Lots 19 - 21 Old Coast Rd, Lake Clifton - Park Home Redevelopment

Environmental Impact Assessment Document

Beck Advisory

science+design

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1.0 Introduction

1.1 Background

The Tony Scolaro Family Trust intends to redevelop an existing caravan park on Lot 21 Old Coast Road, Lake Clifton into a Park Home Estate (the Proposal) under a Development Approval. The site is located within the Shire of Waroona, approximately 100 km south of the Perth Central Business District (**Map 1**). The total area of the site is approximately 6.05 ha.

The Proposal was referred to the Environmental Protection Authority (EPA) for assessment on 26 August 2009, who indicated that further information would be required to allow assessment potentially under the Environmental Protection Statement process (now the Assessment on Proponent Information (API) process). The EPA requested that the proponent demonstrate how the following EPA objectives for the Lake Clifton Catchment, as outlined in Guidance Statement No. 28 *Protection of the Lake Clifton Catchment* (EPA 1998), could be achieved during implementation of the Proposal:

1. Water balance: new developments should be managed so that the water balance following development is as close to pre-development water balance as possible.
2. Nutrient loads: new developments should be managed so that phosphorus and nitrogen export to the lake catchment is negligible. At a minimum, a reduction should be achieved.
3. Regionally significant wetlands: new developments should be managed such that direct impacts of humans and stock do not cause physical damage to the thrombolites, wetland vegetation, fringing wetland vegetation and dryland buffer of Lake Clifton.

1.2 Purpose of this Document

The purpose of this Environmental Impact Assessment document is to provide a description of the proposed Park Home Redevelopment, to assess its potential environmental impacts and demonstrate how impacts will be addressed through relevant management processes.

This document provides the following information:

- description of the proposal
- characterisation of the receiving environment
- identification of key environmental factors
- findings of studies undertaken to identify and describe key environmental factors and their significance
- discussion of direct and indirect impacts of the proposal should it be implemented
- identification of management measures to be implemented to mitigate significant damaging impacts

- details of stakeholder consultation conducted and responses to issues raised
- details of approval and relevant management processes relevant to the Proposal outside of the *Environmental Protection Act 1986*.

1.3 Proponent Details

The proponent for this Proposal is the Tony Scolaro Family Trust who has appointed Beck Advisory as their agent to act on their behalf.

The contact person at Beck Advisory for this proposal is:

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1.4 Assessment Approach

Assessment of the environmental impacts of the proposal within this document has been conducted in accordance with:

- Environmental Assessment Guideline No 1 - *Defining the Key Characteristics of a Proposal* (EPA 2012)
- Guide to EIA Environmental Principles, Factors and Objectives (EPA 2010b)
- Environmental Impact Assessment Administrative Procedure 2010 (EPA 2010a).

EPA Position Statements considered relevant are:

- Position Statement No. 4 *Environmental Protection of Wetlands* (EPA 2004c)
- Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biological Diversity* (EPA 2002)
- Position Statement No. 7 *Principles of Environmental Protection* (EPA 2004d).

EPA Guidance Statements considered relevant are:

- Guidance Statement No. 10 *Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region* (EPA 2006)
- Guidance Statement No. 28 *Protection of the Lake Clifton Catchment* (EPA 1998)
- Guidance Statement No. 33 *Environmental Guidance for Planning and Development* (EPA 2008)
- Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004a)

- Guidance Statement No. 56 *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004b).

EPA Protection Policies

- *Environmental Protection Swan Coastal Plain Lakes Policy* (EPA 1992).

1.5 Applicable Legislation

This proposal is subject to State and Commonwealth environmental legislation. The key State legislation applicable in this case are:

- *Environmental Protection Act 1986*
- *Rights in Water and Irrigation Act 1914*
- *Wildlife Conservation Act 1950.*

Other relevant State legislation includes, but is not limited to:

- *Aboriginal Heritage Act 1972*
- *Agriculture and Related Resources Protection Act 1976*
- *Bush Fires Act 1954*
- *Contaminated Sites Act 2003*
- *Health Act 1911*
- *Heritage of Western Australia Act 1990*
- *Litter Act 1979*
- *Local Government Act 1995*
- *Main Roads Act 1930*
- *Planning and Development Act 2005*
- *Soil and Land Conservation Act 1945.*

Key Commonwealth legislation applicable:

- *Environment Protection and Biodiversity Conservation Act 1999.*

2.0 Proposal Description and Key Characteristics

2.1 Proposal Overview

Lot 21 Old Coast Rd is currently used as a caravan park. The Proposal will involve the construction of new infrastructure including 120 park homes (demountable houses), associated access roads, a new wastewater treatment plant (WWTP) and infiltration areas for stormwater and treated wastewater (**Figures 1** & **2**). The development will not involve a subdivision and all of the land will continue to be managed by the current owner, who will take responsibility for the maintenance of infrastructure.

Park homes will be selected by the buyer and installed by the developer. The park homes will be bought and leased by new occupants with some to be retained by the developer for rental as holiday accommodation. The development will operate as a leased estate and owners will pay a fee to the developer for the upkeep of infrastructure and communal open space.

2.2 Key Characteristics

Table 1: Summary of the Proposal

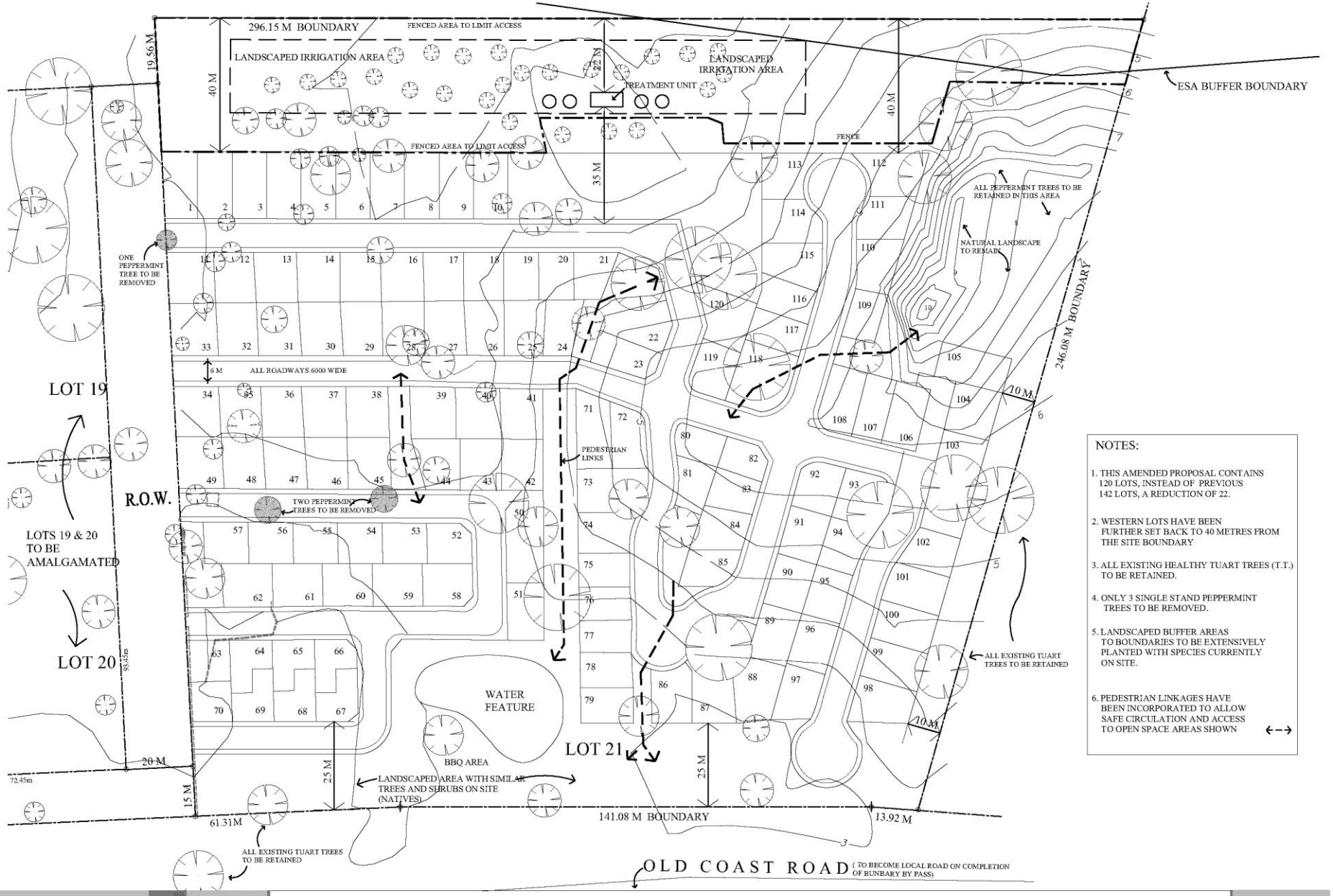
Proposal Title	Park Home Redevelopment - Lot 21 Old Coast Rd Lake Clifton
Proponent Name	Tony Scolaro Family Trust
Short description	This proposal is to redevelop an existing caravan park on Lot 21 Old Coast Rd, Lake Clifton into a park home estate, including the construction of 120 park homes, associated access roads, WWTP and infiltration areas for stormwater and treated wastewater.

Table 2: Physical Elements of Proposal

Element	Location	Proposed Extent
Park Home Lots	Figure 1	120 Lots, 2.3 ha total extent, 1.7 ha in previously cleared areas
Roads and road reserve	Figure 1	1.1 ha total extent, 0.7 ha in previously cleared areas
Wastewater Treatment Plant	Figure 1	91 m^2 wholly within previously cleared area
Treated Wastewater Irrigation Area	Figure 1	0.83 ha in total, 0.68 ha within previously cleared areas
Nutrient Stripping Basins	Figure 2	Basin 1 Total Area 1660 m^2 Basin 2 Total Area 1286 m^2 Basin 3 Total Area 1210 m^2 all within previously cleared areas

Table 3: Operation Elements of Proposal

Element	Location	Proposed Extent
Groundwater Abstraction	From two existing production bores. One bores is located in a proposed lot and will be relocated to a site more than 200 m from the boundary of Lake Clifton.	Maximum 2,000 kL/ha/yr or 12,000 kL/yr
Treated Wastewater Infiltration	Figure 1	Maximum 8.3 ML/yr



NOTES:

1. THIS AMENDED PROPOSAL CONTAINS 120 LOTS, INSTEAD OF PREVIOUS 142 LOTS, A REDUCTION OF 22.
2. WESTERN LOTS HAVE BEEN FURTHER SET BACK TO 40 METRES FROM THE SITE BOUNDARY
3. ALL EXISTING HEALTHY TUART TREES (T.T.) TO BE RETAINED.
4. ONLY 3 SINGLE STAND PEPPERMINT TREES TO BE REMOVED.
5. LANDSCAPED BUFFER AREAS TO BOUNDARIES TO BE EXTENSIVELY PLANTED WITH SPECIES CURRENTLY ON SITE.
6. PEDESTRIAN LINKAGES HAVE BEEN INCORPORATED TO ALLOW SAFE CIRCULATION AND ACCESS TO OPEN SPACE AREAS SHOWN ←→

DOEPEL MARSH

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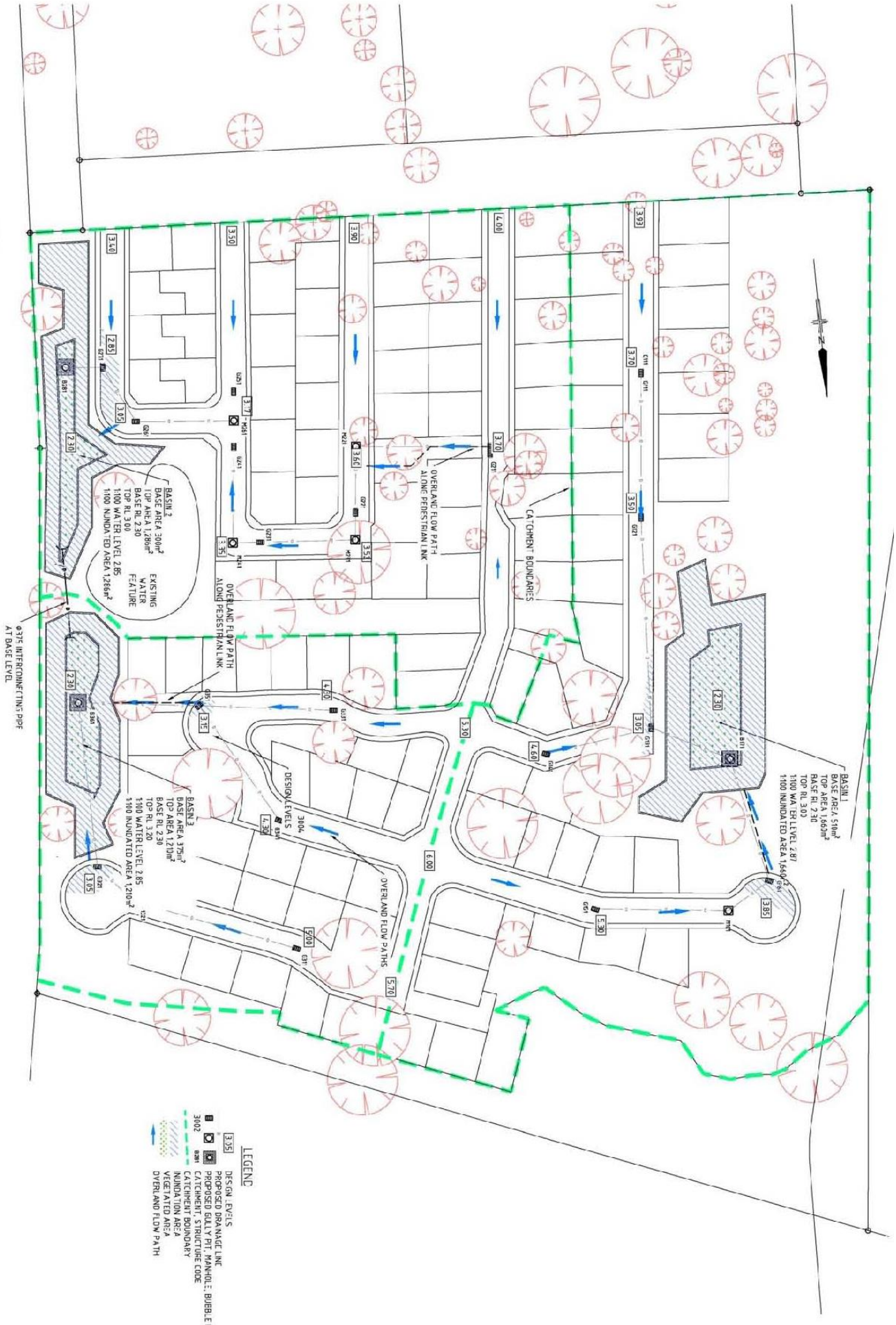
AMENDED PARK HOME SITE PLAN
SCALE 1:500

LAKE CLIFTON DEVELOPMENT
LOT 21 OLD COAST ROAD, LAKE CLIFTON

JOB NO. 28.31
DATE: 15th FEB. 13


BASIN 2
BASE AREA 300m²
TOP AREA 1,280m²
BASE RL 2.30
TOP RL 3.00
1:100 WATER LEVEL 2.85
1:100 INUNDATED AREA 1,260m²
EXISTING WATER FEATURE
BASIN 3
BASE AREA 375m²
TOP AREA 1210m²
BASE RL 2.30
TOP RL 3.20
1:100 WATER LEVEL 2.85
1:100 INUNDATED AREA 1,210m²
BASIN 1
BASE AREA 510m²
TOP AREA 1,660m²
BASE RL 2.30
TOP RL 3.00
1:100 WATER LEVEL 2.87
1:100 INUNDATED AREA 1,660m²
Ø375 INTERCONNECTING PIPE AT BASE LEVEL
OVERLAND FLOW PATH ALONG PEDESTRIAN LINK
OVERLAND FLOW PATH ALONG PEDESTRIAN LINK
CATCHMENT BOUNDARIES
DESIGN LEVELS
OVERLAND FLOW PATHS
LEGEND
DESIGN LEVELS
PROPOSED DRAINAGE LINE
PROPOSED GULLY PIT MANHOLE: BUBBLE UP
CATCHMENT STRUCTURE CODE
CATCHMENT BOUNDARY
INUNDATION AREA
VEGETATED AREA
OVERLAND FLOW PATH

It should be noted that the caravan park was not originally designed for long term residents, and therefore its current capacity was not developed for this purpose. Given that a high proportion of the parks existing residents are permanent, this highlights a need for longer term accommodation in the area, particularly for semi and non-working retirees, and those seeking a weekender/tourism option.

The proposed redevelopment of the existing caravan site into a more appropriate modern park home facility has a significant local and regional importance. If approved, the development will provide additional affordable low cost accommodation, predominantly for people aged over fifty five years. The site could also accommodate families as permanent or semi-permanent residents; or may provide an attractive tourist destination and stopover hub for motorists and tourists travelling to Perth and the Southwest of the State.

The proposed redevelopment is also strategically located close to expanding and developing areas within the Southwest coastal urban expansion corridor. For example, there are long term plans to develop the land at Preston Beach, which is likely to be a substantial community. The site is also adjacent to major transport links, including the Forrest Highway, and has good access to Perth, Mandurah, Bunbury and locally to the township of Waroona.

2.4 Schedule

The redevelopment of the site will commence upon development approval from the Shire of Waroona, which is contingent on final environmental approval from the EPA.

2.5 Proposal Description

2.5.1 SITE SELECTION

The Scolaro family purchased the existing caravan park on Lot 21 Old Coast Road in 2004, along with adjoining Lots 19 and 20. The combined area of the Lots owned by the family constitutes approximately 80% of the commercial zoned land in the Lake Clifton Township, and to date Lot 21 has been operated as a caravan park designed primarily for temporary residence.

2.5.2 DISTURBANCE AREA

The proposal will involve disturbance of up to 4.64 ha to establish the 120 lots, associated access roads, stormwater management infrastructure, wastewater treatment plant and effluent irrigation area. It should be noted that 3.49 ha (75.2%) of this has previously been disturbed.

2.6 Tenure

The Site is currently zoned as Rural under the Peel Region Scheme (Western Australian Planning Commission 2003), and is also designated at Special Use within the Shire of Waroona's Town Planning Scheme (**Map 2**).

3.0 Environmental Impact Assessment Methodology

This section outlines those environmental factors relevant to the Proposal consistent with EPA Principles of Environmental Protection and outlines how the proponent has considered these principles in the design and subsequent implementation of the Proposal (**Table 4**).

3.1 Key Environmental Factors

Key environmental factors were identified via a process encompassing interpretation of EPA assessment guidelines and issues identified during consultation with key stakeholders.

The key environmental factors identified during this process and addressed in detail within this environmental review document are:

1. flora and vegetation
2. terrestrial fauna
3. water balance
4. water quality
5. Lake Clifton.

Each of these key environmental factors is addressed in relation to the proposal in **Section 6**.

3.2 Consistency with Environmental Principles

Table 4: Consistency with Principles of Environmental Protection

Environmental Protection Principle	Consideration given in the Proposal	Relevant Part
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by: • careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and • an assessment of the risk-weighted consequences of various options.	The evolution of the Proposal has sought, via consultation and detailed site assessments, to maximise opportunities and minimise negative impacts to the key environment values of the local environment. Significant redesign of the Proposal has occurred throughout the design phase based upon concerns/issues identified including a large reduction in lot number to minimise the amount of native vegetation clearing.	See detailed assessment of major environmental factors in Section 6.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	Beyond the protection measures outlined in Sections 6 and 10, ongoing management and monitoring is proposed to maintain the environmental values of the areas.	See Sections 7 and 8 of Urban Water Management Plan (**Appendix Two**) for details of proposed ongoing monitoring, maintenance and commitments of the proponent.
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Biological investigations have been conducted to identify key pre-existing values of environmental significance. The design and evolution of the Proposal has sought to avoid in the first instance, or otherwise minimise, potential impact to these local values.	See Section 6 that outlines studies conducted and management/mitigation measures aimed at conserving biological diversity and ecological integrity.

Environmental Protection Principle	Consideration given in the Proposal	Relevant Part
4. The principle relating to improved valuation, pricing and incentive mechanisms (1) Environmental factors should be included in the valuation of assets and services. (2) The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. (3) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes. (4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.	The proponent understands that the total cost of the Proposal must include environmental impact management/mitigation, monitoring and closure activities. These associated costs have been incorporated into the total project costs. No outside funding is being sought for this development.	See Section 7 and 8 of UWMP for developer commitments for the life of the Proposal.
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Waste management of the Proposal has been designed to in order of priority: • reduce and reuse at source • reuse and recycle • treat and/or dispose.	Addressed in Section 6, with particular focus on wastewater and stormwater management.

4.0 Stakeholder Consultation

Beck advisory initially commissioned Coakes Consulting to undertake a Social Impact Statement (SIS) in 2009 to assess and predict the likely social consequences of a wider development that also included a proposed commercial development in conjunction with the upgrade of existing facilities (tavern and bakery) on Lots 19 and 20. The proposed park home development was also more intensive in comparison that currently proposed and included the provision of 10 chalets and approximately 205 park home sites across Lots 19 and 21. A full copy of the SIS that outlines the initial design of the development is provided in **Appendix One.**

During the SIS key stakeholders were consulted via personal meetings and telephone interviews to obtain the views and perceptions of stakeholders in and around the proposed Lake Clifton caravan park site and within the broader community. A total of 50 people were interviewed across the following sectors: Local Government, existing caravan park residents, neighbouring Lake Clifton residents, local community groups and service providers. Concerns/issues raised during this process informed the revision of the development plan to its current state, most notably:

- the number of park home lots was reduced down to 120 entirely within Lot 21
- western lots were further set back to 40 m from the lot boundary
- Retention of the relatively less disturbed vegetation in the north west of the development and all healthy Tuart trees wherever practicable.

Further follow up consultation has been undertaken with the DEC, DoW and Peel Preservation Group and to help inform the evolution of the development and ensure that the Proposal seek to maximise opportunities and minimise negative impacts to the environment and local community.

A summary of the key stakeholders consulted during the development of the Proposal is outlined below:

GOVERNMENT AGENCIES

Commonwealth

- Department for Sustainability, Environment, Water, Population and Communities (DSEWPaC)

State

- Office of the Environmental Protection Authority (OEPA)
- Department of Environment and Conservation (DEC) – Swan regional office
- Department of Water (DoW) – Kwinana/Peel Region

Local

- Shire of Waroona

NONGOVERNMENT AGENCIES

- Peel Preservation Group

COMMUNITY

- Caravan Park Manager
- Caravan Park Residents
- Trans WA
- South West Coach Lines
- Serpentine Park Home Village
- Banksia Tourist Park
- Dawesville Caravan Park
- Waroona Playgroup
- The Lake Clifton Progress Association
- Lake Clifton Volunteer Fire Brigade
- Blue Wren Park
- LC's Café and Bakery
- Forest House Medical Group in Waroona
- Infant Health and Immunisation Clinic in Waroona
- Miami Medical Centre
- Gemini Medical Centre
- Peel Health Campus
- Quambie Park (Pam Corkers House)
- YMCA Early Starts Childcare Centre
- Waroona Play Group
- St Joseph's Catholic Primary School
- Waroona District High School
- Pinjarra Senior High School
- Waroona Police
- Mandurah Police
- St Johns Ambulance
- Neighbouring Land Owner.

Table 5: Topics discussed during consultation with key stakeholders

Date	Stakeholder/s	Purpose/Issue	Response
February 2009 Telephone interviews conducted by Coates Consulting (full report presented in **Appendix One**).	*Local Government* • Shire Planners (2 people) • Shire Councillors (1 person) *Caravan Park Residents* • Permanent Full-time Resident Site Owners (11 people) • Permanent Holiday Site Owners (2 people) *Community Groups* • Lake Clifton Progress Association (10 people) • Neighbouring Landholder (1 person) *Service Providers* • LC's Bakery and Café (1 person) • Blue Wren Caravan Park (2 people) • Aged Care Facility (1 person) • Childcare Providers (2 people) • Primary Schools (1 person) • High School / District High School (2 people) • Emergency Services (e.g. Police) (4 people) • Health Providers (e.g. Medical Centres, General Practitioners) (5 people) • Transport Operators (2 people) • Other Park Home Site Managers (3 people)	Concern expressed regarding over taxing of the existing water supply and impacts on the water table	The development will keep groundwater demands below 2000 kL/ha/yr or 12 000 kL/yr for the development, as required by the South West Coastal Groundwater Area Groundwater Management Plan (Water Authority of Western Australia 1989), which sets allocations for the Lake Clifton area. The current estimates of demand post development in the Urban Water Management Plan (UWMP, see **Appendix Two**) are approximately 9 800 kL/yr. Current total water use for the site is estimated at 3 900 kL/yr (Strategen 2013). Groundwater levels on the site are not anticipated to change as a result of the Proposal. It is anticipated that any potential impacts of groundwater abstraction, and associated required management measures, can be dealt with in detail by the DoW through the licensing process under the *Rights in Water and Irrigation Act 1914*.
		Concern regarding sewerage infrastructure for an increased resident population	Wastewater on the site will be collected and treated using a Membrane Biological Reactor (MBR) type WWTP and effluent disposal area. The plant will be designed to achieve a very high effluent quality of 5 mg/L total nitrogen and 1 mg/L total phosphorus. The size of the effluent disposal (irrigated) area (0.9 ha) has been designed to meet this load criteria according to DoW guidelines (see Section 4.3.1 of UWMP, **Appendix Two**). Using the more conservative Department of Health (DoH) volume estimates for wastewater, the nutrient load drops from 359 kg/yr TN to 41 kg/yr TN and from 32 kg/yr TP to 8 kg/yr TP post development.
		Proximity of the development to the wetlands	A wetland boundary delineation study was undertaken by Ecoscape to better delineate the boundary of Lake Clifton. This boundary was based on the presence of wetland vegetation and other factors in accordance with Draft Guideline for the Determination of Wetland Buffer Requirements and discussions with the DEC (Western Australian Planning Commission 2005). The development has been designed to avoid infrastructure being placed within 50 m of conservation category wetland boundary.
		Impacts on fauna such as local birdlife	While some impacts to common and abundant animals may occur as a result of the proposal, it is unlikely that significant impact to any local or subregional populations of native terrestrial fauna would occur. The management measures proposed will ensure disturbance to remaining habitat is kept to that which is necessary, and adjoining habitat is protected as far as practicable.

Date	Stakeholder/s	Purpose/Issue	Response
		Impacts on existing stands of Tuart trees as a result of park development	Design revised to minimise clearing and retain the relatively less disturbed vegetation in the north west of the development and all healthy Tuart trees wherever practicable.
		Impacts on the wetlands and thrombolites through increased human traffic in the area.	The development is currently fenced to prevent access to the air strip and beyond that, Lake Clifton. This fencing is proposed to be retained.
24 April 2009	DSEWPaC (then DEWHA, Janine Douglas) Response letter provided in **Appendix Three**	Clarification of potential for the Proposal to impact on matters of national significance protected under the *EPBC Act 1999.*	The Department advised the proposed development is unlikely to have a significant impact on the following matters of national significance; threatened species, such as Baudin's Black Cockatoo and Western Ringtail Possum and Lake Clifton which is part of the RAMSAR listed Peel-Yalgorup wetland system.
24 November 2009	OEPA	Discuss referral of Proposal, likely level of assessment and further information required.	Proponent committed to undertake additional studies to allow the EPA to assess the Proposal potentially via the EPS process, and clarify how it could meet the EPA objectives for the Lake Clifton Catchment.
1 December 2009	DoW (Chantelle Doorn) Response letter provided in **Appendix Three**	Discussion of required works to satisfy DoW requirements	Proponent to undertake groundwater monitoring pre and post development. Stormwater/Local/Urban Water Management Plan to be developed in consultation in DoW.
3 May 2010	DoW (Tom Lerner)	Clarification of requirements of Water Management Plan	Proposed scope of work submitted to DoW for approval and comment.
25 June 2010	Peel Preservation Group Response letter provided in **Appendix Three**	Concerned about the level of population density associated with the Proposal will directly impact on the thrombolites	No access to Lake Clifton is proposed and existing fencing is to be retained. Prevent access to the Lake will avoid physical damage to the fringing wetland vegetation, associated fauna habitat and thrombolite community as a result of human traffic.
		Potential for Proposal to increase the amount of nutrient discharge into Lake Clifton	Nutrient balance calculations contained in UWMP estimate post-development nutrient loads are reduced to 140 kg/yr TN and 24 kg/yr TP. This is less than half the nutrient load in the pre-development scenario. The development therefore offers a significant improvement in nutrient loads compared to the current scenario.
		Lowering of watertable as a result of groundwater abstraction need to service the Proposal	Groundwater levels on the site are not anticipated to change as a result of the Proposal, as the site represents such a small portion of the boundary of Lake Clifton. It is anticipated that potential impact of groundwater abstraction, and required management measures, can be adequately addressed via the DoW licencing process.
		Removal of mature Tuarts, associated reduction in Black Cockatoo breeding habitat	All healthy Tuarts to be retained where ever practicable.
10 August 2010	DEC (Lyndon Mutter – Swan Region Office)	Need to control/manage access to Lake Clifton	No access to Lake Clifton is proposed as part of the Proposal. Lot 21 is separated from the Lake by an adjoining lot not owned by the Proponent. The development is currently fenced along this boundary to prevent access to the air strip and beyond that, Lake Clifton. This fencing is proposed to be retained.

Date	Stakeholder/s	Purpose/Issue	Response
		Extent of groundwater abstraction	Groundwater to be used for non-potable uses only. Estimated yield of groundwater abstraction to be 9 800 kL/yr. Potential impacts of abstraction and required management measures to be addressed via the DoW licencing process.
		Management of wastewater	Post development volume estimates for wastewater, calculate that nutrient loads will drops from 359 kg/yr TN to 41 kg/yr TN and from 32 kg/yr TP to 8 kg/yr TP. The size of the effluent disposal irrigation area has been designed according to this nutrient loading and DoW guidelines.
		Impacts to Black Cockatoo roosting habitat	All healthy Tuarts to be retained where ever practicable.
		Potential of contamination from neighbouring prior land use (former service station on Lot 20)	Gemec undertook underground storage tank (UST) removal and soil validation works for the former Gull Service Station on Lot 20 over July and August 2012 (full report provided in **Appendix Four**). All identified hydrocarbon impacted soil within the excavation was removed and disposed of at a licenced facility.
		Wetland buffer requirement	Wetland buffer study undertaken. The results of the study determined that the wetland boundary closely follows the edge of the existing water dependent native vegetation, based mainly on soil characteristics. The WAPC guidelines were consulted for the determination of the wetland function area, the threatening processes, the role of separation and the establishment of an appropriate separation requirement. A 50 m separation requirement was determined and used to locate the extent of the buffer area required to adequately protect Lake Clifton.
		Management of stormwater	Management of stormwater has been addressed in UWMP. There is currently no flow off the site in a 1 in 100 year ARI rainfall event and no flow off the site will occur post-development. Water will therefore be treated and infiltrated within the development. Storage in events up to the 1 in 100-year ARI event will be retained within the development.
		Potential loss of Western Ringtail Possum habitat through removal of peppermint trees	The lack of a significant number of trees with hollows and large areas of dense Peppermint woodlands precludes the likelihood of a resident population.
19 November 2012	OEPA	Discuss assessment of Proposal, most likely via the Assessment of Proponent Information (API) process, presentation of draft UWMP and investigations conducted to date to address issues raised in previous correspondence.	OPEA suggested followup with DoW to seek comment/advice on Draft UWMP.

Date	Stakeholder/s	Purpose/Issue	Response
26 November 2012	DoW (Brett Dunn – Kwinana/Peel Region) DoW letter and Strategen response to comments provided in **Appendix Three**	Comment on draft UWMP requested prior to completion	DoW provided advice to suggested changes to UWMP covering nutrient modelling, stormwater, WWTP, groundwater for non potable supply. Strategen responded to comments and updated the UWMP as required.

5.0 Regional Environment and Social Setting

5.1 Physical Environment

5.1.1 CLIMATE

The Peel region experiences a Mediterranean type climate of hot dry summers and mild wet winters. The climate varies seasonally, with rainfall, temperature and winds following a well-defined annual cycle. The summer weather pattern, from September to March, usually produces hot, dry easterly winds from high-pressure systems crossing the state in a westerly direction. In winter, the high-pressure systems move north, allowing cold fronts to cross the coast. Summer rainfall is scant, but occasional thunderstorms and decaying tropical cyclones can produce occasional heavy rainfalls (Peel Development Commission & Peel Harvey Catchment Council 2003). The majority of the rainfall occurs in the winter months with 90% falling between April and October.

Historic temperature and rainfall records from the Mandurah Park weather station, located approximately 35 km north of the study area, are presented in **Figure 3**. July has the lowest temperatures with average daily minimum and maximum temperatures of 8.6 °C and 17.3 °C, respectively. February has the highest temperatures with an average daily minimum and maximum temperatures of 17 °C and 29.6 °C, respectively. The average annual rainfall for the site is 875.1 mm (Bureau of Meteorology 2012).

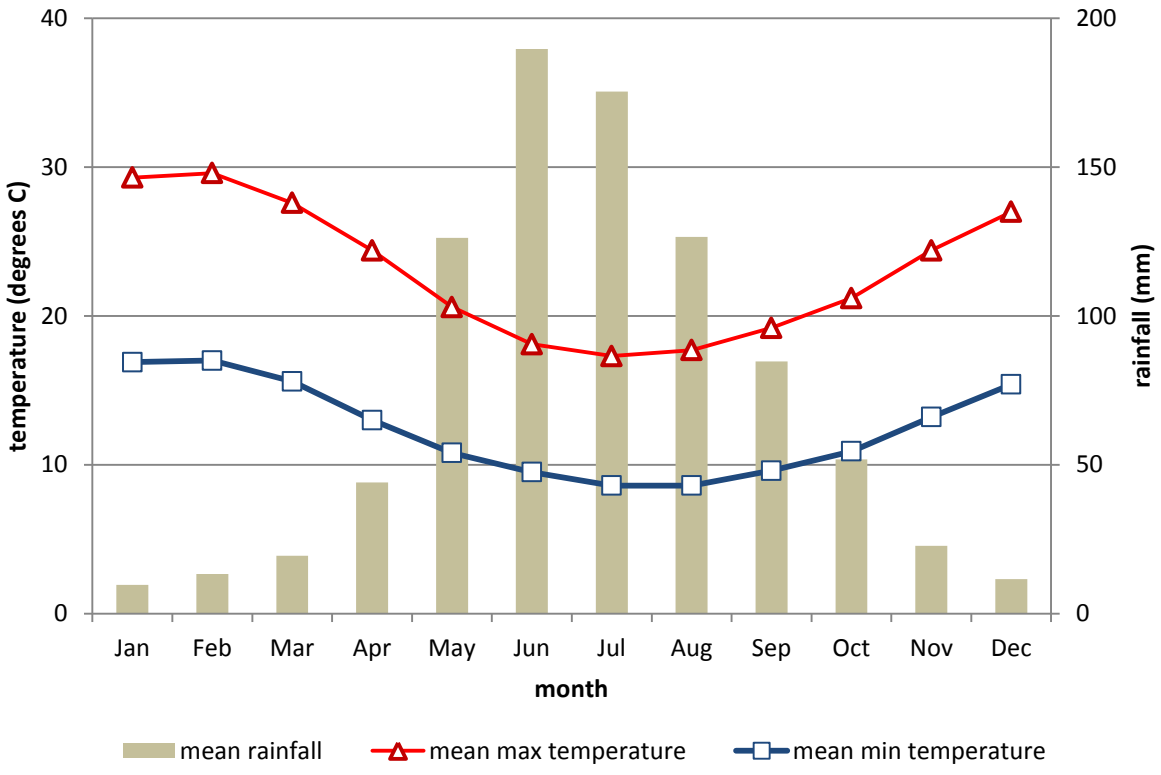


Figure 3: Mean monthly temperature and rainfall at Mandurah Park weather station

5.1.2 GEOLOGY

The Geological Survey of Western Australia and Gozzard (1987) identified the superficial geology of the site as predominantly Tamala Limestone (LS1), with areas of sand derived from Tamala Limestone (S7) and LS5 Limestone:

- LS1 - Tamala Limestone, is described as light yellowish-brown, fine to coarse-grained, sub-angular to well-rounded, calcarenite composed largely of fossil skeletal fragments (mainly foraminifera and mollusc) with various amounts of quartz and trace feldspar (Biggs *et al*. 1980; Gozzard 1987)
- S7 - Sand derived from Tamala Limestone (S7) is similar though has negligible carbonate (shell) content, and is pale to olive yellow in colour
- LS5 Limestone is very pale yellowish brown, vuggy, fine to medium; sub-angular quartz and shell debris, generally friable (Gozzard 1987).

Tamala Limestone occurs discontinuously throughout the Swan Coastal Plain and forms ridges roughly parallel to the coast. The formation was originally accumulated as coastal sand dunes and the ridges in which it now occurs represent successive lines of Late Pleistocene dunes. The most extensive, delineated by series of limestone-capped 'peaks' such as Reabold Hill, Shire View Hill and Mount Brown, forms part of the Spearwood Dune System (Biggs *et al*. 1980).

5.1.3 TOPOGRAPHY AND LANDFORMS

Topography across the study area can be broadly described as flat to very gently undulating sandplain with outcropping limestone on low crests. Elevation on site ranges from a minimum of 2.5 m up to 10 m AHD (Australian Height Datum) (**Map 3**).

The study area is located within the Cottesloe unit of the Spearwood Dunes (Churchward & McArthur 1980). The Spearwood Dunes are of aeolian origin, and are intermediate in age between the older Bassendean Dunes to the east, and the younger Quindalup Dunes to the west (McArthur & Bettenay 1960). The system consists of a core of Tamala Limestone with a hard capping of calcite (cap-rock) overlain by a variable depth of yellow to brown sands (McArthur 1991). The Cottesloe unit runs along the western extent of the Spearwood Dunes, consisting of shallow yellow brown sands and exposed limestone (Churchward & McArthur 1980).

5.1.4 SOILS

The Spearwood S4b soil phase (Map unit - 211Sp_S4b) occurs across the entirety of the study area according to Soil-Landscape mapping published by the Department of Agriculture and Food (DAWFA) (2012) (**Map 3**). The soil phase is described as flat to gently undulating sandplain with shallow to moderately deep siliceous yellow-brown and grey-brown sands with minor limestone outcrop.

5.1.4.1 Phosphorus Retention Index

Phosphorus is one of the key pollutants of concern near sensitive water resources. High levels of phosphorus can lead to algal blooms and fish deaths. Management of phosphorus should be a key element of any proposal to develop in the Peel-Harvey System. This is likely to include an assessment of the capability of the soils to retain phosphorus (Peel Development Commission 2006).

Phosphorus Retention Index (PRI) is a commonly used laboratory-based measure of the potential for a soil to adsorb and bind phosphorus. PRI is defined as the ratio $P_{ads} : P_{eq}$ where P_{ads} is the amount of phosphorus adsorbed by soil (µg P/g) and P_{eq} is the equilibrium concentration of phosphorus remaining in solution (ug P/mL). The phosphorus fixation properties of soil may be described by the following PRI values:

- negative = desorbing
- 0 - 2 = weakly adsorbing
- 2 - 20 = moderately adsorbing
- 20 - 100 = strongly adsorbing
- >100 = very strongly adsorbing.

Soils associated with sandy rises and slopes of the Spearwood soil system, typically comprise of sands and loams with a significant sesquioxide (iron and aluminium oxide) content. These soils are referred to locally to as 'yellow or brown sands' in reference to their colouration by iron oxides. The amount of iron and aluminium coating the sand grains also increases the capacity of the sands to retain phosphorus (Bolland 1998). The positively charged surfaces of these sesquioxides sorb anions such as phosphate, resulting in moderate to high PRI values (>15) (Peel Development Commission 2006).

Site Assessment

Preliminary assessment of the phosphorus retention capacity of the soils on site was undertaken by Ecoscape in 2009. Bulked soil samples were taken from the two soil pits and sent to the WA Chemistry Centre for PRI analysis. The soil sampled from site 1 was taken from the top 10 cm of the profile, including the transition zone between the A11 and A12 horizons. While at site 2 the sample was taken between depths of 20 to 30 cm within the A12 horizon (see Map 3 in **Appendix Five** for pit locations). Results of Chemistry Centre's analysis are provided in **Table 6**.

Table 6: PRI results for soil samples

Site	Depth of sample	Depth of sample	PRI
1	10 cm	0 – 10cm	20
2	20 cm	20 – 30 cm	24

Both samples had PRI of 20 or higher, classifying them as moderately to highly adsorbing. Further detailed investigation was conducted as part of Douglas Partner's preliminary geotechnical

investigations that found the soils to be moderately absorbing (**Table 7**). The location of these test pits and bore holes are shown on **Drawing 1** in **Appendix Seven**.

Table 7: Summary of Chemical Laboratory Test Results from Geotechnical Investigations

Site	Depth of sample	pH	EC (µs/cm)	PRI	CEC (meq/100g)
TP1	0.5 m	6.4		11	2.9
TP4	0.2 m	7.3		18	4.3
TP7	0.3 m	7.4		9.2	2.4
BH11	0.2 m	7.2		7.8	9.5
BH13	0.5 m	7.2		19	7.7

EC: Electrical conductivity

PRI: Phosphorus retention index

CEC: Cation exchange capacity

5.1.4.2 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are generally naturally occurring soils containing sulfides that have reacted with oxygen and water to produce acids. Passive Acid Sulfate Soils (PASS) contains sulfides that have not reacted, usually due to being permanently waterlogged which prevent exposure to oxygen. They produce acids when exposed to air by excavation, filling, and creation of artificial water courses or groundwater abstraction/dewatering.

The impacts associated with acid sulfate soils can be associated with the increase in acidity and/or the release of heavy metals into the environment. This can result in:

- wetlands degradation
- localised reduction in habitat and biodiversity
- deterioration of surface and groundwater quality
- loss of groundwater for irrigation
- increased health risks associated with arsenic and heavy metals contamination in surface and groundwater, and acid dust
- risk of long-term infrastructure damage through corrosion of sub-surface pipes and foundations by acid water
- invasion by acid tolerant water-plants and dominance of acid tolerant plankton species causing loss of biodiversity.

The site is located in an area considered to have a high risk of actual or potential ASS at a depth of less than 3 m from soil surface (DEC 2012a). However, the presence of alkaline limestone on the site and lack of evidence of peaty soils in the geotechnical investigations indicate that ASS are unlikely to occur on the site.

5.1.5 HYDROGEOLOGY

Regional hydrogeological studies covering the strategy area were undertaken in the 1980s by Commander (1988) and Deeney (1989) of the Geological Survey of Western Australia. Deeney (1989) identified the Yanget and Mialla groundwater mounds, and the Waroona, Myalup and Serpentine Flow Systems in the vicinity of the southern half of Lake Clifton and beyond Lake Preston to the Collie River. The study site is located within the Waroona flow system (Deeney 1989) with groundwater on site flowing approximately to the west towards Lake Clifton (Commander 1988; Deeney 1989). Groundwater contours indicate that groundwater level beneath the site to be less than 1 m AHD (Deeney 1989).

5.1.6 SURFACE HYDROLOGY

The primary surface water body in the area is Lake Clifton, which is located to the west of the site (**Map 5**). There are no surface water bodies on the site and the sandy nature of the local soils means that surface water flows are considered unlikely except in extreme events (greater than the 1 in 100 year Average Return Interval (ARI) event). Inspection of the site indicated no obvious surface water flow pathways, such as creeks or erosion lines. A constructed dam is located in the southeast of Lot 21.

Water levels in Lake Clifton were monitored by ENV Australia between January and October 2008 as part of a separate project (ENV Australia Pty Ltd (ENV) 2009). Water levels varied between -0.7 and 0.5 m AHD over this period, being below sea level between approximately January and mid June (ENV 2009). Salinity in varied between 37 700 and 61 800 mg/L (ENV 2009). In comparison, seawater has a salinity of approximately 35 000 mg/L. The lake water is pH was alkaline, with pH varying between 7.86 and 8.46 (ENV 2009).

5.1.7 WETLANDS

Wetland Function and Values

Wetlands are one of the most notable features of the Swan Coastal Plain (SCP) (Hill *et al*. 1996). Hydrologically, wetlands also play an important flood control function by acting as a compensation or retention basin. The vegetation fringing lakes and wetlands partially act as filters that assimilate nutrients, sediments and pollutants from adjacent land surface runoff (EPA 1993).

Wetlands can play a variety of social functions. There can be historical or archaeological values such as aboriginal sites. There are nature study, education values and access to wildlife values, such as bird watching. There is also an overall aesthetic consideration to the local community (EPA 1993).

Wetlands in the Swan Coastal Plain have been classified by Hill et al (Hill *et al*. 1996) as being *Conservation, Resource Enhancement* or *Multiple Use*, according to a management category. Management priorities for these categories are outlined in **Table 8**.

Table 8: Management categories and objectives and recommendations for change

Category	Wetland description	Management Priorities
Conservation (C category) wetlands	Wetlands which support high levels of attributes and functions	To preserve wetland attributes and functions through reservation in parks, crown reserves, state owned land and protection under environmental protection policies
Resource Enhancement (R category) wetlands	Wetlands which have been partly modified but still support substantial functions and attributes	To restore wetlands through maintenance and enhancement of wetland functions and attributes by protection in crown reserves, state or local government owned land and by environmental protection policies, or in private property by sustainable management
Multiple Use (M category) wetlands	Wetlands with few attributes which still provide important wetland functions	Use, development and management should be considered in the context of water (catchment/strategic drainage planning), town (land use) and environmental planning through landcare

(Hill *et al*. 1996)

Existing Wetlands

Lake Clifton (UFI 3089) is classified in the DEC (Department of Environment and Conservation 2012b) *Geomorphic Wetlands Swan Coastal Plain* dataset as a Conservation Category Wetland and is located approximately 100 m to the west of the study area (**Map 5**).

5.2 Land use

Lot 21 Old Coast Rd is currently being utilised as a caravan park which has an extent of 2.3 ha (38% of total lot area). The remaining 62% is former grazing land consisting of cleared land (1.8 ha, 31%) and highly disturbed native vegetation (1.8 ha, 31%).

5.2.1 ADJACENT LANDUSE

Part of Lot 20 was developed as a service station in 1973. Operations at the site ceased in February 2003, with removal of all aboveground petroleum storage and distribution infrastructure (aboveground storage tank and all fuel dispensers). The current site use is as a bakery and café (LC's Café and Bakery) operating out of the former shop/sales building (Gemec Pty Ltd (Gemec) 2012).

5.2.1.1 Potential Contamination

Gemec undertook Underground Storage Tank (UST) removal and soil validation works over July and August 2012 (full report provided in **Appendix Four**). The former fuel storage and dispensing infrastructure consisted of three decommissioned USTs and a concrete plinth that housed the diesel and liquefied petroleum gas dispensers.

Upon removal, the USTs were found to be in good condition with no visible holes or damage. Excavations were then extended to maximum depth of 3.3 m below ground surface (m BGS) and to 1.1 m BGS beneath the former automotive diesel fuel dispenser location. The extent of the excavation area was approximately 10 m by 15 m. All identified hydrocarbon impacted soil within the UST dispenser excavation was removed and disposed of at a licenced facility. The site is deemed suitable for on-going commercial land use (Gemec 2012).

5.3 Socio-Economic Environment

5.3.1 LOCAL GOVERNMENT

The study area is located within the Shire of Waroona approximately 100 km south of the Perth Central Business District. The Shire of Waroona covers 835 km^2 and is located within the Commonwealth Electoral Division of Canning and the State District of Murray-Wellington. In addition to Lake Clifton, the Shire also encompasses the towns of Hamel, Nanga Brook, Preston Beach and Wagerup.

5.3.2 POPULATION AND COMMUNITIES

The area of Lake Clifton includes the small townships of Lake Clifton, Armstrong Hills, Tuart Grove and Herron (which has overlapping boundaries with the City of Mandurah). Lake Clifton was established in 1921 as a company town to support the WA Portland Cement Company's lime deposit mine which closed three years later in 1924. Given its proximity to Preston Beach, the town offers a rural retreat lifestyle to residents and visitors. The area has about 112 families living in what can be described as a semirural area of 5 to 10 acre blocks within a few subdivisions

According to census data, in 2011 Lake Clifton had a population of 406 persons, and comprised approximately 11% of the Shire of Waroona's total population of 3,582 (Australian Bureau of Statistics 2012).

5.3.3 ECONOMIC SETTING

Lake Clifton's population appears to be relatively affluent, when compared with the averages for the Shire of Waroona. Data from the 2006 census suggests that a greater proportion of Lake Clifton's residents fell within the higher income brackets of $1000 - $1200 and $2500 - $2999 per week, relative to both the Shire and State averages (Coakes Consulting 2009).

According to the 2006 census data, Lake Clifton's population recorded a relatively higher unemployment rate (5%) compared to the Shire of Waroona (4.2%) and the State (3.8%). According to the Shire, a large proportion of Lake Clifton's residents are either semi-retired or retired, particularly those who reside in Lake Clifton's caravan park. Among those who were employed, these residents typically commuted away from the town into neighbouring Mandurah or Waroona for work (Coakes Consulting 2009).

Lake Clifton residents are diversified in their industries of employment, with Manufacturing and Construction representing the highest proportion of the workforce. In terms of specific occupation of employment, most employed persons in Lake Clifton are employed as technicians and trades workers, followed by labourers and related workers. These roles tend to be more compatible with the manufacturing and construction industries, both of which are dominant employment sectors for Lake Clifton residents as previously outlined (Coakes Consulting 2009).

5.3.1 HERITAGE

According to the Heritage Council of WA's spatial layers available via the online WA Atlas resource (Government of Western Australia 2012)) and the EPBC Protected Matters Search Tool (DSEWPaC 2013), there are no registered heritage values inside of or within a 5 km radius of the study area.

The Department of Indigenous Affairs (DIA) Sites and Surveys Enquiry System (DIA 2012) was reviewed for any registered indigenous heritage values that may occur in the local area of the study site. The DIA database has no recorded indigenous heritage sites within the study area. Areas located within approximately 5 km of the study area are presented in **Table 9**. **Map 1** also illustrates the proximity of DIA Heritage Sites in local area.

Table 9: DIA Heritage Sites Located within 5 km of the study area.

Site ID	Site Name	Type	Site no.
351	Boundary Lake	Man-Made Structure, Fish Trap	S02963
3253	Harvey Estuary 23:farmers	Artefacts/Scatter	S00322
3254	Harvey Estuary 24:swamp	Artefacts/Scatter	S00323
3257	Lake Clifton 3		S00326
3258	Harvey Estuary 26:pine	Artefacts/Scatter	S00327
3451	Island Point		S02676
17275	Little Harvey 02/Black Bream Pool	Modified Tree, Artefacts/Scatter	
17276	Little Harvey 03	Artefacts/Scatter, Historical	

5.4 Biological Environment

5.4.1 IBRA BIOREGIONS

The study area is located within in the Swan Coastal Plain 2 (SWA2) Interim Biogeographic Regionalisation for Australia (IBRA) subregion. The subregion is composed of colluvial and aeolian sands, alluvial river flats, and coastal limestone. Typical vegetation patterns include Heath and/or Tuart woodlands on limestone, *Banksia* and Jarrah-*Banksia* woodlands on Quaternary dune systems, and Marri woodlands on colluvial and alluvials. The region also includes a complex series of seasonal wetlands (Mitchell *et al*. 2002).

6.0 Key Environmental Factors

6.1 Flora and Vegetation

6.1.1 STUDIES UNDERTAKEN

A Level 1 flora and vegetation survey encompassing Lot 21 was undertaken by Ecoscape on January 22, 2009 to form part of a wider Environmental Impact Report. The survey was conducted outside of the period recommended for flora and vegetation surveys in the southwest of Western Australia (spring). Despite this, the highly modified/disturbed nature of the site as a result of past landuse and subsequent absence of native understorey species, indicates that the results of the survey are likely to reflect the level of native botanical diversity remaining on site.

The purpose of the survey was to identify the flora and vegetation of the area and identify any associated values with conservation significance (e.g. Threatened or Priority Flora [TF and PF], Threatened or Priority Ecological Communities [TECs and PECs], and regionally or local significant species/vegetation types). The presence of weeds was also recorded. The study report including full methodology is provided in **Appendix Five**.

6.1.2 DESCRIPTION OF FACTOR

6.1.2.1 Regional Vegetation Associations

Heddle *et al.* (1980) mapped and described the vegetation of the Darling System in Western Australia, according to a system of twenty eight complexes, each with had shared distinctive characteristics such as flora species composition, soil types and landform. Two of the Heddle *et al.* (1980) vegetation complexes are known to occur in the study area (**Map 4**):

- Cottesloe Complex – Central and South - Mosaic of woodland of *Eucalyptus gomphocephala* and open forest of *Eucalyptus gomphocephala* - *Eucalyptus marginata* - *Corymbia calophylla*; closed heath on the limestone outcrops.
- Yoongarillup Complex - Woodland to tall woodland of *Eucalyptus gomphocephala* with *Agonis flexuosa* in the second storey. Less consistently an open forest of *Eucalyptus gomphocephala* - *Eucalyptus marginata* - *Corymbia calophylla*.

EPA Guidance Statement No 10 (2006) using 1997/1998 data, has the Cottesloe Complex-Central and South, and the Yoongarillup vegetation complexes as having 41.1% and 45% of the original extent remaining, respectively (**Table 10**).

Table 10: Extent of Vegetation Complexes on Swan Coastal Plain (EPA 2006)

Vegetation Complex	Present extent (1997/98) in the System 6 / part System 1		Remaining in Secure Tenure (2002)	
	Area (ha)	% Remaining of pre-1750 Extent	Area (ha)	% Remaining of pre-1750 Extent
Cottesloe Complex-Central and South	18 474	41.1	3 951	8.8
Yoongarillup Complex	11 140	45	3 449	13.9

6.1.2.2 Vegetation Types

Only one vegetation type was recorded for the site, *Eucalyptus gomphocephala* (Tuart) Woodland, over *Agonis flexuosa* (Peppermint) Low Open Woodland. The 1.8 ha extent of the vegetation type is illustrated in **Map 4**. The understorey was dominated by non-native grasses and other pasture/disturbance weeds. There was variation in density of the various species within the community. The following description was recorded from a relevè (unbounded sampling site) with Lot 21 during the 2009 assessment; *Eucalyptus gomphocephala* Woodland to 20m over *Agonis flexuosa* Low Woodland to 8m over **Avena fatua* Closed Grassland and **Euphorbia terracina* Very Open Herbland to 0.5m (Ecoscape 2009).

6.1.2.3 Vegetation Condition

Vegetation condition was rated according to the Keighery (1994) Bushland Condition Scale. More than 90% (5.5 ha) of study area was considered to be completely degraded with little or no native understorey remaining. A less disturbed variant of the vegetation type retaining a level of native understorey was located over an area of limestone ridge/outcrop in the north-western corner of Lot 21 (see **Map 3** for position of ridge). This area accounted for less than approximately 10% (0.5 ha) of total area, and was considered to be degraded (Ecoscape 2009).

6.1.2.4 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

The following two TECS and two PECs are known to occur within 8 km of the study area according to the DEC Ecological Communities Database (Ecoscape 2009):

- TECs
  - Critically Endangered *Clifton-microbialite community* - Stromatolite like freshwater microbialite community of coastal brackish lakes
  - Endangered *Limestone ridges (SCP 26a) community - Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges
- Priority 3 PEC
  - *SCP 29a community* - Coastal shrublands on shallow sands
  - *SCP 29b community - Acacia* shrublands on taller dunes.

The *Clifton-microbialite community* is also listed as Critically Endangered under the Commonwealth *EPBC Act 1999* (DSEWPaC 2012). The only additional Commonwealth protected TEC know to occur within 8 km of the study site is the Critically Endangered *Claypans of the Swan Coastal Plain* community (DSEWPaC 2013).

It is highly unlikely that any of the vegetation within the Proposal is a representative of these Threatened or Priority Communities.

6.1.2.5 Flora

Twenty seven vascular plant species were observed in the survey area. Of these, 17 were introduced. The plant families with the highest representation on site were the Poaceae (7 species all non-native), Fabaceae (6 species including one non-native), and Myrtaceae (3 species all native).

Conservation Significant Flora

Searches of the EPBC Protected Matters database and DEC/WA herbarium databases indicate that a total of four TF and 18 PF are known to occur within 8 km of the study area. None of these conservation significant species were observed on the site during the 2009 assessment. Although the timing of the site visit was outside of that recommended for flora surveys in the south-west of WA , the completely degraded nature of the site, absence of native understorey species, and past land use allows for a degree of certainty that these species are highly unlikely to be present on site (Ecoscape 2009).

Local and Regionally Significant Flora

Tuart (Eucalyptus gomphocephala)

Tuart is endemic to the Swan Coastal Plain of WA, growing near the coast in a 400-kilometre band from Jurien Bay on the Plain's north to the Sabina River, east of Busselton (Keighery *et al*. 2002). It is generally confined to two the Quindalup and Spearwood Dunes, although there is a series of outlying populations near the Murray, Serpentine, Swan and Canning Rivers. Its extent has been greatly reduced by agriculture, industrial, and urban development. Many of the remaining tuart woodlands have been disturbed by grazing, altered fire regimes and past timber harvesting (Tuart Response Group 2004).

The values of tuart woodlands include conserving biodiversity, protecting ecosystem function and providing connectivity between remnant vegetation. Tuart woodlands provide important landscape, cultural, social and economic values. Processes that threaten the integrity of tuart values include habitat loss, fragmentation and alteration caused by changes in natural and human induced vegetation disturbance regimes (Tuart Response Group 2004).

Tuart is a characteristic/dominant component of the vegetation on site and occurs as isolated trees over the majority of the lot with smaller areas of fragmented woodland.

Introduced Flora

Seventeen weed species were identified from within the study area, including six of which that are considered as significant due to being either a Declared Plant under the *Agriculture and Related Resources Protection Act 1976*, listed as a Weed of National Significance (WONS) (Weeds Australia 2012), or rated as 'Very High' on the Environmental Weed Census and Prioritisation (EWCP) Swan Natural Resource Management (NRM) Region Environmental Weed List (DEC 2008) (**Table 11**).

Table 11: Weed species observed during 2009

Scientific Name	Common Names	EWCP	WONS	ARRPA
Avena fatua	Wild Oat	Very High	-	
Bromus diandrus	Great Brome	Very High	-	
Carduus sp.	Thistle	High – Very High	-	
Cynodon dactylon	Couch	Very High	-	
Cenchrus clandestinum	Kikuyu	High	-	
Disa bracteata		Unrated	-	
Ehrharta longiflora	Annual Veldgrass	FAR	-	
Eragrostis curvula	African Love Grass	High	-	
Euphorbia terracina	Geraldton Carnation Weed	Very High	-	
Ficus carica	Edible Fig	High	-	
Gomphocarpus fruticosus	Swan Plant or Narrowleaf Cottonbush	Moderate	-	P1, P4
Lagurus ovatus	Hares Tail Grass	High	-	
Lupinus cosentinii	Sandplain Lupin	Unrated	-	
Phytolacca octandra	Ink Weed, Red Ink Plant	FAR	-	
Solanum nigrum	Black Nightshade	Moderate	-	
Sonchus asper	Prickly Sowthistle	FAR	-	
Trachyandra divaricata	Strap Lily, Dune Onion Weed	FAR	-	

6.1.3 ASSESSMENT OF POTENTIAL IMPACT AND MITIGATION

6.1.3.1 EPA Objective for Flora and Vegetation

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge (EPA 2010)

6.1.3.2 Potential Sources of Impact

Activities or aspects of the proposal that may affect flora and vegetation values include:

- vegetation clearing required on-site to establish the proposed park home lots, associated access roads, stormwater management infrastructure, wastewater treatment plant and effluent irrigation area
- alteration of hydrological regime.

6.1.3.3 Assessment of Potential Impact

Clearing of Flora and Vegetation

The proposal will require the clearing of up to 1.1 ha of vegetation which is already highly modified (Completely Degraded to Degraded according to the Keighery (1994) Bushland Condition scale). The revised development plan has endeavoured to avoid the vast majority of the relatively less disturbed vegetation in the north west of the development occurring on the outcropping limestone, and retain all healthy Tuart trees wherever practicable.

The EPA (2006) has identified several levels to describe the status of a regional vegetation complex within the metropolitan region and southwest. These are:

- Threshold level – 30% of the pre-clearing extent is the level at which species loss appears to accelerate exponentially at an ecosystem level
- Endangered level – 10% of the original extent is regarded as being a level representing "endangered".

Both Heddle *et al.* (1990) vegetation complexes on have more than 30% of the original extent remaining, which is the level the EPA has adopted in as a minimum required to protect biodiversity in the System 6 area (EPA 2006). The proposed 1.1 ha of further clearing will not lead to either regional vegetation complex falling below the EPA's threshold level.

At a local level the *Eucalyptus gomphocephala* (Tuart) Woodland, over *Agonis flexuosa* (Peppermint) Low Open Woodland observed on site is considered to be well represented within Yalgorup National Park. The small amount of clearing proposed (1.1 ha) is not considered to be significant in maintaining the continued viability, diversity and geographic distribution of this vegetation type.

Based upon differences in characteristic or dominant species and typical landform, where provided in DEC's descriptions of TECs and PECs (DEC Species and Communities Branch 2012a; 2012b), it is considered unlikely the vegetation on site constitutes a representatives of the five TEC/PECs identified from the DEC and EPBC database searches.

No Threatened Flora listed under the Commonwealth *EPBC Act 1999* or listed by the WA DEC or otherwise conservation significant flora (e.g. Priority Flora) were recorded from the Proposal area, and none would be expected to occur, therefore no impact on these values is expected.

6.1.3.4 Management Measures

- Clearing only to be undertaken in marked designated areas.
- Limit construction of access and bypass tracks and vehicle turning areas through areas with relatively more intact vegetation structure.
- All healthy Tuart trees to be retained wherever practicable.
- Minimisation of soil disturbance and movement to limit spread of weeds, ensuring that any soil or vegetation moved within, into or out of the works area is weed-free.
- Spring and autumn monitoring for noxious or invasive weeds that may impact on Lake Clifton.
- Yearly fire risk evaluation, removal of excessive fuel loads as per Shire and FESA regulations.

6.1.3.5 Potential Cumulative Impacts

Cumulative impact is predicted to be minimal due to the small size of the proposal and level of past disturbance adjacent to the Proposal area. The eastern shore of Lake Clifton has been modified for agricultural land use to a large degree and the proposal is not providing significant changes in the level of disturbance that currently exists.

6.1.3.6 Predicted Environmental Outcome

- Proposed clearing will not have a significant effect on the representation of vegetation communities at a local or regional level.
- The Proposal will not affect the conservation status of any conservation significant species (including TF and PF).
- Management procedures will be implemented to mitigate the introduction of new weed species and the spread of existing weeds will be contained within the Proposal area.
- No TECS or PECs will be impacted by the Proposal as none have been recorded within the area.

6.2 Fauna

6.2.1 STUDIES UNDERTAKEN

A Level 1 fauna survey and habitat assessment encompassing Lot 21 was undertaken by Ecoscape on the 22nd of January 2009 by an Ecoscape Senior Zoologist. The field survey focussed on the presence of potential habitat, fauna presence, and signs of fauna including tracks, bones, scats and diggings, particularly in respect to conservation significant species. The study report including full methodology is provided in **Appendix Five**.

6.2.2 DESCRIPTION OF FACTOR

6.2.2.1 Fauna Habitats

The study area provides limited habitat of good quality (<1%) due to the modified landscape as a result of the current land use for temporary housing. Little to no understorey of native vegetation remains with small scattered patches of Tuart and Peppermint trees located across the study area.

6.2.2.2 Recorded Fauna

The reconnaissance survey undertaken was aligned with EPA Level 1 requirements and due to the nature of the disturbed site, is appropriate to adequately assess the impacts of the proposal. Observations of fauna species was limited to mainly avian species as there is little habitat for ground dwelling species to occupy viably (**Table 12**). Scat searches were undertaken for the conservation significant fauna species Western Ringtail Possum at the base of Tuart and Peppermint trees with no scats of this species being recorded.

Table 12: Fauna Observations

Scientific name	Common Name	Detection Method
Mammal		
Oryctolagus cuniculus	European wild rabbit*	Observed/Diggings
Bird		
Aquila audax	Wedge-tailed eagle	Observed
Aquila morphnoides	Little Eagle	Observed
Cacatua roseicapilla	Galah	Observed
Columba livia	Domestic Pigeon	Observed
Corvus coronoides	Australian Raven	Observed
Cracticus tibicen dorsalis	Australian Magpie	Observed
Dacelo novaeguineae	Laughing Kookaburra	Heard
Daphoenositta chrysoptera	Sittella	Observed
Phaps elegans	Brush Bronzewing	Observed
Strepera versicolor	Grey Currawong	Observed
Platycercus zonarius semitorquatus	Twenty-eight Parrot	Observed

6.2.2.3 Species of Conservation Significance

The search results of the DEC threatened fauna databases (see Table 13 in **Appendix Five)** and the *EPBC Act* databases (see Table 14 in **Appendix Five**), indicated four *Wildlife Conservation Act 1950* Scheduled or Priority fauna species, and 26 *EPBC Act 1999* listed species, have been recorded within 5 km of the study area. The field survey failed to observe any signs of presence for any of these listed species within the study area.

Species likely to inhabit the study site or utilise nesting or feeding resources present would include the following three species, as identified from the database searches of both the *Wildlife Conservation Act 1950* and *EPBC Act 1999:*

- *Pseudocheirus occidentalis* (Western Ringtail Possum) - There is a small likelihood of transient dispersing possums occurring on the study site. The lack of a significant number of trees with hollows and large areas of dense Peppermint woodlands precludes the presence of a resident population.
- *Calyptorhynchus baudinii* (Baudin's Black-Cockatoo) – The species is potentially able to use nesting hollows that may be present in the Tuart trees on site. Potential habitat trees as identified during the 22nd January field survey are presented in **Map 4**. The development plan proposed for the site has endeavoured to retain, wherever possible, the majority of Tuarts on the site.
- *Charadrius rubricollis* (Hooded Plover) - This species is likely to be found along the margins of Lake Clifton and although close to the study site is not within the proposed development boundary. Required habitat is the shoreline of wetlands and Lakes with associated fringing wetland vegetation.

6.2.2.4 Short Range Endemic Species

It was deemed not suitable to survey for SRE species due to the degraded nature of the study area.

6.2.2.5 Introduced Species

Evidence of use by Rabbits (*Oryctolagus cuniculus*)and European Red Fox (*Vulpes vulpes*) was recorded and it is assumed that Feral Cats (*Felis catus*) would also utilise the study area. Rubbish disposal will be an issue for the effective management of the Fox and Feral Cat.

6.2.3 ASSESSMENT OF POTENTIAL IMPACTS AND MITIGATION

6.2.3.1 EPA Objective for Terrestrial Fauna

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge (EPA 2010).

6.2.3.2 Potential Sources of Impact

Activities or aspects of the proposal that may affect terrestrial fauna values include:

- vegetation clearing
- spread or introduction of weed species
- vehicle movement

6.2.3.3 Assessment of Potential Impacts and Mitigation

Vegetation Clearing

The proposal will require the clearing of up to 1.1 ha of remaining native vegetation. No impacts from vegetation clearing to conservation significant fauna species are expected, as the study area has no capacity to support a population of Western Ringtail Possum and limited foraging resources for Baudin's Black Cockatoo. No habitat exists that is suitable for the Hooded Plover.

Spread or Introduction of Weed Species

The fauna habitats in close proximity may become degraded due to the introduction of weed species. The study area has been in a degraded state for many years and any potential introductions of weed species that would increase the level of degradation would be remote or non-existent.

Vehicle Movements

The proposal may increase the level of human activity and therefore increase the level of vehicle traffic through the development.

6.2.3.4 Management Measures

Management measures will include:

- clearing of up to 1.1 ha of vegetation within the proposed footprint only
- undertaking weed management measures to reduce likelihood of exotic species escapes. This will include regular site inspections, resident education, vehicle hygiene measures and correct disposal of clippings
- educating residents and implementing speed controls and access for vehicle movement.

The above measures will be detailed in an Environmental Management Plan prior to development approval.

6.2.3.5 Cumulative Impact

Cumulative impact is predicted to be minimal due to the small size (1.1 ha) of the proposed disturbance. The eastern shore of Lake Clifton has been modified for agricultural land use to a large degree and the proposal is not providing significant changes in the level of disturbance that currently

exists. The proposal intends to retain the majority (approximately 99%) of the remaining tree species and therefore no significant cumulative loss is expected.

6.2.3.6 Predicted Environmental Outcome

While some impacts to common and abundant animals may occur as a result of the proposal, it is expected that no significant impact to any local or subregional populations of native terrestrial fauna would occur.

Consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of terrestrial fauna at species and ecosystem levels would be maintained, thereby conserving regional biological diversity. The management measures proposed will ensure disturbance to remaining habitat is kept to that which is necessary, and adjoining habitat is protected as far as practicable.

6.3 Water Balance

6.3.1 STUDIES UNDERTAKEN

Groundwater monitoring commenced in April 2010 to record the following aspects that included measuring depth to groundwater. Monitoring continued until 31 August 2011. The results are presented in **Appendix Six**.

An Urban Water Management Plan (UWMP) was developed in 2012 (Strategen 2013) to provide sustainable water supply management with no exporting of potable water off the site. Limited importation of potable water may occur if rainwater supplies are not adequate to supply in-house water, as outlined in Section 6.3.2.4 (**Appendix Two**).

6.3.2 DESCRIPTION OF FACTOR

6.3.2.1 Surface Water

Lot 21 contains no obvious surface water flow pathways, such as creeks or erosion lines. An effluent disposal area is located in the southeast of Lot 21 (**Section 5.1.6**).

6.3.2.2 Depth to Groundwater and Direction of Flow

Groundwater monitoring was undertaken on site by Ecoscape between April 2010 and August 2012 at six bore locations located over Lots 19 and 21 (**Map 5**).

Depth and Direction of Flow

Groundwater levels on the site peaked in August 2011, with levels generally peaking between 0.391 and 0.424 m AHD, with a westward flow direction (**Map 5**). The exception to this is MB03, which consistently experienced levels approximately 0.6 m higher than the other bores on the site. Maximum groundwater levels recorded at this bore is 1.00 m AHD. MB03 is located close to the lake

and there is no obvious reason for this discrepancy. Minimum groundwater levels were recorded in February 2011 and ranged between 0 to 0.03 m AHD, with the exception of MB03. The water levels in the bores that were not considered outliers were consistent with the levels observed by Commander (1988).

6.3.2.3 Existing Water Provisioning Servicing

The site currently provides its own water supply from two production bores located within the property. Caravans on the site do not have their own sanitary facilities. Groundwater is provided for washing, toilet and laundry purposes at the ablutions block. Each caravan is provided with a standpipe with a tap (Strategen 2013).

Bores on the property are not metered. Based on estimates of use for caravan parks from DoH of 270 L/caravan/day when in use, and assuming that two thirds of the caravans are in use at any time, the total water use for the site is estimated at 3.9 ML/yr (Strategen 2013).

6.3.2.4 Proposed Services

The Proposal is not located on a reticulated water or wastewater supply network. The nearest reticulated supply network is several kilometres from the site and the Proposal is not proposing to connect to this network.

The Proposal will have a policy of sustainable self supply. Water will be sourced from a mixture of sources, which are likely to include:

- rainwater
- groundwater
- recycled wastewater.

At a lot level, rainwater collected from rooves will be used for in-house supply. Residents may be provided with groundwater for irrigation (Strategen 2013).

Groundwater and recycled water will be used for irrigation of open space. Wastewater not recycled will be disposed of by irrigation of a tree lot area. This methodology will minimising the use of potable water where drinking water quality is not essential, particularly for ex-house uses (Strategen 2013).

Groundwater Use and Availability

Through the formulation of the Proposal, the proponent has become aware that the site does not have current licenses for groundwater abstraction. Since the Proposal is located within the South West Coastal Groundwater Area, Lake Clifton sub area, as proclaimed under the *Rights in Water and Irrigation (RIWI) Act 1914*, any groundwater abstraction for purposes other than domestic and/or stock watering taken from the superficial aquifer, is subject to licensing by the DoW. The current

allocation plan for the South West Coastal Groundwater Area, Lake Clifton sub area would currently allow and abstraction yield of 2000 kL/ha/yr with specific management measures required to prevent saline intrusion. The proponent is in the process of lodging an application for an abstraction license.

Development groundwater demands will be kept below 2000 kL/ha or 12 000 kL for the development, as required by the South West Coastal Groundwater Area Groundwater Management Plan (Water Authority of Western Australia 1989). Groundwater use on the site will be metered. Groundwater use for irrigation is expected to consist of:

- up to 6.8 ML/yr for POS irrigation
- 2.9 ML/yr for domestic irrigation (Strategen 2013).

Limited volumes of groundwater will be required for WWTP operation. Commissioning volumes for the WWTP are estimated at 60-80 kL. During operation, WWTP use will be limited to the occasional requirements for flushing out of the reticulation system for maintenance and testing of tanks or other infrastructure at replacement, and are anticipated to average less than 30 kL per year. The total volume of groundwater required is estimated at approximately 9.8 ML/yr.

Reticulated Non-potable Supply

A non-potable supply may be provided to residents for irrigation. This would include provision of a low flow tap in the front yard, signposted to show that the water was not suitable for potable use. This system is unlikely to require licensing from Department of Health. Annual checks would be undertaken to confirm that the system has not been cross connected for internal use (Strategen 2013).

Potable Water Use Estimation

Not all of the park homes are anticipated to be occupied on a full time basis. It is anticipated that:

- 40% of the site to be used in frequently, being 12 times a year for up to three days
- 40% of the site to be utilised for approximately five days per week for six months a year
- 20%of the site will consist of full time residents.

Internal water use is estimated at 85 kilolitres (kL)/house/year or 43 kL/person/year. Assuming that the irrigated area of the lot is 70 m^2 with water efficient features, then total water use is estimated at 65 kL/person/year. This demand will depend primarily on the frequency of use of the site. Owners who are not often present are less likely to landscape and irrigate their lots (Strategen 2013).

Rainwater Tanks

Rainwater provides a sustainable source of water that can be used for drinking water. Each home will be required to include a rainwater tank of at least 15,000 L in volume to be connected to the whole roof area. The developer will install all the park homes, including services. This ensures that

the installation of measures such as rainwater tanks will be undertaken in a standardised manner, consistent with the requirements of SoW and Plumbers' Licensing Board (Strategen 2013).

A 15,000 L tank is estimated to provide 63 kL/yr of water if connected to the full roof area. This volume may not be adequate for permanent residents or frequent users if the use occurs over summer. In this case, residents would be expected to organise and pay for their own water cartage. It is anticipated that the amount of additional water required will average at most one tank full (15,000 L) per park home per year, as some park homes will not be frequently occupied (Strategen 2013).

6.3.3 ASSESSMENT OF POTENTIAL IMPACT AND MITIGATION

6.3.3.1 EPA Objectives

To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected (EPA 2010).

6.3.3.2 Potential Sources of Impact

- modification of current water balance of site due to the increase in the amount of groundwater abstraction
- intrusion of underlying saline groundwater as a result of deep and or high yielding bores within the shallow fresh water lense
- increase in stormwater flows.

6.3.3.3 Assessment of Potential Impact

Modification of Current Water Balance

The current water cycle on the site consists of inputs from rainwater being infiltrated on site and abstracted by bores for use as a water supply. This water is used for domestic purposes and irrigation. Water used for domestic purposes is treated and the effluent is disposed of on site. Water used for irrigation is either used by plants or infiltrates to groundwater. Water is not imported to the site as a reticulated supply and water does not leave the site as stormwater or untreated wastewater (Strategen 2013).

The development is not proposing to significantly alter this process, except for the importation of potable water to top up rainwater tanks. The Proposal consists of a closed cycle, with rainwater water being captured on site and reinfiltrated via landscaping and the tree lot (Strategen 2013).

This is considered to be a relatively small impact as the Clifton Lake sub area catchment is approximately 11,500 ha (EPA 1998), the proposal impact occurs over 6.05 ha, approximately 0.0005% of the Clifton Lake sub area catchment.

The volume of water imported to the site is estimated at a maximum of 15,000 L per park home per year. This is equivalent to 1.8 ML/yr over the 6 ha site. This water will be used for domestic purposes, treated and used for irrigation. Assuming that none of this water is lost due to evapotranspiration (an unlikely worst case scenario), the total increase of recharge from water importation into the development is equivalent to an additional 30 mm of recharge. This additional recharge volume is low due to the limited importation of water to the development site. Rainfall in the area is estimated to average 845 mm/yr (Strategen 2013).

Intrusion/Upconing of Saline Groundwater

Groundwater in the vicinity of Lake Clifton is characterised by a fresh water lense floating on saline water (Commander 1988). The use of deep and/or high yielding bores in the area can potentially lead to saline intrusion and or up-coning.

Groundwater abstraction is proposed to increase from an estimated 3.9 ML/yr pre development to 9.8 ML/yr post development. This will be used solely for non-potable uses (irrigation of open space, commissioning of WWTP, etc.). Shallow bores will be designed to avoid the potential intrusion and or upconing of deeper saltier water. It is anticipated that any potential impacts from groundwater abstraction can be dealt with in detail by the DoW through the licensing process (see Strategen's response to DoW comments on UWMP, **Appendix Three**). Development groundwater demands will be kept below 2000 kL/ha or 12 000 kL for the development, as required by the South West Coastal Groundwater Area Groundwater Management Plan (Water Authority of Western Australia 1989).

The bores will be required to be licensed under the Rights in Water and Irrigation Act 1914 (RIWI Act). The impacts of abstraction can be managed through this process, which allows DoW to assess hydrological impacts of proposal abstraction.

Increase in Stormwater Flows

Currently no stormwater flows off site in a 1 in 100 year ARI rainfall event and none will occur post-development. Water will therefore be treated and infiltrated within the development. Storage in events up to the 1 in 100-year ARI event will be retained within the development. This will maintain the current surface water hydrology of Lake Clifton, where water does not enter via surface runoff (Strategen 2013).

6.3.3.4 Management Measures

- DoW (see letter dated 28 November 2012, **Appendix Three**) has indicated that abstraction bores on the site should be located more than 200 m from Lake Clifton because of potential salt intrusion issues. Of the two bores present on the site, one is located within 200 m of the boundary of Lake Clifton. This bore is located in a proposed lot and will be relocated to a site more than 200 m from the boundary as part of the development process. Bores will be

designed to be shallow to avoid the intrusion of deeper saltier water associated with the saline lake (Strategen 2013).

- Stormwater management within Proposal has been designed to maintain pre-development flows off the site. There is currently no flow off the site in a 1 in 100 year ARI rainfall event. Full details of the measures used at both a lot and development scale are outlined in full in the UWMP (**Appendix Two**).
- The developer will ensure that all units are fitted with water efficient showers and toilets as part of the fit out of the units to reduce water use on the site.
- A Sustainability Package detailing the water supply situation and appropriate water conservation measures on the site will be explained to buyers at the time of sale.
- The open space will be predominantly planted, with small areas of grass where amenity is required. Plantings will consist of local native species. This type of landscaping requires little input of fertiliser and water beyond the establishment phase.
- Grassed areas on the site will require irrigation. Irrigation water will be sourced from either recycled wastewater or groundwater. If recycled wastewater is chosen, a Recycled Water Quality Management Plan (RWQMP) will be prepared for approval by Department of Health (Strategen 2013).

6.3.3.5 Potential Cumulative Impacts

The Proposal covers a small percentage (approximately 0.1% according to land area) of the proclaimed Lake Clifton groundwater subarea. Development groundwater demands will be kept below 2000 kL/ha or 12 000 kL for the development, as required by the South West Coastal Groundwater Area Groundwater Management Plan (Water Authority of Western Australia 1989). Any potential cumulative impacts can be effectively managed via the licencing process administered by the DoW under the *RIWI Act 1914*.

6.3.3.6 Predicted Environmental Outcome

- A total increase in water entering the site equivalent to an additional 30 mm of recharge per annum as a result of limited importing of potable water.
- Detailed design of abstraction bores will be undertaken during the licensing process to ensure that no upconing or intrusion of saline groundwater occurs as a result of the proposed increase in groundwater abstraction (Shallow bores will be used at a distance greater than 200 m from the boundary of Lake Clifton.
- No flow of stormwater off the site in events up to the 1 in 100 year ARI event, as occurs in the current situation.

