will act as an impediment to downward movement of water and, in the case where they are overlain by more permeable sediments like sand or silt, there is potential for development of shallow perched watertables to develop.

For practical purposes, the soil profile relevant to the watertable aquifer system is assumed to extend to around 20 m bgl. This assumption is based on the more regional interpretation of lithological information presented in cross section in Figure 2.5. Below this depth the extensive occurrence of clay across the region is assumed to act as an aquitard separating the surface system from the deeper confined aquifers.

It should be noted that drill holes completed in this study were targeting either the groundwater table (REM and Connell-Wagner holes) or the shallow soil composition (Golder Associates), so the resulting lithological information covers only a portion of the profile associated with the upper Quaternary sedimentation and shallow aquifers. In particular, holes in North Sector East extend to near 10 metres, while those in South Sector West extend to only 3.5 metres.

2.2 Site Hydrogeology

2.2.1 Groundwater levels and flow direction

Groundwater level gauging of new and existing monitoring wells has been undertaken by REM, using an electronic dip meter, on four separate occasions as part of this investigation (Table 4.1). Initial water level gauging of available existing wells took place during REM's initial site visit on 8 January 2008 and during new monitoring well installation works on 15

January 2008. Gauging of all newly installed REM wells took place on 7 February 2008, followed by repeat gauging of all new REM wells and one existing well during groundwater sampling activities on 20-21 February 2008. Following installation of the additional wells by Connell Wagner, a last round of water level gauging was undertaken by REM on 2 July 2008, including all new and available existing wells.

The results of groundwater level gauging from 7 February 2008 showed the elevation of the watertable beneath the site ranging from a low of 1.38 m AHD in MWREM08, situated in the southernmost and lowest point of the site, to a high of 6.40 m AHD in MWREM01, situated in the northernmost and highest point of the site. As with most areas, the watertable elevation and groundwater flow direction across the study area generally mimics the shape of the land surface dropping down towards the coast. Groundwater elevations vary from around 8 m AHD immediately northeast of the site to 0 m AHD at sea level not far to the southeast and east of the site.

Groundwater elevation contours interpreted from the 7 February 2008 data (Figure 4.2) and the 2 July 2008 data (Figure 4.3) show that groundwater flow occurs in a general westerly and south westerly direction towards the coast. Comparison of the two sets of data show some minor changes in watertable elevation, but all of the main features of the groundwater flow pattern across the study area are essentially the same. This provides an improved level of confidence in the data. Two areas of groundwater mounding were quite well defined by both sets of data. The first area is situated in the vicinity of wells MWREM04, MWREM06 and GW2. The cause of more elevated groundwater levels in this area is not clear, but it may be associated with historic or current irrigation practices in that area. The second area is situated in the vicinity of well 6628-20004, which is completed at a depth of 3 m bgl. Groundwater mounding at that location is more obviously caused by roof runoff and possibly excess irrigation from adjacent glass house horticulture. This well is nested with an 8 m deep well, which recorded a water level of 1 - 2 m lower than the shallower well. This indicates that a perched watertable has developed in sediments on top of a shallow low permeability clay layer in this area. At this site REM personnel observed that downpipes channelled runoff from the glass house roofs to an area right next to the nested shallow wells. It seems likely that this localised source of recharge has affected the shallow groundwater levels in this area. While this water level data point has been included in the interpretation of groundwater elevation contours across the study area, it might have unduly influenced the interpretation of water levels in the surrounding area, causing groundwater mounding to appear more extensive than is actually the case.

The hydraulic gradient across the site varies between about 1 to 2 metres per kilometre (0.001 to 0.002) and is controlled by factors including hydraulic conductivity of aquifer materials, recharge, surface drainage and topography. The hydraulic gradient is somewhat steeper across the eastern part of the site and this could be due to factors including steeper surface topography, variable hydraulic parameters and/or higher recharge from irrigation activities.

Local variations to the shallow groundwater flow not picked up in this monitoring data might occur close to hydrological features including rivers and drains and near the salt lakes where groundwater mounds exist. Due to the elevated pool levels in the salt lakes immediately to the southwest of the site, it is likely that over time water from the salt lakes has seeped through the beds and caused mounding of shallow groundwater in that vicinity. However, during construction of the salt lakes a system of groundwater drains surrounding the lakes was also installed, in an attempt to manage the effects of groundwater mounding on the surrounding land. These drains are supposed to collect seepage water and channel it into the natural drainage that discharges to the sea. In reality it would appear that flow gradients are so slight in that low lying area that most water discharge occurs as evaporative out flux from the open drains and from shallow groundwater tables.

A reduction in the groundwater flow gradient towards the coast is evident in the interpreted watertable elevation contours, but specific hydraulic effects of the elevated pool levels in the salt lakes are not apparent in the available data.

2.2.2 Depth to groundwater

The results of groundwater level gauging undertaken by REM reveal that the groundwater table is quite shallow, at less than 4 m, across the majority of the site. Depth to groundwater, measured on 7 February 2008 in the 11 new wells installed by REM (Table 4.2), ranged from 0.88 m bgl in MWREM07, situated in the low lying south sector west, to 5.67 m bgl in MWREM03 situated on the higher ground adjacent to the Gawler River along the northern boundary of the site. A subsequent round of water level gauging on 2 July 2008 (Table 4.2) showed minimal change at MWREM07 and a fall in the watertable at MWREM03 to 5.82 m bgl.

Mapping of depth to groundwater across the study area, covering all points in between the measured points obtained from groundwater gauging activities, was achieved by subtracting an interpolation of groundwater elevation from the ground surface elevation. This method minimises the error in the interpretation of groundwater depth because it accounts for the variability in the ground surface in addition to spatial trends identified in gauging data. However, it must be stressed that while the groundwater data is valid for the current situation, future changes to groundwater levels may occur that would require periodic updates to the data set.

Interpreted groundwater depth across the study area is presented in Figure 4.4, for the 2 July 2008 water level gauging event. This information shows a broad gradient in depth to groundwater, with deepest levels along the Gawler River to the north, and also highlights the fairly extensive occurrence of shallow groundwater (less than 4 m depth) across much the site, particularly along the south, east and west perimeter. The watertable could be less than 4 m bgl across much of the central sector, south sector and south sector west of the site. The occurrence of shallow groundwater is strongly controlled by the surface topography, with these areas occurring in the lower lying places and natural or artificial depressions in the landscape. The land along the Gawler River, in the north sector east and north sector west, is the only portion of the site where groundwater is likely to be deeper than about 4 m BGL. A spur of higher ground extending down the southwest of the site increases the depth to groundwater in that area slightly.

Problems associated with water logging and salinity are most likely to occur in areas where the depth to groundwater is less than 2 m bgl. This hazard is independent of whether the shallow groundwater is in the regional watertable aquifer or in a more localised perched aquifer sitting on top of a low permeability clay layer. The latter occurrence is typically of most concern when the top of said clay layer occurs within the top 4 m of the soil profile.

2.2.3 Hydraulic aquifer characteristics

Aquifer testing was undertaken on 20 - 21 February 2008 to provide aquifer property data for input to the numerical groundwater flow model. Water level recovery tests were conducted on the eleven newly installed wells MWREM01 thru MWREM09 and MWREM11 and MWREM12 plus one existing well with the state database Observation Number PTA058.

Hydraulic conductivity values are presented in Table 4.3. Values range from 0.01 to 1.12 m/day. Lower values are reported along the Gawler River where values of 0.01 and 0.07 m/day were recorded for bores MWREM01 and MWREM07 respectively. These are the lowest values on site with the other value of similar magnitude (0.06 m/day) occurring at MWREM09. Slightly more elevated values occur along the southern boundary (0.12 m/day at MWREM07, 0.18 m/day at MWREM08 and 0.19 m/day at MWREM12. Remaining wells have still slightly higher values of hydraulic conductivity but all of the wells tested display low hydraulic conductivities.

The information provided by the slug recovery testing on the shallow wells installed by REM provides perhaps an overly conservative indication of the permeability of near surface sediments across the study area. It is recognised that the wells were installed mainly to enable monitoring of groundwater levels and, as such, they do not fully penetrate the watertable aquifer. In many cases the well screen penetrates only partially into sandy sediments that were encountered. Therefore it is quite likely that the resulting permeability values obtained from these wells are an underestimation of the actual values of this parameter for the watertable aquifer system. Based on experience it is possible that actual aquifer permeability values could range from around 0.01 m/d for clayey sediments up to around 10 m/d for coarser sandy sediments.

2.3 Groundwater Analytical Results

Groundwater analytical results are presented in Table 4.4 and laboratory analytical reports are contained in Appendix F.

2.3.1 Field parameters

Field parameters (Table 4.5) measured during the groundwater sampling program, which was undertaken on 7 February and 13 February 2008, indicate the following hydro-geochemical conditions exist in groundwater sampled from wells across the Buckland Park site area:

- pH values range from 6.66 at MWREM06 to 7.97 at MWREM09. Groundwater was generally neutral to slightly alkaline. Groundwater sampled from MWREM06 and MWREM07, at the low lying southwest end of the site, was slightly acidic.

- Electrical conductivity of sampled groundwater ranged from 5.02 mS/cm at MWREM09 to 106.6 mS/cm at MWREM06.

- Temperature of sampled groundwater ranged from 18.7 ^{o}C at MWREM11 to 23.2^{o}C at MWREM06.

2.3.2 Groundwater salinity

The salinity of sampled groundwater from the Buckland Park site has been estimated, as total dissolved solids (TDS), from field measurements of groundwater electrical conductivity (EC). This approach has been adopted in favour of using the sum of cations and anions from the analytical laboratory data because the charge balance error was in excess of acceptable limits.

The simple linear relationship reported in Hem (1985) was used to convert field measured EC in mS/cm into TDS in mg/L, by applying a multiplication factor of 750. In natural waters this multiplication factor commonly ranges between 550 and 750, with the higher values generally being associated with water high in sulphate concentration. Perusal of the analytical data for sampled groundwater from Buckland Park shows high sulphate concentrations for many of the samples, thus the higher multiplication factor was used.

The salinity of groundwater samples collected from the new wells installed by REM (Table 4.5) ranged from a relatively fresh 3,765 mg/L at MWREM09 to a hyper-saline 79,725 mg/L at MWREM07 and 79,950 mg/L at MWREM06. Both of these hyper-saline wells are situated adjacent to the salt lakes in the low lying southwest corner of the site.

When combined with available data from existing nearby wells this information provides a good indication of the spatial variability of the salinity of shallow groundwater across the study area. As shown in Figure 4.5, groundwater salinity is broadly more saline in the west and fresher to the east. Some notable features of the groundwater salinity data include the following points:

- The salinity of groundwater in MWREM09, located centrally in the south sector west, was measured at 3,765 mg/L, which is much fresher than that of surrounding nearby wells. This is an area that is suspected to have been subject to historic irrigation, and it is postulated that the lower salinity correlates to a lens of fresh water remaining from the historic irrigation.

- The salinity of groundwater in MWREM05, measured at 18,450 mg/L, was significantly higher than that of other nearby wells. Field observations made by REM staff and interpretation of the site aerial photo suggest that this well is adjacent to clay pans and a natural depression where water tends to pond. It is likely that groundwater in this area is subject to a higher rate of evaporative discharge and subsequent concentration of salts in groundwater.

- At sites where data from nested monitoring wells is available, the groundwater in the shallower well is usually much fresher than that in the deeper well. This suggests that perched groundwater does occur in some areas of the site and it is likely that this water originates from drainage of excess irrigation water. Thus it follows that perched groundwater would typically be expected in areas where such irrigation practices are in effect.

2.3.3 Analytical laboratory data

Major ions

Major ion chemistry data showed that the sampled groundwater at Buckland Park was generally very saline (average TDS of 28,930 mg/L), and the ionic composition of the groundwater samples was dominated by sodium and chloride, as is usual for most natural waters, but a significant proportion of sulphate was also present in most samples.

Sulphate concentrations exceeded the SA EPA (2003) guideline value for Livestock use of 1000 mg/L in samples from seven of the eleven wells across the site. The highest levels of sulphate occurred in wells MWREM06 (6,990 mg/L), MWREM07 (9,820 mg/L) and MWREM08 (3,390 mg/L) all of which are situated in the hyper-saline area adjacent to the salt lakes. Other samples with sulphate levels of 1000 to 3000 mg/L were from MWREM03, MWREM04, MWREM05, MWREM08 and MWREM12.

Sulphate concentrations exceeded the SA EPA (2003) guideline value for Potable use of 500 mg/L in samples from ten of the eleven wells across the site. In addition to the wells listed above for exceeding the Livestock value, samples from wells MWREM01, MWREM02 and MWREM11 exceeded the Potable guideline value, with sulphate concentrations from 731 to 981 mg/L.

The ionic balance errors for MW3, MW9, MW12 and MW6 were reported to be greater than the 5% target amount due to analytes not quantified in the reported analysis. This is a limitation to the confidence that can be placed in the major ionic composition of these samples, but does not affect the validity of other samples or analytes. Re sampling and analysis of major ion chemistry and TDS would enable a more accurate determination of the cation and anion composition of these samples.

Flouride

Fluoride concentrations were reported for field duplicate samples analysed by Labmark. Fluoride concentrations exceeded the SA EPA (2003) guideline value for Livestock use of 2 mg/L in MWREM07 (3.2 mg/L). Fluoride concentrations also exceeded SA EPA (2003) guideline values for Irrigation use of 1 mg/L in MWREM11 (1.3 mg/L).

Nutrients

Groundwater analytical results for nutrients identified the following:

- Ammonia concentration exceeding the SA EPA (2003) Aquatic Ecosystem (Fresh) guideline value of 0.5 mg/L was reported in groundwater sampled from MWREM06 (0.61 mg/L). In addition, ammonia concentration exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) guideline value of 0.2 mg/L was reported in groundwater sampled from MWREM06 (0.61 mg/L) and MWREM07 (0.43 mg/L).

- Nitrate concentration exceeding the SA EPA EPP (2003) Water Quality (Potable Use) guideline value of 10 mg/L was reported in groundwater sampled from MWREM02 (23.4 mg/L).

- Total nitrogen concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) guideline value of 5 mg/L were reported in groundwater sampled from MWREM02 (26.4 mg/L), MWREM04 (7.4 mg/L), MWREM08 (5.6 mg/L) and MWREM11 (5.0 mg/L)

- Total phosphorous concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) guideline value of 0.5 mg/L were reported in groundwater sampled from MWREM01 (0.57mg/L), MWREM04 (0.97 mg/L), MWREM07 (0.5 mg/L) and MWREM08 (1.39 mg/L).

Metals

Groundwater analytical results for heavy metals identified the following:

- Chromium concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) Chromium VI guideline value of 0.0044 mg/L were reported in groundwater sampled from MWREM05 (0.005 mg/L), MWREM07 (0.014 mg/L) and MWREM09 (0.005 mg/L).

- Copper concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) Copper guideline value of 0.01 mg/L were reported in groundwater sampled from MWREM06 (0.016 mg/L), MWREM07 (0.04 mg/L) and MWREM08 (0.011 mg/L)

- Lead concentrations exceeding the SA EPA (2003) Potable Water use guideline value of 0.01 mg/L were reported in groundwater sampled from MWREM06 (0.014 mg/L) and MWREM07 (0.123 mg/L).

- Manganese concentrations exceeded the SA EPA (2003) Irrigation use guideline value of 2 mg/L were reported in groundwater sampled from MWREM01 (8.55 mg/L).

- Nickel concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) guideline value of 0.015 mg/L were reported in groundwater sampled from MWREM01 (0.016 mg/L), MWREM06 (0.015 mg/L) and MWREM08 (0.015 mg/L).

- Zinc concentrations exceeding the SA EPA (2003) Aquatic Ecosystem (Marine) guideline value of 0.05 were reported in groundwater sampled from MWREM06 (0.302 mg/L) and MWREM07 (0.071 mg/L).

Three of the eleven samples analysed for chromium showed levels elevated above the SA EPA criteria for chromium VI in marine aquatic ecosystems. However, in the absence of specific industrial activities that generate chromium VI, chromium in the environment occurs as the relatively benign chromium III species. It is likely that the small amount of chromium detected in some of the samples from the Buckland Park site is the latter chromium III species.

TPH and BTEX
The SA EPA does not nominate a limit for TPH under Potable, Irrigation, Livestock or Aquatic Ecosystem guidelines. Dutch Intervention Levels state a limit of 600 µg/L for Total C10-C36. All samples analysed from the Buckland Park site were returned at levels below this standard.

Groundwater sampled from all but two bores reported levels of BTEX below detection limits. Those samples that did report BTEX components at detectable levels were well below SA EPA (2003) standards for Potable Water, Aquatic Ecosytems (Marine) or Aquatic Ecosystems (Fresh).

PAH's
The PAH criteria value specified by the SA EPA is known to be the limit for benzo-a-pyrene. No other values are specified. The laboratory standard detection limits of reporting for PAH's are higher than this SA EPA guideline value and higher than some of the ANZECC (2000) and Dutch Intervention Levels values but all samples analysed from the Buckland Park site came back at below the laboratory standard detection limit of reporting.

OCP's
Similarly, all samples analysed for organochlorine pesticides came back at below the laboratory standard detection limits of reporting, although for some individual analytes this limit was above the available guideline value.

Phenoxyacetic acid herbicides
The SA EPA does not nominate a limit for PAH under Potable, Irrigation, Livestock or Aquatic Ecosystem guidelines. Dutch Intervention Levels state a limit of 50 µg/L for MCPA. All samples analysed from the Buckland Park site were returned at levels below this standard.

2.4 Analytical Data Quality

The quality of analytical data produced for this project has been assessed with reference to the following issues:

- sampling technique;
- preservation and storage of samples upon collection and during transport to the laboratory;
- sample holding times;
- analytical procedures;
- laboratory limits of reporting;
- field duplicate agreement;
- laboratory quality assurance/quality control (QA/QC) procedures; and
- the occurrence of apparently unusual or anomalous results.

Laboratory QA/QC procedures and results are detailed in the certified laboratory results contained in Appendix F. A summary of the data quality assessment and a summary of the field duplicate sample relative percentage differences are included as Appendix G.

All samples were collected, stored and transported to the laboratory in accordance with standard REM protocols which are consistent with the requirements of Schedule B(2) of the NEPM (NEPC,1999). Laboratory analysis was undertaken within specified holding times and in accordance with National Association of Testing Authorities (NATA) accepted analytical procedures and the requirements of Schedule B(3) of the NEPM (NEPC,1999).

Laboratory quality control information indicates an acceptable degree of QA/QC information was collected and reported and the data provides confidence in the accuracy and precision of reported results.

Relative Percentage Differences (RPD's) were elevated for a range of analytes in some samples. The discrepancy is not considered significant in the interpretation of the results as the results were either close to the limit of reporting where precision is somewhat comprised or the absolute differences between reported concentration results were quite small. The remaining elevated RPD% of field duplicates were within acceptable limits giving confidence to the values reported by the primary laboratory.

Overall, the accuracy and precision of analytical data is considered suitable to form a basis for interpretation of results for the purposes of this assessment.

The Limit of Reporting (LOR) for some analytes in some samples was increased due to matrix interference as a result of high sample salinity. Increased LORs occurred for Ammonia, Metals and Phenoxy Acid Herbicides.

Three intra-laboratory duplicates (MW2, MW7 and MW11) and two inter-laboratory duplicates (MW7 and MW11) were undertaken as part of the sampling activities. For MW111 the primary and intra-lab duplicate samples were lost en-route to the lab for all analytes except TPH and BTEX. Two intra-lab duplicates and one inter-lab duplicate have therefore been reported, with the exception of TPH and BTEX for which all duplicates undertaken have been reported.

Elevated RPD's were identified between the primary (ALS) and the intra-laboratory duplicate (ALS) and the inter-laboratory duplicate (Labmark) for the following analytes:

- Nitrate between the primary and intra-lab duplicate samples for MW7. However, the detected concentrations are close to the LOR and are well below the relevant guideline values for nitrate.

- Total phosphorous between the primary and the intra-lab duplicate samples for MW2, however, the detected concentrations are close to the LOR so the actual exceedance is considered marginal. Total phosphorous between the primary and inter-lab duplicate samples for MW7, however, the exceedance is considered relatively small and neither value exceeded any of the relevant guideline values.

- Reactive phosphorous between the primary and the intra-lab duplicate samples for MW7, however, the exceedance is marginal and the reported values are close to the LOR and well below the relevant guideline values.

- Lead between the primary and intra- and inter-laboratory duplicates for W7. The intra- and inter-laboratory samples are more similar to, and considerably lower than the primary sample, thus placing the validity of the primary sample into question. It is likely that the actual lead concentration is lower than the value reported for the primary sample.

- Zinc between the primary and inter-lab duplicate samples for MW7. Also zinc between the primary and intra-lab duplicate samples for MW2.

- Toluene between the primary and intra-lab duplicate samples for MW2. However, the reported values are near or below the LOR and well below the relevant guideline value.

APPENDIX C

Reports of Boreholes and Test Pits (with Explanatory Notes)

Golder Associates

DRAFT

REPORT OF BOREHOLE: BH01

CLIENT:	WALKER CORPORATION	COORDS: 273004 m E 6163884 m N 54 AMG84	SHEET: 1 OF 1
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	DRILLER: SOIL SURVEYS
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: AJB DATE: 21/1/08
			CHECKED: [signature] DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	H		0.0					SC	Clayey SAND, fine to medium grained, dark brown, low plasticity fines.	D		Fine roots throughout layer.
				0.65				SC	Clayey SAND, fine to medium grained, orange/brown, low plasticity fines.			Weakly cemented.
	M			0.90				SP	SAND, medium to coarse grained, orange/brown, with plastic fines, trace of fine to medium gravel (inferred quartz).			
				1.80				GC	Clayey GRAVEL, fine grained, red/brown, high plasticity fines.			
	M-H			1.90				CH	Sandy CLAY, high plasticity, orange/brown, fine to medium sand.		H	Layer of fine to medium sand at 2.0m.
				2.00	PP = 400 kPa PP = >600 kPa PP = 480 kPa			CH	Sandy CLAY, high plasticity, orange/brown mottled pale orange, fine to medium sand, with fine to medium calcareous gravel.			
				2.50	PP = 500 kPa PP = 240 kPa PP = 440 kPa				Brown with pale brown mottling.		VSt - H	
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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Golder Associates

DRAFT

REPORT OF BOREHOLE: BH02

CLIENT: WALKER CORPORATION	COORDS: 273180 m E 6163392 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: SOIL SURVEYS	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: AJB	DATE: 21/1/08
		CHECKED: Vm	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M-H		0.0					CL	Sandy CLAY, low plasticity, dark brown, fine to medium sand.	D	H	
				0.30				CH	Sandy CLAY, high plasticity, dark brown, trace of fine to medium calcareous gravel.			Layer of sand at 1.8m.
				0.45	PP = >600 kPa PP = 500 kPa PP = 540 kPa				Brown.			
			0.5	0.75	PP = 550 kPa PP = 450 kPa PP = 530 kPa PP = 480 kPa PP = >600 kPa PP = 530 kPa PP = 500 kPa				Orange/brown.			
			1.0									
			1.5									
				1.80	PP = 110 kPa				Pale orange/brown.	M	St	
			2.0	2.20	PP = 140 kPa PP = 120 kPa PP = 110 kPa PP = 200 kPa PP = 250 kPa PP = 360 kPa PP = 240 kPa PP = 380 kPa PP = 360 kPa				Red/brown, mottled grey.		VSt	
			2.5									
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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Golder Associates

DRAFT

REPORT OF BOREHOLE: BH03

CLIENT: WALKER CORPORATION	COORDS: 273564 m E 6162604 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: SOIL SURVEYS	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: AJB	DATE: 21/1/08
		CHECKED: Wm	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					SC	Clayey SAND, fine to medium grained, dark brown, low plasticity fines.	D		Fine roots.
			0.5	0.40	PP = >600 kPa PP = >600 kPa PP = >600 kPa PP = >600 kPa			CH	Sandy CLAY, high plasticity, pale brown mottled brown, fine to medium sand, trace of fine to medium calcareous gravel.	D	H	
			1.0	1.00	PP = >600 kPa PP = 550 kPa			CH	Gravelly Sandy CLAY, high plasticity, pale brown mottled brown, fine to medium sand, and calcareous gravel up to 25 mm in size.	D	H	
			1.5	1.30	PP = 430 kPa PP = 360 kPa PP = 370 kPa PP = 440 kPa PP = 500 kPa PP = 380 kPa			CH	Sandy CLAY, high plasticity, orange / brown, fine to medium sand, trace of fine to medium calcareous gravel.	M	VSt - H	At 1.5m, pocket of fine grained calcareous gravel.
			2.0	2.00	PP = 570 kPa PP = 250 kPa				Mottled grey / brown.	M	VSt - H	
			2.5	2.30				SP	SAND, fine to medium grained, orange / brown mottled grey, with clay.	M		
			3.0	2.95	PP = >600 kPa			CH	Sandy CLAY, high plasticity, orange brown, fine to medium sand.		H	
									END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH04

CLIENT: WALKER CORPORATION	COORDS: 273025 m E 6162423 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: SOIL SURVEYS	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: MH	DATE: 21/1/08
		CHECKED: Ujn	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					SC	Clayey SAND, fine to medium, brown, low plasticity fines.	D	H	Trace of root fibres.
				0.20	PP = >600 kPa PP = >600 kPa			CH	Sandy CLAY, high plasticity, orange / brown, fine to medium sand, trace of calcareous gravel.			
			0.5	0.60	PP = >600 kPa PP = >600 kPa			CH SC	Sandy CLAY / Clayey SAND, red / brown, high plasticity fines, fine to medium sand.			
			1.0	0.90	PP = >600 kPa PP = 550 kPa PP = 540 kPa PP = >600 kPa PP = 480 kPa PP = 580 kPa PP = >600 kPa PP = 450 kPa PP = 350 kPa PP = 570 kPa PP = 450 kPa			CH	Sandy CLAY, high plasticity, orange / brown, fine to medium sand, trace of fine calcareous gravel.			
			2.0	2.00	PP = >600 kPa PP = 370 kPa PP = 410 kPa				Red/brown.		VSt - H	
			2.5	2.30	PP = 450 kPa PP = 270 kPa PP = 430 kPa PP = 380 kPa				Brown with grey/brown mottling.	M		
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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GAP gINT FN. F01a RL2

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REPORT OF BOREHOLE: BH05

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 272753 m E 6163072 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: MH DATE: 21/1/08
CHECKED: [illegible] DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					SP	SAND, fine to medium grained, brown, trace of high plasticity fines.	D		
			0.5	0.50	PP = >600 kPa PP = >600 kPa			CH	Sandy CLAY, high plasticity, red / brown, fine to medium sand.		H	
			1.0	0.90				SP	SAND, fine to medium grained, brown, trace of high plasticity fines, with fine to medium calcareous gravel.			
			1.5	1.60	PP = 150 kPa PP = 220 kPa PP = 190 kPa PP = 450 kPa PP = 370 kPa PP = 250 kPa PP = >600 kPa			CH	Sandy CLAY, high plasticity, brown with pale brown / red mottling, fine to medium sand.		St-H	Trace of black specks.
			2.5	2.80	PP = 590 kPa PP = 400 kPa				With calcareous gravel.			
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH06

CLIENT: WALKER CORPORATION	COORDS: 272407 m E 6163662 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: SOIL SURVEYS	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.50 m	LOGGED: MH / JV	DATE: 22/1/08
		CHECKED: [signature]	DATE: 29/5/08

Drilling: METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M-H		0.0					CL	Sandy CLAY, low plasticity, dark grey, fine to medium sand.	D	Fb	Inferred topsoil. Root material.
			0.5	0.50				SC	Clayey SAND, fine to medium grained, pale brown, with high plasticity fines.			
				0.80				SP	SAND, fine to medium grained, pale brown / yellow.			
			2.0	1.90				SC	Clayey SAND, fine to coarse grained, grey brown, high plasticity fines.			Mica flecks.
			3.0	3.05	PP = >500 kPa			CH	Sandy CLAY, high plasticity, red brown / brown / pale brown, fine to coarse grained sand.		H	Calcareous nodules and cementation.
			3.5	3.50					END OF BOREHOLE @ 3.50 m GROUNDWATER NOT ENCOUNTERED REFUSAL @ 3.5m.			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH07

CLIENT: WALKER CORPORATION	COORDS: 271936 m E 6163658 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: SOIL SURVEYS	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: ND	DATE: 22/4/08
		CHECKED: [signature]	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT			0.0		PP = >500 kPa (0.5)			CL	Sandy CLAY, low plasticity, dark brown, fine grained sand.	D	H	Inferred topsoil. Trace of fine roots and plant material.
				0.90				CL	Sandy CLAY, low plasticity, dark grey, fine to coarse grained sand.		Fb	Trace of fine roots.
				1.30				CL	Sandy CLAY, low plasticity, mottled brown / yellow brown / dark grey, fine to coarse grained sand, trace of calcareous pale grey gravel.		Fb	
				2.20	PP = >500 kPa (2.5)			CH	Sandy CLAY, high plasticity, mottled brown / brown yellow / pale brow / dark grey, fine to coarse grained sand, trace of gravel.		H	Calcareous throughout layer.
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