6.4 Water Quality

6.4.1 STUDIES UNDERTAKEN

A preliminary geotechnical investigation was undertaken in 2010 (Douglas Partners 2010, **Appendix Seven**). The purpose of the investigation was to assess the subsurface conditions beneath the site and provide factual information on:

- the ground conditions encountered during the investigation
- depth to groundwater
- depth to limestone
- the nutrient retention capacity of the soils.

Groundwater monitoring commenced in April 2010 to record the following aspects:

- depth to groundwater
- pH; conductivity and Total Dissolved Solids (TDS)
- nutrient levels (Nitrogen; organic nitrogen; nitrite Nox; ammonia nitrogen; Phosphorus; *E. coli*; total coliforms)
- concentrations of metals (Arsenic; Cadmium; Chromium; Copper; Lead; Zinc; Nickel and Mercury).

Monitoring continued until 31 August 2011. The results are presented in **Appendix Six**.

An UWMP was developed in 2012 (Strategen 2013) to provide management measures for surface stormwater and wastewater treatment.

6.4.2 DESCRIPTION OF FACTOR

6.4.2.1 Hydrogeology

Regional hydrogeological studies covering the strategy area were undertaken in the 1980s by Commander (1988) and Deeney (1989) of the Geological Survey of Western Australia. Deeney (1989) identified the Yanget and Mialla groundwater mounds, and the Waroona, Myalup and Serpentine Flow Systems in the vicinity of the southern half of Lake Clifton and beyond Lake Preston to the Collie River. The study site is located within the Waroona flow system (Deeney 1989) with groundwater on site flowing approximately to the west towards Lake Clifton (Commander 1988; Deeney 1989). Groundwater contours indicate that groundwater level beneath the site to be less than 1 m AHD (Deeney 1989).

6.4.2.2 Surface Hydrology

The primary surface water body in the area is Lake Clifton, which is located to the west of the site (**Map 5**). There are no surface water bodies on the site and the sandy nature of the local soils means that surface water flows are considered unlikely except in extreme events (greater than the 1 in 100 year Average Return Interval (ARI) event). Inspection of the site indicated no obvious surface water

flow pathways, such as creeks or erosion lines. A constructed dam is located in the southeast of Lot 21.

Lake Clifton water levels varied between -0.7 and 0.5 m AHD between January - October 2008, being below sea level between approximately January and mid June (ENV 2009). Salinity varied between 37 700 and 61 800 mg/L (ENV 2009). In comparison, seawater has a salinity of approximately 35 000 mg/L. The lake water is pH was alkaline, with pH varying between 7.86 and 8.46 (ENV 2009).

6.4.2.3 Groundwater Quality

Groundwater quality is an important aspect in maintaining healthy ecosystems, the quality of water transported through groundwater indicates the ability of ecosystem sustainability. Groundwater monitoring indicates a neutral to slightly alkaline groundwater with a generally fresh to slightly brackish characteristics (**Table 13**).

Table 13: Summary of Groundwater Quality Results

Parameter	Minimum	Maximum	Median	Lake Clifton range of results (ENV 2009)
pH	7	7.7	7.4	7.86 – 8.49
Total dissolved solids (mg/L)	170	1200	535	37 700 - 61 800
Total nitrogen (mg/L)	0.15	11	2.90	2.0 - 3.6
Total phosphorus (mg/L)	<0.01	0.56	0.04	0.005 - 0.22

Nutrient levels in groundwater on the site were more variable than those recorded in Lake Clifton, however the median concentrations were within the range recorded at Lake Clifton. The total nitrogen levels varied between 0.15 and 11 mg/L, with a median concentration of 2.9 mg/L (**Table 13**). Total phosphorus concentrations varied from <0.01 to 0.56 mg/L, with a median of 0.04 mg/L (**Table 13**).

Full groundwater monitoring results can be found in **Appendix Six**.

6.4.2.4 Existing Servicing

Wastewater from the ablutions block and caretaker's house are treated through the use of septic tanks and infiltrated on site. Effluent quality at the outlet of the existing system was tested by Strategen on 3 August 2012. The effluent had a total nitrogen concentration of 91 mg/L and a total phosphorus concentration of 8 mg/L. This is considered to be a high nitrogen concentration for treated wastewater (Strategen 2013).

6.4.3 ASSESSMENT OF POTENTIAL IMPACTS AND MITIGATION

6.4.3.1 EPA Objectives

To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards (EPA 2010).

6.4.3.2 Potential Sources of Impact

Activities that may adversely affect surface and ground water quality at the proposal site include:

- wastewater management (wastewater quality and effluent disposal)
- stormwater management.
- fertiliser use and management

6.4.3.3 Assessment of Potential Impact

Wastewater Management, Wastewater Quality

Wastewater on the site will be collected and treated using a Membrane Biological Reactor (MBR) type WWTP. The MBR plant is an activated sludge treatment plant using membrane ultrafiltration and alum dosing to remove nutrients. Effluent disinfection will be undertaken to produce a fit-for-purpose effluent quality and may include the use of liquid sodium hypochlorite and ultraviolet radiation, depending on whether the effluent is to be reused or irrigated on the tree lot (see Appendix Four of UWMP (**Appendix Two**)). The WWTP will be designed to achieve a very high effluent quality of:

- 5 mg/L total nitrogen
- 1 mg/L total phosphorus (Worley Parsons 2012, see Appendix Five in UWMP (**Appendix Two**)).

The UWMP (Strategen 2013) has identified that there are currently no best management practices or wastewater management measures beyond soakwells used on the site. The WWTP currently in use does not appear to be operating well in terms of the removal of nitrogen and phosphorus.

In the post-development scenario, the MBR system results in significant reductions in nutrient loads from wastewater. Using the more conservative Department of Health volume estimates for wastewater, the nutrient load drops from 359 kg/yr TN to 41 kg/yr TN and from 32 kg/yr TP to 8 kg/yr TP.

Wastewater Management, Effluent Disposal

The sizing of the effluent disposal area has been undertaken to comply with the guidelines for nutrient loadings and effluent in Water Quality Protection Note 22: Irrigation with nutrient rich wastewater (WQPN 22) (DoW 2008). The document recommends that the guidelines for nutrient loads for sandy soils that are adjacent to areas with a risk of eutrophication be within the following:

- maximum nitrogen load of 140 kilograms per hectare per year (kg/ha/yr)
- maximum phosphorus load of 10 kg/ha/yr (DoW 2008).

These guidelines cover inputs from wastewater and other nutrient sources, such as fertilisers.

Based on an assumed effluent nitrogen concentration of 5 mg/L and a volume of 8.3 ML/yr, a total of 41 kg per year of nitrogen would be present in the WWTP effluent. This will require 0.30 ha of irrigated area to meet the load criteria. This is a low nitrogen concentration for a wastewater effluent, but is considered to be achievable through the use of the MBR plant. The effluent disposal area will be designed as a tree lot to maximise nutrient uptake. A species suitable for use in tree lots, such as Blue Gum (*Eucalyptus globulus*), could be used.

Based on an assumed effluent phosphorus concentration of 1 mg/L, a total of 8.3 kg per year of nitrogen would be present in the WWTP effluent. This requires an irrigated area of 0.83 ha to meet the load criteria (see Appendix Five in UWMP, **Appendix Two**). This is the larger of the two requirements and the irrigated area has been designed on this basis.

Stormwater Management

Impacts from stormwater are expected to be minimal as the proposal will implement a best practice system of treatment areas to reduce nutrient levels infiltrating the groundwater system. The redevelopment will utilise three nutrient stripping basins (Figure 4). These basins will be planted with native vegetation designed to strip nutrients. The vegetation will be harvested on the site and removed to prevent overgrowth and nutrients in dead vegetation being remobilised. This allows new growth to form and take up additional nutrients. Stormwater will infiltrate, rather than being allowed to enter Lake Clifton by overland flow. Additional information regarding stormwater management can be found in the UWMP.

Fertilizer Use and Management

The use of fertilizers within the development will be managed in alignment with best management practice outlined in the Environmental Guidelines for the Establishment and Maintenance of Turf and Grassed Areas (DEC & WRC 2001). These management practices will ensure phosphorus and nitrogen export to the surrounding environment from the use of fertilizer is negligible.

6.4.3.4 Management Measures

- Wastewater on the site will be collected and treated using a Membrane Biological Reactor (MBR) type WWTP.
- Treated wastewater to be disposed via a 0.89 ha effluent irrigation area designed to comply with maximum nutrient loadings.
- Stormwater to contained and infiltrated on site via structural best practice consisting of three nutrient stripping basins.

- Landscaping will consist primarily of appropriate local native vegetation with turf used sparingly where appropriate.
- Slow release fertilisers will be applied sparingly to turf areas.
- Fertilizer will not be applied in areas where treated wastewater is used for irrigation
- Sustainability Packages will be provided to residents at the point of sale, outlining appropriate fertiliser regimes and when and how this should be applied. This information will be followed up on an annual basis with letter drops outlining the need to minimise fertiliser use. Pets will not be allowed on the site to reduce pet waste loadings and to prevent attacks on wildlife.

6.4.3.5 Potential Cumulative Impacts

No cumulative impacts are predicted from the proposal. Proposed treatment of stormwater and wastewater reflects best management and are expected to lead to a net benefit in terms of the level of nutrients current entering the environment according the UWMP (**Appendix Two**).

6.4.3.6 Predicted Environmental Outcome

An overall environmental benefit is predicted based on utilising the management measures proposed. In the post development scenario, a number of nutrient management measures will be put in place to reduce nutrient loads, as discussed above. These include the use of a substantially improved wastewater disposal system, along with the use of low fertiliser native gardens for lots and open space and community education. With the implementation of these measures, the estimated post-development nutrient loads are reduced to 140 kg/yr TN and 24 kg/yr TP from the existing situation (see Appendix Five of UWMP, **Appendix Two**) compared to a pre-development estimate of 583 kg/yr TN and 57 kg/yr TP. This is less than half the nutrient load in the pre-development scenario. The development therefore offers a significant improvement in nutrient loads compared to the current scenario.

6.5 Lake Clifton

6.5.1 STUDIES UNDERTAKEN

An assessment of wetland boundary location and wetland function for adjacent areas of Lake Clifton were undertaken to determine the location of the wetland boundary edge, in relation to the proposal, and the wetland values that may be impacted by the proposal. Methods followed those as described in the Western Australian Planning Commission *Draft Guideline for the Determination of Wetland Buffer Requirements* (WAPC 2005). The results of these studies are attached (Ecoscape 2013, **Appendix Eight**).

The study identified the following threatening processes:

- alteration of water regime
- habitat modification

- inappropriate recreational use
- diminished water quality

A 50 m separation requirement was determined as the extent of the buffer area required to adequately protect Lake Clifton from adjacent development. This distance was derived by selecting the largest separation requirement from the WAPC Guideline for the Determination of Wetland Buffer Requirements for the identified threatening processes.

A UWMP has been developed to address the management of surface and groundwater flows into Lake Clifton (Strategen 2013, **Appendix Two**). The management plan also addresses the treatment of wastewater in order to reduce the levels of nutrient export from the site.

6.5.2 DESCRIPTION OF FACTOR

6.5.2.1 Wetland Significance

International Significance

Lake Clifton, as part of the Peel-Yalgorup system, is listed and protected under the Ramsar Convention that designates wetlands of international importance. Designated RAMSAR wetlands are sites containing representative, rare or unique wetland types or those that are important for conserving biological diversity (The Ramsar Convention on Wetlands 2009).

National Significance

The *EPBC Act 1999* enhances the management and protection of Australia's RAMSAR wetlands, as 'Matters of National Environmental Significance' protected under sections 16 and 17b of the Act. A 'declared RAMSAR wetland' is an area that has been designated under Article 2 of the RAMSAR Convention or declared by the Minister to be a declared RAMSAR wetland under the *EPBC Act 1999*.

The eastern edge of Lake Clifton supports a thrombolytic community listed as critically endangered under the *EPBC Act 1999*. The community is listed as critically endangered due to the following summarised criterion:

- the restricted in distribution both in a nature and geographical context
- decline in functionally important species
- reduction in the integrity of ecological processes
- rate of continuing change is severe.

State Significance

The *Geomorphic Wetlands Swan Coastal Plain dataset* also defines Wetland UFI 3089 as a *Conservation Category Wetland* (CCW) (DEC 2012b). The conservation status means these wetlands have a high degree of naturalness with a management priority directed towards protecting and enhancing the natural features of the wetland (Hill *et al*. 1996). A minimum 50 m buffer from the

wetland boundary (i.e. the extent of wetland dependent vegetation) is recommended by the DEC for preserving the wetlands from habitat modification unless a site-specific buffer requirement determines the site suitability for a small buffer distance (EPA 2008).

Lake Clifton is also protected under the Western Australian E*nvironmental Protection (Swan Coastal Plain Lakes) Policy 1992,* meaning that it is an offence under the *Environmental Protection Act 1986* to excavate, modify or drain into or out of an EPP wetland (EPA 1992). Lake Clifton (wetland UFI 3089) is a declared Environmentally Sensitive Area (ESA) under the Government of Western Australia (2005) Environmental Protection (Environmentally Sensitive Areas) Notice. An ESA defines those areas where priority flora and fauna species, wetlands or TECs are likely to occur and as such are subject to strict land clearing regulations.

Regional Significance

Lake Clifton is of regional significance as it is one of a small number of wetlands in the region that maintain significant natural values for wildlife. It acts as a buffer, filtering excess nutrients and pollutants, as well as providing food and habitat to a variety of fauna species.

6.5.3 ASSESSMENT OF POTENTIAL IMPACT AND MITIGATION

6.5.3.1 EPA Objectives

To maintain the integrity, ecological functions and environmental values of wetlands. Ensure EPP lakes are protected and their key ecological functions are maintained (EPA 2010).

6.5.3.2 Potential Sources of Impact

The primary aspects of the proposal that may potentially affect Lake Clifton are:

- extraction of groundwater
- surface water runoff/flow from the proposal into Lake Clifton that may carry nutrients from excess fertiliser application
- nutrient level increases to groundwater flows into the Lake through septic waste systems
- buffer impacts.

The wetland buffer assessment determined that the wetland boundary closely follows the edge of the existing water dependent native vegetation, based on soil characteristics. A 50 m buffer was determined and used to locate the extent of the buffer area required to adequately protect Lake Clifton. The assessment determined that no overlap of the proposed development footprint with the buffer will occur (**Appendix Eight**).

6.5.3.3 Assessment of Potential Impact

Extraction of Groundwater

Groundwater abstraction is a potential impact to the sustainability of water levels in Lake Clifton (Section 6.4). Groundwater abstraction is proposed to increase from an estimated 3.9 ML/yr pre development to 9.8 ML/yr post development. This will be used solely for non-potable uses (irrigation of open space, commissioning of WWTP, etc.). Shallow bores will be designed to avoid the potential intrusion and or upconing of deeper saltier water. It is anticipated that any potential impacts from groundwater abstraction can be dealt with in detail by the DoW through the licensing process (see Strategen's response to DoW comments on UWMP, **Appendix Three**). Development groundwater demands will be kept below 2000 kL/ha or 12 000 kL for the development, as required by the South West Coastal Groundwater Area Groundwater Management Plan (Water Authority of Western Australia 1989).

The bores will be required to be licensed under the Rights in Water and Irrigation Act 1914 (RIWI Act). The impacts of abstraction can be managed through this process, which allows DoW to assess hydrological impacts of proposal abstraction.

Surface Water

Increased surface water runoff has the potential to change the current water regime of inputs to the wetland. Surface water has the potential to carry excess nutrients in fertilisers into the wetland (Section 6.4). . The redevelopment will utilise three nutrient stripping basins (Figure 6). These basins will be planted with native vegetation designed to strip nutrients. The vegetation will be harvested on the site and removed to prevent overgrowth and nutrients in dead vegetation being remobilised. This allows new growth to form and take up additional nutrients. Stormwater will infiltrate, rather than being allowed to enter Lake Clifton by overland flow. Additional information regarding stormwater management can be found in the UWMP.

Groundwater Nutrient Levels

The proposal has the potential to increase the level of nutrients in groundwater systems that feed Lake Clifton (Section 6.4). Nutrient levels in groundwater on the site were monitored in 2010 and shown to be more variable than those recorded in Lake Clifton, however the median concentrations were within the range recorded at Lake Clifton. The total nitrogen levels varied between 0.15 and 11 mg/L, with a median concentration of 2.9 mg/L (**Table 13**). Total phosphorus concentrations varied from <0.01 to 0.56 mg/L, with a median of 0.04 mg/L (**Table 13**). Currently, the site is subject to nutrient loads of 359 kg/yr TN and 32 kg/yr TP .

The development proposes to implement an UWMP to implement best practice urban water management practices within the site. The UWMP proposes to implement the following:

- MBR type WWTP

- effluent disposal area designed as a tree lot to maximise nutrient uptake
- storm water disposal through three nutrient stripping basins planted with native vegetation designed to strip nutrients
- best practice management of fertilizer use to ensure phosphorus and nitrogen export to the surrounding environment from the use of fertilizer is negligible.

With the implementation of these measures, the estimated post-development nutrient loads are reduced to 140 kg/yr TN and 24 kg/yr TP from the existing situation (see Appendix Five of UWMP, **Appendix Two**) compared to a pre-development estimate of 583 kg/yr TN and 57 kg/yr TP. This is an 89% and 75% reduction in TN and TP loading respectively. The development therefore offers a significant improvement in nutrient loads compared to the current scenario.

Buffer to Lake Clifton

The proposed development is located approximately 80 - 100 m to the east of the Boundary of the wetland dependent vegetation of Lake Clifton.. The proximity of adjacent land uses to Lake Clifton has the potential to adversely impact the environmental values and functions of Lake Clifton. A Wetland Buffer Separation Study (Ecoscape 2012) assessed and identified the requirement for buffer from Lake Clifton. The study was undertaken in alignment with Draft Guideline for the Determination of Wetland Buffer Requirements (WAPC 2005). The following threatening processes:

- alteration of water regime
- habitat modification
- in appropriate recreational use
- diminished water quality

A 50 m separation requirement was determined as the extent of the buffer area required to adequately protect Lake Clifton. This distance was derived by selecting the largest separation requirement from the WAPC Guideline for the Determination of Wetland Buffer Requirements for the identified threatening processes.

The proposed development implements a buffer of 80 -100m which is between 30 - 50m beyond the minimum buffer identified in the wetland buffer separation study.

Management Measures

Surface and groundwater flows in the proposal area will be managed in accordance with the UWMP that has been developed for the proposal (Strategen 2013, **Appendix Two**) which include:

- Implementation of 80 - 100 m buffer to protect the environmental values and functions of Lake Clifton from adjacent proposed land uses
- The use of non-phosphorus bearing (or slow release) fertilisers and resident education of how to reduce the use of fertilisers

- installing a wastewater treatment system, with reuse on open space or a tree farm, to effectively reduce nutrient laden wastewater entering the surface and groundwater. This will replace the current use of septic tank systems
- implementing surface water infiltration through bioretention swales to ensure overland flow does not enter Lake Clifton and reduce nutrients entering Lake Clifton via groundwater.

The UWMP, when implemented, will ensure the values and ecological functions of Lake Clifton are maintained. Also in accordance with the Shire of Waroona's local planning strategy for the Lake Clifton precinct, all dwellings will be located at least 150 m from the high water mark of Lake Clifton.

Development groundwater demands will be kept below 2 ML/ha or 12 ML/yr for the development, as required by the South West Coastal Groundwater Area Groundwater Management Plan (Water Authority of Western Australia 1989). The implementation of the Buffer area will effectively remove land use practises that may impact on the water quality of Lake Clifton.

6.5.3.4 Potential cumulative impacts

The proposal area and density of dwellings are predicted to provide minimal cumulative impact due to the small area of the proposal and the low density of dwellings around the Lake. Management of wastewater and treatment of inputs via surface and groundwater will effectively reduce the level of nutrients from those that currently exist on site from 359 kg/yr TN to 41 kg/yr TN and from 32 kg/yr TP to 8 kg/yr TP. The installation of the proposed wastewater treatment plant is one of two in the area around Lake Clifton. Cumulative impacts are expected to be low and not significant.

6.5.3.5 Predicted environmental outcome

The implementation of the UWMP will provide long term environmental benefits from the reduction of nutrients entering Lake Clifton through UWMP design measures and substantial improvements in wastewater quality.

The implementation of a buffer distance of 80 - 100m will ensure the avoidance of adverse impacts on Lake Clifton. The proposed buffer distance is 30 - 50 m greater than the recommended 50 m buffer distance to protect to Lake Clifton from identified threatening processes as outlined in wetland buffer separation study.

Consistent with EPA objectives, the protection and maintenance of wetland values and functions will be ensured through the implementation of the management measures proposed

7.0 Conclusion

The key environmental factors that will be potentially impacted by the Proposal were identified through consultation with the Proponent, decision making authorities (government agencies) and the local community. The key factors considered during the design of the Proposal are:

1. flora and vegetation
2. terrestrial fauna
3. water balance
4. water quality
5. Lake Clifton.

Environmental studies undertaken have assessed the relevant impacts as low to negligible which are able to be effectively managed through the EP Act and outside of the Act.

7.1 Impacts and Mitigation

Key potential impacts and their mitigation /management are presented in Table 14.

Table 14: Key Potential Impacts and Mitigation Measures

Key Factor	Potential Impact	Management/Mitigation Measures	Predicted Outcome
Flora and Vegetation	Adverse impact on vegetation or flora values from disturbance clearing	Disturbance of up to 1.1 ha of native vegetation, which is already highly modified (Degraded according to the Keighery (1994) Bushland Condition scale).	The redevelopment has avoided majority of the relatively less disturbed vegetation in the north west of the development occurring on the outcropping limestone, and retain all healthy Tuart trees wherever practicable.
		The proposed extent of clearing will not have a significant effect on the representation of vegetation communities at a local or regional level.	No expected impact to conservation significant flora species (including TF and PF).

Key Factor	Potential Impact	Management/Mitigation Measures	Predicted Outcome
		No TECS or PECs will be impacted by the Proposal as none have been recorded within the area. Stormwater generated is to be retained on site, a net improvement in nutrient balance will be achieved and groundwater conditions are expected to remain unchanged post development to manage in-direct impacts on the Clifton-microbialite TEC.	No TECS or PECs will be impacted by the Proposal. No in-direct impacts on the Clifton-microbialite TEC.
	Spread or introduction of Noxious Weeds	Spread of noxious weeds to Lake Clifton will be minimised through strict weed hygiene measures, ongoing monitoring and management.	No increase or introduction of noxious weeks
Terrestrial Fauna	Adverse impact on terrestrial fauna values	Implementation of environmental Management Plan addressing vegetation clearing within the development footprint, vehicle speeds, weed management and pet restrictions on site.	No significant adverse impacts to any local or subregional populations of native terrestrial fauna.
Water Balance	Modification of site water balance	An increase in water entering the site estimated as approximately 30 mm of recharge per annum as a result of limited importing of potable water.	No change to site water balance

Key Factor	Potential Impact	Management/Mitigation Measures	Predicted Outcome
	Intrusion of underlying saline groundwater	Groundwater abstraction to increase from an estimated 3.9 ML/yr predevelopment to 9.8 ML/yr post development used solely for non-potable uses. Shallow bores will be designed and placed in excess of 200 m of the boundary of the CCW to minimise the potential intrusion and upconing of deeper saltier water.	No significant intrusion and upconing of saline groundwater.
Lake Clifton Water Quality	Increased nutrient loading on groundwater and Lake Clifton	The implementation of the UWMP will provide long term environmental benefits through the reduction of nutrient loading from 359 kg/yr TN to 41 kg/yr TN and from 32 kg/yr TP to 8 kg/yr TP post development.	An 89% and 75% reduction in TN and TP loading on Lake Clifton per year.
	Adverse impact on the environmental values and functions of Lake Clifton	The proposed development implements a buffer of 80 -100m which is between 30 - 50m beyond the minimum buffer identified in the wetland buffer separation study.	Protection of environmental values and functions of Lake Clifton from adjacent proposed land uses.

7.2 Management Processes outside of the *Environmental Protection Act 1986*

The development proposal is subject to management and planning approval processes contributing to the mitigation of environmental impacts outside of the provisions of the *Environmental Protection Act 1986*. These management and planning processes are outlined in Table 15.

Table 15 Additional Management and Planning Processes

Process	Legislative Instrument	Approval Agency	Management Outcome
Development Approval	*Planning and Development Act 2005*	Shire of Waroona and WAPC	Controls on extent of clearing and other relevant controls on nature of development
WWTP Approval	*Health Act 1911* Building Code of Australia	DoH DoW	Installation of a WWTP compliant to rigorous controls on the levels of nutrients and pathogens that may occur in wastewater effluent and their effects on public health. The design of the WWTP is scrutinised by the both the Department of Health and the Department of Water for appropriate effluent outputs.
Waste Management	*Waste Avoidance and Resource Recovery Act 2007*	Shire of Waroona and WAPC	Implementation of an approved waste management strategy to effectively minimise and manage waste from the development.
Urban Water Management	*Planning and Development Act 2005*	Shire of Waroona and WAPC	Implementation of water sensitive urban design consistent with: • State Planning Policy 2.9 Water Resources (Government of Western Australia 2006) • Liveable Neighbourhoods (WAPC & DPI 2009) • Better Urban Water Management Guidelines (WAPC 2008)

Process	Legislative Instrument	Approval Agency	Management Outcome
Groundwater Abstraction License	*Rights in Water and Irrigation Act 1914*.	DoW	Management and mitigation of any potential impacts from the abstraction of ground water. The abstracted groundwater is for non-potable uses within the proposed development

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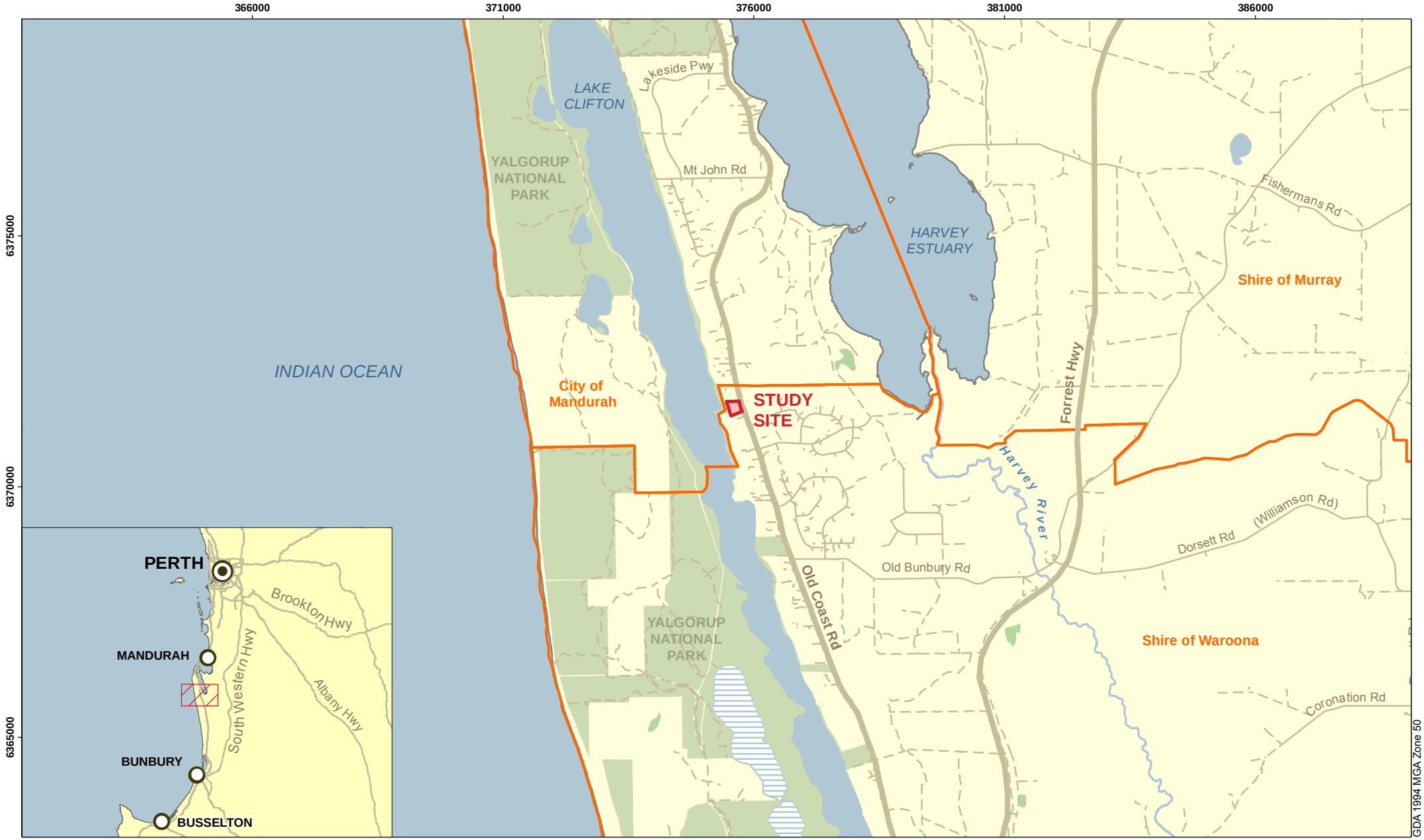
Maps



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web: www.ecoscape.com.au

AUTHOR: JN CHECKED: SB
DATE: 11-12 PROJECT NO: 2216-08 V1

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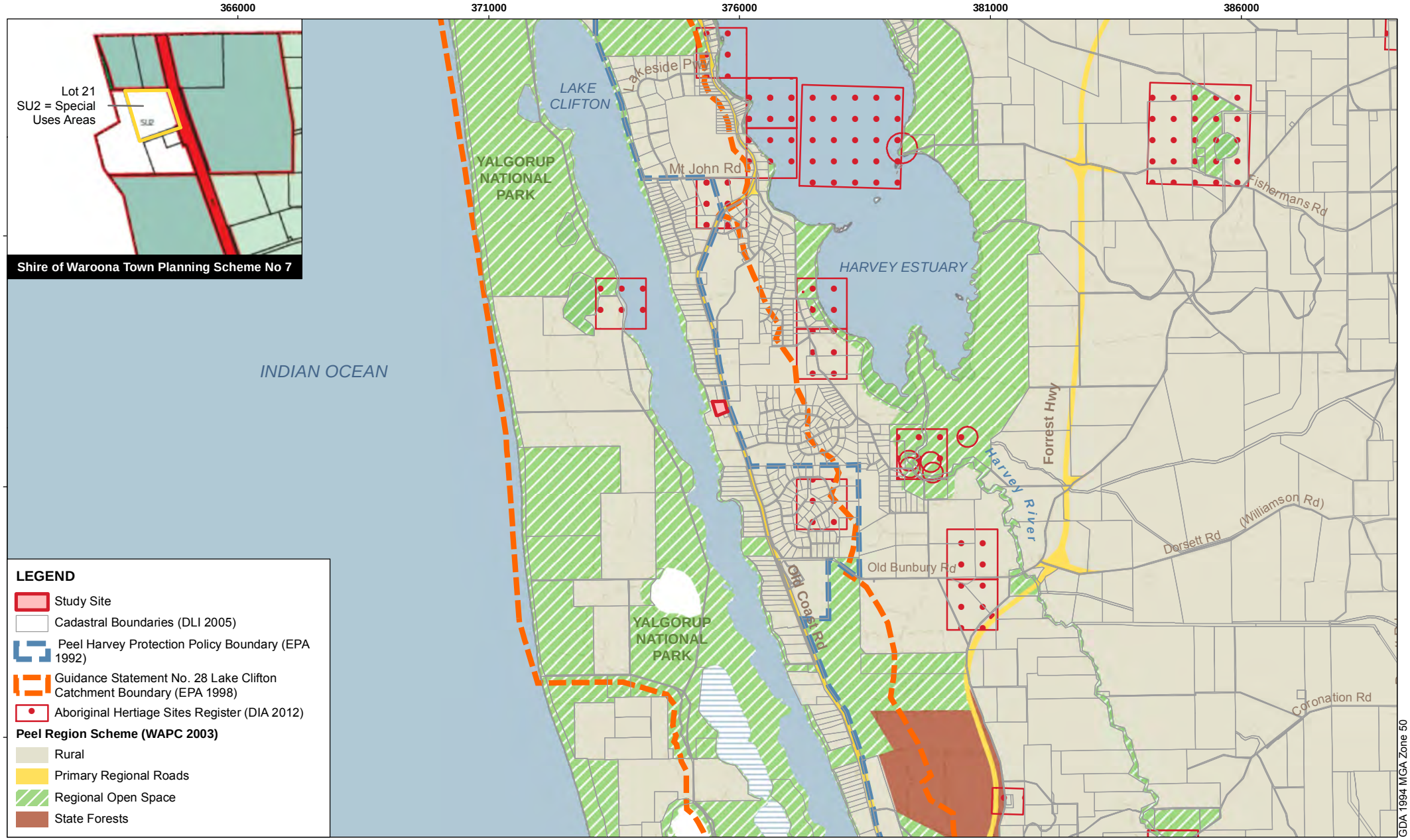
LOT 21 OLD COAST RD
PARK HOME REDEVELOPMENT

CLIENT: BECK ADVISORY

STUDY AREA LOCATION

MAP 1



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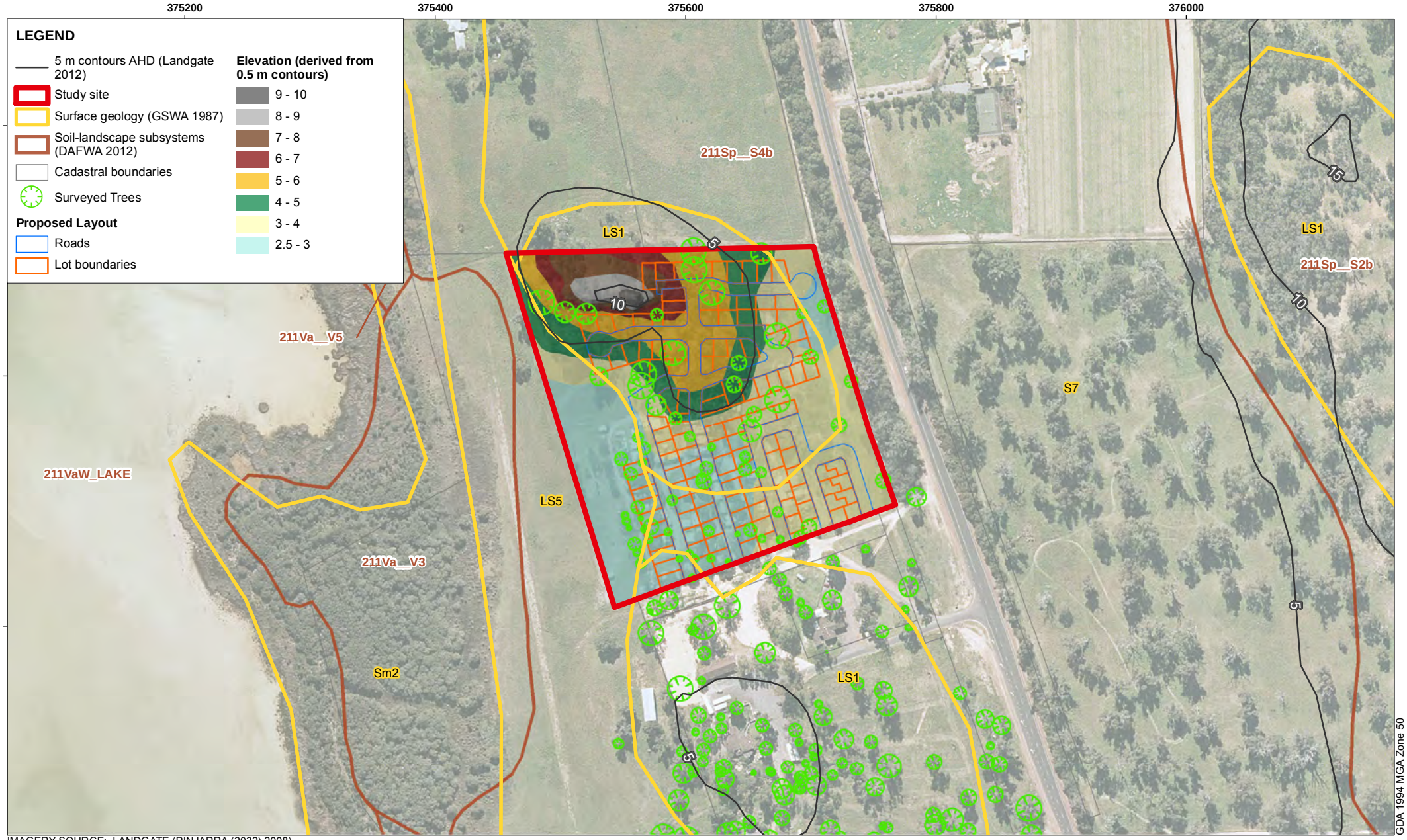
LOT 21 OLD COAST RD
PARK HOME REDEVELOPMENT

CLIENT: BECK ADVISORY

TENURE & PLANNING

MAP 2



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Scale 1:4,000 @ A4

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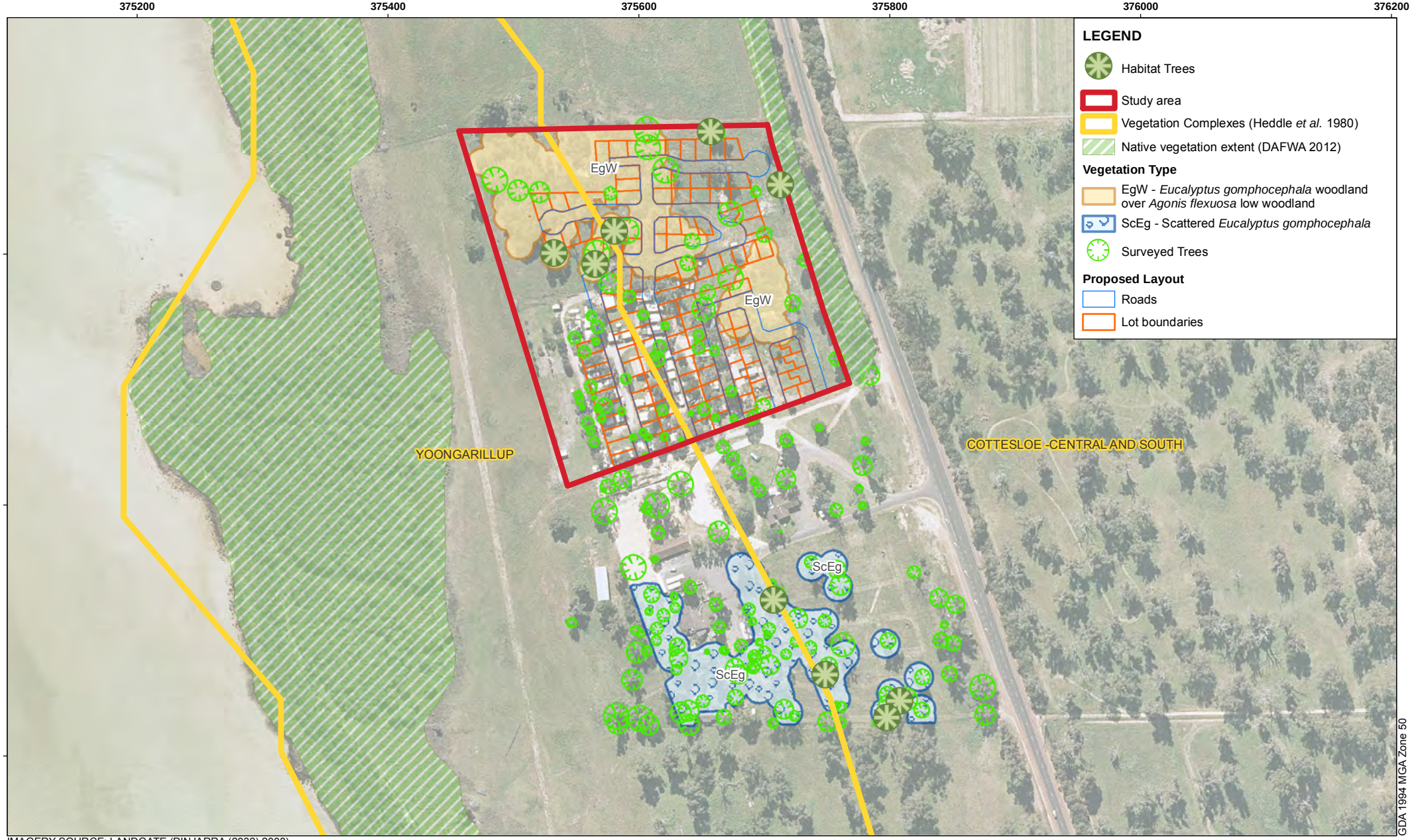
LOT 21 OLD COAST RD
PARK HOME REDEVELOPMENT

CLIENT: BECK ADVISORY

BIOPHYSICAL VALUES

MAP 3



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LOT 21 OLD COAST RD
PARK HOME REDEVELOPMENT

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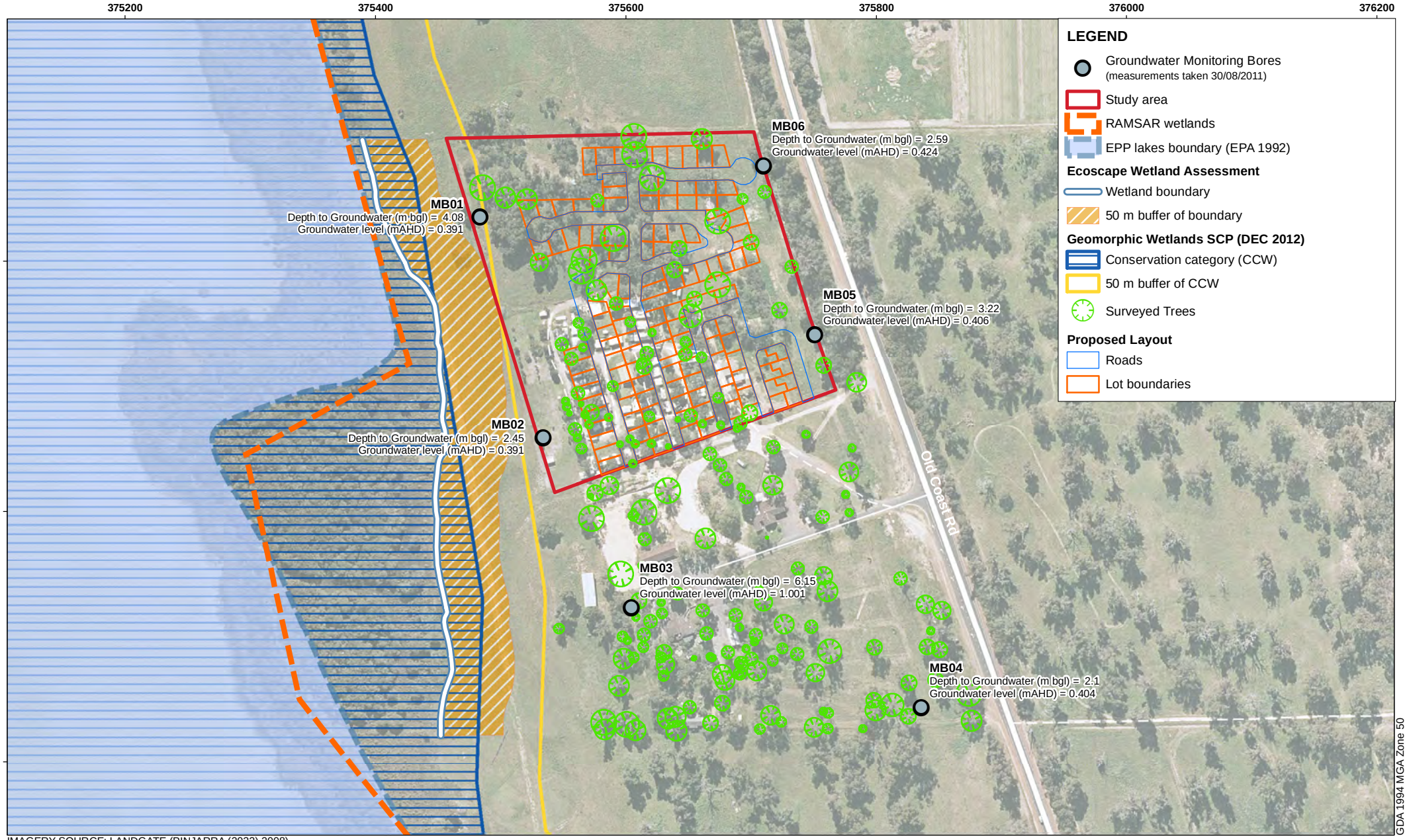
FLORA,VEGETATION AND FAUNA VALUES

MAP 4



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Scale 1:4,000 @ A4

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LOT 21 OLD COAST RD
PARK HOME REDEVELOPMENT

CLIENT: BECK ADVISORY

HYDROLOGY AND WETLANDS

MAP 4

Appendix One: Social Impact Study

COAKES CONSULTING®
Social Impact and Community Consultants

Social Impact Statement for the Development Application of a Park Home Site at Old Coast Road, Lake Clifton

REPORT

Prepared for

Beck Advisory



March 2009

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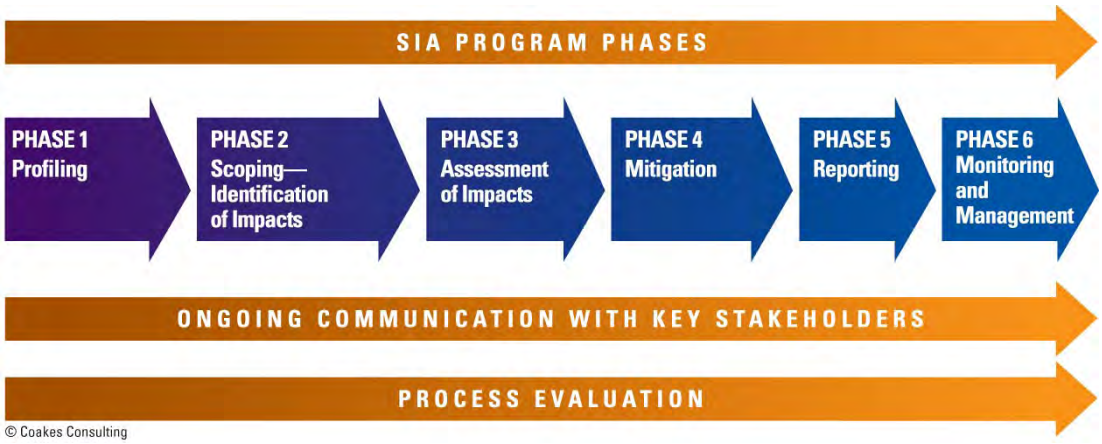
Executive Summary

Project Background

This report provides an assessment of the social impacts relating to a proposal by Beck Advisory (agent for the Scolaro family), to develop the existing Lake Clifton Caravan Park, tavern and former service station, located at Lots 19-21 Old Coast Road, Lake Clifton. The proposed development application is for conversion of the Caravan Park into a Park Home Site (of approximately 205 units) on the same lease area, as per plans prepared by Doepel Marsh Architects.

Social Assessment Methodology

Social assessment is concerned with assessing and predicting the likely consequences of a proposed action in social terms. The social impact assessment has involved a phased approach to identifying and assessing the social impacts associated with the proposed development. These phases are summarised in the figure below.



Social Impact Assessment Program
Source: Coakes Consulting (March, 2009)

As part of the program, consultation with key stakeholders has been undertaken. Survey methods (personal meetings and telephone interviews) were used to obtain the views and perceptions of stakeholders in and around the proposed Lake Clifton caravan park site and within the broader community. A total of 50 people were interviewed across the following sectors: Local Government, existing caravan park residents, neighbouring Lake Clifton residents, local community groups and service providers.

These issues have then been further assessed and evaluated and, where relevant, appropriate strategies developed to address issues raised.

Project Context

Lake Clifton is located in the Shire of Waroona, which falls within the boundaries of the Peel Region. The small town is situated just off the Old Coast Road, between Mandurah and Bunbury at the north end of the Yalgorup National Park. It is approximately 38 kilometres from Mandurah and 29 kilometres from the town of Waroona.

Lake Clifton was established in 1921 as a company town to support the WA Portland Cement Company's lime deposit mine which closed three years later in 1924. Given its proximity to Preston Beach, the town offers a rural retreat lifestyle to residents and visitors.

According to the ABS census data, in 2006 Lake Clifton had a population of 440 persons, comprising approximately 13% of the Shire of Waroona's total population of 3,450. The majority of these residents reside on 5 to 10 acre blocks within a number of semi-rural subdivisions. The Lake Clifton community is also home to a proportion of caravan park dwellers that are predominantly semi-retired / retired.

The following table provides a summary snapshot of the socio-demographic profile of the Lake Clifton community and comparisons with the Shire of Waroona and WA State statistics based on the 2006 ABS Census.

Socio-economic Demographic Profile for Lake Clifton

	Lake Clifton	Shire of Waroona	Town and Shire Comparison	WA State	State and Shire Comparison
Age structure					
Percent 14 and below	21.5%	22.5%	↑	20.2%	↓
Percent 15-64 (workforce)	68.0%	62.8%	↓	67.7%	↓
Percent 65 and above	10.5%	14.8%	↑	12.2%	↑
Employment					
Unemployment rate	5%	4.2%	↓	3.8%	↓
Employment Rate	95%	95.8%	↑	96.2%	↑
Education					
Percent with a postgraduate degree or diploma	2.5%	3.9%	↑	4.2%	↑
Percent with a Bachelors degree	13.6%	12.1%	↓	17.5%	↑
Percent with a certificate or diploma	83.9%	84.0%	↑	53.1%	↓

	Lake Clifton	Shire of Waroona	Town and Shire Comparison	WA State	State and Shire Comparison
Income					
Median individual income ($/week)	374	392	↑	500	↑
Median family income ($/week)	1075	1165	↑	1246	↑
Median household income ($/week)	987	962	↓	1066	↑
Family Composition					
Couple family with children	44.6%	59.7%	↑	31.8%	↓
Couple family without children	47.9%	28.7%	↓	48.3%	↑
One parent family	7.4%	11.7%	↑	14.8%	↑
Dwellings					
Separate house	91.4%	90.5%	↓	86.9%	↓
Semi-detached	0.0%	7.0%	↑	7.5%	↑
Flat, unit or apartment	0.0%	0.4%	↑	4.6%	↑
Other, including caravan	8.6%	2.1%	↓	0.8%	↓
Housing tenure					
Fully owned	43%	41.3%	↓	31.3%	↓
Being purchased	47%	38.3%	↓	37.6%	↓
Rented	15%	20.4%	↑	27.2%	↑

Source: ABS Census, 2006

Identified Impacts and Assessment

The following table summarises the perceived issues/impacts identified during consultation with key stakeholders; provides further assessment and analysis of these issues/impacts; and clearly outlines how each of the issues/impacts is to be addressed by the proponent as part of the proposal.

Proposed recommendations to address impact areas

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
Environment – *Water Usage, Quality and Sewerage Disposal*	• Current caravan park residents expressed concern regarding provision of sufficient water and sewerage disposal due to an increased number of residents • Significant concern expressed regarding over taxing of the existing water supply and impacts on the water table • Concern regarding sewerage infrastructure for an increased resident population	• Original caravan park was not developed to house a permanent resident population • Current proposal will develop appropriate infrastructure to meet additional population requirements • Relevant environmental and infrastructure assessment has been undertaken by Ecoscape and Shawmac Engineers	Environmental Consultant Recommendations • Monitoring bores to be installed on site prior to development to collect baseline level and water quality data, and ensure continued monitoring • An Urban Water Management Plan be developed, implemented and monitored over a 3 year period to ensure that the values and ecological functions of Lake Clifton are maintained • The large water feature to the front of the proposed plan to be used to collect water run off • A Filtrex split system will be utilised in the proposed development, which will reuse all household water to irrigate garden areas, thus significantly reducing water usage.

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
			• Rain water collection tanks for all units for all domestic uses. • Each park home to be serviced by an eco-friendly on-site sewerage treatment package unit. • On-site water infiltration for the absorption of effluent water.
Environment - *Protection of Wetlands and Local Flora and Fauna*	Stakeholders expressed concerns over possible impacts on the environment, these included: • Proximity of the development to the wetlands • Impacts on fauna such as local birdlife • Impacts on existing stands of Tuart trees as a result of park development	• Environmental studies undertaken by Ecoscape to assess the impacts of the proposed development on the neighbouring wetlands and local flora and fauna	• Endorsement of the DEC recommendation to ensure a minimum 50 metre buffer between the proposal and the wetland boundary • In accordance with the Shire of Waroona's local planning strategy for Lake Clifton, all dwellings will be located at least 150m from the high water mark • Wherever possible, Tuart trees are to be maintained on the existing site so as to minimise impacts to the Baudin's Black-Cockatoo

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
	• Impacts on the wetlands and thrombolites through increased human traffic in the area.		• The proposed application includes extensive tree planting of local native species
Potential Displacement of Residents	• Concerns expressed by permanent caravan park residents that related to: • Sale of their homes • Future accommodation options • Lack of information regarding the proposed development	• The current caravan park was not developed to house a permanent population. • Information regarding the proposal should be clear and consistent to address resident fears and uncertainties	• Improved communication and provision of information to existing park residents through the planning phase, including detail of the phased nature of the development
Pressure on Existing Local and Regional Services	• Concern was expressed by residents of Lake Clifton that the	• All service providers consulted across key community sectors (health, education, childcare,	• Provision of information to park home residents regarding service catchments and local facilities.

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
	additional population of the park home site would place greater pressure on existing services in the locality	emergency services, transport) reported that they could easily accommodate a population increase in the locality • Additional population seen to be of assistance to voluntary service sectors e.g. Emergency services.	• Development of commercial centre as part of the current proposal, likely to provide additional 'services' to the Lake Clifton Community e.g. local retail outlets and community facilities.
Access to Services	• Concern that new park home site residents may have differing expectations regarding access to and provision of services.	• The majority of households in lake Clifton have their own modes of transport e.g. current ABS data (2006) indicates that 98% of households in Lake Clifton own at least 1 vehicle, with 68% owning 2 or more vehicles • There are two transport providers that offer daily services between Lake Clifton and Mandurah or Perth. o Trans WA runs a coach service that stops at the Lake Clifton Roadhouse and	• Communicate service access and availability to new park home site residents to ensure effective management of resident expectations • Provision of a community bus to transport residents from the park home site to local centres to facilitate access to relevant services in Falcon, Mandurah and other local centres. • Undertake discussions with existing transport operators to facilitate expansion and upgrade of their existing services to Lake Clifton, given

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
		continues on to the Mandurah bus station. This service is available 1 to 3 times a day, depending on the day of the week. o Southwest Coach Lines offer a service that goes from Busselton, to Bunbury, and then on to Perth, and also in the opposite direction. Both of these lines operate three times a day, with one in the morning, lunch/afternoon, and evening.	potential population predictions outlined in the current assessment. • Development of a new commercial centre on the proposed site to provide daily retail provisions e.g. IGA, fruit and vegetable shop, newsagent, bakery, tavern etc. This will reduce the requirement for residents to travel to other centres for daily necessities • Redevelopment of the existing tavern as a community facility/venue to facilitate recreational activities for park home residents and the broader community
Population change	• Associated with the influx of new residents to the park home site.	• Population modelling indicates that an additional 400 new residents (207 home sites x 2 persons per site) into the township would reflect a 90% growth in the town's overall population; and a 325% growth to	• Development of the commercial centre and provision of services and amenities relevant to the predicted population demographic.

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
		the town within the 55 years and over age group category.	
Changing nature of community	• Concern was raised regarding the demographic that may be attracted to the park home site given the lower cost of accommodation and related social problems	• Concerns appear exacerbated by media reports regarding increased anti-social behaviour and crime in areas such as Preston Beach. • Other developments are proposed in the Preston Beach area. • 8.6% of the existing Lake Clifton community currently reside in other types of accommodation including caravans, cabins and houseboats. • The majority of Lake Clifton residents consulted, including caravan park dwellers, outlined the peace and quiet of the area as a key attribute of their place of residence. • The proposed park home site is specifically targeted at the over 55 year old demographic (semi-retired,	• Appropriate marketing of the park home site to the targeted demographic population – over 55 years, semi-retired or retired couples seeking a lifestyle based on a tourist function.

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
		retired), requiring a semi-rural lifestyle, in relative proximity to key services. • Current composition of the caravan park is largely consistent with the above demographic age group.	
	• The proposed development has been viewed by existing residents to be contradictory to the Shire of Waroona's Planning strategies that seek to maintain Lake Clifton's semi rurality (no land divisions smaller than 2 hectares)	• The current caravan park is already zoned as a commercial site earmarked for provision of land for the continued development of the Lake Clifton community and tourist centre; and has been defined as a significant development node. • The proposal is in line with the required expectations (area uses and conditions) outlined in the Shire of Waroona's Development Guide Plan (DGP).	• The development of the commercial centre and community facilities have been designed to provide additional services to the Lake Clifton community; and to facilitate greater integration of community residents through common use commercial and recreational community facilities.
	• It was perceived by some stakeholders that	• The Shire of Waroona's Cultural Plan recommends that any new	• The proposed commercial centre has the potential to be a significant

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
	the new development would increase the divide currently felt between the Lake Clifton towns' people and the current caravan park dwellers	developments reduce barriers that inhibit growth of the community spirit and sense of togetherness in Lake Clifton • Lake Clifton's social capital and community well-being have been identified as key factors which need to be taken into consideration as part of any new developments within the township.	development node for Lake Clifton • The new community facility has been designed to increase sense of community by being a multi-purpose, multi-use facility. Community barbecue facilities and additional recreational space is also proposed as part of the current proposal.

Source: Coakes Consulting (2009)

In conclusion, the socio-economic assessment has identified a range of perceived community issues/social impacts associated with the proposal. These issues have been documented and, where relevant, appropriate strategies identified and proposed to address the issues raised.

As is the case with other developments of this kind, the perceived social impacts/ issues are greatest for those living in closest proximity to the proposal, or those who perceive they will be most directly impacted by the development. Therefore, it will be essential for the proponent to maintain an ongoing dialogue with local residents throughout the implementation stages of the project in relation to issues of relevance and importance to the community.

1 Introduction

This report addresses the social impacts associated with Beck Advisory's proposal to develop a park home site in Lake Clifton at Lot 19-21 Old Coast Road Lake Clifton.

Beck Advisory's development plans are underpinned by an inclusive approach to social and environmental assessment, to ensure that the proposed park home site is planned and managed to maximise opportunities and to minimise negative impacts to the local community.

As such, the social assessment program had the following key objectives:

- To identify and assess the social impacts associated with the proposed development to inform the Planning Application for the Shire of Waroona; and
- To provide recommendations as to how such impacts could be effectively managed or mitigated.

The report is structured as follows:

Section 1 – provides a brief background to the proposal and outlines the project;

Section 2 – provides an overview of the methodology employed as part of the social assessment program;

Section 3 – provides a detailed social profile, a desktop study, of Lake Clifton and the surrounding area including the Shire of Waroona and the Regional City of Mandurah;

Section 4 – reports on the perceived social impacts of the proposal identified during consultation with existing caravan park residents, community groups and service providers;

Section 5 - provides an assessment of these perceived impacts; while

Section 6 – recommends a number of potential strategies to mitigate and/or address the issues raised by the community.

2 Background

The Company

Beck Advisory is an asset management company who assist clients with the management and development of their investments.

Beck Advisory has been appointed as agents for the Scolaro family, the current owners of the caravan park in Lake Clifton and proponents of the application to the Shire of Waroona. The Scolaro family purchased the existing caravan park on Lot 19-21 Old Coast Road in 2004. The site owned by the family constitutes approximately 80% of the commercial zoned land in the Lake Clifton Township, and to date has been operated as a caravan park designed primarily for temporary residence. The Park has an onsite manger and there is a separate Manager for the Tavern, which is also located on the site. A bakery which is located in the old Service Station, is also part of the existing site, and is privately owned and operated.

The Proposal

The proposal seeks approval to upgrade the existing commercial and caravan site (including the existing bakery and tavern) into a more appropriate modern park home facility.

The new park home site will include the provision of 10 chalets, approximately 205 park home sites and refurbishment of the existing tavern as a community facility. The proposal is designed to be completed in a staged manner, which would see approximately 20 new lots completed and released each year.

The site plans for the proposed development are shown below.

Figure 2.1: Plan of Development

Source: Doepel Marsh Architects, Perth

Strategic Importance of the Site

The proposed application for an upgraded tavern, commercial and caravan site into a more appropriate modern facility is seen by the proponent to have significant local and regional importance. If approved, the development would provide additional retail and recreational facilities within the area as well as offering affordable low cost accommodation, predominantly for people aged over fifty five years. The site could also accommodate families as permanent or semi permanent residents; or may provide an attractive tourist destination and stopover hub for motorists and tourists travelling to Perth and the Southwest of the State.

The new commercial centre (similar to that previously approved by the Waroona Shire on the 23rd March 2005,) will include an IGA or similar retail outlet, a new tavern and other general store outlets such as a fruit and vegetable shop, newsagency etc. The bakery will also remain. The existing tavern will be converted into a new community hall/centre. This site has a nice aspect overlooking Lake Clifton and additional recreational space and barbecue facilities will also be developed for use by park residents and the broader Lake Clifton community. The proposed park home site and commercial centre development is consistent with the permitted use and conditions of the area, as outlined in the Shires Development Guide Plan (DGP).

The proposed development is also strategically located close to expanding and developing areas within the Southwest coastal urban expansion corridor. For example, there are long term plans to develop the land at Preston Beach, which is likely to be a substantial community. The site is also adjacent to major transport links, including the Perth Bunbury Highway which is due to open in late 2009, and has good access to Perth, Mandurah, Bunbury and locally to the township of Waroona.

Current Activity at the Site

The existing site is located within the Waroona shire approximately 100 kilometres south of the Perth Central Business District. The combined area of Lots 19-21 is approximately 11 hectares, which is predominantly "parkland cleared".

The current commercial facilities on the site consist of The Lake Clifton Tavern and LC's bakery (on the site of the old service station.)

The current caravan park, which is operated by an onsite manager, has a total of 33 caravans that are occupied mainly by non-working or retired people in their fifties. The site has a combination of site owned and resident owned caravans. Thirteen of the vans are owned privately by permanent long term residents; 11 are owned and used as holiday homes; 7 vans are rented for long and short term accommodation by the caravan park; and 21 sites are available for tourist/caravan park use.

It should be noted that the caravan park was not originally designed for long term residents, and therefore its current capacity was not developed for this purpose. Given that a high proportion of the parks existing residents are permanent, this highlights a need for longer term accommodation in the area, particularly for semi and non-working retirees, and those seeking a weekender/tourism option.

3 Methodology

In order to assess the potential impacts that the proposed park home site development may have on the Lake Clifton community, a social assessment and community consultation program was undertaken in January through March 2009.

The aim of the social impact assessment (SIA) was to identify and assess the potential social impacts associated with the proposed development, particularly accessibility to local services and community infrastructure, as well as the compatibility of the development with existing land uses and community values.

The SIA program involved the following key phases, as illustrated in the chart below.

Figure 3.1: Social Impact Assessment Program
Source: Coakes Consulting (March, 2009)

The program has included profiling the local community and surrounding area to obtain an improved understanding of Lake Clifton's socio-economic characteristics; has involved consultation with various stakeholder groups with an interest in the proposal to identify perceived impacts associated with the proposal; an assessment of these impacts/issues; and identification of relevant strategies to address the issues that have been raised.

The following table summarises the mechanisms employed as part of the program.

Table 3.1: Summary of methods utilised as part of the SIA program

Method	Description
Assessment Methods	
Documentary Analysis	Collation, examination and review of relevant reports and studies relating to the project area.
Social Indicator Analysis	Examination of census data (2006) to develop a detailed profile of the Lake Clifton community in context of the Shire and the State.
Media Reviews	Review of local, regional and state media to identify community issues in the area.
Population change modelling	Modelling to determine the likely impacts on the local population as a result of an influx of new residents to the area and the subsequent demand on local and regional services.
Impact Significance Assessment	Assessment of the likely impacts of the proposal based on the importance of the issues to the community and further social assessment.
Consultation Methods	
Personal Interviews	Semi structured interviews with a number of stakeholders across the community e.g. Local government representatives, caravan park residents, local community representatives, local landholders, and local service providers to identify salient community issues and likely impacts of the proposal.
Telephone interviews	Structured telephone interviews with service providers across salient community sectors, namely; health, aged care, child care, education, retail and commercial services, recreation and leisure and transport, to identify likely impacts and capacity of these services to cope with an increase in population associated with the proposal.

Source: Coakes Consulting (2009)

3.1 Stakeholder Consultation

As highlighted in the following table, a total of 50 interviews were undertaken with a range of key stakeholders in the Lake Clifton community and surrounding regional area. A detailed list of the stakeholders consulted is also provided in the Appendix. Interviews were conducted over a two week period in February 2009.

Table 3.2: Stakeholders Consulted as part of the SIA program

Stakeholder Group	No. Of People
Local Government Stakeholders	
Shire Planners	2
Shire Councillors	1
Caravan Park Residents	
Permanent Full-time Resident Site Owners	11
Permanent Holiday Site Owners	2
Community Groups	
Lake Clifton Progress Association	10
Neighbouring Landholder	1
Service Providers	
LC's Bakery and Cafe	1
Blue Wren Caravan Park	2
Aged Care Facility	1
Childcare Providers	2
Primary Schools	1
High School / District High School	2
Emergency Services (e.g. Police)	4
Health Providers (e.g. Medical Centres, General Practitioners)	5
Transport Operators	2
Other Park Home Site Managers	3
Total:	**50**

Source: Coakes Consulting (2009)

Stakeholders were contacted and asked whether they would be interested in participating in a personal meeting or telephone interview as part of the program. Interviews were conducted over a two-week period in February 2009.

Interview guides were developed to guide discussions with the various stakeholder groups, and focused on identifying potential impacts associated with the proposed development, access to local services and compatibility of the development in the local area.

4 Social Profile

4.1 Geographical Location and Characteristics

Lake Clifton is located in the Shire of Waroona, which falls within the Peel Region of Western Australia. The small town is situated just off the Old Coast Road, between Mandurah and Bunbury at the north end of the Yalgorup National Park. The town is located approximately 38 kilometres from Mandurah and 29 kilometres from the town of Waroona.

Peel Region

In addition to the Shire of Waroona, the Peel region includes the City of Mandurah and the Shires of Boddington, Murray, Serpentine-Jarrahdale. The Peel region is vast, covering an area of 5,600 square kilometres and is home to 130 square kilometres of estuary and inland waterways, including Lake Clifton Wetland, which is of International Importance under the Ramsar Convention (Peel Development Commission, 2009).

The Peel region has a population of almost 94,000, the majority of which reside in Mandurah. Interestingly, the Peel region has been identified as the fastest growing region in Western Australia, with an average annual population growth rate of 3.9% between 2002 and 2007 (Australian Bureau of Statistics; Peel Development Commission). In recent times there have been numerous developments within the region. Many of these developments have been designed as lifestyle type villas, marketed as luxury apartments and aimed at the higher end of the market. Consequently, caravan and park home sites, which offer cheaper temporary and permanent accommodation options for the 55 year plus age group, are less prevalent, despite an apparent demand for this type of housing within the region (Caravan Industry Australia, Western Australia, 2006).

The region's economy is dominated by mining, manufacturing, building and construction, as well as retail and tourism. The agricultural and pastoral industry also makes a significant contribution to the region's economy. In 2006 – 2007, Peel had a gross regional product of $5.5 billion, marking a 21.5% increase relative to the previous financial year (Peel Development Commission, 2009). Such a figure places the Peel region as the fourth largest and fastest growing regional economy in Western Australia.

Figure 4.1: Peel Region
Source: Peel Development Commission, retrieved 2009

Shire of Waroona

The Shire of Waroona covers 835 square kilometres and is located within the Commonwealth Electoral Division of Canning and the State District of Murray-Wellington. In addition to Lake Clifton, the Shire also encompasses the towns of Hamel, Nanga Brook, Preston Beach, as well as Wagerup. National parks and state forests located around both the Yalgorup lakes and the Darling Scarp jarrah forests occupy approximately half the total land area of the Shire.

The Shire of Waroona was originally established as Drakesbrook in the late 1830s before becoming known as Waroona. Following the development of the Pinjarra to Picton Railway in 1893, Waroona became an independent town. Today the shire is primarily supported by agriculture as well as tourism. The Shire operates under the following mission statement:

"The Shire of Waroona will continue to provide and deliver effective and efficient services to its residents through a responsive, united and democratic system of local government that is a reflection of our community."

The Shire's Strategic Plan (2005 – 2025) has been developed around this mission, recognising the potential impacts of population growth and acknowledging the need for creating greater land availability to cater for adequate community services and infrastructure; particularly across the following community sectors: the aged, health care, education, as well as policing and recreation.

Lake Clifton

The area of Lake Clifton includes the small townships of Lake Clifton, Armstrong Hills, Tuart Grove and Herron (which has overlapping boundaries with the City of Mandurah). Lake Clifton encompasses the Yalgorup National Park which is home to the unique thrombolites as well as many different species of migratory water birds (Shire of Waroona cultural plan, 2006).

Lake Clifton was established in 1921 as a company town to support the WA Portland Cement Company's lime deposit mine which closed three years later in 1924. Given its proximity to Preston Beach, the town offers a rural retreat lifestyle to residents and visitors. The area has about 300 families living in what can be described as a semi-rural area of 5 to 10 acre blocks within a few subdivisions (Source: www.lakeclifton.com.au).

The wider Lake Clifton community is also home to a proportion of caravan park dwellers that are predominantly semi-retired / retired. As outlined in the ABS census statistics (2006), a significantly larger proportion of Lake Clifton's residents fall within the older workforce age of 55 – 64 years (17.6%), relative to the Shire of Waroona (12.8%) and State (10.2%) averages.

In 2006, Sustainable Community Development undertook a community consultation program to inform the Shire of Waroona's Community Cultural Plan. The Plan identified past achievements and potential opportunities for future cultural activities within the Shire, as identified by local residents living in the Shire's local communities.

Outcomes of this program highlighted that due to the geographic isolation of Lake Clifton residents from one another, there has been a fragmenting of the 'sense of community' in the area. Typically, those who reside in Lake Clifton's caravan park have also been regarded as separate from the broader Lake Clifton community. Consequently, the Shire of Waroona's Community Cultural Plan (2006) places a predominant emphasis on reducing any barriers that might inhibit growth of community spirit and "togetherness" within the Lake Clifton Township. As part of the Shire's initiatives, Lake Clifton's social capital and community well-being have been identified as key factors which need to be taken into consideration as part of any new developments within the small township.

This aspect, is addressed later in this report, in relation to the proposed conversion of the existing tavern on the site, to a community centre for use by park residents and the broader community (refer to Section 7).

4.2 Lake Clifton Socio-Economic Characteristics

4.2.1 Population and Mobility

According to the ABS census data, in 2006 Lake Clifton had a population of 440 persons, and comprised approximately 13% of the Shire of Waroona's total population of 3,450.

The mobility of an area can be assessed by how long the population has resided at their current address. Data from the 2006 census suggests that Lake Clifton's residents are not particularly mobile, with most having the same address 5 years ago. Residents of the caravan park in the area also appear to comprise mostly permanent

residents, with 13 (39%) of the park's 33 caravans owned and used as a place of permanent residence.

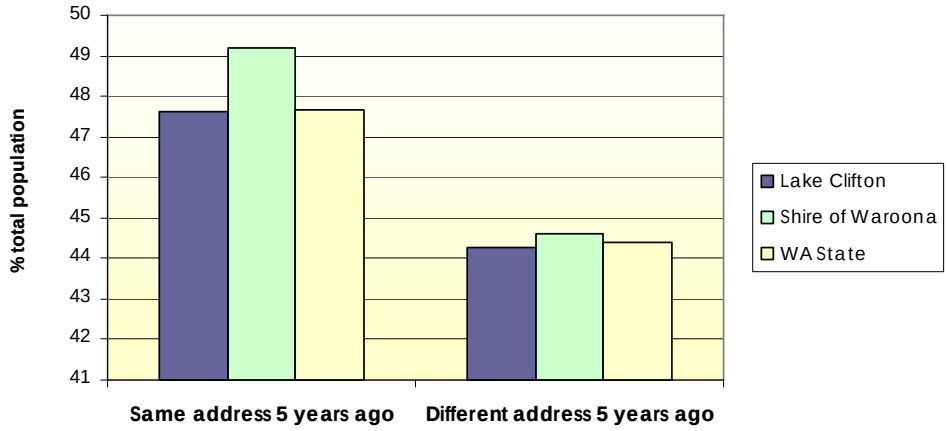


Figure 4.2: Household Mobility in Lake Clifton, Shire of Waroona and WA State
Source: ABS Census (2006)

4.2.2 Age Characteristics

The age structure of a community provides an indication of the area's residential role and highlights likely demand for public services and facilities. The majority of Lake Clifton's residents are between the older workforce ages of 35 – 64 years; with a lower than Shire / State average proportion of younger adults between the ages of 20 – 34 years residing in Lake Clifton. While Lake Clifton has a slightly greater proportion of dependent children between the ages of 5 – 14 years, compared to both the Shire and the State average;, the proportion of elderly dependents over the age of 65 years is less prevalent. Of the caravan park dwellers residing in Lake Clifton, the average age was between 55 – 64 years.

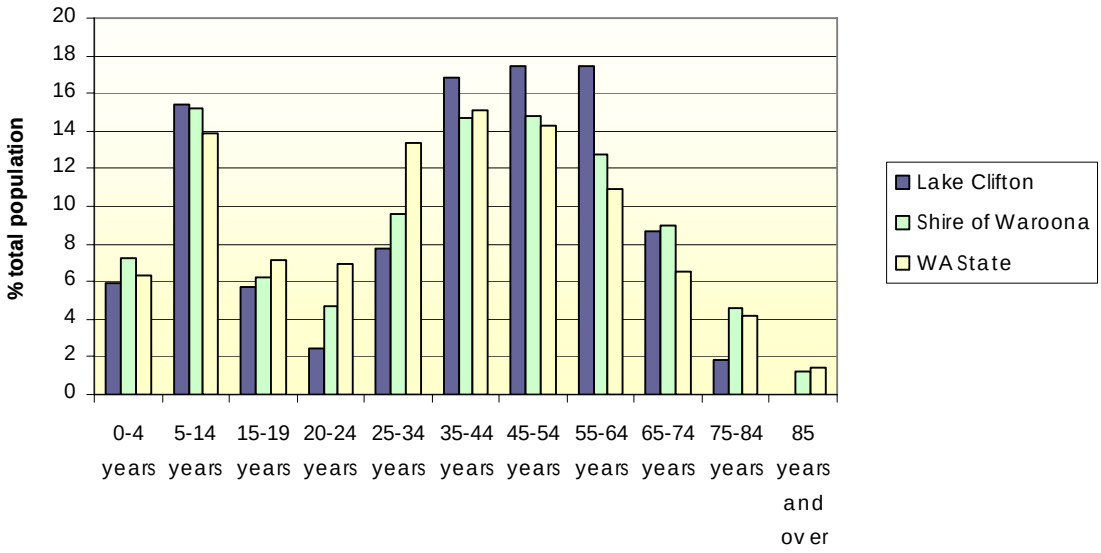


Figure 4.3: Age Structure of Lake Clifton, Shire of Waroona and WA State
Source: ABS Census (2006)

4.2.3 Education and Qualifications

The educational qualifications of a population may indicate potential economic opportunities and socio-economic status within an area. In 2006, a predominant proportion of Lake Clifton's residents were enrolled in primary schools (31.4%), followed by secondary schools (16.1%). Interestingly, substantial proportions were also enrolled in technical institutions in pursuance of vocational studies. It is noteworthy, however, that a large majority of Lake Clifton residents did not indicate their attendance of educational institutions. Therefore, this is likely to result in a biased representation of true proportions across these institutional categories.

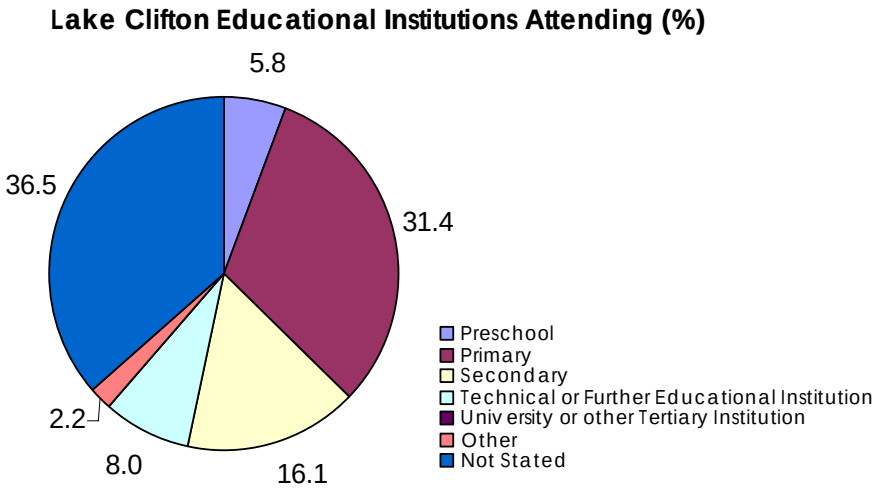


Figure 4.4: Educational Institutions attending in Lake Clifton
Source: ABS Census (2006)

Among those Lake Clifton residents who pursued further education, the most popular field of study was Engineering and Related Technologies, followed by Food Hospitality and Personal Services, as well as Health.

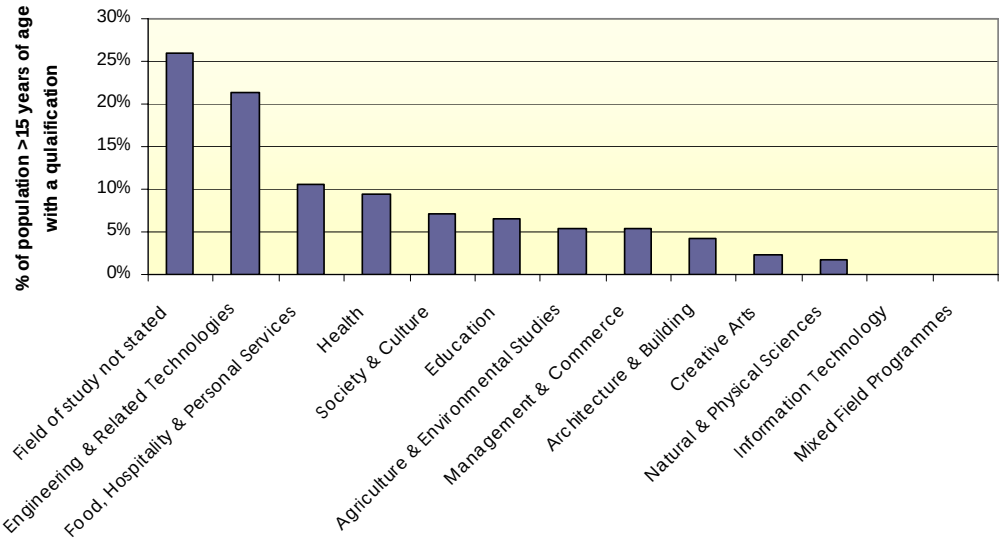


Figure 4.5: Field of Study in Lake Clifton
Source: ABS Census (2006)

4.2.4 Occupations, Income and Industry of Employment

Household income is one of the most important indicators of socio-economic status. The following figure compares weekly household income trends for Lake Clifton relative to the Shire of Waroona and the broader WA State. Lake Clifton's population appears to be relatively affluent, with household income levels comparatively higher than that of the Shire's average. In 2006, a greater proportion of Lake Clifton's residents fell within the higher income brackets of $1000 - $1200 and $2500 - $2999 per week, relative to both the Shire and State averages.