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REPORT OF BOREHOLE: BH08

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 272392 m E 6162843 m N 54 AMG84		DRILL RIG: ROCKMASTER	
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD		DRILLER: SOIL SURVEYS	
LOCATION:	BUCKLAND PARK	INCLINATION: -90°		LOGGED: AJB	DATE: 22/1/08
JOB NO:	077662060	HOLE DIA: mm	HOLE DEPTH: 3.00 m	CHECKED:	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.15				CH	CLAY, high plasticity, grey, trace of sand.	D	H	Inferred topsoil.
				0.24	PP = >600 kPa PP = 500 kPa			CH	Sandy CLAY, high plasticity, dark grey, fine to coarse grained sand.			
			0.5	0.90	PP = 410 kPa PP = 310 kPa PP = >600 kPa PP = >600 kPa PP = >600 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium sand.			
			1.0	1.40	PP = >600 kPa PP = 500 kPa				Pale orange/brown, with calcareous gravel.			
			1.5	1.60					Dark grey with brown mottling.			
				2.00	PP = 600 kPa PP = 360 kPa PP = 280 kPa PP = 550 kPa				Orange/brown with grey/brown mottling.		VSt - H	
			2.0	2.30	PP = 480 kPa			SC	Clayey SAND, fine to medium, orange / brown with grey / brown mottling, high plasticity fines.	M		
			2.5	3.00	PP = 560 kPa PP = 370 kPa PP = 540 kPa PP = 520 kPa PP = >600 kPa			CH	Sandy CLAY, fine to medium, orange / brown mottled grey, high plasticity fines.		VSt - H	
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH09

CLIENT: WALKER CORPORATION	COORDS: 272564 m E 6162212 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: SOIL SURVEYS	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: AJB	DATE: 21/1/08
		CHECKED: [signature]	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.10				SC	Clayey SAND, fine to medium, dark brown, low plasticity fines, trace of fine gravel.	D		Inferred topsoil. Fine roots.
				0.32	PP = >600 kPa PP = >600 kPa			CH	Sandy CLAY, high plasticity, dark brown, fine to medium sand.		H,Fb	
			0.5	0.75	PP = >600 kPa PP = 560 kPa			CH	Sandy Gravelly CLAY, high plasticity, mottled orange / brown, dark brown and pale brown, fine to coarse sand, fine to medium calcareous gravel.			
			1.0	1.60	PP = >600 kPa			GC	Sandy Clayey GRAVEL, fine to coarse grained, pale orange / brown, fine to medium sand, high plasticity fines.			Calcareous gravel.
			1.5	1.70	PP = 500 kPa PP = 510 kPa			CH	Gravely Sandy CLAY, high plasticity, orange / brown, fine to medium sand, fine to medium calcareous gravel.		H	
				2.00				SP	SAND, fine to medium grained, orange/brown mottled red/brown, with clay.	M		Weakly cemented.
			2.0	2.10					Pale orange/brown, with weakly cemented sand, with fine to medium gravel, up to 20mm in size.			
		AJB 21/01/2008	2.5	3.00					Orange/brown.	W		
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 2.3m.			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH10

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 272157 m E 6161983 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: AJB DATE: 21/1/08
CHECKED: [signature] DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M-H		0.0					SC	Clayey SAND, fine to medium, brown, low plasticity fines.	D		Trace of root fibres. Inferred topsoil.
				0.20	PP = 330 kPa PP = 500 kPa PP = 490 kPa PP = 300 kPa PP = 280 kPa PP = >600 kPa PP = 330 kPa PP = 340 kPa PP = 430 kPa PP = 530 kPa			CH	Sandy CLAY, high plasticity, dark brown, fine to medium sand, trace of calcareous gravel.		VSt - H	
			1.5	1.50	PP = 470 kPa PP = >600 kPa			SP	SAND, fine to medium grained, orange / brown, with high plasticity fines.			
				1.80	PP = 290 kPa PP = 500 kPa PP = 320 kPa			CH	Sandy CLAY, high plasticity, brown with grey/brown mottling, fine to medium sand.		VSt - H	Trace of black specks 2 - 2.2m.
				2.20	PP = >600 kPa PP = 310 kPa				Orange/brown.			
				2.80					Trace of calcareous gravel.			
			3.0	3.00	PP = 540 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH11

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 271912 m E 6162644 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

SHEET: 1 OF 1
DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: AJB DATE: 22/1/08
CHECKED: [signature] DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.15				CL	Sandy CLAY, low plasticity, dark brown, fine to medium sand.	D	VSt - H	Trace of organic material, including root fibres.
					PP = 460 kPa PP = 500 kPa PP = 460 kPa PP = 320 kPa PP = 270 kPa PP = 260 kPa PP = 250 kPa PP = 300 kPa PP = 220 kPa PP = 280 kPa PP = 300 kPa PP = 320 kPa			CH	Sandy CLAY, high plasticity, dark grey, fine to medium sand.			
				1.60	PP = 460 kPa PP = 560 kPa PP = 600 kPa				Brown with dark brown mottling.	M		Trace of calcareous gravel.
				1.90	PP = >600 kPa				Orange / brown.			
				2.10	PP = >600 kPa PP = >600 kPa				Red / brown.			Trace of black specks.
				2.30	PP = 590 kPa				Brown.			
				2.60	PP = 320 kPa PP = 460 kPa PP = 420 kPa PP = 320 kPa				Brown with grey mottling.			
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH12

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 271643 m E 6163282 m N 54 AMG84		DRILL RIG: ROCKMASTER	
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD		DRILLER: SOIL SURVEYS	
LOCATION:	BUCKLAND PARK	INCLINATION: -90°		LOGGED: MH	DATE: 22/1/08
JOB NO:	077662060	HOLE DIA: mm	HOLE DEPTH: 3.00 m	CHECKED: Wg	DATE: 29/5/08

Drilling: METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					CH	Sandy CLAY, high plasticity, brown, fine to medium sand.	D	H	Trace of root fibres.
			0.5		PP = >600 kPa							
				0.80				SP	SAND, fine to medium grained, pale brown, trace of high plasticity fines.			
			1.0									
			1.5	1.50				CH	Sandy CLAY, high plasticity, brown, fine to medium sand.		H	
			2.0		PP = 490 kPa							
			2.5		PP = >600 kPa							
					PP = >600 kPa							
			3.0	3.00	PP = >600 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH13

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 271217 m E 6163089 m N 54 AMG84	DRILL RIG: ROCKMASTER		
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS		
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH	DATE: 22/1/08	
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED:	DATE: 29/5/08	

Drilling					Sampling	Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.30				SP	SAND, fine to medium grained, pale brown, trace of high plasticity fines.	D		Trace of root fibres.
			0.5	0.90				SC	Clayey SAND, fine to medium grained, dark brown, high plasticity fines.			Trace of root fibres.
			1.0 / 1.5	1.70	PP = >600 kPa PP = >600 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium sand.		H	
			2.0 / 2.5	2.70	PP = 480 kPa			SP	SAND, fine to medium grained, pale brown, trace of high plasticity fines.			
				3.00	PP = 390 kPa PP = 510 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium sand.		VSt - H	
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

3.5 — 4.0 — 4.5 — 5.0 — 5.5 — 6.0 — 6.5

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REPORT OF BOREHOLE: BH14

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SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 271508 m E 6162461 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH	DATE: 22/1/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 6.00 m	CHECKED: lyr	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M-H		0.0 – 1.00	1.00	PP = >450 kPa PP = >450 kPa PP = >450 kPa	CH	Sandy CLAY, high plasticity, dark grey / dark brown, fine to coarse grained sand, with fine to medium sand.	D	H	Fine roots.
			1.00 – 1.30	1.30	PP = >450 kPa PP = >450 kPa PP = >450 kPa	CH	CLAY, high plasticity, dark brown, with fine to medium sand, with fine to medium pale brown calcareous gravel.	D	H	Contains vesicules.
			1.30 – 1.80	1.80	PP = >450 kPa PP = >450 kPa PP = >450 kPa PP = >450 kPa	CH	Sandy CLAY, high plasticity, brown mottled orange / brown, fine to medium sand, with fine to medium pale brown calcareous gravel.	D	H	Contains vesicules.
			1.80 – 2.00	2.00		SP	SAND, fine to medium grained, orange / brown.	D		Piece of strongly cemented sand at 2.0m depth, 30mm in size.
			2.00 – 2.20	2.20	PP = >450 kPa PP = >450 kPa PP = >450 kPa PP = >450 kPa PP = 400 kPa PP = 300 kPa PP = 300 kPa PP = >450 kPa	CH	Sandy CLAY, high plasticity, orange/brown mottled grey/ brown, fine to medium sand, trace of fine to medium pale brown calcareous gravel. Red/brown mottled grey/brown.	M	VSt - H	
			3.10	3.10	PP = 325 kPa PP = 280 kPa PP = 275 kPa PP = 230 kPa		Grey, mottled orange/brown.	M	VSt - H	
	MH	22/01/2008 (4.0)	3.75	3.75	PP = 270 kPa PP = 175 kPa		Orange/brown mottled red/brown and pale brown, with fine to medium pale brown calcareous gravel.	M / W	VSt - H	
			4.30 – 6.00	4.30 / 6.00	PP = 70 kPa PP = 80 kPa PP = 125 kPa PP = 125 kPa PP = 90 kPa	SC CH	Sandy CLAY, interbedded with Clayey SAND. SAND is fine to medium grained, CLAY is high plasticity, orange/brown, mottled red/ brown and grey.	W	F - St	
			6.0 – 6.5				END OF BOREHOLE @ 6.00 m GROUNDWATER ENCOUNTERED @ 4.05m			

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REPORT OF BOREHOLE: BH15

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 271773 m E 6161970 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH	DATE: 22/1/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED:	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M-H		0.0		PP = >600 kPa			SP	SAND, fine to medium grained, brown, with high plasticity fines.	D		Trace of root fibres.
				0.30	PP = >600 kPa			CH	Sandy CLAY, high plasticity, orange / brown, fine to medium sand.		H	Trace of black specks.
			1.0	1.00								
				1.10	PP = 360 kPa				Brown, with calcareous gravel.			
					PP = 390 kPa			SC	Clayey SAND, fine to medium grained, orange / brown, high plasticity fines.	M		
			1.5	1.40	PP = 510 kPa			CH	Sandy CLAY, high plasticity, orange / brown, fine to medium sand, with calcareous gravel.		H	
					PP = >600 kPa			SC	Clayey SAND, fine to medium grained, orange / brown, high plasticity fines.			
				1.65								
				1.75	PP = 520 kPa			CH	Sandy CLAY, high plasticity, red / brown, fine to medium sand.		H	
					PP = 560 kPa							
			2.0						Pale brown / orange, trace of calcareous gravel.			
				2.30								
				2.40	PP = 400 kPa				Brown, with calcareous gravel.			
			2.5		PP = 430 kPa				Red/brown.			
				2.70	PP = 470 kPa				Brown with brown/grey mottling, trace of calcareous gravel.			
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH16

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 271502 m E 6161591 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH / JV	DATE: 24/1/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.90 m	CHECKED: wm	DATE: 29/5/08

Drilling: METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	Field Material Description: SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.30				SC	Clayey SAND, fine to coarse grained, brown, low plasticity fines.	D		Calcareous nodules and cementation.
			0.5	0.80				SP	SAND, fine to coarse grained, orange brown, with low plasticity fines.			Mica flecks.
			1.0	1.15	PP = 200 kPa			CH	Sandy CLAY, high plasticity, orange brown, fine to coarse grained sand.		VSt	
				1.40	PP = 160 kPa			SP / CH	SAND, fine to coarse grained, orange brown, with low plasticity fines. / Sandy CLAY, high plasticity, red brown / brown, fine to coarse grained sand.		St	
			1.5	1.80				SC	Clayey SAND, fine to coarse grained, brown / pale brown / grey brown, low plasticity fines.			Calcareous.
			2.0	2.25	PP = 380 kPa; PP = 210 kPa			CL	Sandy CLAY, low plasticity, brown / pale brown / pale grey, fine to coarse grained sand.	M	VSt	Calcareous.
		MH / JV 24/01/08 ▽	2.5; 3.0	3.30				SC CL	Clayey SAND/Sandy CLAY, fine to coarse grained sand, brown / grey, low plasticity fines.	W		
			3.5	3.75				SC	Clayey SAND, fine to coarse grained, brown / grey, low plasticity fines, trace of gravel.			
				3.90				SP	SAND, medium to coarse grained, brown / grey.			
			4.0; 4.5; 5.0; 5.5; 6.0; 6.5						END OF BOREHOLE @ 3.90 m GROUNDWATER ENCOUNTERED @ 2.3m.			

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REPORT OF BOREHOLE: BH17

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 271033 m E 6162260 m N 54 AMG84		DRILL RIG: ROCKMASTER	
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD		DRILLER: SOIL SURVEYS	
LOCATION:	BUCKLAND PARK	INCLINATION: -90°		LOGGED: MH / JV	DATE: 24/1/08
JOB NO:	077662060	HOLE DIA: mm	HOLE DEPTH: 3.00 m	CHECKED:	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.35				SC	Clayey SAND, fine to coarse grained, grey / dark grey, low plasticity clay.	D		Inferred topsoil. Fine roots.
			0.5	0.60				SP	SAND, fine to coarse grained, brown, trace of low plasticity clay.			
			1.0	1.30	PP = >500 kPa			SC	Clayey SAND, low plasticity, red brown with grey mottling, fine to coarse grained sand.			Black flecks. Calcareous nodules. Calcareous cementation at 0.8 - 1.0m.
			1.5	1.50				SP	SAND, fine to coarse grained, yellow brown, trace of gravel.			
			2.0	2.25				SP	SAND, fine to coarse grained, brown / red brown, with low plasticity clay.	M		
			2.5	3.00				SC	Clayey SAND, fine to coarse grained, pale brown / brown, low plasticity fines.			Calcareous.
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH18

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 270713 m E 6162893 m N 54 AMG84	DRILL RIG: ROCKMASTER		
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS		
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH	DATE: 22/1/08	
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: 40	DATE: 29/5/08	

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M-H		0.0		PP = >600 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium sand.	D	H	Root fibres, organic material.
			0.5	0.50	PP = >600 kPa PP = >600 kPa			CH	CLAY, high plasticity, dark brown / grey.			
				0.80								
				0.90				CH	Sandy CLAY, high plasticity, dark brown with brown mottling, fine to medium sand.			
			1.0					SP	SAND, fine to medium grained, pale brown.			
				1.20	PP = >600 kPa							
				1.30				SC	Clayey SAND, fine to medium grained, pale brown, high plasticity fines.			
			1.5					SP	SAND, fine to medium grained, pale brown.			
				1.60	PP = 390 kPa PP = 440 kPa PP = 340 kPa			CH	Sandy CLAY, high plasticity, orange / brown, fine to medium sand.		VSt - H	
				2.70					Trace of calcareous gravel.			
				2.80	PP = 540 kPa PP = 380 kPa							
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH19

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 270374 m E 6162660 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH	DATE: 22/1/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: 4J	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M-H		0.0					CH	Sandy CLAY, high plasticity, dark brown, fine to medium grained sand.		H	Trace of root fibres @ 0 - 0.2 m.
			0.5		PP = >600 kPa							
				0.80					Brown.			
			1.0	1.00	PP = >600 kPa							
				1.10				SP	SAND, fine to medium grained, orange / brown, trace of high plasticity fines.			
								CH	Sandy CLAY, high plasticity, orange / brown, fine to medium grained sand.		H	
				1.30	PP = >600 kPa				With calcareous gravel.			
			1.5	1.70								
				1.80				SP	SAND, fine to medium grained, orange / brown, trace of high plasticity fines.			
					PP = >600 kPa			CH	Sandy CLAY, high plasticity, orange / brown, fine to medium grained sand.		H	
			2.0		PP = >600 kPa							
				2.30					With calcareous gravel.			
			2.5									
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH20

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SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 270587 m E 6162044 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: JV	DATE: 23/1/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED:	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.30				CL	Sandy CLAY, low plasticity, grey, fine to medium grained sand.	D	Fb	Inferred topsoil, contains root material.
			0.5	0.65				SP	SAND, fine to coarse grained, dark brown, with low plasticity clay.			Calcareous.
			1.0	1.10				SC	Clayey SAND, fine to coarse grained, brown / orange brown, high plasticity fines.			Calcareous nodules.
			1.5	1.60	PP = 500 kPa			CH	Sandy CLAY, high plasticity, grey / brown / orange brown, fine to coarse grained sand.		H	Calcareous nodules and cementation.
				1.90	PP = >500 kPa			CH	Sandy CLAY, high plasticity, orange brown / brown, fine to coarse grained sand.		H	Calcareous nodules.
			2.0	2.30				SC	Clayey SAND, fine to coarse grained, dark brown / brown / orange brown, high plasticity fines.			Calcareous nodules. Black flecks.
		JV 23/01/08	2.5	3.00	PP = 320 kPa PP = 250 kPa			CH	Sandy CLAY, high plasticity, brown / pale grey, fine to coarse grained sand.	M W	VSt	Calcareous.
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 2.6m.			

Depth scale: 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH21

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 270829 m E 6161577 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: MH / JV DATE: 28/2/08
CHECKED: [signature] DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					CL	Sandy CLAY, low plasticity, grey, fine to medium grained sand.	D	Fb, H	Inferred topsoil. Root material.
				0.30	PP = 450 kPa			CL	Brown.			
				0.70	PP = 400 kPa			CL	Weakly cemented fine to medium grained sand.			Calcareous.
				1.15	PP = 300 kPa			CH	CLAY, high plasticity brown / grey, with fine to medium grained sand.		VSt	Calcareous.
				1.45	PP = >500 kPa			CH	Sandy CLAY, high plasticity, brown / orange brown / grey, fine to coarse grained sand.	M	H	Calcareous nodules. Black flecks.
				2.15				SC	Clayey SAND, fine to coarse grained, dark grey / brown / grey / orange brown, low plasticity fines.			Calcareous.
				2.25				CL	Sandy CLAY, low plasticity, brown / dark grey / orange brown, fine to coarse grained sand.			Calcareous nodules and cementation. Black flecks.
				2.80	PP = >500 kPa			SC	Clayey SAND, fine to coarse grained, grey / orange brown, low plasticity fines.			Calcareous nodules.
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH22A

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 270901 m E 6160178 m N 54 AMG84	DRILL RIG: ROCKMASTER
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH DATE: 23/1/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: [signature] DATE: 23/5/08

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					SP	SAND, fine to medium grained, brown, with clay.	D		0 - 0.1 m inferred topsoil, and contains root fibres.
				0.35					Orange Brown.			
			0.5	0.50				SC CH	Clayey SAND interbedded with Sandy CLAY, red / brown mottled brown, fine to medium grained sand, high plasticity clay.			
				0.75					Brown mottled orange / brown.	M		
			1.0	1.10				SC	Clayey SAND, fine to coarse grained, orange brown, high plasticity fines.			
			1.5	1.50					Orange / brown mottled red / brown and grey.			
			2.0	2.00	PP = 450 kPa PP = 220 kPa			CH	Sandy CLAY, high plasticity, grey, mottled pale brown, fine to coarse grained, trace of fine gravel.		VSt - H	
			2.5	2.70	PP = 250 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium grained sand.			
			3.0	3.00	PP = 450 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH22B

CLIENT: WALKER CORPORATION	COORDS: 270901 m E 6160178 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: GEODRILL	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 2.20 m	LOGGED: JV	DATE: 24/4/08
		CHECKED: AO	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M	24/4/08 JV	0.0	0.20				SC	Clayey SAND, fine to coarse grained, red brown, low plasticity fines.	D		Inferred topsoil. Trace of fine to medium roots.
				0.45				SC	Clayey SAND, fine to coarse grained, brown, low plasticity fines, trace of fine to coarse calcareous gravel.	D		
			0.5 – 1.0	1.20	PP = 180 kPa PP = 180 kPa BH22b/01 (1.0-1.05m) PASS Sample BH22b/02 (1.15-1.2m) PASS Sample			CH	Sandy CLAY, high plasticity, mottled brown / orange brown, trace of fine to coarse calcareous gravel.	M	St	
			1.5	1.80	BH22b/03 (1.5-1.55m) PASS Sample			SC	Clayey SAND, fine to coarse grained, orange brown, low plasticity fines, trace of fine to course calcareous gravel.	W		
			2.0	2.00	PP = 100 kPa			CH	Sandy CLAY, high plasticity, mottled orange brown / pale grey / pale brown, fine to coarse sand.	M	St	Trace of calcareous material.
				2.20				SP	SAND, fine to coarse grained, mottled orange brown / pale brown, trace of low plasticity fines.	W		
			2.5 – 6.5						END OF BOREHOLE @ 2.20 m GROUNDWATER ENCOUNTERED @ 1.1m.			

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REPORT OF BOREHOLE: BH23

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 271244 m E 6159755 m N 54 AMG84	DRILL RIG: ROCKMASTER
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH DATE: 23/1/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: [signature] DATE: 23/5/08

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					SP	SAND, fine to medium grained, brown.	D		Contains fine root fibres.
			0.5	0.40				SC	Clayey SAND, fine to coarse grained, orange / red / brown, high plasticity fines.			Trace of fine roots throughout layer. Trace of calcareous pale brown gravel 0.8 - 0.9m.
			1.0	0.90				SP	SAND, fine to coarse grained, orange / brown.			
			1.5	1.50					Brown, with clay.			
			2.0	1.90 / 2.00	PP = 410 kPa PP = 390 kPa			CH	Sandy CLAY, high plasticity, red / brown, fine to medium grained sand. Red / brown mottled pale brown.	M	Fb. H	2 - 2.7m, trace of fine calcareous gravel.
			2.5	2.40 / 2.50	PP = >450 kPa				Brown mottled pale brown. Brown / pale brown / pale grey mottled.			
				2.70	PP = 430 kPa PP = 250 kPa PP = 290 kPa PP = 350 kPa			CH	Sandy CLAY, high plasticity, grey / orange / pale brown, fine to medium grained sand.		VSt - H	
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH24

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 270773 m E 6159338 m N 54 AMG84		DRILL RIG: ROCKMASTER	
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD		DRILLER: SOIL SURVEYS	
LOCATION:	BUCKLAND PARK	INCLINATION: -90°		LOGGED: ND/MH	DATE: 23/1/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m		CHECKED:	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0				CH	Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand.	D	Fb	Inferred topsoil. High organic content (fine roots and plant material). Calcareous nodules. Increasing sand content with depth.
			0.5	0.50			CH	Sandy CLAY, high plasticity, brown / yellow / red, fine to coarse grained sand.	D	Fb	Calcareous.
	MH	23/1/08	1.0	0.90 / 1.00	PP = >500 kPa		CH	Sandy CLAY, high plasticity, mottled orange brown / brown / yellow brown / dark grey.	D	H	Calcareous.
				1.00	BH24 (1.2 - 1.4 m) PASS Sample BH24 (1.4 - 1.5 m) PASS Sample		SC	Clayey SAND, fine to coarse, brown yellow / yellow / red, high plasticity fines, trace of calcareous nodules.	D-M		Trace of fine roots.
			2.0	1.90	PP = 100 kPa PP = >500 kPa		CH	Sandy CLAY, high plasticity, mottled brown / pale brown / yellow / red / red brown, fine to coarse grained sand, trace of calcareous nodules.	M	F - H	Increasing calcareous material and root fibres with depth. Increasing grey mottling with depth. Trace of roots.
			3.0	3.00				END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED AT 1.0m.			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH25

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 271168 m E 6159157 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: ND/MH DATE: 23/1/08
CHECKED: lyn DATE: 29/5/08

Drilling: METHOD PT; PENETRATION RESISTANCE M; WATER: groundwater MH 23/1/08 at 2.0 m

DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
0.00–0.40		CH	Sandy CLAY, high plasticity, brown / dark brown, fine to coarse grained sand.	D	Fb	Inferred topsoil. Trace of fine roots.
0.40–0.60	PP = >500 kPa	CH	Sandy CLAY, high plasticity, brown / yellow brown, fine to coarse grained sand, trace of calcareous nodules.	D	H	Trace of fine roots.
0.60–1.00		SP	Gravelly SAND, fine to coarse grained, yellow brown, fine to coarse gravel.	D		
1.00–1.30	PP = >500 kPa	CH	Sandy CLAY, high plasticity, mottled brown / brown yellow, fine to coarse grained sand, trace of gravel.	D	Fb, H	Highly calcareous lens 1.1 - 1.15m. Increasing clay content with depth, with transition to sand.
1.30–1.90		SC	Gravelly Clayey SAND, fine to coarse, brown / dark brown / brown yellow, high plasticity fines.	D		Clay and gravel content varies throughout layer. Calcareous inclusions.
1.90–2.60		SC	Clayey SAND, fine to coarse, high plasticity fines.	D / W		Calcareous.
2.60–3.00	PP = >500 kPa	CH	Sandy CLAY, high plasticity, mottled brown / pale brown / yellow / red, fine to coarse grained sand.	W	H	Calcareous.
3.00			END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTED @ 2.0m			

Depth scale (metres): 0.0 – 6.5

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REPORT OF BOREHOLE: BH26

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 271832 m E 6159337 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH / JV	DATE: 23/1/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: ly	DATE: 29/5/08

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.30				SC	Clayey SAND, fine to coarse grained, dark brown, low plasticity fines.	D		Root material.
			0.5	0.55	PP = 250 kPa			CH	Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand.		Fb, Vst	
				0.85				SC	Clayey SAND, fine to coarse grained, brown, low plasticity fines.			Sand content increases with depth. Calcareous nodules.
			1.0	1.15				SP	SAND, fine to coarse grained, orange brown, with low plasticity fines.			
			1.5	1.75	PP = 150 kPa			CL	Sandy CLAY, low plasticity, orange brown, fine to coarse sand.		Fb, St	Calcareous nodules.
			2.0	2.10	PP = 250 kPa			CH	Sandy CLAY, high plasticity, orange brown, fine to coarse grained sand.	M	Fb, VSt	Calcareous mottling and nodules at 2.25 - 2.5m.
			2.5	2.70					Mottled orange brown and pale grey.			
	MH / JV 23/1/08	▽	3.0	3.00				SP	SAND, fine to coarse grained, mottled orange red and pale grey, with low plasticity fines.	W		Organic matter inclusions.
			3.5						END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 2.7m.			
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH27

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 271578 m E 6160087 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH / JV	DATE: 23/1/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 5.10 m	CHECKED: [signature]	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					CL	Sandy CLAY, low plasticity, brown, fine to coarse grained sand.	D	Fb	Topsoil, root material.
			0.5	0.50	PP = >500 kPa			CL	Sandy CLAY, low plasticity, brown / grey, fine to coarse grained sand.	D	H	Root material. Calcareous nodules.
				1.20					Dark brown / brown / grey mottled.	D	H	Black flecks.
				1.70				SP	SAND, fine to coarse grained, brown, with low plasticity clay.	M		Black flecks. Trace of Mica.
				2.35				CH	Sandy CLAY, high plasticity, brown / grey, fine to coarse grained sand.	M		
				2.45				SC	Clayey SAND, fine to coarse grained, brown / pale grey, low plasticity fines.	M		
				2.60	PP = 160 kPa			CL	Sandy CLAY, low plasticity, brown / pale brown / orange brown, fine to coarse grained sand.	M	St	
			3.0	3.05	PP = 200 kPa			CL	Sandy CLAY, low plasticity, red brown / brown, fine to coarse grained sand.	M	St	Calcareous.
			3.5	3.50	BH22/01 (3.5-3.6)	■		CH	CLAY, high plasticity, red brown, with fine to coarse sand.	M	H	Calcareous nodules.
		23/1/08 MH / JV	4.0	3.65	PP = 500 kPa PP = 360 kPa BH22/02 (3.9-4.0)	■		CH	Sandy CLAY, high plasticity, brown / pale brown, fine to coarse grained sand.	M	VSt - H	Calcareous nodules. Calcareous cementation at 3.75 - 4.0m.
			4.5	4.45	PP = >500 kPa			CH	CLAY, high plasticity, red brown, with fine to coarse sand.	W	H	Calcareous nodules.
			5.0	5.10					END OF BOREHOLE @ 5.10 m GROUNDWATER ENCOUNTERED @ 3.95m.			
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH28

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 272286 m E 6159977 m N 54 AMG84	DRILL RIG: ROCKMASTER
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: MH / JV DATE: 23/1/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: [signature] DATE: 29/5/08

Drilling: METHOD	Drilling: PENETRATION RESISTANCE	Drilling: WATER	Drilling: DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					CH	Sandy CLAY, high plasticity, grey brown, fine to coarse grained sand.	D	H	Root material.
			0.5	0.45	PP = >500 kPa PP = >500 kPa			CH	Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand.			Calcareous nodules.
			1.0	1.10	PP = 500 kPa			CH	Sandy CLAY, high plasticity, brown, fine to coarse grained sand.			Calcareous.
			1.5	1.60	PP = 400 kPa			CH	CLAY, high plasticity, brown, with sand.	D-M	Fb, H	Sand content increasing with depth.
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale (metres): 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH29

CLIENT: WALKER CORPORATION	COORDS: 271917 m E 6160303 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: SOIL SURVEYS	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: MH	DATE: 23/1/08
		CHECKED: [signature]	DATE: 29/5/08

Drilling: METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.40				CL	Sandy CLAY, low plasticity, dark brown / dark grey, fine to medium grained sand.	D	Fb	Inferred topsoil, 0 - 0.1m. Contains root fibres.
			0.5	0.85	PP = >450 kPa PP = >450 kPa			CH	Sandy CLAY, high plasticity, brown mottled pale brown, fine to medium grained sand, with fine pale brown calcareous gravel throughout layer.	D	Fb, H	
			1.0	1.10				SP	SAND, fine to coarse grained, red / brown, with high plasticity clay.	M		Calcareous gravel at bottom of layer 20mm in size.
				1.50	PP = 100 kPa PP = 160 kPa			CH	Sandy CLAY, high plasticity, orange / brown mottled pale brown, fine to coarse grained sand, with fine to medium pale brown calcareous gravel.	M	St - VSt	
			1.5	1.80	PP = 310 kPa				Brown mottled pale brown.	M	St - VSt	
			2.0 2.5	3.00	PP = 250 kPa PP = 150 kPa PP = 130 kPa PP = 50 kPa PP = 275 kPa PP = 110 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium grained sand, trace of fine to medium pale brown calcareous gravel throughout layer.	M	F - St	
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5 4.0 4.5 5.0 5.5 6.0 6.5									

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REPORT OF BOREHOLE: BH30

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 272168 m E 6160684 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: MH / JV DATE: 23/1/08
CHECKED: [signature] DATE: 29/8/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0–0.40		CL	Sandy CLAY, low plasticity, grey, fine to medium grained sand.	D	Fb	Inferred topsoil, contains roots.
			0.40–0.80	PP = 400 kPa	CL	Sandy CLAY, low plasticity, brown, fine to coarse grained sand.	D	Fb, H	Calcareous nodules.
			0.80–1.25	PP = >500 kPa	CH	Sandy CLAY, high plasticity, brown, fine to coarse grained sand.	D	H	Calcareous nodules.
			1.25–1.35		SC	Clayey SAND, fine to coarse grained, orange brown / pale grey, low plasticity fines.			
			1.35–2.15	PP = 350 kPa	CH	Sandy CLAY, high plasticity, orange brown / grey, fine to coarse grained sand.	M	VSt	Calcareous mottling at 1.7 - 2.1m.
			2.15–2.45		SC	Clayey SAND, fine to coarse grained, brown, low plasticity fines.	M		Dark grey mottling at 2.35m.
			2.45–3.00		SP	SAND, fine to coarse grained, brown, trace of low plasticity clay.	W		Mica flecks.
			3.00			END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

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REPORT OF BOREHOLE: BH31

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 271594 m E 6160597 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB	DATE: 31/1/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED:	DATE: 29/5/08

Drilling				Sampling			Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					CH	Sandy CLAY, high plasticity, dark grey, fine to medium sand.	D	VSt - H, Fb	Contains fine roots.
				0.40	PP = 300 kPa							
			0.5		PP = 400 kPa PP = 300 kPa PP = 270 kPa				Grey/brown.			
				0.85	PP = 450 kPa PP = 360 kPa			SP	SAND, medium to coarse grained, orange / brown, trace of plastic fines.	M		
			1.0	1.20								
				1.30	PP = 180 kPa			SC	Clayey SAND, medium to coarse grained, brown, high plasticity fines.		St-H / Fb	
			1.5	1.50				CH	Sandy CLAY, high plasticity, brown, fine to medium sand.			
					PP = 375 kPa PP = 275 kPa PP = 220 kPa				Red/brown.			
			2.0	2.00	PP = 440 kPa PP = 260 kPa PP = 140 kPa				Red/brown, with fine to medium calcareous gravel.			
			2.5		PP = >450 kPa PP = >450 kPa PP = >450 kPa PP = >450 kPa						H	
			3.0	3.00	PP = >450 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH32

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 272616 m E 6159394 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB	DATE: 31/1/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: [signature]	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY / DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.20				SP	Clayey Gravelly SAND, fine to medium grained, brown grey, fine to medium gravel, low plasticity fines.	D		Inferred topsoil, contains numerous roots.
				0.40	PP = 230 kPa			CH	Sandy CLAY, high plasticity, dark brown, fine to medium sand.		St-H	
			0.5	0.80	PP = 450 kPa PP = 320 kPa PP = 400 kPa PP = 440 kPa				Brown.			
			1.0	1.30	PP = 180 kPa PP = 270 kPa PP = 140 kPa				Yellow/brown.	M		
				1.40	PP = 125 kPa				Red/brown.			
			1.5	1.50 1.60	PP = 125 kPa			CH	Clayey SAND / Sandy CLAY, high plasticity fines, fine to coarse grained sand, mottled grey and orange/ brown.		F - St	Pocket of pale brown, fine to medium grained calcareous gravel between 1.7 - 1.8m.
				1.70	PP = 200 kPa				Brown.			
					PP = 50 kPa				Brown, mottled dark grey.			
			2.0	2.00	PP = 150 kPa PP = 200 kPa				Brown.			
			2.5	3.00	PP = 375 kPa PP = 440 kPa PP = 375 kPa PP = 450 kPa PP = 420 kPa PP = 450 kPa			CH	Sandy CLAY, high plasticity, brown mottled grey, with fine to medium pale brown calcareous gravel.		VSt - H	
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH33

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 270736 m E 6160912 m N 54 AMG84	DRILL RIG: ROCKMASTER
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB DATE: 31/1/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: DATE: 29/4/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0			SC	Clayey SAND, fine to medium grained, dark brown, low plasticity fines.	D		
				0.50		SP	SAND, fine to medium grained, brown, with plastic fines.	D		
				0.70		SP	SAND, fine to medium grained, orange/brown, with plastic fines and fine pale brown gravel.	D / M		
				1.70	PP = 160 kPa PP = 130 kPa PP = <50 kPa	SC	Sandy CLAY interbedded with Clayey SAND. SAND is fine to medium grained, CLAY is high plasticity. Brown, with fine to medium pale brown calcareous gravel.	M / W	S - St	
				2.30	PP = 50 kPa BH33/02 (2.4-2.5)		Brown, mottled grey.	W	S - St	
		AJB 31/01/2008		2.60	PP = 50 kPa PP = 110 kPa BH33/01 (2.75-2.8) PP = 210 kPa PP = 230 kPa PP = 330 kPa	CH	Sandy CLAY, high plasticity, brown, fine to medium grained sand, with pale brown fine to medium calcareous gravel.	W	St - VSt	
			3.0	3.00			END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 2.7			

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REPORT OF BOREHOLE: BH34

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 271370 m E 6160936 m N 54 AMG84	DRILL RIG: ROCKMASTER		
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS		
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB	DATE: 31/1/08	
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: [illegible]	DATE: 29/5/08	

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					SP	SAND, fine to medium grained, brown, with plastic fines.	D		Fine roots throughout layer. Pocket of brown, high plasticity sandy clay.
				0.30					Red/brown.			
			0.5	0.75					Brown.			
			1.0	1.30					Trace of fine to medium gravel.			
			1.5	1.50								
				1.65	PP = 110 kPa PP = 100 kPa PP = 160 kPa PP = 370 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium sand.	M	St-H	Trace of roots. Fine to medium gravel.
			2.0									
			2.5	2.60	PP = 380 kPa PP = 450 kPa PP = 430 kPa PP = 390 kPa				Fine to medium gravel			
				2.85				SC	Clayey SAND, fine to medium grained, grey / brown with brown mottling, high plasticity fines.			
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH35

CLIENT:	WALKER CORPORATION	COORDS: 271828 m E 6161152 m N 54 AMG84		SHEET: 1 OF 1	
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD		DRILL RIG: ROCKMASTER	
LOCATION:	BUCKLAND PARK	INCLINATION: -90°		DRILLER: SOIL SURVEYS	
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m		LOGGED: AJB	DATE: 31/1/08
				CHECKED:	DATE: 29/5/08

Drilling: METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	Field Material Description: SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					SC	Clayey SAND, fine to medium grained, grey / brown, low plasticity fines.	D	VSt - H.Fb	Inferred topsoil. Contains vesicules, fine roots.
				0.25	PP = >450 kPa PP = >450 kPa			CH	Sandy CLAY, high plasticity, dark brown/dark grey, fine to medium sand, with fine to medium pale brown calcareous gravel. Brown with dark brown mottling.			Contains vesicules between 1.25 - 2m.
				0.90	PP = >450 kPa				Red/brown.			
			1.0	1.10	PP = 450 kPa PP = 290 kPa PP = >450 kPa PP = 330 kPa PP = 180 kPa PP = 360 kPa PP = 80 kPa PP = 260 kPa				Orange/brown.	M	F - H.Fb	
				2.80	PP = 50 kPa			SC	Clayey SAND, fine to medium grained, orange / brown, high plasticity fines.			
			3.0	3.00	PP = 140 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH36

CLIENT: WALKER CORPORATION	COORDS: 272810 m E 6160926 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: SOIL SURVEYS	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: AJB	DATE: 31/1/08
		CHECKED: [illegible]	DATE: 29/[illegible]

Drilling: METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	Sampling: DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.20	PP = 340 kPa			CL	Sandy CLAY, low plasticity, dark grey / dark brown, fine to medium grained sand, with fine gravel.	D	VSt	Inferred topsoil. Fine roots.
				0.40	PP = 400 kPa PP = 330 kPa			CH	Sandy CLAY, high plasticity, dark brown, fine to medium sand.	M		Contains vesicules between 0.4 - 1m.
			0.5		PP = 210 kPa PP = 300 kPa				Orange/brown with brown mottling, with fine to medium pale brown calcareous gravel.			
			1.0	1.00	PP = 265 kPa PP = 180 kPa PP = 225 kPa PP = 340 kPa PP = 290 kPa				Brown with grey and grey/brown mottling.		VSt - H	
			1.5		PP = 450 kPa PP = 380 kPa PP = 410 kPa PP = 310 kPa							
			2.0	2.10	PP = 365 kPa				Trace of fine calcareous pale brown gravel.			
			2.5	2.50	PP = 360 kPa PP = 270 kPa							
					PP = 380 kPa PP = 360 kPa							
			3.0	3.00	PP = 450 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH37

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 272934 m E 6160420 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

DRILL RIG: ROCKMASTER
DRILLER: SOIL SURVEYS
LOGGED: AJB DATE: 31/1/08
CHECKED: [signature] DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.25	PP = >450 kPa			SC	Clayey SAND, fine to medium grained, dark grey, low plasticity fines.	D		Inferred topsoil, contains numerous fine roots.
				0.40				CH	Clayey SAND, high plasticity, dark grey, fine to medium grained sand.		H / Fb	
			0.5	0.50	PP = 300 kPa				Red/brown.			
								SC	Clayey SAND, fine to coarse grained, brown, high plasticity fines, with fine to medium pale brown calcareous gravel.	M		
			1.0									
			1.5	1.50				SP	SAND, medium to coarse grained, brown, trace of plastic fines.			
			2.0	2.00					With fine to medium gravel.			
	AJB	31/01/2008		2.10					Pocket of grey high plasticity clay.			
				2.30						W		
			2.5									
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 2.2m.			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH38

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 273146 m E 6159768 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: SOIL SURVEYS	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB	DATE: 31/1/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.70 m	CHECKED:	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0		PP = 400 kPa			CH	Sandy CLAY, high plasticity, orange/brown, fine to coarse grained sand, with fine to medium pale brown calcareous gravel.	D	St - H / Fb	Fine roots, 0 - 0.3m.
			0.5	0.40	PP = 300 kPa				Brown.			
				0.70	PP = 260 kPa				Orange/brown.	M		
			1.0		PP = 160 kPa PP = 230 kPa							
			1.5	1.40	PP = 160 kPa PP = 200 kPa				Brown.			
	AJB	31/01/2008	2.0	2.00	PP = 80 kPa			SC	Clayey SAND, fine to medium grained, brown, high plasticity fines, trace of fine to medium gravel.			
	H		2.5 – 3.5	2.40				SP	SAND, fine to coarse grained, brown.	W		
				3.70					END OF BOREHOLE @ 3.70 m GROUNDWATER ENCOUNTERED @ 2.3m. REFUSAL ON DENSE SAND AT 3.7m DEPTH.			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH39

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 272884 m E 6159944 m N 54 AMG84	DRILL RIG: ROCKMASTER
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB DATE: 2/4/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: [signature] DATE: 29/5/08

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0	0.10				SC	Clayey SAND, fine to medium grained, dark brown, low plasticity fines.	D		
				0.30				SP	SAND, fine to medium, brown, with clay.			
			0.5	0.80	PP = 140 kPa PP = 250 kPa			CH	Sandy CLAY, high plasticity, orange brown mottled brown, fine to medium grained sand, with fine to medium gravel.	M	St - VSt / Fb	Contains vesicules.
			1.0	1.20	PP = 110 kPa PP = 140 kPa			SC	Clayey SAND, fine to medium grained, orange brown, high plasticity fines, with fine to medium gravel.			
		AJB 2/04/08	1.5 2.0	2.20	PP = 50 kPa PP = 75 kPa PP = <50 kPa PP = <50 kPa				Brown.			
			2.5	3.00					Mottled grey brown, medium to coarse grained sand.	W		
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 2.2m.			

Depth scale: 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH40

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 271742 m E 6159791 m N 54 AMG84	DRILL RIG: ROCKMASTER		
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL		
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB	DATE: 2/4/08	
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 6.00 m	CHECKED:	DATE: 29/5/08	

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0	0.20	BH40/01 (Jar) (0 - 0.2)	SC	Clayey SAND, fine to medium grained, brown, high plasticity fines.	D		Inferred topsoil. Fine roots.
				0.30						
			0.5, 1.0	1.20	PP = >450 kPa; PP = >450 kPa; BH40/02 (Jar) (0.5 - 0.7); PP = >450 kPa; PP = 450 kPa; PP = 450 kPa; PP = 240 kPa	CH	Sandy CLAY, high plasticity, dark brown, medium to coarse grained sand. Brown, trace of fine gravel.	M	VSt - H	Contains vesicules.
				1.30	BH40/03 (Jar) (1.2 - 1.3)	SP	SAND, medium to coarse grained, yellow brown, with clay.	M		
				1.40	BH40/04 (Jar) (1.3 - 1.4)	CH	Sandy CLAY, high plasticity, brown, medium to coarse grained sand.	M	St	
			1.5	1.65	PP = 150 kPa	SP	SAND, medium to coarse grained, red brown.	M		
				1.75						
			2.0, 2.5	3.00	BH40/05 (Jar) (1.4 - 1.6); PP = 75 kPa; BH40/06 (1.8 - 2.0); PP = 180 kPa; PP = 380 kPa; PP = 260 kPa; PP = 380 kPa; PP = 350 kPa	CH	Sandy CLAY, high plasticity, red brown, medium to coarse grained sand, with pale brown fine to medium grained gravel. Mottled brown, orange brown, grey brown.	M	F - VSt	Gravel inferred calcareous.
			3.0, 3.5	3.70	PP = >450 kPa; BH40/07 (Jar) (3.2 - 3.4); PP = 360 kPa; PP = 380 kPa; PP = 400 kPa	CH	CLAY, high plasticity, brown, with sand.	M	VSt - H	
		AJB 2/04/08		4.00	BH40/08 (Jar) (3.7 - 3.8); PP = 200 kPa; PP = 200 kPa	CH	Sandy CLAY, high plasticity, mottled brown grey, medium to coarse grained sand.	M	St	
			4.0, 4.5, 5.0	5.50	BH40/09 (Jar) (4.1 - 4.3); PP = 60 kPa	SC CH	Sandy CLAY, interbedded with Clayey SAND, brown. CLAY is high plasticity, SAND is medium to coarse grained.	W	F	
			5.5	6.00	BH40/10 (Jar) (5.6 - 5.8); PP = >450 kPa; PP = >450 kPa	CH	Sandy CLAY, high plasticity, brown grey mottled, medium to coarse grained sand.	M	H	Mottled with white calcareous gravel at bottom of layer.
			6.0				END OF BOREHOLE @ 6.00 m GROUNDWATER ENCOUNTERED @ 3.9m.			
			6.5							

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REPORT OF BOREHOLE: BH41

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 272447 m E 6160354 m N 54 AMG84	DRILL RIG: ROCKMASTER
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB DATE: 2/4/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: [signature] DATE: 29/5/08

Drilling: METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0	0.20				CH	Sandy CLAY, high plasticity, grey brown, fine to medium grained sand.	D		Inferred topsoil. Fine roots.
				0.45	PP = >450 kPa			CH	Sandy CLAY, high plasticity, dark brown, fine to medium grained sand.	M	H	
			0.5	0.75	PP = 380 kPa PP = 430 kPa PP = 330 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium grained sand.		Fb. VSt	
				0.90	PP = 230 kPa				Orange Brown.			
			1.0 1.5	1.60	PP = 260 kPa PP = 70 kPa PP = 240 kPa			CH	Gravelly Sandy CLAY, high plasticity, brown mottled orange brown, fine to coarse grained sand, fine to medium grained gravel.		F - VSt	Gravel is inferred calcareous.
			2.0 2.5	2.90	PP = 280 kPa PP = 300 kPa PP = 440 kPa PP = 410 kPa PP = 360 kPa PP = 380 kPa PP = 350 kPa PP = 420 kPa PP = 240 kPa			CH	CLAY, high plasticity, brown mottled grey brown, trace of sand.		VSt - H	
			3.0	3.00	PP = 130 kPa			CH	Sandy CLAY, high plasticity, brown mottled grey brown, fine grained sand.		VSt	
									END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH42

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 272127 m E 6161077 m N 54 AMG84	DRILL RIG: ROCKMASTER
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB DATE: 2/4/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: [signature] DATE: 29/5/08

Drilling				Sampling			Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0	0.10				SC	Clayey SAND, fine to medium grained, dark brown, high plasticity fines.	D		Inferred topsoil, contains roots.
				0.30	PP = >450 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium grained sand, with fine to medium calcareous gravel.		H	
			0.5	0.50				SC	Clayey SAND, medium to coarse grained, red brown, high plasticity fines.			
					PP = 250 kPa PP = 50 kPa PP = 100 kPa PP = 125 kPa PP = 110 kPa			CH	Sandy CLAY, high plasticity, brown mottled pale brown, with fine to medium gravel.	M	F-H	
			1.5	1.50	PP = 190 kPa PP = 400 kPa PP = 310 kPa PP = 120 kPa PP = 230 kPa PP = 330 kPa				Brown mottled grey, trace of fine to medium gravel.			
				2.70	PP = 80 kPa PP = >450 kPa				Brown mottled grey and red brown, trace of fine to medium gravel.			
			3.0	3.00	PP = 450 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH43

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 271112 m E 6161329 m N 54 AMG84		DRILL RIG: ROCKMASTER	
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD		DRILLER: GEODRILL	
LOCATION:	BUCKLAND PARK	INCLINATION: -90°		LOGGED: JV / NG	DATE: 18/3/08
JOB NO:	077662060	HOLE DIA: mm	HOLE DEPTH: 6.00 m	CHECKED:	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.30	BH43/01 Jar Sample (0.2-1.0)	CH	Sandy CLAY, high plasticity, grey brown, fine to coarse grained sand.	M (<PL)	Fb	Trace of roots.
			0.5	1.00		CH	Sandy CLAY, high plasticity, brown, fine to coarse grained sand.	M (<PL)	Fb	Calcareous.
			1.0	1.40	BH43/02 Jar Sample (1.0-1.4)	SC	Clayey SAND, fine to coarse grained, red brown, high plasticity fines.	M		
			1.5		BH43/03 Jar Sample (1.5-4.0) PP = 420 kPa; PP = 380 kPa; PP = 150 kPa; PP = 220 kPa	CH	Sandy CLAY, high plasticity, mottled grey brown, fine to coarse grained sand, trace of fine to medium gravel.	M (<PL)	VSt-H	
		JV/NG 18/3/08	5.0	5.80	BH43/04 Jar Sample (5.0-5.8) PP = 100 kPa			M (>PL)	St - VSt	
			5.8	6.00		SC	Clayey SAND, fine to coarse grained, pale brown, high plasticity fines, trace of fine to coarse gravel.	W		
			6.0				END OF BOREHOLE @ 6.00 m GROUNDWATER ENCOUNTERED @ 5.0m.			

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REPORT OF BOREHOLE: BH44

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 27223 m E 6161673 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB	DATE: 2/4/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED:	DATE: 29/5/08

Drilling				Sampling			Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0					CH	Sandy CLAY, high plasticity, dark brown, fine to medium grained sand.	D	H	0 - 0.1m inferred topsoil. Trace of vesicules and fine roots.
			0.5	0.50	PP = >450 kPa				Trace of fine gravel.			
				0.85				SP	SAND, medium to coarse grained, red brown, with clay.	M		
			1.0	1.00				SC	Clayey SAND, medium to coarse grained, orange brown, high plasticity fines, trace of fine to medium calcareous gravel.			
			1.5	1.30	PP = 250 kPa PP = 325 kPa PP = >450 kPa PP = >450 kPa			CH	Sandy CLAY, high palsticity, brown mottled pale brown, grey brown, fine to medium grained sand, with fine to medium calcareous gravel.		VSt - H	
			2.0		PP = >450 kPa							
			2.5		PP = >450 kPa							
			3.0	3.00	PP = 260 kPa				END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF TEST PIT: BH45

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 273368 m E 6161363 m N 54 AMG84		MACHINE: ROCKMASTER	
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD		CONTRACTOR: GEODRILL	
LOCATION:	BUCKLAND PARK	PIT DEPTH: 3.00 m		LOGGED: JV	DATE: 18/4/08
JOB NO:	077662060	BUCKET TYPE:		CHECKED: lyn	DATE: 29/5/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0					SC	Clayey SAND, fine to medium grained, dark brown, low plasticity fines.	M		Inferred topsoil. Trace of fine roots.
				0.30				CH	Sandy CLAY, high plasticity, mottled pale brown / orange brown / red brown, fine sand.		Fb	Calcareous.
				0.90				SC	Clayey SAND, fine grained, mottled pale grey / pale brown / brown, low plasticity fines, trace of gravel.		St	Trace of roots. Lense of gravel @1.0-1.1m.
				1.20	PP = 120 kPa PP = 100 kPa			CH	Sandy CLAY, high plasticity, mottled brown / yellow brown / grey / red brown, fine to coarse sand.		St - VSt	Trace of fine roots. Trace of calcareous gravel 1.6-2.6m.
			3.0	3.00	PP = 350 kPa				TEST PIT DISCONTINUED @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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GAP gINT FN. F01e
RL2

REPORT OF BOREHOLE: BH46

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SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 273348 m E 6162082 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: JV / ND	DATE: 18/4/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: [signature]	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.20	BH46/01 (0.05 - 0.1m) Jar Sample	SC	Clayey SAND, fine to medium grained, dark brown, low plasticity fines.	D		Inferred topsoil. Trace of roots.
			0.90	BH46/02 (0.4 - 0.5m) Jar Sample; BH46 (0.5 - 0.65m) Bulk Sample	SC	Clayey SAND, fine to medium grained, mottled orange brown / pale brown / grey, low plasticity fines.	D		Calcareous.
			1.10	BH46/03 (0.95 - 1.05m) Jar Sample	CH	Sandy CLAY, high plasticity, orange brown / brown, fine sand.	M	Fb	
			1.35		SC	Clayey SAND, fine grained, brown / yellow brown, low plasticity fines, trace of gravel.	M		
			1.80	BH46/04 (1.35 - 1.4m) Jar Sample	CH	Sandy CLAY, high plasticity, mottled orange brown / grey / brown, fine sand, trace of gravel.	M	Fb	Trace of fine roots.
			2.50	BH46/05 (2.05 - 2.1m) Jar Sample	SC	Clayey SAND, fine to medium grained, grey mottled orange brown / brown, high plasticity fines, trace of gravel.	M		
			3.00	BH46/06 (2.85 - 2.9m) Jar Sample	CH	Sandy CLAY, high plasticity, mottled grey / orange brown, fine sand.	M	Fb	Calcareous gravel @ 2.65 - 2.85m.
						END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

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REPORT OF BOREHOLE: BH47

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 272937 m E 6161935 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

SHEET: 1 OF 1
DRILL RIG: ROCKMASTER
DRILLER: GEODRILL
LOGGED: ND DATE: 18/4/08
CHECKED: Ug DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0	0.35	PP = >500 kPa			SC	Clayey SAND, fine to medium, mottled dark grey / orange brown / grey / brown yellow, low plasticity fines, trace of gravel.	D		Trace of fine roots.
			0.5 – 1.5	1.60				CH	Sandy CLAY, high plasticity, mottled pale grey / brown yellow / brown / yellow / red, fine to course sand, trace of gravel.	M	Fb	Calcareous.
				1.90	PP = 300 kPa			CH	Sandy CLAY, high plasticity, mottled grey / brown / yellow / red, fine to coarse grained sand.		VSt	
			2.0	2.10				SC	Clayey SAND, fine to coarse grained, high plasticity fines, trace of gravel.			
			2.5	3.00	PP = 200 kPa PP = 400 kPa			CH	Sandy CLAY, high plasticity, mottled orange brown / grey, fine to coarse grained sand		VSt - H	
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH48

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 274777 m E 6162480 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 3.00 m

DRILL RIG: ROCKMASTER (UNIT 2)
DRILLER: GEODRILL
LOGGED: ND DATE: 18/4/08
CHECKED: [signature] DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0	0.25	BH 48/01 (0.1 - 0.2m) Jar Sample	CH	Sandy CLAY, high plasticity, mottled dark brown / orange brown, trace of gravel.	M		Inferred topsoil, trace of roots. Calcareous.
			0.5	1.00	BH48/02 (0.8 - 0.95m) Jar Sample	SC	Clayey SAND, fine to medium, orange brown, low plasticity fines, trace of gravel.	D		Fine roots. Calcareous.
			1.0	1.30		CL	Sandy CLAY, low plasticity, mottled brown / orange brown, fine to medium sand.	M		Calcareous nodules.
			1.5	1.55	BH48/03 (1.4m - 1.5m) Jar Sample	SC	Clayey SAND, fine grained, orange brown, low plasticity fines.	M		
						GP	GRAVEL, fine to coarse grained, grey / pale brown.	D		
			2.0	2.10		CH	Sandy CLAY, high plasticity, mottled yellow / red / brown, fine to coarse grained sand.	M	VSt	Calcareous.
				2.30	PP = 220 kPa		Orange clayey sand (fine grained)	M	VSt	
			2.5	3.00	BH48 (2.5 - 2.6m) Jar Sample PP = 100 kPa PP = 320 kPa	CH	Sandy CLAY, high plasticity, mottled pale grey / orange brown, fine to coarse grained sand, trace of gravel.	M	St - VSt	Calcareous.
			3.0				END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5							
			4.0							
			4.5							
			5.0							
			5.5							
			6.0							
			6.5							

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REPORT OF BOREHOLE: BH49

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SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 274507 m E 6162063 m N 54 AMG84		DRILL RIG: ROCKMASTER (UNIT 2)	
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD		DRILLER: GEODRILL	
LOCATION:	BUCKLAND PARK	INCLINATION: -90°		LOGGED: ND	DATE: 18/4/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 6.00 m		CHECKED: [signature]	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0	0.40				SC	Clayey SAND, fine to coarse grained, dark brown, low plasticity fines, trace of fine to course gravel.	D		Inferred topsoil. Trace of fine to medium roots.
			0.5	0.80				CL	Sandy CLAY, low plasticity, mottled orange brown / brown, fine to coarse grained sand, trace of fine to coarse gravel.	M (<PL)	Fb	Trace of fine to medium roots. Increasing sand content.
			1.0 / 1.5	1.80	PP = 150 kPa			SC	Clayey SAND, fine to coarse grained, mottled brown / yellow brown / orange brown / red brown, low plasticity fines, trace of fine to coarse gravel.	M		Calcareous nodules and gravel. Trace of fine roots.
	JV	18/4/08	2.0	2.30				SC	Clayey SAND, fine to coarse grained, mottled brown / pale brown, low plasticity fines, trace of fine to coarse gravel.	W		Trace of roots.
			2.5 / 3.0	3.10				SP	Gravelly SAND, fine to coarse grained, pale brown / orange brown / brown, fine to coarse gravel.	W		Calcareous.
			3.5 / 4.0 / 4.5 / 5.0 / 5.5	5.80	PP = 50 kPa PP = 200 kPa			SC	Clayey SAND, fine to coarse, mottled grey / orange brown / yellow / red, high plasticity fines.	W		
				6.00					Pale grey calcareous material.			
			6.0 / 6.5						END OF BOREHOLE @ 6.00 m GROUNDWATER ENCOUNTERED @ 2.1m			