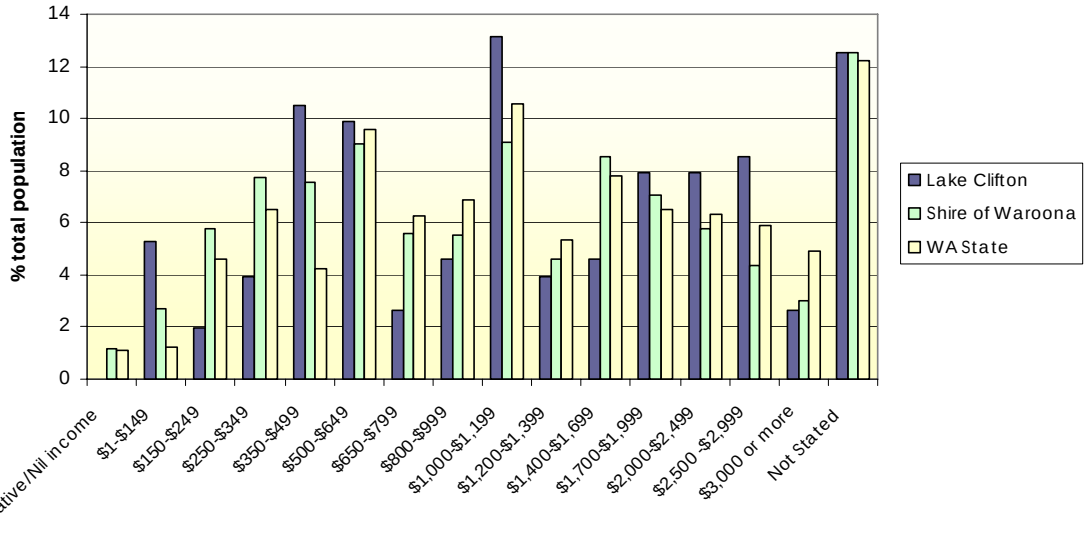


Figure 4.6: Weekly Household Incomes of Lake Clifton, Shire of Waroona, and WA State
Source: ABS Census (2006)

According to the 2006 census data, Lake Clifton's population recorded a relatively higher unemployment rate (5%) compared to the Shire of Waroona (4.2%) and the State (3.8%). According to the Shire, a large proportion of Lake Clifton's residents are either semi-retired or retired, particularly those who reside in Lake Clifton's caravan park. Among those who were employed, these residents typically commuted away from the town into neighbouring Mandurah or Waroona for work.

Lake Clifton residents are diversified in their industries of employment, with Manufacturing and Construction representing the highest proportion of the workforce as outlined in the figure below.

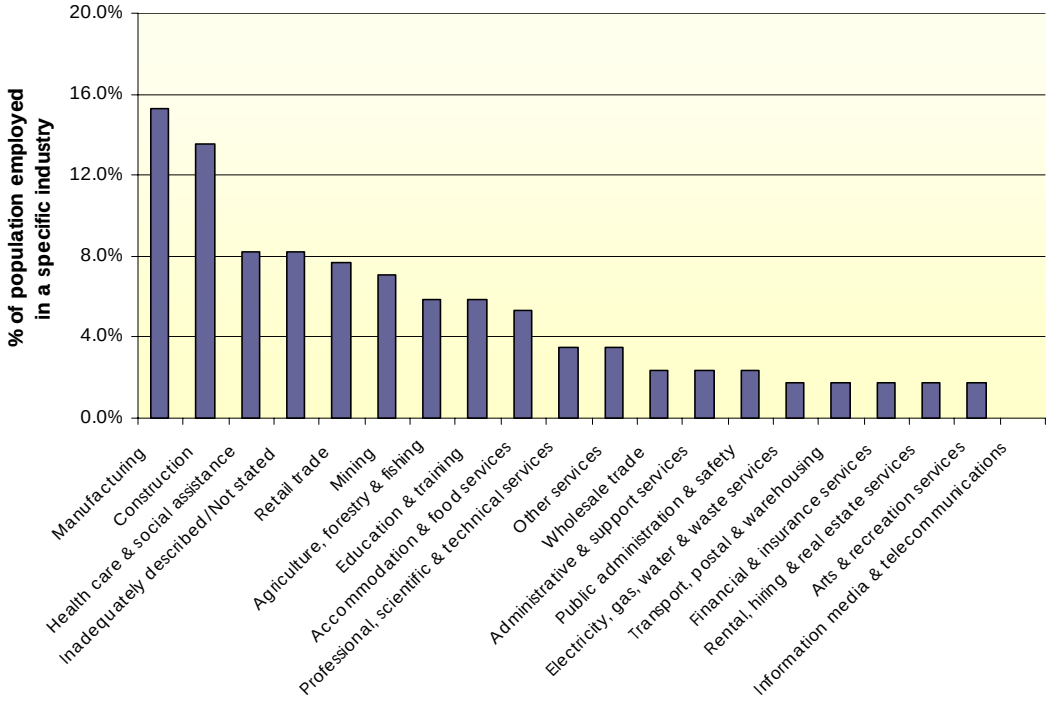


Figure 4.7: Industry of Employment in Lake Clifton, Shire of Waroona and WA State
Source: ABS Census (2006)

In terms of specific occupation of employment, most employed persons in Lake Clifton are employed as technicians and trades workers, followed by labourers and related workers. These roles tend to be more compatible with the manufacturing and construction industries, both of which are dominant employment sectors for Lake Clifton residents as previously outlined.

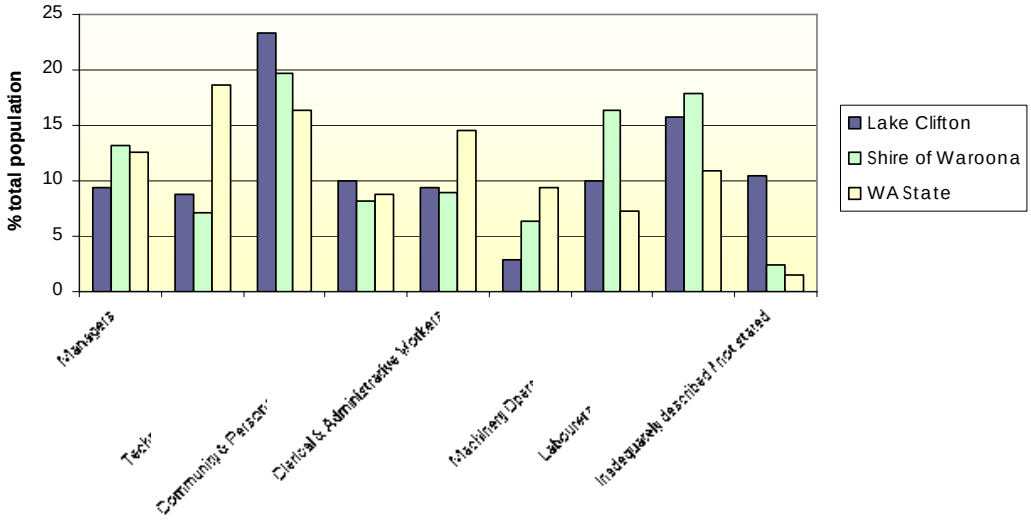


Figure 4.8: Occupation of Employment in Lake Clifton, Shire of Waroona and WA State
Source: ABS Census (2006)

4.2.5 Households and Family Structure

Lake Clifton is characterized by a greater proportion of couple families without children relative to couple families with children. It is, however, noteworthy that family composition trends in Lake Clifton are not markedly different to that of the Shire of Waroona and the broader WA State.

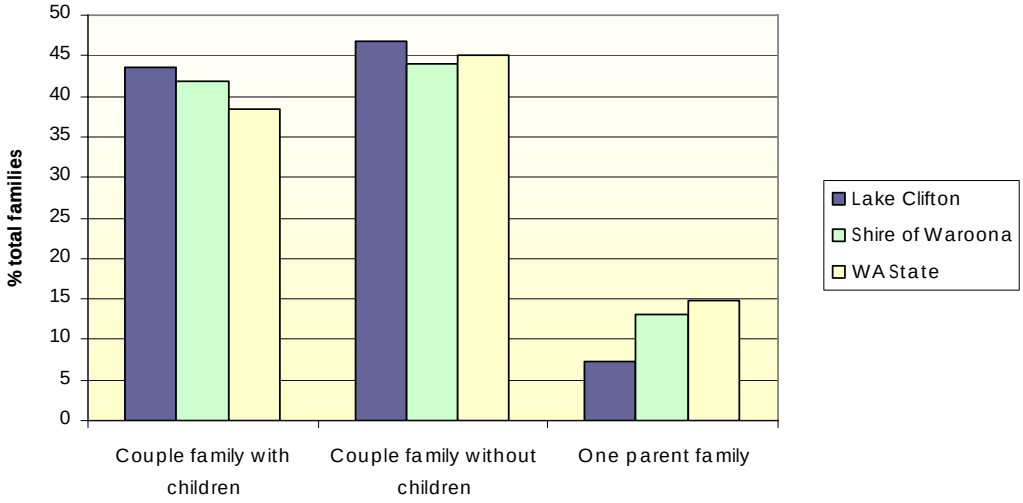


Figure 4.9: Family Composition in Lake Clifton, Shire of Waroona and WA State
Source: ABS Census (2006)

The 2006 census data also suggests that 8.6% of Lake Clifton's population reside in *other* types of accommodation that include caravans, cabins and houseboats. This trend is interestingly more predominant in Lake Clifton than in the Shire of Waroona (2.1%) and the State (0.8%), suggesting that caravan park dwellers constitute a component of Lake Clifton's residential population.

The census data also indicates that in 2006, Lake Clifton was characterised by a high proportion of home ownership, with a substantial 43% who fully owned their places of residence and 47% who were in the process of purchasing their homes. A relatively smaller proportion of households were rented (15%) relative to the Shire of Waroona (20%) and WA State (27%).

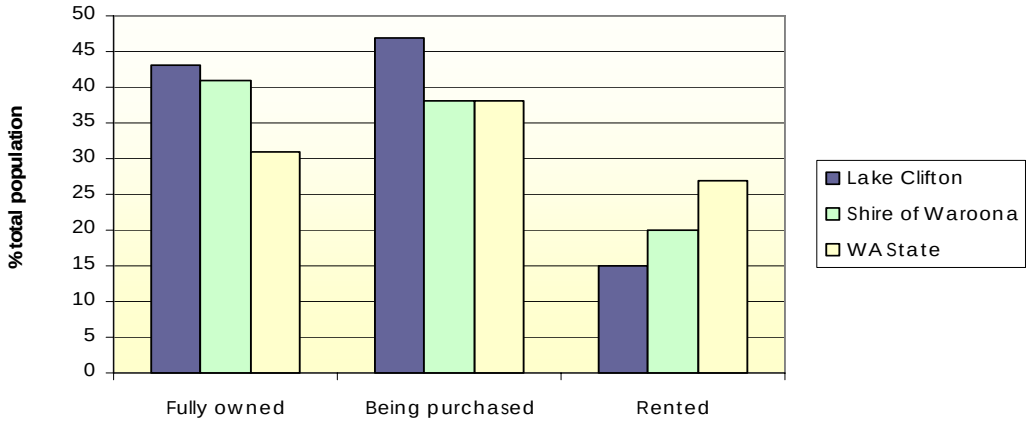


Figure 4.10: Household Tenure in Lake Clifton, Shire of Waroona and WA State
Source: ABS Census (2006)

4.2.6 Summary of Lake Clifton's Socio-Economic Profile

The following table provides a summary snapshot of the socio-demographic profile of the Lake Clifton community and comparisons with the Shire and WA State statistics.

Table 4.1: Socio-economic Demographic Profile for Lake Clifton

	Lake Clifton	Shire of Waroona	Town and Shire Comparison	WA State	State and Shire Comparison
Age structure					
Percent 14 and below	21.5%	22.5%	↑	20.2%	↓
Percent 15-64 (workforce)	68.0%	62.8%	↓	67.7%	↓
Percent 65 and above	10.5%	14.8%	↑	12.2%	↑
Employment					
Unemployment rate	5%	4.2%	↓	3.8%	↓
Employment Rate	95%	95.8%	↑	96.2%	↑
Education					
Percent with a postgraduate degree or diploma	2.5%	3.9%	↑	4.2%	↑
Percent with a Bachelors degree	13.6%	12.1%	↓	17.5%	↑
Percent with a certificate or diploma	83.9%	84.0%	↑	53.1%	↓
Income					
Median individual income ($/week)	374	392	↑	500	↑
Median family income ($/week)	1075	1165	↑	1246	↑
Median household income ($/week)	987	962	↓	1066	↑
Family Composition					
Couple family with children	44.6%	59.7%	↑	31.8%	↓
Couple family without children	47.9%	28.7%	↓	48.3%	↑
One parent family	7.4%	11.7%	↑	14.8%	↑

	Lake Clifton	Shire of Waroona	Town and Shire Comparison	WA State	State and Shire Comparison
Dwellings					
Separate house	91.4%	90.5%	↓	86.9%	↓
Semi-detached	0.0%	7.0%	↑	7.5%	↑
Flat, unit or apartment	0.0%	0.4%	↑	4.6%	↑
Other, including caravan	8.6%	2.1%	↓	0.8%	↓
Housing tenure					
Fully owned	43%	41.3%	↓	31.3%	↓
Being purchased	47%	38.3%	↓	37.6%	↓
Rented	15%	20.4%	↑	27.2%	↑

Source: ABS Census, 2006

4.3 Lake Clifton's Community Services and Infrastructure

This section provides an overview of the community services and infrastructure available within the Lake Clifton area. As with the majority of very small rural communities, with populations under 500 people, key community services such as health and education are often not located within the township itself, but can be accessed in larger urban localities. Consequently, where services are not available in Lake Clifton itself, relevant service catchments have been established through consultation with existing Lake Clifton residents.

4.3.1 Health Services

There is currently no medical care available in Lake Clifton; however up until recently, a part-time doctor has visited the community one hour a day, three times a week, utilising the Lake Clifton Community Hall to see patients. This service was organised by the Lake Clifton Progress Association, but the service has subsequently ceased due to the doctor's retirement. Discussions are currently underway regarding the provision of a Community Health Nurse and clinic to facilitate paediatric healthcare within the township.

Lake Clifton community residents who require basic medical care have two main service options: The Waroona Health and Community Resource Centre, which is located in Waroona approximately 20 minutes away (by car) from Lake Clifton, is staffed on weekdays in the mornings and afternoons by an attending doctor, and is also serviced on Wednesday evenings. Nurses and pathology services are also available three days during the week. Alternatively, Lake Clifton residents have the option of travelling to the Falcon Grove Medical Centre located in Falcon, Mandurah, approximately 30 minutes away (by car) from Lake Clifton. The Centre is

open on weekdays during office hours, and is permanently staffed by three doctors and a registered nurse.

For more serious healthcare needs like emergency services / hospitalisation, Lake Clifton residents are likely to utilize the Peel Health Campus in Mandurah. The Campus is the major health care provider in the Peel region, and has been in operation since 1997. It houses both public and private hospital services and offers a range of specialised clinical services including palliative care, cancer treatment, radiology, physiotherapy, as well as obstetrics and surgery. In addition, the campus also has a specialist led Emergency Department. However, the campus does not have intensive care facilities, so patients in need of intensive care are likely to be transferred to metropolitan hospitals such as Fremantle or King Edward Memorial Hospital. The Harvey Hospital also services the area, but is a relatively small regional hospital.

4.3.2 Aged Care Services

Elderly Lake Clifton residents, in need of aged care would access such services in neighbouring Waroona. The Home and Community Care section of Quambie Park, the closest aged care accommodation to Lake Clifton (Pam Corker House) is situated in Waroona. This facility assists the aged with transport to the shopping centre, as well as day care facilities and meals on wheels services. Aged residents also have the option of utilising one of the several other aged care accommodations located in Falcon or Mandurah.

4.3.3 Child Care Services

The closest child care services to Lake Clifton are offered in Falcon or Mandurah, where a range of services are available. The privately run child care centre that used to operate in Waroona closed in December 2008, due to lack of financial viability. In the Waroona Township there is a playgroup that meets regularly during the week.

4.3.4 Education Services

There are no pre-primary schools for young children in Lake Clifton. Primary schools can be accessed at Waroona's pre-primary school, located adjacent to the Waroona District High School. Families also have the option of St Joseph's, a private Catholic school that caters to children until Year 7. Other private schools are located in Mandurah, which are accessible by private bus services.

Lake Clifton is not serviced by any primary / secondary schools. Therefore, school-aged children from Lake Clifton are likely to travel to the neighbouring Waroona District High School which accepts enrolments from kindergarten through to Year 10. The school currently has a total of 360 students (260 primary and 100 secondary), and maintains very good relationships with local businesses and industry, thus affording students the opportunities of work experience and volunteering. A daily school bus service is offered to transport Lake Clifton residents to school in Waroona. Those students who wish to continue to Years 11 and 12 are likely to travel to Pinjarra Senior High School via a dedicated school bus from Waroona.

4.3.5 Retail and Commercial Services

In relation to retail and commercial services in Lake Clifton, there are a number of local businesses including: a web design company, boarding kennel, garden centre and property maintenance group. Other community services offered in Lake Clifton include; a tavern / motel, a couple of cafes and restaurants and a service station. For daily groceries, post office and/or banking facilities, residents of the caravan park outlined that they usually travel to Falcon (approximately 31 kilometres away), where the Miami Village, Falcon Grove and Miami Plazas all have supermarkets including IGA, Woolworths, post office, banks and other speciality retail outlets.

4.3.6 Recreation and Leisure

The Lake Clifton Township does have a very active Lake Clifton Herron Progress and Sporting Association (LCHCSA), which was established by a group of community minded residents in 1986. The group has recently completed construction of the Lake Clifton / Herron Community Centre, which provides a community gathering space for up to 150 individuals. The centre also has tennis and basketball courts, children's play equipment, and has the potential to host a children's play group. The play group is currently not active, but the Association continues to seek parents interested in getting involved. The centre is available to community members free of charge and can be rented out for private functions. The Association also produces a regular newsletter which affords community members and local businesses the opportunity to discuss current local issues.

Lake Clifton also has a number of significant recreational / leisure destinations. These include the Yalgorup Lakes System, a Ramsar conservation wetlands site which is home to over 60 different species of birds. The Lakes are also home to living and fossilized Thrombolites. The Lake Clifton Thrombolite reef is over 6 kilometres long, and

is possibly the largest of its kind in the southern-hemisphere. The Blue Wren Park, also located in Lake Clifton, has a café that provides casual lunches against a backdrop of 23 acres of natural vegetation and trails for bushwalking, as well as a golf course. Lake Clifton also has a local vineyard and winery.

4.3.7 Transport

Lake Clifton is most accessible by car from the Old Coast Road or from the Old Bunbury Road which comes off the South Western Highway.

Currently, Trans WA runs a coach service that stops at the Lake Clifton Roadhouse and continues on to the Mandurah bus station. This service is available 1 to 3 times a day, depending on the day of the week, on weekends bus services are more limited. Therefore, it would be advantageous for those living in Lake Clifton to have their own form of vehicular transportation to access essential services. An assessment of vehicle ownership by household (ABS, 2006) suggests that 98% of households in Lake Clifton have at least one car.

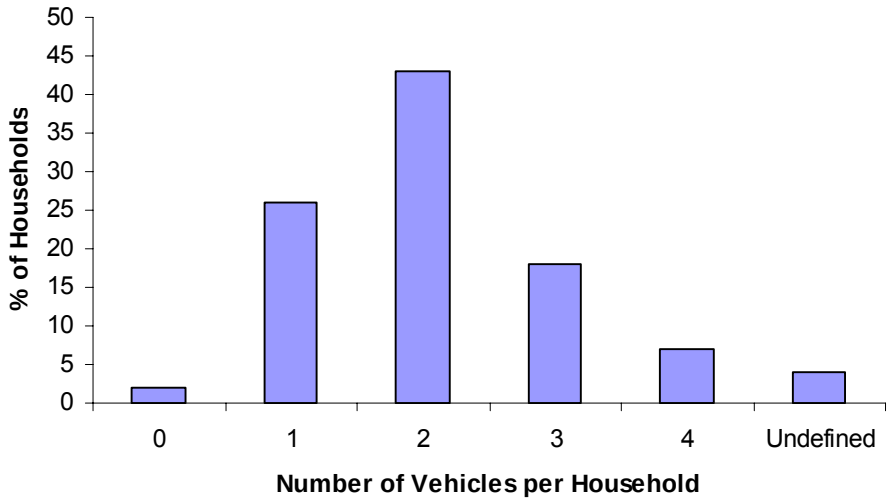


Figure 4.11: Number of Vehicles per Household in Lake Clifton
Source: ABS Census (2006)

Southwest Coach Lines also offer a service that goes from Busselton, to Bunbury, and then on to Perth. This line operates three times a day, with one in the morning, lunch/afternoon, and evening. There are also three buses a day that operate in the opposite direction, originating in Perth, going through to Bunbury and then Busselton at approximately the same time as the others. This service only stops at Lake Clifton if

a ticket has been pre-booked. The bus stop is located at the BP service Station on the Old Coast Highway, just out of the Lake Clifton town site.

4.3.8 Other Park Home Site Facilities

Within the Peel region, there are several Park Home Site developments similar to the one that is being proposed. The following table provides a comparison of existing sites in the area. As the table highlights, two of these sites have good access to services, with one having more limited access. The sites also appear to have a mix of park home sites (for more permanent residents) and cabin accommodation for visitors and families.

Table 4.2: Existing Park Home Sites in the larger area surrounding Lake Clifton

Park Home	Overall Demographic	Mix of other accommodation	Access to Services	Transport Links	Comments
Serpentine Park Home Village South Western Highway Serpentine WA 6125	Lifestyle Village catering for largely over 55 year age group (have some residents in their late 40's) Mainly owner occupied	Some cabins and powered sites – majority park homes	Nearest major town – Armadale	No bus service. Weekly Transperth bus comes to the park to take residents to Armadale. Other trips occasionally organized by park to Garden City Shopping Centre.	Most similar example to Lake Clifton, with no scheduled bus service.
Banksia Tourist Park 219 Midland Road, Hazelmere WA 6065	Over 55's Lifestyle Village	Separate section of park away from park home sites for visitors/families. Cabins and powered sites.	Nearest town Midland – 5 mins in car, 10 mins by bus. All major services. 5 mins in car Helena Valley Medical Centre (not in walking distance)	Bus every half hour outside Park to Midland.	Good local services close by to cater for resident needs. Social committee with organized activities.
Dawesville Caravan Park 1140 Old Coast Road, Dawesville	Mixture of park home sites and visitor sites (50:50) Park home and strata sites occupied by over 55 residents, but there is no age restriction. 82 Park home owners overall.	Caravans, strata sites, park homes, powered sites.	Most services accessed either in Falcon or Mandurah. Hospital – Peel Campus Falcon 7 mins by car – 2 doctors surgeries, hairdressers, shopping centre.	Bus every hour outside site to Mandurah and Falcon.	More varied demographic – more purchase or lease options. Good links to services.

Source: Coakes Consulting (2009)

4.4 Media Review

A review of local, regional and state media coverage was undertaken for the Lake Clifton locality to assist in highlighting community issues, public opinion and regional trends with respect to urban development within the area. The media analysis, dating from 2006 to present, has highlighted a number of salient community issues that include environmental and health concerns relating to drinking water and lake water quality, as well as protection of surrounding wetlands from encroachment of industrial activities and potential urban development.

The following figure provides details of media headlines, with further explanation of community issues provided in the sub-sections below.

Lake Clifton Media Review

December 2005	**$511m highway:** The Western Australian Government has awarded an alliance contract for designing and constructing the new Perth Bunbury Highway… The Weekend Courier, 15 December 2005
February 2006	**Horror of Old `Ghost' Road:** Old Coast Road coined Ghost Road due to large number of road fatalities… The West Australian, 5 February 2006
June 2006	**Peel turns over a new leaf:** Plans are afoot to turn what has been a quiet backwater between Mandurah and Bunbury into a thriving community. The West Australian, 24 June 2006
November 2006	**Growing pains as growth accelerates:** The City of Mandurah is under pressure to meet demands for basic infrastructure for an area that continues to amaze property experts and statisticians. The West Australian, 19 November 2006
March 2007	**Lakes battle looming:** Moves to develop Preston Beach and west of Lake Clifton will be fought vigorously by a new environmental group committed to protecting and sustaining the area's fragile coastal environment. Mandurah Coastal Times, 7 March 2007
May 2007	**We need a school:** Why is there no listing for a government high school to be constructed somewhere in the south Mandurah area and that there may be a wait of 10 years or longer? Mandurah Coastal Times, 9 May 2007
July 2007	**Concerns aired about underground CO2 plan:** The Collie Coal Futures Group released a report last week that says a site near Lake Clifton is the best area to inject carbon dioxide emissions into sediments near the earth's crust. Australian Broadcasting Corporation (ABC News), 9 July 2007
	Environment group takes 3,000 strong petitions to WA Parliament: Environmentalists in the Peel region are taking their campaign to protect the Yalgorup area to Western Australia's Parliament House. Australian Broadcasting Corporation (ABC News), 23 July 2007
August 2008	**Concern at sewage used as fertiliser:** The Water Corporation is dumping 800 tonnes of treated sewage each week on to a pine plantation near Lake Clifton, south of Mandurah, sparking fears that groundwater will be contaminated. The West Australian, 6 August 2008
	Residents voice anger over waste dumping: Lake Clifton residents believe ongoing dumping of biosolids on a nearby plantation by the Water Corporation may affect their drinking water and damage local lakes. Mandurah Coastal Times, 13 August 2008
September 2008	**Perth to Bunbury Highway ahead of schedule Perth to Bunbury Highway:** Perth to Bunbury Highway could be opened more than six months ahead of schedule. Australian Broadcasting Corporation (ABC News), 4 September 2008
December 2008	**WA Crash Claims Two Lives:** A four-wheel drive carrying four people and a car with two people on board collided on the Old Coast Road at Lake Clifton, south of Mandurah The West Australian, 27 December 2008

4.4.1 Road Use / Traffic

Lake Clifton is situated off the Old Coast Road, which comes off the South Western Highway. Over the years, the media has consistently reported several fatalities along the Old Coast Road, due largely to driver fatigue as well as reckless driving. Locals living in the area blame deteriorating road conditions and high volumes of traffic, for the high number of fatalities. Indeed, the Old Coast Road has also been synonymously coined the *Old Ghost Road* given the high prevalence of traffic-related fatalities in the area.

There is growing potential for safer road use on the Old Coast Road, with the impending completion of the Perth to Bunbury Highway. The highway is anticipated to reduce traffic volume on the Old Coast Road from a daily average of 8000 motorists to approximately 700 (*The West Australian, 2006*). The Perth to Bunbury Highway commenced construction in late 2006, with recent reports suggesting that the highway is expected to be completed in mid-2009, well ahead of schedule (*ABC News, 2008*). The highway encompasses a 70.5 kilometre dual carriageway road from the Kwinana Freeway extension through to Lake Clifton, and is expected to reduce travelling time from Perth to Bunbury by approximately 30 minutes (*Weekend Courier, 2006*). This is also expected to improve accessibility for Lake Clifton residents in utilizing metropolitan services and infrastructure when needed.

4.4.2 Environmental Issues

The media analysis has also highlighted predominant environmental concerns among Lake Clifton residents around water quality and the health of surrounding wetlands. A recent trigger for these concerns was the Water Corporation's provision of tonnes of waste to the Forest Products Commission for use as soil conditioner on the McLarty Pine Plantation (*Mandurah Coastal Times, 2008*). Lake Clifton residents have expressed concerns around the potential for ongoing waste dumping to affect their drinking water and damage local lakes. These residents have since taken their concerns to the Water Corporation and the Department of Environment and Conservation (DEC), raising issues around odours and harmful toxins contained in the waste.

Environmental concerns have also been raised around urban encroachments in the area. Many developers have expressed a recent interest in the coastal strip between Mandurah and Bunbury (*The West Australian, 2007*). A seven kilometre stretch of waterfront bordering lakes and a national park has been marked for development by

private businesses which have bought significantly large tracts of land at both Preston Beach and Lake Clifton. The population in the region is expected to grow from a few hundred, into the thousands over the next two decades (The West Australian, 2006). Examples of major developer movements include the Satterly Group, Ron Farris and Mirvac who were considering the development of residential homes on the dunes between Lake Preston and the Indian Ocean. Cape Bouvard Investment also cited plans to build a luxury resort and 4000 homes west of Lake Clifton. As a result, developer Fairbridge Asset has started the process of releasing land at Clifton Estate, with plans to redevelop the Lake Clifton Tavern and surrounding lands (*The West Australian, June 2006*).

Environmental groups in the area have therefore put up a fierce battle in ensuring ongoing protection of the Yalgorup lakes system and its flora, fauna, and underground water. Local communities in the area have raised prevalent concerns around the potential for future development plans to convert the environmentally sensitive and protected region into a bustling suburb with busy schools and industry activities, thereby destroying the unique character of the wetlands forever (*Mandurah Coastal Times, 2007*).

4.4.3 Community Services and Infrastructure

The potential for population growth and influxes into rural towns such as Lake Clifton is likely to correspondingly impose greater strains on surrounding regional centres. Due to the small population size and limited services available in Lake Clifton itself, the town's residents typically travel to neighbouring Falcon in Mandurah to access the locality's services. In 2006, a report surfaced in the media highlighting that Mandurah was under heightened pressure to ensure that its local infrastructure and service provision was at optimal standards, so as to cater effectively to increased population growth within both its boundaries as well as in neighbouring rural localities (The West Australian, 2006).

4.5 Social Profile Summary – Project Implications

Lake Clifton's socio-economic profile characterises the small township as a rural locality with a predominant proportion of older-aged residents, including a substantial proportion of caravan park dwellers that are either semi-retired or retired.

Due to the community's small population size, most residents traverse to neighbouring townships and regional centres in order to access essential household services and related community infrastructure.

The majority of Lake Clifton residents interviewed agreed that the peace and quiet of the area was one of the things they valued the most about living in the area. In particular, residents have cited the relaxed rural country lifestyle and the added attractions of living close to the estuary and ocean (Source: www.lakeclifton.com.au).

Most residents also recognize the impacts of limited accessibility to services and community infrastructure and subsequent effects on community involvement and participation. However, in an effort to foster a greater sense of community, the Lake Clifton Progress Association has initiated improvements to Lake Clifton's existing community infrastructure and social capital. For instance, the Association publishes and distributes a quarterly Newsletter across homes in Lake Clifton so as to keep local residents abreast of local community events and happenings. The Association also initiates support for local youth through local sporting and recreational activities, as well as investing effort in improving the town's local amenities and community infrastructure, through the original development of the Community Centre, but subsequent shading of children's playground areas and improving outdoor amenities, to facilitate community events and involvement.

Given relatively recent media focus on environmental concerns and angst among Lake Clifton residents relating to the encroachment of urban development and potential industrial activities in the area; it is suggested that similar community and environmental group sentiment is also likely to prevail in relation to the current development application for the Lake Clifton Caravan Park.

5 Perceived Social Impacts of the Proposal – Community Issues and Sentiments

Based on analysis of the outcomes of the consultation program, a number of issue themes have been identified that relate to the proposed development of a park home site at Lake Clifton. These perceived issues were raised by both existing caravan park residents and other community representatives interviewed as part of the SIA program. Section 5 provides an assessment and evaluation of these perceived issues; while Section 6 provides a range of suggested strategies to address the issues outlined below.

5.1 Relocation / Displacement Concerns

For those that have been long-term residents of the park, the biggest concern relating to the proposal was fear/uncertainty relating to their future accommodation. Many of the residents are semi-retired, retired, or living on disability pensions and so have little financial security. A number of residents reported that all of their money had been put into their homes and that they were permanent structures which they felt could not be moved or relocated away from their existing sites. There was also a concern that they would be unable to sell their homes as they would be worthless to anyone else if the development was to proceed.

5.2 Misinformation relating to Development Plans

A factor which was seen to contribute to residents' level of concern was the degree and manner in which information had been disseminated amongst caravan owners in relation to the proposal. It was apparent that residents had varying interpretations of the details of the proposal; thus contributing further to their personal fears and uncertainties. This meant that many residents discussed their concerns in terms of what they believed was going to happen to the park, as opposed to what was actually going to occur; and a range of issues were raised regarding proposed park infrastructure e.g. adequate drainage, water, disability access, ablution facilities, and the absence of sealed roads.

While many of the residents were aware of the proposed staging of the development this was not seen to alleviate or reduce their levels of concern, as illustrated in the following quotes:

"It doesn't matter if it is now or in ten years, we would still lose everything"

"It would just be harder if I was 68 rather than 58"

5.3 Environmental Concerns

A number of perceived environmental issues were identified by members of the community. These issues are further identified below.

5.3.1 Impacts on Flora and Fauna

Community residents identified that they were concerned regarding the impact of the proposed development on the flora and fauna of the area around the existing park. Some caravan park residents explained that one of the things they enjoyed about living in the park was that they could bird watch from their homes, cataloguing many different types of birds in the nearby bush land.

Some suggested that there should be restrictions placed on people having pets in the park home site, especially domestic animals that have the potential to roam e.g. dogs and cats. However, there were also views that such a policy could not be controlled or policed.

It was also suggested that the Tuart trees are native to the area and are important as they are currently protected under Australian national conservation law.

5.3.2 Water Usage and Sewerage Disposal

The permanent caravan park residents also stated that they were concerned about the impacts that a significant population increase would have on important infrastructure services such as sewerage and water. Residents expressed problems in accessing adequate water and felt that any additional population would further exacerbate such problems and place greater stress on the local environment. In relation to this issue, it should be noted that the existing caravan park was not developed to house a permanent population and thus park infrastructure was developed accordingly. The proposed park home site development will need to address the infrastructure requirements of a larger population, including consideration of water and sewerage disposal (refer to Section 7 for further discussion of the proposed strategies in this regard).

The water table is a significant concern for a number of residents in the Lake Clifton area, with concerns relating largely to water depletion. It was perceived that additional population would further stress the fragile water table and bore water system.

It was also expressed, that the water constraints that face the community are one of the reasons why properties in Lake Clifton cannot be any smaller than 2 hectares, so as to not over tax the water supply. It was outlined, that when the watertable is overused, it draws salt water up into it, and this salt water never recedes once it has been pulled up into the table.

The current residents also use rain water tanks for the provision of additional water, and whilst they would be in favour of the proposed park using rain water tanks; there were concerns that tanks would lessen the amount of water available for the watertable.

"That would be good, but at the end of the day, the more water that is collected by rain water tanks, the less water that is actually going into the ground."

There was also a perception that whilst home owners in the Lake Clifton community were responsible for their properties, including their water usage and sewerage disposal; it was felt that people living in a park home site would not be responsible for their individual usage and maintenance of such systems.

"Who is going to monitor how much water each individual lot uses?"

Furthermore, several of the community representatives interviewed, discussed their issues relating to the disposal of the proposed development's sewerage. The larger volume of sewerage that would be created due to additional population was of concern given the proximity of the proposed development to the Lake. Furthermore, given that each lot appeared too small to have its own sewerage tank; questions were raised as to where on the plan the sewerage facility would be located?

5.3.3 Lake Clifton and the Ramsar Wetlands

Several community representatives identified that any potential impacts on the lake and wetlands were the most important issues relating to the proposed development. It was outlined that all activities on, or in close proximity to, the lake are prohibited, as any activity, even something as gentle as walking, can have significant negative impacts on the delicate ecosystem of the lake and the wetlands. It was suggested that the Thrombolites may also come under threat from people walking around the lake.

There was also apprehension expressed over the proposed distance between the edge of the development and the lake.

"Anything less than 500 metres is completely unacceptable."

In this regard, the DEC recommends a minimum buffer from the wetland boundary (i.e. the extent of wetland dependent vegetation) of 50 metres for preservation of the wetland from habitat modification.

5.4 Access to Services

There was also some concern expressed over the expectations that new residents to the area may bring regarding access to services and amenities. It was suggested that the current residents of the Lake Clifton community generally, were fully aware of the implications of a rural lifestyle; while others may not have such awareness. It was expressed that existing residents were more than happy to travel to services in areas such as Falcon and Mandurah, because they understood that this was part of living a rural lifestyle.

"Nobody uses the bus because people who come here come for the rural way of life, and will happily travel to the shops."

However, they were concerned that those drawn to the park home would expect to have services nearby, and may potentially not have sufficient transport options to be able to access services as required.

5.5 Population Change Impacts

Concerns were also expressed regarding the various impacts that a large increase in population may have on the existing community of Lake Clifton and its residents. One of the issues raised was in relation to the provision of health and medical services. Although most of those interviewed stated that they accessed medical services in Falcon, Pinjarra or Mandurah, they still reported that there were difficulties in gaining medical attention within an appropriate time frame.

"What is going to happen with getting a doctors appointment, we already have to wait a week."

Concern was also raised regarding the increase in the number of people that would be using the highway and the turn off for both the Lake Clifton town site and the existing Lake Clifton Caravan Park. It was perceived that the increase in traffic would lead to an increase in fatalities and accidents on what was already a dangerous piece of road.

"I'm already nervous every time I slow down to turn, that is only going to get worse with more people using the road."

"Hoon driving is just going to get worse than it already is."

The community also raised concern over the effect 400 new residents would have on the level of noise in the park. It was reported that the noise level in the caravan park is sometimes too high already, and that this would only get worse with a large number of new residents.

"We already have issues with the noise from the caravan park, and with more new residents it can only go up."

5.6 Changing Nature of Community – Perceived disruptions to the 'Rural Way' of Life

There was significant concern throughout the community that the type of people that may be attracted to a lower cost housing option, offered by the proposed park home site, may be drawn to the park due to financial restraints, not because of the lifestyle offered in the area. Consequently, there was great concern that this may result in greater social problems, particularly given that the area is somewhat isolated from services and facilities. For example, it was suggested that if families with teenage children came into the area, there may be an increase in unwanted behaviours, as there are few recreational or entertainment facilities to occupy young people of this age group. In this regard, community members discussed the occurrence of similar problems at Preston Beach, which have included break-ins and burglaries, illegal fireworks being set off in the national park, jet skis being used on prohibited waterways, and drug busts.

Many of those interviewed also suggested that they considered the proposed urban development to be contradictory to existing land use in the area; and inconsistent with the Shire's Strategic Plan for the area. For example it was expressed that this included no subdivisions or release of lots of land smaller than 2 hectares. However, the current caravan park is already zoned as a commercial site earmarked for provision of land for the continued development of the Lake Clifton community and tourist/shopping village; and has been defined as a significant development node. The proposal also appears in line with the required expectations (area uses and conditions) outlined in the Shire of Waroona's Development Guide Plan (DGP) which include uses such as a tavern, motel, caravan park, wildlife park, museum etc.

A summary of the main issue themes that were raised during the consultation is outlined in the following table. The table illustrates that there are similar re-occurring issues between Lake Clifton stakeholder groups, particularly in relation to environmental issues (i.e. water usage and sewerage management and protection of wetlands). There are also some shared issues around access to services and the capacity of existing services to deal with a population change that may be associated with the new development.

Table 5.1: Issue Themes by Stakeholder Group

Issues - Themes	Lake Clifton Stakeholder Groups			
	Current Park Residents	Local Gov't	Progress Association	Service Providers
Environment - Water	✓	✓	✓	
Environment - Sewerage	✓	✓	✓	
Environment – Protection of Wetlands	✓	✓	✓	
Displacement of Residents	✓		✓	
Access to Services		✓	✓	
Population Change	✓	✓	✓	
Changing Nature of Community	✓	✓	✓	✓

Source: Coakes Consulting (2009)

6 Assessment of Perceived Issues/Impacts

Based on the identification of issues of importance to the community and further assessment of these issues, the following table highlights the social impacts that have been identified as important in relation to the proposed development.

Table 6.1: Assessment of key impacts associated with the proposed development

Key Impacts	Description of Impact
Population Change	• Influx of new residents within a particular age group category (55 years plus) • Increased traffic issues • Potential increases in noise levels • Potential impact on sense of community
Provision of, and access to, local/regional services	• Access to services and amenities for new residents • Provision of public transport to key regional centres • Capacity of local services to accommodate population change
Environmental Impacts	• Impact on flora and fauna • Water usage and sewerage disposal • Impact on Lake Clifton and the Ramsar Wetlands

Source: Coakes Consulting (2009)

Where relevant, further assessment of these impacts is outlined in the sub-sections below.

6.1 Population Change

To assess the impacts of changes in population on the Lake Clifton community, as a result of the proposed development, population modelling was undertaken.

According to the 2006 ABS Census, Lake Clifton's population totals 440. Based on this figure, an additional 400 new residents (207 home sites x 2 persons per site) into the township would reflect a 90% growth in the town's overall population. Indeed, this increment is significant. According to Burdge (1994), if a population change is greater than 5%, then the locality under analysis is likely to experience significant population impacts e.g. accessibility to local services and community infrastructure, as well impacts on existing lifestyle and community cohesion.

The 2006 ABS Census indicates that approximately 28% of Lake Clifton's population is currently aged 55 years and over. Consequently, an additional 400 new residents in this same age bracket would constitute a 325% growth to the town within this specific

age group category. Again, this population change is very significant and is likely to impact on those amenities and community infrastructure which exist to support this particular population age group.

6.2 Provision and Access to Local Services

Telephone and face to face interviews were conducted with various service providers throughout the Lake Clifton community and service area catchment, including Waroona, Falcon, Miami, Pinjarra and Mandurah. The prospective population additions associated with the proposed development may have the potential to impact on access to services and community infrastructure. Therefore, the current capacity of existing services within the catchment was assessed, along with the ability of these services to accommodate any hypothesised change in population. Results of this analysis are summarised in the table below. For the purpose of this analysis, it has been assumed that the population likely to reside in the park home site will be of the 55 years and over demographic.

Table 6.3: Service Provider Capacity to Manage Population Change associated with the proposed development

Service	Service Description	Location	Existing Capacity	Ability to Accommodate Population Change
Health Service Providers				
Forest House Medical Centre	Primary General Practice, 14 GP's, equal to 8 full time, 5 Nursing staff; Staff travel to Waroona on a rotating basis to operate out of the community centre, with 1 doctor to be based in Waroona 4 days a week	Main centre in Pinjarra, but with a satellite service in Waroona	Approx 3 000 to 4 000 a month – Annually approx 42 000 – Able to accommodate 3 New GP's, so could accommodate a greater number of patients	Yes
Miami Medical Centre	Small surgery attached to a larger surgery, only 1/ 2 GP's	Falcon	Unsure	Yes

Service	Service Description	Location	Existing Capacity	Ability to Accommodate Population Change
Gemini Medical Centre	6 consulting rooms, between5 and 8 doctors present at one time	Falcon	Not sure – Doctors Have regular patients	Doctors are currently very busy with regular patients, could possibly absorb a few more patients, but not excessive amounts
Peel Health Campus	Large medical facility, including a private hospital, public hospital, 24 hour Emergency Department, and Theatre	Peel - Mandurah	Emergency Department has over 30 000 presentations a year	Yes
Quambie Park (Pam Corkers House)	Community based charity organisation, including an aged care facility, independent living villas, and community aged care packages	Waroona	33 residents in the aged care facility, 11 Community aged care packages, 25 independent Living Units, 7 Independent Living Villas	Already have waiting list for aged care facility, In the process of building 6 new independent living villas, could provide additional community packages with appropriate funding and forewarning
Child Health Clinic	Services children aged 0 to 4 years, but with a focus on newborns	Offices located in Waroona, Pinjarra, Falcon and Mandurah	Currently provides adequate service to the catchment area	Provision for service to be developed in the Lake Clifton area should population numbers suffice
Education Service Providers				
YMCA Early Starts Childcare Centre	Before and After school Childcare	Falcon	92 Placement Capacity - Currently at 58% capacity Room for approximately an additional 40 children	Yes
Waroona Playgroup	Playgroup – 3 sessions a week, each session 2 hours long	Waroona	Currently 50 families, approx 110 children, but not attend each session	Yes - Room for many additional children, but need community volunteers to assist with playgroup operation
St Josephs Catholic Primary School	Private Catholic Primary School	Waroona	Currently at full capacity of 156 students	Looking to expand in the next couple of years with 2 new buildings,

Service	Service Description	Location	Existing Capacity	Ability to Accommodate Population Change
				taking enrolments to approx 200 students
Waroona District High School	From pre-primary to year 10, 4 year olds to 15 year olds	Waroona	Currently 330 students, usually have 350 students	Yes - Full capacity is 450, so have ability to absorb additional students
Pinjarra Senior High School	High School, years 8 to 12	Pinjarra	750 Students for 2008, but this number fluctuates	Yes - Full capacity is 1000, so can accommodate new students
Emergency Services				
Waroona Police	Police station which operates during business hours, shares the coverage of Lake Clifton with Mandurah Police	Waroona	6 full time officers	Yes - If they receive the proposed new officer, they could handle the additional number of residents
Mandurah Police	Major regional police station which covers some of the Lake Clifton boundary with the Waroona Police	Mandurah	58 full time officers	The impacts on the police will depend on the age range and demographic of new residents
Lake Clifton Volunteer Fire Fighters Brigade	Volunteer based community fire fighting brigade	Lake Clifton		Yes - Could accommodate servicing the population change as long as they had new members from the new residents
St Johns Ambulance	Provides emergency care, emergency transport, patient transfer to and from hospital, as well as running local first aid courses	Waroona		Yes – Could accommodate potential population change as long as they had additional volunteers Could accommodate potential population change as long as they had additional volunteers

Service	Service Description	Location	Existing Capacity	Ability to Accommodate Population Change
Commercial/Retail Providers				
Blue Wren Park	9.3 hectare property including a Bed and Breakfast, tearooms, nursery, 18 hole golf course, and craft shop	Lake Clifton	Tearooms 46 people, B + B has 3 double rooms	Yes - Park is quite busy but never full, therefore can definitely accommodate more customers
LC's Bakery	Bakery and café	Lake Clifton	Service roughly 200 to 300 customers a day	Yes - Could definitely accommodate more people, would hire more staff to do this
Transport Service Providers				
TransWA	Public transport, offering long distance coach service between Perth and Pemberton, via Augusta and Bunbury	Main terminal – East Perth, Lake Clifton stop is at the BP road House, approx 5km from existing caravan park	Each coach has 56 seat capacity, operating at an average of 60% Definitely has capacity for more people, can take approximately 22 additional passengers per coach journey	Yes
South West Coach Lines	Offers 3 services a day from Busselton to Perth via Bunbury, and 3 services a day for the opposite journey, however must be prebooked or will not stop	Terminals in Busselton, Bunbury and Perth, Lake Clifton stop is located opposite the tavern on Old Coast Road		Yes – Could accommodate additional passengers, and if there was demand would put on additional buses. Would also be willing to erect a bus shelter if additional passengers required

Source: Coakes Consulting (2009)

The majority of service providers that were consulted as part of the program stated that they could accommodate an increase in population due to the proposed development; and where capacity was less available; such concerns could potentially be addressed through planning to provide an extended service, increases in funding, infrastructure, or employment of additional staff.

Those service providers who did express concerns over the proposed application for the Lake Clifton Caravan Park were more likely to do so if their services were manned by volunteers. Thus any extension of services would require the involvement of additional community volunteers, rather than an increase in infrastructure or equipment. Such groups, however, did outline that an increased population may provide them with access to a greater number of community members/potential volunteers, which could alleviate pressures in service provision.

In relation to the provision of emergency health services, the travelling distance between Lake Clifton and the location of the service was noted as a potential issue, particularly if an increase in population equated to greater service usage by residents in the Lake Clifton area.

In relation to retail and commercial services, Lake Clifton residents currently access a range of services in Mandurah, Falcon and Miami. The planned development, as part of the current proposal, of a new commercial centre on the park home site has the potential to offer small retail outlets that afford the provision of general supplies to residents of the park home site, but also for the wider Lake Clifton community. The location of this commercial centre is highlighted in the Local Planning Strategy (2008 – Shire of Waroona) as having significant potential as a development node; and through further development may provide a significant service to the locality.

Lastly, in relation to transport services, Trans WA currently runs a coach service that stops at the Lake Clifton Roadhouse and continues on to the Mandurah bus station, available 1 to 3 times a day, depending on the day of the week. However, ABS statistics do suggest that the majority of households in Lake Clifton (98%) have a least one car or more, facilitating resident access to other centres.

The following map highlights the service catchments that relate to the Lake Clifton community, that is where services are most likely to be accessed by Lake Clifton residents.

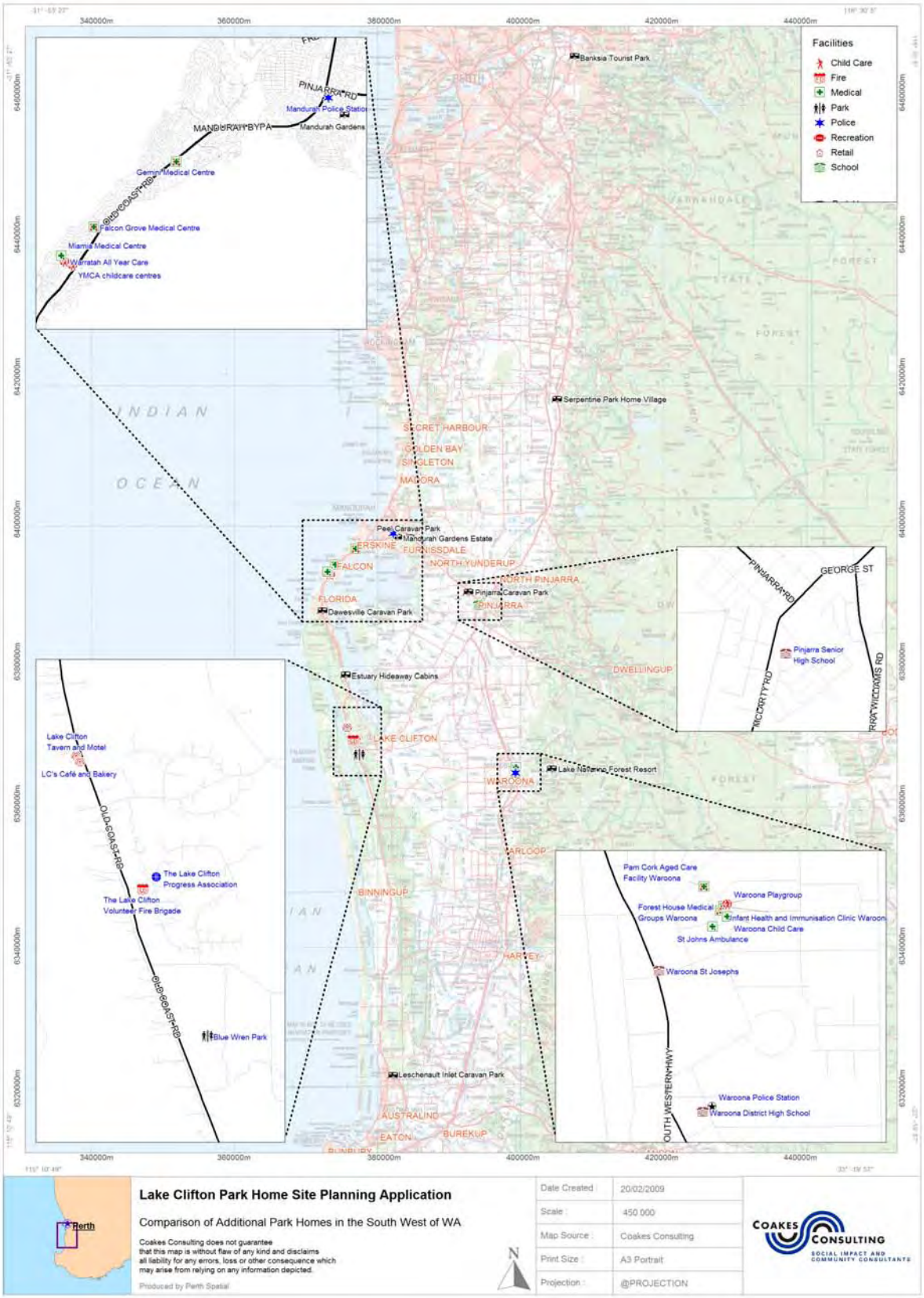


Figure 6.1: Service Catchments for Lake Clifton
Source: Coakes Consulting (2009)

7 Impact Management

Amelioration or mitigation strategies are processes, programs or plans designed to address the perceived impacts / issues raised by stakeholders during the assessment process. Such strategies can go some way in ensuring that perceived impacts raised by the community are addressed or off-set in an appropriate manner. In more specific instances, a particular strategy may fully address the concern raised. However, in other instances, where particular values are held, such strategies may only assist in making a proposal more acceptable to the community, rather than changing the values held by particular stakeholder groups.

Community involvement in the development and implementation of such strategies may develop a greater knowledge of the project, a heightened level of trust in the proponent and a greater ownership over issue solutions. Such factors are essential in effective amelioration/mitigation of social impact.

In response to the perceived issues/impacts raised by the community in Section 4 of the report, the following table provides a number of recommended strategies that may be employed by the proponent to address the issues raised.

Table 7.1: Proposed recommendations to address impact areas

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
Environment – *Water Usage, Quality and Sewerage Disposal*	• Current caravan park residents expressed concern regarding provision of sufficient water and sewerage disposal due to an increased number of residents • Significant concern expressed regarding over taxing of the existing water supply and impacts on the water table • Concern regarding sewerage infrastructure for an increased resident population	• Original caravan park was not developed to house a permanent resident population • Current proposal will develop appropriate infrastructure to meet additional population requirements • Relevant environmental and infrastructure assessment has been undertaken by Ecoscape and Shawmac Engineers	Environmental Consultant Recommendations • Monitoring bores to be installed on site prior to development to collect baseline level and water quality data, and ensure continued monitoring • An Urban Water Management Plan be developed, implemented and monitored over a 3 year period to ensure that the values and ecological functions of Lake Clifton are maintained • The large water feature to the front of the proposed plan to be used to collect water run off • A Filtrex split system will be utilised in the proposed development, which will reuse all household water to irrigate garden areas, thus significantly reducing water usage.

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
			• Rain water collection tanks for all units for all domestic uses. • Each park home to be serviced by an eco-friendly on-site sewerage treatment package unit. • On-site water infiltration for the absorption of effluent water.
Environment - *Protection of Wetlands and Local Flora and Fauna*	Stakeholders expressed concerns over possible impacts on the environment, these included: • Proximity of the development to the wetlands • Impacts on fauna such as local birdlife • Impacts on existing stands of Tuart trees as a result of park development	• Environmental studies undertaken by Ecoscape to assess the impacts of the proposed development on the neighbouring wetlands and local flora and fauna	• Endorsement of the DEC recommendation to ensure a minimum 50 metre buffer between the proposal and the wetland boundary • In accordance with the Shire of Waroona's local planning strategy for Lake Clifton, all dwellings will be located at least 150m from the high water mark • Wherever possible, Tuart trees are to be maintained on the existing site so as to minimise impacts to the Baudin's Black-Cockatoo

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
	• Impacts on the wetlands and thrombolites through increased human traffic in the area.		• The proposed application includes extensive tree planting of local native species
Potential Displacement of Residents	• Concerns expressed by permanent caravan park residents that related to: • Sale of their homes • Future accommodation options • Lack of information regarding the proposed development	• The current caravan park was not developed to house a permanent population. • Information regarding the proposal should be clear and consistent to address resident fears and uncertainties	• Improved communication and provision of information to existing park residents through the planning phase, including the phased nature of the development
Pressure on Existing Local and Regional Services	• Concern was expressed by residents of Lake Clifton that the	• The majority of service providers consulted across key community sectors (health, education,	• Provision of information to park home residents regarding service catchments and local facilities.

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
	additional population of the park home site would place greater pressure on existing services in the locality	childcare, emergency services, transport) reported that they could easily accommodate a population increase in the locality • Additional population seen to be of assistance to voluntary service sectors e.g. Emergency services.	• Development of commercial centre as part of the current proposal, likely to provide additional 'services' to the Lake Clifton Community e.g. local retail outlets.
Access to Services	• Concern that new park home site residents may have differing expectations regarding service access and provision.	• The majority of households in lake Clifton have their own modes of transport e.g. current ABS data (2006) indicates that 98% of households in Lake Clifton own at least 1 vehicle, with 68% owning 2 or more vehicles • There are two transport providers that offer daily services between Lake Clifton and Mandurah or Perth. o Trans WA runs a coach service that stops at the Lake Clifton Roadhouse and	• Communicate service access and availability to new park home site residents to ensure effective management of resident expectations • Provision of a community bus to transport residents from the park home site to local centres to facilitate access to relevant services in Falcon, Mandurah and other local centres. • Undertake discussions with existing transport operators to facilitate expansion and upgrade of their existing services to Lake Clifton, given

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
		continues on to the Mandurah bus station. This service is available 1 to 3 times a day, depending on the day of the week. o Southwest Coach Lines offer a service that goes from Busselton, to Bunbury, and then on to Perth, and also in the opposite direction. Both of these lines operate three times a day, with one in the morning, lunch/afternoon, and evening.	potential population predictions outlined in the current assessment. • Development of a new commercial centre on the proposed site for daily retail provisions e.g. IGA, fruit and vegetable shop, newsagent, bakery, tavern etc., would reduce the requirement for residents to travel to other centres for daily necessities • Redevelopment of the existing tavern as a community hall/venue to facilitate recreational activities for park home residents and the broader community
Population change	• Associated with the influx of new residents to the park home site.	• Population modelling indicates that an additional 400 new residents (207 home sites x 2 persons per site) into the township would reflect a 90% growth in the town's overall population; and a 325% growth to	• Development of the commercial centre and provision of services and amenities relevant to the predicted population demographic.

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
		the town within the 55 years and over age group category.	
Changing nature of community	• Concern was raised regarding the demographic that may be attracted to the park home site given the lower cost of accommodation and related social problems	• Concerns appear exacerbated by media reports regarding increased anti-social behaviour and crime in areas such as Preston Beach. • Other developments are proposed in the Preston Beach area. • 8.6% of the existing Lake Clifton community currently reside in other types of accommodation including caravans, cabins and houseboats. • The majority of Lake Clifton residents consulted, including caravan park dwellers, outlined the peace and quiet of the area as a key attribute of their place of residence. • The proposed park home site is specifically targeted at the over 55 year old demographic (semi-retired,	• Appropriate marketing of the park home site to the targeted demographic population – over 55 years, semi-retired or retired couples seeking a lifestyle based on a tourist function.

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
		retired), requiring a semi-rural lifestyle, in relative proximity to key services. • Current composition of the caravan park is largely consistent with the above demographic age group.	
	• The proposed development has been viewed by existing residents to be contradictory to the Shire of Waroona's Planning strategies that seek to maintain Lake Clifton's semi rurality (no land divisions smaller than 2 hectares)	• The current caravan park is already zoned as a commercial site earmarked for provision of land for the continued development of the Lake Clifton community and tourist centre; and has been defined as a significant development node. • The proposal is in line with the required expectations (area uses and conditions) outlined in the Shire of Waroona's Development Guide Plan (DGP).	• The development of the commercial centre and community facilities have been designed to provide additional services to the Lake Clifton community; and to facilitate greater integration of community residents through common use commercial and recreational community facilities.
	• It was perceived by some stakeholders that	• The Shire of Waroona's Cultural Plan recommends that any new	• The proposed commercial centre has the potential to be a significant

Perceived Impact Theme	Specific Issues	Assessment of Issue	Strategy Solutions
	the new development would increase the divide currently felt between the Lake Clifton towns' people and the current caravan park dwellers	developments reduce barriers that inhibit growth of the community spirit and sense of togetherness in Lake Clifton • Lake Clifton's social capital and community well-being have been identified as key factors which need to be taken into consideration as part of any new developments within the township.	development node for Lake Clifton • The new community facility has been designed to increase sense of community by being a multi-purpose, multi-use facility. Community barbecue facilities and additional recreational space is also proposed as part of the current proposal.

Source: Coakes Consulting (2009)

8 Conclusion

In conclusion, the socio-economic assessment has identified a range of perceived community issues/social impacts associated with the proposal. These issues have been documented and, where relevant, appropriate strategies identified and proposed to address the issues that have been raised.

As is the case with other developments of this kind, the perceived social impacts/ issues are greatest for those living in closest proximity to the proposal, or those who perceive they will be most directly impacted by the development. Therefore, it will be essential for the proponent to maintain an ongoing dialogue with local residents throughout the implementation stages of the project in relation to issues of relevance and importance to the community.

9 References

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Shire of Waroona website - http://www.waroona.gov.au

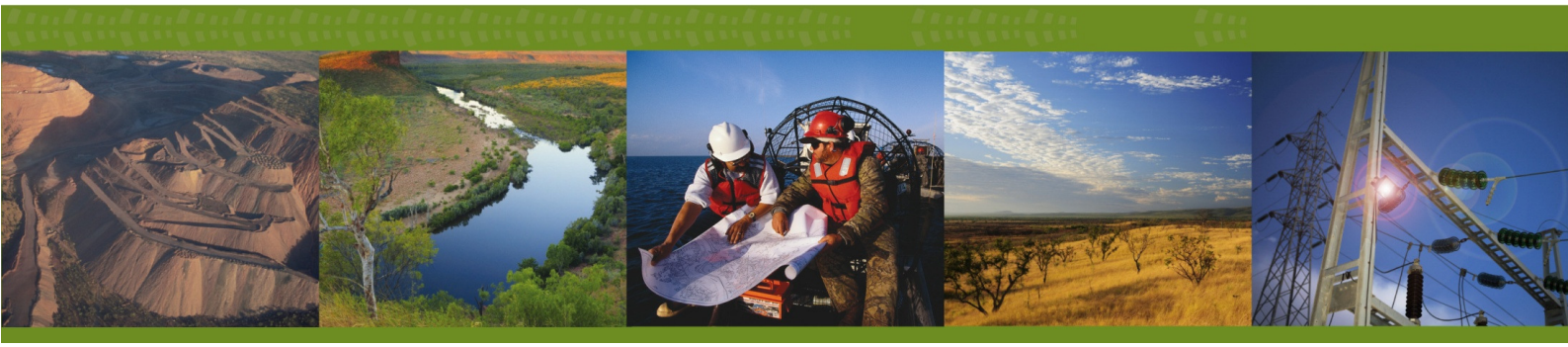
10 Appendix

Table 10.1: Complete List of Stakeholders Consulted

Stakeholders Consulted
Shire of Waroona
Lake Clifton Shire Council
Caravan Park Manager
Caravan Park Residents
Trans WA
South West Coach Lines
Serpentine Park Home Village
Banksia Tourist Park
Dawesville Caravan Park
Waroona Playgroup
The Lake Clifton Progress Association
Lake Clifton Volunteer Fire Brigade
Blue Wren Park
LC's Café and Bakery
Forest House Medical Group in Waroona
Infant Health and Immunisation Clinic in Waroona
Miami Medical Centre
Gemini Medical Centre
Peel Health Campus
Quambie Park (Pam Corkers House)
YMCA Early Starts Childcare Centre
Waroona Play Group
St Josephs Catholic Primary School
Waroona District High School
Pinjarra Senior High School
Waroona Police
Mandurah Police
St Johns Ambulance
Neighbouring Land Owner

Source: Coakes Consulting (2009)

Appendix Two: Urban Water Management Plan



Lake Clifton Park Home Development Urban Water Management Plan

FINAL DRAFT

Prepared for
Beck Advisory acting for Tony Scolaro Family Trust
by Strategen

March 2013

STRATEGEN
environmental consultants

Lake Clifton Park Home Development Urban Water Management Plan

FINAL DRAFT

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Client: Beck Advisory acting for Tony Scolaro Family Trust

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Draft Report	A	Draft Report	M.Dunlop / D. Walsh	Electronic	23 Oct 12
Final Draft Report	0	Report for release to regulators	M.Dunlop / D. Walsh	Electronic	30 Oct 12
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Final Report					

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Executive summary

Beck Advisory group intends to redevelop Lot 21 Old Coast Road, Lake Clifton (the Site) into a Park Home development under a Development Approval. The site is located in the Shire of Waroona, approximately 100 km south of the Perth Central Business District. The total area of the site is approximately 6.05 ha.

The site is currently a caravan park. The redevelopment will involve the construction of new infrastructure including park homes, and a new wastewater treatment plant (WWTP). The project will include 120 park homes of one or two bedrooms with their own cooking and ablution facilities. The development is not a subdivision and all of the land will continue to be managed by the current owner, who will take responsibility for the maintenance and upkeep of infrastructure.

Park homes (demountable houses) will be selected by the buyer and installed by the developer. The developer is anticipating selling the park homes, with some to be retained by the developer for rental as holiday accommodation. The development will operate as a leased estate and owners will pay a fee to the developer for the upkeep of infrastructure and communal open space.

Lake Clifton, which is a part of the Peel-Yalgorup System, is located approximately 100m to the west of the site and is listed and protected under the Ramsar Convention. Because of this, water and nutrient management is a key issue for the development of the site

The Lake Clifton Park Home site will manage water and nutrients in an appropriate manner to minimise any potential impact upon Lake Clifton. This includes:

- sustainable water supply management with no net importing or exporting of potable water off the site
- installation of a Membrane Bioreactor style Wastewater Treatment Plant with dosing for phosphorus removal
- no flow of stormwater off the site in events up to the 1 in 100 year ARI event
- treatment of stormwater through nutrient stripping basins
- use of non-structural best management practices to reduce nutrient inputs at a development and lot scale
- installation of a wastewater treatment plant that produces an effluent with very low nitrogen and phosphorus concentrations
- ensuring that immobile stormwater is infiltrated within 96 hours to prevent mosquito and midge breeding (Table ES 1).

Table ES 1 provides a summary of the design elements and requirements for best management practices and how these comply with the key principles and objectives for water sensitive design on the site.

Through these measures, it is considered that the development complies with the water balance and nutrient objectives of the EPA (1998) *Guidance Statement No. 28, Development of the Lake Clifton Catchment.*

Table ES 1 Design elements and requirements for best management practices and critical control points

Category	Principles	Objectives	Development design elements and requirements
Water use	• consider all potential water sources in water supply planning • integration of water and land use planning • sustainable and equitable use of all water sources having consideration for the needs of all users, including community, industry and the environment.	Minimise the use of potable water where drinking water quality is not essential, particularly for ex-house uses.	The development will have a policy of sustainable self supply. Water for the development will be sourced from a mixture of sources, which will include: • rainwater • groundwater • recycled wastewater. At a lot level, rainwater collected from rooves will be used for in-house supply, with groundwater likely to be provided for garden use. Where rainwater volumes are not adequate for household use purposes, carted water will be used. Volumes of carted water are expected to be less than 15,000 L/household/year. Groundwater and recycled water will be used for irrigation of open space. Wastewater not recycled will be disposed of by irrigation of a tree lot area. This methodology meets the objective of minimising the use of potable water where drinking water quality is not essential, particularly for ex-house uses.
Groundwater levels and surface water flows	• to retain natural drainage systems and protect ecosystem health • to protect from flooding and water-logging • to implement economically viable stormwater systems • post development annual discharge volume and peak flow rates to remain at pre-development levels or defined environmental water requirements.	For ecological protection, 1 in 1-year ARI volume and peak flow rates maintained at or below pre-development conditions Where there are identified impacts on significant ecosystems, maintain or restore desirable environmental flows and/or hydrological cycles For flood management, manage up to the 1 in 100-year ARI event within the development area to pre-development flow rates.	There will be no flow off the site in events up to the 1 in 100-year ARI event, as is currently the case. Stormwater will not enter Lake Clifton in events up to the 1 in 100-year ARI event. As the water balance on the site is not anticipated to change, the development will not impact upon groundwater levels in the area.
Groundwater and surface water quality	• to maintain or improve groundwater and surface water quality • where waterways/open drains intersect the water table, minimise the discharge of pollutants from groundwater • where development is associated with an ecosystem dependent upon a particular hydrologic regime, minimise discharge or pollutants to shallow groundwater and receiving waterways and maintain water quality in the specified environment.	Implement current known best management practice as detailed in the DoW *Stormwater Management Manual for Western Australia* (DoW 2004 – 2007) and the *Decision Process for Stormwater Management in Western Australia* (DoE & SRT 2005), with an emphasis on a treatment train approach including nutrient input source control, use of bioretention systems, and maintaining 1 in 1 year ARI post development discharge volumes and peak flow rates at pre-development levels. Minimise the export of pollutants such as phosphorus and nitrogen to surface or groundwater from stormwater and rainwater.	Best Management Practices (BMPs) have been implemented in the form of nutrient stripping basins through the development to minimise pollution. Non-structural BMPs on the site will be extensively utilised, including Sustainability Packages provided at point of sale and regular advice on methods to reduce fertilisers use at a lot scale. Open space landscaping on the site will be designed to minimise fertiliser and water use. Fertiliser will be of a slow release type and will used sparingly. Nutrient balance indicates that the new development and improved wastewater treatment will significantly reduce nutrient loads from the site.

Category	Principles	Objectives	Development design elements and requirements
Disease vector and nuisance insect management	• to reduce the health risk from mosquitoes, retention and detention treatments should be designed to ensure that between the months of November and May, detained immobile stormwater is fully infiltrated within a time period not exceeding 96 hours.	Permanent water bodies are discouraged, but where accepted by DoW, must be designed to maximise predation of mosquito larvae by native fauna to the satisfaction of the local government on advice of Departments of Water and Health.	Detained stormwater will be fully infiltrated within 96 hours The existing water feature on the site shall be retained. This feature contains fish and is managed to prevent mosquito and midge breeding.

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1. Introduction and planning approval

1.1 Project description

The Tony Scolaro Family Trust intends to redevelop Lot 21 Old Coast Road, Lake Clifton (the Site) into a Park Home Development under a Development Approval. The site is located in the Shire of Waroona (SoW), approximately 100 km south of the Perth Central Business District (Figure 1). The total area of the site is approximately 6.05 ha.

The site is currently a caravan park. The redevelopment will involve the construction of new infrastructure including park homes, and a new wastewater treatment plant (WWTP). The project will include 120 park homes of one or two bedrooms with their own cooking and ablution facilities (Figure 2). The development is not a subdivision and all of the land will continue to be managed by the current owner, who will take responsibility for the maintenance and upkeep of infrastructure.

Park homes (demountable houses) will be selected by the buyer and installed by the developer. The park homes will be bought and leased by new occupants with some to be retained by the developer for rental as holiday accommodation. The development will operate as a leased estate and owners will pay a fee to the developer for the upkeep of infrastructure and communal open space. Lake Clifton, which is a part of the Peel-Yalgorup System, is located approximately 100m to the west of the site. Lake Clifton is considered to be an Environmentally Sensitive Area and includes a Ramsar wetland and an endangered thrombolite community. Because of this, water and nutrient management is a key issue for the development of the site.

1.2 Approvals

Because of the location of the development, the project was referred to the Environmental Protection Authority (EPA) in 2009. As part of the approval of the development under the Environmental Position Statement process (now Assessment of Proponent Information process), the EPA requested that the development demonstrate that the development needed to address the following objectives from EPA (1998) *Guidance Statement No. 28, Development of the Lake Clifton Catchment:*

1. Water balance: new developments should be managed so that the water balance following development is as close to the pre-development water balance as possible.
2. Nutrient loads: new developments should be managed so that phosphorus and nitrogen export to the lake catchment is negligible. At a minimum, a reduction should be achieved.
3. Regionally significant wetlands: new developments should be managed such that the direct impacts to humans and stock do not cause physical damage to the thrombolites, wetland vegetation, fringing wetland vegetation and dryland buffer of Lake Clifton (EPA 2009).

An Urban Water Management Plan (UWMP) is the normal mechanism for addressing the management of stormwater, groundwater and nutrients at the scale of a development. This UWMP has been prepared to address the first two of the above objectives. An Environmental Impact Assessment and a Wetland Buffer Definition Study have been prepared by Ecoscape to address the third objective.

The development was referred to the then Department of Environment, Water, Heritage and the Arts (DEWHA) under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act). The development was considered to be 'not a controlled action' and was not assessed by DEWHA (DEWHA 2009).

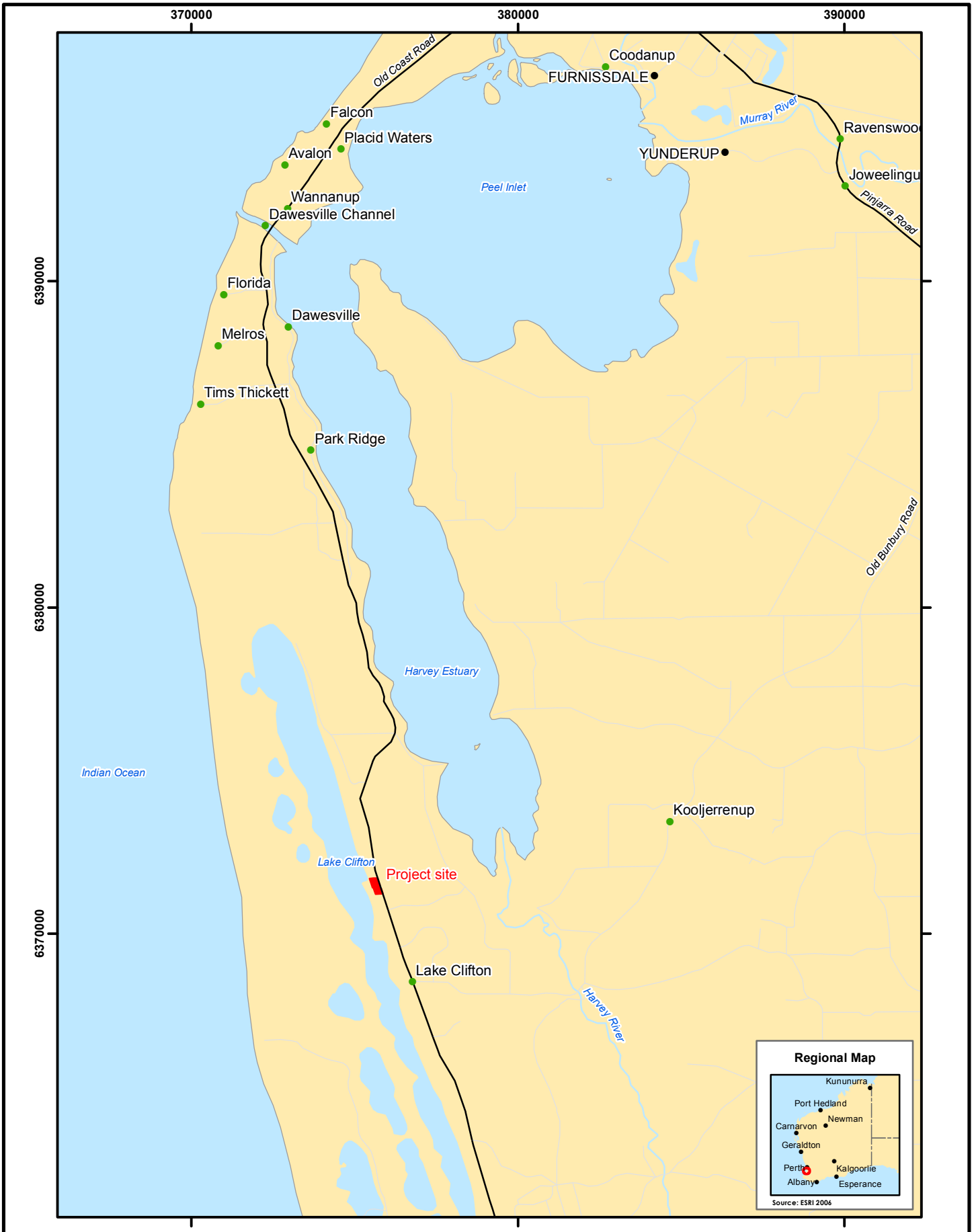

Figure 1 Site location

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Scale
0 1 2 3 4 5
Kilometres

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1:155,702
at A4

Coordinate System: GDA 1994 MGA Zone 50
Date: 4/10/2012
Author: JCrute
Path: Q:\GIS\Consult\2012\BAD\BAD12112.01\ArcMap_documents\R001\RevA\BAD12110_01_R001_RevA_F001.mxd

Source: Geoscience Australia 2006
Note that positional errors may occur in some areas

Legend
- Town
- Locations
- Major road
- Minor road
- Major river
- Lakes
- Lot boundary

STRATEGEN

Lake Clifton Park Home Urban Water Management Plan

Development plan

Figure 2

1.3 Purpose of report

The purpose of the report is to provide Beck Advisory and Tony Scolaro Family Trust with an Urban Water Management Plan (UWMP) which addresses the EPA objectives and incorporates water sensitive urban design into the site redevelopment plans. This will assist with the approval of the development application, and will ensure that the redevelopment is consistent with *State Planning Policy 2.9 Water Resources* (Government of Western Australia 2006) and *Liveable Neighbourhoods* (WAPC & DPI 2009).

The Western Australian Planning Commission (WAPC) released the *Better Urban Water Management Guideline*s (WAPC 2008) which aims to integrate water cycle management with development planning. The *State Planning Policy 2.9 Water Resources* (Government of Western Australia 2006) outlines the key principles of integrated water cycle management which include:

- consideration of all water resources, including wastewater, in water planning
- integration of water and land use planning
- the sustainable and equitable use of all water sources, having consideration of the needs of all water users, including the community, industry and the environment
- integration of human water use and natural water process
- a whole-of-catchment integration of natural resource use and management.

This UWMP addresses these issues.

A copy of the UWMP checklist can be found in Appendix 1.

2. Design objectives

2.1 Key principles and objectives

The UWMP uses the following documents to define its key principles and objectives:

- *Liveable Neighbourhoods* (WAPC & DPI 2009)
- *Water Resources Statement of Planning Policy 2.9* (WAPC 2006)
- *Stormwater Management Manual for Western Australia* (DoW 2004 – 2007)
- *Decision Process for Stormwater Management in Western Australia* (DoE & SRT 2005)
- *Better Urban Water Management* (WAPC 2008).

The site is not covered by a Drainage and Water Management Plan, District Water Management Strategy or Local Water Management Strategy. The site is not considered to be within the Peel Harvey Catchment and as such advice for this catchment does not apply (Parker A [DoW] 2009, letter 19 December).

The key guiding principles of the UWMP are to:

- facilitate implementation of sustainable best practice in urban water management
- encourage environmentally responsible development
- provide integration with planning processes and clarity for agencies involved with implementation
- facilitate adaptive management responses to the monitored outcomes of development
- minimise public risk
- maintain the total water cycle of the site.

Summaries of principles and objectives applicable to the UWMP for the Site based on these documents are provided in Table 1 and summarised in Sections 2.1.1 to 2.1.3.

Table 1 Summary of UWMP principles and objectives

Category	Principles	Objectives
Water use	• consider all potential water sources in water supply planning • integration of water and land use planning • sustainable and equitable use of all water sources having consideration for the needs of all users, including community, industry and the environment.	• minimise the use of potable water where drinking water quality is not essential, particularly for ex-house uses.
Groundwater levels and surface water flows	• to retain natural drainage systems and protect ecosystem health • to protect from flooding and water-logging • to implement economically viable stormwater systems • post development annual discharge volume and peak flow rates to remain at pre-development levels or defined environmental water requirements.	• for ecological protection, 1 in 1-year ARI volume and peak flow rates maintained at or below pre-development conditions • where there are identified impacts on significant ecosystems, maintain or restore desirable environmental flows and/or hydrological cycles • for flood management, manage up to the 1 in 100-year ARI event within the development area to pre-development flow rates.

Groundwater and surface water quality	• to maintain or improve groundwater and surface water quality • where waterways/open drains intersect the water table, minimise the discharge of pollutants from groundwater • where development is associated with an ecosystem dependent upon a particular hydrologic regime, minimise discharge or pollutants to shallow groundwater and receiving waterways and maintain water quality in the specified environment.	• implement current known best management practice as detailed in the DoW *Stormwater Management Manual for Western Australia* (DoW 2004 – 2007) and the *Decision Process for Stormwater Management in Western Australia* (DoE & SRT 2005), with an emphasis on a treatment train approach including nutrient input source control, use of bioretention systems, and maintaining 1 in 1 year ARI post development discharge volumes and peak flow rates at pre-development levels. • Minimise the export of pollutants such as phosphorus and nitrogen to surface or groundwater from stormwater and rainwater.
Disease vector and nuisance insect management	• to reduce the health risk from mosquitoes, retention and detention treatments should be designed to ensure that between the months of November and May, detained immobile stormwater is fully infiltrated within a time period not exceeding 96 hours.	• permanent water bodies are discouraged, but where accepted by DoW, must be designed to maximise predation of mosquito larvae by native fauna to the satisfaction of the local government on advice of Departments of Water and Health.

2.1.1 Water Resources Statement of Planning Policy 2.9 and Liveable Neighbourhoods

The LWMS has been developed in accordance with regional and local principles and objectives of Integrated Urban Water Management (IUWM).

WAPC (2006) defines IUWM (also known as total water cycle management) as promoting *'management of the urban water cycle as a single system in which all urban water flows are recognised as a potential resource and where the interconnectedness of water supply, stormwater, wastewater, flooding, water quality, waterways, estuaries and coastal waters is recognised'*.

IUWM should also promote water conservation measures, reuse and recycling of water and best practice in stormwater management (WAPC 2006). These objectives are consistent with Liveable Neighbourhoods (WAPC & DPI 2009).