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REPORT OF BOREHOLE: BH50

CLIENT: WALKER CORPORATION	COORDS: 274243 m E 6162535 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER (UNIT 2)	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: GEODRILL	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: ND	DATE: 18/4/08
		CHECKED: [illegible]	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0	0.30				SC	Clayey SAND, fine to medium, mottled orange brown / pale grey, low plasticity fines, trace of gravel.	D		Inferred topsoil 0 - 0.2m. Fine roots. Calcareous.
			0.5	0.80				CH	Sandy CLAY, high plasticity, mottled pale grey / orange brown, fine to coarse grained sand.		Fb	Calcareous trace of fine roots.
			1.0	1.20				SC	Clayey SAND, fine to medium, mottled pale brown / orange brown, high plasticity fines, trace of gravel.			Calcareous.
			1.5	1.60				SC	Clayey SAND, fine to medium, mottled brown / orange brown, high plasticity fines.	M		
				1.80					Calcareous pale brown / pale grey nodules.			
				2.00								
			2.0 / 2.5	3.00	PP = 350 kPa			CH	Sandy CLAY, high plasticity, mottled pale grey / pale brown / orange brown, fine to coarse grained sand.		VSt	Calcareous.
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

3.5
4.0
4.5
5.0
5.5
6.0
6.5

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REPORT OF BOREHOLE: BH51

CLIENT: WALKER CORPORATION	COORDS: 274432 m E 6162925 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: GEODRILL	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: AJB	DATE: 2/4/08
		CHECKED: ajn	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L-M		0.0	0.15	PP = >450 kPa PP = >450 kPa PP = >450 kPa PP = >450 kPa PP = >450 kPa PP = >450 kPa			CH	Sandy CLAY, high plasticity, dark brown, fine to medium sand, with fine to medium grained calcareous gravel. Red brown.	D	H	Inferred topsoil 0-0.15m depth, contains fine roots. Contains vesicules.
			1.0	1.00				SP	SAND, fine to medium grained, brown, with clay.	D		
				1.20				SC	Clayey SAND, fine to medium grained, orange brown with black specks, high plasticity fines, with fine to medium grained calcareous gravel.	M		
				1.80	PP = 370 kPa			CH	Sandy CLAY, high plasticity, dark brown, fine to medium sand, fine to medium grained calcareous gravel.	M	VSt	
			2.0	1.90				SC	Clayey SAND, fine to medium grained, mottled grey and brown, high plasticity fines, trace of fine to medium calcareous gravel.	M		
				2.10				SC	Brown.	M		
			2.5	2.40	PP = >450 kPa PP = 450 kPa PP = 400 kPa PP = 400 kPa			CH	Sandy CLAY, high plasticity, brown / grey brown mottled, fine to medium grained sand, with fine to medium grained calcareous gravel.	M	H	
			3.0	3.00					END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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RL2

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REPORT OF BOREHOLE: BH52

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 270725 m E 6160368 m N 54 AMG84	DRILL RIG: ROCKMASTER
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB DATE: 2/4/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 5.50 m	CHECKED: [signature] DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L		0.0	0.20	BH52/01 (0-0.2m) Jar Sample	SP	SAND, fine to medium grained, brown, trace of clay.	D		
			0.5	0.65	BH52/02 (0.3-0.5m) Jar Sample	SP	SAND, medium to coarse grained, brown.			
			1.0	1.05	BH52/03 (0.8-0.9m) Jar Sample	SP	SAND, medium to coarse grained, orange brown, with clay, trace of fine gravel.	M		
		AJB 2/04/08		1.20	BH52/04 (1.05-1.2m) Jar Sample	SC CH SP	Sandy CLAY interbedded with Clayey SAND, brown. SAND is medium to coarse grained, CLAY is high plasticity.			
			1.5	2.00	BH52/05 (1.3-1.5m) Jar Sample		SAND, medium to coarse grained, brown, with clay.	W		
	M		2.0	2.20	PP = 100 kPa PP = 140 kPa	CH	Gravelly Sandy CLAY, high plasticity, brown, medium to coarse sand, fine to medium gravel.	M	F - VSt	
			2.5 – 3.0	3.30	PP = 140 kPa BH52/06 (2.4-2.6m) Jar Sample PP = 130 kPa PP = 250 kPa PP = 320 kPa PP = 310 kPa PP = 80 kPa PP = 140 kPa PP = 170 kPa		Mottled brown, yellow brown, grey brown.			
			3.5 – 4.0	4.10	PP = 180 kPa PP = 290 kPa BH52/07 (3.6-3.8m) Jar Sample PP = 450 kPa PP = 380 kPa PP = 450 kPa	CH	CLAY, high plasticity, grey brown mottled, with sand, trace of fine gravel throughout layer.		VSt-H	
	M-H		4.5	4.70	PP = >450 kPa PP = >450 kPa PP = >450 kPa BH52/08 (4.2-4.4m) Jar Sample	CH	Sandy CLAY, high plasticity, mottled grey and brown, fine to medium sand.		VSt - H	
			5.0	5.50	PP = 280 kPa PP = 100 kPa PP = 300 kPa BH52/09 (4.8-5m) Jar Sample PP = 260 kPa PP = 250 kPa PP = 330 kPa PP = >450 kPa		Brown mottled red brown, pale brown, pale grey. Trace of fine to medium gravel.		St - H	
			5.5 – 6.5		PP = >450 kPa		END OF BOREHOLE @ 5.50 m GROUNDWATER ENCOUNTERED @ 1.2m. REFUSAL WITH PUSHTUBE AT 5.5m.			

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REPORT OF BOREHOLE: BH53

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 273890 m E 6163122 m N 54 AMG84	DRILL RIG: ROCKMASTER
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL
LOCATION:	BUCKLAND PARK	INCLINATION: -90°	LOGGED: AJB DATE: 2/4/08
JOB NO:	077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	CHECKED: [signature] DATE: 29/5/08

Drilling: METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	L		0.0	0.30	PP = >450 kPa			CL	Sandy CLAY, low plasticity, dark brown, fine to medium grained sand.	D	H	
								GP	GRAVEL, fine to medium grained, pale brown.			Subangular gravel.
			0.5 – 1.0	1.40				SC	Clayey SAND, fine to medium grained, brown mottled pale brown, high plasticity fines, fine to medium grained calcareous gravel throughout layer.	M		
			1.5	1.60	PP = 140 kPa			SC CH	Sandy CLAY / Clayey SAND, fine to medium grained sand, high plasticity clay, brown, with fine to coarse gravel.		St	Subrounded gravel 50mm in size at top of layer.
		AJB 2/04/08 (water level)	2.0 – 2.5	2.65				SP	SAND, medium to coarse grained, brown, with clay.	W		
			3.0	3.00	PP = 125 kPa PP = 190 kPa PP = 280 kPa PP = 320 kPa			CH	Sandy CLAY, high plasticity, mottled grey and brown, fine to medium grained sand.		St - VSt	
									END OF BOREHOLE @ 3.00 m GROUNDWATER ENCOUNTERED @ 2.2m.			

Depth scale (metres): 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF BOREHOLE: BH54

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 273203 m E 6162909 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 6.00 m

DRILL RIG: ROCKMASTER
DRILLER: GEODRILL
LOGGED: JV / NG DATE: 18/3/08
CHECKED: DATE:

Drilling: METHOD	Drilling: PENETRATION RESISTANCE	Drilling: WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0 – 0.60	0.60			SC	Clayey SAND, fine to coarse grained, grey brown, low plasticity fines.	D		
			0.60 – 1.40	1.40			SC	Clayey SAND, fine to coarse grained, orange brown, high plasticity fines.	D		Contains calcareous gravel.
			1.40 – 2.80	2.80	PP = 280 kPa		CH	Sandy CLAY, high plasticity, orange brown, fine to coarse sand.	M (cPL)	VSt	
			2.80 – 4.30	4.30	PP = 340 kPa BH55/06 Jar Sample (3.0-6.0)		CH	CLAY, high plasticity, mottled grey brown, with fine to coarse sand.	M (cPL)	VSt	
		JV / NG 18/03/2008 (water level 4.5)	4.30 – 5.00	5.00			SP	SAND, fine to coarse grained, orange brown, with fine to coarse gravel.	W		
			5.00 – 6.00	6.00	PP = 280 kPa		CH	Sandy CLAY, high plasticity, mottled orange brown and grey, fine to coarse sand.	M (>PL)	VSt	

END OF BOREHOLE @ 6.00 m
GROUNDWATER ENCOUNTERED @ 4.5m

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REPORT OF BOREHOLE: BH55

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 272030 m E 6163006 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: JV / NG	DATE: 18/3/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 6.00 m	CHECKED:	DATE:

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT			0.0	0.40	BH55/01 Jar Sample (0.0-0.4)			CL	Sandy CLAY, low plasticity, grey brown, fine to coarse sand.	M (<PL)	Fb	Topsoil. Trace of root material.
			0.5, 1.0	1.20	BH55/02 Jar Sample (0.4-1.2)			CL	Sandy CLAY, low plasticity, dark brown, fine to coarse sand.	M (<PL)	Fb	
			1.5, 2.0	2.10	BH55/03 Jar Sample (1.2-2.1)			SC	Clayey SAND, fine to coarse, brown, low plasticity, fines,	D		
			2.5	2.75	BH55/04 Jar Sample (2.1-2.75)			SP	SAND, fine to coarse grained, pale brown, trace of low plasticity fines.	D		
			3.0, 3.5	3.60	BH55/05 Jar Sample (2.75-3.6)			SC	Clayey SAND, fine to coarse grained, pale brown, low plasticity fines.	M		
			4.0, 4.5, 5.0, 5.5, 6.0	6.00	BH55/06 Jar Sample (3.6-6.0) PP = 340 kPa; PP = 320 kPa; PP = 200 kPa; PP = 100 kPa			CH	Sandy CLAY, high plasticity, mottled grey brown, fine to coarse sand.	M (<PL); M (>PL)	VSt; St	
			6.5						END OF BOREHOLE @ 6.00 m GROUNDWATER NOT ENCOUNTERED			

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REPORT OF BOREHOLE: BH56

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CLIENT: WALKER CORPORATION	COORDS: 271174 m E 6162611 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILL RIG: ROCKMASTER	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	DRILLER: GEODRILL	
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 3.00 m	LOGGED: JV / NG	DATE: 18/3/08
		CHECKED: [signature]	DATE: 29/5/08

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.30				SC	Clayey SAND, fine to coarse grained, grey brown, low plasticity fines.	D		Inferred topsoil.
			0.5	0.95	PP = 500 kPa			CH	Sandy CLAY, high plasticity, orange brown, fine to coarse sand, trace of fine to coarse gravel.	M (<PL)	H	Calcareous nodules.
			1.0	1.25				SC	Clayey SAND, fine to coarse grained, orange brown, low plasticity fines.	D		
				1.50				SP	SAND, fine to coarse grained, pale brown, trace of low plasticity fines.	D		
			1.5	1.80	PP = 320 kPa			CH	Sandy CLAY, high plasticity, red brown, trace of fine to coarse gravel.	M (cPL)	VSt	
			2.0	2.10				SC	Clayey SAND, fine to coarse, orange brown, low plasticity fines.	D		
			2.5	3.00	PP = 200 kPa			CH	Sandy CLAY, high plasticity, grey brown, fine to coarse sand.	M (cPL)	VSt	
			3.0						END OF BOREHOLE @ 3.00 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF BOREHOLE: BH57

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 270108 m E 6162235 m N 54 AMG84
SURFACE RL: m DATUM: AHD
INCLINATION: -90°
HOLE DIA: mm HOLE DEPTH: 6.00 m

DRILL RIG: ROCKMASTER
DRILLER: GEODRILL
LOGGED: JV / NG DATE: 18/3/08
CHECKED: [signature] DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0	0.20			CH	Sandy CLAY, high plasticity, grey brown, fine to coarse sand.	M (<<PL)	Fb	Trace of fine to medium roots.
				0.70			CL	Sandy CLAY, low plasticity, grey brown, fine to coarse sand.	M (<PL)	Fb	
				1.30			SC	Clayey SAND, fine to coarse grained, pale brown, low plasticity fines.	D		
				1.60	PP = 160 kPa		CH	Sandy CLAY, high plasticity, grey brown, fine to coarse sand.	M (<PL)	St	
				2.20	PP = 390 kPa		CH	Sandy CLAY, high plasticity, red brown, fine to coarse sand.	M (<PL)	VSt - H	
				4.70	PP = 400 kPa PP = 340 kPa		CH	Sandy CLAY, high plasticity, mottled grey brown, fine to coarse sand.	M (<PL)		
				5.00			SC	Clayey SAND, fine to coarse, mottled grey brown, high plasticity fines.	M		
		JV / NH 18/03/2008	5.5	5.90			CH	Sandy CLAY, high plasticity, mottled, grey brown, fine to coarse sand.	M (>PL)		
			6.0	6.00			SP	SAND, fine to coarse grained, brown.	W		
			6.5					END OF BOREHOLE @ 6.00 m GROUNDWATER ENCOUNTERED @ 5.5m.			

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REPORT OF BOREHOLE: BH58

SHEET: 1 OF 1

CLIENT:	WALKER CORPORATION	COORDS: 270332 m E 6163164 m N 54 AMG84		DRILL RIG: ROCKMASTER	
PROJECT:	SUBDIVISION	SURFACE RL: m DATUM: AHD		DRILLER: GEODRILL	
LOCATION:	BUCKLAND PARK	INCLINATION: -90°		LOGGED: JV / NG	DATE: 18/3/08
JOB NO:	077662060	HOLE DIA: mm	HOLE DEPTH: 6.00 m	CHECKED: [signature]	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					CL	Sandy CLAY, low plasticity, pale brown, fine to medium sand.	M (<PL)		Trace of root material.
				0.90	PP = 450 kPa			CH	Sandy CLAY, high plasticity, grey brown, fine to coarse sand.	M (cPL)	H	
				1.40				SC	Clayey SAND, fine to coarse grained, orange brown, low plasticity fines.	D		
				1.90	PP = 350 kPa			CH	Sandy CLAY, high plasticity, orange brown, fine to coarse sand, trace of fine to coarse gravel.	M (cPL)	VSt	
				2.50				SC	Clayey SAND, fine to coarse, mottled orange brown / grey brown, high plasticity fines.	M		
				4.60				SP	SAND, fine to coarse grained, pale brown, trace of fine to coarse gravel.	M		
			6.0	6.00					END OF BOREHOLE @ 6.00 m GROUNDWATER NOT ENCOUNTERED			
			6.5									

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REPORT OF BOREHOLE: BH59

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 271665 m E 6163644 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: JV / NG	DATE: 18/3/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 5.20 m	CHECKED: [signature]	DATE: 29/5/08

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT	M		0.0					CL	Sandy CLAY, low plasticity, grey brown, fine to coarse sand.	M (<PL)	Fb	
			1.20	1.20	PP = >500 kPa (2.5 m); PP = 440 kPa (2.9 m)			CH	CLAY, high plasticity, grey, with fine to medium sand, trace of fine to medium gravel.	M (<PL)	H	
			2.90	2.90	PP = 400 kPa (3.6 m); PP = 300 kPa (5.2 m)			CH	Sandy CLAY, high plasticity, mottled grey brown, fine to coarse sand, trace of calcareous gravel.	M (<PL) to 4.5 m; M (<PL) below	VSt-H	Calcareous Cementation (3.5 m)
			5.20	5.20					END OF BOREHOLE @ 5.20 m GROUNDWATER NOT ENCOUNTERED PUSH TUBE REFUSAL @ 5.2m.			

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REPORT OF BOREHOLE: BH60

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 272802 m E 6164329 m N 54 AMG84	DRILL RIG: ROCKMASTER	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	DRILLER: GEODRILL	
LOCATION: BUCKLAND PARK	INCLINATION: -90°	LOGGED: JV / NG	DATE: 18/3/08
JOB NO: 077662060	HOLE DIA: mm HOLE DEPTH: 6.00 m	CHECKED: Ao	DATE: 29/5/08

METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY / DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
PT			0.0		BH60/01 Jar Sample (0.0-1.6)			CH	Sandy CLAY, high plasticity, grey brown, fine to coarse sand.	M (<PL)	Fb	Inferred topsoil, from 0 - 0.2 m.
			1.6	1.60	BH60/02 Jar Sample (1.6-2.4) PP = >500 kPa			CH	Sandy CLAY, high plasticity, orange brown, fine to coarse sand.	M (<PL)	H	
			2.4	2.40	BH60/03 Jar Sample (2.4-3.3)			SC	Clayey SAND, fine to coarse grained, orange brown, high plasticity fines.	M		
			3.3	3.30	BH60/04 Jar Sample (3.3-3.45)			SP	SAND, fine to coarse grained, orange brown, with low plasticity fines.	M		
			3.45	3.45	PP = 100 kPa			CH	Sandy CLAY, high plasticity, mottled red brown and brown, fine to coarse sand.	M (<PL)	F	Calcareous Mottling from 4 - 4.5m.
		JV / NG 18/03/2008	5.0	5.00	PP = 40 kPa			SC	Clayey SAND, fine to coarse grained, mottled grey and orange brown, high plasticity fines.	M / W	S	
			5.5	5.50				SP	SAND, fine to coarse, orange brown, with fine to coarse gravel.			
			6.0	6.00					END OF BOREHOLE @ 6.00 m GROUNDWATER ENCOUNTERED @ 5.1m.			

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REPORT OF TEST PIT: TP01

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 273369 m E 6162547 m N 54 AMG84	MACHINE: CASE 580L BACKHOE	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	CONTRACTOR: ER SILVA	
LOCATION: BUCKLAND PARK	PIT DEPTH: 2.80 m	LOGGED: AJB	DATE: 13/2/08
JOB NO: 077662060	BUCKET TYPE: 600 mm	CHECKED: [signature]	DATE: 29/5/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	M		0.0 – 0.20	0.20			SP	SAND, fine to medium grained, dark brown, with clay.	D		Inferred topsoil.
			0.20 – 0.75	0.75	TP01/01 (0.4 - 0.5) Bulk and Jar Sample		CI	Sandy CLAY, medium plasticity, dark brown, fine to coarse sand, trace of fine to medium gravel.	D		Calcareous inclusions.
			0.75 – 2.20	2.20			SP	SAND, medium to coarse grained, orange brown, with plastic fines.	M		
			2.20 – 2.80	2.80	PP = 330 kPa PP = 130 kPa PP = 360 kPa TP01/02 (2.7 - 2.8) Jar Sample		CH	Sandy CLAY, high plasticity, orange brown mottled grey, medium to coarse sand.	M	St - VSt	
								TEST PIT DISCONTINUED @ 2.80 m GROUNDWATER NOT ENCOUNTERED			

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REPORT OF TEST PIT: TP02

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 272997 m E 6163596 m N 54 AMG84	MACHINE: CASE 580L BACKHOE	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	CONTRACTOR: ER SILVA	
LOCATION: BUCKLAND PARK	PIT DEPTH: 2.60 m	LOGGED: AJB	DATE: 13/2/08
JOB NO: 077662060	BUCKET TYPE: 600 mm	CHECKED: [signature]	DATE: 29/5/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	H		0.0	0.20				CH	Sandy CLAY, high plasticity, dark brown, fine to medium sand.	D	VSt - H	Inferred topsoil.
	M		0.5	0.60	TP02 (0.2 - 0.4) Bulk Sample PP = >450 kPa			CH	Sandy CLAY, high plasticity, brown, fine to medium sand.	D	VSt - H	Calcareous inclusions.
	L		1.0	1.50	TP02 (0.4 - 0.6) Bulk Sample PP = 380 kPa PP = >450 kPa; TP02/01 (1.0 - 1.1) Jar Sample PP = 280 kPa PP = 250 kPa			CH	Sandy CLAY, high plasticity, orange brown, fine to medium sand.	M	VSt - H	
	L		1.5 / 2.0 / 2.5	2.60	TP02/02 (2.5 - 2.6) Jar Sample			SC	Clayey SAND, medium to coarse grained, orange/brown with grey mottling, high plasticity fines.	M		
			3.0 – 6.5						TEST PIT DISCONTINUED @ 2.60 m GROUNDWATER NOT ENCOUNTERED			

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REPORT OF TEST PIT: TP03

CLIENT: WALKER CORPORATION	COORDS: 272162 m E 6162353 m N 54 AMG84	MACHINE: CASE 580L BACKHOE	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	CONTRACTOR: ER SILVA	
LOCATION: BUCKLAND PARK	PIT DEPTH: 3.00 m	LOGGED: AJB	DATE: 13/2/08
JOB NO: 077662060	BUCKET TYPE: 600 mm	CHECKED: Wyn	DATE: 29/5/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	H		0.0	0.25				CH	Sandy CLAY, high plasticity, dark brown / dark grey, fine to coarse grained sand.	D		Inferred topsoil.
	M			0.50	TP03/01 (0.25 - 0.5) Bulk and Jar Sample PP = 160 kPa PP = 330 kPa PP = 440 kPa			CH	Sandy CLAY, high plasticity, dark brown, medium to coarse sand.	M	VSt - H / Fb	
	L		0.5	1.00				CH	Sandy CLAY, high plasticity, brown, medium to coarse sand.			Calcareous inclusions.
			1.0	3.00	TP03/02 (0.5 - 1) Bulk and Jar Sample PP = 180 kPa PP = 375 kPa PP = 350 kPa PP = 330 kPa PP = 170 kPa PP = 130 kPa PP = 230 kPa				Orange / brown mottled red / brown.		St - Vst / Fb	
			3.0						TEST PIT DISCONTINUED @ 3.00 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF TEST PIT: TP04

CLIENT: WALKER CORPORATION	COORDS: 271291 m E 6161998 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	MACHINE: CASE 580L BACKHOE	
LOCATION: BUCKLAND PARK	PIT DEPTH: 3.15 m	CONTRACTOR: ER SILVA	
JOB NO: 077662060	BUCKET TYPE: 600 mm	LOGGED: AJB	DATE: 13/2/08
		CHECKED:	DATE: 29/5/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	M		0.0	0.20	PP = >450 kPa	CH	Sandy CLAY, high plasticity, dark grey / dark brown, fine sand.	D	H	Inferred topsoil.
	H		0.5	0.55	TP04/01 (0.2 - 0.4) Bulk and Jar Samples	CL	Sandy CLAY, low plasticity, dark brown, fine to coarse sand.			
				0.75	TP04 (0.55 - 0.75) Bulk Sample; PP = >450 kPa	CH	Sandy CLAY, high plasticity, brown, fine to medium sand.		H / Fb	Calcareous inclusions.
			1.0	1.00	TP04/02 (0.75 - 1.0) Jar Sample; PP = >450 kPa	CH	SOIL (50%) interbedded with INFERRED CALCRETE (50%). SOIL is: Sandy CLAY, high plasticity, brown, fine to medium sand. INFERRED CALCRETE is: Gravel and cobbles, pale brown.			
	M			1.30	PP = 180 kPa	CH	Sandy CLAY, high plasticity, brown, fine to medium sand.		VSt - H / Fb	Calcareous inclusions.
			1.5			SP	SAND, medium to coarse grained, red / brown.			
	L		2.0	2.00	PP = 80 kPa; PP = 75 kPa; PP = 250 kPa; PP = 120 kPa	CH SC	Clayey SAND/Sandy CLAY, high plasticity fines, fine to medium grained sand, brown mottled red/brown and grey.	M	F - St	
	AJB 13/02/2008	▽	3.0	3.15				W		
			3.5 – 6.5				TEST PIT DISCONTINUED @ 3.15 m GROUNDWATER ENCOUNTERED @ 3.0m			

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GAP gINT FN. F01e RL2

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REPORT OF TEST PIT: TP05

CLIENT: WALKER CORPORATION	COORDS: 270725 m E 6162366 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	MACHINE: CASE 580L BACKHOE	
LOCATION: BUCKLAND PARK	PIT DEPTH: 3.05 m	CONTRACTOR: ER SILVA	
JOB NO: 077662060	BUCKET TYPE: 600 mm	LOGGED: AJB	DATE: 13/2/08
		CHECKED: [illegible]	DATE: 29/5/08

Excavation: METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	Field Material Description: SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	L		0.0					SP	SAND, fine to medium grained, dark brown, with clay.	D		Inferred topsoil, 0.0 - 0.15m.
			0.5	0.40	TP05/01 (0.4 - 0.6) Bulk and Jar Samples			CL	Sandy CLAY, low plasticity, dark brown, fine to medium sand.			
			1.0	0.80				SP	SAND, fine to medium grained, dark grey / dark brown, with clay.			
				1.20				SC	Clayey SAND, medium to coarse grained, red / brown, high plasticity fines.			
	L		1.5	1.50				CH SC	CALCRETE ROCK, strength material, pale brown calcareous. Sandy CLAY/Clayey SAND, high plasticity fines, medium to coarse grained sand, orange / red / brown mottled.	M	S	
			2.0		PP = <50 kPa							
			2.5	2.40				SP	SAND, medium to coarse grained, yellow / brown, mottled grey, with clay.			
			3.0	3.05	TP05/02 (2.8 - 3.0) Jar Sample							
									TEST PIT DISCONTINUED @ 3.05 m GROUNDWATER NOT ENCOUNTERED			
			3.5									
			4.0									
			4.5									
			5.0									
			5.5									
			6.0									
			6.5									

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REPORT OF TEST PIT: TP06

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 271618 m E 6162931 m N 54 AMG84
SURFACE RL: m DATUM: AHD
PIT DEPTH: 3.30 m
BUCKET TYPE: 600 mm

SHEET: 1 OF 1
MACHINE: CASE 580L BACKHOE
CONTRACTOR: ER SILVA
LOGGED: AJB DATE: 13/2/08
CHECKED: [signature] DATE: 29/5/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	M		0.00–0.20	PP = >450 kPa	CH	Sandy CLAY, high plasticity, dark grey / dark brown, fine to medium sand.	D	H / Fb	Inferred topsoil.
			0.20–0.65	TP06/01 (0.2 - 0.4) Bulk and Jar Samples; PP = >450 kPa	CH	Sandy CLAY, high plasticity, dark grey / dark brown, medium to coarse sand.	D	H / Fb	
			0.65–1.00	PP = >450 kPa; PP = 400 kPa; PP = >450 kPa; PP = >450 kPa	CH	Sandy CLAY, high plasticity, dark grey / dark brown, medium to coarse grained sand.	D	H / Fb	
			1.00–2.30	PP = >450 kPa	CH	Sandy CLAY, high plasticity, brown, medium to coarse grained sand.	M	H / Fb	
			2.30–2.80	TP06/02 (2.6 - 2.8) Jar Sample	SP	SAND, medium to coarse grained, orange / brown, with clay.	M		
			2.80–3.00		SC	Clayey SAND, medium to coarse grained, orange / red / brown mottled, high plasticity fines.	M		Calcareous inclusions.
			3.00–3.30		SC	Clayey SAND, fine to medium grained, yellow / brown, mottled grey, low plasticity fines, trace of cobbles.	M		Weakly to strongly cemented gravel inclusions.
			3.30			TEST PIT DISCONTINUED @ 3.30 m GROUNDWATER NOT ENCOUNTERED			

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REPORT OF TEST PIT: TP07

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 272287 m E 6163260 m N 54 AMG84	MACHINE: CASE 580L BACKHOE	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	CONTRACTOR: ER SILVA	
LOCATION: BUCKLAND PARK	PIT DEPTH: 2.80 m	LOGGED: AJB	DATE: 13/2/08
JOB NO: 077662060	BUCKET TYPE: 600 mm	CHECKED: [signature]	DATE: 29/5/08

Excavation: METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	Sampling: SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH			0.0	0.20				CH	Sandy CLAY, high plasticity, dark brown / dark grey, fine to medium grained.	D		Inferred topsoil.
			0.5 / 1.0	1.05	TP07 (0.2 - 0.4) Bulk Sample PP = >450 kPa PP = >450 kPa PP = 450 kPa PP = 450 kPa			CI	CLAY, medium plasticity, brown, trace of fine to coarse sand, trace of fine calcareous brown gravel.		H / Fb	
				1.25				SP	SAND, medium to coarse grained, orange / brown.			
			1.5	1.80				SC	Clayey SAND, medium to coarse grained, brown, high plasticity fines.			
			2.0	2.30				SP	SAND, medium to coarse grained, red / brown.			
			2.5	2.80				SP	SAND, medium to coarse grained, orange / brown, with fine to coarsse cemented gravel, trace of clay.			Weakly cemented.
			3.0 – 6.5						TEST PIT DISCONTINUED @ 2.80 m GROUNDWATER NOT ENCOUNTERED			

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REPORT OF TEST PIT: TP08

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 271074 m E 6160805 m N 54 AMG84	MACHINE: BACKHOE	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	CONTRACTOR: ER SILVA	
LOCATION: BUCKLAND PARK	PIT DEPTH: 2.90 m	LOGGED: SY / JV	DATE: 29/2/08
JOB NO: 077662060	BUCKET TYPE: 600 mm with soil teeth	CHECKED: Vy	DATE: 29/5/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	M		0.0			CH	Sandy CLAY, high plasticity, brown, fine to coarse grained sand.	D	Fb	Topsoil, roots <2mm diameter.
				0.40		SP	SAND, fine to coarse grained, orange brown, with clay.			Micaceous. Trace of calcareous nodules.
				1.05	TP08/01 Large Bulk Sample (1.0 - 1.2)	SP	SAND, fine to coarse grained, pale yellow brown, trace of clayey fines.			Fine roots.
				1.95	TP08/02 Small Bulk Sample (1.95 - 2.15) PP = 110 kPa	CH	CLAY, high plasticity, red brown, with fine to coarse grained sand.	D-M	St / Fb	
				2.70	TP08/03 Small Bulk Sample (2.7 - 2.8) PP = 200 - 400 kPa	CL	Sandy CLAY, low plasticity, grey, mottled grey brown and red brown, fine to coarse sand.	M	VSt-H	Calcareous material and nodules. Micaceous.
				2.90			TEST PIT DISCONTINUED @ 2.90 m GROUNDWATER NOT ENCOUNTERED			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF TEST PIT: TP09

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 271596 m E 6161163 m N 54 AMG84	MACHINE: BACKHOE	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	CONTRACTOR: ER SILVA	
LOCATION: BUCKLAND PARK	PIT DEPTH: 3.40 m	LOGGED: SY / JV	DATE: 29/2/08
JOB NO: 077662060	BUCKET TYPE: 600 mm with soil teeth	CHECKED: [signature]	DATE: 29/5/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	M		0.0 – 0.30		SC	Clayey SAND, fine to coarse grained, grey brown, low plasticity fines.	D-M		Topsoil, roots and bulbs.
			0.30 – 0.75		CH	Sandy CLAY, high plasticity, mottled red brown / brown / yellow, brown, fine to coarse grained sand.	D-M	Fb	Calcareous nodules. Moisture increasing with depth.
			0.75 – 1.05	PP = 300 kPa	CH	CLAY, high plasticity, brown, with fine to coarse grained sand.	M	VSt -H	
			1.05 – 1.30	PP = >500 kPa PP = 350 kPa TP09/01 Large Bulk Sample (1.1 - 1.2)	CH	Sandy CLAY, high plasticity, red brown, mottled with grey brown, dark brown, fine to coarse grained sand.	M	VSt	Interbeded sandy lenses.
			1.30 – 2.50	PP = <100 kPa TP09/02 Small Bulk Sample (1.9 - 2.0)	CL	Sandy CLAY, low plasticity, yellow brown, fine to coarse grained sand, trace of fine to coarse gravel.	M (>PL)	Fb/F	Calcareous. Pockets of cemented sand.
			2.50 – 3.10	PP = 100 - 200 kPa TP09/03 Jar Sample (2.7 - 2.8)	CL	Sandy CLAY, low plasticity, pale grey brown / yellow brown.	M (>PL)	Fb	
		SY / JV 29/2/08	3.10 – 3.40			Mottled grey brown / yellow brown.	W		
			3.40			TEST PIT DISCONTINUED @ 3.40 m GROUNDWATER ENCOUNTERED @ 3.1 m			

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REPORT OF TEST PIT: TP10

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 272713 m E 6160931 m N 54 AMG84	MACHINE: BACKHOE	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	CONTRACTOR: ER SILVA	
LOCATION: BUCKLAND PARK	PIT DEPTH: 3.10 m	LOGGED: SY / JV	DATE: 29/2/08
JOB NO: 077662060	BUCKET TYPE: 600 mm with soil teeth	CHECKED: [signature]	DATE: 29/1/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	M		0.0	0.25				CL	Sandy CLAY, low plasticity, brown / white, fine to coarse grained sand, with fine gravel.	D		Inferred topsoil. Calcrete cobbles at surface.
			0.5		PP = >500 kPa TP10/01 (0.3 - 0.5m) Large Bulk Sample			CI	CLAY, medium plasticity, pale orange brown / grey, with fine to coarse sand, trace of fine to coarse gravel.	M	H	Calcareous.
			1.0	1.20	TP10/02 (1.1 - 1.3m) Small Bulk Sample				Orange brown mottling.			
				1.40								
			1.5	1.50	TP10/03 (1.4 - 1.5m) Jar Sample			SP	SAND, fine to coarse grained, mottled orange brown / grey / dark brown, trace of clay.	M-W		Contains gravel sized cemented sand.
		SY 29/2/08 ▽	2.0		PP = 250 kPa			CL	Sandy CLAY, low plasticity, mottled dark brown / orange brown / grey, fine to coarse grained sand.	M	H	
			2.5		PP = 300 kPa							
			3.0	3.10					TEST PIT DISCONTINUED @ 3.10 m GROUNDWATER ENCOUNTERED @ 2.0m.			
			3.5 – 6.5									

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REPORT OF TEST PIT: TP11

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION	COORDS: 271481 m E 6160352 m N 54 AMG84	MACHINE: BACKHOE	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	CONTRACTOR: ER SILVA	
LOCATION: BUCKLAND PARK	PIT DEPTH: 3.10 m	LOGGED: SY / JV	DATE: 29/2/08
JOB NO: 077662060	BUCKET TYPE: 600 mm with soil teeth	CHECKED: [signature]	DATE: 29/3/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	M		0.0	0.40				CH	Sandy CLAY, high plasticity, dark grey brown.	D	Fb	Topsoil.
			0.5	0.80	PP = >500 kPa			SC	Clayey SAND, fine to coarse grained, mottled orange brown / dark brown, high plasticity fines.	D		Calcareous.
			1.0	1.10	PP = >500 kPa TP11/01 (0.9 - 1.1m) Large Bulk Sample / Jar	■		SC	Clayey SAND, fine to coarse grained, mottled pale brown / pale orange brown, low plasticity fines.	D-M		
			1.5	1.70	PP = 350 kPa			CH	Sandy CLAY, high plasticity, mottled pale brown / pale orange brown, fine to coarse sand.	M	H	
				1.85				CH	Sandy CLAY, high plasticity, red brown grey, fine to coarse sand.	M	Fb	
	SY / JV 29/2/08	▽	2.0 – 3.0	3.10	TP11/02 (2.5 - 2.7m) Jar Sample	■		CL	Sandy CLAY, low plasticity, grey, mottled grey and red brown to mottled grey / pale orange brown / yellow brown, fine to coarse sand.	M-W	Fb	Calcareous nodules.
			3.5 – 6.5						TEST PIT DISCONTINUED @ 3.10 m GROUNDWATER ENCOUNTERED @ 2.6m.			

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REPORT OF TEST PIT: TP12

CLIENT: WALKER CORPORATION	COORDS: 272717 m E 6160241 m N 54 AMG84	SHEET: 1 OF 1	
PROJECT: SUBDIVISION	SURFACE RL: m DATUM: AHD	MACHINE: BACKHOE	
LOCATION: BUCKLAND PARK	PIT DEPTH: 3.10 m	CONTRACTOR: ER SILVA	
JOB NO: 077662060	BUCKET TYPE: 600 mm with soil teeth	LOGGED: SY / JV	DATE: 29/2/08
		CHECKED: [signature]	DATE: 29/5/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	M		0.0	0.15				SC	Clayey SAND, fine to coarse grained, brown, low plasticity fines.	D		Topsoil.
				1.00	PP = ~350 - >500 kPa TP12/01 (0.2 - 0.4m) Large Bulk Sample / Jar			SC	Clayey SAND, fine to coarse grained, mottled orange brown / yellow brown / dark brown, low plasticity fines.	D-M	H	Calcareous nodules.
			1.0	2.10	PP = 320 kPa			CH	CLAY, high plasticity, mottled pale brown / pale orange, with fine to coarse grained sand.	M	H	Sand content varies throughout layer. At 1.8m, cemented clay pieces up to 60mm in size.
	SY / JV 29/2/08	▽	2.0	3.10	TP12/02 (2.1 - 2.3m) Jar / Small Bulk Sample PP = 100 - 350 kPa			CH	CLAY, high plasticity, mottled grey / orange brown, trace of fine to coarse grained sand.	M-W	Fb/VSt-H	
			3.0						TEST PIT DISCONTINUED @ 3.10 m GROUNDWATER ENCOUNTERED @ 2.1m.			

Depth scale (metres): 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF TEST PIT: TP13

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SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 271135 m E 6159556 m N 54 AMG84
SURFACE RL: m DATUM: AHD
PIT DEPTH: 2.30 m
BUCKET TYPE: 600 mm with soil teeth

MACHINE: BACKHOE
CONTRACTOR: ER SILVA
LOGGED: SY / JV DATE: 29/2/08
CHECKED: [signature] DATE: 29/5/08

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH	M		0.0	0.20				SP	SAND, fine to medium grained, brown, trace of clay.	D		Topsoil, roots.
				0.40	PP = 320 kPa			CH	Sandy CLAY, high plasticity, red brown, fine to coarse grained sand.	D-M	VSt	Mica flecks.
		SY / JV 29/02/08	0.5	1.10	PP = 100 kPa TP13/01 (0.7 - 0.9m) Large Bulk Sample PP = <100 kPa			CL	Sandy CLAY, low plasticity, brown, fine to coarse sand.	M		
			1.0 / 1.5	1.80	TP13/02 (1.5 - 1.8m) Small Bulk Sample			SP	SAND, fine to coarse grained, brown, trace of clay.	W		Fine roots. Grey clay mottling towards base of layer.
				1.90				SP	SAND, fine to coarse, red brown, trace of clay.			Sand transition layer.
			2.0	2.10	TP13/03 (1.9 - 2.0m) Jar Sample			SC	Clayey SAND, fine to coarse, red brown, high plasticity fines.	D-M		
				2.30				CL	Sandy CLAY, low plasticity, orange brown / yellow brown with grey mottling, fine to coarse grained sand.		F	
			2.5						TEST PIT DISCONTINUED @ 2.30 m GROUNDWATER ENCOUNTERED @ 1.1m. PIT WALLS COLLAPSING.			

Depth scale: 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

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REPORT OF TEST PIT: TP14

SHEET: 1 OF 1

CLIENT: WALKER CORPORATION
PROJECT: SUBDIVISION
LOCATION: BUCKLAND PARK
JOB NO: 077662060

COORDS: 271960 m E 6159662 m N 54 AMG84
SURFACE RL: m DATUM: AHD
PIT DEPTH: 3.00 m
BUCKET TYPE: 600 mm with soil teeth

MACHINE: BACKHOE
CONTRACTOR: ER SILVA
LOGGED: SY / JV DATE: 29/2/08
CHECKED: DATE:

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH RL	SAMPLE OR FIELD TEST	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
BH			0.0		SC	Clayey SAND, fine to coarse grained, brown to dark brown, low plasticity fines.	D		Inferred topsoil.
			0.40			Orange brown.	D-M		
			0.65			Pale yellow brown / brown.	M		Calcareous.
			0.80			Pale brown.	M		
			1.05	TP14/01 (1.1 - 1.3) Large Bulk Sample		Orange brown, trace of fine gravel.	M-W		
		SY / JV 29/2/08	2.00		SP	SAND, fine to coarse grained, pale brown / brown, dark grey streaks.	W		
			2.40		SP	SAND, fine to coarse grained, red brown, trace of clay.	W		Clay interbedded layers.
			2.50	TP14/02 (2.5 - 2.8) Small Bulk Sample	CI	Sandy CLAY, medium plasticity, orange brown / yellow brown, fine to coarse sand, trace of fine to medium gravel.	D-M		Calcareous nodules.
			2.80	TP14/03, TP14/04 (2.8 - 3.0) Small Bulk Sample, Jar Sample	CL	Sandy CLAY, low plasticity, mottled grey / orange brown / pale brown, fine to coarse grained sand.	D-M		Calcareous.
			3.00			TEST PIT DISCONTINUED @ 3.00 m GROUNDWATER ENCOUNTERED @ 2.0m.			

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METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS

FILL

GRAVEL (GP or GW)

SAND (SP or SW)

SILT (ML or MH)

CLAY (CL, CI or CH)

ORGANIC SOILS (OL or OH or Pt)

COBBLES or BOULDERS

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

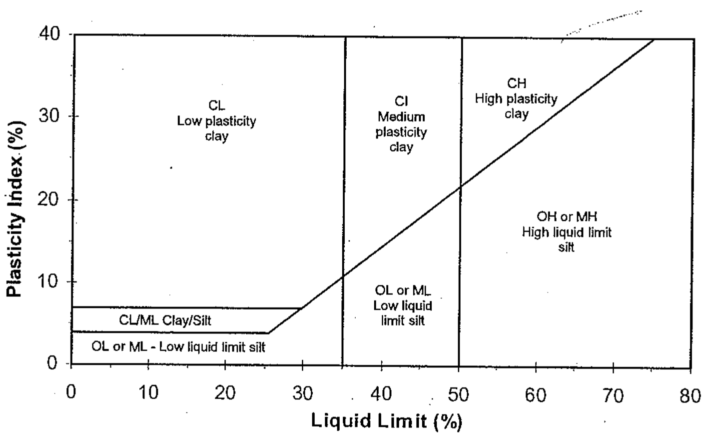
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726 – 1993, Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		> 200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties



MOISTURE CONDITION

AS1726 - 1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

AS1726 - 1993

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary blade or drag bit	HQ	Diamond Core - 63 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V-Bit	RAB	Rotary Air Blast	NQ	Diamond Core - 47 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	BH	Tractor Mounted Backhoe
HA	Hand Auger	PT	Push Tube	EX	Tracked Hydraulic Excavator
ADH	Hollow Auger	CT	Cable Tool Rig	EE	Existing Excavation
DTC	Diatube Coring	JET	Jetting	HAND	Excavated by Hand Methods
WB	Washbore or Bailer	NDD	Non-destructive drilling		

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance.** Rapid penetration possible with little effort from the equipment used.

M **Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used.

H **High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.

R **Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER

▽	Water level at date shown	◁	Partial water loss
▷	Water inflow	◀	Complete water loss

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-1993
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (s_v = peak value, s_r = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure tests

Ranking of Visually Observable Contamination and Odour (for specific soil contamination assessment projects)

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\textit{Length of core recovered}}{\textit{Length of core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\sum \textit{Length of cylindrical core recovered}}{\textit{Length of core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum \textit{Axial lengths of core} > 100\,mm}{\textit{Length of core run}} \times 100$$

APPENDIX D

Fieldwork Photographs (CD-ROM)