2.1.2 Stormwater Management Manual for Western Australia

The DoW position on Urban Stormwater Management in Western Australia is outlined in Chapter 2: Understanding the Context of the Stormwater Management Manual for Western Australia (DoW 2004 – 2007), which details the management objectives, principles, and a stormwater delivery approach for WA. Principal objectives for managing urban water in WA are stated as:

- Water Quality: to maintain or improve the surface and groundwater quality within development areas relative to pre-development conditions
- Water Quantity: to maintain the total water cycle balance within development areas relative to the pre-development conditions
- Water Conservation: to maximise the reuse of stormwater
- Ecosystem Health: to retain natural drainage systems and protect ecosystem health
- Economic Viability: to implement stormwater systems that are economically viable in the long term
- Public Health: to minimise the public risk, including risk of injury or loss of life to the community
- Protection of Property: to protect the built environment from flooding and water-logging
- Social Values: to ensure that social aesthetic and cultural values are recognised and maintained when managing stormwater
- Development: to ensure the delivery of best practice stormwater management through planning and development of high quality developed areas in accordance with sustainability and precautionary principles.

The then Department of Environment (now Department of Environment and Conservation [DEC] and DoW) and Swan River Trust released the *Decision Process for Stormwater Management in Western Australia* in 2005 to provide a decision framework for the planning and design of stormwater management systems and assist in meeting the objectives specified above.

2.1.3 Better Urban Water Management

This UWMP has been developed to be consistent with the framework and process detailed in the guideline document *Better Urban Water Management* (WAPC 2008).

3. Site Characteristics

3.1 Climate

The Peel region experiences a Mediterranean type climate of hot dry summers and mild wet winters. The majority of the rainfall occurs between April and October (Table 2).

Table 2 Climate statistics for Harvey (2000 to 2012) (BoM Station 9812) (BoM 2012)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max Temp (°C)	29	29.5	27.8	24.1	21.2	18.8	17.7	18	19.2	21.4	24.1	26.8	23.1
Mean Min Temp (°C)	15.6	16.1	14.9	12.2	10.5	8.3	7.4	7.5	8.4	9.5	11.9	13.3	11.3
Mean Rainfall (mm)	13.2	11.7	11	52	106.4	154.2	149.5	131.7	112.4	49.7	38	14.4	845.1

3.2 Site conditions and topography

Topography across the study area can broadly be described as a gently undulating sandplain with outcropping limestone on low crests. Elevation ranges from 2 m to 10 m AHD (metres Australian Height Datum) (Figure 3).

The site is predominantly cleared, with some large trees remaining (Figure 3). An air strip lies between the site and Lake Clifton.

3.3 Geology and soils

The Geological Survey of Western Australia (1987) mapping of the site shows the site to be a mixture of Tamala limestone and Spearwood sand derived from Tamala limestone (

Figure 4). The limestone is pale yellow brown in colour with subangular to rounded quartz grains of marine origin. The sands are of a similar composition and are pale yellow to olive yellow in colour. This is consistent with the geotechnical investigations undertaken on site by Douglas Partners (2010) who described the soils of the site as:

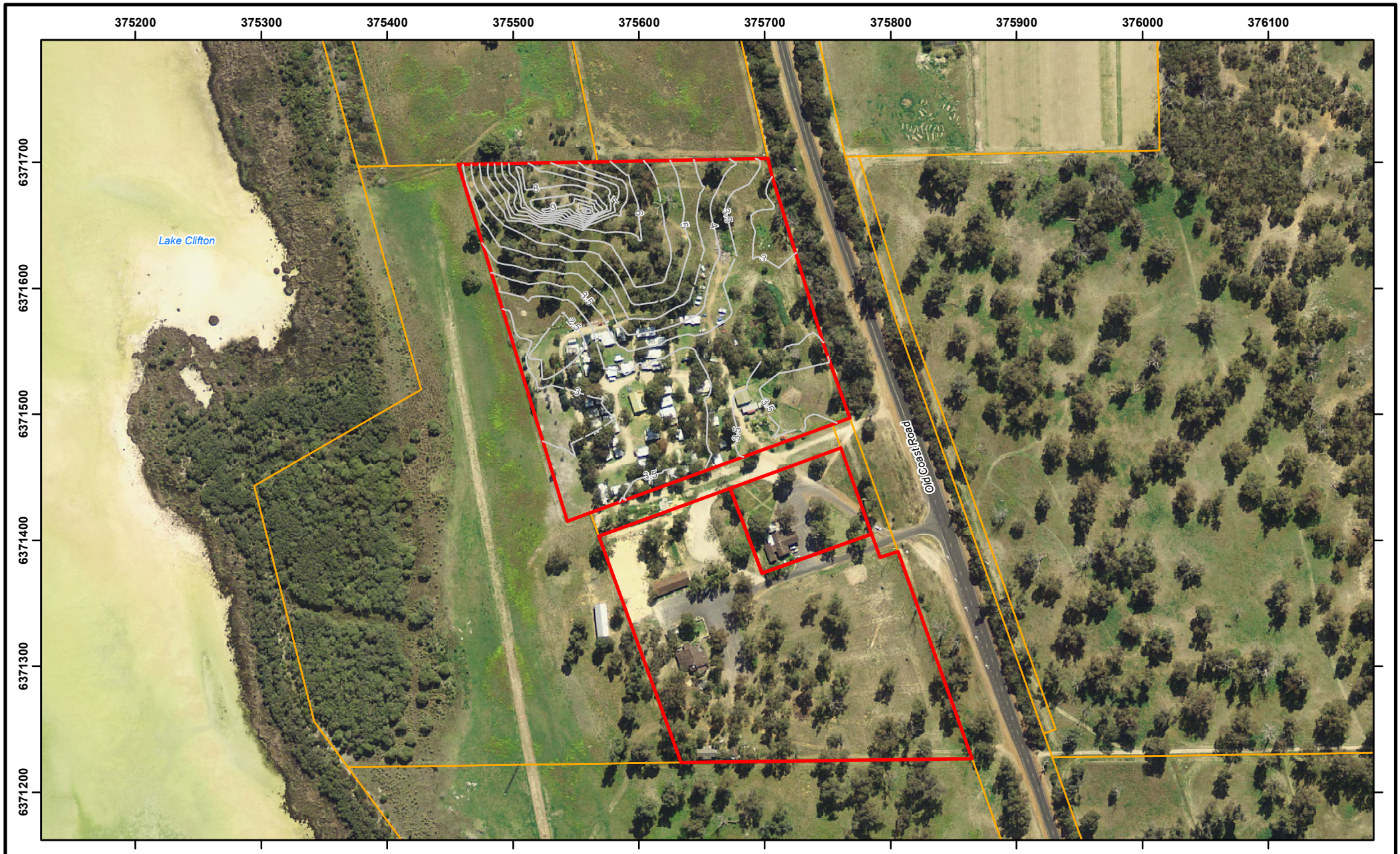
- topsoil: dark grey silty sandy topsoil with rootlets to depths of between 0.1 m and 0.2 m, overlying
- sand: generally medium dense, orange-brown sand with a trace of silt to depths of between 0.3 m and 1.1 m, overlying
- limestone low to medium strength, light yellowish brown limestone underlying the sand at all test locations to the depth of investigation, being between 0.4 and 1.8 m.

A copy of the Douglas Partners report can be found in Appendix 2.

Phosphorus Retention Index (PRI) testing was undertaken by Ecoscape (2009). The PRI of the two samples taken were 20 and 24, being moderately to highly adsorbing (Ecoscape 2009).

The site is located in an area considered to have a high risk of actual or potential Acid Sulphate Soils (ASS) at a depth of less than 3 m from soil surface (DEC 2006). However, the presence of alkaline limestone on the site and lack of evidence of peaty soils in the geotechnical investigations indicate that ASS are unlikely to occur on the site.

There is no known contamination on the site.



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Scale
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Figure 3 Site layout plan

Coordinate System: GDA 1994 MGA Zone 50
Date: 19/10/2012
Author: jcrute

Scale: 1:4,000 at A4
Source: Aerial image: Landgate 2012. Elevation: online SLIP Database, Landgate 10/2012. Cadastre: Ecoscape 2009. Note that positional errors may occur in some areas

Legend
- Surface elevation (mAHD)
- Lot boundary
- Cadastral boundaries

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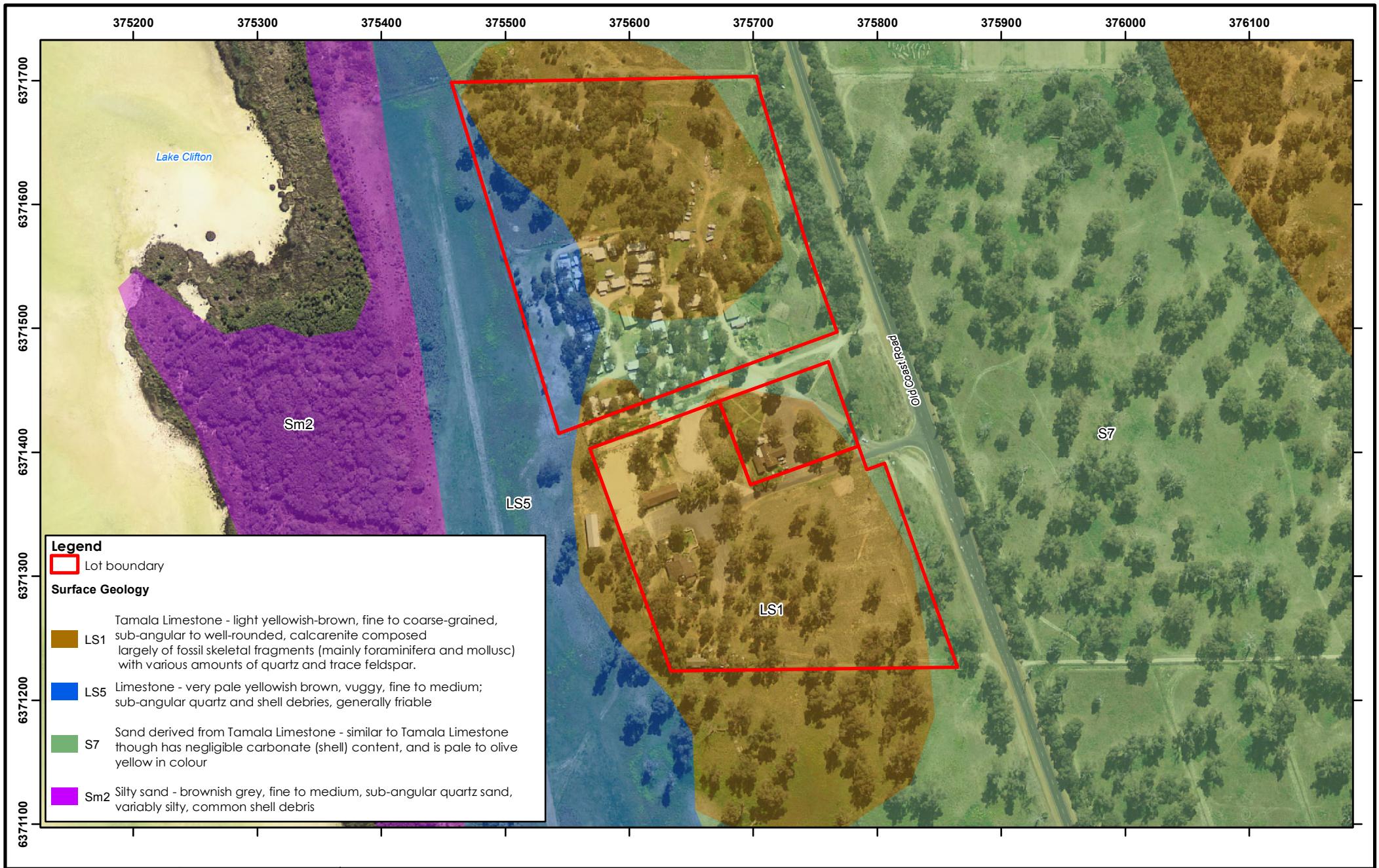

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Figure 4 Geological plan

Coordinate System: GDA 1994 MGA Zone 50
Date: 4/10/2012
Author: jcrute

Scale: 1:4,000 at A4
Source: Aerial image: Landgate 2012. Geology: DMP 10/2012.
Description geology: DMP 10/2012 & Ecoscape 2009.
Note that positional errors may occur in some areas

Path: Q:\GIS\Consult\2012\BAD\BAD12112.01\ArcMap_documents\R001\RevA\BAD12110_01_R001_RevA_F004.mxd

3.4 Hydrology

3.4.1 Surface water hydrology

The primary surface water body in the area is Lake Clifton, to the west of the site (Figure 5). There are no surface water bodies on the site and the sandy nature of the local soils means that surface water flows are considered unlikely except in extreme events (greater than the 1 in 100 year Average Return Interval (ARI) event). Inspection of the site indicated no obvious surface water flow pathways, such as creeks or erosion lines.

Water levels in Lake Clifton were monitored by ENV Australia between January and October 2008 as part of a separate project (ENV 2009). Water levels varied between -0.7 and 0.5 m AHD over this period, being below sea level between approximately January and mid June (ENV 2009). Salinity in varied between 37 700 and 61 800 mg/L (ENV 2009). In comparison, seawater has a salinity of approximately 35 000 mg/L. The lake water is pH was alkaline, with pH varying between 7.86 and 8.46 (ENV 2009).

A search of the DoW database did not locate any long term surface water monitoring data for Lake Clifton. Limited data was available for the period 1983-6, which indicated water levels similar to those found by ENV. Monitoring of lake water levels and quality was not undertaken by Ecoscape.

ENV (2009) noted that nutrient concentrations within the Lake were highest concentrations in autumn and lowest in winter, which was considered to reflect dilution effects due to seasonal increasing and decreasing water volumes in the Lake. The monitoring work noted total nitrogen varying between 2.0 and 3.6 mg/L, and total phosphorus concentrations between 0.005 and 0.22 mg/L (ENV 2009).

3.4.2 Groundwater hydrology

The site lies on a small groundwater mound between Lake Clifton and the Peel-Harvey Estuary (Commander 1988). Regional groundwater data indicates that groundwater in the area flows towards Lake Clifton with groundwater levels less than 1 m AHD (Commander 1988).

Groundwater monitoring was undertaken by Ecoscape between April 2010 and August 2012 at six bore locations (Figure 6, Appendix 3). Groundwater levels on the site peaked in August 2011, with levels generally peaking between 0.391 and 0.424 m AHD, with a westward flow direction (Figure 6). The exception to this is MB03, which consistently experienced levels approximately 0.6 m higher than the other bores on the site. Maximum groundwater levels recorded at this bore is 1.00 mAHD. MB03 is located close to the lake and there is no obvious reason for this discrepancy. Minimum groundwater levels were recorded in February 2011 and ranged between 0 to 0.03 m AHD, with the exception of MB03.

The water levels in the bores that were not considered outliers were consistent with the levels observed by Commander (1988). No offsite bores were monitored for water levels concurrently with the onsite bores.

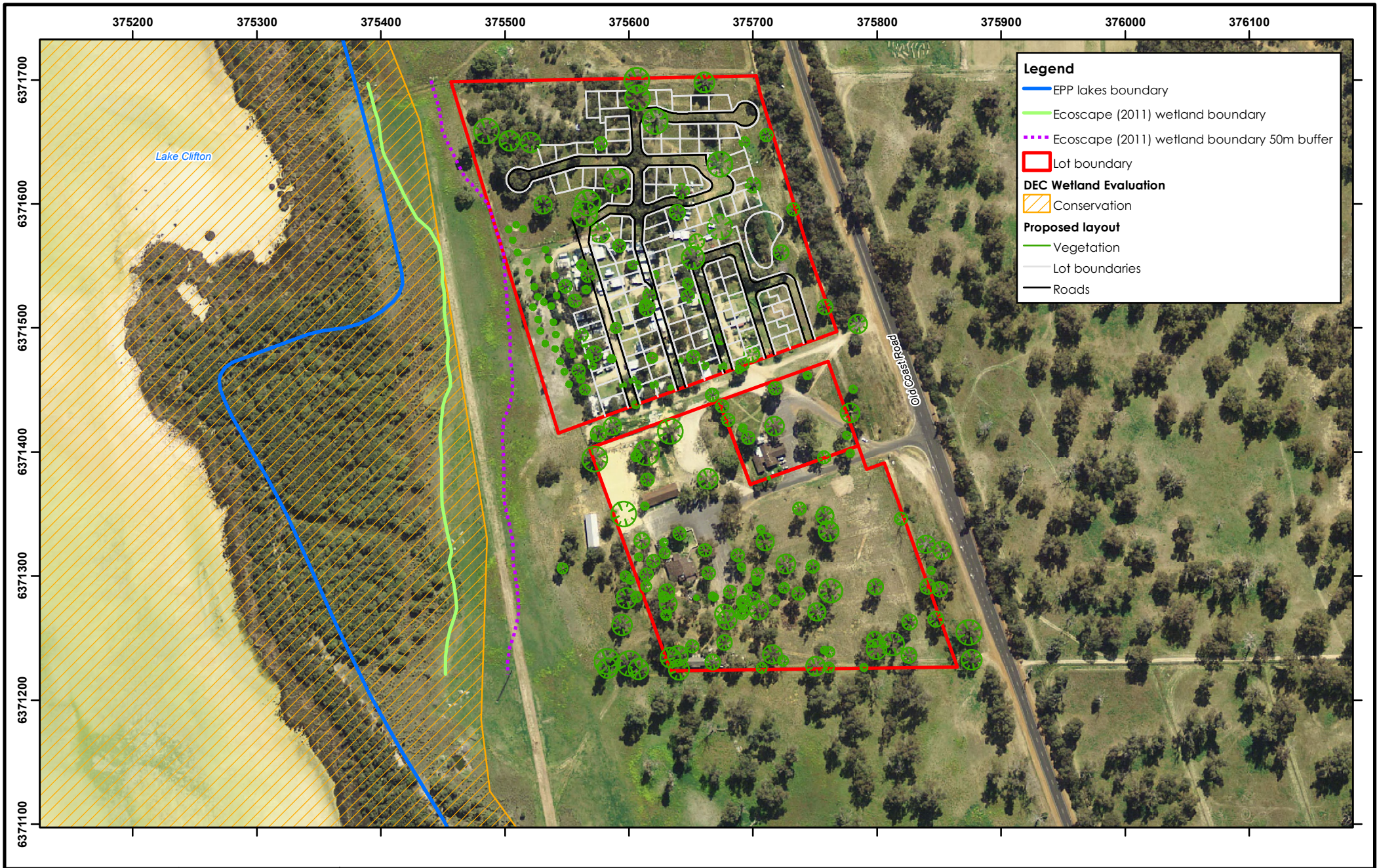

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Figure 5 Surface water and wetlands plan

Coordinate System: GDA 1994 MGA Zone 50
Date: 19/10/2012
Author: jcrute

Scale: 1:4,000 at A4
Source: Aerial image: Landgate 2012. Wetlands evaluation: DEC 2009.
Wetland boundary: Ecoscape 2011. Development layout: Doepel Marsh 2012.
Note that positional errors may occur in some areas

Path: Q:\GIS\Consult\2012\BAD\BAD12112.01\ArcMap_documents\R001\RevA\BAD12110_01_R001_RevA_F005.mxd

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Figure 6 Groundwater plan

Coordinate System: GDA 1994 MGA Zone 50
Date: 19/10/2012
Author: jcrute

Scale: 1:4,000 at A4
Source: Aerial image: Landgate 2012.
Monitoring bores and GW levels: Ecoscape 2010-2011.
Note that positional errors may occur in some areas

Legend

- Monitoring bores
- Groundwater level (mAHD)*
- Depth to groundwater (m bgl)*
- Surface elevation (mAHD)
- Lot boundary
- General direction of flow

*Date measured: 30/08/2011

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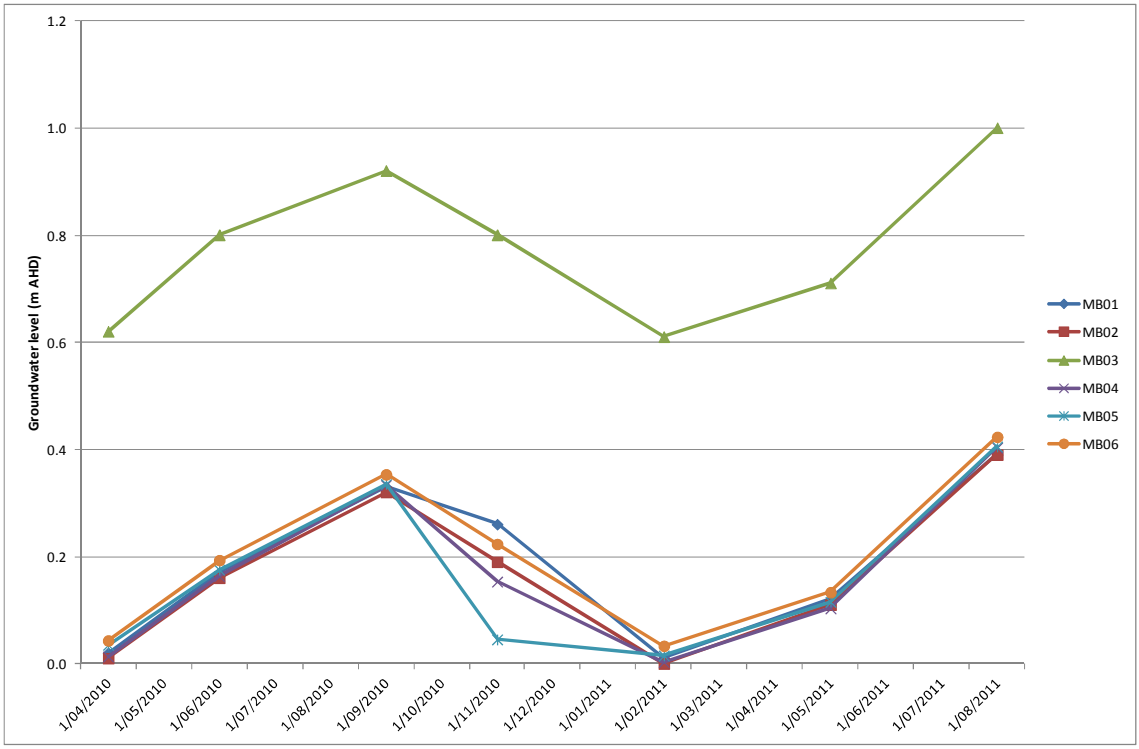

Figure 7 Variation in groundwater levels over time

Groundwater monitoring indicates a neutral to slightly alkaline groundwater with a generally fresh to slightly brackish characteristics (Table 3, Appendix 3).

Table 3 On site groundwater quality

Parameter	Minimum	Maximum	Median	Lake Clifton range of results (ENV 2009)
pH	7	7.7	7.4	7.86 – 8.49
Total dissolved solids (mg/L)	170	1200	535	37 700 - 61 800
Total nitrogen (mg/L)	0.15	11	2.90	2.0 - 3.6
Total phosphorus (mg/L)	<0.01	0.56	0.04	0.005 - 0.22

Nutrient levels in groundwater on the site were more variable than those recorded in Lake Clifton, but the median concentrations were within the range recorded at Lake Clifton. The total nitrogen levels varied between 0.15 and 11 mg/L, with a median concentration of 2.9 mg/L (Table 3). Total phosphorus concentrations varied from <0.01 to 0.56 mg/L, with a median of 0.04 mg/L (Table 3).

Full groundwater monitoring results can be found in Appendix 3.

3.5 Vegetation and flora

Vegetation and flora studies on the site were undertaken by Ecoscape in 2009. The vegetation was described as *Eucalyptus gomphocephala* (Tuart) Woodland, over *Agonis flexuosa* (Peppermint) Low Open Woodland over an understory of introduced grasses and weed species in the north and scattered A. *flexuosa* in the south of the site (Figure 8, Ecoscape 2009). This understorey reflected that the site has previously been parkland cleared. Greater than 90% of study area was considered to be completely degraded with little or no native understorey remaining (Ecoscape 2009).

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Figure 8 Vegetation and fauna plan

Coordinate System: GDA 1994 MGA Zone 50
Date: 24/10/2012
Author: jcrute

Scale: 1:4,000 at A4
Source: Aerial image: Landgate 07/2012.
Vegetation & habitat trees: Ecoscape 2009.
Note that positional errors may occur in some areas

Path: Q:\GIS\Consult\2012\BAD\BAD12112.01\ArcMap_documents\R001\RevA\BAD12110_01_R001_RevA_F008.mxd

A total of 27 vascular plant species were observed in the survey area, 17 of which were introduced (Ecoscape 2009). Because of the lack of native vegetation, it was decided that a spring survey of the site was not required.

3.6 Fauna

The site is considered to have low habitat value due to lack of understorey and low number of trees (Ecoscape 2009). The following species of conservation significance may potentially use t he site:

- *Pseudocheirus occidentalis* (Western Ringtail Possum) may disperse through the site
- *Calyptorhynchus baudinii* (Baudin's Black-Cockatoo) may utilise the Tuarts on the site for nesting hollows
- *Charadrius rubricollis* (Hooded Plover) may feed within the adjacent Lake Clifton (Ecoscape 2009).

Potential habitat trees for Black-Cockatoo and Western Ringtail Possum have been identified and will be retained (Figure 8).

3.7 Wetlands

Lake Clifton is classified in the DEC Geomorphic Wetlands Swan Coastal Plain dataset as a Conservation Category Wetland and is located approximately 100m to the west of the site (Figure 5). Lake Clifton is listed and protected under the Ramsar Convention Ramsar sites as a wetland of international importance (Ecoscape 2009).

Lake Clifton is maintains significant natural values for wildlife and a community of critically endangered stromatolites (Ecoscape 2009). The thrombolites rely on the inflow of fresh groundwater containing calcium and bicarbonate for their growth (ENV 2009). The lake is also provides important habitat for waterbirds over the summer months, when other water bodies on the Coastal Plain dry up (CALM 1995).

A wetland boundary delineation study was undertaken by Ecoscape (2011) to better delineate the boundary of Lake Clifton. This boundary was based on the presence of wetland vegetation and other factors in accordance with *Draft Guideline for the Determination of Wetland Buffer Requirements* and discussions with the DEC (WAPC 2005) (Figure 5). The development has been designed to avoid infrastructure being placed within 50 m of the wetland boundary.

3.8 Servicing

The site currently provides its own water supply from two bores located within the property. Caravans on the site do not have their own sanitary facilities. Groundwater is provided washing, toilet and laundry purposes at the ablutions block. Each caravan is provided with a standpipe with a tap.

Bores on the property are not metered. Based on estimates of use for caravan parks from DoH of 270 L/caravan/day when in use (Richard A [DoH] 2012, pers. comm. 3 August), and assuming that two thirds of the caravans are in use at any time, the total water use for the site is estimated at 3.9 ML/yr.

Through the UWMP process, the developer has become aware that the site does not have current licenses for groundwater abstraction on the site. The developer is in the process of lodging an application for an abstraction license.

Wastewater from the ablutions block and caretaker's house are treated through the use of septic tanks and infiltrated on site. Effluent quality at the outlet of the existing system was tested by Strategen on 3 August 2012. The effluent had a total nitrogen concentration of 91 mg/L and a total phosphorus concentration of 8 mg/L. This is considered to be a high nitrogen concentration for treated wastewater. In comparison, the new wastewater treatment plant being constructed at Alkimos achieves a median nitrogen concentration of 7 mg/L (Water Corporation 2010).

3.9 Landscaping

Landscaping on the site will predominantly consist of native vegetation with some grassed areas. Existing trees will be predominantly retained on the site to provide habitat, as shown on Figure 2.

The development on the site will be undertaken as a leased estate, with park home owners paying fees to the developer for upkeep. Other park homes may be rented out by the developer as weekend or holiday accommodation. Landscaping outside the park home lots will be maintained by the developer as part of the overall lease arrangement. Water for development scale landscaping will be sourced from either recycled wastewater or bores on the site.

Because of the small lot size, it is likely that the lots will predominantly consist of roofed area and hardstand for car parking and outdoor living. Landscaping will be undertaken by the owners of the lots under the supervision of the owner/manager. Water for this landscaping will come from bores and/or rainwater.

The existing water feature will be retained (Figure 2). This feature consists of a lined, above ground koi pond with a waterfall feature to keep water moving and prevent mosquito breeding. The feature operates effectively without issues and is considered to be part of the character of the site. The pond is well maintained and is considered to comply with the requirements of the DoW *Interim Position Statement: Constructed Lakes* (2007) in that it does not cause water quality problems and is well managed. The pond does not have a drainage or irrigation water function.

The development is currently fenced to prevent access to the air strip and beyond that, Lake Clifton. This fencing is proposed to be retained.

4. Water use sustainability initiatives

4.1 Water balance and philosophy

The development is not located on a reticulated water or wastewater supply network. The nearest reticulated supply network is several kilometres from the site and the development is not proposing to connect to this network.

The development will have a policy of sustainable self supply. Water for the development will be sourced from a mixture of sources, which are likely to include:

- rainwater
- groundwater
- recycled wastewater.

At a lot level, rainwater collected from rooves will be used for in-house supply. Residents may be provided with groundwater for irrigation.

Groundwater and recycled water will be used for irrigation of open space. Wastewater not recycled will be disposed of by irrigation of a tree lot area. This methodology meets the objective of minimising the use of potable water where drinking water quality is not essential, particularly for ex-house uses. Should groundwater be required but no allocation available, the developer will seek to purchase an allocation from another user and/or minimise non-potable water demands on the site.

4.2 Water supply and efficiency measures

4.2.1 Water supply

Potable water use estimation

Not all of the park homes are anticipated to be occupied on a full time basis. It is anticipated that:

- 40% of the site to be used in frequently, being12 times a year for up to three days
- 40% of the site to be utilised for approximately five days per week for six months a year
- 20%of the site will consist of full time residents.

Using the Water Efficiency Calculator (Water Corporation undated), and assuming two permanent residents per park home with water efficient fixtures, the internal water use is estimated at 85 kilolitres (kL)/house/year or 43 kL/person/year. Assuming that the irrigated area of the lot is 70 m^2 with water efficient features, then total water use is estimated at 65 kL/person/year. This demand will depend primarily on the frequency of use of the site. Owners who are not often present are less likely to landscape and irrigate their lots.

Rainwater tanks

Rainwater provides a sustainable source of water that can be used for drinking water. Each home will be required to include a rainwater tank of at least 15,000 L in volume to be connected to the whole roof area. The developer will install all the park homes, including services. This ensures that the installation of measures such as rainwater tanks will be undertaken in a standardised manner, consistent with the requirements of SoW and Plumbers' Licensing Board.

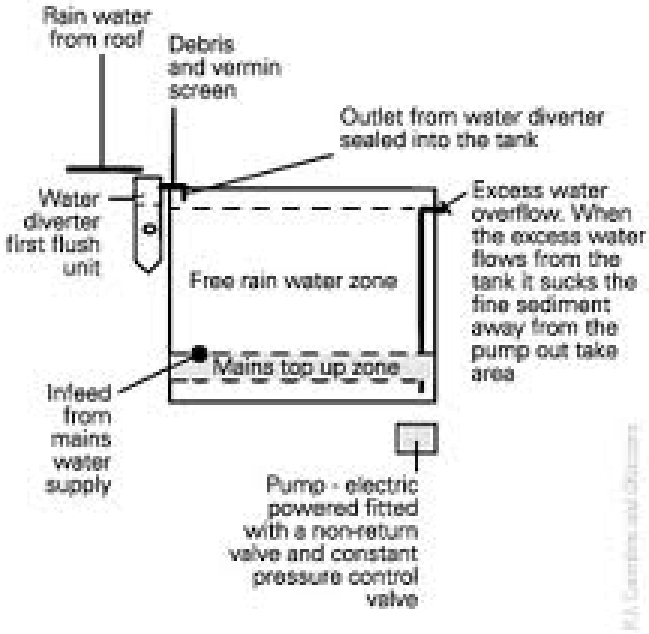


Figure 9 Rainwater tank with reticulated water top up (source *www.yourhome.gov.au*)

Rainwater tanks will be designed and installed to ensure water quality is maintained. All rainwater tanks will include:

- screened inlet and overflow to prevent birds, animals and insects from gaining direct access to the water (including mosquitoes)
- a cover and sealed manhole to allow access while preventing light from reaching the water, as light encourages the growth of bacteria and algae
- first flush diverter to downpipe to flush off leaves and debris and prevent gutters blocking
- guttering and piping that is self draining or fitted with drainage points to prevent mosquito breeding
- an overflow pipe that extends into anaerobic zone to remove sludge and sediment off bottom of tank
- pump to provide pressure and flow for in-house water use (Figure 9).

Overflow from the tank will enter the soakwell on the lot.

A 15,000 L tank is estimated to provide 63 kL/yr of water if connected to the full roof area. This volume may not be adequate for permanent residents or frequent users if the use occurs over summer. In this case, residents would be expected to organise and pay for their own water cartage. It is anticipated that the amount of additional water required will average at most one tank full (15,000 L) per park home per year, as some park homes will not be frequently occupied.

Owners will be provided with information on maintaining their tanks, which will include advice on:

- cleaning of gutters and downpipes
- pruning of trees and shrubs around the property
- the need to desludge the tank every two to three years (DoH, undated).

Reticulated non-potable supply

Anon-potable supply may be provided to residents for irrigation. This would include provision of a low flow tap in the front yard, signposted to show that the water was not suitable for potable use. This system is unlikely to require licensing from Department of Health. Annual checks would be undertaken to confirm that the system has not been cross connected for internal use.

Should all residents use this water for irrigation, then the estimated demand would be 2.9 ML/yr.

4.2.2 Lot scale water efficiency measures

The developer will install all park homes on the site. The developer will ensure that all units are fitted with water efficient showers and toilets as part of the fit out of the units to reduce water use on the site.

A Sustainability Package detailing the water supply situation and appropriate water conservation measures on the site will be explained to buyers at the time of sale. This will outline the need to conserve water on the site and provide information on low water use fixtures and sustainable gardens as well as advice on being waterwise in the home.

Landscaping will be undertaken by the owner. A portion of lots are likely to be used as holiday homes, in which case these lots are unlikely to be heavily landscaped and irrigated.

4.2.3 Irrigation and development scale water efficiency measures

The main factor determining water use at a development scale is the use of water for irrigation. The total area of open space on the site that may possibly require irrigation is estimated at 1.8 ha, assuming that all of this is to be irrigated. Road reserves on the site are very narrow (approximately 6 m wide) and will be fully paved. Approximately 0.9 ha of this will be irrigated with treated wastewater, as outlined in Section 4.3.1. This leaves a balance of approximately 0.9 ha to be irrigated with bore water. Assuming this is irrigated at a rate of 7,500 kL/ha/yr, this would result in a total of 6.8 ML/yr of water being used for irrigation.

The open space will be predominantly planted, with small areas of grass where amenity is required. Plantings will consist of local native species. This type of landscaping requires little input of fertiliser and water beyond the establishment phase. As such, irrigation demands are anticipated to be limited beyond establishment. The 6.8 ML/yr provided above is therefore considered to be an overestimate of the actual irrigation demand.

Grassed areas on the site will require irrigation. Irrigation water will be sourced from either recycled wastewater or groundwater. If recycled wastewater is chosen, then the irrigation system will the a Recycled Water Quality Management Plan (RWQMP) will be prepared and approved by Department of Health, as per the *Guidelines for the Non-potable Uses of Recycled Water in Western Australia* (DoH 2011).

Existing trees will be predominantly retained on the site to provide habitat, as shown on Figure 2.

4.2.4 Groundwater use and availability

DoW (letter dated 28 November 2012) has indicated that abstraction bores on the site should be located more than 200 m from the CCW because of potential salt intrusion issues. Of the two bores present on the site, one is located within 200 m of the boundary of the CCW. This bore is located in a proposed lot and will be relocated to a site more than 200 m from the boundary as part of the development process. Bores will be designed to be shallow to minimise the intrusion of deeper saltier water associated with the saline lake.

Development groundwater demands will be kept below 2000 kL/ha or 12 000 kL for the development, as required by the *South West Coastal Groundwater Area Groundwater Management Plan* (Water Authority of Western Australia 1989). Groundwater use on the site shall be metered. Groundwater use for irrigation is expected to consist of:

- up to 6.8 ML/yr for POS irrigation
- 2.9 ML/yr for domestic irrigation.

Limited volumes of groundwater will be required for WWTP operation. Commissioning volumes for the WWTP are estimated at 60-80 kL. During operation, WWTP use will be limited to the occasional requirements for flushing out of the reticulation system for maintenance and testing of tanks or other infrastructure at replacement, and are anticipated to average less than 30 kL per year. The total volume of groundwater required is estimated at approximately 9.8 ML/yr.

4.2.5 Water Balance

The current water cycle on the site consists of inputs from rainwater being infiltrated on site and abstracted by bores for use as a water supply. This water is used for domestic purposes and irrigation. Water used for domestic purposes is treated and the effluent is disposed of on site. Water used for irrigation is either used by plants or infiltrates to groundwater. No water is bought to the site as a reticulated supply and water does not leave the site as stormwater or untreated wastewater.

The development is not proposing to significantly alter this process. Excepting the importation of potable water to top up tanks, the development consists of a closed cycle, with rainwater water being captured on site and reinfiltrated via landscaping and the tree lot.

The volume of water imported to the site is estimated at a maximum of 15,000 L per park home per year. This is equivalent to 1.8 ML/yr over the 6 ha site. This water will be used for domestic purposes, treated and used for irrigation. Assuming that none of this water is lost due to evapotranspiration (an unlikely worst case scenario), the total increase is equivalent to an additional 30 mm of recharge. Rainfall in the area is estimated to average 845 mm/yr (Section 3.1).

4.3 Wastewater management

Wastewater on the site will be collected and treated using a Membrane Biological Reactor (MBR) type WWTP. The MBR plant is an activated sludge treatment plant using membrane ultrafiltration and alum dosing to remove nutrients. Effluent disinfection will be undertaken to produce a fit-for-purpose effluent quality and may include the use of liquid sodium hypochlorite and ultraviolet radiation, depending on whether the effluent is to be reused or irrigated on the tree lot (Worley Parsons 2012, Appendix 4). The plant will be designed to achieve a very high effluent quality of:

- 5 mg/L total nitrogen
- 1 mg/L total phosphorus (Worley Parsons 2012, Appendix 4).

In comparison, the new wastewater treatment plant being constructed at Alkimos achieves a median total nitrogen concentration of 7 mg/L and total phosphorus concentration of 12 mg/L (Water Corporation 2010).

Advice received from Department of Health (DoH) considers that design for effluent disposal systems for holiday facilities should be based on 270 L/day for one bedroom units and 540 L/day for two bedroom units (Richard A [DoH] 2012, pers. comm. 3 August). In comparison, the estimation using the Water Corporation rates outlined in Section 4.2.1 gives an in-house consumption of approximately 234 L/day for a two person household.

The development is anticipated to consist of 100 two bedroom units and 20 one bedroom units. Using the occupancy assumptions outlined above, the peak wastewater production volume using DoH rates is estimated at 59 kL/day and 8.3 megalitres per year (ML/yr). This compares to a peak volume of 28 kL/day and 4.6 ML/yr using the Water Corporation rates. This assumes that all of the water used in-house becomes wastewater. A conservative approach to wastewater has been taken, with the wastewater treatment plant and effluent disposal area sized based on the DoH rates to meet their requirements.

Based on the estimated capacity of the plant (less than 100 kL/day), the new wastewater treatment plant and associated disposal method will not require a works approval or registration with DEC. The treatment plant design will require approval from SoW.

Treated wastewater reuse and disposal

Consideration was given to the use of this water for irrigation of crops off site, as nearby areas are used for vegetable and turf farming. The volume of treated wastewater that could be provided by the site is potentially 4.6 to 8.3 ML/yr. Irrigation rates for vegetables are estimated at 5 to 15 ML/yr (Water and Rivers Commission 1996). Turf farm irrigation rates are anticipated to be similar. In the best scenario (i.e. maximum estimate for wastewater volumes and minimum irrigation rate), 1.66 ha of vegetables could be irrigated using the treated wastewater.

In order for off-site irrigation to occur, the following steps would be required:

1. The irrigator would be required to obtain DoH approval, including preparing a Recycled Water Management Plan (RWQMP).
2. If edible crops were chosen, the wastewater would need to be treated to a very high standard, suitable for irrigation of edible crops. The irrigator would be required to test water quality on a regular basis, including continuous online testing for disinfectant residuals (such as chlorine), turbidity and pH and weekly bacteriological testing (DoH 2011). If a turf farm was selected, daily testing would be required for disinfectant residuals and pH would still be required (DoH 2011). If the effluent quality does not meet criteria, then supply may be discontinued (DoH 2011).
3. Annual reporting to DoH and three yearly audits of the irrigation system would be required (DoH 2011).
4. An agreement of supply would need to be signed between the Park Home site and the irrigator, with involvement of ERA (Hilton H [ERA] 2012, pers. Comm. 12 July).

This would place a significant onus on the irrigator for what is effectively a small amount of water that can be had without significant cost from locally available groundwater. The option of reuse of treated wastewater off site was therefore discounted.

The options and need for reuse of treated wastewater on site are being assessed. The use of effluent outside a fenced irrigation area without access would require a RWQMP and appropriate measures to be undertaken to manage effluent quality. The WWTP proposed is able to treat the effluent to a suitable standard suitable for irrigation with some restricted public access, such as signs advising that the area was irrigated with wastewater and not to enter the area during irrigation (DoH 2011). Continuous online testing would be required (DoH 2011). A fenced irrigation area is required for situations where the effluent does not meet the testing criteria or when rain is forecast (DoH 2011).

Providing treated effluent to homeowners for irrigation is more problematic, as it opens the risk of cross connection of treated wastewater to potable supplies and homeowners working directly with treated wastewater. Managing this risk is difficult and such schemes are in their infancy in Australia. This option is not being considered at Lake Clifton.

Wastewater management approvals

Based on the estimated capacity of the plant (less than 100 kL/day), the new wastewater treatment plant and associated disposal method will not require a works approval or registration with DEC under the Environmental Protection Regulations 1987. The treatment plant design will require approval from SoW.

As the wastewater system will treat more than 0.54 kL/day, DoH approval is required for the WWTP. required to approve all wastewater systems treating greater than 0.54 kL/day of sewage.

4.3.1 Effluent disposal area sizing

The sizing of the effluent disposal area has been undertaken to comply with the guidelines for nutrient loadings and effluent in *Water Quality Protection Note 22: Irrigation with nutrient rich wastewater* (WQPN 22) (DoW 2008). The document recommends that the guidelines for nutrient loads for sandy soils that are adjacent to areas with a risk of eutrophication of:

- maximum nitrogen load of 140 kilograms per hectare per year (kg/ha/yr)
- maximum phosphorus load of 10 kg/ha/yr (DoW 2008).

These guidelines cover inputs from wastewater and other nutrient sources, such as fertilisers.

Based on an assumed effluent nitrogen concentration of 5 mg/L and a volume of 8.3 ML/yr, a total of 41 kg per year of nitrogen would be present in the WWTP effluent. This will require 0.30 ha of irrigated area to meet the load criteria (Appendix 5). This is a low nitrogen concentration for a wastewater effluent, but is considered to be achievable through the use of the MBR plant. The effluent disposal area will be designed as a tree lot to maximise nutrient uptake. A species suitable for use in tree lots, such as Blue Gum, will be used. The location of the tree lot area is shown in Figure 2.

Based on an assumed effluent phosphorus concentration of 1 mg/L, a total of 8.3 kg per year of nitrogen would be present in the WWTP effluent. This requires an irrigated area of 0.83 ha to meet the load criteria (Appendix 5). This is the larger of the two requirements and the irrigated area has been designed on this basis.

5. Stormwater and groundwater management

5.1 Groundwater management

Groundwater levels on the site are not anticipated to change as a result of the development. Any increase in recharge on the site caused by the development is anticipated to be offset by the drying climate being experienced in South-Western Australia.

A separation of 1.2 to 1.5 m between design groundwater levels and finished lot levels is generally required for developments on the Swan Coastal Plain to ensure that the risk of water logging and rising damp in developments is limited. The minimum road levels proposed on the development are approximately 3.35 mAHD in the south-east corner of the site (Figure 10). The maximum groundwater level recorded on the site that was not considered an outlier was 0.42 mAHD (Section 3.4.2). To allow for variation between dry and wet years, a clearance between the maximum groundwater level and design groundwater level (DGL) of 0.6 m has been used to ensure that sufficient clearance can be maintained. The design groundwater level has therefore been set at 1.02 mAHD, which is below the levels estimated by Commander for the area (Section 3.4.2).

The difference between the DGL and the minimum lot level is 2.32 m, which is considered to provide adequate separation to groundwater. Control of groundwater by subsoil drainage is not proposed on the site.

Minimum base levels of basins on the site are proposed at 2.30 mAHD. This allows approximately 1.3 m separation from base levels to groundwater, which is considered more than adequate for infiltration and ensuring the bottom of basins remain dry outside of storm events.

Earthworks on the site will be limited to minimal amounts of cut and fill required to shape basins and ensure lots are comparatively flat (Figure 10). Fill is required on the southern boundary so that stormwater does not discharge onto the adjacent land holding to the south and adequate road grades are provided for drainage. This fill will be sourced from the material removed to shape the basins and from cut operations from the north-west portion of the site.

As the water balance on the site is not anticipated to change, the development will not impact upon groundwater levels in the area.

Management measures for water quality on the site will jointly address surface water and groundwater quality on the site, as all stormwater will be infiltrated on the site. Details of these measures can be found in Section 5.3.

STRATEGEN

Lake Clifton Park Home Development Urban Water Management Plan

Earthworks Plan

Figure 10

5.2 Stormwater quantity management

One of the aims of stormwater management on the site is to maintain pre-development flows off the site. There is currently no flow off the site in a 1 in 100 year ARI rainfall event and no flow off the site will occur post-development. Water will therefore be treated and infiltrated within the development. Storage in events up to the 1 in 100-year ARI event will be retained within the development. This maintains the current surface water hydrology of Lake Clifton, where water does not enter via surface runoff.

5.2.1 1 in 1 year Average Return Interval event

Lot scale measures

Lots will be required to retain the 1 in 1 year ARI storm event on the lot. To ensure this occurs, the developer will install two 1.2 m diameter by 1.5 m deep soakwells on each lot. The soakwells will receive overflow from the rainwater tank. This is based on a total area of hardstand and roofing on the lot of 120 m^2. Development covenants will limit residences to this total area. Lot connections between soakwells and the development stormwater system are not considered necessary.

Development scale measures

In the 1 in 1 year ARI event, water from roads will enter a series of manholes and gully pits in the road reserve (Figure 11). From there, the water travels to a series of three nutrient stripping basins, two in the east of the site and one in the west, via bubble-up structures. The basins will be stepped to maximise the useability of the space available while preventing the need for fencing or other structures (Figure 12). The lower areas of the nutrient stripping basins will be planted with local species that are tolerant of inundation and have nutrient stripping properties in line with water sensitive urban design principles. This allows for treatment of events up to and including the 1 in 1 year ARI event. The higher levels of the nutrient stripping basins are likely to be native vegetation, but may be landscaped in turf, if this is considered to offer better amenity to the area.

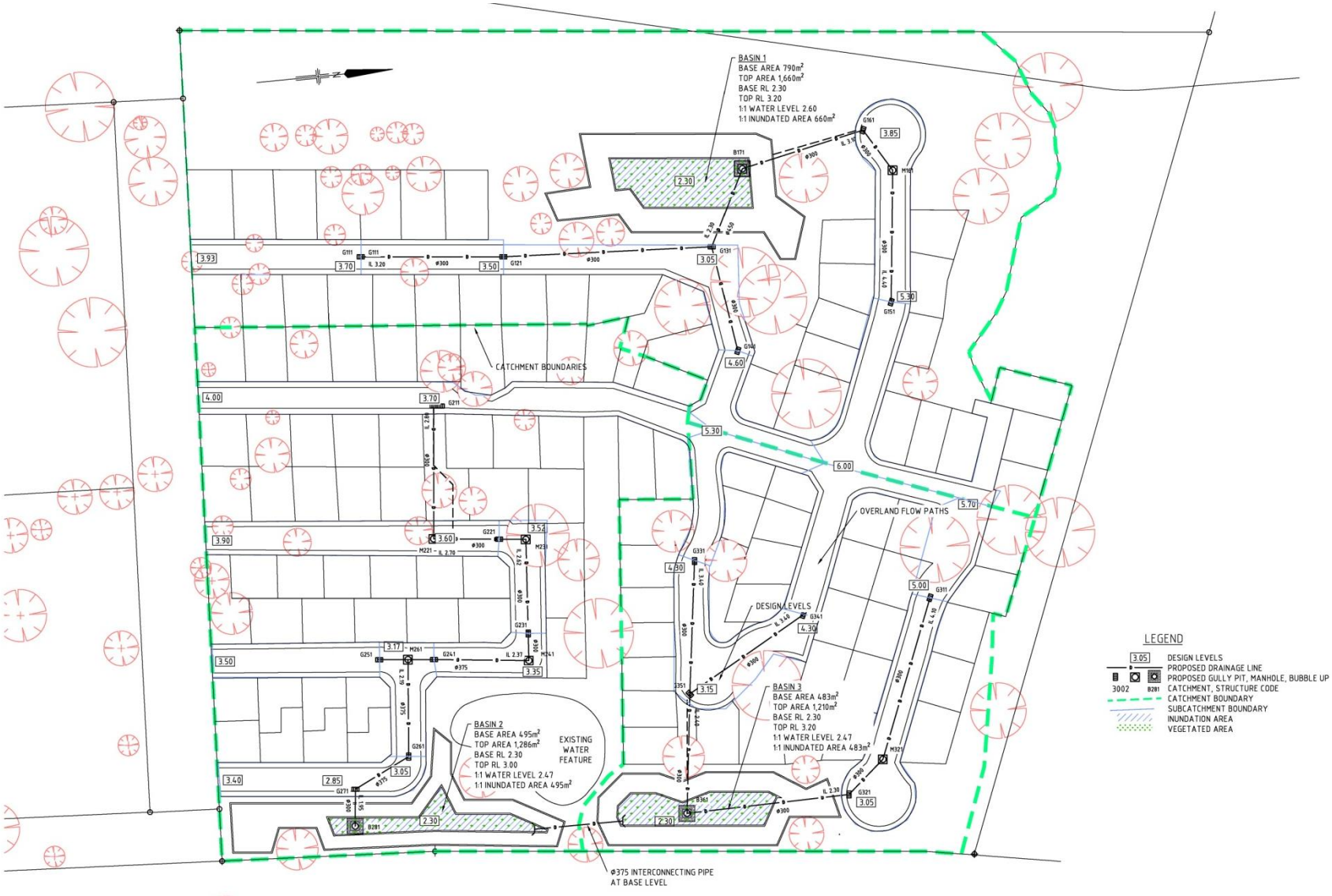
In the 1 in 1 year event, only the bottom level of each basin is anticipated to be inundated (Figure 11). Water may flow between Basins 2 and 3 in all events order to balance water levels and flows.

Road reserves in the development have been limited to a width of six metres. The small width of the road reserve and small lot size (with associated driveways) means that road scale vegetated areas are not suitable on the site. Because of the limited width, manholes and gully pits will be installed in the centre of the road. These manholes and gully pits will need to be trafficable. In sandy and limestone soils, trafficable manholes and pits may experience erosion and subsidence if open bases are used, causing road subsidence. Closed base manholes have therefore been selected for this development.

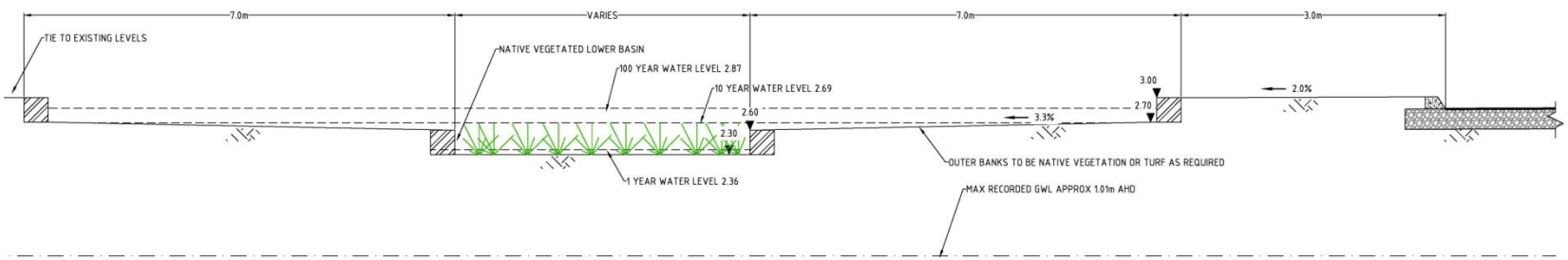
Design calculations for the basins in all events can be found in Appendix 6.

5.2.2 1 in 10 year Average Return Interval event

The 1 in 10 year ARI event is similar to the 1 in 1 year event, in that all flow from the roads is piped (Figure 13). In the 1 in 10 year ARI event, the soakwells on the lots will overflow into the road drainage system. In this event, the higher level of each basin will become inundated.

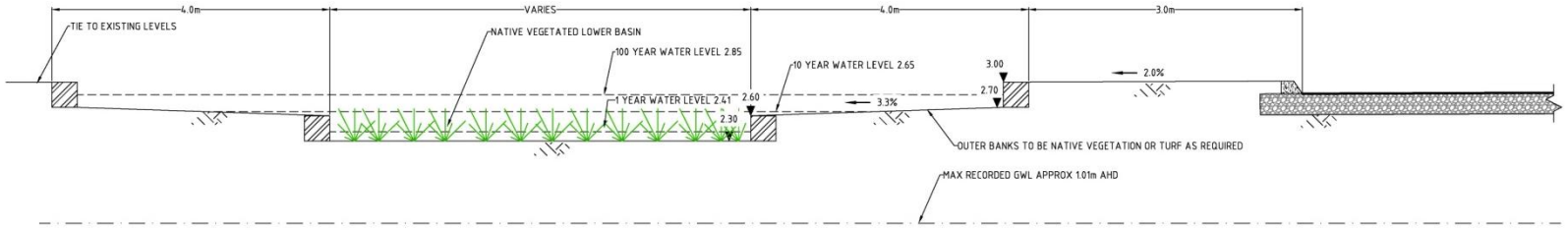


STRATEGEN	Lake Clifton Park Home Development Urban Water Management Plan 1 in 1 year ARI event plan	Figure 11



TYPICAL SECTION THROUGH BASIN 1

NTS



TYPICAL SECTION THROUGH BASIN 2

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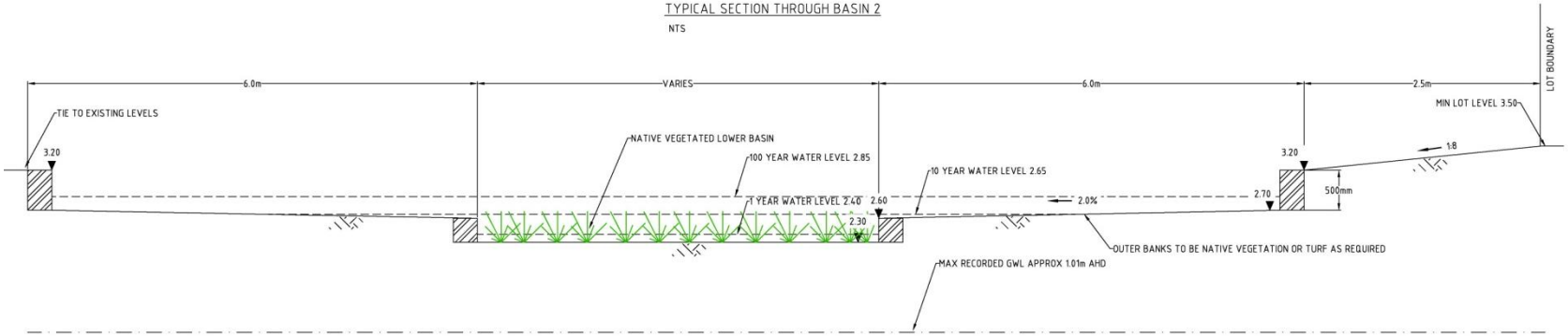
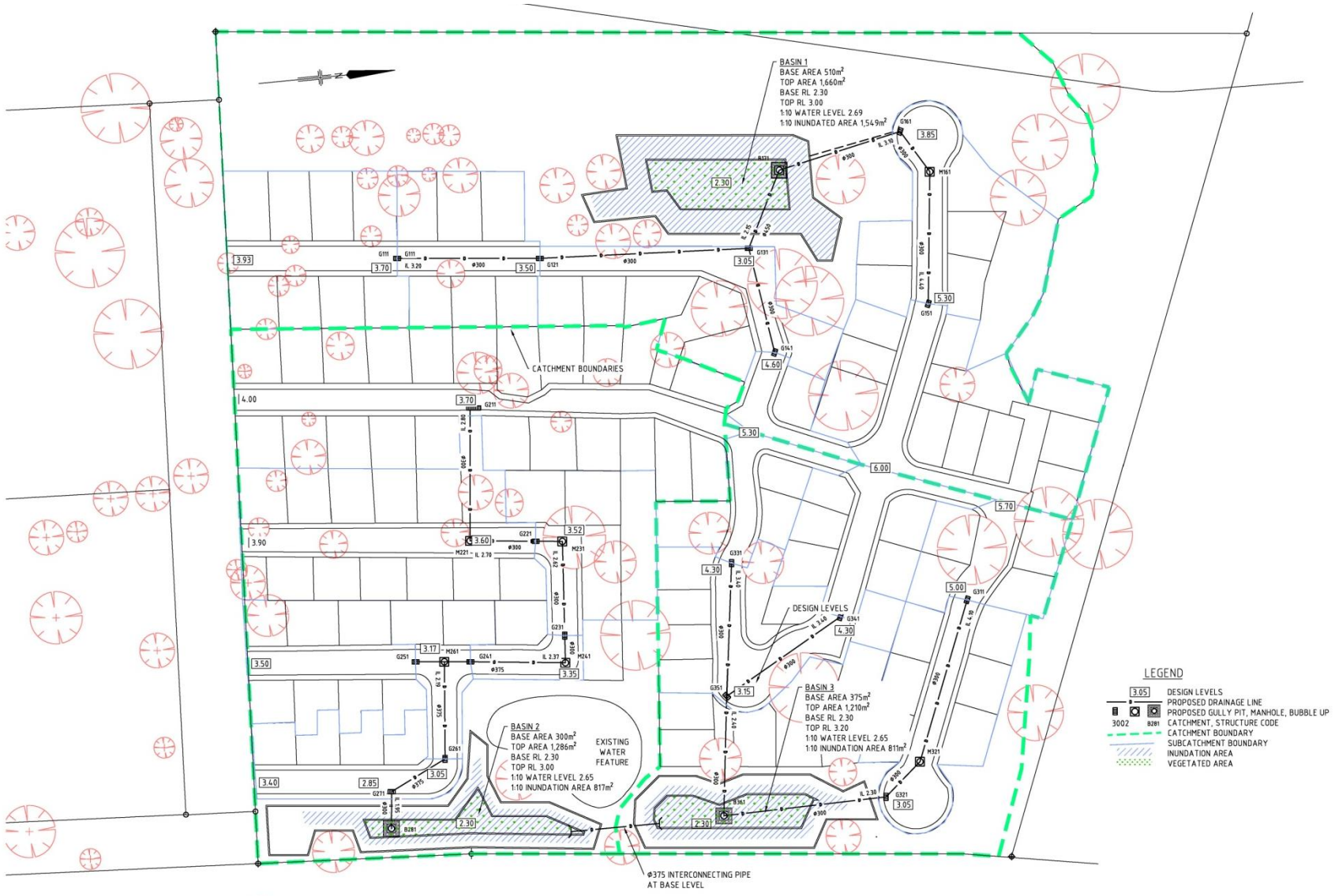


TYPICAL SECTION THROUGH BASIN 3

NTS

STRATEGEN	Lake Clifton Park Home Development Urban Water Management Plan Basin cross sections	Figure 12

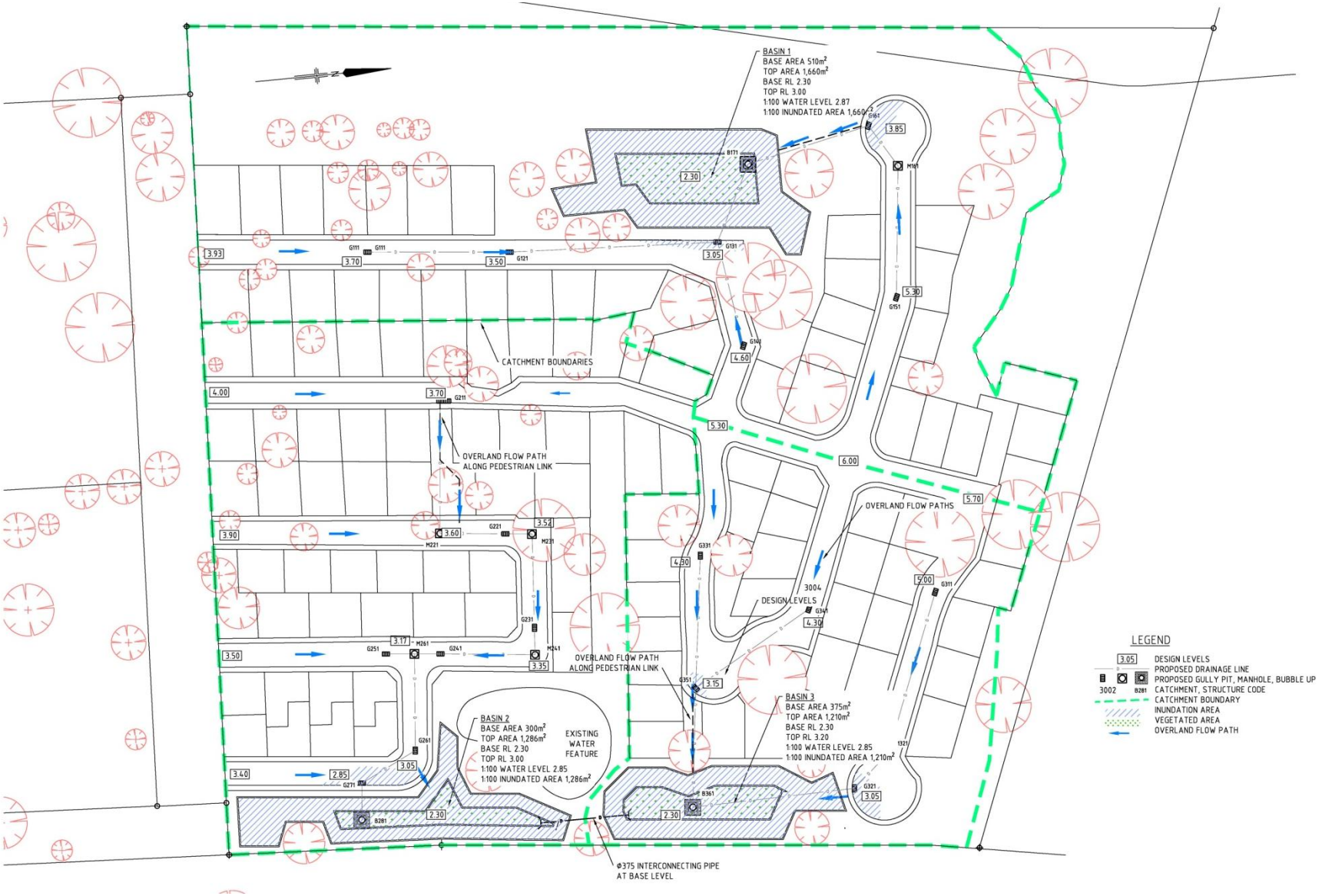


STRATEGEN

Lake Clifton Park Home Development Urban Water Management Plan

1 in 10 year ARI event plan

Figure 13



STRATEGEN	Lake Clifton Park Home Development Urban Water Management Plan 1 in 100 year ARI event plan	Figure 14

5.2.3 1 in 100 year Average Return Interval event

In the 1 in 100 year ARI event, water will enter the basins by both piped and overland flow (Figure 14). Basins will be inundated with a minimum of 0.15 m of freeboard allowed (Table 4). Some inundation of the road reserve will occur adjacent to the basins up to the kerb height which will dissipate generally within minutes after the peak flow, as capacity is attained within the piped drainage system. This will not prevent access or egress from the site and thus meets accessibility criteria required under Liveable Neighbourhoods (WAPC & DPI 2009) (Figure 14).

Table 4 Basin volumes and inundated areas in the 1 in 100 year ARI event

Basin	Top of basin level (mAHD)	Base level (mAHD)	Top area (m^2)	Base area (m^2)	Critical storm duration (hrs)	Top water level (mAHD)	Inundated area (m^2)	Volume (m^3)
1	3.20	2.30	1660	510	3	2.87	1660	538
2	3.00	2.30	1286	300	3	2.85	1286	364
3	3.20	2.30	1210	375	3	2.85	1210	375

The basins will be dry within 96 hours of the 1 in 100 year ARI event, meeting the objectives for prevention of mosquito and nuisance insect breeding outlined in Table 1. By managing all flows up to and including the 1 in 100 year ARI event by infiltration on site, the development meets the objectives for surface water flows outlined in Table 1.

5.3 Water quality management

5.3.1 Structural best management practices

The structural best management practices on the site consist of the three nutrient stripping basins. These basins will be planted with native vegetation designed to strip nutrients. The vegetation will be harvested on the site and removed to prevent overgrowth and nutrients in dead vegetation being remobilised. This allows new growth to form and take up additional nutrients.

5.3.2 Non-structural best management practices

Non-structural best management practices are considered to be a key element of nutrient management on the site. These are partially driven by the need to reduce water usage on the site.

At a development scale, landscaping will consist primarily of native plantings with turf used sparingly where appropriate. If treated wastewater is used for irrigation, then fertiliser will not be necessary and will not be applied. If treated wastewater is not used, then fertiliser will be applied sparingly to turf areas, when rain is not forecast. Slow release fertilisers will be used.

At a lot level, residents will be encouraged to use native vegetation for planting. Sustainability Packages will be provided at the point of sale, outlining appropriate fertiliser regimes and when and how this should be applied. This information will be followed up on an annual basis with letter drops outlining the need to minimise fertiliser use. Pets will not be allowed on the site to reduce pet waste loadings and to prevent attacks on wildlife.

5.4 Nutrient balance

A nutrient balance was undertaken on the site based on the assumptions and method of the Nutrient Irrigation Decision Support System (NIDSS) presented in the *Southern River/ Forrestdale/ Brookdale/ Wungong Urban Water Management Strategy, (*Water and Rivers Commission [WRC] 2002), with additions to allow for treated wastewater disposal. The NIDSS model was prepared by JDA Consultant Hydrologists for the WRC for the purpose of estimating pre- and post- urbanisation nutrient loads in the Southern River catchment. This study represents the most detailed available study of residential nutrient loadings in Western Australia and is based on a mixture of:

- surveys of residential nutrient input rates from fertiliser, car washing and pet waste
- City of Armadale records of POS fertiliser use between 1996 and 2000
- analysis by JDA of effectiveness of nutrient input source controls including community education programs, native gardens and water pollution control ponds (Appendices D and E of WRC 2002).

This is the most recent comprehensive survey and analysis of the type available for the Swan Coastal Plain. Information on nutrient loads for holiday homes and short stay accommodation is not available for Western Australia. As such, the information presented in this report is considered to be the most appropriate information on which to base a nutrient model of the site. A copy of the nutrient balance model can be found in Appendix 5.

For the pre-development scenario, the current estimates of effluent volumes and the measured concentrations were used. In this scenario, approximately 583 kg/yr of total nitrogen (TN) and 57 kg/yr of total phosphorus (TP) added per year (Appendix 5). There are currently no best management practices or stormwater management measures beyond soakwells used on the site. As discussed in Section 3.8, the wastewater treatment plant on the site does not appear to be operating well in terms of the removal of nitrogen and phosphorus.

In the post-development scenario, the wastewater treatment system results in significant reductions in nutrient loads from wastewater. Using the more conservative DoH volume estimates for wastewater, the nutrient load drops from 359 kg/yr TN to 41 kg/yr TN and from 32 kg/yr TP to 8 kg/yr TP (Appendix 5).

In the post development scenario, it is assumed that a number of nutrient management measures have been put in place to reduce nutrient loads, as discussed above. These include the use of low fertiliser native gardens for lots and open space and community education. With the implementation of these measures, the estimated post-development nutrient loads are reduced to 140 kg/yr TN and 24 kg/yr TP (Appendix 5). This is less than half the nutrient load in the pre-development scenario. The development therefore offers a significant improvement in nutrient loads compared to the current scenario.

6. Management of subdivisional works

Works undertaken will include vegetation removal, bulk earthworks, installation of underground services and installation of park homes. Dewatering is not anticipated to be required for this development.

This work will be undertaken by the developer. Given the location of the site, there are unlikely to be any sensitive receivers for dust and noise beyond the current residents. The developer will manage the impacts of dust and noise in a manner consistent with *Environmental Guidance for Planning and Development* (EPA 2008).

7. Monitoring and maintenance

Monitoring and maintenance will be undertaken by the developer in line with the schedule in Table 5.

Table 5 Monitoring and maintenance schedule

Function	Item to monitor	Trigger to action	Maintenance action required	Monitoring frequency
Drainage management system	Structural effectiveness (build up of rubbish, debris and sediment)	Rubbish, debris and sediments causing build up or blockages	Remove any material causing blockages	Every 3 months
	Sediment build up	Sediment taking up more than 15% of pit depth	Remove sediment	Every 3 months
	Vegetation build up	Vegetation becoming overgrown and covering more than 80% of the basin area	Remove vegetation and remove cuttings from the site	Remove vegetation every three years
	Weeds	Weeds are noxious or invasive or cover more than 25% of basin area	Remove weeds	Every 3 months
	Rubbish/litter	Litter entering basins	Remove litter and inspect for source. If recurring problem, consider actions	Every 3 months
Groundwater	Quality	Results outside guidelines as outlined in Section 7.1	Consider alterations to fertiliser regimes, as outlined in Section 7.1	Every 3 months
Non-potable groundwater supply to residents	Appropriate use of system (no cross connections or potable use)	Detection of cross connections or potable use.	Explain to residents that system is for non-potable purposes, remove any cross connections	Every 12 months
Open space	Weeds	Presence of noxious or invasive weeds that may impact Lake Clifton	Remove weeds	Spring and autumn
	Fire risk – build up of vegetation	Inspection of native vegetation and turf	As per Shire and FESA regulations	Spring each year

7.1 Groundwater monitoring

Post-development monitoring will be undertaken in line with the *Water Monitoring Guidelines for Better Urban Water Management Strategies/Plans (Draft)* (DoW 2011); or the final guidelines when these are developed. Post-development monitoring will occur from the installation of the first park homes until two years following the completion of construction.

The monitoring will include quarterly monitoring for water levels and quality Water monitoring will include:

- water levels
- pH and electrical conductivity
- total nitrogen, nitrate/nitrite, ammonia, Kjeldahl nitrogen, total phosphorus and phosphate.

Parameters will be monitored at bores 1, 2, 5 and 6, which are adjacent to the development. Results will be compared to the baseline results outlined in Section 3.4.2. Should nutrient concentrations exceed pre-development concentrations for two consecutive events, then investigations will be undertaken into the reason for this exceedence. Management measures undertaken may include:

- changes to fertilisation regimes such as reducing amounts of fertiliser used or altering timing if this is considered a factor (e.g. avoiding rainy periods)
- advising residents of the matter and to reduce their fertiliser use.

Monitoring results and any subsequent actions will be provided to DoW on an annual basis.

Additional monitoring may be required to meet the requirements of DoH and SoW with respect to the wastewater system. This monitoring will be reported to these agencies will be undertaken and reported in compliance with their licences and permits.

8. Implementation plan

Developer commitments and the roles of the developer are discussed in Table 6. No outside funding is being sought for this development.

Table 6 Developer commitments

Role	Responsibility	Requirement	Period
Post-development monitoring	Developer	Undertake post-development monitoring in a manner consistent with Table 5.	Two years following completion of construction
Maintenance of open space and structural drainage controls	Developer	Maintain open space and drainage controls in a manner consistent with Table 5.	Life of development.
Non-structural controls: public awareness of Water Sensitive Urban Design	Developer	Provide Sustainability Packages, including information regarding non-structural control issues such as fertiliser application and native gardens to new residents.	Point of sale
	Developer	Provide annual reminders of the need to limit fertiliser use and ways to limit water and fertiliser use. Limit use of fertiliser on open space and ensure any fertiliser used is of a slow release variety and is applied when rain is not anticipated.	Life of development.
Water efficiency	Developer	Construction of waterwise open space, including retention of native vegetation and low water use landscaping. Provision of information regarding water supply and water efficiency to buyers.	At construction.
Wastewater treatment plant construction and management	Developer	Construct and operate wastewater treatment plant in a manner consistent with all approvals. If wastewater to be reused for irrigation, gain approvals and operate system in a manner consistent with approvals.	Life of development.
Non-potable groundwater supply system	Developer	Assess requirement for reticulated supply provided. If required, obtain relevant approvals	Prior to construction.
	Developer	Maintain and operate reticulated non-potable supply.	Life of development.
	Developer	Ensure that residents are aware that supply is non-potable and inappropriate use and cross connections do not occur	Life of development.
	Owner	Manage rainwater tanks in a manner consistent with health requirements	Life of development.
	Owner	Use non-potable supply appropriately	Life of development.

9. Summary

The Lake Clifton Park Home site will manage water and nutrients in an appropriate manner to minimise any potential impact upon Lake Clifton. This includes:

- sustainable water supply management with no net export and limited importing of potable water
- installation of a Membrane Bioreactor style Wastewater Treatment Plant with dosing for phosphorus removal
- no flow of stormwater off the site in events up to the 1 in 100 year ARI event
- treatment of stormwater through nutrient stripping basins
- use of non-structural best management practices to reduce nutrient inputs at a development and lot scale
- installation of a wastewater treatment plant that produces an effluent with very low nitrogen and phosphorus concentrations
- ensuring that immobile stormwater is infiltrated within 96 hours to prevent mosquito and midge breeding (Table 7).

Table 7 provides a summary of the design elements and requirements for best management practices and how these comply with the key principles and objectives for water sensitive design on the site.

Through these measures, it is considered that the development complies with the water balance and nutrient objectives of the EPA (1998) *Guidance Statement No. 28, Development of the Lake Clifton Catchment*.

Table 7 Design elements and requirements for best management practices and critical control points

Category	Principles	Objectives	Development design elements and requirements
Water use	• consider all potential water sources in water supply planning • integration of water and land use planning • sustainable and equitable use of all water sources having consideration for the needs of all users, including community, industry and the environment.	Minimise the use of potable water where drinking water quality is not essential, particularly for ex-house uses.	The development will have a policy of sustainable self supply. Water for the development will be sourced from a mixture of sources, which will include: • rainwater • groundwater • recycled wastewater. At a lot level, rainwater collected from rooves will be used for in-house supply, with groundwater likely to be provided for garden use. At a lot level, rainwater collected from rooves will be used for in-house supply, with groundwater likely to be provided for garden use. Where rainwater volumes are not adequate for household use purposes, carted water will be used. Volumes of carted water are expected to be less than 15,000 L/household/year. Groundwater and recycled water will be used for irrigation of open space. Wastewater not recycled will be disposed of by irrigation of a tree lot area. This methodology meets the objective of minimising the use of potable water where drinking water quality is not essential, particularly for ex-house uses.
Groundwater levels and surface water flows	• to retain natural drainage systems and protect ecosystem health • to protect from flooding and water-logging • to implement economically viable stormwater systems • post development annual discharge volume and peak flow rates to remain at pre-development levels or defined environmental water requirements.	For ecological protection, 1 in 1-year ARI volume and peak flow rates maintained at or below pre-development conditions Where there are identified impacts on significant ecosystems, maintain or restore desirable environmental flows and/or hydrological cycles For flood management, manage up to the 1 in 100-year ARI event within the development area to pre-development flow rates.	There will be no flow off the site in events up to the 1 in 100-year ARI event, as is currently the case. Stormwater will not enter Lake Clifton in events up to the 1 in 100-year ARI event. As the water balance on the site is not anticipated to change, the development will not impact upon groundwater levels in the area.
Groundwater and surface water quality	• to maintain or improve groundwater and surface water quality • where waterways/open drains intersect the water table, minimise the discharge of pollutants from groundwater • where development is associated with an ecosystem dependent upon a particular hydrologic regime, minimise discharge or pollutants to shallow groundwater and receiving waterways and maintain water quality in the specified environment.	Implement current known best management practice as detailed in the DoW *Stormwater Management Manual for Western Australia* (DoW 2004 – 2007) and the *Decision Process for Stormwater Management in Western Australia* (DoE & SRT 2005), with an emphasis on a treatment train approach including nutrient input source control, use of bioretention systems, and maintaining 1 in 1 year ARI post development discharge volumes and peak flow rates at pre-development levels. Minimise the export of pollutants such as phosphorus and nitrogen to surface or groundwater from stormwater and rainwater.	Best Management Practices (BMPs) have been implemented in the form of nutrient stripping basins through the development to minimise pollution. Non-structural BMPs on the site will be extensively utilised, including Sustainability Packages provided at point of sale and regular advice on methods to reduce fertilisers use at a lot scale. Open space landscaping on the site will be designed to minimise fertiliser and water use. Fertiliser will be of a slow release type and will used sparingly. Nutrient balance indicates that the new development and improved wastewater treatment will significantly reduce nutrient loads from the site.

Category	Principles	Objectives	Development design elements and requirements
Disease vector and nuisance insect management	• to reduce the health risk from mosquitoes, retention and detention treatments should be designed to ensure that between the months of November and May, detained immobile stormwater is fully infiltrated within a time period not exceeding 96 hours.	Permanent water bodies are discouraged, but where accepted by DoW, must be designed to maximise predation of mosquito larvae by native fauna to the satisfaction of the local government on advice of Departments of Water and Health.	Detained stormwater will be fully infiltrated within 96 hours The existing water feature on the site shall be retained. This feature contains fish and is managed to prevent mosquito and midge breeding.

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List of appendices

The following appendices are contained on CD-ROM inside the back cover of this report

Appendix 1 UWMP Checklist

Checklist for integrated water cycle management assessment of application for subdivision or urban water management plan

1. Tick the status column for items for which information is provided.
2. Enter N/A in the status column if the item is not appropriate and enter the reason in the comments column.
3. Provide brief comments on any relevant issues.
4. Provide a brief description of any proposed best management practices, e.g. multi-use corridors, community based-social marketing, water re-use proposals.