07762060
Buckland Park
BH43
18/3/08
JV


Buckland Park
BH44 0-3m
077662060
AJB 2/4/08


Buckland Park
BH44 0-3m
077662060
AJB 2/4/08


Buckland Park
BH45 0-3.0m
18/4/08
JV


07766 2060
Buckland Park
BH47 0-3.0m
18/4/08 JV
18/04/200


07766 2060
Buckland Park
BH49 0-6.0m
18/4/08 JV
18/04/200


07766 2060
Buckland Park
BH46 0-3.0m
18/4/08 JV
18/04/200


07766 2060
Buckland Park
BH48 0-3.0m
18/4/08 JV
18/04/200


07762060
Buckland Park
BH50 0-3.0m
18/4/08
JV


Buckland Park
BH51, BH42 } 0-3m
077662060
AJB 2/4/08


Buckland Park
BH51, BH42 } 0-3m
077662060
AJB 2/4/08


Buckland Park
BH52
0-5.5m
077662060
AJB 2/4/08


077662060
Buckland Park
BH55
18/3/08
TV


077662060
Buckland Park
BH57


077662060
Buckland Park
BH54


077662060
Buckland Park
BH56
18/3/08
TV


Buckland Park
BH58
18/3/08


Buckland Park
BH59.
18/3/08


Buckland Park
BH59.
18/3/08


Buckland Park
BH60.
18/3/08


077662060
Buckland Park
21/1/08 AJB/MH
BH01 0-3m


077662060
Buckland Park
21/1/08 AJB/MH
BH02 0-3m


077662060
Buckland Park
21/1/08 AJB/MH
BH02 0-3m


077662060
Buckland Park
21/1/08 AJB/MH
BH03 0-3m
BH04


077662060
Buckland Park
22/1/08 AJB/MH
BH06 0-6m


077662060
Buckland Park
22/1/08 AJB/MH
BH07 0-3m


077662060
Buckland Park
22/1/08 AJB/MH
BH08 0-3m


077662060
Buckland Park
21/1/08 AJB/MH
BH09 0-3m


07762060
Buckland Park
22/1/08 AJB/MH
BH010 0-3m


07762060
Buckland Park
22/1/08 AJB/MH
BH 11 0-3m


07762060
Buckland Park
22/1/08 AJB/MH
BH12 0-3m


07762060
Buckland Park
22/1/08
BH13 0-3m


07762060
Buckland Park
22/1/08 AJB/MH
BH15 0-6m


07762060
Buckland Park
24/1/08 AJB/MH
BH16 0-6m


07762060
Buckland Park
24/1/08 AJB/MH
BH17 0-3m


07762060
Buckland Park
22/1/08 AJB/MH
BH18 0-3m


0776620060
Buckland Park
22/1/08 AJB/MH
BH19 0-3m
BEN


0776620060
Buckland Park
23/1/08 AJB/MH
BH20 0-3m


0776620060
Buckland Park
23/1/08 AJB/MH
BH21 0-3m
BEN


0776620060
Buckland Park
23/1/08 AJB/MH
BH22 0-3m


077662060
Buckland Park
23/1/08 AJB/MH
BH24 0-3m


077662060
Buckland Park
23/1/08 AJB/MH
BH26 0-3m


077662060
Buckland Park
23/1/08 AJB/MH
BH23 0-3m


077662060
Buckland Park
23/1/08 AJB/MH
BH25 0-3m
GLAD


07762060
Buckland Park
23/1/08 AJB/MH
BH27 0-3m


07762060
Buckland Park
23/1/08 AJB/MH
BH28 0-3m


07762060
Buckland Park
23/1/08 AJB/MH
BH29 0-3m


07762060
Buckland Park
23/1/08 AJB/MH
BH30 0-3m


Buckland Park
077662060
AJB 31/1/08
BH31 , BH35
0-3m


Buckland Park
077662060
AJB 31/1/08
BH31 , BH35


Buckland Park
077662060
AJB 31/1/08
BH32
0-3m


Buckland Park
077662060
AJB 31/1/08
BH32
0-3m


Buckland Park
077662060
AJB 31/1/08
BH33, BH34
0-3m


Buckland Park
077662060
AJB 31/1/08
BH33, BH34
0-3m


Buckland Park
077662060
AJB 31/1/08
BH33, BH34
0-3m


Buckland Park
077662060
AJB 31/1/08
BH37, BH36
0-3m


Buckland Park
077662060
AJB 31/1/08
BH37, BH36
0-3m


Buckland Park
077662060
AJB 31/1/08
BH38
0-3.7m

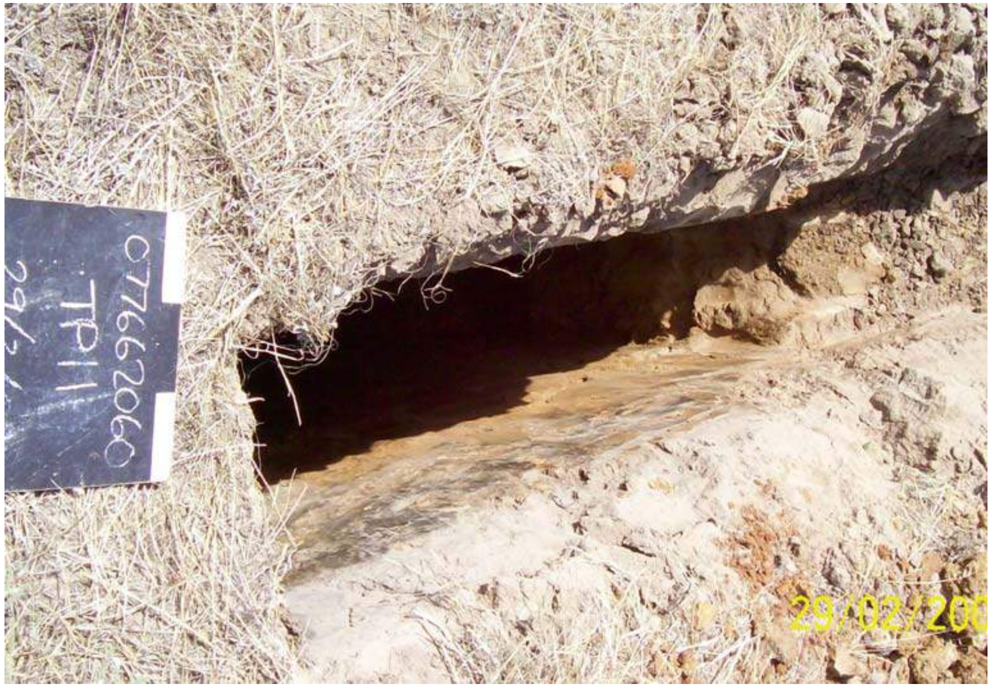

Buckland Park
BH39, BH53 } 0-3m
077662060
AJB 2/4/08


Buckland Park
BH40, 0-6m
077662060
AJB 2/4/08


BH41
077662060
Buckland Park
2.4.08
AJB


BH41
077662060
Buckland Park
2.4.08
AJB


29/02/200


CT7662060
TP11
29/02/200


CT7662060
TP10
29/2/08
29/02/200


CT7662060
TP10
29/2/08
29/02/200


29/02/200


C77662060
TP11
29/02/200


29/02/200


C77662060
TP11
29/02/200


29/02/200


TP12
29/2/08
29/02/200

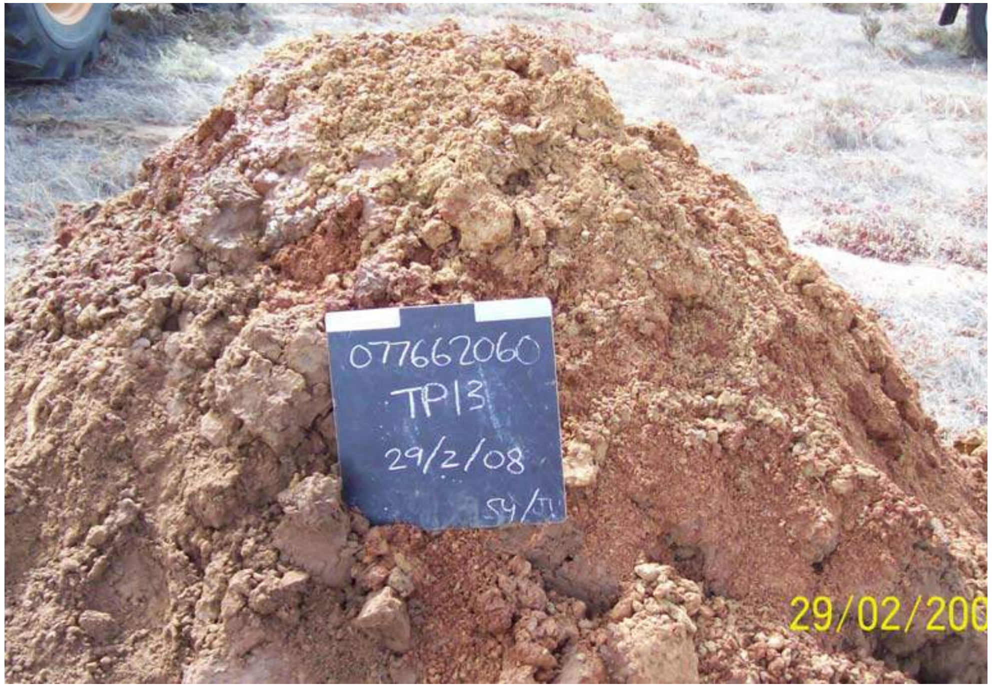

TP12
29/2/08
29/02/200


29/02/200


29/02/200


077662060
TP13
29/2/08
29/02/200


077662060
TP13
29/2/08
29/02/200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TP13
29/2/08
29/02/200


29/02/200


C77662060
TP14
29/2/08
29/02/200


C77662060
TP14
29/2/08
29/02/200


29/02/200


077662060
TP14
29/2/08
29/02/200


Buckland Park
077662060
0-2.8m
TP01
AJB/OH 13.2.08


077662060
TP14
29/2/08
29/02/200


29/02/200


Buckland Park
077662060
0-2.8m
TP01
AJC/OH 13-2-08


Buckland Park
077662060
0-2.8m
TP01
AJC/OH 13-2-08


Buckland Park
077662060
0-2.8m
TP01
AJC/OH 13-2-08


Buckland Park
077662060
0-2.6m
TP02
AJB/OH 13.2.08


Buckland Park
077662060
0-2.6m
TP02
AJB/OH 13.2.08


Buckland Park
077662060
0-2.6m
TP02
AJB/OH 13.2.08


Buckland Park
077662060
0-3.0m
TP03


Buckland Park
077662060
0-3.0m
TP03


Buckland Park
077662060
0-3.0m
TP03
AJB/OH 13.2.08


Buckland Park
077662060
0-3.0m
TP03
AJB/OH 13.2.08



Buckland Park
077662060
0-3.15
TP04
AJB/OH 13.2.08


Buckland Park
077662060
0-3.15
TP04
AJB/OH 13.2.08


Buckland Park
077662060
0-3.15
TP04
AJB/OH 13.2.08


Buckland Park
077662060
0-3.15
TP04
AJB/OH 13.2.08


Buckland Park
077662060
0-3.05
TP05
AJB/OH 13.2.08


Buckland Park
077662060
0-3.05
TP05
AJB/OH 13.2.08


077662060
0-3.15
TP04
AJB/OH 13.2.08


Buckland Park
077662060
0-3.05
TP05
AJB/OH 13.2.08


Buckland Park
077662060
0-3.05
TP05
AJB/OH 13.2.08

Buckland Park
077662060
0-3.05
TP05
AJB/OH 13.2.08

Buckland Park
077662060
0-3.05
TP05
AJB/OH 13.2.08

Buckland Park
077662060
0-3.05
TP05
AJB/OH 13.2.08


Buckland Park
077662060
0-3.05
TP05
AJB/OH 13.2.08

Buckland Park
077662060
0-3.3
TP06
AJB/OH 13.2.08

Buckland Park
077662060
0-3.05
TP05
AJB/OH 13.2.08

Buckland Park
077662060
0-3.05
TP05
AJB/OH 13.2.08


Buckland Park
077662060
0-3.3
TP06
13.2.08

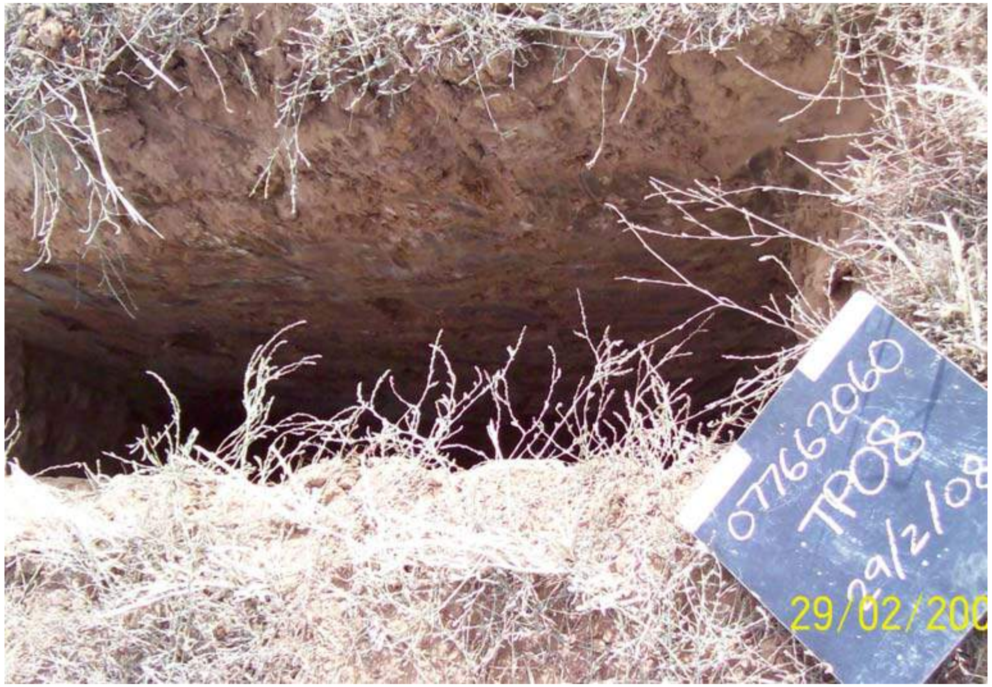

Buckland Park
077662060
0-3.3
TP06
13.2.08


077662060
0-2.8m
TP07
AJB/OH 13/2/08


Buckland Park
077662060
0-2.8m
TP07
AJB/OH 13/2/08


Buckland Park
077662060
0-2.8m
TP07
AJB/OH 13/2/08


Buckland Park
077662060
0-2.8m
TP07
AJB/OH 13/2/08


07766 2060
TP08
29/2/08
29/02/200


0-2.8m
TP07
AJB/OH 13/2/08


Buckland Park
07766 2060
0-2.8m
TP07
AJB/OH 13/2/08


077662060
TP08
29/2/08
SY/JV
29/02/200

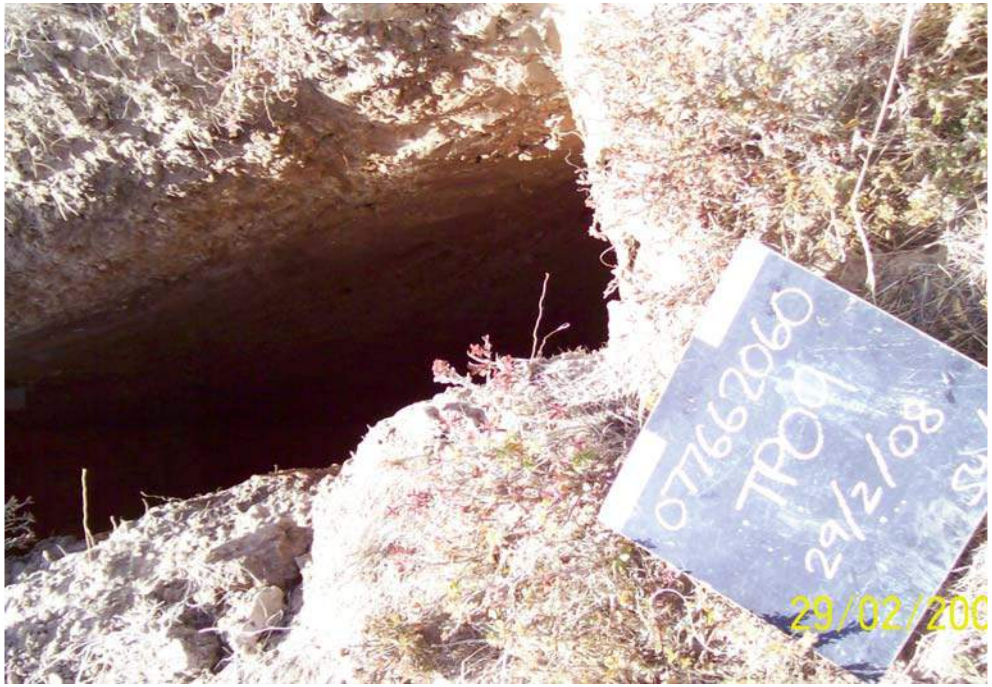

SWL 950Kgs
29/02/200


29/02/200


077662060
TP08
29/2/08
SY/JV
29/02/200


29/02/200


077662060
TP09
29/2/08
29/02/200


077662060
TP09
29/2/08
29/02/200


077662060
TP09
29/2/08
29/02/200

APPENDIX E

Acid Sulphate Soil Field and Laboratory Test Results

TABLE 1 LABORATORY ASS TEST RESULTS
WALKER CORPORATION
BUCKLAND PARK

Test Location	Depth Range (m - BGL)	Material Description	pH_{KCl}	TAA	sTAA Converted to %S*	S_{NAS} (if pH less than 4.5)	Existing Acidity %S (sTAA + 0.75 x S_{NAS})	Chromium Reduceable Sulfur (S_{CR})	Acid Neutralising Capacity %CaCO3 (if pH	Net Acidity %S (S_{CR}+Existing Acidity -	Is This ASS	Is This PASS	Liming Rate for Net Acidity (Neutralises both AASS & PASS) (kg/m3)
BH24	1.2-1.4	Clayey Sand	9.2	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH24	1.2-1.4	Clayey Sand	9.3	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH24	1.4-1.5	Clayey Sand	9.2	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH25	2.0-2.3	Clayey Sand	9.4	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH25	2.5-2.7	Sandy Clay	9.5	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH26	2.0-2.2	Sandy Clay	9.3	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA
BH26	2.5-2.6	Sandy Clay	9.2	< 0.5	< 0.016		0.000	< 0.005		< 0.005	No	No	NA

Note: * Equivalent oxidisable sulphur calculated as TAA/30.59
Liming rates assume a bulk density of 1.6t/m^3
Fineness Factor = 3
No chemical result

Prepared by	SY	Date	29/05/2008
Checked by		Date	

Input By: ???
Date: 29/05/2008
Checked By: ???
Date: 29/05/2008

J:\3env04\046?????\PASS table 29.05.08.xls\Lab Results.xls

TABLE 1 FIELD pH TEST RESULTS
WALKER CORPORATION
BUCKLAND PARK

Sample No.	Depth (m)	Soil Type	pH	pH fox	reaction	Interpreted PASS Potential		
						high	medium	low
BH22b/01	1.0 - 1.05	brown sand	7.84	6.53	no			X
BH22b/02	1.15 - 1.2	brown clayey sand	8.02	5.81	no			X
BH22b/03	1.5 - 1.55	pale brown sand	7.93	6.74	minor			X
BH24	1.2 - 1.4	red-brown sand	8.02	5.95	minor			X
BH24	1.4 - 1.5	orange-brown sand	7.82	5.58	minor			X
BH25	2.0 - 2.3	red-brown sand	7.92	6.23	minor			X
BH25	2.5 -2.7	brown sandy clay	7.79	6.54	no			X
BH26	2.0 - 2.2	brown clayey sand	8.23	6.54	minor			X
BH26	2.5 - 2.6	brown clay	7.84	5.82	no			X
BH27/01	3.5 - 3.1	orange sand	8.03	6.91	minor			X
BH27/02	3.9 - 4.0	brown sandy clay	8.19	7.00	reaction		X	
BH27/02b	3.9 - 4.0	brown sandy clay	8.21	6.09	minor			X
BH33/01	2.75 - 2.8	red-brown sandy clay	7.80	5.93	no			X
BH33/02	2.4 - 2.5	brown sandy clay	8.12	6.29	minor			X

Note: pH meter calibrated prior to use.

APPENDIX F

Geotechnical Testing – Laboratory Test Reports

Golder Associates Pty Ltd
199 Franklin Street, Adelaide SA 5000

Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	**Date:**	2-May-08
Location:	Buckland Park **Job No.** 077662060	**Report No.**	077662060 / R1
Lab Reference No.	0860428	**Sample Identification:**	TP 08/02 1.95 - 2.15m
Laboratory Specimen Description:	(CH) CLAY, high plasticity, brown, with fine to coarse sand.		

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
9.5 mm	100	
6.7 mm	100	
4.75 mm	100	
2.36 mm	100	
1.18 mm	100	
600 um	99	
425 um	98	
300 um	95	
150 um	83	
75 um	74	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	67	
Plastic Limit	%	AS1289 3.2.1	25	
Plasticity Index	%	AS1289 3.3.1	42	
Linear Shrinkage	%	AS1289 3.4.1	15.0	
Moisture Content	%	AS1289 2.1.1	30.4	

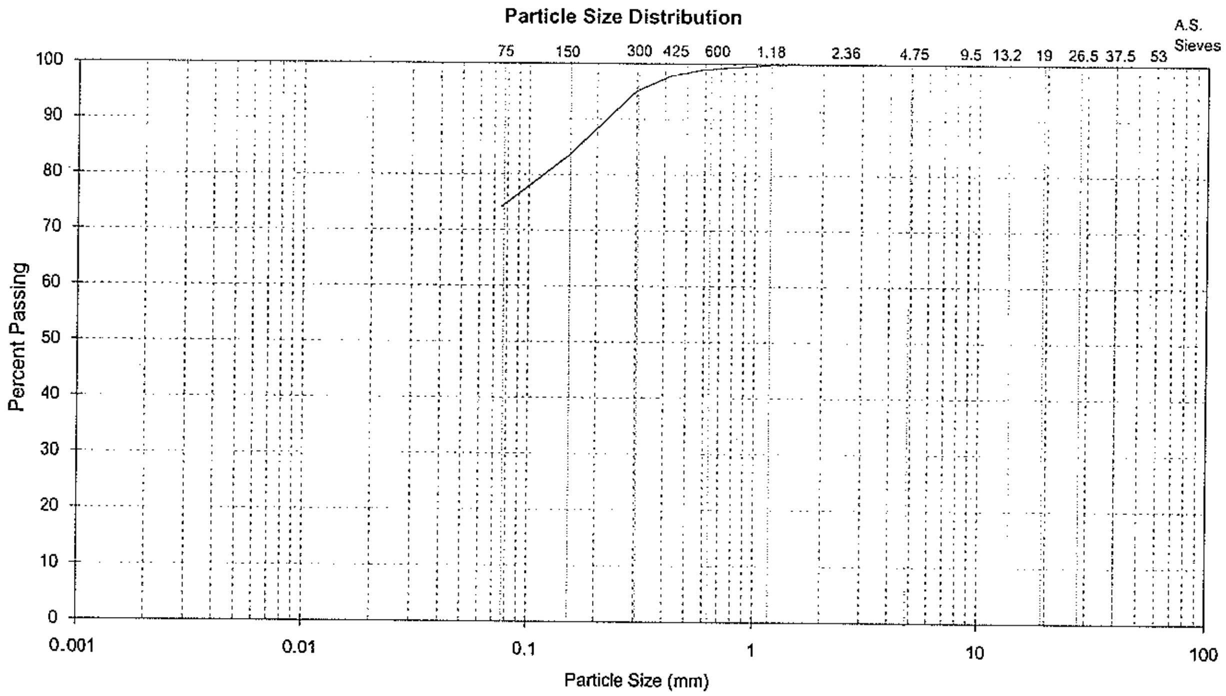
Sample History:	Air Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	No
Linear shrinkage mould length:	250 mm

ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.2.1

Maximum Dry Density:	t/m3
Optimum Moisture Content:	%

Notes



Adelaide Laboratory - Accredited Laboratory No. 1961

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NATA

Approved Signatory, Darren Shotton - Laboratory Manager

Golder Associates

Golder Associates Pty Ltd
199 Franklin Street, Adelaide SA 5000

Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	**Date:**	2-May-08
Location:	Buckland Park **Job No.** 077662060	**Report No.**	077662060 / R2
Lab Reference No.	0860429	**Sample Identification:**	TP 09/02 1.9 - 2.0m
Laboratory Specimen Description:	(CL) Sandy CLAY, low plasticity, pale brown, approx. 35% fine to coarse sand, trace fine to coarse gravel.		

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	94	
19.0 mm	94	
13.2 mm	94	
9.5 mm	94	
6.7 mm	94	
4.75 mm	94	
2.36 mm	94	
1.18 mm	92	
600 um	89	
425 um	86	
300 um	81	
150 um	69	
75 um	57	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	34	
Plastic Limit	%	AS1289 3.2.1	15	
Plasticity Index	%	AS1289 3.3.1	19	
Linear Shrinkage	%	AS1289 3.4.1	8.5	
Moisture Content	%	AS1289 2.1.1	17.1	

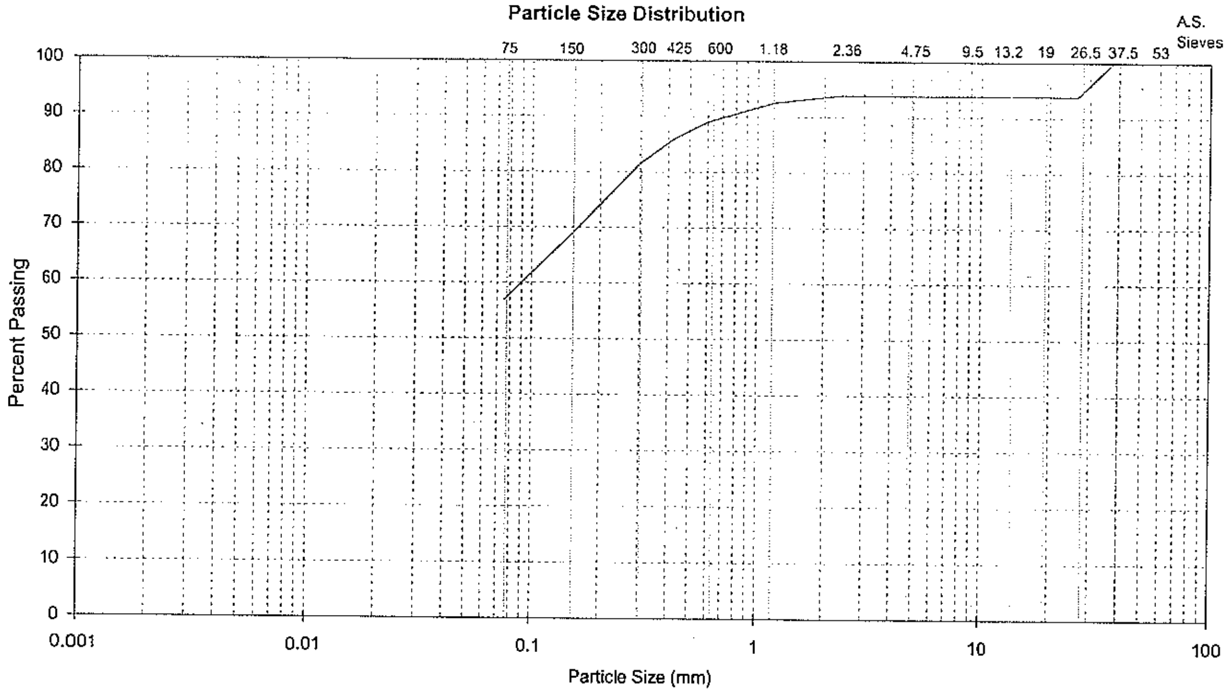
Sample History:	Air Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	No
Linear shrinkage mould length:	250 mm

ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.2.1

Maximum Dry Density:	t/m3
Optimum Moisture Content:	%

Notes



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Approved Signatory, Darren Shotton - Laboratory Manager

Golder Associates

Golder Associates Pty Ltd
199 Franklin Street, Adelaide SA 5000

Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	**Date:**	2-May-08
Location:	Buckland Park	**Job No.** 077662060	**Report No.** 077662060 / R3
Lab Reference No.	0860430	**Sample Identification:**	TP 11/01 0.9 - 1.1m
Laboratory Specimen Description:	(SC) Clayey SAND, fine to coarse grained, mottled orange pale brown, approx. 50% low plasticity fines.		

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
9.5 mm	100	
6.7 mm	100	
4.75 mm	100	
2.36 mm	100	
1.18 mm	100	
600 um	100	
425 um	99	
300 um	98	
150 um	88	
75 um	48	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	30	
Plastic Limit	%	AS1289 3.2.1	15	
Plasticity Index	%	AS1289 3.3.1	15	
Linear Shrinkage	%	AS1289 3.4.1	4.5	
Moisture Content	%	AS1289 2.1.1	12.7	

Sample History:	Air Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	No
Linear shrinkage mould length:	250 mm

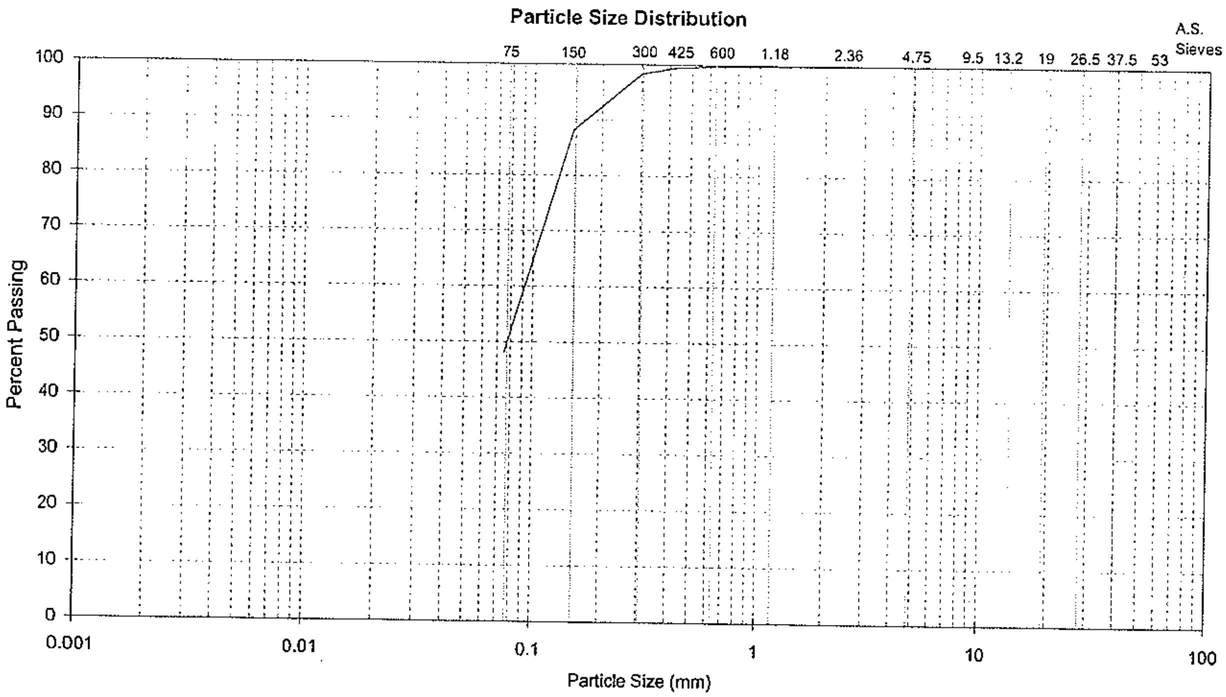
ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.1.1

Maximum Dry Density: 1.84 t/m3

Optimum Moisture Content: 14.0 %

Notes



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Approved Signatory, Darren Shotton - Laboratory Manager

Golder Associates

Golder Associates Pty Ltd
199 Franklin Street, Adelaide SA 5000

Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	**Date:**	2-May-08
Location:	Buckland Park **Job No.** 077662060	**Report No.**	077662060 / R4
Lab Reference No.	0860431	**Sample Identification:**	TP 12/02 2.1 - 2.3m
Laboratory Specimen Description:		(CH) CLAY, high plasticity, mottled grey brown, trace fine to coarse sand.	

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
9.5 mm	100	
6.7 mm	100	
4.75 mm	100	
2.36 mm	100	
1.18 mm	99	
600 um	99	
425 um	99	
300 um	98	
150 um	96	
75 um	90	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	71	
Plastic Limit	%	AS1289 3.2.1	23	
Plasticity Index	%	AS1289 3.3.1	48	
Linear Shrinkage	%	AS1289 3.4.1	16.5	
Moisture Content	%	AS1289 2.1.1	27.4	

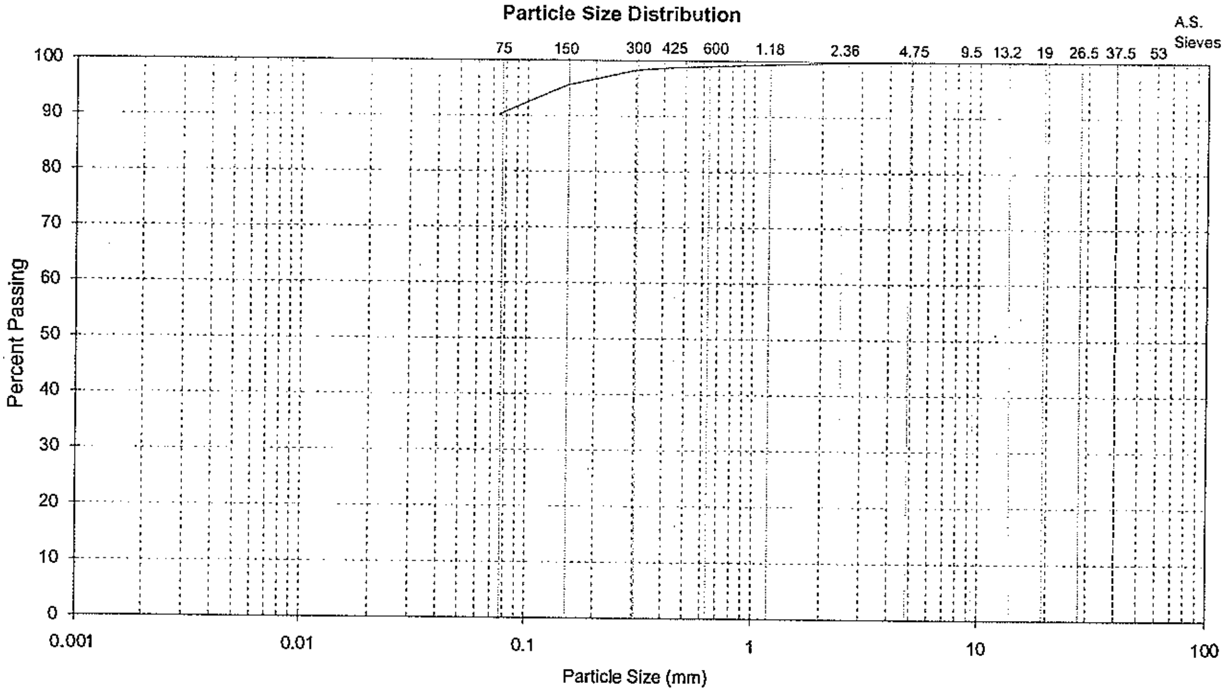
Sample History:	Air Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	No
Linear shrinkage mould length:	250 mm

ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.2.1

Maximum Dry Density:	t/m3
Optimum Moisture Content:	%

Notes



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199 Franklin Street, Adelaide SA 5000

Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	Date:	2-May-08
Location:	Buckland Park	Job No. 077662060	Report No. 077662060 / R5
Lab Reference No.	0860432	Sample Identification:	TP 13/01 0.7 - 0.9m
Laboratory Specimen Description:	(CL) Sandy CLAY, low plasticity, mottled grey brown, approx. 50% fine to coarse sand.		

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
9.5 mm	100	
6.7 mm	100	
4.75 mm	100	
2.36 mm	100	
1.18 mm	100	
600 um	100	
425 um	99	
300 um	98	
150 um	89	
75 um	50	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	26	
Plastic Limit	%	AS1289 3.2.1	17	
Plasticity Index	%	AS1289 3.3.1	9	
Linear Shrinkage	%	AS1289 3.4.1	0.5	
Moisture Content	%	AS1289 2.1.1	21.7	

Sample History:	Air Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	No
Linear shrinkage mould length:	250 mm

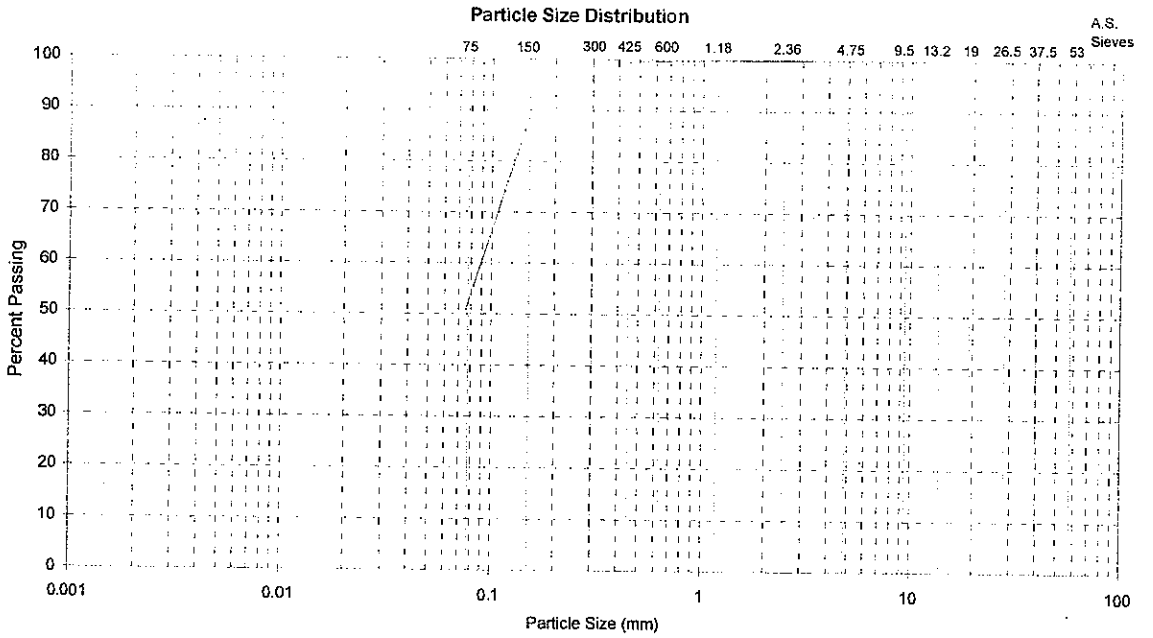
ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.1.1

Maximum Dry Density: 1.77 t/m3

Optimum Moisture Content: 16.5 %

Notes



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Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	**Date:**	2-May-08
Location:	Buckland Park **Job No.** 077662060	**Report No.**	077662060 / R6
Lab Reference No.	0860433	**Sample Identification:**	TP 14/01 1.1 - 1.3m
Laboratory Specimen Description:		(SC) Clayey SAND, fine to coarse grained, orange brown approx. 50% low plasticity fines, trace fine gravel.	

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
9.5 mm	100	
6.7 mm	100	
4.75 mm	100	
2.36 mm	99	
1.18 mm	99	
600 um	97	
425 um	95	
300 um	90	
150 um	72	
75 um	49	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	24	
Plastic Limit	%	AS1289 3.2.1	17	
Plasticity Index	%	AS1289 3.3.1	7	
Linear Shrinkage	%	AS1289 3.4.1	3.0	
Moisture Content	%	AS1289 2.1.1	15.4	

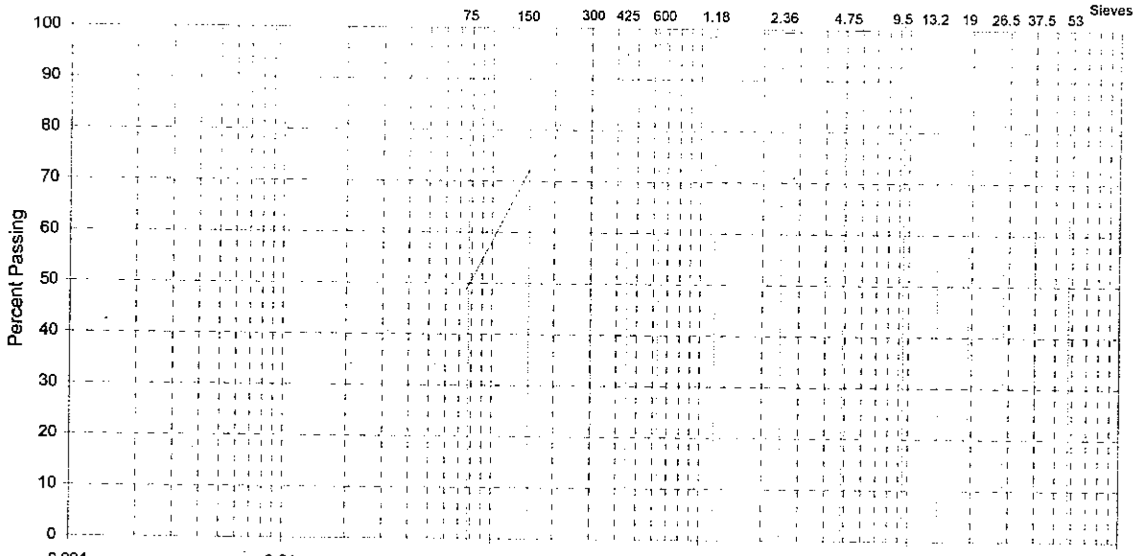
Sample History:	Air Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	No
Linear shrinkage mould length:	250 mm

ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.2.1

Maximum Dry Density:	t/m3
Optimum Moisture Content:	%

Notes



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Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	Date:	2-May-08
Location:	Buckland Park Job No. 077662060	Report No.	077662060 / R7
Lab Reference No.	0860434	Sample Identification:	TP 14/02 2.5 - 2.8m
Laboratory Specimen Description:	(CI) Sandy CLAY, medium plasticity, pale brown, approx. 25% fine to coarse sand, trace fine to medium gravel.		

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
9.5 mm	100	
6.7 mm	99	
4.75 mm	99	
2.36 mm	98	
1.18 mm	97	
600 um	97	
425 um	96	
300 um	94	
150 um	83	
75 um	72	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	39	
Plastic Limit	%	AS1289 3.2.1	18	
Plasticity Index	%	AS1289 3.3.1	21	
Linear Shrinkage	%	AS1289 3.4.1	10.0	
Moisture Content	%	AS1289 2.1.1	27.1	

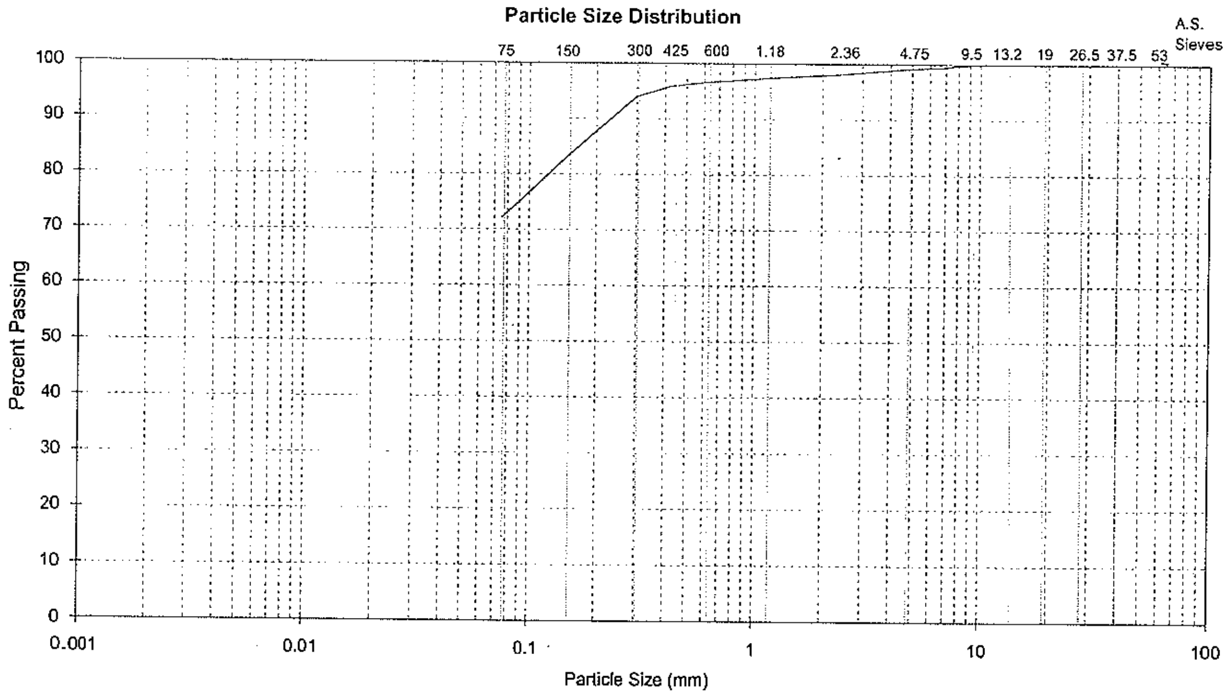
Sample History:	Air Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	No
Linear shrinkage mould length:	250 mm

ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.2.1

Maximum Dry Density:	t/m3
Optimum Moisture Content:	%

Notes



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Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	**Date:**	2-May-08
Location:	Buckland Park Job No. 077662060	**Report No.**	077662060 / R8
Lab Reference No.	0860435	**Sample Identification:**	TP 10/01 0.3 - 0.5m

Laboratory Specimen Description: (CI) CLAY, medium plasticity, grey brown, with fine to coarse sand, trace fine to coarse gravel.

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	97	
13.2 mm	96	
9.5 mm	94	
6.7 mm	92	
4.75 mm	89	
2.36 mm	86	
1.18 mm	84	
600 um	82	
425 um	81	
300 um	79	
150 um	71	
75 um	60	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	41	
Plastic Limit	%	AS1289 3.2.1	16	
Plasticity Index	%	AS1289 3.3.1	25	
Linear Shrinkage	%	AS1289 3.4.1	9.5	
Moisture Content	%	AS1289 2.1.1	17.1	

Sample History:	Air Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	No
Linear shrinkage mould length:	250 mm

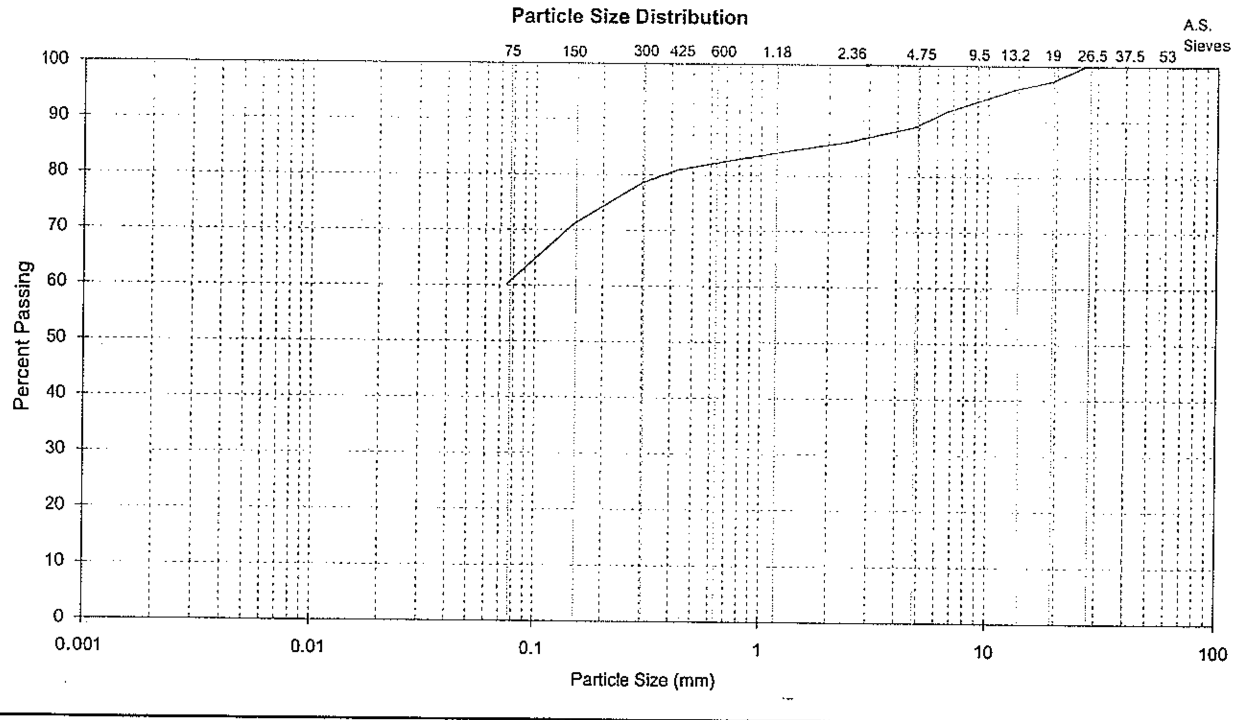
ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.1.1

Maximum Dry Density: 1.73 t/m3

Optimum Moisture Content: 18.5 %

Notes



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Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	**Date:**	2-May-08
Location:	Buckland Park	**Job No.** 077662060	**Report No.** 077662060 / R9
Lab Reference No.	0860436	**Sample Identification:**	TP 01/01 0.4-0.5m
Laboratory Specimen Description:		(CI) Sandy CLAY, medium plasticity, brown, approx. 40% fine to coarse sand, trace fine to medium gravel.	

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
9.5 mm	99	
6.7 mm	99	
4.75 mm	98	
2.36 mm	97	
1.18 mm	96	
600 um	95	
425 um	94	
300 um	90	
150 um	73	
75 um	55	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	42	
Plastic Limit	%	AS1289 3.2.1	16	
Plasticity Index	%	AS1289 3.3.1	26	
Linear Shrinkage	%	AS1289 3.4.1	11.0	
Moisture Content	%	AS1289 2.1.1	11.1	

Sample History: Air Dried

Preparation Method: Dry sieved

Crumbling / Curling of linear shrinkage: No

Linear shrinkage mould length: 250 mm

ND = not determined NO = not obtainable NP = non plastic

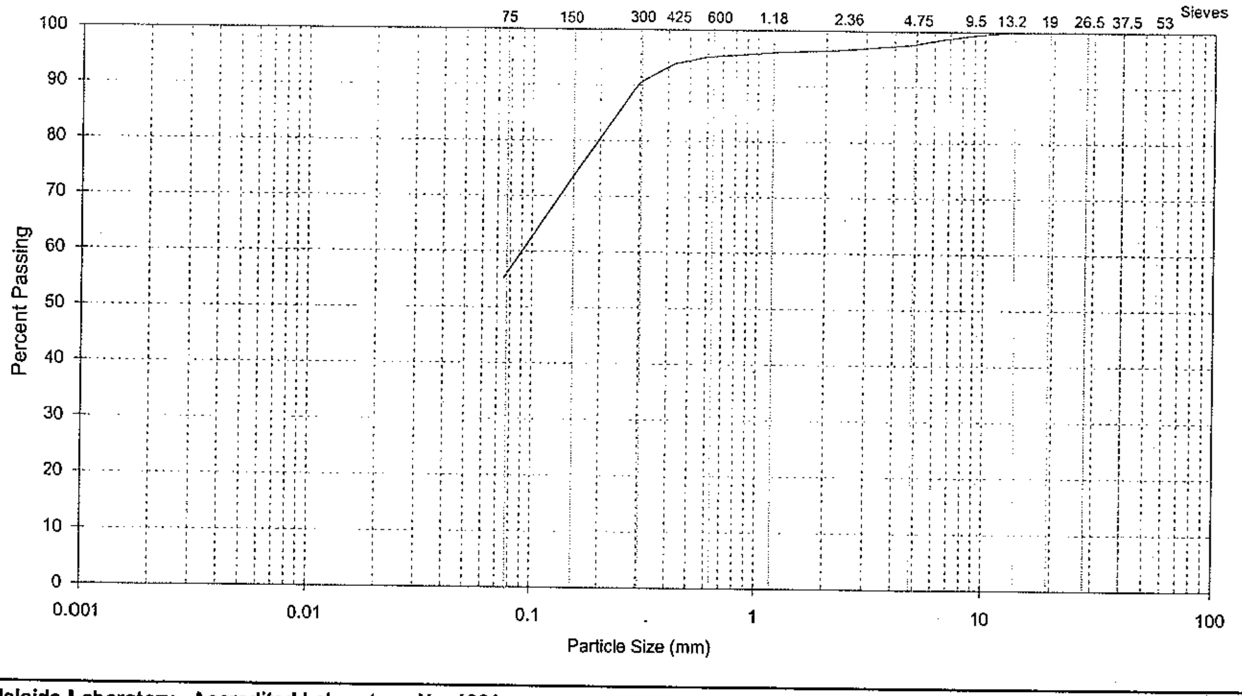
Moisture / Dry Density Relationship AS 1289 5.1.1

Maximum Dry Density: 1.72 t/m3

Optimum Moisture Content: 16.0 %

Notes

Particle Size Distribution



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Particle Size Distribution & Consistency Limits Test Report

Client: Walker Corporation, GPO Box 4073, Sydney, NSW, 2001

Project: Subdivision

Date: 2-May-08

Location: Buckland Park

Job No. 077662060

Report No. 077662060 / R10

Lab Reference No. 0860437

Sample Identification: TP 04/01
0.2 - 0.4m

Laboratory Specimen Description: (CL) Sandy CLAY, low plasticity, brown, approx. 50% fine to coarse sand.

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
9.5 mm	100	
6.7 mm	100	
4.75 mm	100	
2.36 mm	100	
1.18 mm	100	
600 um	99	
425 um	98	
300 um	95	
150 um	69	
75 um	51	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	21	
Plastic Limit	%	AS1289 3.2.1	15	
Plasticity Index	%	AS1289 3.3.1	6	
Linear Shrinkage	%	AS1289 3.4.1	3.0	
Moisture Content	%	AS1289 2.1.1	5.5	

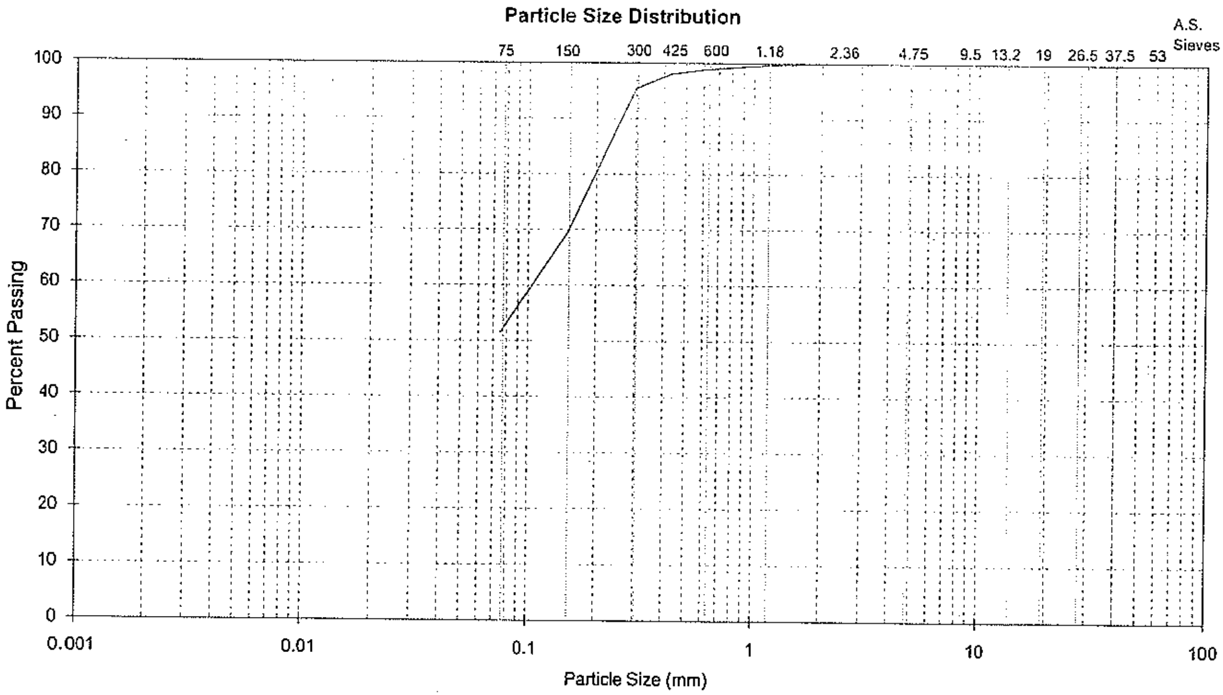
Sample History: Air Dried
Preparation Method: Dry sieved
Crumbling / Curling of linear shrinkage: No
Linear shrinkage mould length: 250 mm

ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.1.1

Maximum Dry Density: 1.76 t/m3
Optimum Moisture Content: 13.0 %

Notes



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Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	Date:	2-May-08
Location:	Buckland Park Job No. 077662060	Report No.	077662060 / R11
Lab Reference No.	0860438	Sample Identification:	TP 07 0.2 - 0.4m
Laboratory Specimen Description:	(CI) CLAY, medium plasticity, brown, trace fine to coarse sand, trace fine gravel.		

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
9.5 mm	100	
6.7 mm	100	
4.75 mm	100	
2.36 mm	100	
1.18 mm	100	
600 um	99	
425 um	98	
300 um	98	
150 um	94	
75 um	91	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	48	
Plastic Limit	%	AS1289 3.2.1	19	
Plasticity Index	%	AS1289 3.3.1	29	
Linear Shrinkage	%	AS1289 3.4.1	12.0	
Moisture Content	%	AS1289 2.1.1	13.4	

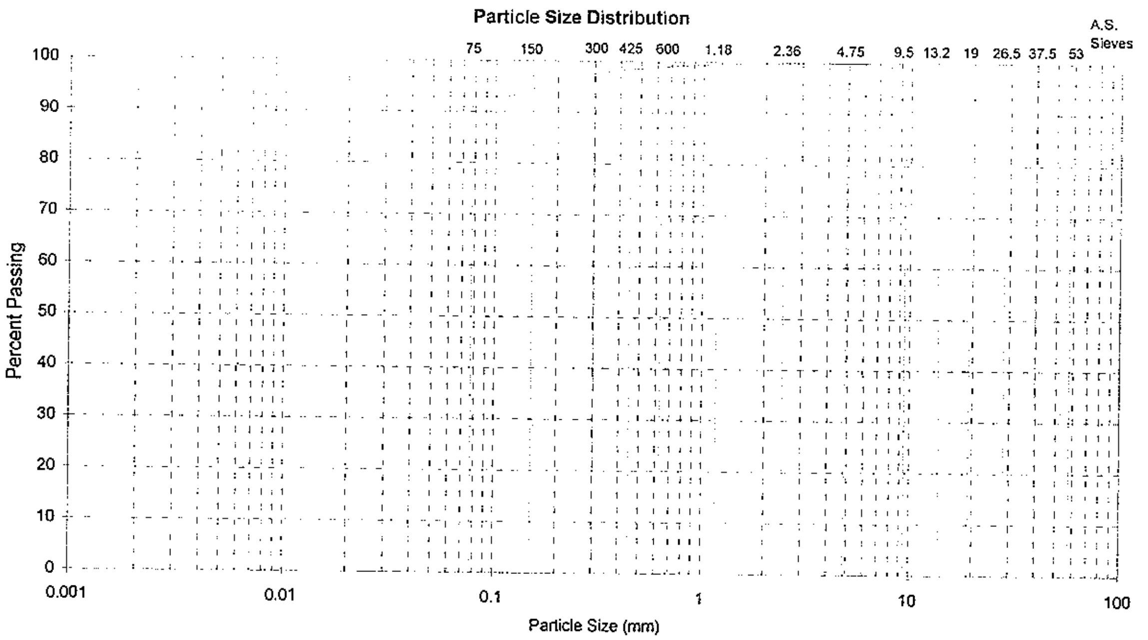
Sample History:	Air Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	No
Linear shrinkage mould length:	250 mm

ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.1.1

Maximum Dry Density: 1.52 t/m3
Optimum Moisture Content: 23.0 %

Notes



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California Bearing Ratio Test Report

Client:	Walker Corporation, GPO Box 4073, SYDNEY, NSW, 2001	**Project No.**	077662060
Project:	Subdivision	**Report No.**	077662060 / R12
Location:	Buckland Park	**Date:**	1 May 2008

SAMPLE INFORMATION

Lab Reference No.	0860430	0860430	
Date Sampled	-	-	
Date Tested	7/4/08	7/4/08	
Sample Identification	TP 11/01 0.9 – 1.1m	TP 11/01 0.9 – 1.1m (unsoaked)	
Laboratory Specimen Description	(SC) Clayey SAND, fine to coarse grained, mottled orange pale brown, approx. 50% low plasticity fines.	(SC) Clayey SAND, fine to coarse grained, mottled orange pale brown, approx. 50% low plasticity fines.	

TEST RESULTS

Laboratory Compaction & Moisture Content - Test Methods AS1289 5.1.1 and AS1289 2.1.1

Maximum Dry Density	t/m^3	1.84	1.84	
Optimum Moisture Content	%	14.0	14.0	
Field Moisture Content	%	12.8	12.8	

California Bearing Ratio - Test Method AS1289 6.1.1

	Dry Density t/m^3	Before Soaking	1.80	1.80	
		After Soaking	1.78	-	
C	Density Ratio %	Before Soaking	97.5	97.5	
B		After Soaking	97.0	-	
R	Moisture Content	Before Soaking	14.0	14.0	
	%	After Soaking	16.5	-	
T	Number of Days Soaked		4	-	
E	Surcharge	kg	4.5	4.5	
S	Moisture Content	Top 30mm	16.5	-	
T	After Test %	Whole Sample	16.5	-	
	Swell After Soaking	%	0.97	-	
	CBR Value @	%	11 @ 5.0mm	12 @ 5.0mm	

Remarks:

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Laboratory Manager

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California Bearing Ratio Test Report

Client:	Walker Corporation, GPO Box 4073, SYDNEY, NSW, 2001	Project No.	077662060
Project:	Subdivision	Report No.	077662060 / R13
Location:	Buckland Park	Date:	1 May 2008

SAMPLE INFORMATION

Lab Reference No.	0860432	0860432	
Date Sampled	-	-	
Date Tested	7/4/08	7/4/08	
Sample Identification	TP 13/01 0.7 – 0.9m	TP 13/01 0.7 – 0.9m (Unsoaked)	
Laboratory Specimen Description	(CI) Sandy CLAY, low plasticity, brown, approx. 50% fine to coarse sand.	(CI) Sandy CLAY, low plasticity, brown, approx. 50% fine to coarse sand.	

TEST RESULTS

Laboratory Compaction & Moisture Content - Test Methods AS1289 5.1.1 and AS1289 2.1.1

Maximum Dry Density	t/m^3	1.77	1.77	
Optimum Moisture Content	%	16.5	16.5	
Field Moisture Content	%	21.0	21.0	

California Bearing Ratio - Test Method AS1289 6.1.1

CBR TEST	Dry Density t/m^3	Before Soaking	1.73	1.73	
		After Soaking	1.73	-	
	Density Ratio %	Before Soaking	98.0	98.0	
		After Soaking	98.0	-	
	Moisture Content %	Before Soaking	16.5	16.5	
		After Soaking	18.0	-	
	Number of Days Soaked		4	-	
	Surcharge	kg	4.5	4.5	
	Moisture Content After Test %	Top 30mm	17.5	-	
		Whole Sample	17.5	-	
	Swell After Soaking	%	NIL	-	
	CBR Value @	%	8 @ 5.0mm	8 @ 5.0mm	

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California Bearing Ratio Test Report

Client:	Walker Corporation, GPO Box 4073 SYDNEY, NSW, 2001	Project No.	077662060
Project:	Subdivision	Report No.	077662060 / R14
Location:	Buckland Park	Date:	1 May 2008

SAMPLE INFORMATION

Lab Reference No.	0860435	0860435	
Date Sampled	-	-	
Date Tested	7/4/08	7/4/08	
Sample Identification	TP 10/01 0.3 – 0.5m	TP 10/01 0.3 – 0.5m (Unsoaked)	
Laboratory Specimen Description	(CI) CLAY, medium plasticity, grey brown, with fine to coarse sand, trace fine to coarse gravel.	(CI) CLAY, medium plasticity, grey brown, with fine to coarse sand, trace fine to coarse gravel.	

TEST RESULTS

Laboratory Compaction & Moisture Content - Test Methods AS1289 5.1.1 and AS1289 2.1.1

Maximum Dry Density	t/m^3	1.73	1.73	
Optimum Moisture Content	%	18.5	18.5	
Field Moisture Content	%	18.0	18.0	

California Bearing Ratio - Test Method AS1289 6.1.1

CBR TEST	Dry Density t/m^3	Before Soaking	1.69	1.69	
		After Soaking	1.69	-	
	Density Ratio %	Before Soaking	97.5	97.5	
		After Soaking	97.5	-	
	Moisture Content %	Before Soaking	18.5	18.5	
		After Soaking	20.5	-	
	Number of Days Soaked		4	-	
	Surcharge	kg	4.5	4.5	
	Moisture Content After Test %	Top 30mm	21.5	-	
		Whole Sample	20.5	-	
	Swell After Soaking	%	0.15	-	
	CBR Value @	%	11 @ 2.5mm	12 @ 5.0mm	

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California Bearing Ratio Test Report

Client:	Walker Corporation, GPO Box 4073, SYDNEY, NSW, 2001	Project No.	077662060
Project:	Subdivision	Report No.	077662060 / R15
Location:	Buckland Park	Date:	1 May 2008

SAMPLE INFORMATION

Lab Reference No.	0860436	0860436	
Date Sampled	-	-	
Date Tested	7/4/08	7/4/08	
Sample Identification	TP 01/01 0.4 – 0.5m	TP 01/01 0.4 – 0.5m (Unsoaked)	
Laboratory Specimen Description	(CI) Sandy CLAY, medium plasticity, brown, approx. 40% fine to coarse sand. trace fine to medium gravel.	(CI) Sandy CLAY, medium plasticity, brown, approx. 40% fine to coarse sand. trace fine to medium gravel.	

TEST RESULTS

Laboratory Compaction & Moisture Content - Test Methods AS1289 5.1.1 and AS1289 2.1.1

Maximum Dry Density	t/m^3	1.72	1.72	
Optimum Moisture Content	%	16.0	16.0	
Field Moisture Content	%	12.0	12.0	

California Bearing Ratio - Test Method AS1289 6.1.1

CBR TEST	Dry Density t/m^3	Before Soaking	1.68	1.68	
		After Soaking	1.67	-	
	Density Ratio %	Before Soaking	98.0	98.0	
		After Soaking	97.0	-	
	Moisture Content %	Before Soaking	16.0	16.0	
		After Soaking	20.5	-	
	Number of Days Soaked		4	-	
	Surcharge	kg	4.5	4.5	
	Moisture Content After Test %	Top 30mm	20.0	-	
		Whole Sample	20.5	-	
	Swell After Soaking	%	0.80	-	
	CBR Value @ 2.5mm	%	10	13	

Remarks:

Adelaide Laboratory – Accredited Laboratory No. 1961

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Approved Signatory: ____________
Darren Shotton
Laboratory Manager

Golder Associates

Golder Associates Pty Ltd
199 Franklin Street, Adelaide SA 5000

California Bearing Ratio Test Report

Client:	Walker Corporation, GPO Box 4073, SYDNEY, NSW, 2001	Project No.	077662060
Project:	Subdivision	Report No.	077662060 / R16
Location:	Buckland Park	Date:	1 May 2008

SAMPLE INFORMATION

Lab Reference No.	0860437	0860437	
Date Sampled	-	-	
Date Tested	7/4/08	7/4/08	
Sample Identification	TP 04/01 0.2 – 0.4m	TP 04/01 0.2 – 0.4m (Unsoaked)	
Laboratory Specimen Description	(CL) Sandy CLAY, low plasticity, brown, approx. 50% fine to coarse sand.	(CL) Sandy CLAY, low plasticity, brown, approx. 50% fine to coarse sand.	

TEST RESULTS

Laboratory Compaction & Moisture Content - Test Methods AS1289 5.1.1 and AS1289 2.1.1

Maximum Dry Density	t/m^3	1.76	1.76	
Optimum Moisture Content	%	13.0	13.0	
Field Moisture Content	%	5.7	5.7	

California Bearing Ratio - Test Method AS1289 6.1.1

CBR TEST	Dry Density t/m^3	Before Soaking	1.72	1.72	
		After Soaking	1.72	-	
	Density Ratio %	Before Soaking	98.0	98.0	
		After Soaking	98.0	-	
	Moisture Content %	Before Soaking	13.0	13.0	
		After Soaking	16.5	-	
	Number of Days Soaked		4	-	
	Surcharge	kg	4.5	4.5	
	Moisture Content After Test %	Top 30mm	15.0	-	
		Whole Sample	16.0	-	
	Swell After Soaking	%	0.13	-	
	CBR Value	%	5 @ 2.5mm	7 @ 5.0mm	

Remarks:

Adelaide Laboratory – Accredited Laboratory No. 1961

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NATA

Approved Signatory: ____________
Darren Shotton
Laboratory Manager

Golder Associates

Golder Associates Pty Ltd
199 Franklin Street, Adelaide SA 5000

California Bearing Ratio Test Report

Client:	Walker Corporation, GPO Box 4073 SYDNEY, NSW, 2001	Project No.	077662060
Project:	Subdivision	Report No.	077662060 / R17
Location:	Buckland Park	Date:	1 May 2008

SAMPLE INFORMATION

Lab Reference No.	0860438	0860438	
Date Sampled	-	-	
Date Tested	7/4/08	7/4/08	
Sample Identification	TP 07 0.2 – 0.4m	TP 07 0.2 – 0.4m (Unsoaked)	
Laboratory Specimen Description	(CI) CLAY, medium plasticity, brown, trace fine to coarse sand, trace fine gravel.	(CI) CLAY, medium plasticity, brown, trace fine to coarse sand, trace fine gravel.	