UWMP item	Deliverable	Included?	Location in text
Executive summary			
Development design elements and compliance with design objectives	Table 1: Design elements & compliance	✓	Executive Summary
Key design requirements for detailed design – critical control points and elements	Table 2: Design requirements for critical control points		
Introduction and planning approval			
Location plan, adjoining lots, key landscape features and roads. Local Water Management Strategy. Structure plan, zoning and land use. Subdivision plan and/or approval	Location plan, site context plan, subdivision layout plan or combination of above	✓	Section 1, Figure 2
Design objectives			
Agreed design objectives and source of objective		✓	Section 2
Site characteristics			
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		✓	Section 3
Site Conditions - existing topography/ contours, aerial photo underlay, major physical features	Site condition plan	✓	Section 3.2, Figure 3
Geotechnical - topography, test pit locations, soil zones and descriptions, site classification zones, proposed earthworks and approximate finished contour levels	Geotechnical plan	✓	Section 3.3, Figure 4
Environmental - sensitive or significant vegetation areas, wetlands and buffers, waterways and buffers, contaminated sites	Environmental Plan plus supporting data where appropriate	✓	Sections 3.5 - 3.7, Figures 5 and 7.
Surface Water – topography, 100 year floodways and flood fringe areas, 100 year proposed flow paths, water quality of flows entering and leaving (if applicable)	Surface Water Plan	✓	Section 3.4.1, Figure 5
Groundwater – topography, test bore locations, groundwater pre development, groundwater post development, water quality details, groundwater variation hydrograph	Groundwater Plan plus details of groundwater monitoring and testing	✓	Section 3.4.2, Figure 6.
Landscape - proposed public open space areas, water source, bore(s), lake details (if applicable), approx watering requirements and water balance, indicative irrigation schedule. Demonstrate compliance with DoW Constructed Lakes Position Statement if applicable	Landscaping plan	✓	Section 3.9
Water use sustainability initiatives			
Water supply & efficiency measures		✓	Section 4
Fit-for-purpose strategy and agreed actions. If non-potable supply, support with water balance		✓	Section 4
Wastewater management		✓	Section 4.3

UWMP item	Deliverable	Included?	Location in text
Stormwater and groundwater management design			
Flood protection - peak flow rates, top water levels at control points,100 year flow paths - floodways and flood fringe zones and/or along roads and reserves, 100 year inundation areas and volumes	100yr event Plan Long section of critical points	✓	Section 5.2.3, Figure 13
Stormwater management system - storage areas, flows and hydraulic grade lines for both major and minor events including controlling inverts (critical control points). Locations and arrangements for agreed structural and non-structural best management practices and treatment trains supported by sizing criteria, areas of inundation, flow paths and cross sections. Show integration with landscaping	1yr event Plan 5yr event Plan Typical cross sections	✓	Sections 5.2 and 5.3, Figures 10-13
Post development groundwater levels and fill requirements (including existing and final surface levels), outlet controls, and any subsoils (showing drawdown/impacts near sensitive environments). Describe modelling assumptions.	Groundwater/subsoil Plan Typical cross section (max and minimum)	✓	Section 5.2, Figure 9
Actions to address acid sulfate soils or contamination		N/A	No risk of ASS or contamination on site
Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages		✓	Sections 3.5 – 3.7
Management of disease vector and nuisance insects		✓	Section 3.9
Management of subdivisional works			
Management of construction activities including dewatering, acid sulfate soils, constructed best management practices, and dust, sediment and erosion control – timing and possible staging		✓	Section 6
Monitoring program			
Sampling and assessment plan including duration and arrangements for ongoing actions		✓	Section 7.1
Implementation plan			
Roles, responsibilities, funding for implementation		✓	Section 8
Maintenance arrangements as agreed		✓	Section 7.2
Assessment and review		✓	Section 8

Appendix 2 Geotechnical Report

Douglas Partners
Geotechnics • Environment • Groundwater

Integrated Practical Solutions

REPORT
ON
PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL SUBDIVISION
LOTS 19 – 21 OLD COAST ROAD
LAKE CLIFTON, WA

Prepared for
TONY SCOLARO FAMILY TRUST

Project 76038
August 2010

Douglas Partners
Geotechnics • Environment • Groundwater

REPORT
ON
PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL SUBDIVISION
LOTS 19 – 21 OLD COAST ROAD
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RDS:DR
Project: 76038
18 August 2010

REPORT ON PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL SUBDIVISION
LOTS 19 – 21 OLD COAST ROAD, LAKE CLIFTON, WA

1. INTRODUCTION

This report presents the results of a geotechnical investigation undertaken for a proposed residential subdivision at Lots 19 - 21 Old Coast Road, Lake Clifton. This investigation was commissioned in a fax dated 18 June 2010 by Hamish Beck of Beck Advisory on behalf of Tony Scolaro Family Trust and was undertaken in accordance with Douglas Partners' proposal dated 12 May 2010.

The purpose of the investigation is to assess the sub surface conditions beneath the site and thus provide factual information on:

- the ground conditions encountered during the investigation;
- depth to groundwater, if encountered at the time of the investigation;
- depth to limestone, if encountered; and
- the nutrient retention capacity of the soils.

Details of the field work and laboratory testing are presented in this report.

2. SITE DESCRIPTION

The site comprises a rectangular shaped area of approximately 17.3 ha. It is bounded by Old Coast Road to the east, vacant land to the north and south and Lake Clifton to the west of the (Refer to Drawing 1, Appendix A).

At the time of the investigation the site generally comprised vacant land covered with grass, small shrubs and large trees. A small caravan park, a petrol station and a few residential houses occupy the central portion of the site. Limestone outcrop was observed in many locations.

The site is generally flat with surface levels of between RL 2 m and 5 m AHD, and two high points at around RL 8 m to 10 m AHD in the north-western and south-western corners.

The Lake Clifton–Hamel 1:50 000 Environmental Geology sheet indicates that shallow sub surface conditions beneath the site comprise sand derived from Tamala Limestone overlying limestone, possibly at shallow depth.

3. FIELD WORK METHODS

Field work was carried out on 16 July 2010 and comprised the excavation of eight test pits (TP1 to TP8) and 5 boreholes (BH9 to BH13).

The test pits were excavated using a Komatsu 5 tonne excavator equipped with a 600 mm toothed bucket. The boreholes were drilled using a 110 mm diameter hand auger. Each test location was logged in general accordance with AS1726 – 1993 by a suitably experienced representative from Douglas Partners. Representative soil samples were recovered from selected locations for subsequent laboratory testing. Perth Sand Penetrometer (PSP) tests were carried out adjacent to selected test locations in accordance with AS1289.6.3.3 to assess the *in situ* conditions of the shallow soils.

All test locations were determined using existing site features and are shown on Drawing 1, Appendix A. Surface elevations at each test location were interpolated from a contour plan provided by the client and are quoted in metres above Australian Height Datum (AHD).

4. FIELD WORK RESULTS

4.1 Ground Conditions

Detailed logs of the ground conditions and results of the field testing are presented in Appendix B, together with notes defining descriptive terms and classification methods.

The ground conditions encountered at the test locations generally comprise topsoil overlying sand and limestone. A summary of the conditions encountered is provided below:

TOPSOIL - dark grey silty sandy topsoil with rootlets to depths of between 0.1 m and 0.2 m;

SAND - generally medium dense, orange-brown sand with a trace of silt to depths of between 0.3 m and 1.1 m; and

LIMESTONE - low to medium strength, light yellowish brown limestone underlying the sand at all test locations to the depth of investigation.

The depths below existing surface level and relative levels of the top of the limestone at each test location are summarised in Table 1, below.

Table 1 – Summary of Limestone Depths and Levels

Test Location	Interpolated Surface Level (m AHD)	Depth to Top of Limestone (m)	Interpolated Level of Top of Limestone (m AHD)
TP1	6.0	0.6	5.4
TP2	2.8	0.6	2.2
TP3	5.0	0.4	4.6
TP4	3.2	0.3	2.9
TP5	2.4	1.1	1.3
TP6	5.9	0.8	5.1
TP7	4.8	0.4	4.4
TP8	3.0	0.4	2.6
BH9	3.2	0.4	2.8
BH10	2.6	0.4	2.2
BH11	3.2	0.6	2.6
BH12	3.5	0.7	2.8
BH13	2.7	0.5	2.2

4.2 Groundwater

No free groundwater was observed within any of the test pits or boreholes on 16 July 2010 to RL 0.9 m AHD.

5. LABORATORY TESTING RESULTS

A geotechnical laboratory testing programme was carried out by a NATA registered laboratory and comprised the determination of the particle size distribution on two sand samples and the point load index on five irregular lump samples of limestone.

The results of the testing are summarised in Table 2 and test certificates are presented in Appendix C.

Table 2 – Summary of Geotechnical Laboratory Test Results

Test	Depth (m)	Soil Type	% fines	d_{10} (mm)	d_{60} (mm)	Is50 (MPa)
TP1	0.7	LIMESTONE – light yellow-brown	-	-	-	1.23
TP2	0.8	LIMESTONE – light yellow-brown	-	-	-	0.24
TP4	0.4	LIMESTONE – light yellow-brown	-	-	-	0.74
TP5	1.2	LIMESTONE – light yellow-brown	-	-	-	0.32
TP8	0.8	LIMESTONE – light yellow-brown	-	-	-	0.35
BH9	0.3	SAND – orange-brown	3	0.08	0.22	-
BH12	0.5	SAND – orange-brown	4	0.08	0.19	-

Notes:
- The %Fines is the amount of particles smaller than 75 µm;
- A d_{10} of 0.10 mm means that 10 % of the sample particles are finer than 0.10 mm;
- A d_{60} of 0.38 mm means that 60 % of the sample particles are finer than 0.38 mm;
- Is50: Point load index; and
- '-' means not tested.

A suite of chemical analyses was also undertaken on five selected samples by a NATA registered laboratory and comprised the determination of:

- pH;
- electrical conductivity;
- cation exchange capacitys; and
- phosphorus retention indexs.

The results of the testing are summarised in Table 3 and test certificates are presented in Appendix C.

Table 3 – Summary of Chemical Laboratory Test Results

Test	Depth (m)	Soil Type	pH	EC (µS/cm)	PRI (mL/g)	CEC (meq/100g)
TP1	0.5	SAND – orange-brown	6.4	1,400	11	2.9
TP4	0.2	SAND – orange-brown	7.3	1,500	18	4.3
TP7	0.3	SAND – orange-brown	7.4	1,600	9.2	2.4
BH11	0.2	SAND – orange-brown	7.2	1,500	7.8	9.5
BH13	0.5	SAND – orange-brown	7.4	1,200	19	7.7

Notes:
- EC: Electrical conductivity;
- PRI: Phosphorus retention index;
- CEC: Cation exchange capacity.

6. LIMITATIONS

Douglas Partners (DP) has prepared the factual report for this project at Lots 19 – 21 Old Coast Road, Lake Clifton in accordance with DP's proposal dated 12 May 2010 and acceptance received from Tony Scolaro Family Trust dated 18 June 2010. This report is provided for the exclusive use of Tony Scolaro Family Trust for the specific project and purpose as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party.

The results provided in the report are considered to be indicative of the sub-surface conditions on the site only to the depths investigated at the specific sampling and/or testing locations, and only at the time the work was carried out. Actual ground conditions and materials behaviour observed or inferred at the test locations may differ from those which may be encountered elsewhere on the site.

This report must be read in conjunction with the attached "Notes Relating to This Report" and any other attached explanatory notes and should be kept in its entirety without separation of

individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others which are not supported by an expressed statement, interpretation, outcome or conclusion stated in this report. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

7. REFERENCES

Australian Standard AS 1289-2000, Methods of Testing Soils for Engineering Purposes

Australian Standard AS 1289.6.3.3-1999, Soil Strength and Consolidation Tests-Determination of the Penetration Resistance of a Soil – Perth Sand Penetrometer Test.

Australian Standard AS 1726-1996, Geotechnical Site Investigation.

DOUGLAS PARTNERS PTY LTD

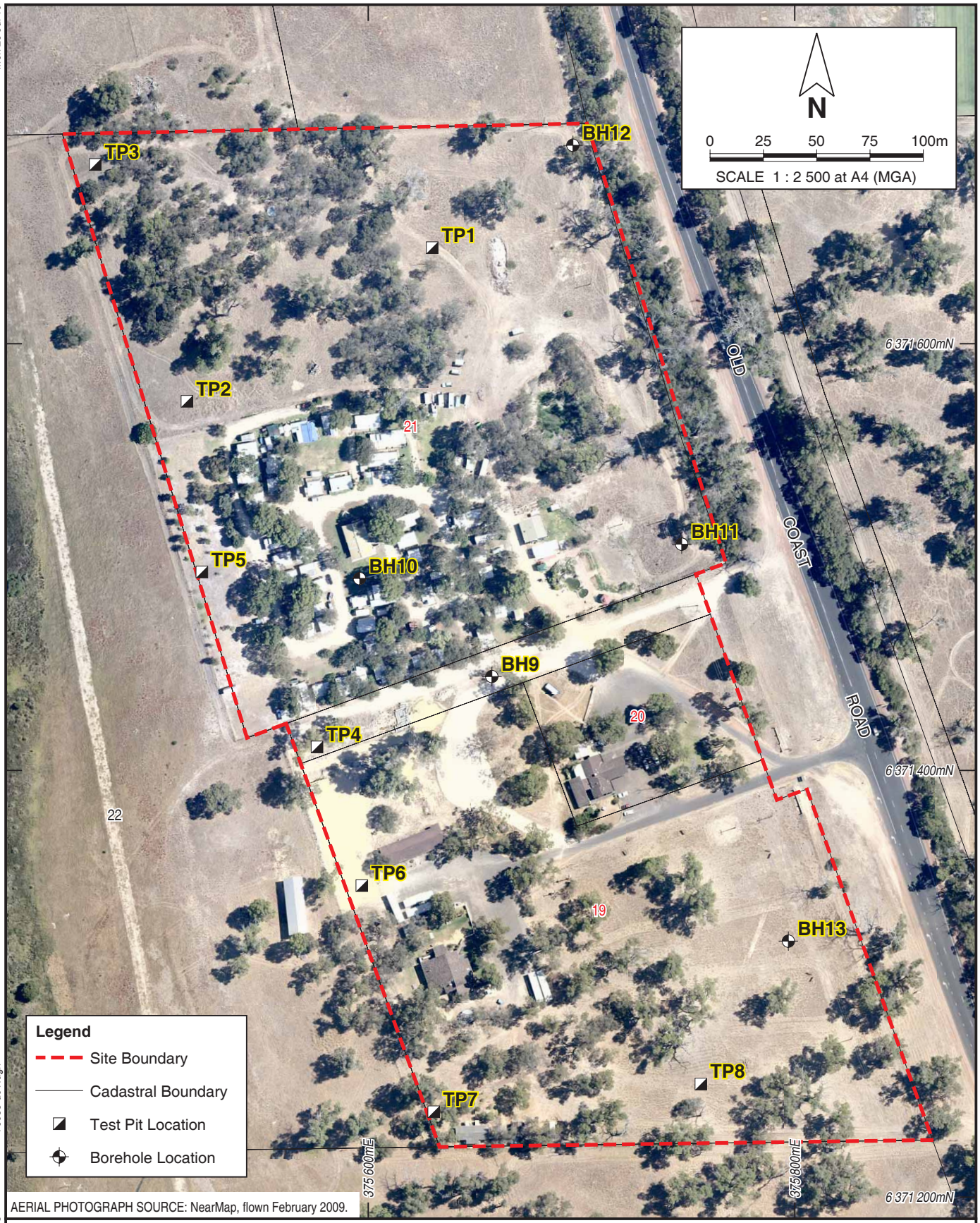
Reviewed by:

Daniel Reaveley
Geo-Environmental Scientist

pp Michael J Thom
Principal

APPENDIX A

Site Plan and Test Locations



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Brisbane, Cairns, Canberra, Darwin, Gold Coast, Melbourne, Minto

Newcastle, Perth, Sydney Sunshine Coast, Townsville, Wollongong, Wyong

Title: LOTS 19-21 OLD COAST ROAD, LAKE CLIFTON

TEST LOCATION PLAN

Client: TONY SCOLARO FAMILY TRUST				Office: PERTH	
Drawn By: R. DA SILVA	Scale: 1 : 2 500	Project No: 76038		DRAWING 1	Revision: A
Approved By: --		Date: 26-07-10			

Mon 26 Jul 10

76038-d01.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

APPENDIX B

Results of Field Work

Notes Relating to this Report

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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in

clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

  as 4, 6, 7
  N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

  as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

q_c (MPa) = (0.4 to 0.6) N (blows per 300 mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

q_c = (12 to 18) c_u

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section

is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 2.8 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 2
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.2	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.							
	0.6	LIMESTONE - low strength, light yellow-brown limestone.		D	0.8				
	0.9	Pit discontinued at 0.9m (due to slow progress)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 5.0 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 3
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.2	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.							
	0.4	LIMESTONE - low to medium strength, light yellow-brown limestone.		D	0.6				
4	0.9	Pit discontinued at 0.9m (due to refusal)							1
	1								

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▽ Water level

CHECKED	
Initials:	
Date:	19.8.10

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TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 3.2 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 4
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.15	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.		D	0.2				
	0.3	LIMESTONE - low to medium strength, light yellow-brown limestone.		D	0.4				
	0.5	Pit discontinued at 0.5m (due to refusal)							

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 16.8.10

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TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 2.4 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 5
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.15	SAND - medium dense, grey mottled dark grey, fine to medium grained, humid sand with some silt.							
2		- becoming light grey with some shells from 0.6m.							
		- becoming light grey from 0.9m.							
1				D	1.0				1
	1.1	LIMESTONE - low to medium strength, very light yellow-brown limestone.							
				D	1.2				
	1.5	Pit discontinued at 1.5m (due to slow progress)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

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TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 5.9 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 6
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
5	0.8	FILLING (SAND) - medium dense, light orange-brown, fine to medium grained, humid sand with trace of silt.							1
	1	LIMESTONE - low strength, light yellow-brown limestone.							
4	1.4	Pit discontinued at 1.4m (due to slow progress)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: R
Date: 14.8.10

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TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 4.8 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 7
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.2	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.		D	0.3				1
4	0.4	LIMESTONE - low to medium strength, light yellow-brown limestone with some sand infill to 1.8m.							
	1			D	1.2				1
3	1.8	Pit discontinued at 1.8m (due to slow progress)							

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

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TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 3.0 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 8
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.2	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.							
	0.4	LIMESTONE - low to medium strength, light yellow-brown limestone with some sand infill to 1.0m.		D	0.8				
~1	1.0	Pit discontinued at 1.0m (due to slow progress)							1

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

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BOREHOLE LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 2.6 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH 10
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	TOPSOIL - dark grey, silty sandy topsoil.							
		SAND - orange-brown, fine to medium grained, humid sand with some silt.		D	0.3				
	0.4	Bore discontinued at 0.4m (due to refusal on limestone)							

RIG: 110mm Hand Auger **DRILLER:** R Da Silva **LOGGED:** R Da Silva **CASING:**
TYPE OF BORING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

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BOREHOLE LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 3.2 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH 11
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
		TOPSOIL - dark grey, silty sandy topsoil.							
	0.1	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt and charcoal fragments.		D	0.2				
3									
	0.6	Bore discontinued at 0.6m (due to refusal on limestone)							
2	1								1

RIG: 110mm Hand Auger
DRILLER: R Da Silva
LOGGED: R Da Silva
CASING:

TYPE OF BORING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED	
Initials:	
Date:	16.8.10

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BOREHOLE LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 3.5 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH 12
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
3	0.1	TOPSOIL - dark grey, silty sandy topsoil.							
		SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.		D	0.5				
	0.7	Bore discontinued at 0.7m (due to refusal on limestone)							
2	1								1

RIG: 110mm Hand Auger **DRILLER:** R Da Silva **LOGGED:** R Da Silva **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: M
Date: 19.8.10

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BOREHOLE LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 2.7 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH 13
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	TOPSOIL - dark grey, silty sandy topsoil.							
		SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.							
	0.5	Bore discontinued at 0.5m (due to refusal on limestone)		D	0.5				

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 110mm Hand Auger **DRILLER:** R Da Silva **LOGGED:** R Da Silva **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

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BOREHOLE LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 3.2 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH 9
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
3	0.2	TOPSOIL - dark grey, silty sandy topsoil.							
		SAND - orange-brown, fine to medium grained, humid sand with some silt.		D	0.3				
	0.4	Bore discontinued at 0.4m (due to refusal on limestone)							
2	1								1

RIG: 110mm Hand Auger **DRILLER:** R Da Silva **LOGGED:** R Da Silva **CASING:**
TYPE OF BORING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.7.10

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TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 6.0 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 1
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.15	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.		D	0.5				
	0.6	LIMESTONE - medium strength, light yellow-brown limestone.		D	0.7				
	0.9	Pit discontinued at 0.9m (due to refusal)							
5	1								1

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: AL
Date: 19.8.10

Douglas Partners
Geotechnics · Environment · Groundwater

APPENDIX C

Laboratory Testing Results

Point Load Strength Index
AS 4133.4.1

Mining and Civil Geotest Pty Ltd
Unit 1, No. 1 Pusey Road
Jandakot WA 6164

Client:	Tony Scalaro Family Trust	Report No.	60017-P10/1838-1842
Project:	Lots 19-21 Old Coast Road	Date Tested:	30/07/2010
Location:	Lake Clifton	Tested By:	S Sandilands
Date of Sampling and Sampling Method:	Tested as received	Client No.:	60017

Sample No. P10/	Sample	Rock Type	Moisture	Test Type	L (mm)	W (mm)	D (mm)	P (kN)	Is (MPa)	Is50 (MPa)	Remarks
1838	TP 1, 0.7m	Limestone	M	L	70	85	40	4.69	1.08	1.23	
1839	TP 2, 0.8m	Limestone	M	L	60	100	41	1.05	0.20	0.24	
1840	TP 4, 0.4m	Limestone	M	L	80	140	46	4.67	0.57	0.74	
1841	TP 5, 1.2m	Limestone	M	L	90	100	50	1.63	0.26	0.32	
1842	TP 8, 0.8m	Limestone	M	L	100	100	48	1.73	0.28	0.35	

Comments

KEY:

Moisture	**Test Type**
D - Dry	L - Lump
M - Moist	A - Axial
W - Wet	D - Diametral

Approved Signatory :

Kevin M Jones

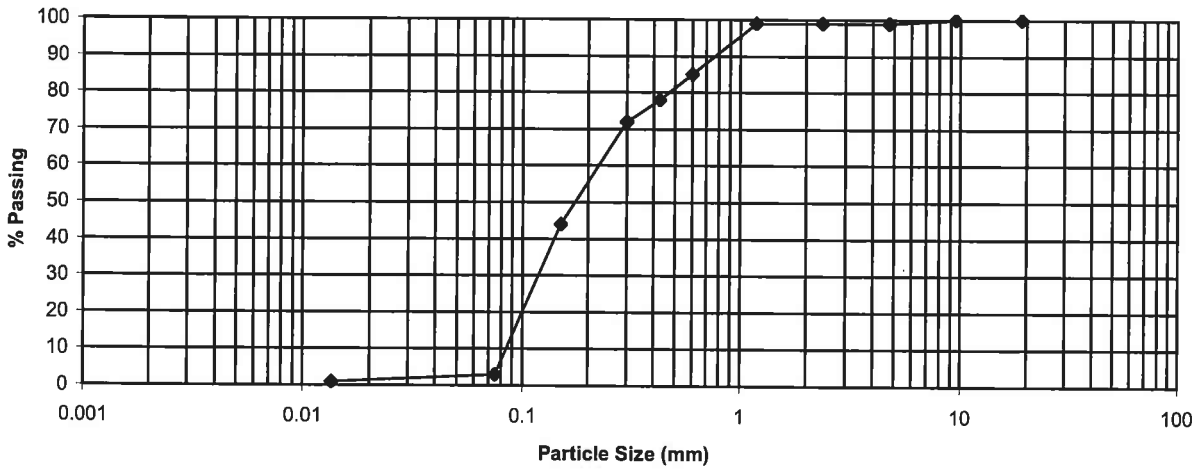
C:\Laboratory\Reports\Douglas 60017\60017-P10.1838-1842 PLI.xls

Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P10/1843**
Sample No:	**P10/1843**
Issue Date:	**30 July 2010**
Sample Location:	**BH 9**
Depth (m):	**0.3**

Client: **Tony Scolaro Family Trust**
Project: **Lots 19 - 21 Old Coast Road**
Location: **Lake Clifton**



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	100
9.5	100
4.75	99
2.36	99
1.18	99
0.600	85
0.425	78
0.300	72
0.150	44
0.075	3
0.0135	1

Plasticity index tests
Australian Standard 1289.

Liquid limit 3.1.1	na	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

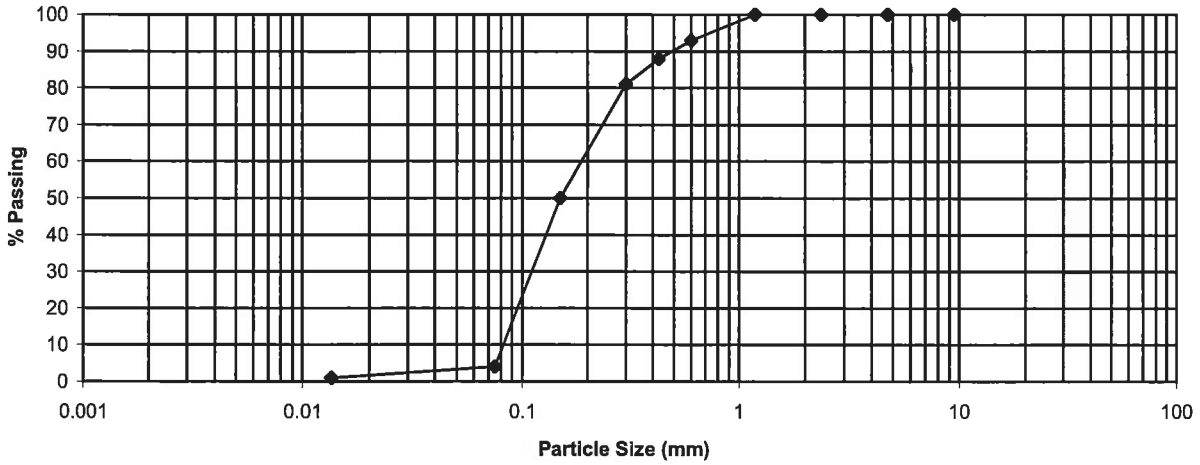
Approved signature

Kevin M Jones

Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

		Job No:	**60017**
		Report No:	**60017-P10/1844**
		Sample No:	**P10/1844**
		Issue Date:	**30 July 2010**
Client:	**Tony Scolaro Family Trust**	Sample Location:	**BH 12**
Project:	**Lots 19 - 21 Old Coast Road**	Depth (m):	**0.5**
Location:	**Lake Clifton**		



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	100
4.75	100
2.36	100
1.18	100
0.600	93
0.425	88
0.300	81
0.150	50
0.075	4
0.0135	1

Plasticity index tests
Australian Standard 1289.

Liquid limit 3.1.1	na	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Kevin M Jones

mpl Laboratories
Part of the Envirolab Group ENVIROLAB GROUP

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PO Box 4023 Myaree BC, Western Australia 6960
Tel: +61 8 9317 2505 / Fax: +61 8 9317 4163
email: laboratory@mpl.com.au
www.envirolabservices.com.au
Envirolab Services (WA) Pty Ltd ABN 53 140 099 207

CERTIFICATE OF ANALYSIS 104222

Client:
Douglas Partners Perth
36 O'Malley St
Osbourne Park
WA 6017

Attention: Rob Shapland

Sample log in details:

Your Reference:	**76038, Lot 19-21 Old Coast Rd**
No. of samples:	5 Soils
Date samples received:	21/7/10
Date completed instructions received:	21/7/10
Location:	Lake Clifton

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	2/08/10
Date of Preliminary Report:	Not issued
Issue Date:	2/08/10

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Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Joshua Lim
Reporting Supervisor

Miscellaneous Inorg - soil						
Our Reference:	UNITS	104222-1	104222-2	104222-3	104222-4	104222-5
Your Reference	----------	TP1	TP4	TP7	BH11	BH13
Depth	----------	0.5	0.2	0.3	0.2	0.5
Date Sampled		16/07/2010	16/07/2010	16/07/2010	16/07/2010	16/07/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/7/10	27/7/10	27/7/10	27/7/10	27/7/10
Date analysed	-	27/7/10	27/7/10	27/7/10	27/7/10	27/7/10
pH 1:5 soil:water	pH Units	6.4	7.3	7.4	7.2	7.4
Electrical Conductivity soil	µS/cm	1,400	1,500	1,600	1,500	1,200
Phosphorus Retention Index	mL/g	11	18	9.2	7.8	19

ESP/CEC Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	104222-1 TP1 0.5 16/07/2010 Soil	104222-2 TP4 0.2 16/07/2010 Soil	104222-3 TP7 0.3 16/07/2010 Soil	104222-4 BH11 0.2 16/07/2010 Soil	104222-5 BH13 0.5 16/07/2010 Soil
Exchangeable Ca*	meq/100g	2.6	4.0	1.8	8.9	7.1
Exchangeable K*	meq/100g	0.08	0.05	0.09	0.08	0.03
Exchangeable Mg*	meq/100g	0.21	0.20	0.33	0.40	0.43
Exchangeable Na*	meq/100g	0.05	0.06	0.18	0.06	0.08
Cation Exchange Capacity*	meq/100g	2.9	4.3	2.4	9.5	7.7

Method ID	Methodology Summary
WILAB.5A	pH - Measured using pH meter and electrode in accordance with APHA 21st ED, 4500-H+.
WILAB.5A	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA2510 21st ED and Rayment & Higginson.
Ext-028	Subcontracted to Chemistry Centre (WA)
Ext-054	Analysed by Envirolab Services Sydney, accreditation number 2901

Client Reference: 76038, Lot 19-21 Old Coast Rd

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/7/10	104222-1	27/7/10 || 27/7/10	LCS	27/7/10
Date analysed	-			27/7/10	104222-1	27/7/10 || 27/7/10	LCS	27/7/10
pH 1:5 soil:water	pH Units		WILAB.5A	[NT]	104222-1	6.4 || 6.4 || RPD: 0	LCS	99%
Electrical Conductivity soil	µS/cm	1	WILAB.5A	<1.0	104222-1	1400 || [N/T]	LCS	96%
Phosphorus Retention Index	mL/g		Ext-028	[NT]	104222-1	11 || [N/T]	[NR]	[NR]
QUALITY CONTROL ESP/CEC	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Exchangeable Ca*	meq/100 g	0.01	Ext-054	<0.01	104222-1	2.6 || 2.6 || RPD: 0	LCS	95%
Exchangeable K*	meq/100 g	0.01	Ext-054	<0.01	104222-1	0.08 || 0.07 || RPD: 13	LCS	96%
Exchangeable Mg*	meq/100 g	0.01	Ext-054	<0.01	104222-1	0.21 || 0.21 || RPD: 0	LCS	92%
Exchangeable Na*	meq/100 g	0.01	Ext-054	<0.01	104222-1	0.05 || 0.06 || RPD: 18	LCS	86%
Cation Exchange Capacity*	meq/100 g	1	Ext-054	<1.0	104222-1	2.9 || 2.9 || RPD: 0	[NR]	[NR]

Report Comments:

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform & E.coli levels are less than 1cfu/100mL.
The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC& ARMC 2004.

Asbestos was analysed by Approved Identifier: Not applicable for this job
Airborne fibres were analysed by Approved Counter: Not applicable for this job

INS: Insufficient sample for this test; NT: Not tested; PQL: Practical Quantitation Limit; <: Less than; >: Greater than
RPD: Relative Percent Difference; NA: Test not required; LCS: Laboratory Control Sample; NR: Not requested
NS: Not specified; NEPM: National Environmental Protection Measure
DOL: Sample rejected due to particulate overload

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however were analysed at a frequency to meet of exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD a matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spike and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and Speciated Phenols is acceptable.
Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.

Appendix 3 Groundwater Monitoring Results

Results of water level sampling - Lake Clifton

Depth to groundwater (m bTOC)

Site	8/04/2010	25/06/2010	2/09/2010	18/11/2010	24/02/2011	30/05/2011	30/08/2011
MB01	5.05	4.9	4.74	4.81	5.06	4.95	4.68
MB02	3.43	3.28	3.12	3.25	3.44	3.33	3.05
MB03	7.13	6.95	6.83	6.95	7.14	7.04	6.75
MB04	3.09	2.94	2.77	2.95	3.1	3	2.7
MB05	4.19	4.05	3.89	4.18	4.21	4.11	3.82
MB06	3.57	3.42	3.26	3.39	3.58	3.48	3.19

Surveyed top of casing levels

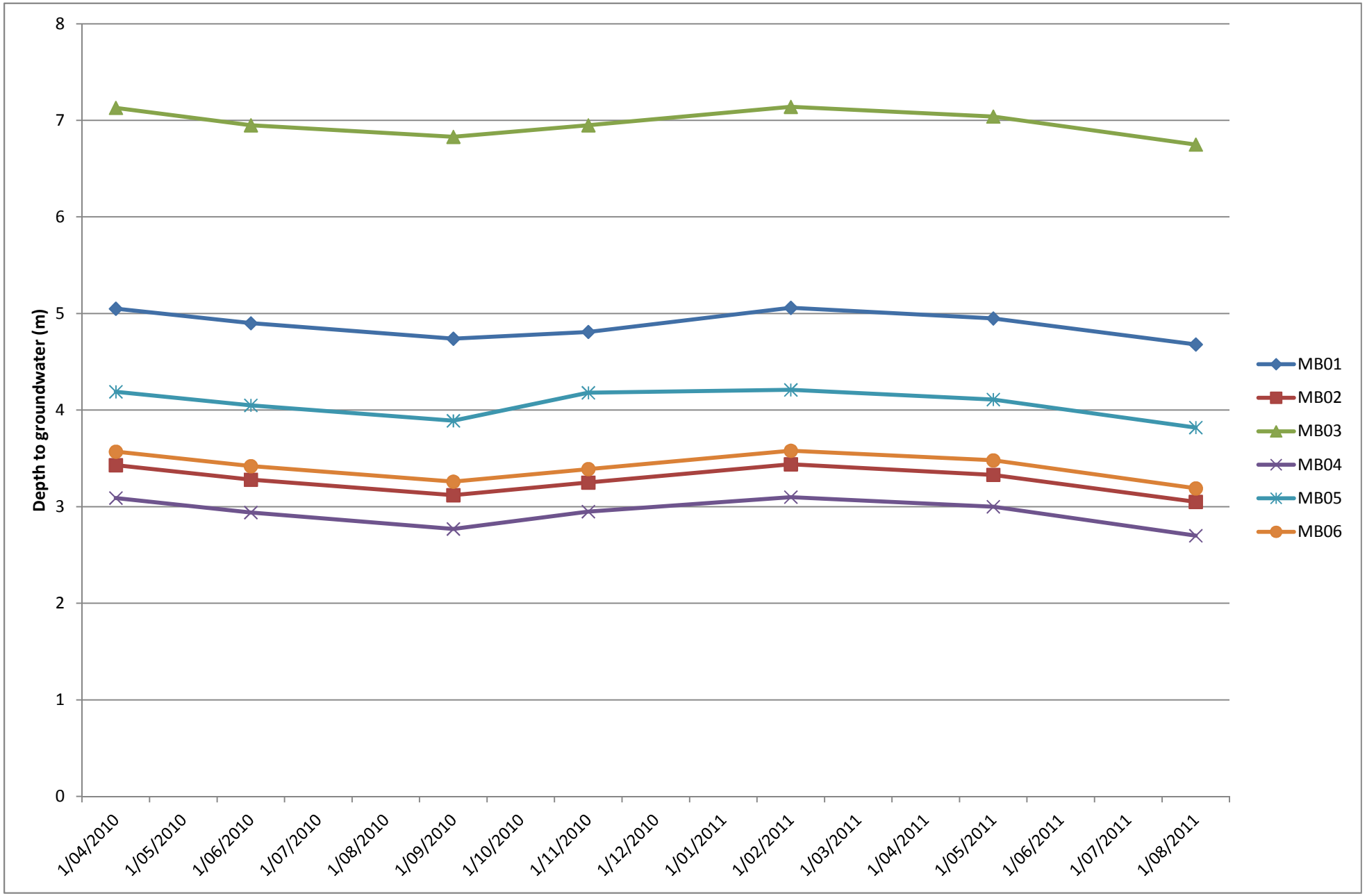
Location ID	Lake Clifton MB01	Lake Clifton MB02	Lake Clifton MB03	Lake Clifton MB04	Lake Clifton MB05	Lake Clifton MB06
AHD (m) T.O.C.	5.071	3.441	7.151	3.104	4.226	3.614
Ground level	4.471	2.841	6.551	2.504	3.626	3.014

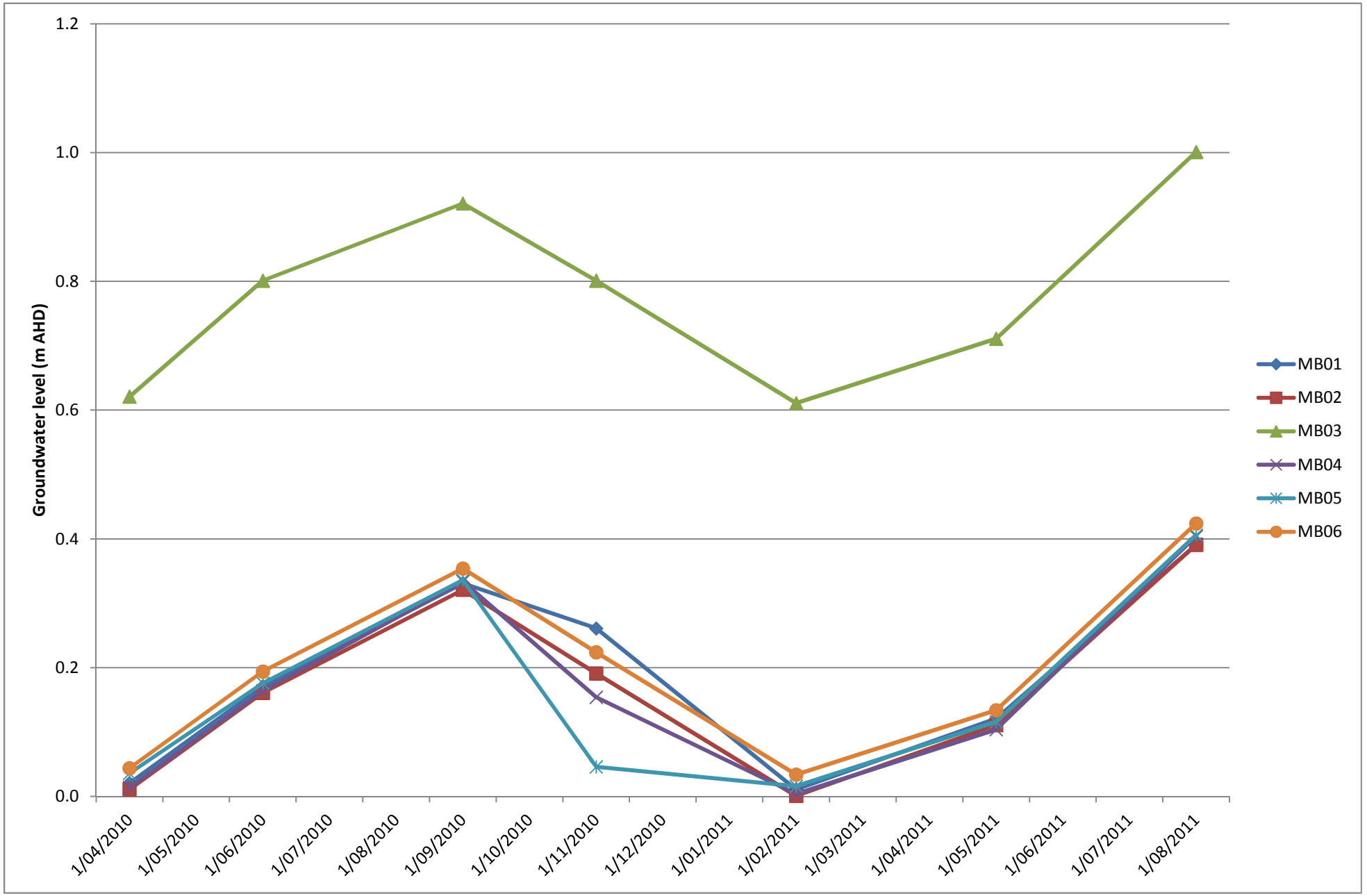
Depth to groundwater (m bgl)

Site	8/04/2010	25/06/2010	2/09/2010	18/11/2010	24/02/2011	30/05/2011	30/08/2011
MB01	4.45	4.3	4.14	4.21	4.46	4.35	4.08
MB02	2.83	2.68	2.52	2.65	2.84	2.73	2.45
MB03	6.53	6.35	6.23	6.35	6.54	6.44	6.15
MB04	2.49	2.34	2.17	2.35	2.5	2.4	2.1
MB05	3.59	3.45	3.29	3.58	3.61	3.51	3.22
MB06	2.97	2.82	2.66	2.79	2.98	2.88	2.59

Groundwater level (m AHD)

Site	8/04/2010	25/06/2010	2/09/2010	18/11/2010	24/02/2011	30/05/2011	30/08/2011
MB01	0.021	0.171	0.331	0.261	0.011	0.121	0.391
MB02	0.011	0.161	0.321	0.191	0.001	0.111	0.391
MB03	0.621	0.801	0.921	0.801	0.611	0.711	1.001
MB04	0.014	0.164	0.334	0.154	0.004	0.104	0.404
MB05	0.036	0.176	0.336	0.046	0.016	0.116	0.406
MB06	0.044	0.194	0.354	0.224	0.034	0.134	0.424


Depth to groundwater (m)
8
7
6
5
4
3
2
1
0
1/04/2010
1/05/2010
1/06/2010
1/07/2010
1/08/2010
1/09/2010
1/10/2010
1/11/2010
1/12/2010
1/01/2011
1/02/2011
1/03/2011
1/04/2011
1/05/2011
1/06/2011
1/07/2011
1/08/2011
MB01
MB02
MB03
MB04
MB05
MB06

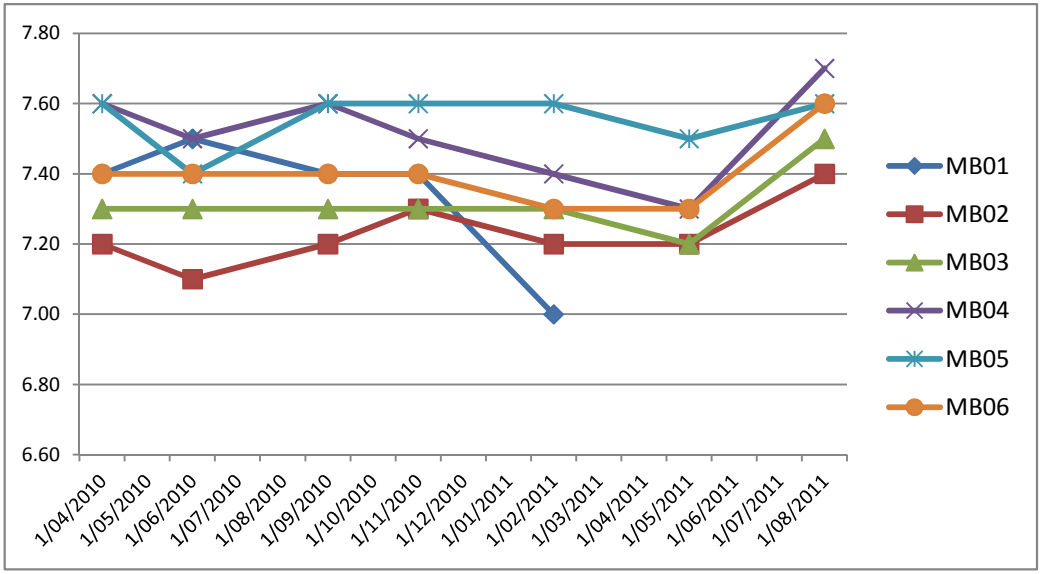

Groundwater level (m AHD)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/04/2010
1/05/2010
1/06/2010
1/07/2010
1/08/2010
1/09/2010
1/10/2010
1/11/2010
1/12/2010
1/01/2011
1/02/2011
1/03/2011
1/04/2011
1/05/2011
1/06/2011
1/07/2011
1/08/2011
MB01
MB02
MB03
MB04
MB05
MB06

Surveyed bore locations and heights

			GDA94 (MGA50)										
Location	**ID**	**Description**	**Easting (m)**	**Horizontal Accuracy (m)**	**Northing (m)**	**Horizontal Accuracy (m)**	**Vertical Accuracy (m)**	**AHD (m) T.O.C.**	**Height Pipe A.G.L. (m)**	**Surface Elevation (m)**	**SWL (m)**	**RWL (m)**	**Notes**
Lake Clifton	MB01	Piezometer	375483.683	0.010	6371635.304	0.010	0.010	5.071	0.600	4.471		5.071	
Lake Clifton	MB02	Piezometer	375534.000	5.000	6371459.000	5.000	0.010	3.441	0.600	2.841		3.441	Spirit Levelled. XY = Handheld.
Lake Clifton	MB03	Piezometer	375604.389	0.010	6371323.061	0.010	0.010	7.151	0.600	6.551		7.151	
Lake Clifton	MB04	Piezometer	375836.090	0.010	6371243.177	0.010	0.010	3.104	0.600	2.504		3.104	
Lake Clifton	MB05	Piezometer	375751.155	0.010	6371541.084	0.010	0.010	4.226	0.600	3.626		4.226	
Lake Clifton	MB06	Piezometer	375710.093	0.010	6371676.233	0.010	0.010	3.614	0.600	3.014		3.614	

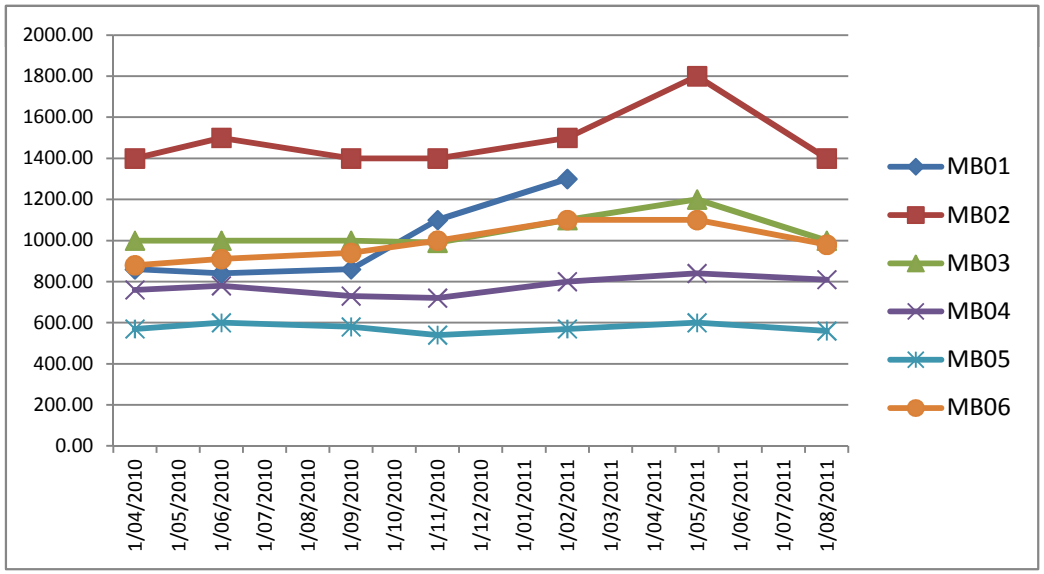
pH

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	7.40	7.20	7.30	7.60	7.60	7.40
25/06/2010	7.50	7.10	7.30	7.50	7.40	7.40
2/09/2010	7.40	7.2	7.3	7.6	7.6	7.4
18/11/2010	7.4	7.3	7.3	7.5	7.6	7.4
24/02/2011	7	7.2	7.3	7.4	7.6	7.3
1/05/2011		7.2	7.2	7.3	7.5	7.3
31/08/2011		7.4	7.5	7.7	7.6	7.6
Max	7.50	7.40	7.50	7.70	7.60	7.60
Min	7.00	7.10	7.20	7.30	7.40	7.30
Median	7.40	7.20	7.30	7.50	7.60	7.40



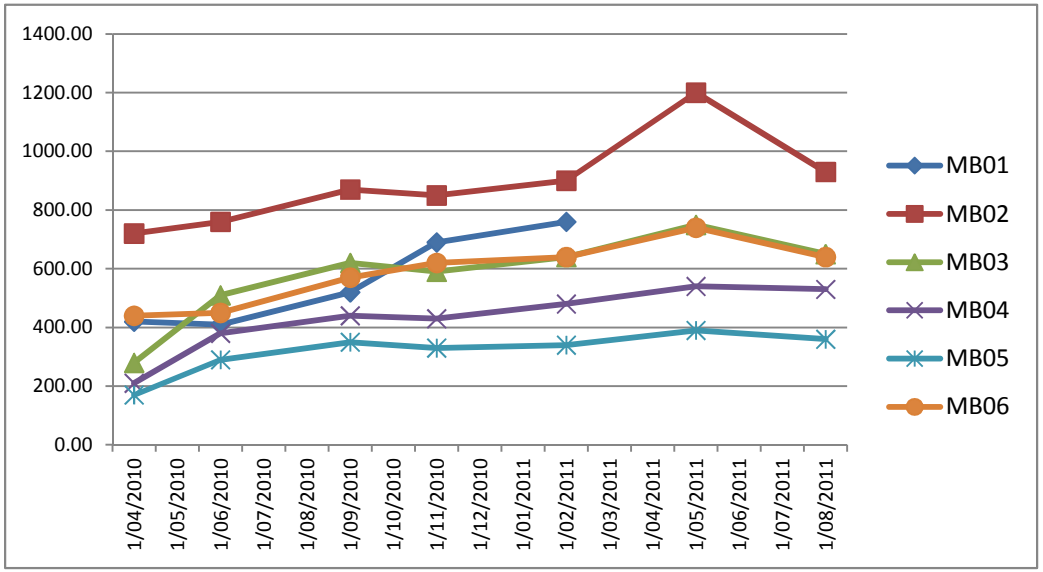
Conductivity (us/cm)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	860.00	1400.00	1000.00	760.00	570.00	880.00
25/06/2010	840.00	1500.00	1000.00	780.00	600.00	910.00
2/09/2010	860.00	1400	1000	730	580	940
18/11/2010	1100	1400	990	720	540	1000
24/02/2011	1300	1500	1100	800	570	1100
1/05/2011		1800	1200	840	600	1100
31/08/2011		1400	1000	810	560	980
Max	1300	1800	1200	840	600	1100
Min	840	1400	990	720	540	880
Median	860	1400	1000	780	570	980



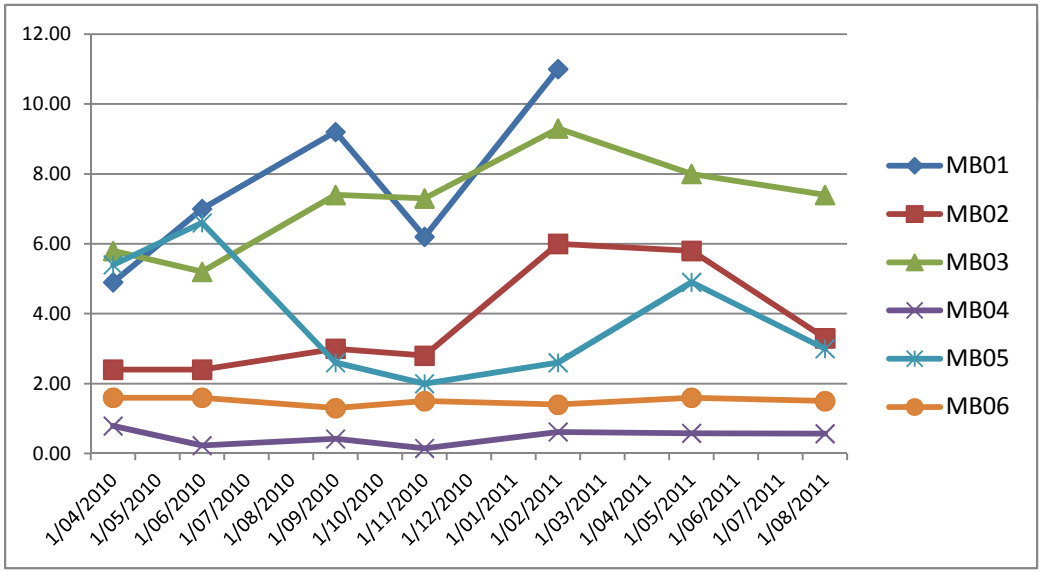
TDS (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	420.00	720.00	280.00	210.00	170.00	440.00
25/06/2010	410.00	760.00	510.00	380.00	290.00	450.00
2/09/2010	520.00	870	620	440	350	570
18/11/2010	690	850	590	430	330	620
24/02/2011	760	900	640	480	340	640
1/05/2011		1200	750	540	390	740
31/08/2011		930	650	530	360	640
Max	760	1200	750	540	390	740
Min	410	720	280	210	170	440
Median	520	870	620	440	340	620



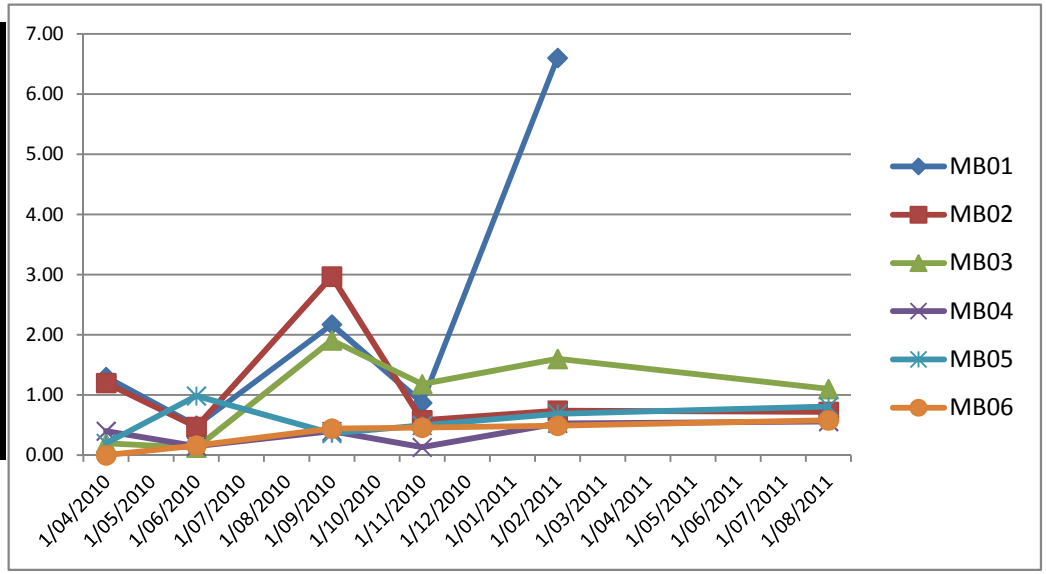
Total Nitrogen (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	4.90	2.40	5.80	0.79	5.40	1.60
25/06/2010	7.00	2.40	5.20	0.23	6.60	1.60
2/09/2010	9.20	3	7.4	0.42	2.6	1.3
18/11/2010	6.2	2.8	7.3	0.15	2	1.5
24/02/2011	11	6	9.3	0.62	2.6	1.4
1/05/2011		5.8	8	0.58	4.9	1.6
31/08/2011		3.3	7.4	0.57	3	1.5
Max	11	6	9.3	0.79	6.6	1.6
Min	4.9	2.4	5.2	0.15	2	1.3
Median	7	3	7.4	0.57	3	1.5



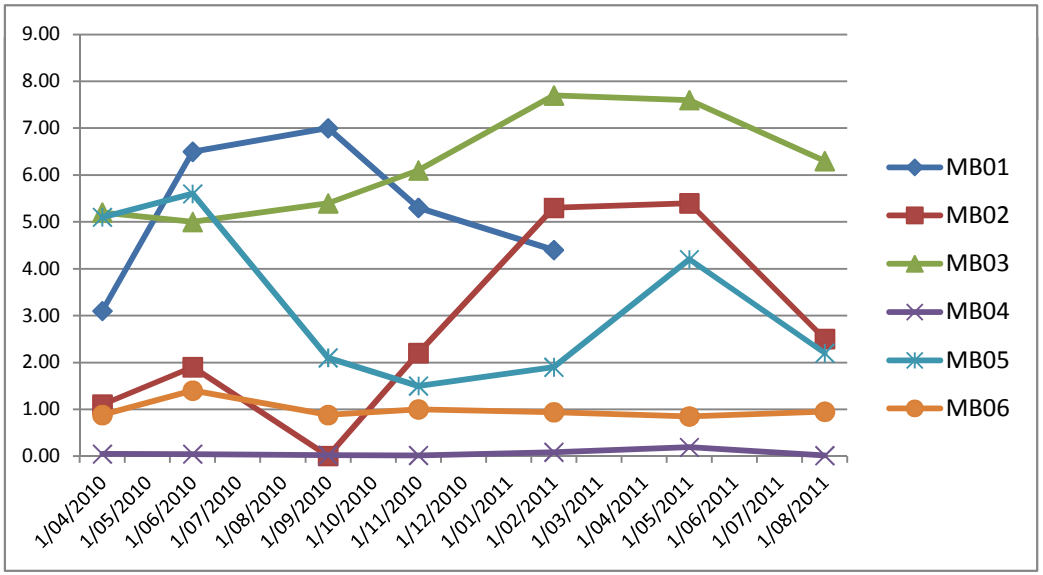
Organic Nitrogen (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	1.30	1.20	0.20	0.40	0.20	<0.2
25/06/2010	0.49	0.47	0.13	0.15	0.99	0.16
2/09/2010	2.17	2.968	1.91	0.398	0.364	0.443
18/11/2010	0.872	0.581	1.181	0.132	0.494	0.459
24/02/2011	6.6	0.74	1.6	0.53	0.69	0.49
31/08/2011		0.72	1.1	0.56	0.81	0.58
Max	6.6	2.968	1.91	0.56	0.985	0.58
Min	0.492	0.47	0.126	0.132	0.2	0.162
Median	1.3	0.73	1.1405	0.399	0.592	0.459



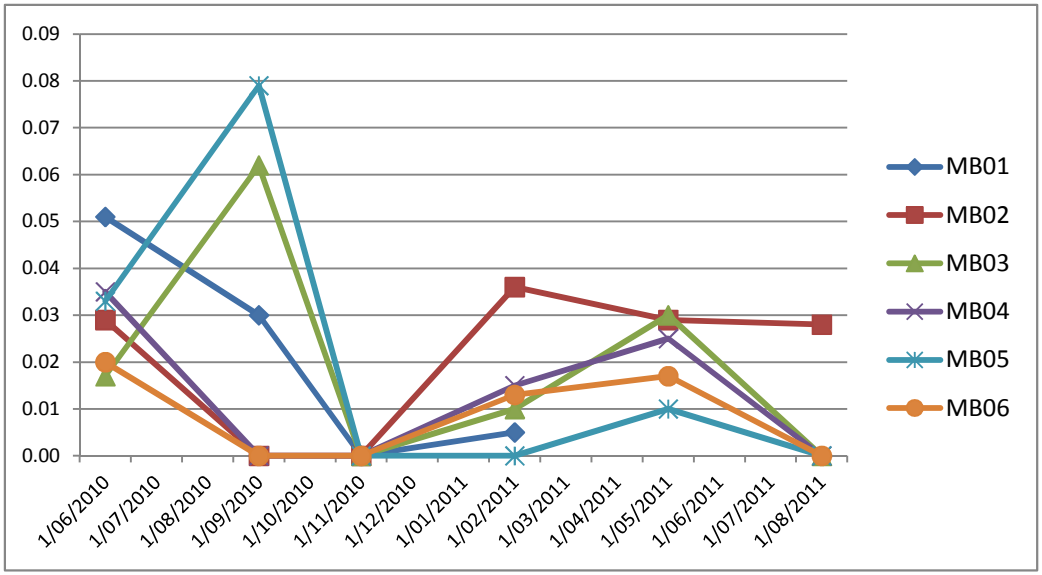
Nitrate/Nitrite Nitrogen, NOx as N (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	3.10	1.10	5.20	0.05	5.10	0.88
25/06/2010	6.50	1.90	5.00	0.05	5.60	1.40
2/09/2010	7.00	0.005	5.4	0.022	2.1	0.88
18/11/2010	5.3	2.2	6.1	0.018	1.5	1
24/02/2011	4.4	5.3	7.7	0.085	1.9	0.94
1/05/2011		5.4	7.6	0.19	4.2	0.85
31/08/2011		2.5	6.3	0.014	2.2	0.95
Max	7	5.4	7.7	0.19	5.6	1.4
Min	3.1	0.005	5	0.014	1.5	0.85
Median	5.3	2.2	6.1	0.046	2.2	0.94



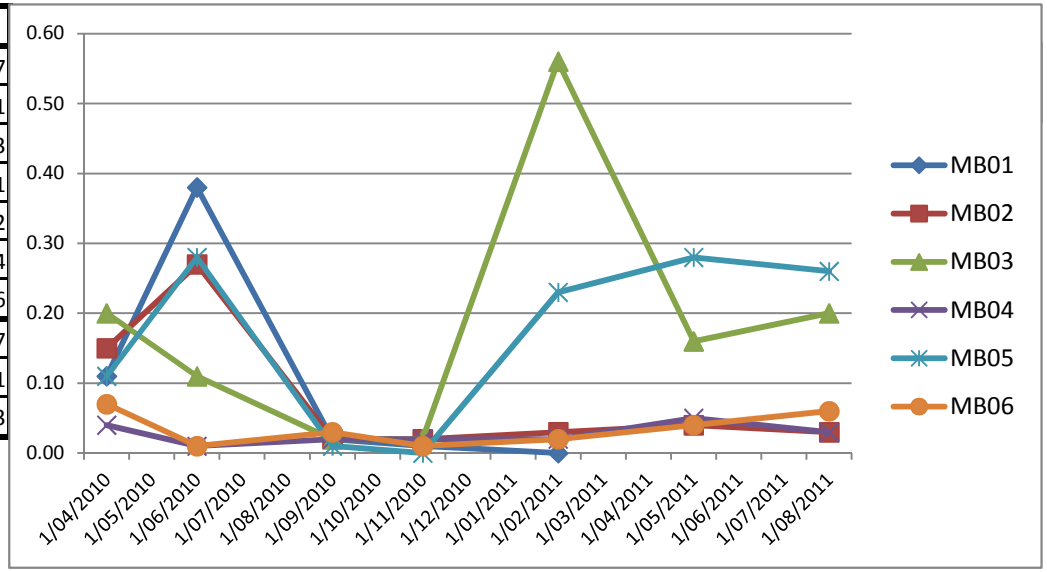
Ammonia Nitorgen, NH_3 as N (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	0.50	0.10	0.30	0.30	0.10	0.60
25/06/2010	0.05	0.03	0.02	0.04	0.03	0.02
2/09/2010	0.03	<0.005	0.062	<0.005	0.079	<0.005
18/11/2010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
24/02/2011	0.005	0.036	0.01	0.015	<0.005	0.013
1/05/2011		0.029	0.03	0.025	0.01	0.017
31/08/2011		0.028	<0.005	<0.005	<0.005	<0.005
Max	0.5	0.1	0.3	0.3	0.1	0.6
Min	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Median	0.03	0.028	0.02	0.025	0.01	0.013



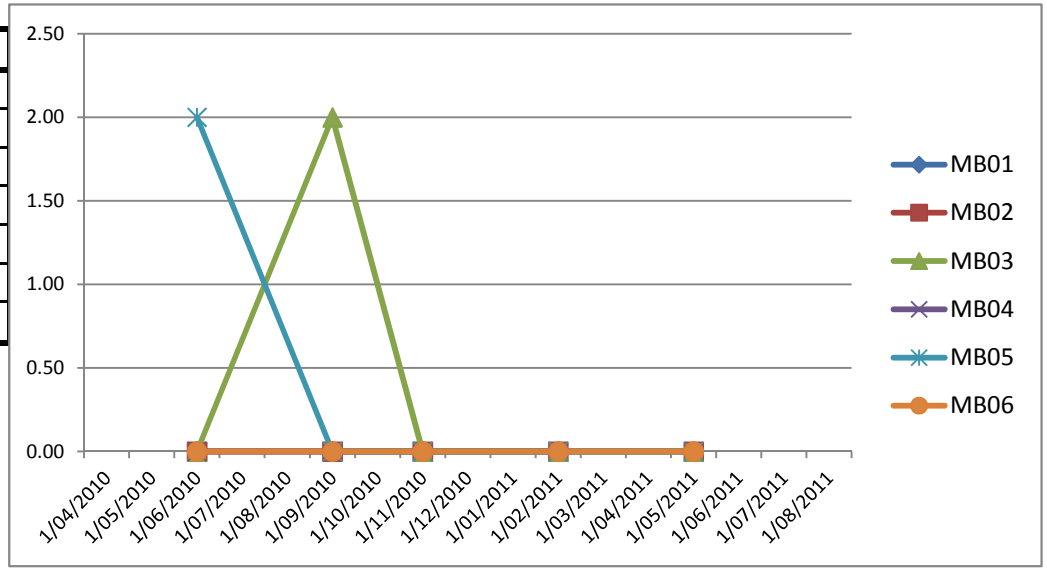
Total Phosphorus (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	0.11	0.15	0.20	0.04	0.11	0.07
25/06/2010	0.38	0.27	0.11	0.01	0.28	0.01
2/09/2010	0.02	0.02	0.02	0.02	0.01	0.03
18/11/2010	0.01	0.02	0.02	0.02	<0.01	0.01
24/02/2011	-	0.03	0.56	0.02	0.23	0.02
1/05/2011		0.04	0.16	0.05	0.28	0.04
31/08/2011		0.03	0.2	0.03	0.26	0.06
Max	0.38	0.27	0.56	0.05	0.28	0.07
Min	0.01	0.02	0.02	0.01	<0.01	0.01
Median	0.065	0.03	0.16	0.02	0.25	0.03



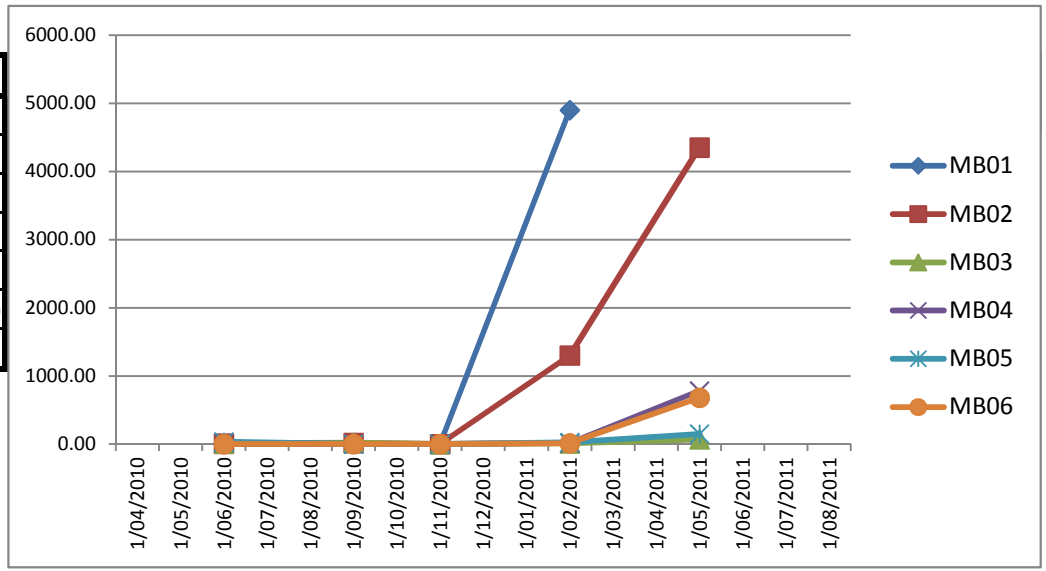
EColi in Water (MPN/100 mL)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010						
25/06/2010	<2	<2	<2	<2	2.00	<2
2/09/2010	<2	<2	2	<2	<2	<2
18/11/2010	<1	N.A.	<1	N.A.	<1	N.A.
24/02/2011	<1	<1	<1	<1	<1	<1
1/05/2011		<10	<10	<10	<10	<10
31/08/2011						



Total Coliforms in Water (MPN/100 mL)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010						
25/06/2010	<2	8.00	11.00	23.00	33.00	<2
2/09/2010	<2	17.00	22	<2	<2	<2
18/11/2010	3.10	N.A.	3.10	N.A.	<1	N.A.
24/02/2011	4900	1300	11	16	25	11
1/05/2011		4350.00	70.00	780.00	150.00	680.00
31/08/2011						



Heavy Metals (mg/L)

	MB01		MB02		MB03		MB04		MB05		MB06	
	9/04/2010	31/08/2011	9/04/2010	31/08/2011	9/04/2010	31/08/2011	9/04/2010	31/08/2011	9/04/2010	31/08/2011	9/04/2010	31/08/2011
Total Arsenic	0.1	-	<0.02	<0.02	0.029	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Cadmium	0.001	-	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005
Total Chromium	0.58	-	0.009	<0.005	0.14	<0.005	0.04	<0.005	0.06	<0.005	0.05	<0.005
Total Copper	0.13	-	0.07	0.006	0.064	<0.005	0.015	<0.005	0.032	<0.005	0.04	<0.005
Total Lead	0.059	-	0.005	<0.005	0.056	<0.005	0.054	<0.005	0.047	<0.005	0.084	<0.005
Total Nickel	0.02	-	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.005
Total Zinc	0.06	-	0.02	0.02	0.04	<0.01	0.01	<0.01	0.03	<0.01	0.02	<0.01
Mercury	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Appendix 4 Lake Clifton Caravan Park Wastewater Treatment and Disposal

From: Ramakrishnan, Parusu (Perth) [Parusu.Ramakrishnan@WorleyParsons.com]
Sent: Tuesday, 4 September 2012 8:38 AM
To: Margaret Dunlop
Subject: RE: Final Invoice

Hi Margaret,

It would have an impact on the overall price. Since it increase the max design by 33% I would think the price would increase by about 25% (approx.). Is there a reason behind DoH's requirement?
I am not sure if we have an environmental health expert in WP. If you have a specific question I may be able to ask around. Thanks.

Regards,

Parusu Ramakrishnan
Lead Water/Wastewater Engineer – Power, Infrastructure & Environment
Tel: +61 (08) 6311 6270 | Mobile: 0405542789 | Fax: +61 (0)8 9278 8110 | GMT +8 |
QV1, 250 St Georges Terrace, Level 4 | Perth WA 6000 | WorleyParsons Services Pty Ltd | ABN 61 001 279 812
www.worleyparsons.com

From: Margaret Dunlop [mailto:m.dunlop@strategen.com.au]
Sent: Friday, 31 August 2012 9:11 AM
To: Ramakrishnan, Parusu (Perth)
Subject: RE: Final Invoice

Thanks Parusu,

I've organised payment of that.

I've had a chat with the DoH and they want us to use a higher rate of flow than what was previously estimated – about 60 kL/day. Would that make a difference to the wastewater system costing?

Do you have any environmental health experts in your team? We may possibly need some assistance with the Health Department in future.

Regards,

Margaret

Margaret Dunlop
Senior Consultant

STRATEGEN
environmental consultants

Ph 9380 3100 Fax 9380 4606
Email M.Dunlop@strategen.com.au
Web www.strategen.com.au
Level 2, 322 Hay St Subiaco WA 6008
PO Box 243 Subiaco WA 6904

From: Ramakrishnan, Parusu (Perth) [mailto:Parusu.Ramakrishnan@WorleyParsons.com]
Sent: Wednesday, 29 August 2012 9:33 AM
To: Margaret Dunlop
Subject: Final Invoice

Hi Margaret,

We have sent out the final invoice. If you have not received it yet, you should be receiving it soon.

Regards,

Parusu Ramakrishnan
Lead Water/Wastewater Engineer – Power, Infrastructure & Environment
Tel: +61 (08) 6311 6270 | Mobile: 0405542789 | Fax: +61 (0)8 9278 8110 | GMT +8 |
QV1, 250 St Georges Terrace, Level 4 | Perth WA 6000 | WorleyParsons Services Pty Ltd | ABN 61 001 279 812
www.worleyparsons.com

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WorleyParsons
resources & energy

EcoNomics

TECHNICAL MEMORANDUM

DATE	1 August 2012
TO	Margaret Dunlop
FROM	Parusu Ramakrishnan
COPY	
PROJECT	301012-01587
SUBJECT	Lake Clifton Caravan Park Wastewater Treatment and Disposal
DOC NO	
FILE LOC	

1 BACKGROUND

A new 129 lot Park Home Site i.e. Caravan Park, is proposed to be developed at Lot 21 Old Coast Road in Lake Clifton, Western Australia (refer to Appendix A for the Amended Park Home Site Plan).

WorleyParsons has been appointed to recommend a suitable method for domestic wastewater treatment and disposal of treated effluent and sludge.

This technical memorandum documents the wastewater treatment and disposal options for the new Park Home Site.

2 SCOPE

- Recommend suitable option(s) for wastewater treatment
- Investigate option(s) for treated wastewater effluent and sludge disposal
- Provide a budget cost estimate for the wastewater treatment plant

3 DESIGN DATA

The source of wastewater is from cooking, laundry, shower facilities and toilet flushing. As such the wastewater generated is considered domestic in nature. No industrial waste is expected to be produced from the site.

Table 1 shows the expected raw wastewater quality.

Table 1: Design Raw Wastewater Quality (indicative)

Description	Quantity	Unit
Biological Oxygen Demand (BOD_5)	75	g/person/day
Total Suspended Solids (TSS)	70	g/person/day
Total Nitrogen (TN)	14	g/person/day
Total Phosphorus (TP)	5	g/person/day
pH	6.5 – 8.5	-
Faecal coliforms	50 x 10^6 / 100mL	-
Temperature	10 -30	°C

Table 2 highlights the proposed treated effluent quality.

Table 2: Required Treated Effluent Quality

Parameter	Required value
BOD_5	< 10mg/L
TSS	< 10mg/L
TN	< 5 mg/L
TP	< 1 mg/L
pH	6.5 – 8.5
Turbidity	< 5 NTU (95%tile)
E.Coli	< 10 cfu/100mL
Residual total chlorine	0.2 – 2.0 mg/L

The site's occupancy rate is made of the following:

- 20% permanent residents
- 40% used infrequently up to 12 times/year for up to 3 days
- 40% used 5 days/week for 6 months/year

Table 3 shows the design influent flow rates.

Table 3: Design Influent Flowrates

Description	Range (kL/day)
Design Flow	8.6 to 45

Appendix B shows how this flow range was calculated.

4 SITE CONSIDERATIONS

The Lake Clifton area has generally been classified as an environmentally sensitive area. It has been identified as having geoheritage features of international significance, ecological communities, flora and fauna species of national significance (listed under the Environment Protection and Biodiversity Conservation Act 1999) and regionally significant vegetation, flora and fauna (Wildlife Conservation Act 1956) as well as significant coastal and landscape values.

As such the proposed wastewater treatment facility and effluent disposal should take this into consideration.

5 WASTEWATER TREATMENT PLANT SELECTION

A centralised wastewater treatment plant is proposed.

Option 1: Conventional activated sludge treatment plant using membrane ultrafiltration (also known as a membrane biological reactor) and effluent disinfection using liquid sodium hypochlorite and ultraviolet radiation.

Option 2: BIOMAX type conventional activated sludge treatment plant (using clarifiers instead of membrane filtration).

The treated effluent is of a quality that can be reused for onsite irrigation in an environmentally safe manner.

6 OTHER TYPES OF WASTEWATER TREATMENT

Aeration Treatment Units (or ATU's) have not been considered in this study as they will not produce consistently good quality effluent suitable for reuse for this site and the ATU's will be decentralised throughout the site making it difficult to monitor and control. A large number of ATU's will also be required which does not make it economical.

7 WASTEWATER TREATMENT PROCESS

The general steps involved in the MBR wastewater plant process are as follows:

- Flow Equalisation: This acts as a buffer tank that will apply only during peak season where the flow is above plant design capacity. It helps to equalise the flow and distributes it during the off peak times of the day for treatment i.e. night time.
- Screening : Using automatic bar screens to remove or screen material detrimental to the biological process and membrane filtration
- Biological Treatment: Consists of an anoxic and aerobic zone both serving different functions. The anoxic zone is primarily for denitrification and aerobic zone for removal of carbonaceous material using fine air bubble diffusers
- Ultrafiltration : Occurs through a special membrane of microscopic pores that prevents particles, bacteria and viruses from passing through. The membranes are cleaned by air scouring and chemicals.
- Chlorination disinfection: Effluent disinfection using liquid sodium hypochlorite
- Treated Effluent Storage: This tank serves to store 2 to 3 days' worth of treated effluent in case irrigation is not possible due to wet weather or process upset.
- Sludge storage: Treated sludge is stored in a covered tank for disposal. As amount of sludge produced is small this tank needs to be emptied once every 3 to 6 months.

For the BIOMAX system the ultrafiltration step is replaced by a clarification process.

8 EFFLUENT AND SLUDGE DISPOSAL

The treated effluent is proposed to be disposed off via two methods.

Effluent Disposal Method 1: Subsurface irrigation is recommended for garden beds within the lots.

Effluent Disposal Method 2: Surface irrigation is recommended for large landscaped areas, shrubs and trees.

Irrigation could be extended to the existing caravan site if it is not possible to irrigate all of the treated effluent within the new site.

In accordance to the draft guidelines for the *Guidelines for Non-Potable Uses of Recycled Water in WA, August 2011,* sub-surface irrigation is considered low risk and surface irrigation is considered medium risk. Restricted public access to irrigation areas is required during surface irrigation periods.

Other forms of wastewater reuse like toilet flushing has not been recommended at this stage until discussions have commenced with the Local Shire and relevant regulatory authorities.

Sludge Disposal Method: The volume of sludge produced from an MBR type plant is minimal. The sludge storage tank is expected to be emptied once every 3 to 6 months. The sludge can be transported to the nearest centralised wastewater treatment plant.

The sludge generated from the Biomax type plant is slightly more and it is expected to be transported to the nearest treatment plant once every 1 to 2 months.

9 BUDGET COST ESTIMATES

Quotes were obtained from two wastewater treatment vendors.

Quote 1: Membrane Biological Reactor Type Wastewater Treatment Plant by Aquacell

Budget Cost: $687,000 (excluding GST)

See Appendix C for the detailed quote. Budget cost includes cost of effluent storage tanks and phosphorus precipitant dosing system. It does not include supply and laying of subsurface dripper effluent disposal system.

Quote 2: Biomax Type Conventional Activated Sludge Plant by Biomax

Budget Cost: $369,000 (excluding GST)

See Appendix D for the email quote. The price includes delivery, installation, training, performance testing, commissioning, supply of O&M manuals including the supply and laying of subsurface dripper effluent disposal system and the phosphorus precipitant dosing system. The quote does not include the equalisation tank, 24 hr effluent storage tanks, earthworks, crane hire, plumbing and electrical connections. It is envisaged that if these costs were included Biomax budget cost would be close to $460,000.

10 OPERATIONAL COSTS

This includes annual chemical, utilities, laboratory water analysis tests and routine maintenance costs only. Major equipment servicing costs have not been accounted for. In addition, replacement of membranes for the MBR plant which usually occurs once every 5 years has not been included.

The annual operational cost for the MBR plant is $30,000 i.e. this includes the cost of plant remote monitoring, technical support and annual major servicing by Aquacell which is estimated at $16,000.

The annual operational cost for the Biomax plant is estimated to be $7,000.

11 PLANT OPERATOR EFFICIENCY

Both vendors have advised that the on-site training provided will be sufficient for the nominated person to operate the plant and perform minor maintenance work. It is also recommended that the designated operator needs to have a basic understanding of general mechanical equipment i.e. pumps.

In the case of the MBR plant quoted by Aquacell the training provided will be sufficient as long as Aquacell is engaged on a service contract to undertake the remote monitoring and operation component. This way the site operator is not involved in any of the more complicated operation activities and an Aquacell operator is able to be in control of the system. Aquacell will also provide technical support to the site operator on a 24hour basis.

12 CONCLUSIONS AND RECOMMENDATIONS

The types of wastewater treatment recommended are:

1. Membrane Biological Reactor or
2. Biomax type wastewater treatment plant

With the MBR type plant effluent can be disposed off on site using a combination of subsurface irrigation for garden beds within lots. Surface irrigation is recommended for large landscaped areas, shrubs and trees. Other forms of wastewater reuse like toilet flushing is also possible.

With the Biomax type plant, effluent disposal via both subsurface irrigation and surface irrigation is possible. However, for surface irrigation enhanced restricted access controls need to be put in place i.e. restricted public access when area is wet, spray drift controls etc (refer to Table 8 of WA *Guidelines for Non-Potable Uses of Recycled Water in WA, August 2011*)

Sludge will be transported to the nearest local wastewater treatment plant.

The use of MBR type plant is more expensive but yields a much higher quality of effluent which is suitable for a wider range of reuse.

13 ASSUMPTIONS

The following assumptions have been made:

- Wastewater reticulation system i.e. collection and pumping, will be done by others

- Major civil works (if required) and electrical work will be carried out by others and has not been factored into the budget cost.
- Wastewater treatment and effluent disposal options were made without liaising with local Shire and DEC. They were based on site conditions, input from Strategen representative and documentation provided.

14 AFTER NOTE

After this tech memo was produced Wastewater Services (WWS) were approached to provide a quote for a membrane bioreactor (MBR) type plant. A verbal quote of $420,000 (excluding GST) was provided for a plant similar to the one quoted by Aquacell.

Wastewater Services are a reputable company and have supplied a large number of wastewater treatment plants throughout WA. WWS could be approached for a firm quote if the MBR plant is being considered as a treatment option.