TEST RESULTS

Laboratory Compaction & Moisture Content - Test Methods AS1289 5.1.1 and AS1289 2.1.1

Maximum Dry Density	t/m^3	1.52	1.52	
Optimum Moisture Content	%	23.0	23.0	
Field Moisture Content	%	13.3	13.3	

California Bearing Ratio - Test Method AS1289 6.1.1

	Dry Density t/m^3	Before Soaking	1.49	1.49	
		After Soaking	1.47	-	
C	Density Ratio %	Before Soaking	98.0	98.0	
B		After Soaking	96.5	-	
R	Moisture Content %	Before Soaking	22.5	22.5	
		After Soaking	29.5	-	
T	Number of Days Soaked		4	-	
E	Surcharge	kg	4.5	4.5	
S	Moisture Content After Test %	Top 30mm	28.5	-	
T		Whole Sample	29.5	-	
	Swell After Soaking	%	1.53	-	
	CBR Value	%	7 @ 2.5mm	15.0 @ 2.5mm	

Remarks:

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Approved Signatory: ____________
Darren Shotton
Laboratory Manager

Golder Associates

Golder Associates Pty Ltd

199 Franklin Street, Adelaide SA 5000

Particle Size Distribution & Consistency Limits Test Report

Client:	Walker Corporation, GPO Box 4073, Sydney, NSW, 2001		
Project:	Subdivision	**Date:**	29-May-08
Location:	Buckland Park **Job No.** 077662060	**Report No.**	077662060 / R18
Lab Reference No.	0860604	**Sample Identification:**	BH 46 0.5 - 0.65m
Laboratory Specimen Description:	(SC) Gravelly Clayey SAND, fine to coarse grained, pale brown, approx. 40% low plasitcity fines, approx. 30% fine to coarse gravel.		

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification
150 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	99	
19.0 mm	98	
13.2 mm	95	
9.5 mm	90	
6.7 mm	84	
4.75 mm	80	
2.36 mm	72	
1.18 mm	66	
600 um	62	
425 um	60	
300 um	57	
150 um	47	
75 um	39	

Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.2	34	
Plastic Limit	%	AS1289 3.2.1	20	
Plasticity Index	%	AS1289 3.3.1	14	
Linear Shrinkage	%	AS1289 3.4.1	7.0	
Moisture Content	%	AS1289 2.1.1	11.4	

Sample History:	Air Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	No
Linear shrinkage mould length:	250 mm

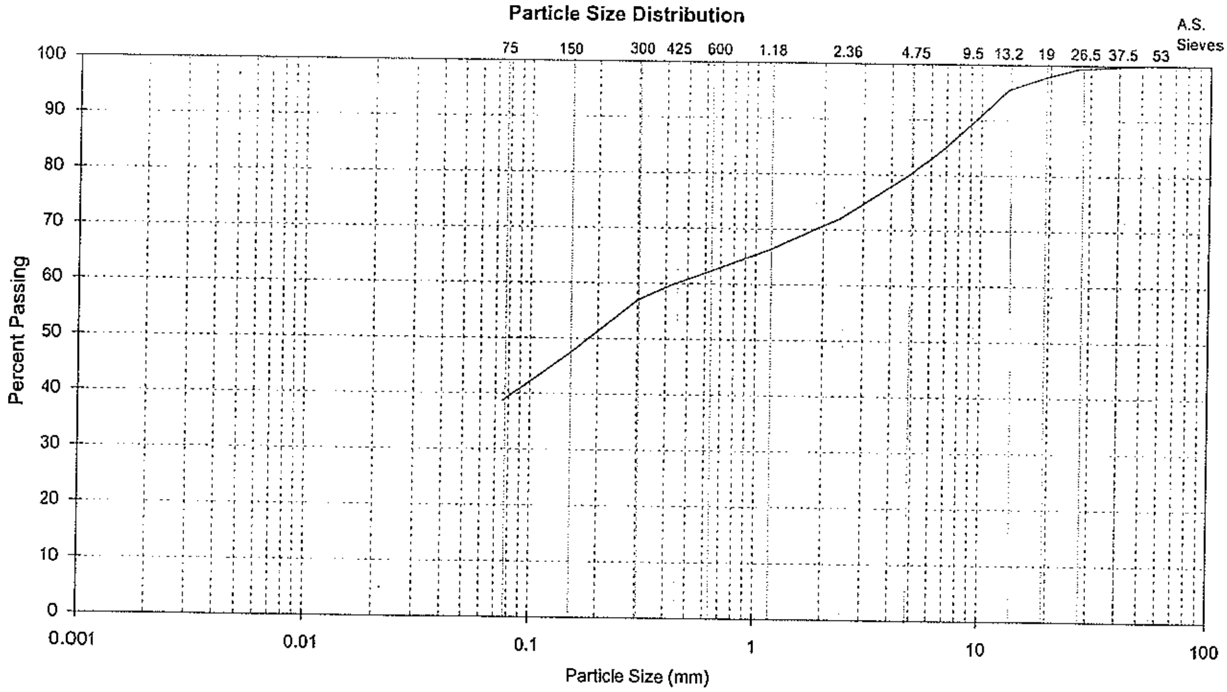
ND = not determined NO = not obtainable NP = non plastic

Moisture / Dry Density Relationship AS 1289 5.1.1

Maximum Dry Density: 1.70 t/m3

Optimum Moisture Content: 16.5 %

Notes



Adelaide Laboratory - Accredited Laboratory No. 1961

AD1069.xls
121006

NATA

Approved Signatory, Darren Shotton - Laboratory Manager

Golder Associates

Golder Associates Pty Ltd
199 Franklin Street, Adelaide SA 5000

California Bearing Ratio Test Report

Client:	Walker Corporation, GPO Box 4073 Sydney, NSW, 2001	Project No.	077662060
Project:	Subdivision	Report No.	077662060 / R19
Location:	Buckland Park	Date:	12 May 2008

SAMPLE INFORMATION

Lab Reference No.	0860604		
Date Sampled	-		
Date Tested	28/4/08		
Sample Identification	BH 46 0.5 – 0.65m		
Laboratory Specimen Description	(SC) Gravelly Clayey SAND, fine to coarse grained, pale brown, approx. 40% low plasticity fines, approx. 30% fine to coarse gravel.		

TEST RESULTS

Laboratory Compaction & Moisture Content - Test Methods AS1289 5.1.1 and AS1289 2.1.1

Maximum Dry Density	t/m^3	1.70		
Optimum Moisture Content	%	16.5		
Field Moisture Content	%	11.4		

California Bearing Ratio - Test Method AS1289 6.1.1

	Dry Density t/m^3	Before Soaking	1.66		
		After Soaking	1.66		
C	Density Ratio %	Before Soaking	97.5		
B		After Soaking	97.5		
R	Moisture Content	Before Soaking	17.0		
	%	After Soaking	22.0		
T	Number of Days Soaked		4		
E	Surcharge	kg	4.5		
S	Moisture Content	Top 30mm	20.0		
T	After Test %	Whole Sample	22.0		
	Swell After Soaking	%	0.08		
	CBR Value @ 5.0mm	%	20.0		

Remarks:

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Approved Signatory:
Darren Shotton
Laboratory Manager

Golder Associates

APPENDIX G

Summary of Sodic and Saline Chemical Test Results

TABLE 1 SUMMARY OF SODIC & SALINE CHEMICAL TESTING
WALKER CORPORATION
BUCKLAND PARK

Sector	Sample ID	Date Sampled	Sample Depth (m)	pH Value	EC	Sulphate as SO4 2-	Chloride	Calcium	Magnesium	Sodium	Potassium	SAR
				pH Unit	µS/cm	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
Central	TP09/03	29/02/2008	2.7-2.8	8.6	1270	380	1450	30	40	1280	30	28
North Sector East	TP01/01	13/02/2008	0.4-0.5	10.0	<1	360	900	10	10	1360	30	55
	TP01/02	13/02/2008	2.7-2.8	9.4	36	220	560	20	170	670	240	10
	TP02/01	13/02/2008	1.0-1.1	9.9	<1	240	380	20	50	1980	160	45
	TP03/02	13/02/2008	0.5-1.0	9.5	100	980	2130	<10	10	2400	20	97
	TP06/01	13/02/2008	0.2-0.4	9.7	235	490	910	<10	<10	1250	<10	51
	TP06/02	13/02/2008	2.6-2.8	9.9	36	140	300	30	160	540	170	8
	BH55/01	18/03/2008	0.0-0.4	6.9	228	80	160	10	10	190	80	8
	BH55/02	18/03/2008	0.4-1.2	8.3	530	300	480	<10	<10	540	10	22
	BH55/03	18/03/2008	1.2-2.1	8.4	297	100	260	<10	20	290	20	10
	BH55/04	18/03/2008	2.1-2.75	8.6	201	80	160	<10	30	190	40	6
	BH55/05	18/03/2008	2.75-3.6	8.6	254	100	170	<10	20	220	30	8
	BH 55/06 (BH60*)	18/03/2008	3.6-6.0	8.7	274	110	180	<10	30	350	50	11
	BH60/01	18/03/2008	0.0-1.6	6.8	277	70	180	30	10	100	20	3
	BH60/02	18/03/2008	1.6-2.4	7.0	870	380	1000	80	90	680	<10	10
	BH60/03	18/03/2008	2.4-3.3	6.8	500	200	540	20	20	410	<10	12
	BH60/04	18/03/2008	3.3-3.45	6.8	549	170	510	20	20	430	<10	12
North Sector West	TP04/01	13/02/2008	0.2-0.4	9.0	994	40	40	20	50	230	100	5
	TP05/01	13/02/2008	0.4-0.6	8.0	235	280	150	110	70	440	90	6
	TP05/02	13/02/2008	2.8-3.0	10.0	100	110	280	<10	<10	470	20	19
	BH43/01	18/03/2008	0.2-1.0	8.8	670	300	490	20	100	820	180	15
	BH43/02	18/03/2008	1.0-1.4	8.9	839	290	760	<10	10	840	30	34
	BH43/03	18/03/2008	1.5-4.0	8.7	1090	360	1250	<10	<10	1160	20	47
	BH43/04	18/03/2008	5.0-5.8	9.2	937	220	1040	<10	<10	1160	20	47
South Sector West	TP11/01	29/02/2008	0.9-1.1	7.9	289	50	280	10	40	260	60	7
	TP11/02	29/02/2008	2.5-2.7	9.2	803	170	690	<10	<10	870	20	35
	TP13/03	29/02/2008	1.9-2.0	8.7	2770	1250	5170	40	60	3890	220	72
	TP14/04	29/02/2008	2.8-3.0	8.8	2660	820	3990	30	40	2880	110	64
	BH40/02	3/04/2008	0.5-0.7	9.7	1510	940	1860	<10	<10	2000	90	81
	BH40/05	3/04/2008	1.4-1.6	9.5	845	370	1050	10	10	1030	50	42
	BH40/06	3/04/2008	1.8-2.0	9.1	1910	810	2330	30	30	2160	80	51
	BH40/09	3/04/2008	4.1-4.3	9.1	1160	350	1620	70	60	1140	50	18
	BH40/10	3/04/2008	5.6-5.8	9.1	1560	980	2580	<10	10	2270	60	92
	BH52/01	3/04/2008	0.0-0.2	8.3	580	360	1080	90	50	700	80	10
	BH52/04	3/04/2008	1.05-1.2	9.2	2620	1040	4630	<10	20	3010	100	104
	BH52/06	3/04/2008	2.4-2.6	9.5	2350	1100	3770	10	20	2750	90	95
	BH52/09	3/04/2008	4.8-5.0	9.4	2250	750	3840	<10	10	2500	110	101
South Sector East	BH46/01	18/04/2008	0.05 - 0.1	8.0	154	10	50	50	10	50	60	1
	BH46/02	18/04/2008	0.4 - 0.5	9.9	713	200	510	20	20	730	60	21
	BH46/03	18/04/2008	0.95 - 1.05	9.4	1010	360	980	<10	<10	1110	40	45
	BH46/04	18/04/2008	1.35 - 1.4	9.0	1120	470	1390	<10	20	1310	50	45
	BH46/05	18/04/2008	2.05 - 2.1	9.1	5950	270	960	<10	10	1000	40	41
	BH46/06	18/04/2008	2.85 - 2.9	9.0	548	160	440	<10	<10	460	20	19
South Sector	TP10/03	29/02/2008	1.4-1.5	9.0	811	140	900	<10	<10	1020	10	41
	TP12/01	29/02/2008	0.2-0.4	9.4	1920	460	2470	<10	<10	2300	60	93
East Sector	BH48/01	18/04/2008	0.1 - 0.2	8.7	798	370	720	60	50	660	260	11
	BH48/02	18/04/2008	0.8 - 0.95	8.8	1040	1830	610	140	30	1180	40	15
	BH48/03	18/04/2008	1.4 - 1.5	9.4	1810	800	1840	<10	<10	1940	50	79
	BH48/04	18/04/2008	2.5 - 2.6	9.8	1030	260	620	<10	<10	1040	40	42

Notes
1. * Sample was incorrectly reported by laboratory as TP60
2. EC - Electrical Conductivity
3. SAR - Sodium Adsorption Ratio

Prepared by	SY	Date	23/05/2008
Checked by		Date	

APPENDIX H

Chemical Testing – Laboratory Results and COCs

Chain of Custody Record - Soil/Sediment Samples

Sheet ..1.. of ...1..

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Buckland Park	DATE RESULTS REQUIRED:	
PROJ No.:	077662060	E-MAIL RESULTS:	abartel@golder.com.au
SAMPLED BY:	AJG	CC RESULTS:	adelaide@golder.com.au
CONTACT:	Anna	LABORATORY:	ALS (Sydney)
		QUOTE No:	EN/002/05

Analyses Required

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	Analyses Required
1	TP01/01	13-2-08			*Please await anayles*
2	TP01/02				
3	TP02/01				
4	TP02/02				
5	TP03/01				
6	TP03/02				
7	TP04/01				
8	TP04/02				
9	TP05/01				
10	TP05/02				
11	TP06/01				
12	TP06/02				
				Totals :	

Environmental Division
Sydney
Work Order
ES0801919
Telephone : + 61-2-8784 8555

Any samples heavily contaminated? No

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	Anna Bartel / Ben	Golder Associates	Yes	Yes	13/2/08	PM	[signature]
RECEIVED BY:	[signature]	AAE	Esky Intact: Yes / No	Security Seals Intact: Yes / No	18/2	PM	[signature]
RELEASED BY:			Yes / No	Yes / No			
RECEIVED BY:	Sey Stephen	ALS Sydney	Esky Intact: Yes / No	Security Seals Intact: Yes / No	14/2/8	10:45am	Say

Laboratory Use Only

Fadi Soro

From: Bartel, Anna [ABartel@golder.com.au]
Sent: Monday, 7 April 2008 3:44 PM
To: Fadi Soro
Cc: O'Malley, Aaron
Subject: Buckland Park

Hi

We spoke on the phone this morning about soil samples you received on Friday (our job number 077662060).

Please test the following samples for pH, major cations and anions, chloride and EC –

BH40/02 1

BH40/05 2

BH40/06 3

BH40/09 4

BH40/10 5

BH52/01 6

BH52/04 7

BH52/06 8

BH52/09 9

Environmental Division
Sydney
Work Order
ES0804727

Telephone : +61-2-8784 8555

Thanks,

Anna.

Anna Bartel | Engineer | **Golder Associates Pty Ltd**
199 Franklin Street, Adelaide, South Australia 5000, Australia
T: +61 8 8213 2100 | **F:** +61 8 8213 2101 | **E:** ABartel@golder.com.au
<mailto:ABartel@golder.com.au> | www.golder.com <http://www.golder.com/>

Chain of Custody Record - Soil/Sediment Samples

Sheet 1 of 1

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Buckland Park	**DATE RESULTS REQUIRED:**	5 days after receipt
PROJ No.:	077662060	**E-MAIL RESULTS:**	aomalley@golder.com.
SAMPLED BY:	JV	**CC RESULTS:**	adelaide@golder.com.au
CONTACT:	Aaron	**LABORATORY:**	ALS Sydney
		QUOTE No:	EN/002/05

Analyses Required

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	pH	Major Anions	Major Cations	Chloride	EC
1	TP43	18/03/2008	Natural	0.2-1.0	/	/	/	/	/
2	TP43	18/03/2008	Natural	1.0-1.4	/	/	/	/	/
3	TP43	18/03/2008	Natural	1.5-4.0	/	/	/	/	/
4	TP43	18/03/2008	Natural	5.0-5.8	/	/	/	/	/
5	TP55	18/03/2008	Natural	0.0-0.4	/	/	/	/	/
6	TP55	18/03/2008	Natural	0.4-1.2	/	/	/	/	/
7	TP55	18/03/2008	Natural	1.2-2.1	/	/	/	/	/
8	TP55	18/03/2008	Natural	2.1-2.75	/	/	/	/	/
9	TP55	18/03/2008	Natural	2.75-3.6	/	/	/	/	/
10	TP55	18/03/2008	Natural	3.6-6.0	/	/	/	/	/
11	TP60	18/03/2008	Natural	0.0-1.6	/	/	/	/	/
12	TP60	18/03/2008	Natural	1.6-2.4	/	/	/	/	/
13	TP60	18/03/2008	Natural	2.4-3.3	/	/	/	/	/
14	TP60	18/03/2008	Natural	3.3-3.45	/	/	/	/	/
				Totals :					

Environmental Division
Sydney
Work Order
ES0803921

Telephone : +61-2-8784 8555

Any samples heavily contaminated? No / Yes ....

Laboratory Use Only

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Siganture
RELEASED BY:	A.O'Malley	Golder Associates	Yes	Yes	18/03/08	PM	
RECEIVED BY:			**Esky Intact** Yes / No	**Security Seals Intact** Yes / No	19/3	Pm	
RELEASED BY:			Yes / No	Yes / No			
RECEIVED BY:		ALS Sydney	**Esky Intact** Yes / No	**Security Seals Intact** Yes / No	20/3/08	12:55pm	

Fadi Soro

FAX: 7/3/8
5:10pm

From: Kieren Burns
Sent: Friday, 7 March 2008 4:09 PM
To: Samples Sydney
Subject: FW: Additional Testing Request

Can you please action this request

Regards

Kieren Burns

Environmental Services Representative

ALS Laboratory Group

Adelaide, Australia

Tel: +61 8 8359 0890

Fax: +61 8 8359 0875

Mob: 0448 527 608

www.alsglobal.com <http://www.alsglobal.com/>

WOES0801919

WOES0802451

1 TP01/01 - 13-2-08
2 TP05/02 - 13-2-08.
3 TP06/01
4 TP01/01
5 TP02/01
6 TP03/02
7 TP04/01
8 TP05/01
9 TP06/02

Environmental Division
Sydney
Work Order
ES0803202

Telephone : +61-2-8784 8555

From: Young, Sarah [mailto:syoung@golder.com.au]
Sent: Friday, 7 March 2008 3:20 PM
To: Ashwini Sharma
Cc: Kieren Burns
Subject: Additional Testing Request

Can I please have the following samples analysed for EC (if not out of holding time);

- 5322 ES0802451 (samples 001, 002, 003)
- ES0801919 (samples 002, 003, 006, 007, 009 & 012) 5233

Thanks

Sarah

Chain of Custody Record - Soil/Sediment Samples

Sheet 1 of 1

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT:	Buckland Park	DATE RESULTS REQUIRED:	5 days after receipt
PROJ No.:	077662060	E-MAIL RESULTS:	syoung@golder.com.au
SAMPLED BY:	SY	CC RESULTS:	adelaide@golder.com.au
CONTACT:	Sarah	LABORATORY:	ALS Sydney
		QUOTE No:	EN/002/05

Analyses Required

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	pH	Major Anions	Major Cations	Chloride	EC
1	TP09/03	29/02/2008	Natural		/	/	/	/	/
2	TP10/03	29/02/2008	Natural		/	/	/	/	/
3	TP11/01	29/02/2008	Natural		/	/	/	/	/
4	TP11/02	29/02/2008	Natural		/	/	/	/	/
5	TP12/01	29/02/2008	Natural		/	/	/	/	/
6	TP13/03	29/02/2008	Natural		/	/	/	/	/
7	TP14/03	29/02/2008	Natural		/	/	/	/	/
8	TP14/04	"	"		/	/	/	/	/
				Totals :					

Environmental Division
Sydney
Work Order
ES0803070
Telephone : +61-2-8784 8555

Any samples heavily contaminated? No / Yes ....

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Siganture
RELEASED BY:	S.Young	Golder Associates	Yes	Yes	5/03/08	PM	[signature]
RECEIVED BY:	[signature]	ADE	Esky Intact Yes / No	Security Seals Intact Yes / No	5/3	Pm	[signature]
RELEASED BY:			Yes / No	Yes / No			
RECEIVED BY:	Fadi	ALS	Esky Intact Yes / No	Security Seals Intact Yes / No	6/3/8	9am	[signature]

Laboratory Use Only

5233

DADI 25/2/8 5:50pm

Fadi Soro

From: Ashwini Sharma
Sent: Monday, 25 February 2008 3:39 PM
To: Samples Sydney; Kerry Stefanovic
Cc: Nanthini Coilparampil
Subject: FW: Work order ES0801919

Fadi/Frank

Can you please rebatch as per the clients request

Kerry

Can you please assign an SRA date of 03/03/08.

Environmental Division
Sydney
Work Order
ES0802451

Telephone : +61-2-8784 8555

Thanks

Ashwini Sharma

Laboratory Manager
ALS Laboratory Group
Environmental Division
Sydney, Australia
Phone: + 61 2 8784 8555
Fax: + 61 2 8784 8500
www.alsglobal.com <file:///C:\Documents%20and%20Settings\victor.kedicioglu\Application%20Data\Microsoft\Signatures\www.alsglobal.com>

From: Young, Sarah [mailto:syoung@golder.com.au]
Sent: Monday, 25 February 2008 1:36 PM
To: Ashwini Sharma
Cc: Kieren Burns
Subject: Work order ES0801919

Hi Ashwini

As discussed on the phone can I please order additional testing for samples sent to you with the above work order number. I require samples TP01/01, TP05/02 and TP06/01 to be tested for saline & sodic (as the other samples have been tested). Can I please have the results emailed to me as the other Golder contact will be working away for

These samples were sent overnight on 21/4/08.

FAXED 22/4/08

Chain of Custody Record - Soil/Sediment Samples

Sheet 1 of 1

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT: Buckland Park — DATE RESULTS REQUIRED: 5 days after receipt

PROJ No.: 077662060 — E-MAIL RESULTS: syoung@golder.com.au

SAMPLED BY: JV — CC RESULTS: adelaide@golder.com.au

CONTACT: Sarah — LABORATORY: ALS Sydney FAX 02 8784 8500

QUOTE No:

Analyses Required

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	pH	Major Anions	Major Cations	Chloride	EC
1	BH 46/01	18/4/08	N	0.05 - 0.10	/	/	/	/	/
2	BH 46/02	18/4/08	N	0.4 - 0.5	/	/	/	/	/
3	BH 46/03	18/4/08	N	0.95 - 1.05	/	/	/	/	/
4	BH 46/04	18/4/08	N	1.35 - 1.4	/	/	/	/	/
5	BH 46/05	18/4/08	N	2.05 - 2.1	/	/	/	/	/
6	BH 46/06	18/4/08	N	2.85 - 2.9	/	/	/	/	/
7	BH48/01	18/4/08	N	0.1 - 0.2					
8	BH48/02	18/4/08	N	0.8 - 0.95					
9	BH48/03	18/4/08	N	1.4 - 1.5					
10	BH48/04	18/4/08	N	2.5 - 2.6					
				Totals:					

Environmental Division
Sydney
Work Order
ES0805558

Telephone: +61-2-8784 8555

Any samples heavily contaminated? No / Yes ....

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	NH	Golder Associates	Yes / No	Yes / No	21/4/08	3pm	NH
RECEIVED BY:	Les	AAE	Esky Intact Yes / No	Security Seals Intact Yes / No	21/4	8pm	
RELEASED BY:			Yes / No	Yes / No			
RECEIVED BY:	Frank	ALS	Esky Intact Yes / No	Security Seals Intact Yes / No	22/4/8	1400	

Laboratory Use Only

Chain of Custody Record - Soil/Sediment Samples

Sheet 1 of 1

Golder Associates Pty Ltd
199 Franklin Street, Adelaide, SA, 5000
Phone: 08 8213 2100
Facsimile: 08 8213 2101

Golder Associates

PROJECT: Buckland Park **DATE RESULTS REQUIRED:** 5 days after receipt
PROJ No.: 077662060 **E-MAIL RESULTS:** syoung@golder.com.au
SAMPLED BY: JV **CC RESULTS:** adelaide@golder.com.au
CONTACT: Sarah **LABORATORY:** ALS Sydney
QUOTE No:

Analyses Required

Laboratory ID	Sample ID (eg. 3823-BH1/1)	Date Sampled	Inferred Soil Horizon (eg. Fill, Natural)	Sample Depth (m)	pH	Major Anions	Major Cations	Chloride	EC
	BH 46/01	18/4/08	N	0.05 - 0.10					
	BH 46/02	18/4/08	N	0.4 - 0.5					
	BH 46/03	18/4/08	N	0.95 - 1.05					
	BH 46/04	18/4/08	N	1.35 - 1.4					
	BH 46/05	18/4/08	N	2.05 - 2.1					
	BH 46/06	18/4/08	N	2.85 - 2.9					
	BH48/01	18/4/08	N	0.1 - 0.2					
	BH48/02	18/4/08	N	0.8 - 0.95					
	BH48/03	18/4/08	N	1.4 - 1.5					
	BH48/04	18/4/08	N	2.5 - 2.6					
				Totals:					

Complete COC to be faxed 22/4/08

Any samples heavily contaminated? No / Yes ....

	Name	Organisation	Samples Intact?	Samples Chilled?	Date	Time	Signature
RELEASED BY:	NJ	Golder Associates	Yes / No	Yes / No	21/4/08	3pm	NJ
			Esky Intact	*Security Seals Intact*			
RECEIVED BY:	Lo	AAE	Yes / No	Yes / No	21/4	8pm	
RELEASED BY:			Yes / No	Yes / No			
			Esky Intact	*Security Seals Intact*			
RECEIVED BY:			Yes / No	Yes / No			

Laboratory Use Only

Fadi Soro

From: Bartel, Anna [ABartel@golder.com.au]
Sent: Monday, 7 April 2008 3:44 PM
To: Fadi Soro
Cc: O'Malley, Aaron
Subject: Buckland Park

Hi

We spoke on the phone this morning about soil samples you received on Friday (our job number 077662060).

Please test the following samples for pH, major cations and anions, chloride and EC –

BH40/02 1	10 BH40/01 03-4-8
BH40/05 2	11 BH40/03
BH40/06 3	12 BH40/04
BH40/09 4	13 BH40/07
BH40/10 5	14 BH40/08

BH52/01 6	15 BH52/02 03-4-8
BH52/04 7	16 BH52/03
BH52/06 8	17 BH52/05
BH52/09 9	18 BH52/07
	19 BH52/08

Environmental Division
Sydney
Work Order
ES0804727

Telephone : +61-2-8784 8555

Thanks,

Anna.

CONTRACT WORK
WO: ES0804727
LAB: ALS Brisbane
DATE: 08/4/8
SPLIT:

Anna Bartel | Engineer | **Golder Associates Pty Ltd**
199 Franklin Street, Adelaide, South Australia 5000, Australia
T: +61 8 8213 2100 | **F:** +61 8 8213 2101 | **E:** ABartel@golder.com.au
<mailto:ABartel@golder.com.au> | www.golder.com <http://www.golder.com/>

APPENDIX I

Important Information About Your Geotechnical Engineering Report

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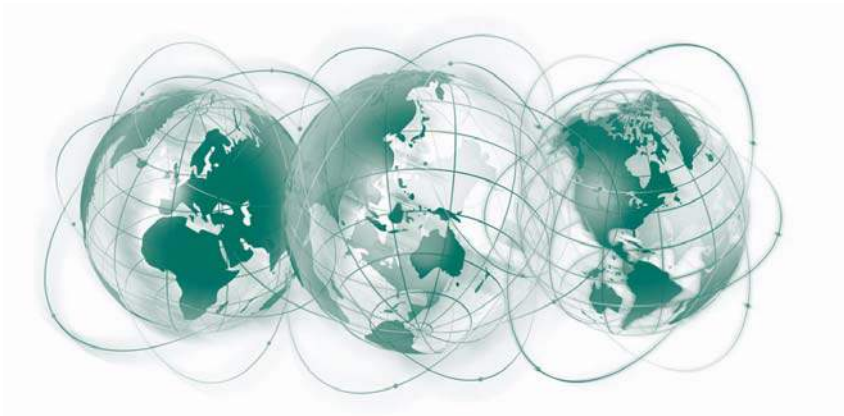

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