APPENDIX

A. AMENDED PARK HOME SITE PLAN
B. DESIGN FLOW CALCULATIONS
C. QUOTE FROM AQUACELL
D. QUOTE FROM BIOMAX

APPENDIX A

296.15 M BOUNDARY

19.56 M

40 M

NEW LANDSCAPING

ESA BUFFER BOUNDARY

ONE PEPPERMINT TREE TO BE REMOVED

ALL PEPPERMINT TREES TO BE RETAINED IN THIS AREA

NATURAL LANDSCAPE TO REMAIN

246.08 M BOUNDARY

6 M ALL ROADWAYS 6000 WIDE

10 M

LOT 19

PEDESTRIAN LINKS

R.O.W.

TWO PEPPERMINT TREES TO BE REMOVED

LOTS 19 & 20 TO BE AMALGAMATED

LOT 20

93.45m

72.45m

20 M

15 M

61.31M

WATER FEATURE

BBQ AREA

25 M

LANDSCAPED AREA WITH SIMILAR TREES AND SHRUBS ON SITE (NATIVES)

LOT 21

141.08 M BOUNDARY

13.92 M

ALL EXISTING TUART TREES TO BE RETAINED

ALL EXISTING TUART TREES TO BE RETAINED

OLD COAST ROAD (TO BECOME LOCAL ROAD ON COMPLETION OF BUNBARY BY PASS)

NOTES:

1. THIS AMENDED PROPOSAL CONTAINS 129 LOTS, INSTEAD OF PREVIOUS 142 LOTS, A REDUCTION OF 13.

2. WESTERN LOTS HAVE BEEN FURTHER SET BACK TO 40 METRES FROM THE SITE BOUNDARY

3. ALL EXISTING HEALTHY TUART TREES (T.T.) TO BE RETAINED.

4. ONLY 3 SINGLE STAND PEPPERMINT TREES TO BE REMOVED.

5. LANDSCAPED BUFFER AREAS TO BOUNDARIES TO BE EXTENSIVELY PLANTED WITH SPECIES CURRENTLY ON SITE.

6. PEDESTRIAN LINKAGES HAVE BEEN INCORPORATED TO ALLOW SAFE CIRCULATION AND ACCESS TO OPEN SPACE AREAS SHOWN

DOEPEL MARSH architects

Beck Advisory
Level 3, 190 St George's Terrace,
Perth - WA

AMENDED PARK HOME SITE PLAN

SCALE 1:500

LAKE CLIFTON DEVELOPMENT

LOT 21 OLD COAST ROAD, LAKE CLIFTON

JOB NO. 28.31

DATE: 01 APR 11

APPENDIX B

Design Flow calculations for the new 129 lot Home Site:

1. 20% full time residents
Flow = 129 lots x 2 persons/lot x 20% x 166 l/day = 8,566 L/day or 8.6 kL/day

2. 40% used infrequently i.e. 12 times/yr for up to 3 days/occasion
Flow = 129 lots x 2 persons/lot x 4 % x 166 l/day = 17,132 L/day or 17.1 kL/day

3. 40% of site used 5 days/week for 6 months/year
Flow = 129 lots x 2 persons/lot x 40% x 166 l/day = 17,132 L/day or 17.1 kL/day

Due to the transient nature of the caravan park the treatment plant must be designed to cater to a range of flow.

Low Flow = 8.6 kL/day

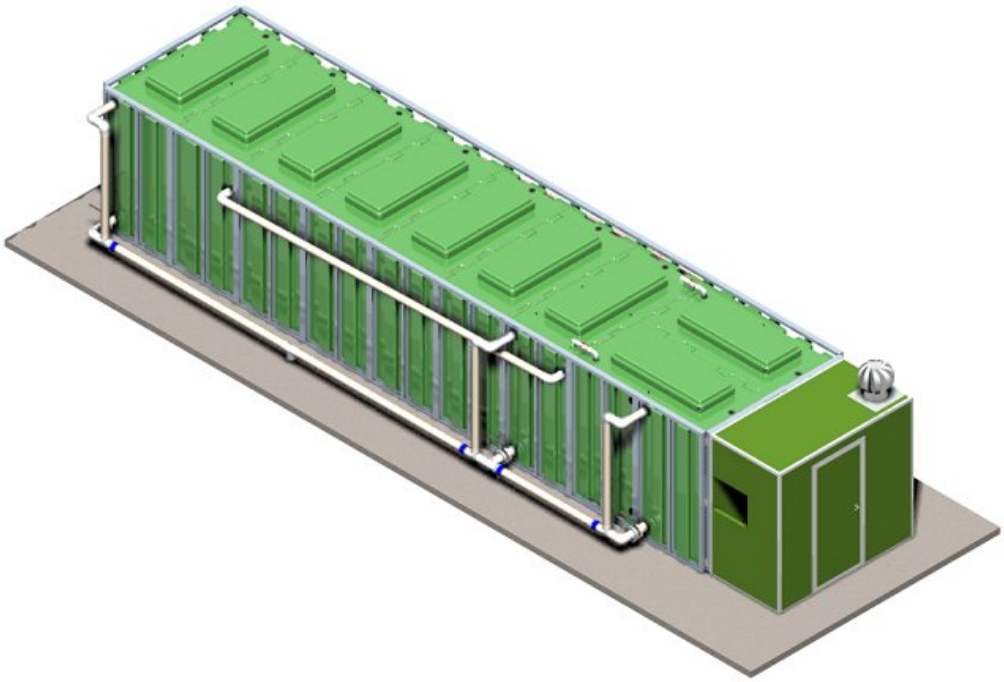
Peak Flow = 8.6 + 17.1 +17.1 = 42.8 kL/day (approximately 45 kL/day)

Due to the inclusion of a 24hour equalisation tank at the head of the plant a peaking factor need not be factored into the flow calculations.

APPENDIX C

Aquacell Wastewater Blackwater Recycling System
Budget Proposal

Project:	**Lake Clifton Caravan Park**
Consultant:	**Worley Parsons**
Location:	**Lake Clifton**
Proposal no:	**12-5045**
Date:	**24th July 2012**



Prepared by: *Michael Conciatore - phone 0409 018 383*
Email: *michaelc@aquacell.com.au*

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www.aquacell.com.au

ABN 79 072 487 015

CONTENTS

Proposal Introduction

We are pleased to provide a budget proposal for a 50kL/day Blackwater plant for the Lake Clifton Caravan Park.

Aquacell are specialists in commercial blackwater and greywater treatment and reuse schemes (see experience on p4), having established numerous commercial schemes across Australia, including in NSW, VIC, ACT, QLD and WA. We therefore have the knowledge and experience to confidently deliver a successful blackwater scheme for this project.

The blackwater solution offered is based on Membrane Bioreactor (MBR) technology; a process that is fast becoming a treatment technology of choice for commercial facilities desiring to achieve a high quality effluent that can be safely reused.

The treatment system is capable of dealing with fluctuating site flow which is perfectly suited to a caravan park with a season site population. The Aquacell is able to be sustained with as little as 10% of its design flow, which preliminary water balance calculations show the caravan park produces more than this figure during off peak periods. Due to the nature of this site which has no main sewer to fall back onto, all critical pumps and blowers require redundancy in design and have been designed in a duty standby arrangement.

In this proposal we have included pricing for recirculation pumps, buffer and storage tanks and concrete slabs for this equipment. With this in mind we are offering a complete end to end solution including design, regulatory approvals, manufacturing, delivery to site, installation commissioning and ongoing operation and training. As this is a preliminary investigation this proposal is of a budgetary nature only.

I hope that this proposal will provide you with sufficient technical and budgetary information to support you with this stage of the project development. Please don't hesitate to call me if you require any further information.

Sincerely

Michael Conciatore
Technical Sales Engineer
m) 0409 018 383
e) michaelc@aquacell.com.au

Aquacell Experience

Blackwater Experience

We have a number of blackwater reuse Plants operating and under construction ranging from 5kL/day to 130kL/day in capacity. These include:

Blackwater Plant	Model	Location	Type of Facility
Blacktown Workers Club (100kL/day)	S100	Blacktown, Sydney, NSW	Sports/workers club, irrigation of sports field
Liverpool Catholic Club (100kL/day) (including Mecure Hotel at Liverpool)	S100	Liverpool, Sydney, NSW	Sports club + Hotel, irrigation of sports field
RMIT (6kL/day)	S5	Melbourne	University
PACE farms (20kL/day)	S20	Western NSW	poultry farm wastewater treatment
1 Bligh St (130kL/day)	S100	CBD Sydney, NSW	6 star green star building, sewer mining for cooling tower reuse
Brindabella – Canberra Airport (50kL/day)	S50	Canberra, ACT	Airport business park
Joalah (20kL/day)	S20	south coast NSW	Beachside Holiday Caravan Park in sensitive environment
Australian National University (90kL/day)	S100	ACT	University
Acton Nishi	S50	ACT	Offices

Greywater Experience

In addition to the blackwater experience already mentioned, Aquacell's experience in commercial grey water treatment makes us one of the leading companies in Australia for delivering greywater solutions. We have a number of Greywater Plants in various stages of construction, approval and operation around Australia. The Table below lists our current contracts.

Greywater Plant	Model	Location	Type of Facility
K2	G10	Windsor (Melbourne), VIC	Public Housing – Residential apartments
Birrigai	G5	Tidbinbilla, ACT	School outdoor education centre
Pinctada	G20	Broome, WA	Resort
Lot 6, Prince Henry at Little Bay Development	G10	Sydney, NSW	Green star, residential apartment block
Lot 7, Prince Henry at Little Bay Development	G10	Sydney, NSW	Green star, residential apartment block
Lot 11, Prince Henry at Little Bay Development	G20	Sydney, NSW	Green star, residential apartment block
Lot 13, Prince Henry at Little Bay Development	G20	Sydney, NSW	Green star, residential apartment block
Lot 18, Prince Henry at Little Bay Development	G10	Sydney, NSW	Green star, residential apartment block
Childers Square	G5	ACT	Commercial Offices
City West	G20	ACT	Commercial Offices
40 Mount St (ARK)	G10	North Sydney, NSW	Commercial Offices
RSL Care	G20	Rockhampton, QLD	Aged Care
King George Central	G10	Brisbane, QLD	Commercial Offices
Star City Casino	G100	Sydney, NSW	Casino
111 Eagle St	G10	Brisbane, QLD	Commercial Offices
Hamilton Harbour	G20	Brisbane, QLD	Residential, Commercial development

Note G5~5kL/day; G10~10kL/day; G20~20kL/day.

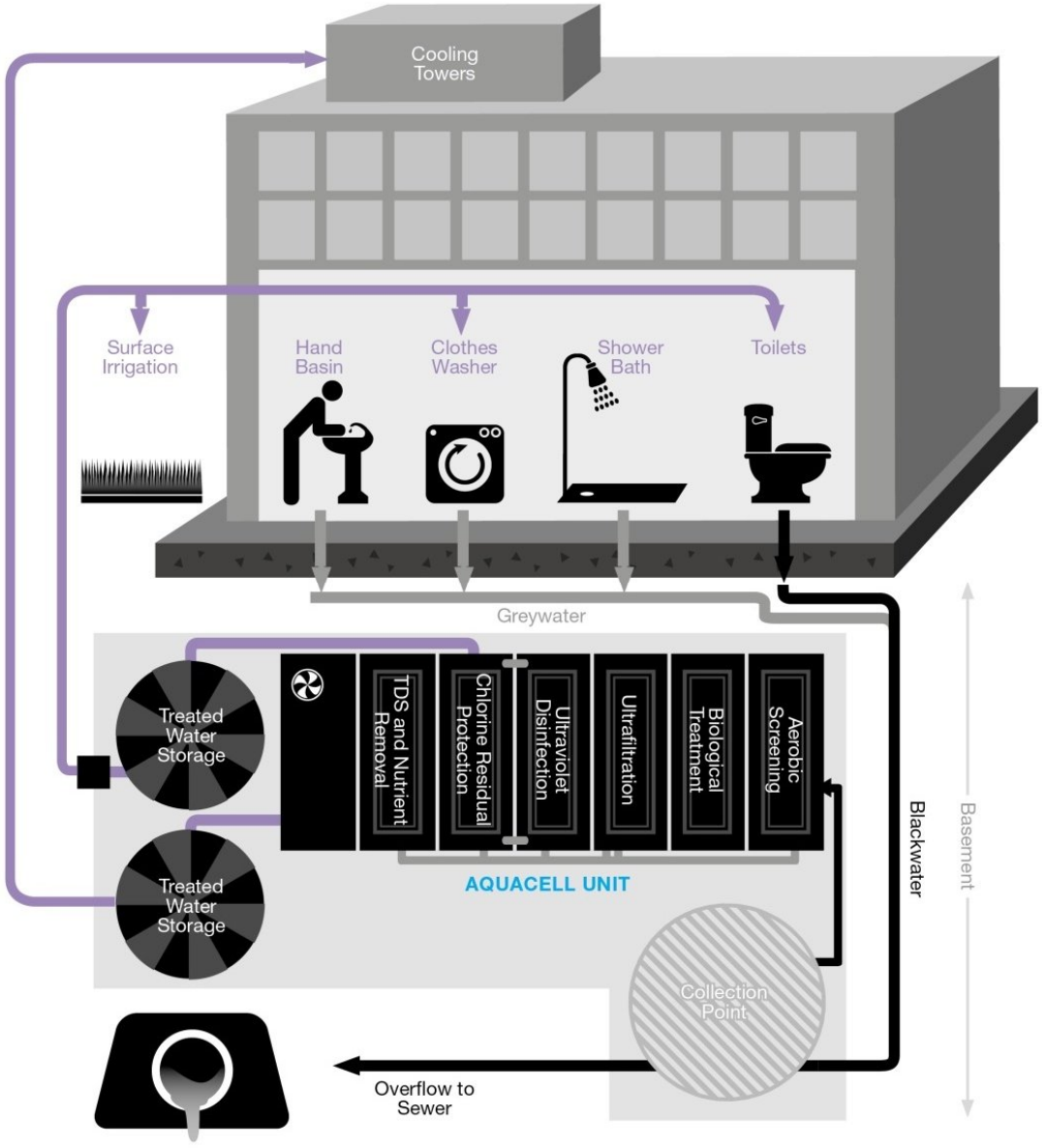
Regulatory Requirements

Aquacell has already obtained approval to operate and reuse wastewater from a 20kL/day Greywater Plant at a resort in Cable Beach, Western Australia. We are therefore able to bring a wealth of local experience to the project in terms of negotiating with Western Australian regulators. Aquacell has had preliminary discussions with WA Health and they have confirmed Blackwater recycling is permitted in WA. Recently WA Health has released a set of guidelines covering the use of recycled water in WA.

Due to Lake Clifton being an environmentally sensitive area further approvals may be required for the onsite water recycling system. Further investigations into the required approvals will need to be undertaken. Aquacell specialises in gaining regulatory approvals, having gained approvals for many varying projects all over Australia including a number in similar environmentally sensitive areas.

Aquacell – Blackwater Recycling Process Summary

A high level schematic showing a typical set up of an Aquacell system for both on-site blackwater and greywater reuse is provided below. Each Plant is site specific and will need to be customised to meet the clients needs and situation.



Schematic of Blackwater Recycling

Blackwater Recycling General Process Features

Some of the key features of the Aquacell Plant to note are:

- The Treatment Plant is based on Membrane Biological Reactor technology; an internationally proven technology that is able to offer a low footprint, high quality final effluent suitable for on-site reuse.

- Aquacell Plants use Ultrafiltration membranes (0.04micron) that are air scoured; No Backwash is Produced (further reducing on site wastewater production). Clean permeate is pushed through the membranes under the normal hydrostatic pressure in the MBR tank.

- Approximate power use of the Aquacell MBR Plant is about 3-3.5kWh/kL for Blackwater, but efficiencies are dependent on how effectively the Plant is utilised.

- The Aquacell Plants have a very high water recovery yield ~99.5%. i.e. 100L of wastewater into the system produces 99.5L of treated A+ effluent.

- Aquacell Plants are modular and skid mounted, therefore minimising on-site installation time and reducing impact on business activities.

- The effluent quality from the MBR Plant will achieve a minimum of log 4-5 removal of pathogens with BOD's <5mg/L. See typical water quality specification.

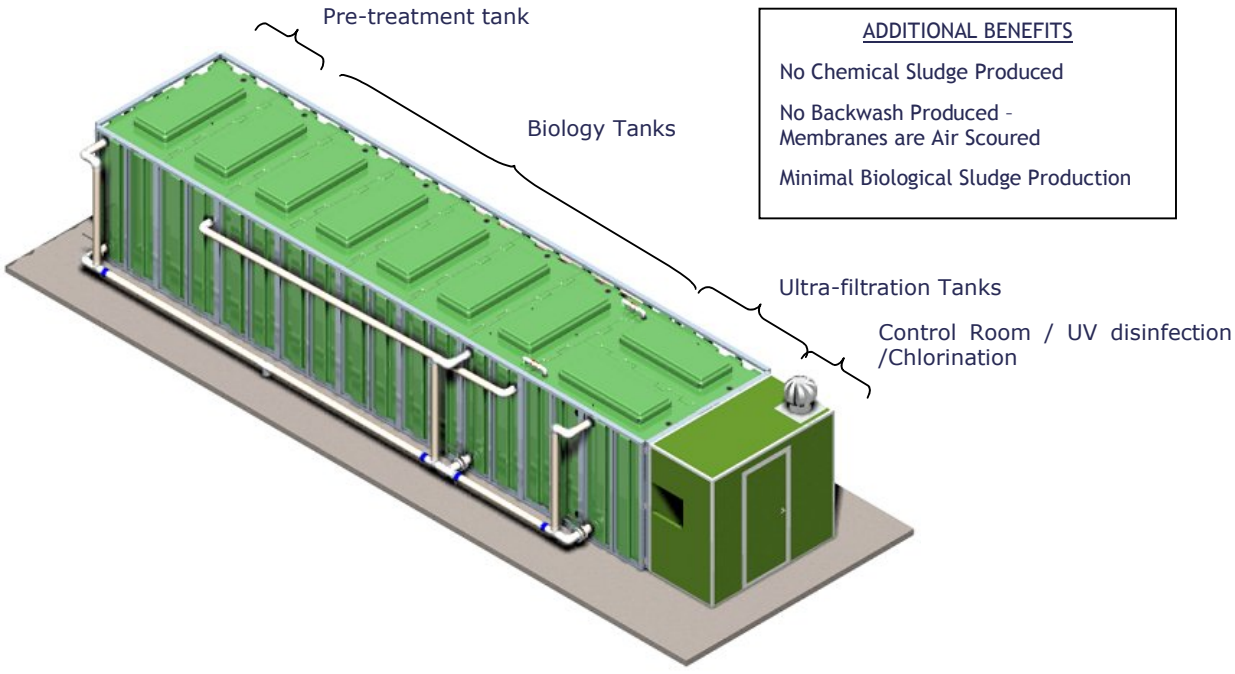
- Very little sludge is produced from the Aquacell system, except for a few cubic meters of biological sludge every 3 months. The sludge waste can be easily removed by a local waste contractor.

- Aquacell Plants are remotely monitored via the internet. Aquacell has the capability to change operational parameters remotely and maintain the ongoing optimisation of the Plant.

Aquacell Process Summary

The Aquacell Plant comprises five main processes:

1. **Pre-treatment**: effluent is pumped from a collection point into the pre-treatment chamber where large solids are screened and separated by a mechanical fine screen. Screenings are dewatered and compacted and deposited by a hygienic bagging system into a bin for removal
2. **Biological Reactors**: Air is diffused into the wastewater to maintain oxygenated conditions to support the growth of aerobic bacteria. These bacteria efficiently break down the organic matter in the effluent. Dissolved oxygen probes ensure that a consistent environment is maintained in the tank to maximise microbial activity.
3. **Ultra-Filtration**: Submersed flat sheet membranes with a pore size several hundredths the thickness of a human hair are used to separate the effluent, without bacteria or virus passing through. These membranes are regularly scoured with air to ensure constant flow rates. Effluent flows through the membranes under the hydraulic head difference between the tank and the outlet.
4. **Ultra Violet Disinfection**: Although the effluent passing through the membranes doesn't contain bacteria/virus', all effluent is passed through UV disinfection to provide additional confidence in the system. ***Potentially this process could be removed from the system since subsurface irrigation is the only intended treated water reuse application, investigations into the relevant regulatory framework are needed to clarify if this is acceptable.***
5. **Chlorine Disinfection**: A chlorine residual is applied as a final disinfection barrier and to combat any microbial contamination that may occur in reticulation lines and effluent storage tanks. ***Potentially this process could be removed from the system since subsurface irrigation is the only intended treated water reuse application, investigations into the relevant regulatory framework are needed to clarify if this is acceptable.***
6. Treated Water is then ready for re-use.



S50 Aquacell Product Specification - Summary

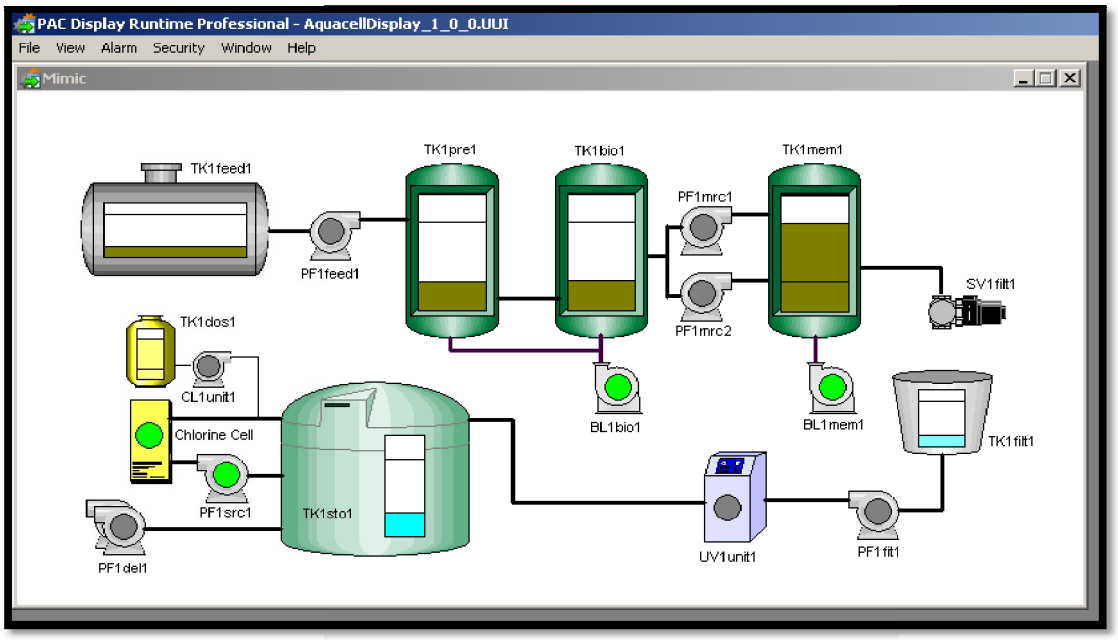
Aspect	Aquacell S50 Specifications
Influent	Blackwater
Design Hydraulic throughput	0 – 50kL/day of blackwater
Final Treated Water Quality	See Effluent Quality Specification
Feed Method	Pump
Tank Description	Enclosed custom moulded polyethylene
Pre-treatment screening	2mm mechanical fine screen
Biology Tank Aeration	Dissolved oxygen controlled, fine bubble aeration
Membranes	Flat Sheet – Ultra-filtration. Nominal pore size 0.04micron.
Membrane operation	Flux through membranes produced by hydraulic head in the membrane tank (i.e. no membrane pumps required). Membranes are air scoured to maintain flux. Chemical clean required infrequently (~3-12 monthly depending on water quality).
Primary Disinfection	UV Treatment: The system will deliver a minimum UV dose of 40mJ/cm^2 at maximum design flow.
Residual Disinfection:	Chlorine dosing post UV treatment. Free Chlorine residual in treated effluent storage tank to be Cl: 0.2-1.0mg/L
Control System and alarms	Integrated Programmable Automation Controller with remote monitoring control. A touch screen on the face of the panel will provide a visible display of plant status, motor manual/off/auto, critical control point status. The plant will be able to operate via the touch-screen interface without remote operation in the event of communications failure. The system will include an ethernet-based web-based human interface with real-time remote operation and control via web-connected PC, and alarming function systems via email and SMS.
Monitoring instrumentation	Continuous on-line monitoring of turbidity, pH of influent and treated water, free chlorine residual in effluent storage tank, Dissolved Oxygen in bioreactor, and total treated water processed.

Remote Monitoring & Controls

A Motor Control Centre and Programmable Automation Controller will be provided. A touch screen on the face of the panel provides a visible display of plant status, motor manual/off/auto, critical control point status. The plant will be able to operate via the touch-screen interface without remote operation in the event of communications failure.

A remote monitoring and data acquisition system will be provided as part of the system to monitor all process variables and critical control points. It will include an ethernet-based web-based human interface with real-time remote operation and control via web-connected PC, and alarming function systems via email and SMS. The system can also be integrated with the Building Management System.

Example of remote monitoring control interface from one of Aquacell's Plants.



The plant will monitor the following parameters and use controls to ensure reliable and safe recycled water supply is available at all times.

Parameter	Monitoring & Control
Level	• MBR Tank levels
	• Recycled water storage tank level
	• High level Alarms
Status or Condition	• Flow
	• Level Sensors
	• Pumps on/off
	• Blowers on/off
	• Filtration
	• Aeration cycle
UV Disinfection	• UV Lamp on/off
	• UVI
Dissolved Oxygen	• Online DOx monitoring
Turbidity	• Online turbidity monitoring
pH	• Online pH monitoring
Chlorine	• Online chlorine monitoring
	•

The recycled water scheme has remote monitoring in place for critical process parameters. For example, turbidity of the recycled water will be monitored online using a turbidity meter. If the turbidity value exceeds 0.5 NTU due to membrane rupture or plant malfunction, recycle water supply will be stopped, and an alarm will be raised and directed to the remote monitor.

Effluent Quality Produced from the Aquacell Plant

The effluent produced from the Plant will be equivalent to A+ quality. Typical effluent quality is shown below. Potentially less stringent requirements may be required due to sub-surface irrigation being the only intended reuse application.

Blackwater Effluent Quality Specifications

Parameter	Influent Water quality	Typical Treated Water quality
Biochemical Oxygen demand (BOD), mg/l	300-600mg/L for blackwater	< 5.0
Suspended solids, mg/l	200-400	<1
pH	6.5-8.5	6.5-8.5
Oil and grease	<50mg/l	<1mg/l
Total Nitrogen, mg/l	85mg/l	<15 mg/l *
Total phosphorous	20mg/l	<10 mg/l *
Faecal coliforms cfu/100ml	$10^6 – 10^8$	<1
E. Coli, organisms/100ml	10^6-10^8	<1
Turbidity, NTU		<2
Viruses		99.9999% removal

Proposal Offer

The following Aquacell components/activities will be supplied under this proposal:

- Process Design customisation of the Treatment Plant – including system management Plan and risk assessment
- Secure the necessary regulatory approvals (WA Health approval only, however we are able to add any other required approvals to our scope of supply)
- Concrete slab for treatment works – we are assuming no excessive excavation will be required.
- In ground concrete 50kL collection/equalisation tank (excavation not included)
- Treated water storage tanks proposed as additional options.
- Delivery pumps (duty/standby) from blackwater collection tank/buffer tank to the S50 Aquacell. (pipe work and tank included)
- Reticulation pump set to supply treated water to the intended reuse application
- Aquacell Treatment Plant Equipment Supplied
    - S50 Aquacell Membrane Bioreactor (MBR) Module. This comprises a Biological Reactor with 0.04micron Ultrafiltration membranes.
    - Mechanical Fine Screen
    - UV disinfection
    - Residual Chlorination dosing equipment to achieve final effluent residual chlorine of 0.2mg/L-1mg/L.
    - Control Panel (total integrated wastewater system control)
    - Remote monitoring unit (Internet control)
    - Delivery of all equipment to site
    - Pre-commissioning of plant prior to leaving factory. Installation and commissioning are included on site. (including travel expenses)
    - Training of local building services staff.
    - Operation Manuals and System Management Plan

Items Not Included in Proposal Offer

In addition to these budget costs, these additional costs should be considered, but are not included:

- Civil/mech/elec design
- Site preparation / excavation
- Plumbing and pipework connecting the Aquacell into the surrounding development.
- Plumbing and irrigation network post treatment Plant.
- 415V Power supply and phone line to Aquacell Control Panel
- Backup Power

Project Scope

Preliminaries

Item		Description	Supplied by	Price for Aquacell-supplied items
1.1	Site survey	Assessment of recycled water demand	Existing	
		Site and Soil Survey	Existing	
1.2	Approvals	Regulatory Approvals – WA Health approval	Aquacell	15,000
1.3	Design	Concrete slab design	Aquacell	3,200
		Detailed Design (Aquacell – process Plant)	Aquacell	12,500
		Irrigation/reticulation	Other	

Treatment Plant

Item		Description	Supplied by	Price for Aquacell-supplied items
2.0	Delivery Pump set	For receiving wastewater from the collection pit and delivering to Aquacell – Includes floats, rising main, guide rails and installation into tank.	Aquacell	7,813
2.1	Emergency overflow	150 NB to sewer	N/A	
2.2	Aquacell	Above ground system including the following major components: • Inlet screening/pre-treatment zone • bioreactor system • blowers • submerged ultrafiltration membranes and housings • Aeration diffusers for air scour of membranes • Aeration diffusers for biological treatment • Level controls and on-line instruments; • Permeate and transfer pumps within Aquacell and to storage tank • Air scour blowers • Bioreactor blowers • UV/chlorine dosing • Control Panel for all Aquacell supply drives and controls • Remote monitoring unit • Factory assembly and testing	Aquacell	318,800
2.3	Buffer Tank	In ground Concrete tank supplied and installed	Aquacell	75,000
		Recommended buffer tank volume:	50kl	
	Treated water storage tank	Please see Aquacell storage tank options below.	Other	
		Recommended storage tank volume:	2 days	
2.4	Reticulation pump-set	Supplying recycled water to re-use points	Aquacell	7,000
2.5	Delivery to site	Aquacell-supplied items	Aquacell	18,800

Site Works

Item		Description	Supplied by	Price for Aquacell-supplied items
3.1	Civil and mechanical works	Concrete slab for treatment works	Aquacell	86,000
3.2		Recommended plant room size (for indoor installation)	N/A	
3.3		Recommended slab size (for outdoor installation)	See Attached GA Drawing	
3.4		Site installation of Aquacell	Aquacell	56,600
3.5	Plumbing and drainage	Internal plumbing of Aquacell into package unit.		**Included in item 2.2**
3.6		Overflows, drains to floor waste		**Included in item 2.2**
3.7		Rising main from buffer tank to Aquacell	Aquacell	**Included in item 2.3**
3.8		Drainage from plant via relief gully trap or reflux valve to sewer	Other	
3.9		Plumbing from Aquacell to treated water storage tank	Aquacell	**Included in item 2.2**
3.10		Vent to stack/mechanical ventilation	N/A	
3.11		Plumbing from treated water storage tank to reticulation pumps and to re-use points (lilac coloured pipes and taps to plumbing codes)	Other	
3.12		Mains water backup supply (via RPZ or physical air gap) to storage tank and plant room if applicable	Other	
3.13		RPZ at property boundary	Other	
3.14		Recycled water signage (plant only)	Aquacell	700
3.15	Electrical and utilities	Incoming 415V power supply to control panel	Other	
3.16		Phone line and internet connection to control panel	Other	
3.17		Electrical conduits from pump station, storage tank and reticulation pumps to panel	Aquacell	**Included in item 3.1**
3.18		Wiring from control panel to Aquacell		Included in 3.4
3.19		Backup power	Other	
3.20	Commissioning	Start-up – mechanical and biological commissioning	Aquacell	26,100
3.21		Performance testing to statutory guidelines – NATA chemical analysis, sampling	Aquacell	18,800
3.22		Operations Manuals	Aquacell	4,700
3.23	Operation	System Management Plan – HACCP Analysis / risk analysis	**Aquacell**	**9,400**

TOTAL FOR AQUACELL SUPPLIED ITEMS – Budget Price $660,413

Alterative price for sub surface irrigation system as per above scope excluding UV Disinfection, Cl Dosing and Turbidity probe

- Budget Price $625,000

Storage Tank Options

Aquacell can offer a range of storage tank solutions for this project. The most cost effective option is to utilise poly round above ground tanks. Below are options for a range of different storage capacities. There may be a regulatory requirement to have wet weather storage available. Price includes delivery and installation.

Component	Dimensions	Cost
20kl Storage using two 10kl round poly tanks.	Each tank is 2510D x 2300H	$7,833
68kl Storage using two 34kl round poly tanks.	Each tank is 4180D x 3050H	$16,667
102kl Storage using three 34kl round poly tanks.	Each tank is 4180D x 3050H	$25,417

Summary of Annual Operational Costs

A service contract will need to be in place prior to the system becoming operational. The first 12 months will be added to the final sale price. Aquacell tailors each service contract to the customer's needs and technical skills. We can offer a complete service contract including all the components below, or we can train site staff to undertake the majority of the components and only look after remote monitoring, technical support, regulatory compliance and annual service

Maintenance Component	Detail	Annual Price
Remote Monitoring & Technical support	• Project Management • Remote monitoring of Plant for alarms and general operational health • Notify client of any emergency alarms • Plant optimisation when required • Brief Quarterly report on Plant operation e.g. amount of water processed, general issues • Maintenance scheduling • Response to client queries	~$9,000
Monthly Servicing	• Monthly general inspection and calibration of instruments • Monthly collection of regulatory water quality samples	~$9,600
Six Monthly Full Technical Servicing	• Full technical inspection • Membrane cleans when required • Replacement of ph Probes (6 monthly) • Replacement of UV tubes (12 monthly)	~$5,000
Consumables	• pH probe – 2 probes replaced 6 monthly • UV tube – replaced 12 monthly • Chlorine (12.5% sodium hypochlorite) • CIP Chemicals	~$4,000
Regulatory Compliance	• Chemical Analysis • Licence fees • Regulatory reports • Ongoing regulatory management of documentation • Independent audits	~$8,000
Power	• 3.5kW/kL for blackwater, based on $0.3/kWh; 52 weeks, 7 days a week	~$3,500

NOTE: A further 2.5% of the Capex value should be allocated per year for ongoing asset replacement at the end of component engineering life e.g. pumps replaced every 3-7 years, membranes replaced 5-7 years, valves replaced 3-5 years etc.

Standard Terms of Offer:

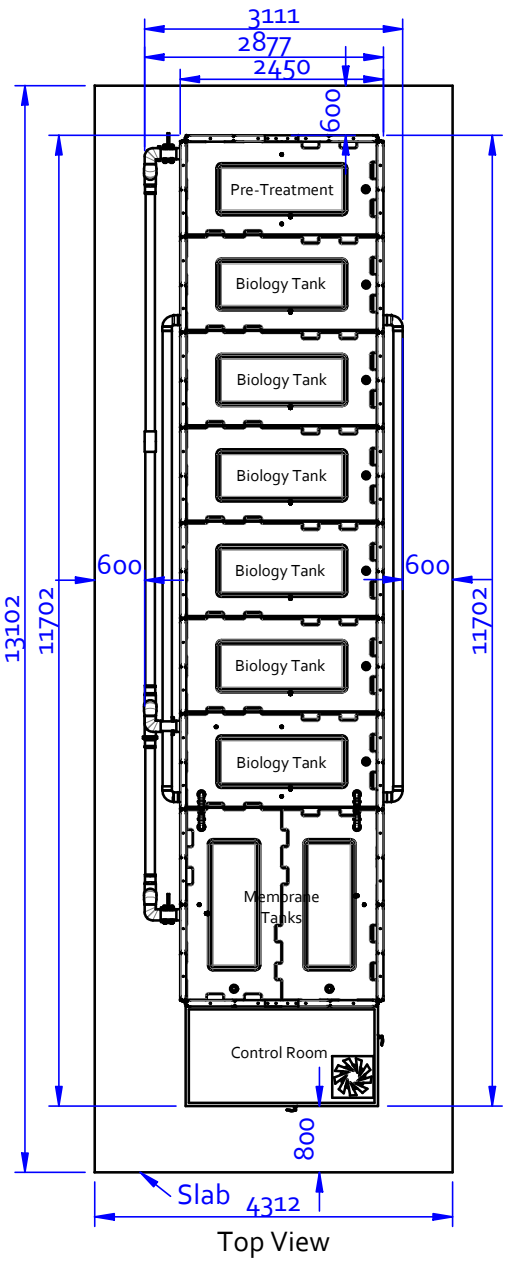
- Price excludes taxes
- Budgetary proposal
- Schedule:
  - Regulatory approval – 2-4 months
  - Design & risk assessment: 1-2 months
  - Equipment procurement and Manufacture: 16-18 working weeks from sign off of detailed design
  - Installation and Commissioning: ~8-12 weeks
  - Post Commissioning regulatory validation: 4-6 weeks
- Validity: 60 days
- Payment terms:
  - To be discussed
- Warranty: 12 months after commissioning, or 18 months after delivery, whichever is earlier
- Our standard terms and conditions of sale apply- copy available on request

APPENDIX A – AQUACELL GENERAL DRAWING

Note that the actual module may differ slightly dependant on site specific design

PRINT MAY BE REDUCED - DO NOT SCALE.

NOT FOR CONSTRUCTION



Top View

Aquacell S50

Right hand configuration shown

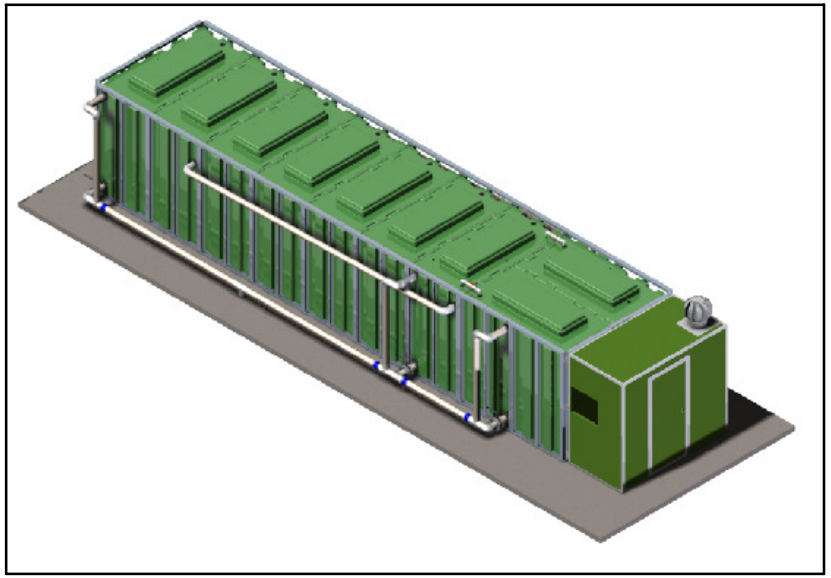
Notes:

Pump station and storage tanks not shown, refer to G50 page 2

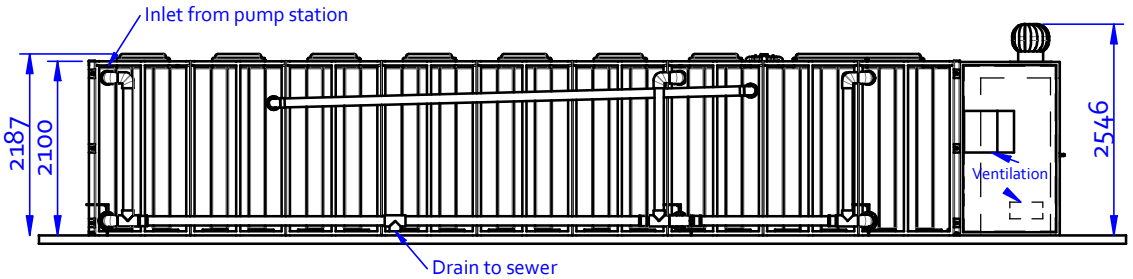
Dry weight: 4500 Kg

Wet weight: 52000 Kg

Iso View



Side View



REV.	DATE	DESCRIPTION	DRN:

GENERAL TOLERANCES (Unless otherwise noted):
Whole: ± 1.0mm
Decimal: ± 0.5mm
Angular: ± 0.5 deg.
Break ALL sharp corners and remove burrs & swarf.
All machining & fabrication to meet MIL-TFD-1111

Clearwater Technology
aquacell water recycling systems
1/26 Megalong St. Katoomba NSW 2780 Australia
PO Box 7091 Leura NSW 2780 Australia
Ph : +61 2 4782 3300, Fax : + 61 2 4782 3211

DRN BR DATE
CKD DATE
MACHINED FINISH: 3.2 UON
All dimensions in mm unless otherwise noted
Third Angle Projection - AS 1100

TITLE Aquacell S50

A3

DWG No: CWT S50

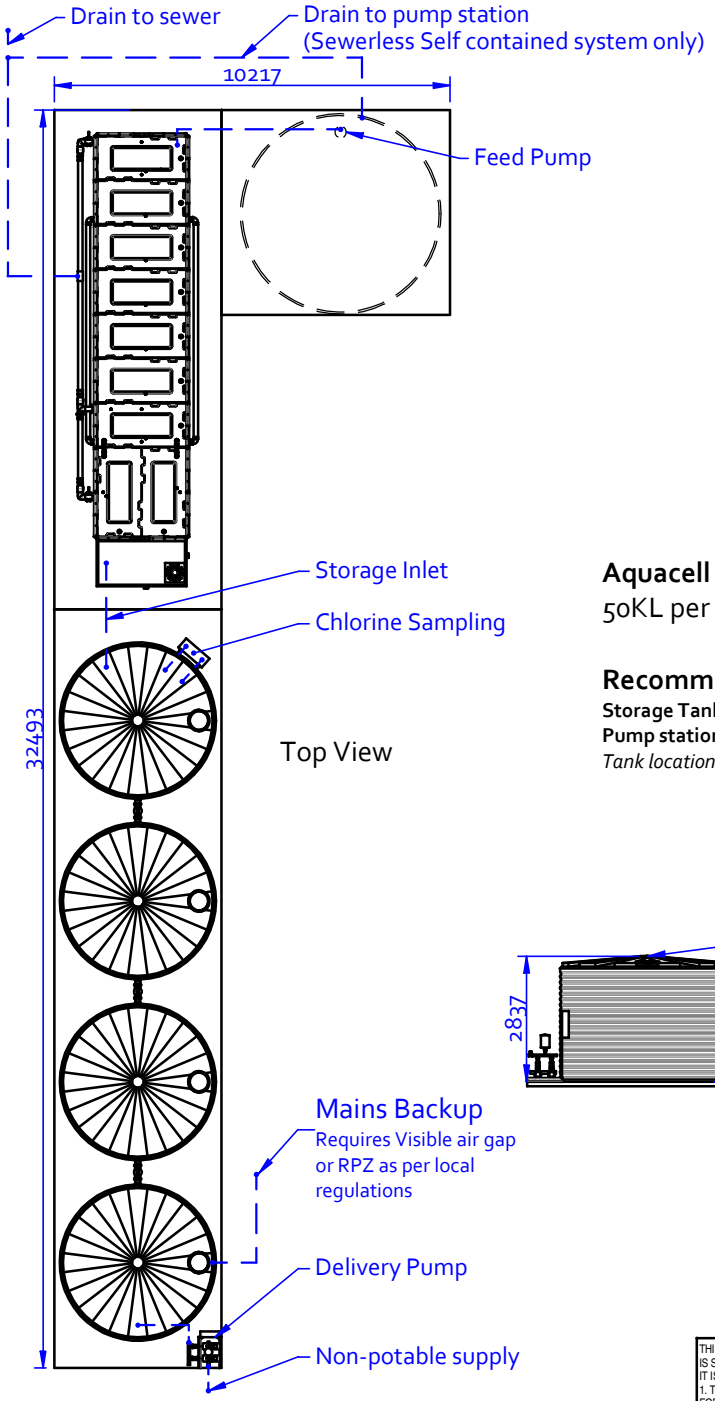
REV No:

SCALE: Noted

SHEET 1 of 1

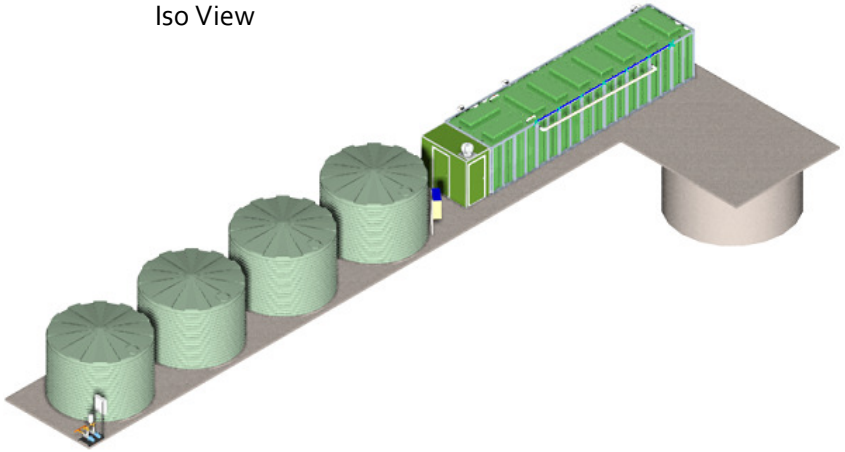
PRINT MAY BE REDUCED - DO NOT SCALE.

NOT FOR CONSTRUCTION



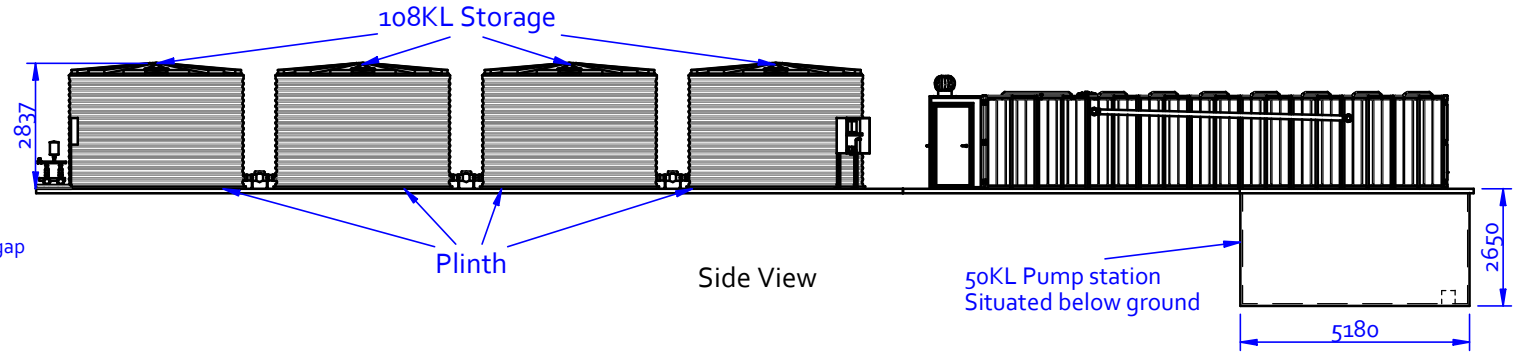
Top View

Iso View



Aquacell G50
50KL per day Treatment plant

Recommended tank sizing
Storage Tank: 108KL
Pump station: 50KL
Tank locations optional



Side View

GENERAL TOLERANCES (Unless otherwise noted):
Whole: ± 1.0mm
Decimal: ± 0.5mm
Angular: ± 0.5 deg.
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All machining & fabrication to meet MIL-TFD-1111

REV.	DATE	DESCRIPTION	DRN:

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CKD DATE
MACHINED FINISH: 3.2 UON
All dimensions in mm unless otherwise noted
Third Angle Projection - AS 1100

TITLE Aquacell G50

A3

DWG No: CWT G50
REV No:
SCALE: Noted
SHEET 2 of 2

APPENDIX B – JOALAH HOLIDAY PARK CASE STUDY

consulting systems projects operations

Aquacell® SRN20

Joalah Holiday Park, NSW

Location: Durras North, NSW

Client: Joalah Holiday Park

Capacity: 20,000L/day

Source: Wastewater from toilet, showers and laundry

Recycled Use: Toilet flushing and irrigation

Commissioned: November 2007

aquacell
water recycling solutions

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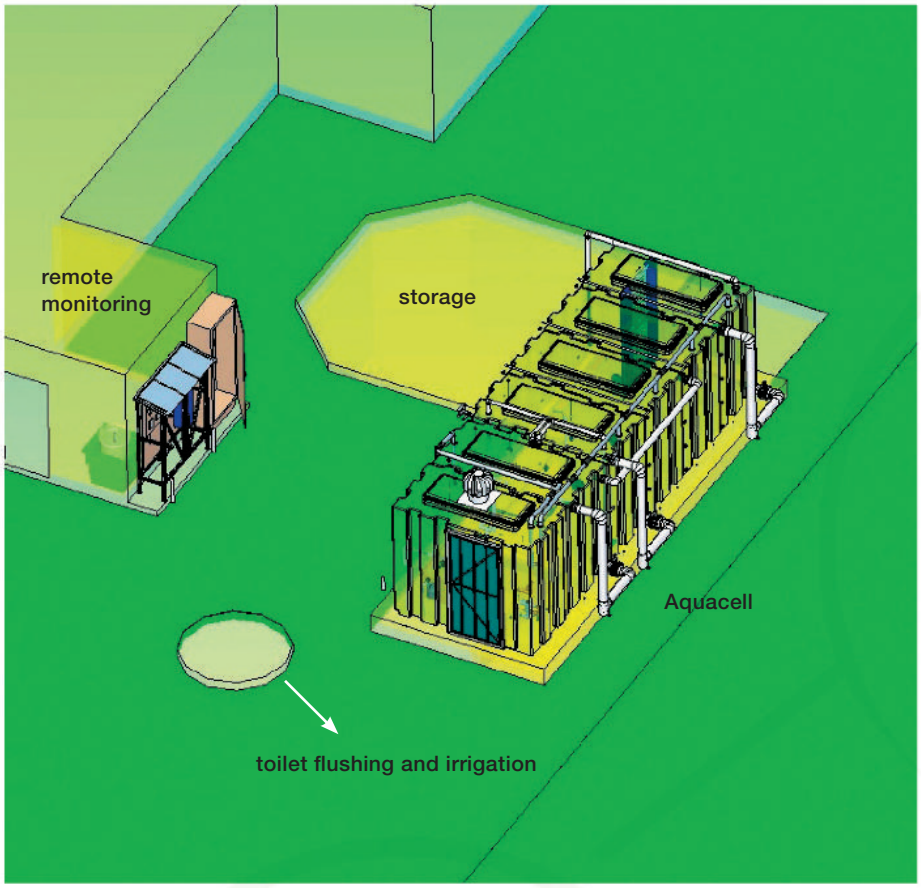
consulting systems projects operations



One recycling solution

Helping small businesses expand with eco-friendly solutions

On the beautiful South Coast of NSW, Joalah Holiday Park is in a pristine environment; adjacent to Murramarang National Park, an estuary, the Pacific Ocean, a migratory bird nesting site, and an abundance of sensitive flora and fauna.

The owners chose to install waterfront cabins with ensuites, and expand the park occupancy rates, which would increase wastewater load. In such a constrained site without a sewer connection, the only option was to recycle water for toilet flushing and irrigation. In conjunction with Dr. Peter Bacon, of Woodlots and Wetlands, a detailed land capability assessment was performed. The result of this study showed the recycled water needed to be low in nutrients, have no odour and create no noise. The solution was Aquacell's SRN20.

By recycling onsite the owners of the park are able to increase occupancy and therefore generate better returns from their resort, without adversely impacting the environment. They are able to offer a better standard of accommodation, to meet the demands of their customers in a truly eco-friendly way.

For further information:

Please contact Aquacell Head Office on 02 4782 3300 or email sales@aquacell.com.au

aquacell water recycling solutions

www.aquacell.com.au

APPENDIX D

Ramakrishnan, Parusu (Perth)

From: Campbell Durrant <campbell@biomax.com.au>
Sent: Tuesday, 24 July 2012 3:01 PM
To: Ramakrishnan, Parusu (Perth)
Subject: RE: Biomax Model for Lake Clifton Caravan Park

Hi Parusu,

Thankyou for your email.

The price includes delivery and installation by our hiab truck, training, performance testing, commissioning and handover, O&M manual and the supply and laying of the sub-strata dripper disposal system.

The price excludes all earthworks, crane hire (if required) and plumbing and electrical connections.

Best wishes

Campbell

From: Ramakrishnan, Parusu (Perth) [mailto:Parusu.Ramakrishnan@WorleyParsons.com]
Sent: Tuesday, 24 July 2012 2:51 PM
To: Campbell Durrant
Subject: RE: Biomax Model for Lake Clifton Caravan Park

Hi Campbell,

Thanks for the quote. May I know if the price includes the following and if not will you be able to provide a budget cost for these items:

- Minor civil and electrical works
- Installation
- Training
- Performance testing to WA effluent guidelines
- Commissioning and Hand over
- O&M manual
- Rate for supply and installation of sub surface and surface irrigation poly pipes i.e. $/meter

Regards,

Parusu Ramakrishnan
Lead Water/Wastewater Engineer – Power, Infrastructure & Environment
Tel: +61 (08) 6311 6270 | Mobile: 0405542789 | Fax: +61 (0)8 9278 8110 | GMT +8 |
QV1, 250 St Georges Terrace, Level 4 | Perth WA 6000 | WorleyParsons Services Pty Ltd | ABN 61 001 279 812
www.worleyparsons.com

-----Original Message-----
From: Campbell Durrant [mailto:campbell@biomax.com.au]
Sent: Tuesday, 24 July 2012 11:13 AM
To: Ramakrishnan, Parusu (Perth)
Subject: RE: Biomax Model for Lake Clifton Caravan Park

Hi Parusu,

Thankyou for your email.

The most suitable Biomax system to treat flows from 8000L/day to 45000L/day is the Biomax Model C50K.

The Model C50K can treat flows from 5000L/day to 50000L/day.

The footprint for the Model C50K is 10m x 20m x 2.8m deep.

The price for the Model C50K is $359 000 plus GST, delivered by our hiab truck.

The quality of effluent from the Model C50K is a Class B which is suitable for irrigation purposes.

Please let me know if you require additional information.

Best wishes

Campbell

-----Original Message-----
From: Ramakrishnan, Parusu (Perth)
[mailto:Parusu.Ramakrishnan@WorleyParsons.com]
Sent: Monday, 23 July 2012 4:24 PM
To: Campbell Durrant
Subject: RE: Biomax Model for Lake Clifton Caravan Park

Hi Campbell,

We spoke. I am after a price for a system that can treat flows from 8kl/day up to 45kl/day. Would you be able to price it up and let me know what quality of effluent we can get from it. Thanks.

Regards,

Parusu Ramakrishnan
Lead Water/Wastewater Engineer - Power, Infrastructure & Environment
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Appendix 5: Nutrient Balance Model

Lake Clifton
Post-development Scenario
Total Nitrogen

All assumptions regarding non-wastewater nutrient input rates and removal rates, are based on
Water and Rivers Commission 2002, *Southern River/Forrestdale/Brookdale/Wungong Urban Water Management Strategy* , Water and Rivers Commission, Perth.
Effluent assumptions are as per the Effluent management sheet

Area breakdown

Lots	Lots	22800	m2	
	Roofed/paved	14400	m2	
	Garden	4200	m2	Assumes half of remainder is lawn, other half garden.
	Lawn	4200	m2	
Open Space	Open space - lawn/garden	18065	m2	
	Effleunt Irrigation area	8300	m2	
	Road reserve	11335	m2	
	Total area	60500	m2	

Nutrient Input Without WSUD		**kg/m2/yr**	**Total area**	**Kg/Yr**	**Percentage**	
Lots	Garden	0.059	2100	123.90	33.73%	Assumes half lawn, half garden
	Lawn	0.033	2100	69.30	18.87%	Assumes half lawn, half garden
	Pet Waste	0	4200	0.00	0.00%	Assumes no pets allowed
	Car Wash			0.10	0.03%	Assumes cars washed monthly, one car per permanently occupied unit, 0.33 g per wash
	sub-total			193.30	52.63%	
POS	Garden/Lawn	0.00734	18065	132.60	36.10%	
	Pet Waste	0	18065	0.00	0.00%	Assumes no pets allowed
	Sub-total			132.60	36.10%	
Road Reserve	Major Roads	0	11335	0.00	0.00%	Road reserves not fertilised
	Minor Roads	0	11335	0.00	0.00%	Road reserves not fertilised
	Sub-total			0.00	0.00%	
Wastewater disposal	As per effluent management sheet			41.40	11.27%	
	Total			**367**	**kg/yr**	

Development Nutrient Removal via Source Control

Education effectiveness:		20%					
			Removal	Total area	Removal	removal	
	% Area of influence		KG/m2/yr		KG/yr	%	
Native Gardens (Lots-Garden)		20%	0.059	2100	24.78	6.75%	Assumes 20% native planting
Native Gardens (Lots-Lawn)		20%	0.033	2100	13.86	3.77%	Assumes 20% native planting
Native Gardens (POS)		50%	0.00734	18065	66.29855	18.05%	Assumes 50% native planting
Community Education (Lawn)		80%	0.049	2100	82.32	22.41%	Lowers use in non-native planting areas
Community Education (Garden)		80%	0.024	2100	40.32	10.98%	Lowers use in non-native planting areas
Totals					**227.57855**	**61.96%**	

Development Nutrient Removal via In transit control

			%Removal	Removal	removal	
	% Area of influence		KG/gross/yr	KG/yr	%	
Gross Pollutant Traps		0.00%	50%	0	0.00%	
Water Pollution Control Ponds		0.00%	50%	0	0.00%	
Totals				**0**	**0.00%**	

Net Nutrient Input	**140**	**kg/yr N**
	61.96	**% N removal compared to no WSUD**

Lake Clifton
Pre-development Scenario
Total Nitrogen

All assumptions regarding non-wastewater nutrient input rates and removal rates, are based on
Water and Rivers Commission 2002, *Southern River/Forrestdale/Brookdale/Wungong Urban Water Management Strategy* , Water and Rivers Commission, Perth.
Effluent assumptions are as per the Effluent management sheet

Area breakdown

Lots	Lots	4000	m2	40 permanent caravans
	Roofed/paved	1600	m2	4 by 10 m on average, with 60 m2 garden
	Garden	1200	m2	Assume half lawn, half garden
	Lawn	1200	m2	
Open Space	Open space - lawn/garden	23000	m2	
	Non-irrigated pasture/fallow	33500	m2	Assumed not to be fertilised
	Road reserve	0	m2	
	Total area	60500	m2	

Nutrient Input Without WSUD		**kg/m2/yr**	**Total area**	**Kg/Yr**	**Percentage**	
Lots	Garden	0.059	600	35.40	6.07%	Assumes half lawn, half garden
	Lawn	0.033	600	19.80	3.40%	Assumes half lawn, half garden
	Pet Waste	0	1200	0.00	0.00%	Assumes no pets allowed
	Car Wash			0.10	0.02%	Assumes cars washed monthly, one car per permanently occupied unit, 0.33 g per wash
	sub-total			55.30	9.49%	
POS	Garden/Lawn	0.00734	23000	168.82	28.97%	
	Pet Waste	0	23000	0.00	0.00%	Assumes no pets allowed
	Sub-total			168.82	28.97%	
Road Reserve	Major Roads	0	0	0.00	0.00%	Road reserves not fertilised
	Minor Roads	0	0	0.00	0.00%	Road reserves not fertilised
	Sub-total			0.00	0.00%	
Wastewater disposal	As per effluent management sheet			358.72	61.55%	
	Total			**583**	**kg/yr**	

Development Nutrient Removal via Source Control

Education effectiveness: 20%

	% Area of influence		Removal KG/m2/yr	Total area	Removal KG/yr	removal %	
Native Gardens (Lots-Garden)		0%	0.059	600	0	0.00%	Assumes 20% native planting
Native Gardens (Lots-Lawn)		0%	0.033	600	0	0.00%	Assumes 20% native planting
Native Gardens (POS)		0%	0.00734	23000	0	0.00%	Assumes 50% native planting
Community Education (Lawn)		0%	0.049	600	0	0.00%	Lowers use in non-native planting areas
Community Education (Garden)		0%	0.024	600	0	0.00%	Lowers use in non-native planting areas
Totals					**0**	**0.00%**	

Development Nutrient Removal via In transit control

	% Area of influence		%Removal KG/gross/yr	Removal KG/yr	removal %	
Gross Pollutant Traps		0.00%	50%	0	0.00%	
Water Pollution Control Ponds		0.00%	50%	0	0.00%	
Totals				**0**	**0.00%**	

Net Nutrient Input **583 kg/yr N**
0.00 % N removal compared to no WSUD

Lake Clifton
Post-development Scenario
Total Phosphorus

All assumptions regarding non-wastewater nutrient input rates and removal rates, are based on
Water and Rivers Commission 2002, *Southern River/Forrestdale/Brookdale/Wungong Urban Water Management Strategy* , Water and Rivers Commission, Perth.
Effluent assumptions are as per the Effluent management sheet

Area breakdown

Lots	Lots	22800	m2	
	Roofed/paved	14400	m2	
	Garden	4200	m2	Assumes half of remainder is lawn, other half garden.
	Lawn	4200	m2	
Open Space	Open space - lawn/garde	18065	m2	
	Effluent Irrigation area	8300	m2	
	Road reserve	11335	m2	
	Total area	60500	m2	

Nutrient Input Without WSUD		**kg/m2/yr**	**Total area**	**Kg/Yr**	**Percentage**	
Lots	Garden	0.027	4200	113.40	76.90%	Assumes half lawn, half garden
	Lawn	0.005	4200	21.00	14.24%	Assumes half lawn, half garden
	Pet Waste	0	8400	0.00	0.00%	Assumes no pets allowed
	Car Wash			0.10	0.06%	Assumes cars washed monthly, one car per permanently occupied unit, 0.33 g per wash
	sub-total			134.50	91.20%	
POS	Garden/Lawn	0.00026	18065	4.70	3.18%	
	Pet Waste	0	18065	0.00	0.00%	Assumes no pets allowed
	Sub-total			4.70	3.18%	
Road Reserve	Major Roads	0	11335	0.00	0.00%	Road reserves not fertilised
	Minor Roads	0	11335	0.00	0.00%	Road reserves not fertilised
	Sub-total			0.00	0.00%	
Wastewater disposal	As per effluent management sheet			8.28	5.61%	
	Total			**147**	**kg/yr**	

Development Nutrient Removal via Source Control

Education effectiveness:		20%				
		Removal	Total area	Removal	removal	
	% Area of influence	KG/m2/yr		KG/yr	%	
Native Gardens (Lots-Garden)	20%	0.027	4200	22.68	15.38%	Assumes 20% native planting
Native Gardens (Lots-Lawn)	20%	0.005	4200	4.2	2.85%	Assumes 20% native planting
Native Gardens (POS)	50%	0.00026	18065	2.34845	1.59%	Assumes 50% native planting
Community Education (Lawn)	80%	0.024	4200	80.64	54.68%	Lowers use in non-native planting areas
Community Education (Garden)	80%	0.004	4200	13.44	9.11%	Lowers use in non-native planting areas
Totals				**123.30845**	**83.61%**	

Development Nutrient Removal via In transit control

		%Removal	Removal	removal	
	% Area of influence	KG/gross/yr	KG/yr	%	
Gross Pollutant Traps	0.00%	50%	0	0.00%	
Water Pollution Control Ponds	0.00%	50%	0	0.00%	
Totals			**0**	**0.00%**	

Net Nutrient Input **24 kg/yr P**

83.61 % P removal compared to no WSUD

Lake Clifton
Pre-development Scenario
Total Phosphorus

All assumptions regarding non-wastewater nutrient input rates and removal rates, are based on
Water and Rivers Commission 2002, *Southern River/Forrestdale/Brookdale/Wungong Urban Water Management Strategy*, Water and Rivers Commission, Perth.
Effluent assumptions are as per the Effluent management sheet

Area breakdown

Lots	Lots	4000	m2	40 permanent caravans	
	Roofed/paved	1600	m2	4 by 10 m on average, with 60 m2 garden	
	Garden	1200	m2	Assume half lawn, half garden	Think this is overestimate of actual garden areas
	Lawn	1200	m2		
Open Space	Open space - lawn/garden	23000	m2		
	Non-irrigated pasture/fallow	32500	m2	Assumed not to be fertilised	
	Road reserve	1000	m2		
	Total area	60500	m2		

Nutrient Input Without WSUD		**kg/m2/yr**	**Total area**	**Kg/Yr**	**Percentage**	
Lots	Garden	0.027	600	16.20	28.52%	Assumes half lawn, half garden
	Lawn	0.005	600	3.00	5.28%	Assumes half lawn, half garden
	Pet Waste	0	1200	0.00	0.00%	Assumes no pets allowed
	Car Wash			0.10	0.17%	Assumes cars washed monthly, one car per permanently occupied unit, 0.33 g per wash
	sub-total			19.30	33.96%	
POS	Garden/Lawn	0.00026	23000	5.98	10.53%	
	Pet Waste	0	23000	0.00	0.00%	Assumes no pets allowed
	Sub-total			5.98	10.53%	
Road Reserve	Major Roads	0	1000	0.00	0.00%	Road reserves not fertilised
	Minor Roads	0	1000	0.00	0.00%	Road reserves not fertilised
	Sub-total			0.00	0.00%	
Wastewater disposal	As per effluent management sheet			31.54	55.51%	
	Total			**57**	**kg/yr**	

Development Nutrient Removal via Source Control

Education effectiveness:		20%				
		Removal	Total area	Removal	removal	
	% Area of influence	KG/m2/yr		KG/yr	%	
Native Gardens (Lots-Garden)	0%	0.027	600	0	0.00%	Assumes 20% native planting
Native Gardens (Lots-Lawn)	0%	0.005	600	0	0.00%	Assumes 20% native planting
Native Gardens (POS)	0%	0.00026	23000	0	0.00%	Assumes 50% native planting
Community Education (Lawn)	0%	0.024	600	0	0.00%	Lowers use in non-native planting areas
Community Education (Garden)	0%	0.004	600	0	0.00%	Lowers use in non-native planting areas
Totals				**0**	**0.00%**	

Development Nutrient Removal via In transit control

		%Removal	Removal	removal	
	% Area of influence	KG/gross/yr	KG/yr	%	
Gross Pollutant Traps	0.00%	50%	0	0.00%	
Water Pollution Control Ponds	0.00%	50%	0	0.00%	
Totals			**0**	**0.00%**	

Net Nutrient Input	**57**	**kg/yr P**
	0.00	**% P removal compared to no WSUD**

Lake Clifton - effluent management

Calculations to determine loading rates and areas required for effluent management

Volume calculations

No of units	120		
No of bedrooms per site	1.8333333		20 at 1 bedroom, balance at 2 bedroom
Peak use of site per day at 0.27 KL/bedroom/day	59.4	kL/day	

Total effluent disposal area to meet DEC/DoW guidelines for effluent disposal

Assume 40% used frequently (36 days/yr), 40% at five days per week, 26 weeks per year (130 days/yr), 20% full time (365 days/yr)

Unit days of use per year	16728		if full time then	43800
Annual water use	8.28036	ML/yr		
Assumed TN concentration	5	mg/L	Based on Worley Parsons spec	
Assumed TP concentration	1	mg/L	Based on Worley Parsons spec	

Annual TN load	41.4018	kg/yr	Guideline	140	kg/ha/yr	Based on Water Quality Protection Note 22
Annual TP load	8.28036	kg/yr	Guideline	10	kg/ha/yr	Based on Water Quality Protection Note 22

Total area for TN to meet above guideline	0.2957271	ha	
Total area for TP to meet above guideline	0.828036	ha	
Max irrigation rate	50	mm/day	Based on DoH draft country sewage policy
	0.05	kL/m2	
Total area required (m2) on DoH country sewage policy	0.1188	m2	
Area required	**0.828036**	**ha**	Maximum of three areas given above

Estimate of current wastewater effluent loads

Assumed TN concentration	91	mg/L	Based on Strategen sampling
Assumed TP concentration	8	mg/L	Based on Strategen sampling
Total no of units	60		
Assumed use per unit	0.27	kL/day	Based on DoH estimates
Assumed to be used all year			
Total use days per year	14600		Assume units used for two thirds of the year on average
Total annual volume	3.942	ML/yr	
Annual TN load	358.722	kg/yr	
Annual TP load	31.536	kg/yr	

Appendix 6: Drainage Calculations

CONSULTING CIVIL & TRAFFIC ENGINEERS, RISK MANAGERS.

Project:	Lake Clifton UWMP
Client:	Strategen
Job Number:	1208004
Author:	Ryan Needham
Signature:	
Date:	17-10-12

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Document Status

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1	R.Needham	B.Garton	17-10-12	Client Review		17-10-12

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Drainage Summary.docx

Contents

1. 1 YEAR EVENT

1 year 1 hour event – road runoff

Catchment	Road Area (m^2)	Max Flow (L/s)	Inflow Volume (m^3)	Water level (m AHD)	Stored Area (m^2)	Stored Volume (m^3)
1	3,795	13.5	48.6	2.36	510	26.5
2	4,341	15.5	55.6	2.41	300	31.6
3	3,199	11.4	41.0	2.40	375	34.1
Total	11,335	40.4	145.2			

1. All stormwater from lot areas retained within lots in soakwells
2. Road C = 0.8, POS C = 0.15
3. Stored depths, areas and volumes shown include runoff from POS areas
4. Infiltration rate assumed 1m/day

Lot Soakwell Sizing

Duration (mins)	5	6	10	20	30	60	120	180	360	720	1440	2880	4320
Inflow Volume (m^3)	0.59	0..66	0.88	1.23	1.46	1.92	2.47	2.85	3.64	4.68	5.99	7.51	8.30
Storage + Infil. Volume (m^3)	2.84	2.84	2.85	2.88	2.91	2.98	3.14	3.30	3.77	4.71	6.60	10.39	14.14
Excess capacity (m^3)	2.25	2.18	1.97	1.65	1.44	1.06	0.67	0.45	0.13	0.03	0.61	2.88	5.83

1. Sizing based on lot size of 200m^2 and roofed/paved area of 120m^2
2. Figures shown represent 2x 1.2dia. x 1.5m deep soakwells
3. Infiltration rate assumed 1m.day

2. 10 YEAR EVENT

Catchment Area	Road Area (m^2)	Lot Area(m^2)	POS (m^2)	10 yr Peak Inflow to Basin (L/s)
1	3,795	7,313	13,696	213
2	4,341	9,319	4,129	109
3	3,199	5,709	3,053	101

1. tc = 50min Lots, 6 min roads, POS varies
2. Road C = 0.8, Residential C = 0.25, POS C = 0.2
3. Coefficient of Runoff and tc from Lot areas reflects storage in soakwells
4. Storage in road/drainage pits excluded
5. Storage in Lot soakwells included

Basin	Top Level (mAHD)	Base Level (mAHD)	Top Area (m^2)	Base Area (m^2)	Total Vol (m^3)	Critical Storm Duration (hrs)	10 Year Water Level (mAHD)	10 Year Area (m^2)	10 Year Vol (m^3)
1	3.00	2.30	1,660	510	817	2	2.69	1,549	242
2	3.00	2.30	1,286	300	604	3	2.65	817	118
3	3.20	2.30	1,210	375	838	3	2.65	811	142

1. Infiltration rate assumed 1m/day

3. 100 YEAR EVENT

Catchment Area	Road Area (m^2)	Lot Area(m^2)	POS (m^2)	100yr Peak inflow to Basin (L/s)
1	3,795	7,313	13,696	431
2	4,341	9,319	4,129	385
3	3,199	5,709	3,053	276

1. tc = 20min Lots, 6 min roads, POS varies
2. Road C = 1.0, Residential C = 0.6, 4 POS C = 0.4
3. Storage in road, drainage pits excluded
4. Storage in Lot soakwells included

Basin	Top Level (mAHD)	Base Level (mAHD)	Top Area (m^2)	Base Area (m^2)	Total Vol (m^3)	Critical Storm Duration (hrs)	100 Water Level (mAHD)	100 Year Area (m^2)	100 Year Vol (m^3)
1	3.20	2.30	1,660	510	817	3	2.87	1,660	538
2	3.00	2.30	1,286	300	604	3	2.85	1,286	364
3	3.20	2.30	1,210	375	838	3	2.85	1,210	375

1. Infiltration rate assumed 1m/day

Appendix Three: Consultation Correspondence

Australian Government

Department of the Environment, Water, Heritage and the Arts

Contact Officer: Janine Douglas
Telephone: (02) 6274 2562 **Facsimile**: (02) 6274 1878

Mr Hamish Beck
Beck Advisory
Level 3, 190 St George's Terrace
PERTH WA 6000

Dear Mr Beck

Following your recent communications with the Department, I am writing to inform you of our findings regarding Beck Advisory's proposed redevelopment of Lake Clifton Caravan Park and to thank you for your cooperation in this matter.

As you may be aware, the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) protects matters of national environmental significance. Matters of national environmental significance include nationally listed threatened species and ecological communities, and Ramsar wetlands of international importance, among others. Matters of national environmental significance which are relevant in the Lake Clifton area include nationally listed threatened species, such as Baudin's Black Cockatoo and Western Ringtail Possum and Lake Clifton which is part of the Ramsar listed Peel-Yalgorup wetland system.

Not all actions affecting matters protected by the EPBC Act will have a significant impact and require approval. Information provided by Beck Advisory, Doepel Marsh Architects and Eco-scape (in writing and during discussions with the Department) indicates that the Lake Clifton Caravan Park redevelopment is unlikely to have a significant impact on the above mentioned matters of national environmental significance.

Please note that this letter must not be construed in any way as Australian Government approval of your proposed development or a decision about its EPBC Act status. A legally binding decision that an action is not subject to the EPBC Act can only be made after the action has been referred to the Department in the way specified in the Act. Any person proposing to take an action must, following suitable investigations, reach their own decision as to whether or not they think the impact of an action is likely to be significant. If a person thinks that the action may be a "controlled action" (which in this context involves having a significant impact on the above mentioned matters of

national environmental significance), the person must refer the action to the Department. Even where a person thinks that the action is not a controlled action, he or she can choose to refer the action to the Department to remove uncertainty.

Should you have any queries about the matters raised in this letter please contact me on (02) 6274 2562 or by return mail. Alternatively, if you would like further information about the referrals process, you may contact the South Australia/Western Australia Assessment Section on (02) 6274 2363.

Yours sincerely

Signed

Janine Douglas
A/g Director
EPBC Act Compliance Section (WA)

24 April 2009

Government of **Western Australia**
Department of **Water**

looking after all our water needs

Our ref: RF17-02
SRS 23287
Enquiries: Chantelle Doorn 9550 4230

16 December 2009

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22 DEC 2009
BY:.....

Chairman
Environmental Protection Authority
Locked Bag 33
CLOISTERS SQUARE WA 6850

Attn: Kathryn Schell

COPY

Dear Sir/Madam

Lots 19, 20 and 21 Old Coast Road Lake Clifton

It has come to the Department of Water's (DoW) attention that the Environmental Protection Authority (EPA) is currently assessing a development at Lots 19 to 21 Old Coast Road Lake Clifton. The DoW had previously provided advice to the Local Council on 19 November 2008 (please refer to attached). The DoW also had a meeting on 1 December 2009 with Ecoscape to discuss the development and the DoW's previous advice. At the meeting, the following issues were addressed and decided:

- The proponents will be required to undertake groundwater monitoring pre- and post development. This monitoring will need to determine groundwater quality and levels.
- A Stormwater Management Plan will need to be submitted for the site, instead of an Urban Water Management Plan as previously requested by the DoW.
- The development is not within the Peel Harvey Catchment. For this reason the advice provided by the DoW relating to the Catchment does not apply.
- Provided monitoring is undertaken for the site, and as the site is not located within the Peel Harvey Catchment, it will be unnecessary for a Land Capability Assessment to be undertaken.
- Approvals for wastewater treatment units will be required from the Shire of Waroona and the Department of Health
- Groundwater abstraction within the subject site is limited to 2000 kilolitres per hectare per annum.

If you wish to discuss the above further please contact the Department's Mandurah Office on (08) 9550 4222.

Yours Sincerely,

Adrian Parker
Program Manager – Urban Water Management
Kwinana Peel Region

CC: Mr Rod Milne
Shire of Waroona
PO Box 20
Waroona WA 6215

Mr Bruce Turner & Mr Jared Nelson
Ecoscape
PO Box 50
North Fremantle WA 6159

107 Breakwater Parade Mandurah Ocean Marina Mandurah Western Australia 6210
PO Box 332 Mandurah Western Australia 6210
Telephone (08) 9550 4222 Facsimile (08) 9581 4560
www.water.wa.gov.au
wa.gov.au

PEEL PRESERVATION GROUP INC.
PO BOX 1784, MANDURAH WA 6210

July 2010

Ecoscape
Attention: Jared Nelson

RE : Ref: TP1194 - Town Planning Scheme 7 - Application for 129 park home sites and Commercial site at Lots 19, 20 & 21 Old Coast Road, Lake Clifton

Peel Preservation Group is not in agreement with this development application in its present form. The scope of the plan is excessive, does not fit in with plans for the area and would put the Peel Yalgorup Park and Lake Clifton at risk.

"Tourist developments to be consistent with the Department of Conservation and Land Management's Management Plan for the Lake and Yalgorup National Park. Development proposals may require referral to the Environmental Protection Authority for environmental impact assessment."

The area (especially the lake and thrombolites) is far too sensitive to sustain this density of population.

In considering the protection of the thrombolites, we must take account of:

- the period of time that they need to be protected. They have been in Lake Clifton for several thousand years and there is no reason to believe that they would not continue to exist for many thousands of years provided that people do not destroy them.

  We must therefore treat the lake system as a special case and ensure that human activity now does not result in negative impacts over hundreds or even thousands of years.

- One of the major threats to the thrombolites is the formation of algae which upsets the balance of the benthic microbial mat in the lake and also coats the thrombolites causing them to die.

  The United States Environmental Protection Agency (USEPA) considered diffuse sources of phosphorus to be mainly responsible for the acceleration of eutrophication processes in surface water around the world (USEPA, 2004). Nitrogen and potassium also act as major nutrients to wetlands and algae.

- The fact that Lake Clifton is a closed system. There is no flushing mechanism and the only things that leave the lake are those which can evaporate (water) or form gases. Potassium and phosphorous do not form gaseous compounds and will never leave the system. Whilst elemental nitrogen is a gas, it is not in its elemental state in effluent and the nitrogen compounds produced during wastewater treatment will enter the biological system and also remain in the lake indefinitely.

  We therefore consider that the only acceptable level of nutrient discharge into the lake is zero.

Whilst nutrients can be largely removed from the liquid stream in sophisticated treatment systems they cannot be destroyed. A small amount is discharged with the liquid stream and the balance reports to the solid biomass (or adsorbent, ion exchange system etc). In a large municipal treatment plant the biomass is removed from the site and disposed of either in non sensitive areas or as a fertiliser (currently used on pine plantations in south west WA). Adsorption, ion exchange and physical removal are not normally practiced on local treatment plants because of cost considerations and the technical difficulty of managing what is a quite complex process. If the biomass (or adsorbent) is not removed from the site, the nutrients remain on the site and over a long period of time (perhaps hundreds of years) will be leached into the lake where, as noted above, they will remain permanently.

It is relatively common to use wetlands to adsorb nutrients from waste stream however in the case of Lake Clifton we consider that this is not a practical solution as the nutrients would find their way into the lake over the very long time period that must be considered in this particular instance.

Given the above, we can only conclude that no form of high density housing should be permitted within several kilometres of the lake unless it is serviced by a remotely located municipal wastewater treatment system.

Apart from the pressure of added infrastructure (homes and roads) the drawdown of the water table from use of bores to service this increased population would adversely affect the lake.

During a meeting with Ecoscape we were advised that there is an existing extraction licence for 2,000kl/ha/yr. This seemed unusual in both the units in which it was expressed and the absolute amount that could be abstracted. The mentioned water allocation figure may not apply to this type of development. The Lake Clifton Guidance Statement No. 28 does mention that figure for Horticultural Developments. This is a document from May 1998 which may need review in light of the EPA comments in the May 2010 “Strategic Environmental Advice on the Dawesville to Binningup Area”.

We therefore contacted Department of Water and were advised that no licence currently exists for any of lots 19, 20 or 21. Further, if a licence were to be granted, it would be for a total amount per annum per property, not per hectare.

Using the Department of Water's figures for domestic consumption of 300 to 500kl/yr/residence, plus an allowance for gardens and other ex house usage, the total allocation required for the project would be a minimum of 40,000kl/yr.

It is recognised that the Department deliberately over estimates domestic consumption but even using actual consumption figure published by Water Corporation, the actual consumption would be in the order of 20,000kl/yr.

These abstraction rates are extremely high and may adversely affect the quantity of groundwater entering the lake. There is also a strong possibility of such a high level of extraction causing the bore to become saline. This is a recognised problem as the space depleted of fresh water potentially cannot be filled sufficiently quickly by horizontal flow of fresh water and the underlying hypersaline water rises to fill the depleted space.

We commend the following recommendation contained in the report prepared by Rockwater Proprietary Limited entitled “Dawesville to Binningup Technical Environmental Studies – Hydrology Study, December 2009” and included as an appendix to the EPA report on the Dawesville to Binnigup area:

“In the eastern parts of the Island Point and Lake Clifton Subareas of the South West Coastal Groundwater Area, limit or curtail activities that may cause reductions in the quantity or deterioration of the quality of the groundwater discharge that supports the Lake Clifton thrombolite communities. ”

The use of the modal “...may...” in this recommendation suggests that it is not necessary to prove that that an activity would cause the problems mentioned. The onus appears to be on a proponent proposing an activity to prove that such activity will definitely not cause damage to the thrombolite communities.

We would certainly challenge the ecological soundness of a proposal for a commercial development eg supermarket, chemist etc with associated parking area as well as a caravan/boat parking area. The current commercial area could be redeveloped but not significantly extended to the extent of requiring the removal of the mature Tuart trees on the southernmost lot of the proposed development (possible room for parking amongst the trees).

The extent of clearing would diminish floral diversity and fauna habitat and have the potential to adversely affect drainage. It is essential that no extra nutrients (for example from fertilizing lawns and gardens) or contaminants (for example oil from roads) should reach the lake and destroy the delicate balance of its ecosystem.

It is also known that Black Cockatoos are increasingly at risk – they too use the Lake Clifton area for breeding and feeding. For this reason the trees in the area need to be retained.

The Peel Yalgorup Lakes are Ramsar listed, in part, because of their importance to migratory waterbirds and as such must be protected as valuable breeding and stopping points on the international flyways. The suggested increase in population will definitely jeopardise this important function of the Lake Clifton area.

A **much** smaller development on the area taken up by the existing Caravan Park may be acceptable with attention to minimal clearing and the above requirement for scheme water and sewerage (municipal waste water treatment)

PEEL PRESERVATION GROUP INC.

Government of **Western Australia**
Department of **Water**

looking after all our water needs

Your ref:
Our ref: RF10837
SRS 32517
Enquiries: Brett Dunn

28 November 2012

Strategen Environmental Consultants
PO Box 243
Subiaco WA 6904

Attn: Margaret Dunlop

Dear Margaret,

RE: LAKE CLIFTON PARK HOME DEVELOPMENT – URBAN WATER MANAGEMENT PLAN

Thank you for the Urban Water Management Plan (UWMP) for the Lake Clifton Park Home Development, received on the 16 November 2012. The Department of Water (DoW) has reviewed the document and wishes to provide the following advice.

Nutrient Modelling

- *Section 5.4 and Appendix 5* – Sections states "*A nutrient balance was undertaken on the site based on the assumptions and method of the Nutrient Irrigation Decision Support System (NIDSS) presented in the Southern River/Forrestdale/Brookdale/Wungong Urban Water Management Strategy (Water and Rivers Commission 2002)*". The following further information should be provided:
  - Reference to NIDDS as JDA Hydrologists model should be acknowledged;
  - Explanation of how assumptions for nutrients have been derived from this model and assurance these assumptions are applicable to the site.

- *Appendix 5* – Post development scenario for total phosphorous is mislabelled as total nitrogen removal.

Stormwater

- Design to for bioretention of the 1 year 1 hour average recurrence interval (ARI) storm event for water quality is supported. Please clarify if design allows for maximum bioretention in these frequent events. That is, will majority of stormwater in these small events infiltrate within the bubble up pits without receiving bioretention?
- Flush curbing where practical should also be investigated adjacent to bioretention/open space areas.

Wastewater Treatment Plant

- The issue of governance of the Wastewater Treatment Plant (WWTP) has not been discussed. Please identify proposed management arrangements for this infrastructure;

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- UWMP should stipulate if approval for WWTP not be granted by the Department of Health and the Shire of Waroona, the UWMP will be revised accordingly with alternative servicing arrangements.

Groundwater for Non Potable Supply

- The UWMP should identify potential yield of groundwater required to service development, inclusive of any top-up required to the WWTP and any use prior to commissioning of system;
- It is not clear whether there are currently any licences held by the property for the abstraction and use of groundwater. The subject area is located within the South West Coastal Groundwater Area, Lake Clifton sub area, as proclaimed under the *Rights in Water and Irrigation Act 1914 (RiWI)*. Any groundwater abstraction in this proclaimed area for purposes other than domestic and/or stock watering taken from the superficial aquifer, is subject to licensing by the DoW. UWMP should detail allocations of current licences on the property;
- The current allocation plan for the South West Coastal Groundwater Area, Lake Clifton sub area would currently allow and abstraction yield of 2000 kL/ha per year. Given proximity to Lake Clifton management measures would be required to manage saline intrusion and impacts to the lake through licensing under the RiWI Act;
- Any bores would need to be located at least 200 m from the edge of the conservation category wetland (CCW) boundary of Lake Clifton to manage potential drawdown issues. As the area is characterised by a fresh water lense floating on saline water, shallow low yielding bores would be required to prevent saline up-coning. The recycling of salts caused by evaporation of irrigation water is also a problem in the area;
- The Department is currently reviewing the management and allocation limits for the South West Coastal Area. The allocation limit is determined by calculating the recharge to the area, the environmental water requirements, an estimate of the current exempt domestic use, considering the current licensed use and determining how much is left to be made available for future licensing. As a result of this review it is likely that there may not be any groundwater available for licensing. It is therefore advisable that an application is submitted as soon as possible to ensure an application is received prior to any changes being made to the allocation limits;
- The UWMP should also outline contingency measures for any required non-potable supply (further to WWTP recycled water) should groundwater not be available.

If you wish to discuss the above further please contact the undersigned at the DoW's Mandurah Office on (08) 9550 4202.

Yours Sincerely,

Brett Dunn
A/Program Manager – Urban Water Management
Kwinana-Peel Region

CC: Shire of Waroona
PO Box 20
WAROONA WA 6215

Kathryn Schell
Office of the Environmental Protection Authority
Locked Bag 33, Cloisters Square
PERTH WA 6850

STRATEGEN
environmental consultants

Brett Dunn
A/Program Manager, Urban Water – Kwinana Peel Region
Department of Water
PO Box 332
MANDURAH WA 6210

Reference: BAD12112.01

Dear Brett,

LAKE CLIFTON PARK HOME DEVELOPMENT URBAN WATER MANAGEMENT PLAN – RESPONSE TO COMMENTS

In response to your letter of 28 November 2012 providing advice on the Urban Water Management Plan (UWMP) for the Lake Clifton Park Home Development, we would like to offer the following updated UWMP and responses.

Number	DoW comment	Response
Nutrient modelling		
1	*Section* 5.4 *and Appendix* 5 -Sections states *"A nutrient balance was undertaken on the site based on the assumptions and method* of *the Nutrient Irrigation Decision Support System (NIDSS) presented in the Southern River/Forrestdale/BrookdalelWungong Urban Water Management Strategy (Water and Rivers Commission 2002)".* The following further information should be provided: • Reference to NIDDS as JDA Hydrologists model should be acknowledged; • Explanation of how assumptions for nutrients have been derived from this model and assurance these assumptions are applicable to the site.	The NIDSS model was prepared by JDA Consultant Hydrologists for the WRC for the purpose of estimating pre- and post- urbanisation nutrient loads in the Southern River catchment. This study represents the most detailed available study of residential nutrient loadings in Western Australia and is based on a mixture of: • surveys of residential nutrient input rates from fertiliser, car washing and pet waste • City of Armadale records of POS fertiliser use between 1996 and 2000 • analysis by JDA of effectiveness of nutrient input source controls including community education programs, native gardens and water pollution control ponds (Appendices D and E of WRC 2002). This is the most recent comprehensive survey and analysis of the type available for the Swan Coastal Plain. Information on nutrient loads for holiday homes and short stay accommodation is not available for Western Australia. As such, the information presented in this report is considered to be the most appropriate information on which to base a nutrient model of the site.
2	Appendix 5 -Post development scenario for total phosphorous is mislabelled as total nitrogen removal.	Amended.
Stormwater		

Number	DoW comment	Response
3	Design to for bioretention of the 1 year 1 hour average recurrence interval (ARI) storm event for water quality is supported. Please clarify if design allows for maximum bioretention in these frequent events. That is, will majority of stormwater in these small events infiltrate within the bubble up pits without receiving bioretention?	As outlined in Section 5.2.1, the manholes and gully pits will have closed bases as these need to be trafficable. So the majority of water entering the road reserve will flow to the bubble up pits for treatment. Lot drainage will be managed through infiltration on the lots without connections to the broader drainage system.
4	Flush curbing where practical should also be investigated adjacent to bioretention/open space areas.	Design has been amended to include flush kerbing (refer Figure 12).
Wastewater treatment plant		
5	The issue of governance of the Wastewater Treatment Plant (WWTP) has not been discussed. Please identify proposed management arrangements for this infrastructure.	As outlined in Section 1.1, the development will be operated as a leased estate and owners will pay a fee to the developer/site owner for the upkeep of infrastructure and communal open space. The developer/site owner is likely to be responsible for the WWTP, but governance issues have not been addressed at this stage. The Department of Health (DoH) and Shire of Waroona (SoW) will require that the issue be resolved prior to a license for the plant being issued and operation commencing. The developer is committed to resolving the governance issue prior to gaining approval to operation of the plant commencing.
6	UWMP should stipulate if approval for WWTP not be granted by the Department of Health and the Shire of Waroona, the UWMP will be revised accordingly with alternative servicing arrangements.	The WWTP is considered the only appropriate servicing option for the site. As outlined in the UWMP, the site is too far from reticulated sewage for this to be feasible and DoH does not consider ATUs appropriate for a development of this density and are likely to result in a suboptimal water quality outcome. The developer is committed to working with DoH and SoW to ensure that a WWTP is approved for the site.
Groundwater for non-potable supply		
7	The UWMP should identify potential yield of groundwater required to service development, inclusive of any top-up required to the WWTP and any use prior to commissioning of system.	The maximum demand expected for the development is 9.8 ML/yr, as outlined in Section 4.2.4. A decision has been made to not provide groundwater for potable use due to potential health issues. Residents may instead be provided with a non-potable groundwater supply for irrigation and use carted water to top up tanks. This system is outlined in Section 4.2.1. The water balance has been amended to reflect this in Section 4.2.5. Based on this, the development will keep groundwater demands below 2000 kL/ha or 12 000 kL for the development, as required by the *South West Coastal Groundwater Area Groundwater Management Plan* (Water Authority of Western Australia 1989), and use metered as outlined in Section 4.2.1 of the UWMP.
8	It is not clear whether there are currently any licences held by the property for the abstraction and use of groundwater. The subject area is located within the South West Coastal Groundwater Area, Lake Clifton sub area, as proclaimed under the Rights in Water and Irrigation Act 1914 (RiWI). Any groundwater abstraction in this proclaimed area for purposes other than domestic and/or stock watering taken from the superficial aquifer, is subject to licensing by the DoW. UWMP should detail allocations of current licences on the property.	Through the UWMP process, the developer has become aware that the site does not have current licenses for historical groundwater abstraction on the site. The developer is in the process of lodging an application for an abstraction license. Text added to this effect at Section 3.8.

Number	DoW comment	Response
9	The current allocation plan for the South West Coastal Groundwater Area, Lake Clifton sub area would currently allow and abstraction yield of 2000 kLlha per year. Given proximity to Lake Clifton management measures would be required to manage saline intrusion and impacts to the lake through licensing under the RiWI Act.	Noted. This issue will be addressed through the licensing process.
10	Any bores would need to be located at least 200 m from the edge of the conservation category wetland (CCW) boundary of Lake Clifton to manage potential drawdown issues. As the area is characterised by a fresh water lense floating on saline water, shallow low yielding bores would be required to prevent saline up-coning. The recycling of salts caused by evaporation of irrigation water is also a problem in the area.	Noted. Text added at 4.2: DoW has indicated that abstraction bores on the site should be located more than 200 m from the CCW because of potential salt intrusion issues. Of the two bores present on the site, one is located within 200 m of the boundary of the CCW. This bore is located in a proposed lot and will be relocated to a site more than 200 m from the boundary as part of the development process. Bores will be designed to be shallow to minimise the intrusion of deeper saltier water associated with the saline lake.
11	The Department is currently reviewing the management and allocation limits for the South West Coastal Area. The allocation limit is determined by calculating the recharge to the area, the environmental water requirements, an estimate of the current exempt domestic use, considering the current licensed use and determining how much is left to be made available for future licensing. As a result of this review it is likely that there may not be any groundwater available for licensing. It is therefore advisable that an application is submitted as soon as possible to ensure an application is received prior to any changes being made to the allocation limits.	Noted. An application for an allocation is being submitted.
12	The UWMP should also outline contingency measures for any required non-potable supply (further to WWTP recycled water) should groundwater not be available.	The two main contingencies for the development in terms on non-potable supply are recycled WWTP water and groundwater. Should groundwater be required but no allocation available, the developer will seek to purchase an allocation from another user and/or minimise non-potable water demands on the site. Other options have been considered but are not considered practical. Rainwater from rooves on the site will be used for potable water and is not anticipated to be adequate to support this and a non-potable supply. Storage of runoff from roads and hardstand is generally not economic in the south-west as rain falls primarily over winter and the demand for irrigation primarily occurs over the summer months. Text added at Section 4.1.

Yours sincerely

Darren Walsh
CHIEF EXECUTIVE OFFICER

4 February 2013

cc: OEPA

Government of **Western Australia**
Department of **Water**

RECEIVED
DATE 11/3/13 BY DE.

looking after all our water needs

Your ref: BAD12112.01
Our ref: RF10837
SRS 32517
Enquiries: Brett Dunn

6 March 2013

Strategen Environmental Consultants
PO Box 243
SUBIACO WA 6904

Attn: Margaret Dunlop

Dear Margaret,

RE: LAKE CLIFTON PARK HOME DEVELOPMENT – REVISED URBAN WATER MANAGEMENT PLAN

Thank you for the revised Urban Water Management Plan (UWMP) for the Lake Clifton Park Home Development, received with correspondence dated 8 February 2013. The Department of Water (DoW) has reviewed the document considers the following outstanding.

Non-potable water supply

Through the review of the UWMP it has been determined that no licence currently exists for the abstraction of groundwater under the *Rights in Water Irrigation Act 1914*. The UWMP estimates 9.8 ML/year will be required for the sites irrigation strategy.

Groundwater allocation in the *South West Coastal Groundwater Area* are currently under review, with this process to be finalised in the near future. The development is reliant on this allocation being secured, thus at minimum a licence application must have been received by the Department for the UWMP to be approved.

If you wish to discuss the above further please contact the undersigned at the DoW's Mandurah Office on (08) 9550 4202.

Yours Sincerely,

Brett Dunn
Program Manager – Urban Water Management
Kwinana-Peel Region

CC: Shire of Waroona
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WAROONA WA 6215

Kathryn Schell
Office of the Environmental Protection Authority
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Appendix Four: Gemec Underground Storage Tank Removal and Soil Validation Report

GEMEC Pty Ltd

FUEL TANK REMOVAL AND SOIL VALIDATION REPORT

for

FORMER GULL LAKE CLIFTON SITE

3234 OLD COAST ROAD, LAKE CLIFTON
WESTERN AUSTRALIA 6215

July 2012

GEMEC Pty Ltd ABN 13 094 203 639
PO Box 89, Melville, Western Australia 6956
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Providing Environmental Solutions

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05 November 2012

The Tony Scolaro Family Trust
c/o Beck Advisory
PO Box 7782
Cloisters Square
PERTH WA 6850

Re: Fuel Tank Removal & Soil Validation Report – Former Gull Lake Clifton Service Station

Dear Mr Beck,

Following is a letter report detailing results of the July 2012 underground storage tank (UST) removal and soil validation works conducted by Gemec Pty Ltd (Gemec) at the former Gull Lake Clifton site located at 3234 Old Coast Road, Lake Clifton, Western Australia (the site).

The purpose of the works was to remove fuel storage and dispensing infrastructure from the site and confirm that no hydrocarbon fuel impacts remained in soils at the former locations of the removed infrastructure that had the potential to present a risk of harm to human health or the environment.

The former fuel storage and dispensing infrastructure consisted of three decommissioned USTs and a concrete plinth that housed the former diesel fuel and liquefied petroleum gas (LPG) dispensers.

Site Details and Background

Site Address:	3234 Old Coast Road, Lake Clifton, Western Australia 6215.
Common Name of Site:	Formerly Gull Lake Clifton, currently LC's Bakery.
Land Title Details:	Lot 20 on Diagram 72036, Volume 2141, Folio 172. Copy attached.
Registered Land Owner:	Maria Michela Rose Scolaro of 75 Lawley Crescent, Mount Lawley.
Site Land Area:	612 m^2.
Local Government:	Shire of Waroona.
Zoning:	'SU2' under Town Planning Scheme No. 7 (Gazette date 1996).
Land Use:	Bakery.

Surrounding Land Use and Zoning:	North (adjacent the site) – Lake Clifton Caravan Park, zoned 'SU2'. East (across Old Coast Road) – bushland, zoned 'Rural 3B - Coastal Highway'. South (adjacent the site) – vacant cleared land, zoned 'SU2'. West (adjacent the site) – Former Lake Clifton Tavern site currently unoccupied, zoned 'SU2'.
Topography:	Flat.
Site Soil Conditions:	Grey/brown/tan medium to fine grained calcareous sand overlying consolidated limestone.
Site Groundwater Conditions:	Shallow groundwater was not intercepted during the works, it is assumed that groundwater in the area resides beneath the observed consolidated limestone layer. It is likely that this groundwater would flow in a westerly direction towards Lake Clifton.
Closest Identified Potential Receptors of Groundwater:	Groundwater abstraction bore located on Lot 18 Old Coast road (west south-west of the site) – WIN ID# 20016988 (refer to the attached Figure 4 for location). Lake Clifton is located 450 m to the west.

The site has been owned by the current title holder since 1960 and was developed as a service station in 1973. The site operated under various trading brands; the most recent being "Gull". Operations at the site ceased in February 2003, with removal of all aboveground petroleum storage and distribution infrastructure (LPG aboveground storage tank [AST] and all fuel dispensers).

The current site use is as a bakery and café (LC's Café and Bakery) operating out of the former shop / sales building.

A Phase I Environmental Site Assessment Report (ESA) was undertaken by Gemec in June 2003. Works performed during the ESA included installation of a total of ten soil borings, four of which were installed at the former fuel dispenser locations, with six installed surrounding the USTs. A groundwater sample was also collected from a groundwater abstraction bore located on the adjacent lot (Lot 18).

Chemicals of potential concern (CoPC) were not reported in soil samples collected surrounding the USTs. Samples collected from soil borings installed at the southernmost petrol dispenser and the diesel dispenser identified minor hydrocarbon impacts to soils from petrol and diesel respectively. Hydrocarbon impact was identified in both borings at 0.7 metres below ground surface (m BGS); however no impact was reported in samples collected from a depth of 2.0 m BGS in both borings. No hydrocarbon impact was detected beneath the two remaining fuel dispenser locations. No CoPC were reported in the groundwater sample collected from the abstraction bore.

The conclusion reached from the 2003 work was that no immediate remediation measures were warranted; however, in the event of the decommissioning / removal of the infrastructure remediation of the impacts should be undertaken. Refer to Gemec's *Phase I Environmental Site Assessment Report - June 2003.*

Government Act / Regulations

As per the Contaminated Sites Act 2003 (CSA) and Contaminated Sites Regulations 2006 (CSR), the Western Australian Department of Environment and Conservation (DEC) definition of "contaminated" is '*in relation to land, water or a site, means having a substance in or on that land, water or site at above background concentrations that presents, or has the potential to present, a risk of harm to human health, the environment or any environmental value*'.

The site is not listed on DEC's contaminated sites database. A DEC site summary form was included within the 2003 ESA Report; however it is not known if the report was forwarded to DEC.

Soil Assessment Criteria

In February 2010, DEC released a revised document entitled '*Assessment levels for soils, sediment and water'* which forms part of the Contaminated Sites Management Series guidelines. This document outlines the screening assessment levels used by DEC in assessing site contamination and determining the requirements for further investigation, management or remedial action. The screening levels adopted for this site have been sourced from the DEC document. With respect to soil contamination the document states "*Ecological Investigation Levels (EILs) and Health Investigation Levels (HILs) are screening assessment levels. If the screening assessment levels are exceeded, further risk assessment is required to determine whether the levels present are likely to pose an actual risk in the site specific setting. EILs and HILs are not default cleanup or remediation levels".*

The EILs are screening assessment levels for the protection of the environment and environmental values. The DEC requires that assessment of soil conditions be compared with the EILs to determine the potential for environmental impact.

The HILs are screening assessment levels for the protection of human health in a variety of settings and site usage e.g. residential, commercial / industrial, parks etc.

Historically the site has been used for commercial enterprise and Gemec expects this land use to continue in the foreseeable future. As such, the HIL-F screening levels – for the protection of human health in a commercial / industrial setting – have been adopted as appropriate site screening levels.

The DEC also acknowledges assessment of hydrocarbon impact in accordance with the CRC CARE Health Screening Levels (HSL). The HSL provide screening levels for the potential for direct contact with contaminated soil and also exposure to potentially toxic vapours emanating from contaminated soil. These guidelines include a specific appraisal of vapour potential depending upon the soil type and the depth of contamination. This guidance should be considered along with the DEC screening levels rather than substituted. For reporting purposes the HSL-D (commercial land use) for direct contact has been applied as the potential for toxic vapours to be present is considered to be negligible based on the results of laboratory testing of the samples that indicated the source of impact was diesel fuel, which is considered to be of low volatility.

The relevant screening level for each analyte, where available, is provided within attached Tables documenting the analytical results. The aforementioned soil screening levels (i.e. EIL, HIL-F and HSL-D) are considered to be appropriate for the site in the context of the potential land use scenarios and current DEC published guidelines and screening levels.

Sample Analysis

The samples were sent under chain of custody (CoC) documentation to NATA accredited laboratories for testing. The primary laboratory used was Australian Laboratory Services (ALS) Perth Environmental laboratory (NATA No. 825) with the quality control (QC) split sample analysis undertaken at the ALS Melbourne laboratory (NATA No. 825).

All samples (including the QC equipment rinsate and trip / field blank samples) were analysed for petroleum hydrocarbon compounds including benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN) and C6-C40 fraction total recoverable hydrocarbons (TRH). Soil validation results are provided in Table 1, with stockpile characterisation results provided in Table 2.

Copies of the completed CoC forms and analytical results are provided in Appendix A.

As a general reporting guideline where QC samples report higher concentrations than the primary sample, the highest concentrations have been reported.

Field Activities

An initial site visit was conducted on 06 July 2012 to confirm the volume of fuel within the three on-site USTs. The ADF UST was found to contain approximately 6500 L of diesel fuel, and required emptying prior to the removal of the USTs. The remaining USTs were found to be empty i.e., containing ≤200 litres of residual fuel.

The occupiers of the site (LC's Café and Bakery) arranged for the diesel fuel to be removed from the UST; as such documentation for the removal was not made available to Gemec.

Gemec mobilised a service locator (Pulse Locating) to the site on 24 July 2012 to locate underground services in the vicinity of the proposed works. Pulse Locating used both ground penetrating radar and a multi-frequency digital line tracer to locate services.

Bunbury firm JW Cross & Sons (JWC) were contracted to undertake the excavation works.

On 25 and 26 July 2012 Gemec and JWC personnel mobilised to site to install temporary fencing and carry out the excavation and removal of the three decommissioned USTs and the concrete plinth, associated validation sampling of in situ soils and backfilling activities. JWC personal remained at the site unsupervised on 27 July to complete backfilling and compaction activities, as well as cleaning up the work site in preparation for bitumen re-surfacing.

Following removal the USTs were found to be in good condition with no visible holes or damage. Minor rust coverage was observed on all USTs, however it was only surficial and of no concern with regards to UST integrity.

The USTs were taken off-site by J&P Deconstruction (J&P) using a licenced controlled waste vehicle. The USTs were transported to J&P's yard in Picton, Western Australia for degassing and disposal (a copy of the disposal certificate is provided in Appendix B).

Following removal of the USTs the excavation was extended to a maximum depth of 3.3 metres below ground surface (m BGS) and to 1.1 m BGS beneath the former ADF dispenser location. The extent of the excavation area was approximately 10 m by 15 m. The lateral extents of the excavation area are illustrated within the attached Figure 3.

Fifteen validation soil samples were collected from the walls and base of the excavation (S1-S15). A total of six stockpile characterisation samples were also collected, three from potentially impacted soil transported off-site for disposal (SPD1-SPD3) and three from soils retained on-site for use as backfill material (SPC1-SPC3).

Soil samples were collected directly from the walls and base of the excavation using a stainless steel sampling trowel. Nitrile gloves were worn during sample collection and discarded after each sample was collected. Samples were collected in laboratory supplied containers and following collection were placed immediately on ice.

Six field QC samples were collected; two blind replicates (Dup 1, Dup 2) and two blind split samples (Split 1 and Split 2) were collected from the S15-3.2m and SPD3 samples respectively. An equipment

rinsate sample was collected from deionised water used to rinse the stainless steel sampling trowel following decontamination at the cessation of sampling. A laboratory supplied trip / field blank sample was placed in the 'esky' at the beginning of the sampling activities and accompanied the samples to the laboratory as a check against potential loss of volatile organic compounds (VOCs) in the field and whilst in transit.

The sampling trowel was decontaminated between sample collections using a laboratory grade phosphate free, biodegradable detergent (Quantumclean©) solution and rinsing with tap water. At each sampling location, one portion of the sample was placed within a laboratory prepared and supplied jar, whilst the remaining portion was placed into a 'zip lock' bag. The zip lock bag was sealed and left to rest for five minutes to allow for any VOCs to accumulate in the headspace of the bag before being field tested for the presence of VOCs using a photo-ionisation detector (PID). This process was used in the field to direct excavation activities.

Due to the presence of the canopy removal of the potentially impacted soil in the vicinity of the former ULP dispenser (as identified during the 2003 ESA) was not undertaken.

Field Observations

Degraded hydrocarbon odours were noted in soil surrounding the unprotected fill points of all three USTs. A volume of potentially impacted soil was also identified at the base of the 25 kL ULP UST, the source of which is assume to be due to minor spills during refuelling leading to fuel running down the sides of the UST. PID results for soil samples collected from stockpiled soils excavated from these areas identified the potential presence of hydrocarbon compounds, with results ranging from 70.1 to 280.8 parts per million by volume ($ppm_{V)}$. The off-site disposal of this soil was predicated on the above field observations (PID results and odour).

Discussion of Results

Soil Validation Samples

A total of 15 validation samples were collected from the walls and base of the excavation void. No samples reported concentrations of petroleum hydrocarbon compounds above the laboratory limit of reporting (LoR). The LoR is also referred to as the practical quantitation limit (PQL). An explanation of the PQL is 'the lowest level that can be reliably achieved within the specified limits of precision and accuracy during routine laboratory operating conditions'.

Refer to Figure 3 for excavation extents and validation sampling locations.

Excavated Soil Stockpile Characterisation and Off-site Disposal

Approximately 50 m^3 of potentially impacted (hydrocarbon) soils were excavated as part of the soil validation works. The potentially impacted soil was separated from excavated soil assessed in the field to be suitable for use as backfill. The potentially impacted soil was disposed of to the Peel Resource Recovery Pty Ltd (PRR) waste management facility at Stanley Road, Australind. Any potentially contaminated soil not able to be immediately mobilised to the landfill was stored temporarily on black plastic until such time that it could be transported off-site. Refer to Appendix B for disposal documentation and Appendix C for a photograph of the temporary stockpiled soil.

Five soil characterisation samples (SPD1 to SPD3 as well as the QC samples Dup 2 and Split 2) were collected from the disposed of / temporarily stockpiled soils and analysed for petroleum hydrocarbon compounds (BTEXN and TRH), with results assessed in consideration of DEC's *Landfill Waste Classification and Waste Definitions 1996 (As amended 2009)* document.

Despite field observations (PID / odour) indicating the presence of hydrocarbons, no sample reported the presence of petroleum hydrocarbon compounds above the laboratory LoR.

Clean Stockpile Characterisation and Backfilling Activities

Three samples were collected from excavated soil assessed in the field to be suitable for use as backfill (SPC1 to SPC3). No sample reported the presence of petroleum hydrocarbon compounds above the laboratory LoR. Based on the analytical results the soil was deemed appropriate for use as backfill material.

To supplement the excavated soil used for backfill, approximately 97 m^3 of quarry sand was imported onto the site. The sand was sourced from PRR's quarry, located at Lot 43, Stanley Road, Australind. Refer to Appendix B for a copy of imported fill documentation.

Compaction of the backfill material was undertaken by JWC using a heavy duty compactor; backfilling and compaction was undertaken in approximately 1 m lifts. Backfilling and compaction was completed on 27 July.

Resurfacing

Following backfilling and compaction of the excavation, bitumen re-surfacing was undertaken by Dunsborough Asphalt on Friday 10 August 2012. The delay in resurfacing was due to inclement weather. Following resurfacing the temporary fencing was removed from the site.

Quality Control

Field

No BTEXN or TRH compounds were reported in the QC trip / field blank or rinsate samples indicating proper adherence to decontamination procedures, sampling protocols and that no loss of VOCs occurred during transport.

As per Australian Standards, QC samples (Dup and Split) were collected in the field to identify variations in analyte concentrations and / or the repeatability of laboratory analysis and proficiency. Evaluation of the QC samples is undertaken by determining the relative percentage difference (RPD) of analyte concentrations in the QC samples compared to the primary sample. Where a positive value is reported for only one of the primary, duplicate or triplicate samples, laboratory LoR values are adopted by default to allow for the calculation of necessary RPDs.

Gemec adopt an RPD acceptance criterion up to 50% for organics in accordance with the Australian Standard AS 4482.1–2005. However, it is noted that RPDs may be higher due to low concentrations, heterogeneity of the samples and / or nature and age of the contaminant. Generally an RPD failure is considered significant if the results are 10 times or greater than the laboratory LoR.

No RPD exceedances were reported as part of these works.

Laboratory

The laboratory reported no outliers for samples collected as part of the works. Both laboratories reported minor QC outliers for anonymous samples accompanying the samples through the laboratory – in the context of this investigation the outliers are considered minor and do not affect the interpretation of results.

By signing the laboratory reports the laboratories infer that the results satisfy their NATA accreditation.

Tier 1 Risk Assessment

Based on the results of the soil validation sampling programme no potential risks to human health or the environment were identified as being present in the soils remaining within the excavation void.

Conclusions

All identified hydrocarbon impacted soil within the UST and former ADF dispenser excavation was removed and disposed of at a licenced facility.

The site is suitable for on-going commercial land use.

Recommendations

Based on the findings of the 2003 ESA a small volume of impacted soil may still be present beneath the southern-most former petrol dispenser location. It will not be possible to remediate this area until such time as the canopy is removed.

We have appreciated the opportunity to provide our professional services to you in relation to the environmental matters pertaining to your site. Please contact us if you require any other information or clarification of the above.

Regards,

Richard Baldwin CEnvP
Director

References

CRC Care Pty Ltd, 2011, Technical Report 10, *Health screening levels for petroleum hydrocarbons in soil and groundwater*

Department of Environment (DoE), 2005, *Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009)*

Department of Environment (DoE), 2001, *Development of Sampling and Analysis Programs,* Contaminated Sites Management Series, Western Australia

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Gemec Pty Ltd, June 2003, *Phase I Environmental Site Assessment Report*

Google Maps (online), 2012, <http://maps.google.com.au/>

National Environment Protection Measure (NEPM), Schedule B (1) 1999, *Guideline on the Investigation Levels for Soil and Groundwater*

National Environment Protection Measure (NEPM), Schedule B (2) 1999, *Guideline on Data Collection, Sample Design and Reporting*

National Environment Protection Measure (NEPM), 1999, *Assessment of Site Contamination*

Photomaps by Nearmap , 2012, <http://www.nearmap.com/>

Shire of Waroona Town Planning Scheme No. 7

Standards Australia, *Australian Standard AS 4482.1-2005, Guide to the investigation and sampling of sites with potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds*

Standards Australia, *Australian Standard AS 4482.2-1999, Guide to sampling and investigation of potentially contaminated soil, Part 2: Volatile substances*

W.A. Land Information Authority (Landgate, online), 2012, <http://www.landgate.wa.gov.au/>

Western Australian Department of Water (DoW), *Registered Groundwater Abstraction Bores within a 1 km radius of 3234 Old Coast Road, Lake Clifton, Western Australia*

Attachments:

Tables:

	Table 1	Validation Sample Analytical Results – BTEXN & TRH
	Table 2	Stockpile Sample Analytical Results – BTEXN & TRH

Figures:	Figure 1	Local Area Photograph
	Figure 2	Aerial Photograph
	Figure 3	Excavation Extents & Soil Validation Sample Locations
	Figure 4	Department of Water WIN Sites within 1 km

Appendix A: Soil Chain of Custody Forms
Soil Analytical Results

Appendix B: DEC Site Summary Form
Land Title Details
Field Calibration Certificates
Tank Disposal Documentation
Clean Fill Documentation
Soil Disposal Documentation
DMP Correspondence
Shire of Waroona Town Planning Scheme Documentation
Dial Before You Dig Plans
Gemec Protocols

Appendix C: Site Photographs

Limitations of Report

The findings and conclusions given in this report are based on the site conditions and those applicable Government regulations that existed at the time the environmental investigation was conducted and this report prepared. This report was prepared in accordance with accepted environmental practices used by environmental professionals undertaking projects of a similar nature.

Environmental investigation identifies subsurface conditions only at those locations where samples are taken and only at the time they are taken. Decisions should not be made on the basis of this report if adequacy of the report has been affected by time as the report is based on conditions that existed at the time the site was investigated.

Gemec warrant that the environmental investigation and the assessments presented in this report identifies actual subsurface conditions at those locations where samples have been taken and at the time they were taken. No other warranty as to the accuracy and completeness, express or implied, is made as to any advice included in this report.

This report has only been prepared for use by the client The Tony Scolaro Family Trust C/- Beck Advisory. This report has not been prepared for use by parties other than the client; third parties should not rely on the contents of the report. Gemec accepts no responsibility to third parties to whom this report or any part of this report is made known whether or not such disclosure is authorised. All third parties rely on this report at their own risk.

This report as a whole presents the findings and conclusions drawn from the environmental investigation and must be read in its entirety. Gemec disclaims any responsibility to the client for claims or damages arising out of the client's use of this report for anything other than the purposes given in the report. Gemec shall not be liable for the contents of this report where the client has failed to consider the entirety of this report and the underlying evaluations. In the above circumstances the client relies on this report at their own risk.

This report shall only be used by the client for the purpose or purposes that this report was bought into existence.

While every effort has been made to ensure accuracy, no liability is accepted for errors of fact or opinion herein.

This report is not intended as a substitute for legal advice which can be given only by a qualified legal practitioner.

TABLES

Table 1: Validation Sample Analytical Results - BTEXN & TRH

Sample No.	Depth (m)	Date	Time	Wall / Base	PID (ppm_v)	BTEXN					Total Recoverable Hydrocarbons			
						Benzene	Toluene	Ethylbenzene	Total Xylenes	Naphthalene	C6-C10	C10-C16	C16-C34	C34-C40
S1	2.5	26.07.12	09:42	W	6.2	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S2	2.0	26.07.12	09:45	W	3.8	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S3	1.4	26.07.12	09:48	W	6.4	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S4	3.2	26.07.12	09:52	B	4.0	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S5	1.7	26.07.12	11:00	W	0.9	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S6	2.0	26.07.12	11:02	W	1.6	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S7	1.5	26.07.12	11:13	W	2.0	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S8	0.5	26.07.12	11:41	W	1.6	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S9	1.1	26.07.12	11:38	B	0.8	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S10	1.4	26.07.12	14:36	W	0.9	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S11	2.1	26.07.12	14:40	W	1.1	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S12	1.3	26.07.12	14:42	W	1.3	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S13	2.5	26.07.12	14:44	W	1.8	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S14	3.3	26.07.12	14:32	B	1.5	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
S15	3.2	26.07.12	14:48	B	4.5	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
		Dup 1				*<0.2*	*<0.5*	*<0.5*	*<0.5*	*<1*	*<10*	*<50*	*<100*	*<100*
		RPD				*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
		Split 1 [1]				*<0.2*	*<0.5*	*<0.5*	*<0.5*	*<1*	*<10*	*<50*	*<100*	*<100*
		RPD				*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Trip Blank	-	26.07.12	07:30	-	-	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
Rinsate [8]	-	26.07.12	15:01	-	-	<1	<2	<2	<2	<5	<20	<100	<100	<100
Ecological Investigation Levels - EIL						1	3	5	5	5	100	500	1000	NE
Health Investigation Levels - HIL-F						5.6	5200	230	2600	2600	NE	NE	450 [2] / 28000 [3]	
Health Screening Levels - D						430	99000	27000	81000	11000	26000 [4]	20000 [5]	27000 [6]	38000 [7]
Laboratory Limit of Reporting						0.2	0.5	0.5	0.5	1	10	50	100	100

Notes: all concentrations reported in milligrams per kilogram (mg/kg) on a dry weight basis
'NA' denotes not applicable - primary and QC sample concentration below laboratory LoR
'NE' denotes screening level not established or under review
'RPD' denotes relative percentage difference
'Total Xylenes' denotes sum of meta-, para- & ortho-xylene

1. sample analysed at ALS Melbourne
2. C_{16}-C_{35} aromatic assessment level
3. C_{16}-C_{35} aliphatic assessment level
4. C_6-C_{10} screening level
5. >C_{10}-C_{16} screening level
6. >C_{16}-C_{34} screening level
7. >C_{34}-C_{40} screening level
8. Rinsate concentrations reported in micrograms per litre (µg/L)

Table 2: Stockpile Sample Analytical Results - BTEXN & TRH

Sample No.	Depth (m)	Date	Time	PID (ppm_V)	BTEXN					Total Recoverable Hydrocarbons			
					Benzene	Toluene	Ethylbenzene	Total Xylenes	Naphthalene	C6-C10	C10-C16	C16-C34	C34-C40
SPD1	-	26.07.12	10:58	70.1	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
SPD2	-	26.07.12	11:11	145.9	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
SPD3	-	26.07.12	13:32	280.8	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
		Dup 2			*<0.2*	*<0.5*	*<0.5*	*<0.5*	*<1*	*<10*	*<50*	*<100*	*<100*
		RPD			*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
		Split 2 [1]			*<0.2*	*<0.5*	*<0.5*	*<0.5*	*<1*	*<10*	*<50*	*<100*	*<100*
		RPD			*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
SPC1	-	26.07.12	13:48	1.8	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
SPC2	-	26.07.12	15:12	2.1	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
SPC3	-	26.07.12	15:30	0.9	<0.2	<0.5	<0.5	<0.5	<1	<10	<50	<100	<100
Ecological Investigation Levels - EIL					1	3	5	5	5	100	500	1000	NE
Health Investigation Levels - HIL-F					5.6	5200	230	2600	2600	NE	NE	450 [2] / 28000 [3]	
Health Screening Levels - D					430	99000	27000	81000	11000	26000 [5]	20000 [6]	27000 [7]	38000 [8]
Class I / II Contaminant Threshold Values (CT1 / CT2)					0.2	160	60	120		NE	NE	NE	NE
Class I / II Concentration Limit (CL1 / CL2)					18	518	1080	1800		2800	NE	450 [2] / 28000 [3] / 280000 [4]	
Laboratory Limit of Reporting					0.2	0.5	0.5	0.5	1	10	50	100	100

Notes: all concentrations reported in milligrams per kilogram (mg/kg) on a dry weight basis
'NA' denotes not applicable - primary and QC sample concentration below laboratory LoR
'NE' denotes screening level not established or under review
'RPD' denotes relative percentage difference
'Total Xylenes' denotes sum of meta-, para- & ortho-xylene

1. sample analysed at ALS Melbourne
2. C_{16}-C_{35} aromatic assessment level
3. C_{16}-C_{35} aliphatic assessment level
4. >C_{35} aliphatic assessment level
5. C_6-C_{10} screening level
6. >C_{10}-C_{16} screening level
7. >C_{16}-C_{34} screening level
8. >C_{34}-C_{40} screening level

FIGURES

GEMEC PTY LTD
PO Box 89
Melville WA 6956
Tel: +61 8 9339 8449
Fax: +61 8 9339 0073
Web: www.gemec.com.au

Site Location

0 0.5 1
Scale (km), approx.

Local Area Photograph - 02.02.09

SOURCE: NearMap

Former Gull Lake Clifton Service Station

3234 Old Coast Road, Lake Clifton, Western Australia

Drawn: TM	Date: 30.07.12	CHECKED RB	APPROVED RB	DRG No. Figure 1
Scale: As Shown				

GEMEC PTY LTD
PO Box 89
Melville WA 6956
Tel: +61 8 9339 8449
Fax: +61 8 9339 0073
Web: www.gemec.com.au

Approximate Site Boundary (not surveyed)
Excavation Extents
Underground Storage Tanks

0 5 10 15 20
Scale (m), approx.

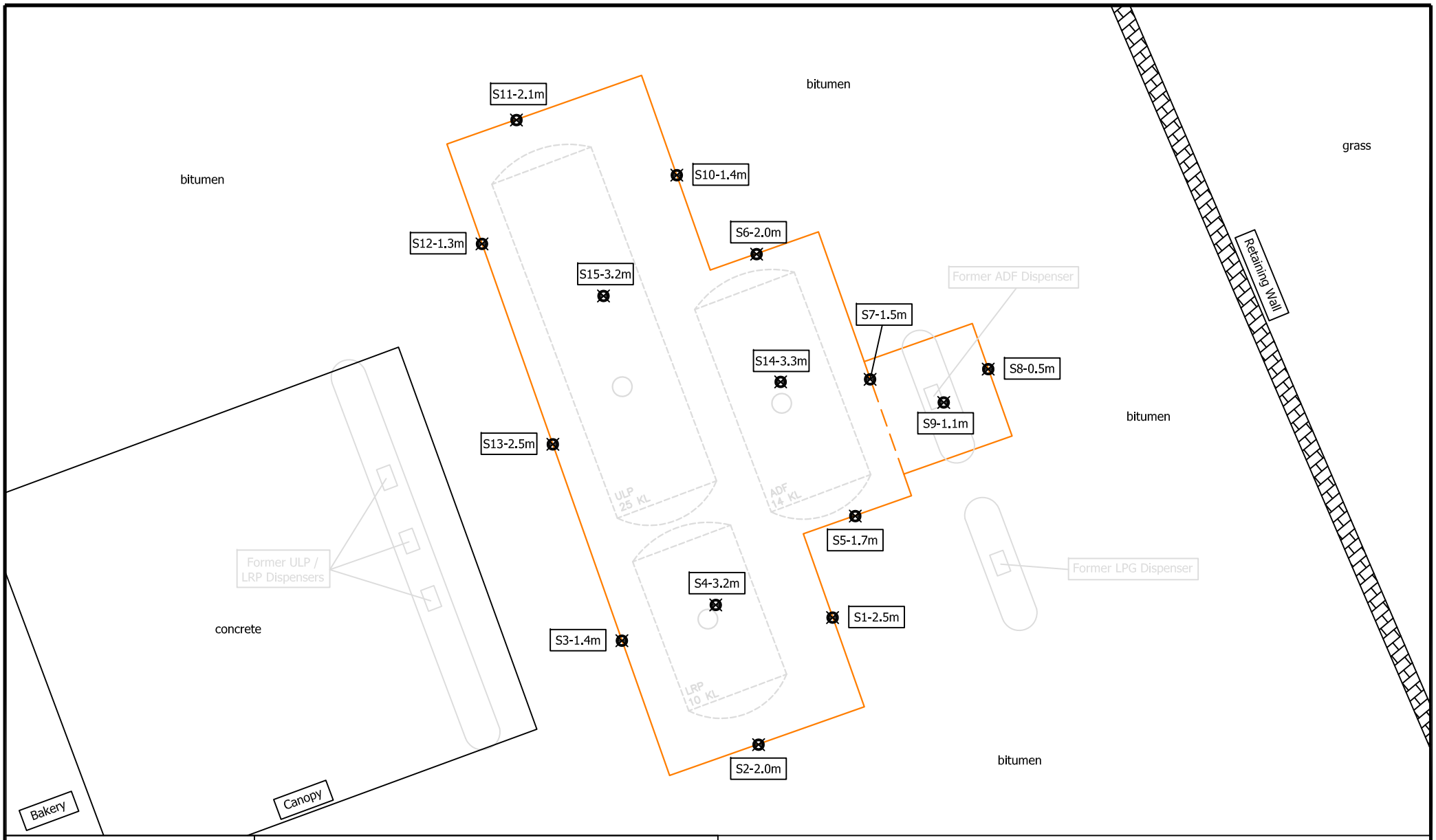
Aerial Photograph - 02.02.09

SOURCE: NearMap

Former Gull Lake Clifton Service Station

3234 Old Coast Road, Lake Clifton, Western Australia

Drawn: TM	Date: 30.07.12	CHECKED RB	APPROVED RB	DRG No. Figure 2
Scale: As Shown				



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Melville WA 6956
Tel: +61 8 9339 8449
Fax: +61 8 9339 0073
Web: www.gemec.com.au

Approximate Site and Lot Boundaries (not surveyed)
Excavation Extents
Former Infrastructure
S1-2.5m Soil Validation Sample Location / ID

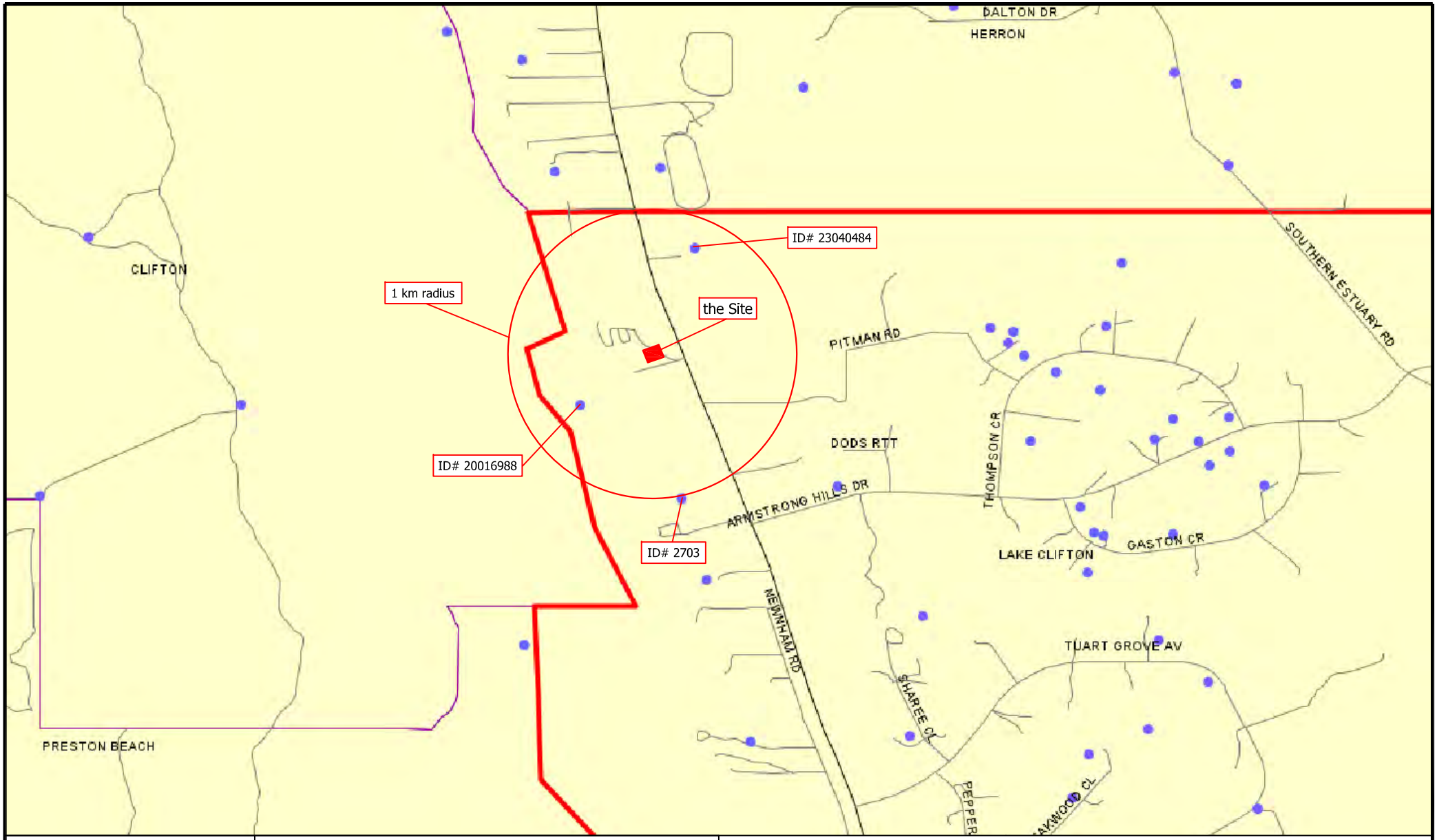
0 1 2 3 4
Scale (m), approx.

Excavation Extents & Soil Validation Sample Locations

Former Gull Lake Clifton Service Station

3234 Old Coast Road, Lake Clifton, Western Australia

Drawn: TM	Date: 01.08.12	CHECKED RB	APPROVED RB	DRG No. Figure 3
Scale: As Shown				



GEMEC PTY LTD
PO Box 89
Melville WA 6956
Tel: +61 8 9339 8449
Fax: +61 8 9339 0073
Web: www.gemec.com.au

Approximate Site and Lot Boundaries (not surveyed)

DoW WIN Site

0 0.5 1
Scale (km), approx.

Department of Water WIN Sites within 1 km

SOURCE: DoW

Former Gull Lake Clifton Service Station

3234 Old Coast Road, Lake Clifton, Western Australia

Drawn: TM	Date: 01.08.12	CHECKED RB	APPROVED RB	DRG No. Figure 4
Scale: As Shown				

APPENDIX A

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

CLIENT: Gemec Pty Ltd	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☑ Standard TAT **(List due date):**	**FOR LABORATORY USE ONLY (Circle)**
OFFICE:		☐ Non Standard or urgent TAT **(List due date):**	Custody Seal Intact? Yes No N/A
PROJECT: Lake Clifton	**ALS QUOTE NO.:** EP-173-10	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER:		COC: (1) 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Toby Munro	**CONTACT PH:** 08 9339 8449	OF: 1 2 (3) 4 5 6 7	Other comment:
SAMPLER: Toby Munro	**SAMPLER MOBILE:** 0423 610 292	**RELINQUISHED BY:** T Munro	**RECEIVED BY:** AVT
COC emailed to ALS? (YES / NO)	**EDD FORMAT (or default):**	DATE/TIME: 27.07.12 / 10:15	DATE/TIME: 27.7.12 1:35pm
Email Reports to (will default to PM if no other addresses are listed): toby@gemec.com.au & richard@gemec.com.au		**RELINQUISHED BY:**	**RECEIVED BY:**
Email Invoice to (will default to PM if no other addresses are listed): marise@gemec.com.au		DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)				CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE	TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	BTEXN / TRH								Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	S1-2.5m	26.07.12	9:42	S	-	1	X								
2	S2-2.0m	26.07.12	9:45	S	-	1	X								
3	S3-1.4m	26.07.12	9:48	S	-	1	X								
4	S4-3.2m	26.07.12	9:52	S	-	1	X								
5	S5-1.7m	26.07.12	11:00	S	-	1	X								
6	S6-2.0m	26.07.12	11:08	S	-	1	X								
7	S7-1.5m	26.07.12	11:13	S	-	1	X								
8	S8-0.5m	26.07.12	11:42	S	-	1	X								
9	S9-1.1m	26.07.12	11:38	S	-	1	X								
10	S10-1.4m	26.07.12	14:36	S	-	1	X								
11	S11-2.1m	26.07.12	14:40	S	-	1	X								
12	S12-1.3m	26.07.12	14:42	S	-	1	X								
					TOTAL	12	12								

Environmental Division
Perth
Work Order
EP1206144

Telephone : +61-8-9209 7655

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

CLIENT: Gemec Pty Ltd	**TURNAROUND REQUIREMENTS :** ☐ Standard TAT **(List due date):**	**FOR LABORATORY USE ONLY (Circle)**
OFFICE:	(Standard TAT may be longer for some tests e.g.. Ultra Trace Organics) ☐ Non Standard or urgent TAT **(List due date):**	Custody Seal Intact? Yes No N/A
PROJECT: Lake Clifton	**ALS QUOTE NO.:** EP-173-10	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER:	**COC SEQUENCE NUMBER (Circle)** COC: 1 (2) 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Toby Munro **CONTACT PH:** 08 9339 8449	OF: 1 2 (3) 4 5 6 7	Other comment:

SAMPLER: Toby Munro	**SAMPLER MOBILE:** 0423 610 292	**RELINQUISHED BY:**	**RECEIVED BY:**	**RELINQUISHED BY:** / **RECEIVED BY:**
COC emailed to ALS? (YES / NO)	**EDD FORMAT (or default):**	T Munro	AVT	
Email Reports to (will default to PM if no other addresses are listed): toby@gemec.com.au & richard@gemec.com.au		DATE/TIME:	DATE/TIME: 27.7.12 1:35PM	DATE/TIME: / DATE/TIME:
Email Invoice to (will default to PM if no other addresses are listed): marise@gemec.com.au		27.07.12 / 10:15		

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)				CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE	TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	BTEXN / TRH								Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
13	S13-2.5m	26.07.12	14:44	S	-	1	X								
14	S14-3.3m	26.07.12	14:32	S	-	1	X								
15	S15-3.2m	26.07.12	14:48	S	-	1	X								
16	SPC1	26.07.12	13:48	S	-	1	X								
17	SPC2	26.07.12	15:12	S	-	1	X								
18	SPC3	26.07.12	15:30	S	-	1	X								
19	SPD1	26.07.12	10:58	S	-	1	X								
20	SPD2	26.07.12	11:11	S	-	1	X								
21	SPD3	26.07.12	13:32	S	-	1	X								
22	Dup 1	26.07.12	--:--	S	-	1	X								
23	Dup 2	26.07.12	--:--	S	-	1	X								
24	Trip Blank	26.07.12	7:30	S	-	1	X								
					TOTAL	12	12								

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

CLIENT: Gemec Pty Ltd	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)	☑ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)
OFFICE:		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: Lake Clifton	ALS QUOTE NO.: EP-173-10	COC SEQUENCE NUMBER (Circle)	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER:		COC: 1 2 (3) 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Toby Munro	CONTACT PH: 08 9339 8449	OF: 1 2 (3) 4 5 6 7	Other comment:

SAMPLER: Toby Munro	SAMPLER MOBILE: 0423 610 292	RELINQUISHED BY: T Munro	RECEIVED BY: AVT	RELINQUISHED BY:	RECEIVED BY:
COC emailed to ALS? (YES / NO)	EDD FORMAT (or default):	DATE/TIME: 27.07.12 / 10:15	DATE/TIME: 27.7.12 1.35pm	DATE/TIME:	DATE/TIME:
Email Reports to (will default to PM if no other addresses are listed): toby@gemec.com.au & richard@gemec.com.au					
Email Invoice to (will default to PM if no other addresses are listed): marise@gemec.com.au					

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)				CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE	TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL CONTAINERS	BTEXN / TRH								Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
25	Rinsate	26.07.12	15:01	W	1XAG, 2XVB	3	X								
					TOTAL	3	3								

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

CERTIFICATE OF ANALYSIS

Work Order	: **EP1206144**	Page	: 1 of 9
Client	: **GEMEC PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR TOBY MUNRO	Contact	: Scott James
Address	: UNIT 1/25 FOSS STREET PALMYRA WA, AUSTRALIA	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: toby@gemec.com.au	E-mail	: perth.enviro.services@alsglobal.com
Telephone	: +61 08 9339 8449	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: Lake Clifton	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 27-JUL-2012
Sampler	: T.M	Issue Date	: 02-AUG-2012
Site	: ----		
		No. of samples received	: 25
Quote number	: EP-173-10 BQ	No. of samples analysed	: 25

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Agnes Szilagyi	Senior Organic Chemist	Perth Inorganics
Agnes Szilagyi	Senior Organic Chemist	Perth Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EP071: Poor Lab QC duplicate #2 recovery due to sample heterogeneity.**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: S1-2.5m	S2-2.0m	S3-1.4m	S4-3.2m	S5-1.7m
				Client sampling date / time: 26-JUL-2012 09:42	26-JUL-2012 09:45	26-JUL-2012 09:48	26-JUL-2012 09:52	26-JUL-2012 11:00
				EP1206144-001	EP1206144-002	EP1206144-003	EP1206144-004	EP1206144-005
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**5.9**	**1.9**	**1.5**	**8.6**	**2.3**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
^ **C6 - C10 Fraction minus BTEX (F1)**	----	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEX								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080: BTEXN								
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ **Total Xylenes**	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**102**	**100**	**111**	**105**	**95.6**
Toluene-D8	2037-26-5	0.1	%	**92.5**	**92.8**	**96.6**	**89.3**	**89.6**
4-Bromofluorobenzene	460-00-4	0.1	%	**88.0**	**84.2**	**81.6**	**76.7**	**79.4**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: S6-2.0m	S7-1.5m	S8-0.5m	S9-1.1m	S10-1.4m
				Client sampling date / time: 26-JUL-2012 11:08	26-JUL-2012 11:13	26-JUL-2012 11:42	26-JUL-2012 11:38	26-JUL-2012 14:36
				EP1206144-006	EP1206144-007	EP1206144-008	EP1206144-009	EP1206144-010
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**2.3**	**2.4**	**3.0**	**3.1**	**2.4**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
^ **C6 - C10 Fraction minus BTEX (F1)**	----	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEX								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080: BTEXN								
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ **Total Xylenes**	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**110**	**110**	**107**	**117**	**114**
Toluene-D8	2037-26-5	0.1	%	**94.1**	**94.8**	**92.8**	**103**	**97.9**
4-Bromofluorobenzene	460-00-4	0.1	%	**87.3**	**83.6**	**79.4**	**83.7**	**87.8**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: S11-2.1m Client sampling date / time: 26-JUL-2012 14:40 EP1206144-011	S12-1.3m 26-JUL-2012 14:42 EP1206144-012	S13-2.5m 26-JUL-2012 14:44 EP1206144-013	S14-3.3m 26-JUL-2012 14:32 EP1206144-014	S15-3.2m 26-JUL-2012 14:48 EP1206144-015
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**1.9**	**2.2**	**1.8**	**6.7**	**11.2**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
^ **C6 - C10 Fraction minus BTEX (F1)**	----	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEX								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080: BTEXN								
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ **Total Xylenes**	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**99.9**	**107**	**111**	**108**	**105**
Toluene-D8	2037-26-5	0.1	%	**88.2**	**90.5**	**97.0**	**92.5**	**84.7**
4-Bromofluorobenzene	460-00-4	0.1	%	**74.6**	**82.8**	**83.4**	**80.4**	**78.4**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SPC1	SPC2	SPC3	SPD1	SPD2
				Client sampling date / time: 26-JUL-2012 13:48	26-JUL-2012 15:12	26-JUL-2012 15:30	26-JUL-2012 10:58	26-JUL-2012 11:11
				EP1206144-016	EP1206144-017	EP1206144-018	EP1206144-019	EP1206144-020
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**3.0**	**1.9**	**1.5**	**7.7**	**4.5**
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
^ **C6 - C10 Fraction minus BTEX (F1)**	----	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEX								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080: BTEXN								
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ **Total Xylenes**	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**111**	**123**	**116**	**116**	**117**
Toluene-D8	2037-26-5	0.1	%	**92.7**	**96.1**	**96.4**	**90.5**	**93.6**
4-Bromofluorobenzene	460-00-4	0.1	%	**81.6**	**84.1**	**80.0**	**80.5**	**84.8**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SPD3	Dup1	Dup2	Trip Blank	----
				Client sampling date / time: 26-JUL-2012 13:32	26-JUL-2012 15:00	26-JUL-2012 15:00	26-JUL-2012 07:30	----
				EP1206144-021	EP1206144-022	EP1206144-023	EP1206144-024	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**5.6**	**10.9**	**5.0**	<1.0	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	----
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	10	mg/kg	<10	<10	<10	<10	----
^ **C6 - C10 Fraction minus BTEX (F1)**	----	10	mg/kg	<10	<10	<10	<10	----
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	----
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	<50	<50	<50	<50	----
EP080: BTEX								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	----
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
EP080: BTEXN								
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	----
^ **Total Xylenes**	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**110**	**100**	**109**	**109**	----
Toluene-D8	2037-26-5	0.1	%	**93.2**	**87.4**	**92.1**	**96.8**	----
4-Bromofluorobenzene	460-00-4	0.1	%	**91.8**	**80.2**	**82.1**	**83.1**	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Rinsate	----	----	----	----
				Client sampling date / time: 27-JUL-2012 15:01	----	----	----	----
				EP1206144-025	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	----	20	µg/L	<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	<100	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	----	----	----	----
Toluene	108-88-3	2	µg/L	<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	----	----	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L	<2	----	----	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**89.5**	----	----	----	----
Toluene-D8	2037-26-5	0.1	%	**106**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	**95.5**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	63.2	132
Toluene-D8	2037-26-5	66.0	125.4
4-Bromofluorobenzene	460-00-4	60.4	124

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	60.5	141.2
Toluene-D8	2037-26-5	73.4	126
4-Bromofluorobenzene	460-00-4	59.6	125.3

QUALITY CONTROL REPORT

Work Order	: **EP1206144**	Page	: 1 of 9
Client	: **GEMEC PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR TOBY MUNRO	Contact	: Scott James
Address	: UNIT 1/25 FOSS STREET PALMYRA WA, AUSTRALIA	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: toby@gemec.com.au	E-mail	: perth.enviro.services@alsglobal.com
Telephone	: +61 08 9339 8449	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: Lake Clifton	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 27-JUL-2012
Sampler	: T.M	Issue Date	: 02-AUG-2012
Order number	: ----		
		No. of samples received	: 25
Quote number	: EP-173-10 BQ	No. of samples analysed	: 25

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Agnes Szilagyi	Senior Organic Chemist	Perth Inorganics
Agnes Szilagyi	Senior Organic Chemist	Perth Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA055: Moisture Content (QC Lot: 2424600)									
EP1206144-001	S1-2.5m	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	5.9	5.8	3.0	No Limit
EP1206144-010	S10-1.4m	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	2.4	2.5	0.0	No Limit
EA055: Moisture Content (QC Lot: 2424601)									
EP1206144-021	SPD3	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	5.6	6.0	6.7	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2424623)									
EP1206144-001	S1-2.5m	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP1206144-011	S11-2.1m	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2424723)									
EP1206144-001	S1-2.5m	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP1206144-011	S11-2.1m	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2424728)									
EP1206118-005	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP1206147-001	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2425377)									
EP1206048-114	Anonymous	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP1206169-001	Anonymous	EP071: C15 - C28 Fraction	----	100	mg/kg	1050	310	# 108	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	690	230	98.8	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2424623)									
EP1206144-001	S1-2.5m	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP1206144-011	S11-2.1m	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2424723)									
EP1206144-001	S1-2.5m	EP080: C6 - C10 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP1206144-011	S11-2.1m	EP080: C6 - C10 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2424728)									
EP1206118-005	Anonymous	EP080: C6 - C10 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP1206147-001	Anonymous	EP080: C6 - C10 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2425377)									
EP1206048-114	Anonymous	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP1206169-001	Anonymous	EP071: >C16 - C34 Fraction	----	100	mg/kg	1690	500	# 108	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	270	100	88.9	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP080: BTEXN (QC Lot: 2424723)									
EP1206144-001	S1-2.5m	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EP1206144-011	S11-2.1m	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EP080: BTEXN (QC Lot: 2424728)									
EP1206118-005	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EP1206147-001	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2425254)									
EP1206048-150	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP1206134-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2425254)									
EP1206048-150	Anonymous	EP080: C6 - C10 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP1206134-001	Anonymous	EP080: C6 - C10 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080: BTEXN (QC Lot: 2425254)									
EP1206048-150	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
EP1206134-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2424623)								
EP071: C10 - C14 Fraction	----	25	mg/kg	----	1130 mg/kg	97.0	64.7	126
		50	mg/kg	<50	----	----	----	----
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	----	----	----	----
		50	mg/kg	----	2505 mg/kg	91.7	61.7	124
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	----	----	----	----
		50	mg/kg	----	351 mg/kg	91.2	64.6	131
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2424723)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	32 mg/kg	86.8	68	140
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2424728)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	32 mg/kg	105	68	140
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2425377)								
EP071: C10 - C14 Fraction	----	25	mg/kg	----	1130 mg/kg	96.6	64.7	126
		50	mg/kg	<50	----	----	----	----
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	----	----	----	----
		50	mg/kg	----	2505 mg/kg	91.6	61.7	124
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	----	----	----	----
		50	mg/kg	----	351 mg/kg	90.3	64.6	131
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2424623)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	1779 mg/kg	97.2	64.7	126
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	2123 mg/kg	90.7	61.7	124
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	87 mg/kg	89.1	64.6	131
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2424723)								
EP080: C6 - C10 Fraction	----	10	mg/kg	<10	33.25 mg/kg	87.3	68	140
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2424728)								
EP080: C6 - C10 Fraction	----	10	mg/kg	<10	33.25 mg/kg	103	68	140
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2425377)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	1779 mg/kg	97.2	64.7	126
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	2123 mg/kg	90.5	61.7	124
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	87 mg/kg	77.2	64.6	131
EP080: BTEXN (QCLot: 2424723)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	88.5	73.4	122
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	2 mg/kg	89.3	74.3	121
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2 mg/kg	86.8	74.2	122

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP080: BTEXN (QCLot: 2424723) - continued								
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4 mg/kg	88.9	74.8	121
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2 mg/kg	90.4	74.2	121
EP080: Naphthalene	91-20-3	1	mg/kg	<1	2 mg/kg	85.3	67.2	122
EP080: BTEXN (QCLot: 2424728)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	110	73.4	122
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	2 mg/kg	108	74.3	121
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2 mg/kg	105	74.2	122
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4 mg/kg	108	74.8	121
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2 mg/kg	112	74.2	121
EP080: Naphthalene	91-20-3	1	mg/kg	<1	2 mg/kg	106	67.2	122

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2425254)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	320 µg/L	116	74.2	142
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2429069)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	4000 µg/L	74.0	44.5	122
EP071: C15 - C28 Fraction	----	100	µg/L	<100	4000 µg/L	79.0	55.1	143
EP071: C29 - C36 Fraction	----	50	µg/L	<50	4000 µg/L	54.2	53.6	128
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2425254)								
EP080: C6 - C10 Fraction	----	20	µg/L	<20	332.5 µg/L	117	74.2	142
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2429069)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	4000 µg/L	74.8	44.5	122
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	6000 µg/L	69.6	55.1	143
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	2000 µg/L	56.9	53.6	128
EP080: BTEXN (QCLot: 2425254)								
EP080: Benzene	71-43-2	1	µg/L	<1	20 µg/L	108	72.6	122
EP080: Toluene	108-88-3	2	µg/L	<2	20 µg/L	113	71.1	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	112	71.9	121
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	114	72.3	122
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	113	72.3	121
EP080: Naphthalene	91-20-3	5	µg/L	<5	20 µg/L	113	78.8	121

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	Spike Recovery (%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2424623)							
EP1206144-002	S2-2.0m	EP071: C10 - C14 Fraction	----	1130 mg/kg	98.4	64.7	126
		EP071: C15 - C28 Fraction	----	2505 mg/kg	92.6	61.7	124
		EP071: C29 - C36 Fraction	----	351 mg/kg	93.0	64.6	131
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2424723)							
EP1206144-002	S2-2.0m	EP080: C6 - C9 Fraction	----	28 mg/kg	98.1	69.1	135
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2424728)							
EP1206147-003	Anonymous	EP080: C6 - C9 Fraction	----	28 mg/kg	95.4	69.1	135
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2425377)							
EP1206048-141	Anonymous	EP071: C10 - C14 Fraction	----	1130 mg/kg	96.8	64.7	126
		EP071: C15 - C28 Fraction	----	2505 mg/kg	90.5	61.7	124
		EP071: C29 - C36 Fraction	----	351 mg/kg	90.3	64.6	131
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2424623)							
EP1206144-002	S2-2.0m	EP071: >C10 - C16 Fraction	----	1779 mg/kg	98.5	64.7	126
		EP071: >C16 - C34 Fraction	----	2123 mg/kg	91.7	61.7	124
		EP071: >C34 - C40 Fraction	----	87 mg/kg	92.0	64.6	131
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2424723)							
EP1206144-002	S2-2.0m	EP080: C6 - C10 Fraction	----	29.25 mg/kg	99.8	69.1	135
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2424728)							
EP1206147-003	Anonymous	EP080: C6 - C10 Fraction	----	29.25 mg/kg	94.8	69.1	135
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2425377)							
EP1206048-141	Anonymous	EP071: >C10 - C16 Fraction	----	1779 mg/kg	96.4	64.7	126
		EP071: >C16 - C34 Fraction	----	2123 mg/kg	89.4	61.7	124
		EP071: >C34 - C40 Fraction	----	87 mg/kg	108	64.6	131
EP080: BTEXN (QCLot: 2424723)							
EP1206144-002	S2-2.0m	EP080: Benzene	71-43-2	2 mg/kg	80.7	76.4	118
		EP080: Toluene	108-88-3	2 mg/kg	85.4	67.4	127
EP080: BTEXN (QCLot: 2424728)							
EP1206147-003	Anonymous	EP080: Benzene	71-43-2	2 mg/kg	80.3	76.4	118
		EP080: Toluene	108-88-3	2 mg/kg	80.0	67.4	127

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	Spike Recovery (%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Matrix Spike (MS) Report: Spike Recovery (%) MS	Matrix Spike (MS) Report: Recovery Limits (%) Low	Matrix Spike (MS) Report: Recovery Limits (%) High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2425254)							
EP1206048-151	Anonymous	EP080: C6 - C9 Fraction	----	280 µg/L	80.5	77.0	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2425254)							
EP1206048-151	Anonymous	EP080: C6 - C10 Fraction	----	292.5 µg/L	84.8	77.0	137
EP080: BTEXN (QCLot: 2425254)							
EP1206048-151	Anonymous	EP080: Benzene	71-43-2	20 µg/L	85.3	77.0	122
		EP080: Toluene	108-88-3	20 µg/L	85.6	73.5	126

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **EP1206144**	Page	: 1 of 8
Client	: GEMEC PTY LTD	Laboratory	: Environmental Division Perth
Contact	: MR TOBY MUNRO	Contact	: Scott James
Address	: UNIT 1/25 FOSS STREET PALMYRA WA, AUSTRALIA	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: toby@gemec.com.au	E-mail	: perth.enviro.services@alsglobal.com
Telephone	: +61 08 9339 8449	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: Lake Clifton	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 27-JUL-2012
Sampler	: T.M	Issue Date	: 02-AUG-2012
Order number	: ----		
		No. of samples received	: 25
Quote number	: EP-173-10 BQ	No. of samples analysed	: 25

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content								
Soil Glass Jar - Unpreserved								
S1-2.5m,	S2-2.0m,	**26-JUL-2012**	**----**	----	----	**30-JUL-2012**	09-AUG-2012	✓
S3-1.4m,	S4-3.2m,							
S5-1.7m,	S6-2.0m,							
S7-1.5m,	S8-0.5m,							
S9-1.1m,	S10-1.4m,							
S11-2.1m,	S12-1.3m,							
S13-2.5m,	S14-3.3m,							
S15-3.2m,	SPC1,							
SPC2,	SPC3,							
SPD1,	SPD2,							
SPD3,	Dup1,							
Dup2,	Trip Blank							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved							
S1-2.5m, S2-2.0m, S3-1.4m, S4-3.2m, S5-1.7m, S6-2.0m, S7-1.5m, S8-0.5m, S9-1.1m, S10-1.4m, S11-2.1m, S12-1.3m, S13-2.5m, S14-3.3m, S15-3.2m, SPC1, SPC2, SPC3, SPD1, SPD2, SPD3, Dup1, Dup2, Trip Blank	**26-JUL-2012**	**30-JUL-2012**	09-AUG-2012	✓	**30-JUL-2012**	09-AUG-2012	✓
Soil Glass Jar - Unpreserved							
SPD3, Dup1, Dup2, Trip Blank	**26-JUL-2012**	**31-JUL-2012**	09-AUG-2012	✓	**01-AUG-2012**	08-SEP-2012	✓
Soil Glass Jar - Unpreserved							
S1-2.5m, S2-2.0m, S3-1.4m, S4-3.2m, S5-1.7m, S6-2.0m, S7-1.5m, S8-0.5m, S9-1.1m, S10-1.4m, S11-2.1m, S12-1.3m, S13-2.5m, S14-3.3m, S15-3.2m, SPC1, SPC2, SPC3, SPD1, SPD2	**26-JUL-2012**	**31-JUL-2012**	09-AUG-2012	✓	**01-AUG-2012**	09-SEP-2012	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft							
Soil Glass Jar - Unpreserved							
S1-2.5m, S2-2.0m, S3-1.4m, S4-3.2m, S5-1.7m, S6-2.0m, S7-1.5m, S8-0.5m, S9-1.1m, S10-1.4m, S11-2.1m, S12-1.3m, S13-2.5m, S14-3.3m, S15-3.2m, SPC1, SPC2, SPC3, SPD1, SPD2, SPD3, Dup1, Dup2, Trip Blank	**26-JUL-2012**	**30-JUL-2012**	09-AUG-2012	✓	**30-JUL-2012**	09-AUG-2012	✓
Soil Glass Jar - Unpreserved							
SPD3, Dup1, Dup2, Trip Blank	**26-JUL-2012**	**31-JUL-2012**	09-AUG-2012	✓	**01-AUG-2012**	08-SEP-2012	✓
Soil Glass Jar - Unpreserved							
S1-2.5m, S2-2.0m, S3-1.4m, S4-3.2m, S5-1.7m, S6-2.0m, S7-1.5m, S8-0.5m, S9-1.1m, S10-1.4m, S11-2.1m, S12-1.3m, S13-2.5m, S14-3.3m, S15-3.2m, SPC1, SPC2, SPC3, SPD1, SPD2	**26-JUL-2012**	**31-JUL-2012**	09-AUG-2012	✓	**01-AUG-2012**	09-SEP-2012	✓
EP080: BTEX							
Soil Glass Jar - Unpreserved							
S1-2.5m, S2-2.0m, S3-1.4m, S4-3.2m, S5-1.7m, S6-2.0m, S7-1.5m, S8-0.5m, S9-1.1m, S10-1.4m, S11-2.1m, S12-1.3m, S13-2.5m, S14-3.3m, S15-3.2m, SPC1, SPC2, SPC3, SPD1, SPD2, SPD3, Dup1, Dup2, Trip Blank	**26-JUL-2012**	**30-JUL-2012**	09-AUG-2012	✓	**30-JUL-2012**	09-AUG-2012	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080: BTEXN							
Soil Glass Jar - Unpreserved							
S1-2.5m, S2-2.0m, S3-1.4m, S4-3.2m, S5-1.7m, S6-2.0m, S7-1.5m, S8-0.5m, S9-1.1m, S10-1.4m, S11-2.1m, S12-1.3m, S13-2.5m, S14-3.3m, S15-3.2m, SPC1, SPC2, SPC3, SPD1, SPD2, SPD3, Dup1, Dup2, Trip Blank	**26-JUL-2012**	**30-JUL-2012**	09-AUG-2012	✓	**30-JUL-2012**	09-AUG-2012	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved							
Rinsate	**27-JUL-2012**	**01-AUG-2012**	03-AUG-2012	✓	**01-AUG-2012**	10-SEP-2012	✓
Amber VOC Vial - Sulfuric Acid							
Rinsate	**27-JUL-2012**	**30-JUL-2012**	10-AUG-2012	✓	**30-JUL-2012**	10-AUG-2012	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft							
Amber Glass Bottle - Unpreserved							
Rinsate	**27-JUL-2012**	**01-AUG-2012**	03-AUG-2012	✓	**01-AUG-2012**	10-SEP-2012	✓
Amber VOC Vial - Sulfuric Acid							
Rinsate	**27-JUL-2012**	**30-JUL-2012**	10-AUG-2012	✓	**30-JUL-2012**	10-AUG-2012	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid							
Rinsate	**27-JUL-2012**	**30-JUL-2012**	10-AUG-2012	✓	**30-JUL-2012**	10-AUG-2012	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	3	24	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH - Semivolatile Fraction	EP071	4	32	12.5	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	4	33	12.1	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
TPH - Semivolatile Fraction	EP071	2	32	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	2	33	6.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
TPH - Semivolatile Fraction	EP071	2	32	6.3	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	2	33	6.1	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
TPH - Semivolatile Fraction	EP071	2	32	6.3	5.0	✓	ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	2	33	6.1	5.0	✓	ALS QCS3 requirement

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
TPH Volatiles/BTEX	EP080	2	15	13.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
TPH - Semivolatile Fraction	EP071	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	15	6.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
TPH - Semivolatile Fraction	EP071	1	6	16.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	15	6.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
TPH Volatiles/BTEX	EP080	1	15	6.7	5.0	✓	ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
TPH - Semivolatile Fraction	EP071	SOIL	(USEPA SW 846 - 8015A) Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C36. This method is compliant with NEPM (1999) Schedule B(3) (Method 506.1)
TPH Volatiles/BTEX	EP080	SOIL	(USEPA SW 846 - 8260B) Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Method 501)
TPH - Semivolatile Fraction	EP071	WATER	USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
TPH Volatiles/BTEX	EP080	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)

Preparation Methods	Method	Matrix	Method Descriptions
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	(USEPA SW 846 - 5030A) 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids (Option B - Non-concentrating)	ORG17B	SOIL	In-house, Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 20mL 1:1 DCM/Acetone by end over end tumble. The solvent is transferred directly to a GC vial for analysis.
Separatory Funnel Extraction of Liquids	ORG14	WATER	USEPA SW 846 - 3510B 500 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2). ALS default excludes sediment which may be resident in the container.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EP080/071: Total Petroleum Hydrocarbons	EP1206169-001	Anonymous	**C15 - C28 Fraction**	----	108 %	0-50%	**RPD exceeds LOR based limits**
EP080/071: Total Recoverable Hydrocarbons - NEPM 2	EP1206169-001	Anonymous	**>C16 - C34 Fraction**	----	108 %	0-50%	**RPD exceeds LOR based limits**

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

CLIENT: Gemec Pty Ltd	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics) ☑ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):
OFFICE:	
PROJECT: Lake Clifton	ALS QUOTE NO.: EP-173-10
ORDER NUMBER:	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7 OF: 1 2 3 4 5 6 7
PROJECT MANAGER: Toby Munro	CONTACT PH: 08 9339 8449
SAMPLER: Toby Munro	SAMPLER MOBILE: 0423 610 292
COC emailed to ALS? (YES / NO)	EDD FORMAT (or default):

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: °C
Other comment:

Email Reports to (will default to PM if no other addresses are listed): toby@gemec.com.au & richard@gemec.com.au

Email Invoice to (will default to PM if no other addresses are listed): marise@gemec.com.au

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
T Munro	AJT		Andrew Webb
DATE/TIME: 27.07.12 / 10:15	DATE/TIME: 27.7.12 1:35pm	DATE/TIME:	DATE/TIME: 28/7/12 7:50am

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)				CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE	TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	BTEXN / TRH								Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	Split 1	26.07.12	-:-	S	-	1	X								External Lab Analysis Required : ALS Melbourne
2	Split 2	26.07.12	-:-	S	-	1	X								
					TOTAL	2	2								

Environmental Division
Melbourne
Work Order
EM1208619
Telephone : + 61-3-8549 9600

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EM1208619**	Page	: 1 of 4
Client	: **GEMEC PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR TOBY MUNRO	Contact	: Client Services
Address	: UNIT 1/25 FOSS STREET PALMYRA WA, AUSTRALIA	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: toby@gemec.com.au	E-mail	: Melbourne.Enviro.Services@alsglobal.com
Telephone	: +61 08 9339 8449	Telephone	: +61-3-8549 9600
Facsimile	: ----	Facsimile	: +61-3-8549 9601
Project	: Lake Clifton	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 28-JUL-2012
Sampler	: TM	Issue Date	: 02-AUG-2012
Site	: ----		
		No. of samples received	: 2
Quote number	: EP-173-10 BQ	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Varsha Ho Wing	Non-Metals Team Leader	Melbourne Inorganics
Xingbin Lin	Senior Organic Chemist	Melbourne Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: SOIL			Client sample ID	Split 1	Split 2	----	----	----
			Client sampling date / time	26-JUL-2012 15:00	26-JUL-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit	EM1208619-001	EM1208619-002	----	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**11.4**	**5.1**	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	----	----	----
C10 - C14 Fraction	----	50	mg/kg	<50	<50	----	----	----
C15 - C28 Fraction	----	100	mg/kg	<100	<100	----	----	----
C29 - C36 Fraction	----	100	mg/kg	<100	<100	----	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	10	mg/kg	<10	<10	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	----	10	mg/kg	<10	<10	----	----	----
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	----	----	----
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	----	----	----
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	----	----	----
EP080: BTEX								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	----	----	----
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	----	----	----
EP080: BTEXN								
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	----	----	----
^ Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	----	----	----
Naphthalene	91-20-3	1	mg/kg	<1	<1	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**67.5**	**70.5**	----	----	----
Toluene-D8	2037-26-5	0.1	%	**83.2**	**92.0**	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	**82.4**	**89.2**	----	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	57	129
Toluene-D8	2037-26-5	58	120
4-Bromofluorobenzene	460-00-4	56	126

QUALITY CONTROL REPORT

Work Order	: **EM1208619**	Page	: 1 of 6
Client	: **GEMEC PTY LTD**	Laboratory	: Environmental Division Melbourne
Contact	: MR TOBY MUNRO	Contact	: Client Services
Address	: UNIT 1/25 FOSS STREET PALMYRA WA, AUSTRALIA	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: toby@gemec.com.au	E-mail	: Melbourne.Enviro.Services@alsglobal.com
Telephone	: +61 08 9339 8449	Telephone	: +61-3-8549 9600
Facsimile	: ----	Facsimile	: +61-3-8549 9601
Project	: Lake Clifton	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 28-JUL-2012
Sampler	: TM	Issue Date	: 02-AUG-2012
Order number	: ----		
		No. of samples received	: 2
Quote number	: EP-173-10 BQ	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Varsha Ho Wing	Non-Metals Team Leader	Melbourne Inorganics
Xingbin Lin	Senior Organic Chemist	Melbourne Organics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (QC Lot: 2425226)									
EM1208617-003	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	12.6	15.1	17.8	0% - 50%
EM1208617-013	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	5.5	4.2	27.3	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2425966)									
EM1208570-037	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EM1208570-052	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 2426581)									
EM1208619-001	Split 1	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
		EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	0.0	No Limit
EM1208625-009	Anonymous	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
		EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2425966)									
EM1208570-037	Anonymous	EP080: C6 - C10 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EM1208570-052	Anonymous	EP080: C6 - C10 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QC Lot: 2426581)									
EM1208619-001	Split 1	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
		EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	0.0	No Limit
EM1208625-009	Anonymous	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
		EP071: >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	0.0	No Limit
EP080: BTEXN (QC Lot: 2425966)									
EM1208570-037	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EM1208570-052	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP080: BTEXN (QC Lot: 2425966) - continued									
EM1208570-052	Anonymous	EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2425966)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	36 mg/kg	83.9	70	133
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2426581)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	544 mg/kg	88.8	55	123
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	1981 mg/kg	111	72	134
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	818 mg/kg	98.3	71	143
EP071: C10 - C36 Fraction (sum)	----	50	mg/kg	<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2425966)								
EP080: C6 - C10 Fraction	----	10	mg/kg	<10	45 mg/kg	83.7	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2426581)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	870 mg/kg	101	69	123
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	2495 mg/kg	105	71	134
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	263 mg/kg	91.0	63	143
EP071: >C10 - C40 Fraction (sum)	----	100	mg/kg	<100	----	----	----	----
EP080: BTEXN (QCLot: 2425966)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	75.8	72	126
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	2 mg/kg	90.9	73	129
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2 mg/kg	85.6	72	126
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4 mg/kg	86.5	70	138
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2 mg/kg	88.5	73	131
EP080: Naphthalene	91-20-3	1	mg/kg	<1	0.5 mg/kg	91.0	70	130

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	Spike Recovery (%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2425966)							
EM1208570-038	Anonymous	EP080: C6 - C9 Fraction	----	28 mg/kg	55.4	49	127
EP080/071: Total Petroleum Hydrocarbons (QCLot: 2426581)							
EM1208619-002	Split 2	EP071: C10 - C14 Fraction	----	544 mg/kg	90.7	54	123
		EP071: C15 - C28 Fraction	----	1981 mg/kg	105	74	134
		EP071: C29 - C36 Fraction	----	818 mg/kg	92.5	63	143
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2425966)							
EM1208570-038	Anonymous	EP080: C6 - C10 Fraction	----	33 mg/kg	# 55.2	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft (QCLot: 2426581)							
EM1208619-002	Split 2	EP071: >C10 - C16 Fraction	----	870 mg/kg	99.2	54	123
		EP071: >C16 - C34 Fraction	----	2495 mg/kg	99.8	74	134
		EP071: >C34 - C40 Fraction	----	263 mg/kg	91.4	63	143
EP080: BTEXN (QCLot: 2425966)							
EM1208570-038	Anonymous	EP080: Benzene	71-43-2	2 mg/kg	59.0	58	136
		EP080: Toluene	108-88-3	2 mg/kg	70.2	63	135

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **EM1208619**	Page	: 1 of 5
Client	: GEMEC PTY LTD	Laboratory	: Environmental Division Melbourne
Contact	: MR TOBY MUNRO	Contact	: Client Services
Address	: UNIT 1/25 FOSS STREET PALMYRA WA, AUSTRALIA	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: toby@gemec.com.au	E-mail	: Melbourne.Enviro.Services@alsglobal.com
Telephone	: +61 08 9339 8449	Telephone	: +61-3-8549 9600
Facsimile	: ----	Facsimile	: +61-3-8549 9601
Project	: Lake Clifton	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 28-JUL-2012
Sampler	: TM	Issue Date	: 02-AUG-2012
Order number	: ----		
		No. of samples received	: 2
Quote number	: EP-173-10 BQ	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content							
Soil Glass Jar - Unpreserved Split 1, Split 2	**26-JUL-2012**	**----**	----	----	**30-JUL-2012**	09-AUG-2012	✓
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved Split 1, Split 2	**26-JUL-2012**	**30-JUL-2012**	09-AUG-2012	✓	**30-JUL-2012**	09-AUG-2012	✓
Soil Glass Jar - Unpreserved Split 1, Split 2	**26-JUL-2012**	**31-JUL-2012**	09-AUG-2012	✓	**01-AUG-2012**	09-SEP-2012	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft							
Soil Glass Jar - Unpreserved Split 1, Split 2	**26-JUL-2012**	**30-JUL-2012**	09-AUG-2012	✓	**30-JUL-2012**	09-AUG-2012	✓
Soil Glass Jar - Unpreserved Split 1, Split 2	**26-JUL-2012**	**31-JUL-2012**	09-AUG-2012	✓	**01-AUG-2012**	09-SEP-2012	✓
EP080: BTEX							
Soil Glass Jar - Unpreserved Split 1, Split 2	**26-JUL-2012**	**30-JUL-2012**	09-AUG-2012	✓	**30-JUL-2012**	09-AUG-2012	✓
EP080: BTEXN							
Soil Glass Jar - Unpreserved Split 1, Split 2	**26-JUL-2012**	**30-JUL-2012**	09-AUG-2012	✓	**30-JUL-2012**	09-AUG-2012	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH - Semivolatile Fraction	EP071	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
TPH - Semivolatile Fraction	EP071	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
TPH - Semivolatile Fraction	EP071	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
TPH - Semivolatile Fraction	EP071	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2010 Draft) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
TPH - Semivolatile Fraction	EP071	SOIL	(USEPA SW 846 - 8015A) Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C36. This method is compliant with NEPM (1999) Schedule B(3) (Method 506.1)
TPH Volatiles/BTEX	EP080	SOIL	(USEPA SW 846 - 8260B) Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Method 501)

Preparation Methods	Method	Matrix	Method Descriptions
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	(USEPA SW 846 - 5030A) 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids (Option B - Non-concentrating)	ORG17B	SOIL	In-house, Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 20mL 1:1 DCM/Acetone by end over end tumble. The solvent is transferred directly to a GC vial for analysis.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EP080/071: Total Recoverable Hydrocarbons - NEPM 2	EM1208570-038	Anonymous	**C6 - C10 Fraction**	----	55.2 %	70-130%	**Recovery less than lower data quality objective**

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

APPENDIX B

DEC SITE SUMMARY FORM

Department of Environment and Conservation

Site Summary Form – Contaminated Site Assessment

For completion by the person(s) submitting a report(s) to be assessed by the Department of Environment and Conservation (DEC) as per the information requirements of the DEC *Reporting on Site Assessments (2001)* guideline. Completing this form enables DEC to maintain accurate records for the site.

Please note: A completed site summary form must accompany each report submitted to DEC for assessment. Each box must be filled out appropriately. Please do not write "refer to report" in any section. Copies of all relevant/current Certificates of Title must accompany this form.

Site location details:

Site name (e.g. where site may be known by a common/ business name): Former Gull Lake Clifton Service Station

Lot no.: 20 | House no.: 32341 | Street: Old Coast Road

Locale: Lake Clifton | State: WA | Postcode: 6215

Crown Reserve (if applicable): N/a

Certificate(s) of Title (or equivalent): Volume/Folio: 2141 / 172

Where the subject site comprises of multiple certificates of title, please list all certificates:……

Where substances have migrated beyond the cadastral boundaries of the subject site, please provide the addresses, relevant Certificates of Title documentation and owners details for all offsite properties impacted (includes soil and/or groundwater), as an attachment to this form.

Is a hard copy of Certificate of Title and associated sketch for all listed sites attached? (Y/N): Y

WAPC reference no. (where applicable): N/a

Current Owner/Occupier details:

Site owner (Name and address): Maria Michela Rose Scolaro of 75 Lawley Crescent, Mount Lawley

Site owner company ACN/ABN: N/A

Site occupier (name and address): LC's Café and Bakery 3234 Old Coast Road, Lake Clifton, WA 6215

Site occupier company ACN/ABN: 27 835 962 574

Site status (at time of reporting): Operational – Café and Bakery

Proposed land use (e.g. high density residential/child care facility): Commercial

Identified substances and relevant media (e.g. benzene in soil and groundwater, xylene in soil only): Trace to minor concentrations of xylenes, & C6-C28 TPH exceeding EILs and or HIL-F- identified at shallow depth (0.7m) in 2003 at one location.

Asbestos (Y/N)	N	Health Risk Assessment (Y/N)	N	Community health concerns identified (Y/N)	N	Radiological issues (Y/N)	N
Air quality issues (Y/N)	N	Past/present landfill (Y/N)	N	Potential human exposure to identified substances > DEC's Health Investigation Levels or equivalent (Y/N)	N	Other human health issues (Y/N)	N

Specify other health issues……

Where 'yes' is recorded for at least one of the above categories, please submit two copies of the report(s) (relevant documentation) to DEC for referral to the Department of Health (or Radiological Council, in the case of radiological issues)

Are site activities licensed under the *Environmental Protection Act 1986?* (Y/N)	N
Where laboratory analysis has been undertaken, is the laboratory NATA accredited for all analytes and analytical methodologies used? (Y/N) (If not, why not?)	Y

Community Consultation: (as per the DEC's *Community Consultation (December 2006)* guideline)

Community consultation program commenced/proposed (Y/N)	N
Are consultation program details (e.g. community consultation plan) provided in attached report (Y/N)	N/a

History of Investigation:

Have previous site investigations been undertaken? (Y/N - if yes, please provide details below)	Y
Report title, date and author:	Phase 1 Environmental Assessment Report, June 2003, Gemec Pty Ltd

Declaration:

The information contained in this site summary form is a true representation of the information contained in the attached report(s)/document(s).

Full name (print)	Richard Baldwin		
Position held	Director		
Signature		Date	06.11.12

Please ensure that a hardcopy of the current Certificate(s) of Title and associated sketch accompanies the site summary form. DEC cannot proceed with the assessment of the report if this information is not provided.

DEC Registrar Only

Registrar name:		Signature:			
CoT verified (Y/N)		Owner details verified (Y/N)		Complete form (Y/N)	
Awaiting Classification (Y/N)					
Awaiting Re-Classification (Y/N)					
Incomplete Form (Y/N)					
LWQB Assessment Officer:					
Comments/Actions:					
Date of data entry:					

LAND TITLE DETAILS

REGISTER NUMBER	
20/D72036	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	**10/10/2011**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2141** FOLIO **172**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 20 ON DIAGRAM 72036

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

MARIA MICHELA ROSE SCOLARO OF 75 LAWLEY CRESCENT, MOUNT LAWLEY
(ND L729107) REGISTERED 26 SEPTEMBER 2011

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 2141-172 (20/D72036).
PREVIOUS TITLE: 1559-496.
PROPERTY STREET ADDRESS: 3234 OLD COAST RD, LAKE CLIFTON.
LOCAL GOVERNMENT AREA: SHIRE OF WAROONA.

NOTE 1: I522193 SECTION 138D TLA APPLIES TO CAVEAT G819921

Application G893073 WESTERN AUSTRALIA

Volume 1559 Folio 496

REGISTER BOOK

CT 2141 172

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

REGISTRAR OF TITLES

Dated 30th September, 1998

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Murray Location 793 and being Lot 20 on Diagram 72036, delineated on the map in the Third Schedule hereto, limited however to the natural surface and therefrom to a depth of 60.96 metres.

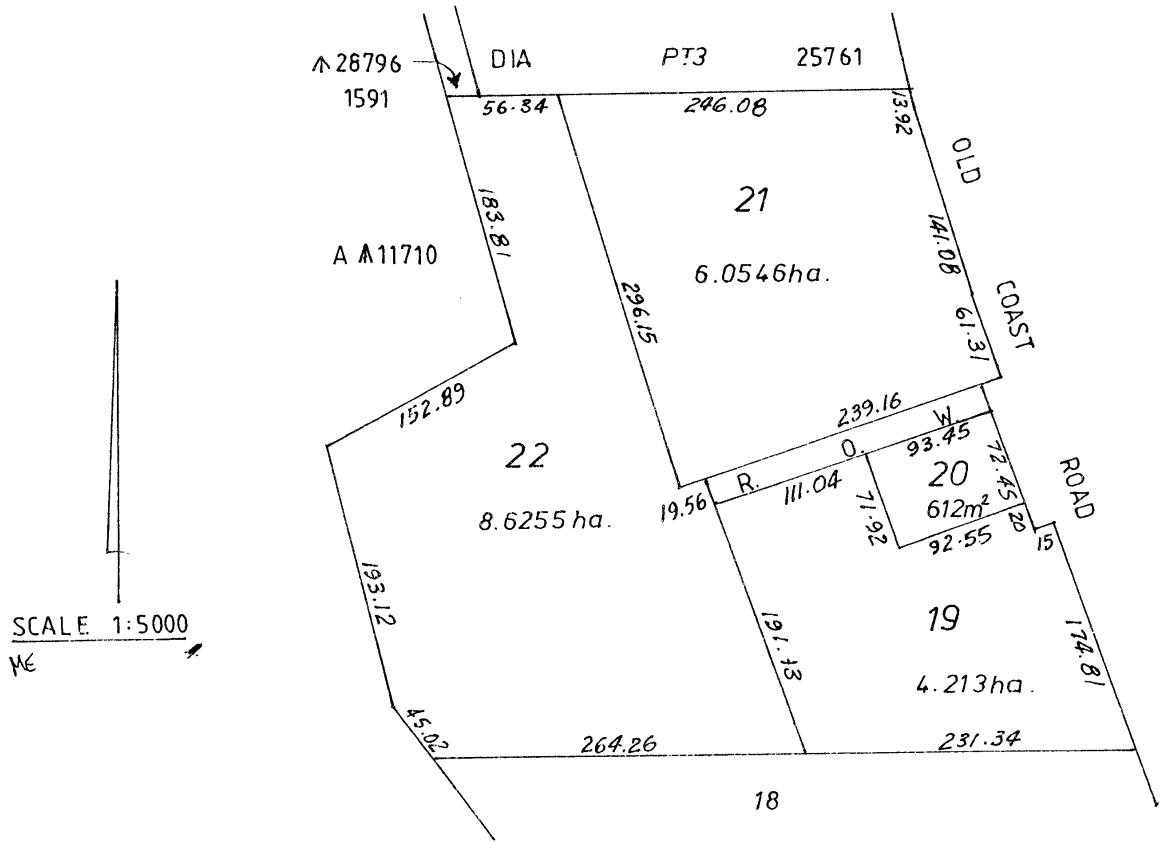
FIRST SCHEDULE (continued overleaf)

~~Ronald Archibald Armstrong and Valma Beryl Armstrong both of RMB 659, Waroona, as joint tenants.~~

SECOND SCHEDULE (continued overleaf)

1. MORTGAGE D975919 to Citibank Savings Ltd. Registered 22.12.88 at 15.48 hrs.
2. CAVEAT G819921. Lodged 15.6.98 at 11.31 hrs.

THIRD SCHEDULE



NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

LT. 37

FIRST SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL	CERT. OFFICER
Ronald Archibald Armstrong of RMB 659 Waroona, by survivorship.	Application	H587072	31.10.00	15.02		

SECOND SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CERT. OFFICER	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	CERT. OFFICER

CERTIFICATE OF TITLE VOL. 2141 FOL. 172

FIELD EQUIPMENT CALIBRATION CERTIFICATES

Calibration Certificate

Manufacturer:	Biosystems
Unit Model:	MultiPro

Customer:

Gemec Pty Ltd

Service Number:	331585504
Serial Number:	57909
Unit Number:	101342
Job Number:	GS 49759
Date Serviced:	23-Jul-12
Customer Ref:	Gemec

GASTECH AUSTRALIA

info@gastech.com.au
Tel:+61 8 6108 0000
Fax:+61 8 9408 1868

24 Baretta Rd
WANGARA WA 6065
ABN 64 087 801 634

Warranty Claim Procedure:
Return unit freight pre-paid for warranty repairs.

If Unit Number is removed, warranty claims must be accompanied by last Calibration Certificate.

Next Service: 23-Jan-13

Unit Report

Condition received: Fair

Comments on receiving unit

Unable to Zero O2 sensor.
O2 sensor faulty
Service and Calibration required.

Comments on completing unit

Replaced O2 sensor.
Serviced and calibrated

Functional Tests

Alarm operation:	Checked	**Display operation:**	Checked
CircuitBoard:	Checked	**Battery test:**	Checked

Sensor Report

CO (4 Gas)

Date Cell Fitted	Cell Number
23/07/2012	04.15680474 020

Zero:	Set at 0 ppm
Span:	Set at 103ppm
Alarm:	30ppm & 200ppm

Certificate Number	Span Gas Concentration
NATA#131376/1	103 ppm

H2S (4 gas)

Date Cell Fitted	Cell Number
30/07/2010	04.15680474 020

Zero:	Set at 0 ppm
Span:	Set at 25 ppm
Alarm:	10 ppm & 15 ppm

Certificate Number	Span Gas Concentration
NATA#131376/1	25 ppm

LEL Methane (4 Gas)

Date Cell Fitted	Cell Number
30/07/2010	03.15486265 020

Zero:	Set at 0 %
Span:	Set at 49 %
Alarm:	5 % & 10 %

Certificate Number	Span Gas Concentration
NATA#131376/1	49.2 % LEL

O2 (4 Gas)

Date Cell Fitted	Cell Number
23/07/2012	59775822 052

Zero:	Read at 18%
Span:	Set at 20.9 %
Alarm:	19.5 % & 23.5 %

Certificate Number	Span Gas Concentration
NATA#131376/1	18.0 %

Serviced by: David Van Beelen

Signature

CALIBRATED IN ACCORDANCE WITH WORK INSTRUCTION 3.5W1-1

BUREAU VERITAS

Calibration Certificate

Manufacturer:	RAE Systems
Unit Model:	MiniRAE 2000

Customer:
Gemec Pty Ltd

Service Number:	331585496
Serial Number:	110-008663
Unit Number:	108155
Job Number:	GS 49759
Date Serviced:	23-Jul-12
Customer Ref:	

GASTECH AUSTRALIA
info@gastech.com.au
Tel:+61 8 6108 0000
Fax:+61 8 9408 1868
24 Baretta Rd
WANGARA WA 6065
ABN 64 087 801 634

Warranty Claim Procedure:
Return unit freight pre-paid for warranty repairs.

If Unit Number is removed, warranty claims must be accompanied by last Calibration Certificate.

Next Service: 23-Jul-13

Unit Report

Condition received: Fair

Comments on receiving unit
Service and calibration due

Comments on completing unit
Serviced and Calibrated

Functional Tests

Alarm operation:	Checked	**Display operation:**	Checked
CircuitBoard:	Checked	**Battery test:**	Checked

Sensor Report

VOC

Date Cell Fitted	**Cell Number**
01/01/2000	Isobutylene

Zero:	Set at 0 ppm
Span:	Set at 100 ppm
Alarm:	50 ppm & 100 ppm

Certificate Number	**Span Gas Concentration**
Isobutylene LOT# 797443 Cyl 52	100 ppm

Serviced by: David Van Beelen

Signature

CALIBRATED IN ACCORDANCE WITH WORK INSTRUCTION 3.5W1-1

BUREAU VERITAS

TANK DISPOSAL CERTIFICATE

J&P GROUP PTY LTD

ATF Kingscape Unit Trust ABN: 17 846 298 982

3 August 2012

CERTIFICATE OF DESTRUCTION

This document certifies that;
1 x T25 steel underground storage tank – used to store petrol
1 x T15 steel underground storage tank – used to store diesel
1 x T10 steel underground storage tank – used to store petrol
have been destroyed.

Client Details:

Name: Richard Baldwin
Gemec Environmental Consultants

Address: 1/25 Foss St,Palmyra,WA 6157

Yours sincerely,

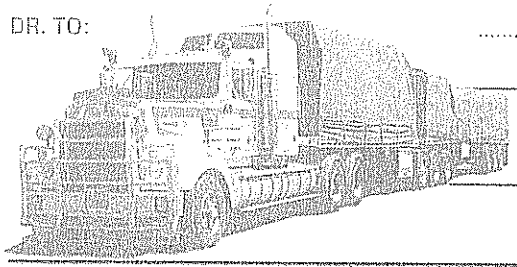
Peter Tolmachoff
General Manager

Lot 90 Short Street
Picton, WA 6229
Phone: (08) 97 255 050
Fax: (08) 97 256 083

M S+P METALS

26/7/12

DR. TO:



K&S FREIGHTERS

A.B.N. 67 007 544 390

DARDANUP BRANCH:
91 Moore Road, Dardanup, W.A. 6236
Postal Address: C/o Post Office, Picton, W.A. 6229
Telephone (08) 9725 4400
After Hours (08) 9795 5597 — Facsimile (08) 9725 4949
Kewdale Branch (08) 6466 6640

TAX INVOICE No. 109204

TO	FROM	DELIVERY DOCKET No.	GOODS	No. ITEMS	WEIGHT TONNES	WEIGHT KILOGRAMS	OFFICE USE
S+P METALS	LAKE CLIFTON.		3 FUEL	3.			
	ROAD HOUSE		TANKS.				
	11AM - 4PM.						

WAITING TIME: IN OUT

CARTAGE PRICE	
FUEL LEVY	
SUB-TOTAL	
GST	
TOTAL PAYABLE (Incl. GST)	

Truck No. 1105 Receiver's Signature

Driver MIKE Please Print Name

CLEAN FILL DOCUMENTATION

PEEL RESOURCE RECOVERY PTY LTD

Inc. CROSS RESOURCE MANAGEMENT (DEC Landfill Lic: 7060)

TRANSFER STATION AND WASTE MANAGEMENT

Phone (08) 9531 3111
Fax: (08) 9531 3444
Email: admin@peelresource.com.au

P.O. Box 222
PINJARRA WA 6208
A.B.N. 98 149 428 697

Address: 49 MUNDAY AVE
PINJARRA WA 6208
A.C.N. 149 428 697

August 20, 2012

Gemec Environmental Consultant
PO Box 89
MELVILLE WA

Dear Sir

Cross Resource Management, which is incorporated under Peel Resource Recovery Pty Ltd. holds a DEC Licence L7060/1997/12 for its landfill site at Stanley Road. This licence allows us to accept the contaminated soils which are treated in their designated cells.

The company also holds an Extractive Industry Licence with Shire of Harvey to quarry sand from Lot 43, Stanley Road; Australind.

For any further queries please do not hesitate to contact Stuart Cross (Operations Manager) on 0428 211 785 or the Pinjarra office.

Yours sincerely,

Beena Verma
On behalf of Peel Resource Recovery P/L

SOIL DISPOSAL DOCUMENTATION

PEEL RESOURCE RECOVERY PTY LTD

Inc. CROSS RESOURCE MANAGEMENT (DEC Landfill Lic: 7060)

TRANSFER STATION AND WASTE MANAGEMENT

Phone (08) 9531 3111
Fax: (08) 9531 3444
Email: admin@peelresource.com.au

P.O. Box 222
PINJARRA WA 6208
A.B.N. 98 149 428 697

Address: 49 MUNDAY AVE
PINJARRA WA 6208
A.C.N. 149 428 697

August 20, 2012

Gemec Environmental Consultant
PO Box 89
MELVILLE WA

Dear Sir

Cross Resource Management, which is incorporated under Peel Resource Recovery Pty Ltd. holds a DEC Licence L7060/1997/12 for its landfill site at Stanley Road. This licence allows us to accept the contaminated soils which are treated in their designated cells.

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For any further queries please do not hesitate to contact Stuart Cross (Operations Manager) on 0428 211 785 or the Pinjarra office.

Yours sincerely,

Beena Verma
On behalf of Peel Resource Recovery P/L

South West Chemical Services
Unit 5, 4 Mummery Cres
Bunbury, WA, 6230
ABN 71 111 052 218
Phone/Fax 08 9721 7170
Mobile 0417 149 645
Email admin@swchemservices.com.au

Certificate of Analysis

Client Name:	Peel Resource Recovery Attn: Stuart Cross		
Address:	PO Box 222, Pinjarra, WA 6208		
Phone No:	9351 3111	Facsimile:	9531 3444
Lab No:	6363	Order No:	
Date samples received:	31/07/12	Report date:	8/08/12

Sample details: 3 sand samples collected from 2 heaps of less than 100 cubic metres, located at Peel Resource Recovery site, Stanley Rd., Australind, WA 6233.
Samples were labelled 1U - from Upper heap, 2LE - from Lower heap east side, 3 - LW - from Lower heap west side.

Scope of Work: Determination of TRH, BTEX of the material and Land fill classification.

Test Methods: Samples were analysed by MPL Laboratories for Total Petroleum Hydrocarbons and BTEX using methodologies ORG-003, 013, 014, Inorg-001, 008 according to the terms of NATA Accreditation 2901

Test Results:

See attached.

Comments:

1. None of the samples showed any evidence of Total Recoverable Hydrocarbons above the detectable level of the method employed
2. Based on the results for Hydrocarbons, the material can be classified as suitable for disposal into a Class 1 Landfill facility without aliphatic/aromatic speciation testing.

David Dodds
Dip.App.Chem. A.G.Inst.Tech.

South West Chemical Services
Unit 5, 4 Mummery Cres.,
Bunbury, WA, 6230
Phone/Fax 08 9721 7170
Mobile 0417 149 645
Email: admin@swchemservices.com.au

Client: Peel Resource Recovery
Address: PO Box 222, Pinjarra, WA 6208
Telephone: 9531 3111
Sample date: 31/07/12

Job No: 6363
Sample Site: Australind Sand Supply, Stanley Rd Australind, WA
Facsimile: 9531 3444
Sampled By: David Dodds

Analyte	Unit	PQL	1U	2LE	3LW	Blind	Landfill	Landfill	EIL	HIL*
						Replicate	Class 1&2	Class 3		
TRH						1U				
C6 - C9	mg/kg	50	<50	<50	<50	<50	2800	28000	100	not stated
C10 - C14	mg/kg	50	<50	<50	<50	<50	450/28000**	4500/280000 **	500	not stated
C15 - C28	mg/kg	100	<100	<100	<100	<100			1000	450 - 28800 **
C29 - C36	mg/kg	100							not stated	**
Benzene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	0.2	2	1	5.6
Toluene	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	160	1600	3	5200
Ethyl Benzene	mg/kg	1	<1	<1	<1	<1	60	600	5	230
m & p - Xylene	mg/kg	2	<2	<2	<2	<2				
o - Xylene	mg/kg	1	<1	<1	<1	<1				
Total Xylenes	mg/kg	3	<3	<3	<3	<3	120	1200	5	2600
Surrogate recovery	%		86	78	85	103				
% Moisture	%	0.1	3.5	8.7	9.3	3.3				

EIL and HIL - Contaminated Sites Management Series, Assessment levels for Soil, Sediment and Water, Version 4, February 2010
LQL = Lower Quantitative Level
EIL = Ecological Investigation Level
HIL* = Health Investigation Level for Commercial/Industrial premises
** = depends on speciation C16-C35 aromatic/C10-C35 aliphatic

Values that are shaded and bolded equal or exceed one or more of the guideline values

DMP CORRESPONDENCE

Toby Munro

From: KAVIRAJ, Saru <Saru.KAVIRAJ@dmp.wa.gov.au>
Sent: Thursday, 9 August 2012 1:53 PM
To: toby@gemec.com.au
Subject: 3234 Old Coast Road, Lake Clifton 6215

Hi Toby

Please be advised that this Dangerous Goods Site Licence (DGS007222) is cancelled on 09/08/2012.

Thank you

Saru Kaviraj | Admin Assistant
Department of Mines and Petroleum | Dangerous Goods Safety Branch
303 Sevenoaks Street, Cannington WA 6107
Postal address: 100 Plain Street, East Perth WA 6004
Tel +61 (08) 9358 8056 | Fax +61 (08) 9358 8188
saru.kaviraj@dmp.wa.gov.au | http://www.dmp.wa.gov.au

TOWN PLANNING SCHEME MAP

SU2

RRes 9

RRes 2

RRes 6

RRes 7

RRes 8

RRes 1

RRes 10

EC2

RRes 11

RRes 10

EC1

RRes 10

HARVEY RIVER

HARVEY RIVER

Lake

YALGORUP

NATIONAL

PARK

Clifton

LAKE CLIFTON
TOWNSITE

Harvey River

Produced by Mapping and GeoSpatial Data Branch, Department of Planning.

Whilst all care has been taken to accurately portray the current Scheme provisions, no responsibility shall be taken for any omissions or errors in this documentation.

Consultation with the respective Local Government should be made to view a legal version of the Scheme. Please advise the Department of Planning of any omissions or errors in the document.

Base Information Supplied by the Western Australian Land Information Authority, GL248-2007-2

SHIRE OF WAROONA

TOWN PLANNING SCHEME NO 7

(DISTRICT SCHEME)

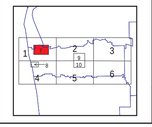
N

GDA
GEOCENTRIC DATUM OF AUSTRALIA

SCALE 1:20000

0 500 m

MAP OVERVIEW



Authorised: Victor Chew
Plot date: 21 Feb 2012
G.Gazette: 17-December-1996

TOWN PLANNING SCHEME MAP No. 7 of 10

LEGEND

PEEL REGION SCHEME RESERVES

- REGIONAL OPEN SPACE
- RAILWAYS
- STATE FORESTS
- WATERWAYS
- PRIMARY REGIONAL ROADS
- OTHER REGIONAL ROADS
- PUBLIC PURPOSES - DENOTED AS FOLLOWS:
  - H HOSPITAL
  - HS HIGH SCHOOL
  - PU PUBLIC UTILITIES
  - SU SPECIAL USES
  - U UNIVERSITY

LOCAL SCHEME RESERVES

- CONSERVATION
- CONSERVATION & RECREATION
- HIGHWAY
- MAJOR ROAD
- NATIONAL OR PROPOSED NATIONAL PARK
- PUBLIC PURPOSES DENOTED AS FOLLOWS:
  - C CEMETERY
  - D DRAINAGE
  - S SCHOOL SITE
- PUBLIC PURPOSES DENOTED AS FOLLOWS:
  - T&G TIMBER & GRAVEL
- RAILWAY
- RECREATION
- WATER PRODUCTION, MINING, RECREATION

ZONES

- URBAN 4 - RESIDENTIAL
- URBAN 5 - SPECIAL RESIDENTIAL
- URBAN 6 - RURAL LIVING
- URBAN 8 - HAMEL
- URBAN 9 - PRESTON BEACH
- URBAN DEVELOPMENT
- URBAN 1 - TOWN CENTRE
- URBAN 3 - SERVICE COMMERCIAL
- SPECIAL USES
- URBAN 2 - COMMUNITY & CIVIC
- SPECIAL INDUSTRY
- URBAN 7 - INDUSTRIAL
- RURAL 1 - GENERAL FARMING
- RURAL 2 - IRRIGATED AGRICULTURE
- RURAL 3A - COASTAL
- RURAL 3B - COASTAL HIGHWAY
- RURAL 4 - HILLS FACE
- RURAL 5 - DARLING RANGE
- RURAL 6 - RURAL RESIDENTIAL
- RURAL 7 - RURAL SMALL HOLDINGS

OTHER

- R20 R CODES
- A1 ADDITIONAL USES
- SCHEME BOUNDARY
- LOCAL GOVERNMENT BOUNDARY
- TOWNSITE -- LAND ACT
- SU2 SPECIAL USES AREAS (SEE SCHEME TEXT)
- RRes 9 RURAL RESIDENTIAL AREAS (SEE SCHEME TEXT)
- PEEL INLET MANAGEMENT AUTHORITY BDY
- SPECIAL DESIGN PRECINCT
- PEEL HARVEY COASTAL PLAIN CATCHMENT BOUNDARY
- DA 1 DEVELOPMENT AREA (SEE SCHEME TEXT)
- RSH1 RURAL SMALL HOLDINGS AREA (SEE SCHEME TEXT)
- EC2 ENVIRONMENTAL CONDITIONS (SEE SCHEME TEXT)
- NO ZONE

VERSION No 1

SHIRE OF WAROONA

TOWN PLANNING SCHEME NO. 7

(DISTRICT SCHEME)

DIAL BEFORE YOU DIG PLANS

Job No 5581795

Phone: 1100
www.1100.com.au

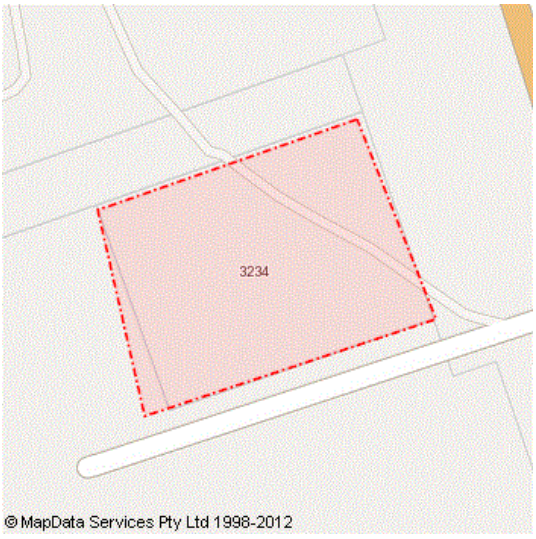
Caller Details

Contact: Mr Toby Munro
Company: Gemec
Address: Unit 1 25 Foss St
PALMYRA WA 6157

Caller Id: 770907 **Phone:** 0893398449
Mobile: Not Supplied **Fax:** Not Supplied
Email: toby@gemec.com.au

Dig Site and Enquiry Details

WARNING: The map below only displays the location of the proposed dig site and does not display any asset owners' pipe or cables. The area highlighted has been used only to identify the participating asset owners, who will send information to you directly.



User Reference: Gull Lake Clifton
Working on Behalf of:
Not Supplied

Enquiry Date:	Start Date:	End Date:
05/07/2012	10/07/2012	13/07/2012

Address:
3234 Old Coast Rd
Lake Clifton WA 6215

Job Purpose: Excavation
Onsite Activity: Mechanical Excavation
Location of Workplace: Private Property
Location in Road: Not Supplied

- Check that the location of the dig site is correct. If not you must submit a new enquiry.
- Should the scope of works change, or plan validity dates expire, you must submit a new enquiry.
- Do NOT dig without plans. Safe excavation is your responsibility. If you do not understand the plans or how to proceed safely, please contact the relevant asset owners.

Notes/Description of Works:
Not Supplied

Your Responsibilities and Duty of Care

- If plans are not received within 2 working days, contact the asset owners directly & quote their Sequence No.
- ALWAYS perform an onsite inspection for the presence of assets. Should you require an onsite location, contact the asset owners directly. Please remember, plans do not detail the exact location of assets.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- Ensure you adhere to any State legislative requirements regarding Duty of Care and safe digging requirements.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using this service, you agree to Privacy Policy and the terms and disclaimers set out at **www.1100.com.au**
- **For more information on safe excavation practices, visit www.1100.com.au**

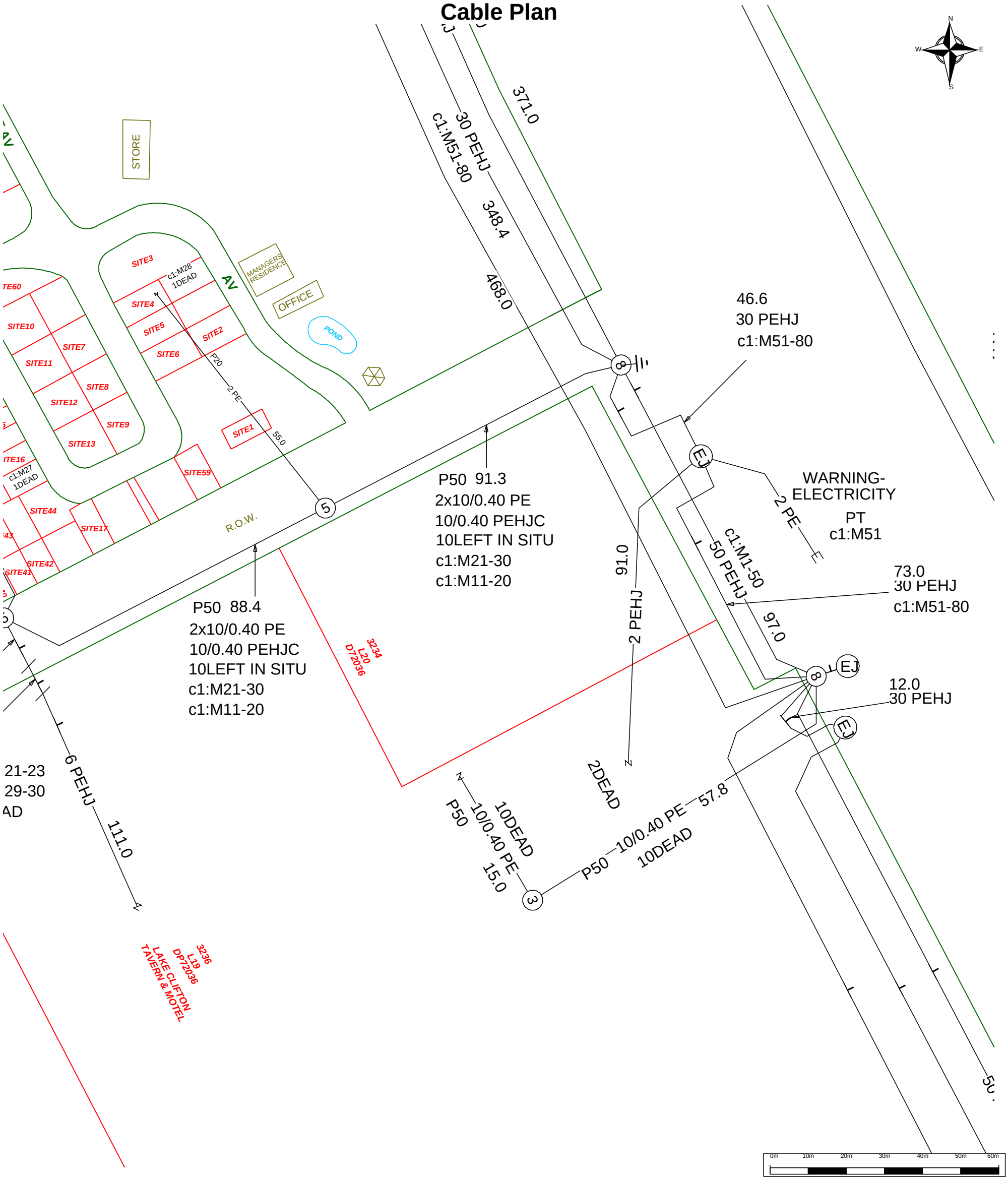
Asset Owner Details

The assets owners listed below have been requested to contact you with information about their asset locations within 2 working days. Additional time should be allowed for information issued by post. It is **your responsibility** to identify the presence of any underground assets in and around your proposed dig site. Please be aware, that not all asset owners are registered with the Dial Before You Dig service, so it is **your responsibility** to identify and contact any asset owners not listed here directly.
** Asset owners highlighted by asterisks ** require that you visit their offices to collect plans.
# Asset owners highlighted with a hash require that you call them to discuss your enquiry or to obtain plans.

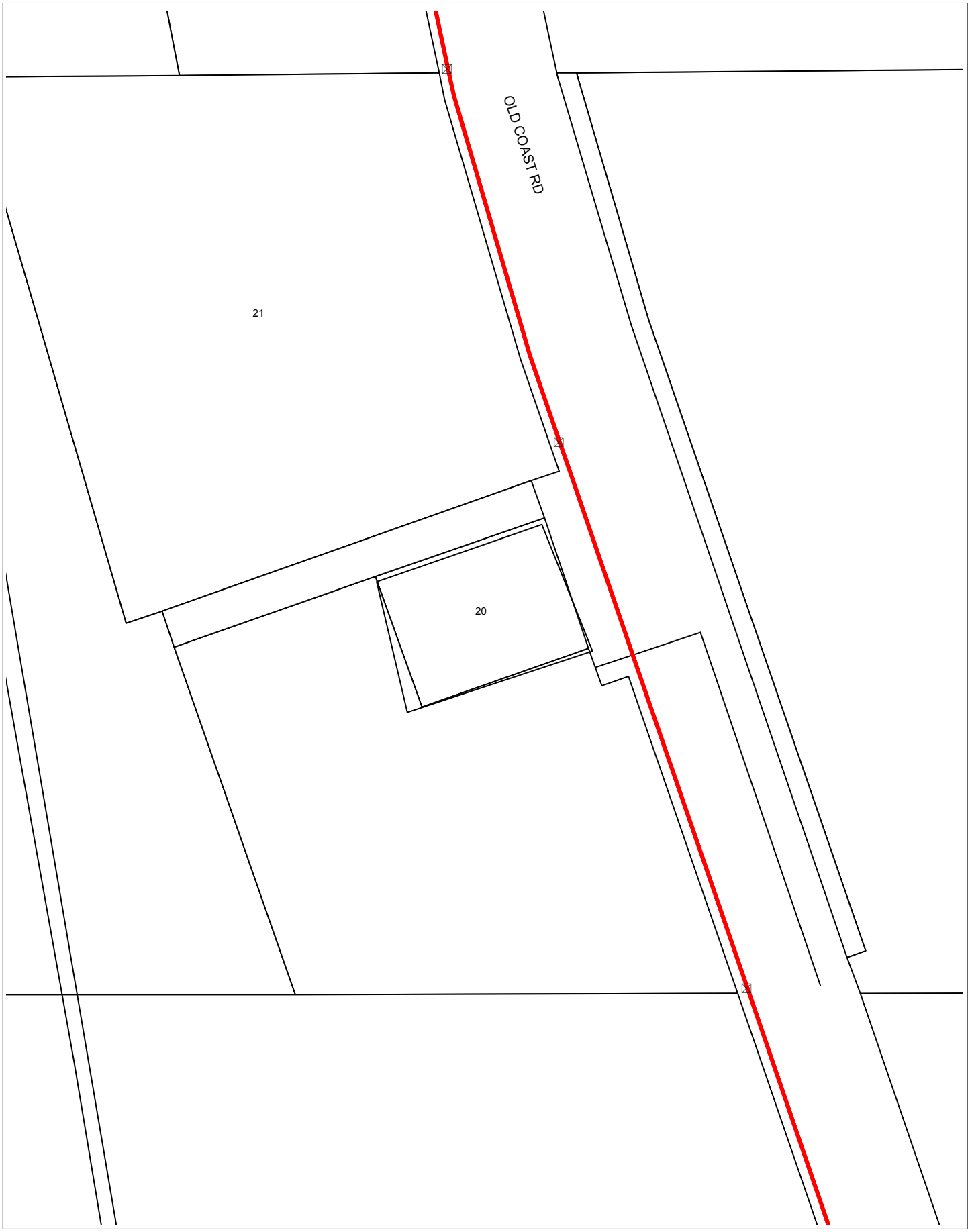
Seq. No.	Authority Name	Phone	Status
25616086	Western Power	1300769345	NOTIFIED
25616087	Telstra, WA	1800653935	NOTIFIED
25616088	Optus and/or Uecomm, WA	1800505777	NOTIFIED
25616089	Water Corporation WA	0894248115	NOTIFIED

END OF UTILITIES LIST

Cable Plan



Telstra	For all Telstra DBYD plan enquiries - email - Telstra.Plans@team.telstra.com For urgent onsite contact only - ph 1800 653 935 (bus hrs)
TELSTRA CORPORATION LIMITED A.C.N. 051 775 556	
Generated On 05/07/2012 14:11:18	Sequence Number: 25616087
	CAUTION: Fibre optic and/ or major network present in plot area. Please read the Duty of Care and contact Telstra Plan Services should you require any assistance.



Sequence Number: 25616088

Date Generated: 05/07/2012

For all Optus DBYD plan enquiries –
Email: Fibre.Locations@optus.net.au
For urgent onsite assistance contact 1800 505 777
Optus Limited ACN 052 833 208

WATER CORPORATION
UNDERGROUND ASSET DETAILS

ABN 28 003 434 917
629 Newcastle Street
Leederville, WA, 6007
PO Box 100
Leederville, WA, 6902
www.watercorporation.com.au
(08) 9424 8115

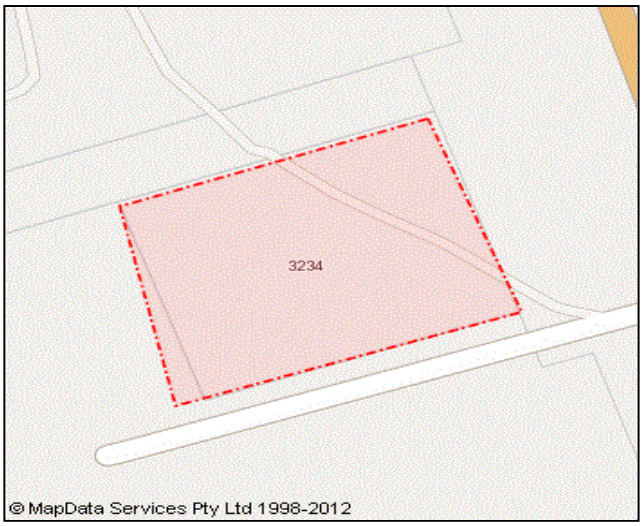
Requestor details

Mr Toby Munro
Gemec
Unit 1 25 Foss St
Palmyra Wa 6157

Phone: 0893398449
Mobile: Not Supplied
Fax: Not Supplied
Email: toby@gemec.com.au

Sequence No: **25616089**
DBYD Job No: 5581795
Enquiry Date: 05/07/2012
Issue Date: 05/07/2012

Requested location details



Address 3234 Old Coast Rd
Lake Clifton WA 6215
GPS X Coordinate
GPS Y Coordinate
Map Ref 48D2

Note: The response for this enquiry has been interpreted from details in the picture location only.

Water Corporation asset impact

NO PIPELINES FOUND
No underground pipes were identified. However be aware that pipes may still exist in your work area.
NOTE: For best results use the polygon function to define your work area. Point and line requests only generate a limited search of the surrounding area.

Important

1. Plans show approximate location only – verify location by potholing before using powered machinery.
2. Please read all information and attachments.
3. All documents must be kept together and retained on site by the work team.
4. This information is valid for 30 days from date of issue.

GEMEC PROTOCOLS

1.0 Hazard & Risk Assessment

Prior to the commencement of any work, an assessment of the potential HAZARDS and RISKS (HRA) is carried out.

The HRA includes (but is not limited to) the following:

- 'dial before you dig' (DBYD) information is accessed from the on-line source to identify the locations of services (communications [including optic fibre], gas electricity, water and sewer). Be aware that DBYD information is not necessarily accurate and is only valid for 1 month;
- contact with the local government authority if investigations are going to extend off-site;
- conduct a walk over of the site to identify the locations of services and relevant infrastructure (look for disturbed ground, concrete, bitumen), location and number of vent lines, location of potentially contaminating infrastructure;
- contracting of an underground services locating company utilising ground penetrating radar (GPR) to locate underground services and structures (all services, underground storage tanks [USTs], lines etc). Note that GPR will identify HDPE and fibreglass pipes whereas 'wand' type devices will only identify steel pipes and lines; and
- completion of a WorkSafe SubbyPack OHSE Management Plan (www.commerce.wa.gov.au/WorkSafe). The OHSE Management Plan includes all stakeholders, including but not limited to: all contractors involved in the works *e.g.,* drilling contractors, service locating personnel the site operator / owner etc. The objectives of an OHSE Management Plan are:
  - control of documents;
  - outline details of the project;
  - hazard identification, risk assessment and control;
  - construction of a risk matrix;
  - identify required personal protective equipment;
  - roles and responsibilities;
  - documenting toolbox / prestart talks;
  - plant and equipment register / prestart checklist / regular checklist;
  - hazard reporting;
  - identify emergency escape routes and muster points;
  - injury and incident investigation / reporting; and
  - identify management of change issues *i.e.,* whenever there is a significant change in conditions at the site, work is to stop and the situation / risk evaluated and risk mitigation procedures put in place as and if required.

All GEMEC personnel have completed basic first aid training and successfully completed their Blue Card training.

2.0 Site Works

Community Consultation is undertaken if and as required.

A photographic record of the various stages of work is to be maintained.

The following Standards, Guidelines and documents are used as reference tools when conducting site works:

- Australian and New Zealand Environment and Conservation Council (ANZECC) / Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), November 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*
- Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) *Minimum Bore Construction Requirements*
- Department of Commerce, *Worksafe SubbyPack*, www.commerce.wa.gov.au/WorkSafe
- Department of Environment and Conservation (DEC), 2010, *Assessment levels for soils, sediment and water*, Version 4.1. Contaminated Sites Management Series
- Department of Environment (DoE), 2001, *Development of Sampling and Analysis Programs*. Contaminated Sites Management Series, Western Australia
- Department of Health (DoH), May 2009, Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia
- Department of Water 1999 – *Monitoring Bores (Slotted Casing)*
- Department of Water, Registered Groundwater Bore Data (within one kilometre radius of the site)
- Department of Water, March 2007, Public Drinking Water Source Areas of Western Australia
- Department of Water, *Geographic Data Atlas, Hydrogeological Atlas & Perth Groundwater Atlas On-line*, water.wa.gov.au/Tools/Maps+and+atlases/default.aspx
- enHEALTH, 2005, Management of asbestos in the non-occupational environment
- National Environment Protection Measure (NEPM), Schedule B (1) 1999, *Guideline on the Investigation Levels for Soil and Groundwater*
- National Environment Protection Measure (NEPM), Schedule B (2) 1999, *Guideline on Data Collection, Sample Design and Reporting*
- National Environment Protection Measure (NEPM), Schedule B (9) 1999, *Guideline on Protection of Health and the Environment During the Assessment of Site Contamination*
- National Environment Protection Measure (NEPM), 1999, *Assessment of Site Contamination*
- Standards Australia, Australian Standard, AS 1726-1993 *Geotechnical site investigations*
- Standards Australia, Australian Standard AS 4482.1:2005, *Guide to the investigation and sampling of sites with potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds*
- Standards Australia, Australian Standard AS 4482.2:1997, *Guide to the sampling and investigation of potentially contaminated soil, Part 2: Volatile substances*
- Standards Australia, *Australian/New Zealand Standard AS/NZS 5667.1:1998, Water Quality – Sampling, Part I: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*
- Standards Australia, *Australian/New Zealand Standard AS/NZS 5667.11:1998, Water Quality – Sampling, Part II: Guidance on sampling of groundwaters*
- Western Australian Commission for Occupational Safety and Health 2005, Occupational Safety and Health Management and Contaminated Sites Work
- Netherlands Ministry of Housing, Spatial Planning and the Environment
- Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG), Volumes 1 to 5
- W.A Land Information Authority (Landgate)
- United States of America Environmental Protection Agency (USEPA) – Region 9 PRGs
- United States of America Environmental Protection Agency (USEPA) – Low Stress (low flow) Purging and Sampling Procedure for the collection of Ground Water Samples from Monitoring Wells – July 30 1996 (Revision 2)

- American Society for Testing and Materials (ASTM) – Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations – D6771-02 / 2002

2.1 Accidents / Near Misses

All near misses and accidents are recorded on the JSA / HASP form and reported to the Safety Officer. Root cause analysis is conducted on all near misses and accidents so as to inform all team members of the circumstances in an effort to eliminate the hazard (if possible) or to put in place mitigating factors to reduce the occurrence.

The following injuries must be reported to the WorkSafe Commissioner:

- a fracture of the skull, spine or pelvis;
- a fracture of any bone in the arm (other than hand or wrist) and leg (other than in the ankle or foot);
- amputation of an arm, hand, finger, finger joint, leg, foot, toe or toe joint; and
- any other injury that is likely to prevent an employee from returning to work within 10 days.

Photographs are taken of any incident.

2.2 Drilling

The drilling rig is to be 'fit for purpose' and be in a safe working condition. The drilling contractor's maintenance records and safety check list must be provided and reviewed prior to the start of work. An inspection of the rig is undertaken to identify any potential hazards e.g. do all energised lines have safety chains attached, are there any items not secured properly that could vibrate free, etc.

Drilling personnel are to be suitably qualified.

The set up location must be barricaded off from traffic and the public by witches hats, barriers, danger tape, etc. The barricaded area must be sufficient for the drilling and Gemec personnel to be able to move freely around the drilling rig. Only drilling and Gemec personnel are allowed within the barricaded area.

Prior to raising the mast of the drilling rig the overhead area must be assessed for hazards and the mast must be clear of energy sources e.g. powerlines. **Note the minimum stand-off distance from powerlines is 6.0 m (22 KvA & 415 v).**

When moving the drilling rig between locations the mast must be lowered.

All personnel in the vicinity of the drilling rig must keep alert as to the operations and stay clear of all rotating equipment.

2.3 Soil Boring / Monitor Well Boring

Soil borings are completed utilising a suitable drilling method and/or hand drilling (hand auger) equipment.

Soil samples are collected as soon as practicable from the borehole, augers, core barrel, split spoon, core tray or hand auger using a clean decontaminated stainless steel trowel or by hand using single use disposable nitrile gloves (to be discarded after each sample is collected).

Following collection the soil samples are immediately placed into 500 mL (18 cm x 17cm) snap lock plastic bags – half fill the bag. The soil borehole number, depth and time is written on the bag in permanent ink. A duplicate of each soil sample is taken and placed into a separate snap lock plastic bag for field headspace screening tests with a photo-ionisation detector (PID). If sufficient soil cannot be collected to fill two snap lock bags, one snap lock bag is used for PID screening and sample

collection – if this is the case minimal disturbance of the sample is undertaken. The PID is calibrated each day prior to the start of work with iso-butylene (97.3 ppm) with reference to benzene (the calibration sheet is completed and included with other field documents for reference in the report). A minimum period of at least 5 minutes is allowed from when the sample was placed in the snap lock bag to the time it is screened with the PID to allow equilibrium of the headspace vapour to occur. The headspace vapours are sampled by piercing the snap lock bag (with as small a hole as is necessary to insert the PID probe tip into) and measuring the maximum volatile organic compounds (VOC) reading (ppm_v). Soil samples taken as PID duplicates are subsequently discarded (appropriately if contaminated).

The PID measures the level of a range of VOC in relation to iso-butylene and indicates potential contamination. The PID results can then be used as a semi-quantitative assessment of soil contamination – *PID readings are not to be substituted for analytical sampling*, they are to be used as a field guide only!

The maximum PID reading is recorded in the field with the time of sampling and background PID reading.

The PID values are used to field rank the soil samples; those samples that reported the highest PID readings are submitted for laboratory analysis. Sample selection is also made on a judgmental basis, i.e. odour, change of geology, etc. Generally, two to three samples are collected from each borehole (with one from the maximum extent of the boring) to delineate the vertical extent of soil impact or (or as agreed with the client).

Once a sample has been selected for analysis the soil is transferred from the snap lock bag into clean laboratory supplied sample jars. Jars are filled completely so that there is zero headspace. Prior to placing the lid on the sample jar the thread and lip of the jar are carefully wiped (with a clean paper towel) to remove any soil so that the lid seals properly and volatiles cannot escape – ensuring that the Teflon seal is in place beneath the lid. The sample number, depth, date and time of sampling, initials of sampler and site location are written on the sample jar in permanent ink.

The locations of the borings / samples are accurately noted on the site plan.

2.3.1 Quality Assurance

The following quality assurance and quality control (QA/QC) samples are collected:

- blind replicate (field duplicate) samples at the rate of 1 in 20
- split samples at the rate of 1 in 20
- rinsate samples at the rate of one per piece of equipment per day (as required)

The QA/QC samples are as homogeneous as possible.

2.3.2 Equipment Decontamination

Drilling equipment and soil core boxes used for laying out of cores and collection of samples are washed thoroughly prior to use by the drillers, using a high pressure water spray and phosphate free detergent – e.g. Quantumclean, so that clean drilling equipment is used for each borehole location and cores are laid in cleaned boxes ready for logging and sampling. Alternatively the sample collection area / core tray can be covered with a clean piece of plastic that is discarded after each sample run is completed.

The sampling trowel is decontaminated between each sample collection by soaking in Quantumclean solution and then an intermediate rinse in clean tap water and final rinse in demineralised water in accordance with AS4482.1-2005 and wiped dry with a clean paper towel.

Disposable nitrile gloves are discarded after each sample collection.

2.3.3 Sample Preservation & Transport

Immediately following jarring of the sample, the sample jar is placed into an esky. Crushed ice or ice bricks are placed around the sample jars. A laboratory supplied trip blank is placed in the esky at the beginning of the work. Bubble wrap or other means of protecting the glass jars / bottles is used to prevent breakages.

2.3.4 Forms

All onsite work is recorded on the Daily Field Report (DFR) worksheet. Other details recorded on the DFR are the personnel onsite and weather conditions.

A borelog is completed for each borehole. The borelog form contains observations relating to soil type, plasticity / particle size, colour, secondary / minor components (& ~percentage), moisture content, consistency / density and any additional observations. Also recorded are the depth log, times, PID values and contaminant observations.

All samples collected for analysis are logged on a Soil Sample Register form.

A Chain of Custody (CoC) form is completed and accompanies the samples to the laboratory. If samples cannot be transported to the laboratory on the same day as collection they are placed in a refrigerator for storage – taking notice of the recommended holding times for different analyses.

2.4 Monitoring Well Installation

Groundwater monitoring wells provide a static geographic point source for information on the physical and chemical conditions of the groundwater at a site over time.

2.4.1 Installation

Monitor wells are generally constructed of new, clean 50mm diameter Class 18 PVC casing and screen (0.4mm slot) with flush threaded joints. Typically the well is constructed so that a minimum of two metres of the screened interval is below the stabilised water concentrations (taking into account seasonal variations). After placing the screen and blank sections in the borehole, graded filtered gravel is placed around the well screen to a depth approximately one-half metre above the top of the screen. A granular bentonite seal is then placed above the gravel pack. The bentonite pellets are then 'activated' by pouring water down the borehole. The remainder of the borehole is backfilled with clean sand (or grouted with cement-bentonite slurry in sensitive locations), with a further bentonite seal placed beneath the surface (aquifer conditions determine what method is employed). A metal flush-mount cast iron cover (or monument cover) is then cemented over the top of the well to protect it from damage from traffic. A tamper proof cap is installed to prevent unauthorised persons from accessing the well.

2.4.2 Monitor Well Development

Monitor wells are developed as soon as possible following installation. Well development is undertaken to remove drill cuttings and fines from the well casings.

For relatively shallow monitor wells, development is achieved by vigorously bailing and surging the well with groundwater with a new, disposable, polyethylene bailer. Generally a minimum of five well volumes is removed via this procedure or until the purge water is observed to be clean. For deeper wells, an electric pump such as a variable flow Grundfos MP1 pump may be used. All development water is disposed of in accordance with the appropriate regulations.

2.5 Groundwater Sampling

2.5.1 Gauging and Sample Collection

Sampling of monitor wells is undertaken seven days post installation where possible.

2.5.1.1 Sampling Method – Disposable Bailers

Prior to the collection of groundwater samples, the depth to water i.e., standing water level (SWL) is measured from the top of the well casing using a depth to water probe or oil/water interface probe. If previous data is available gauging and sampling starts at the least contaminated monitoring well. To eliminate tidal influence on sites in the vicinity of the ocean or estuaries all monitor well SWLs are measured in the shortest practical time frame adhering to decontamination procedures outlined below (s.2.5.2).

If the interface probe signals phase separated hydrocarbons (PSH) a disposable polyethylene bailer (or similar) is to be lowered into the well (slowly) to measure the apparent thickness. If no PSH was detected, a minimum of three to six well volumes is removed (or purged until dry) from the well to purge the stagnant water and allow a representative sample to be collected. During purging field chemical data (pH, electrical conductivity (EC), redox, dissolved oxygen (DO) and temperature) is collected to establish stabilised conditions (generally accepted as when parameters stabilise within 10%). The field chemical meter (YSI 556 MPS) probes are calibrated on a regular (monthly) basis.

When using dedicated disposable clear PVC bailers to purge and sample the wells; the bailer is to be discarded after each well is sampled *i.e.*, a new bailer is to be used for each sample collection. Clean disposable nitrile gloves are to be worn during sample collection and changed prior to the sampling of each subsequent monitor well. When lowering the bailer into the well, the bailer is to be lowered slowly into the well so as to cause the least amount of surging.

A groundwater sample from each monitor well is collected and placed in laboratory prepared bottles (500 mL bottle for C_{10}-C_{36} fraction TPH and two 40 mL vials for BTEX and C_6-C_9 fraction TPH analysis). The sample bottles are filled so that no headspace remains. The samples are labelled with the monitor well identification number, site name and date in permanent ink.

Groundwater samples for contaminants other than BTEX and TPH are collected in appropriate laboratory sample containers preserved as per laboratory requirements and transported to the laboratory within recommended holding times. Where appropriate groundwater samples are field filtered using a 0.45 µm single use polyethersulfone ground water filter.

2.5.1.2 Sampling Method – Low Flow Purging and Sampling

Prior to the collection of groundwater samples, the SWL is measured from the top of the well casing using a depth to water probe or oil/water interface probe. If previous data is available gauging and sampling starts at the least contaminated monitoring well. To eliminate tidal influence on sites in the vicinity of the ocean or estuaries all monitor well SWLs are measured in the shortest practical time frame adhering to decontamination procedures outlined below (s.2.2.2).

Purging and sample collection is to be carried out using a 12 V variable speed stainless steel submersible pump and 12 mm LDPE piping – a new length of LDPE piping is to be used for each well. The 12 V submersible pump is placed approximately 0.5 m below the SWL slowly to minimise disturbances within the well. Whilst purging the SWL is monitored to ensure the purging rate equals the recharge rate – a maximum drawdown of 0.1 m is recommended. Field chemical parameters are to be measured using an YSI 556 MPS field chemistry meter and flow cell and noted on the working field sheet at 3-5 minute intervals until stabilised conditions are achieved. The following parameters represent stabilised conditions:

Parameter	Stabilisation Criterion
pH	±0.2 pH units
Conductivity	±3% of reading
DO	±10% of reading or ±0.2 mg/L, whichever is greater
ORP	±20 mV

Once stabilised conditions are achieved a groundwater sample is collected from the LDPE tubing before the flow cell and placed in laboratory prepared bottles (500 mL bottle for C_{10}-C_{36} fraction TPH and two 40 mL vials for BTEX and C_6-C_9 fraction TPH analysis). The sample bottles are filled so that no headspace remains. The samples are labelled with the monitor well identification number, site name and date in permanent ink.

Groundwater samples for contaminants other than BTEX and TPH are collected in appropriate laboratory sample containers preserved as per laboratory requirements and transported to the laboratory within recommended holding times. Where appropriate groundwater samples are field filtered using a 0.45 µm single use polyethersulfone ground water filter.

When the low flow sampling method is used personnel will adhere to the guidelines as outlined by the ASTM / USEPA documents.

2.5.2 Equipment Decontamination

The probe and tape of the interface meter is decontaminated between wells by soaking in a 3-5% Quantumclean® solution followed by an intermediate rinse in clean tap water and final rinse in demineralised water in accordance with AS4482.1-1997. A rinsate sample is collected from the probe following cessation of gauging.

2.5.3 Quality Assurance

The following quality assurance and quality control (QA/QC) samples are collected:

- blind replicate (field duplicate) samples at the rate of 1 in 20;
- split samples at the rate of 1 in 20; and
- one rinsate sample per piece of equipment per day.

2.5.4 Sample Preservation & Transport

Immediately following collection, samples are placed into an esky. Ice or ice bricks are placed around the sample bottles to keep chilled (4 °C). A laboratory supplied trip blank is placed in the esky at the beginning of the work. Bubble wrap or other means of protecting the glass jars / bottles is used to prevent breakages.

A Chain of Custody (CoC) form is completed and accompanies the samples to the laboratory. If samples cannot be transported to the laboratory on the same day as collection they are placed in a refrigerator for storage – taking note of the recommended holding times for different analyses.

2.5.5 Flow Direction Survey

Following installation of the monitoring wells the tops of the bore casings are surveyed to a relevant datum *e.g.* Australian Height datum (AHD) by a licensed surveyor or other suitably qualified personnel. Surveyed data for the tops of the casings will also include the bearing relative to north, co-ordinates and distance from the temporary benchmark.

2.5.6 Forms

All on-site work is recorded on the Daily Field Report (DFR) worksheet. Other details recorded on the DFR are the personnel onsite and weather conditions.

The field chemical data collected from the purge water is recorded on a groundwater field chemical data form.

2.5.7 Equipment Calibration

All measuring equipment *i.e.*, the PID and the field chemical meter are calibrated on a regular basis using laboratory standards. The calibration forms are to be included in the relevant appendix within the report.

2.6 Hydrogeological Testing

2.6.1 Slug Tests

A Solinst Levelogger Model 3001 is used to record changes in metres of head, or SWL, within a monitor well as a slug is inserted into, and removed from the groundwater monitor well. The slug consists of a sealed sand filled disposable polyethylene bailer (~1027 mL).

The logger is activated prior to testing, recording metres of head and temperature in degrees Celsius (°C) at one second intervals. On-site the logger is positioned within the monitor well at a sufficient depth beneath the SWL so that no contact is made with the slug as the slug is inserted into the water column.

Using a sufficient length of rope, the slug is lowered to a depth to allow complete immersion within the water column in the groundwater monitor well. This action is carried out as quickly as possible without splashing in an attempt to represent immediate displacement of water.

The logger measures the initial increase in head, or displacement of water due to the slug, and the subsequent amount of time required for SWL stabilisation to occur.

After stabilisation of the SWL, the slug is removed and data is again logged recording the amount of time required for the SWL to again stabilise through groundwater recharge.

2.7 Excavations

Excavation works contain inherent safety issues. An excavation is considered to be any ground disturbance that is equal to or more than 1.5 metres deep. All excavations are classed as 'confined space' and therefore must not be entered into without a confined space permit.

If deemed necessary a dilapidation survey is undertaken by a competent person prior to the start of any excavation works to determine the potential for damage to surrounding buildings prior and post excavation works.

2.7.1 Fencing and Signage

If the excavation is of sufficient size and likely to remain open for more than one day, then temporary fencing is erected around the site. Appropriate signage is erected on the fencing; the signage must be clearly visible. Signage includes: *No Smoking*, *Hard Hats To Be Worn*, *Safety Glasses To Be Worn*, *Danger Deep Excavation*, *Keep Out*, etc. In Western Australia any barrier and / or fence must be at least 900 mm high.

Traffic Management Plans (TMPs) (if required) are submitted to the relevant authorities for approval prior to the start of works. If TMPs are to be implemented all signage must be in place prior to the start of works. Consideration of local residents concerns with regard to their ease of ingress and egress to their properties is undertaken. If necessary a community meeting or a letter drop is undertaken to inform the community of the activities and expected length of the works.

2.7.2 Services

The mains water, power, gas, telephone lines, sewer etc, services are located with GPR. If the services are likely to interfere with the excavation the supplies are terminated by a competent person prior to the start of works.

Please note that Gemec will not be held responsible for any damage to subsurface utilities, cables and/or piping unless precise (as built) drawings are made available. Wherever possible Gemec will employ the services an underground services locating company, however they are not fool proof and the above applies.

2.7.3 Excavation Integrity

The design of the excavation takes into account any remaining infrastructure. At no time is the integrity of the infrastructure to be compromised (undermined).

Excavations are constructed to retain suitable batters to maintain the integrity of the excavation. Competent excavator contractors are employed, if they or Gemec personnel are unsure as to the required batter, works must cease and an engineer brought to site to advise on suitable batter for the excavation.

Digging boxes are employed if site conditions / contaminant levels require their use.

2.7.4 Entering Excavations

Employees / contractors are not to enter excavations that are greater than 1.5 meters deep. If it is absolutely necessary to enter an excavation, then "Confined Space Entry" conditions are adhered to; an observer posted in a safe place, outside the excavation, the observer must have an unobstructed view of the person entering the excavation at all times. The person entering the excavation must have a full safety harness on with a rope tethered to a fixed point well outside the top of the excavation. Gemec directors are informed if a person is planning to enter a confined space.

2.7.5 Soil Sampling

Soil samples are obtained from the tines of the excavator bucket when brought to surface. The sample is collected from the middle of the material to produce a more representative sample.

Soil sampling and decontamination procedures are conducted as per s. 2.3.

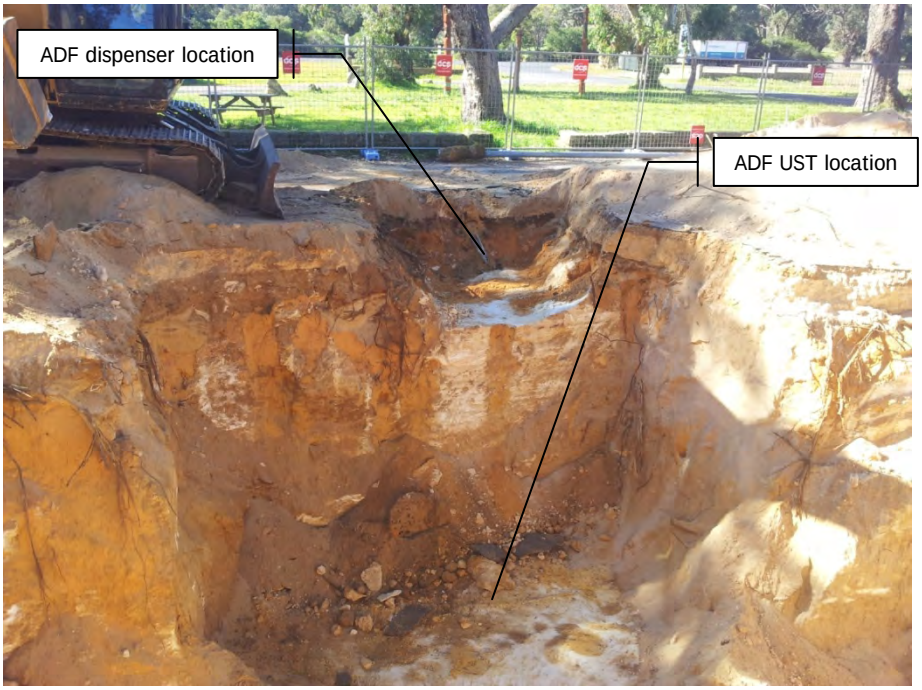
APPENDIX C

Site Photographs – July 2012

Starting surface removal and excavation works – view to the north-west

Exposing the 14 kL ADF and 25 kL LRP USTs – view to the south-east

Removing 14 kL ADF UST from ground – view to the east, north-east



Limestone base below 14 kL UST and ADF dispenser locations – view to the east south-east

Removing 10 kL LRP UST– view to the south south-west

Limestone base below 10 kL LRP UST location – view to the north-east

Exposing 25 kL ULP UST – view to the north north-west

Base of 25 kL ULP UST following removal and scraping of potentially impacted soils from the base – view to the north

All three USTs secured for transport

Minor quantity of temporarily stockpiled potentially impacted soil – view to the north

Completed Works – 14 August 2012

View to the south

View to the north

GEMEC

Appendix Five: Ecoscape 2009 Environmental Impact Report

ENVIRONMENTAL IMPACT ASSESSMENT FOR LOTS 19 – 21 OLD COAST ROAD, LAKE CLIFTON

BECK ADVISORY

Prepared by:

Ecoscape (Australia) Pty Ltd

Document Status

Rev. No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	JN/BT	SG/MM				20/02/09
1	SG	SG				20/03/09

Quality Assurance

Ecoscape (Australia) has implemented a comprehensive range of quality control measures on all aspects of the company's operation and has Quality Assurance certification to ISO 9001.

An internal quality review process has been applied to each project task undertaken by us. Each document is carefully reviewed by senior members of the consultancy team and signed off prior to issue to the client. Draft documents are submitted to the client for comment and acceptance prior to final production.

Limitations Statement

This report has been exclusively drafted for the needs of **BECK ADVISORY**. No express or implied warranties are made by Ecoscape (Australia) Pty Ltd regarding the research findings and data contained in this report. All of the information details included in this report are based upon the existent land area conditions, research provided and obtained, and so forth at the time Ecoscape (Australia) Pty Ltd conducted its analysis into the area. Ecoscape (Australia) Pty Ltd will not be responsible for the application of its recommended strategies by **BECK ADVISORY**.

Please note that the strategies devised in this report may not be directly applicable towards another company's needs or any other specific land area requiring management strategies. We would also warn against the environmental dangers of adapting this report's strategies to another land area which has not been researched and analysed by Ecoscape (Australia) Pty Ltd. Instead, please contact Ecoscape (Australia) Pty Ltd to provide a tailored report for your area's needs. Otherwise, Ecoscape (Australia) Pty Ltd accepts no liability whatsoever for a third party's use of, or reliance upon, this specific report.

Direct all inquiries to:

Ecoscape (Australia) Pty Ltd
9 Stirling Highway • PO Box 50 North Fremantle WA 6159
Ph: (08) 9430 8955 Fax: (08) 9430 8977

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Acronyms

AHD	Australian Height Datum
ARRPA	Agricultural and Related Resources Protection Act
ASS	Acid Sulfate Soil
ATU	Alternative Treatment Unit
BOM	Bureau of Meteorology
CALM	Department of Conservation and Land Management
CCW	Conservation Category Wetland
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation
DEWHA	Department of Environment, Water, Heritage and Arts
DIA	Department of Indigenous Affairs
DOW	Department of Water
DRF	Declared Rare Flora
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
EPBC	Environmental Protection and Biodiversity Conservation
EPP	Environmental Protection Policy
ESA	Environmentally Sensitive Area
EWSWA	Environmental Weed Strategy of Western Australia
GWA	Government of Western Australia
IBRA	Interim Biogeographic Regionalisation for Australia
PASS	Passive Acid Sulfate Soil
PDWSA	Public Water Drinking Supply Area
PEC	Priority Ecological Community
PRI	Phosphorus Retention Index
SCP	Swan Coastal Plain
TEC	Threatened Ecological Community.
UFI	Unique Feature Identifier

WAM	Western Australian Museum
WAPC	Western Australian Planning Commission
WONS	Weed of National Significance

Summary

Environmental Impact Assessment for Lot 19 – 21 Old Coast Road, Lake Clifton

Beck Advisory requested Ecoscape to undertake an Environmental Impact Assessment (EIA) for the redevelopment of an existing tavern, caravan and former service station located on Lots 19 – 21 Old Coast Road, Lake Clifton into a Commercial Development and Park Home Estate, as per the current development plan prepared by Doepel Marsh.

Lake Clifton, which is a part of the Peel-Yalgorup System, is located approximately 100m to the west of the site and is listed and protected under the Ramsar Convention. The Commonwealth *EPBC Act 1999* enhances the management and protection of Australia's Ramsar wetlands under sections 16 and 17b of the Act as Matters of National Environmental Significance. The wetland is also protected under the State E*nvironmental Protection (Swan Coastal Plain Lakes) Policy 1992,* meaning that it is an offence under the *Environmental Protection Act 1986* to excavate or drain into or out of an EPP wetland.

EPA Guidance Statement No. 28 - *Protection of the Lake Clifton Catchment* (EPA 1998) specifies that conventional septic systems are not permitted in the Lake Clifton Catchment. Instead ATUs with high phosphorus retention capabilities will be required due to the potential for the proposal to contribute to nutrient loading of the Peel Harvey Catchment and Lake Clifton. The Shire of Waroona's Local Planning Strategy for the Lake Clifton Precinct also requires effluent systems for proposed development to be Alternative Treatment Units (ATUs).

A total of six recommendations were made throughout the report, which are listed below.

- An Acid Sulfate Soil Assessment be carried out in accordance with the guidelines outlined in *Identification and Investigation of Acid Sulfate Soils* as prepared by the Department of Environment (2006).
- That monitoring bores be installed on site prior to development to collect baseline level and water quality data. Ongoing monitoring is likely to be a condition of approval of the development.
- A minimum 50m buffer between the wetland boundary (i.e. the extent of wetland dependent vegetation) and any proposed development is recommended by the DEC for preserving the wetlands from habitat modification.
- It is recommended that an Urban Water Management Plan be developed and implemented for the proposed development to ensure the values and ecological functions of Lake Clifton are maintained.

- Also in accordance with the shire of Waroona's local planning strategy for the Lake Clifton precinct, all dwellings must be located at least 150m from the high water mark of Lake Clifton.
- Wherever possible Tuarts are to be retained on site.
- Potential impacts on Baudin's Black-Cockatoo can be managed by minimising disturbance to the Tuart trees existing on the site.

1.0 Introduction

Environmental Impact Assessment for Lot 19 – 21 Old Coast Road, Lake Clifton

Beck Advisory engaged Ecoscape to undertake an Environmental Impact Assessment (EIA) for the redevelopment of an existing tavern, caravan and former service station into a Commercial Development and Park Home Estate on Lots 19 – 21 Old Coast Road, Lake Clifton. The development proposal has been previously referred to the Environmental Protection Authority (EPA) for assessment, who indicated that insufficient information had been provided with the referral to enable them to assess the significance of the impact of the proposal on the environment.

The objectives of this report include assessment of the following environmental aspects:

- surface hydrology and impacts on Lake Clifton (an internationally important (Ramsar) wetland and an *Environmental Protection (Swan Coastal Plain Lakes) Policy Wetland 1992)* and the surrounding catchment
- preliminary Acid Sulfate Soils assessment (review of risk mapping)
- wetland locations, classifications and buffer requirements
- topography and surface geology (soils)
- flora and vegetation composition, extent and condition
- impacts on fauna and fauna habitat
- investigation of Indigenous Heritage sites and European Heritage concerns.

This report will provide sufficient information for the EPA to assess the significance of the impact of the proposal on the site and surrounding environment (see **Figure 2**).

1.1 Scope of Report

The scope of this EIA has been prepared based on the current Park Home and Commercial Development plan prepared for the site by Doepel Marsh Architects.

The EIA included the following activities:

- Desktop Investigation, including a review of the:
    - Department Environment and Conservation (DEC) Rare and Priority Flora databases
    - DEC Threatened Fauna databases
    - Ramsar Policy
    - Environmental Protection Policy (EPP)
    - Department of Indigenous Affairs (DIA) Aboriginal Sites Register
    - Acid Sulfate Soils mapping for the area
    - Department of Agriculture and Food Western Australia (DAFWA) Land Capability Mapping for the site

  - Aerial photography of the site.

- Site assessment within the project area for:
  - mapping of vegetation types and condition (using the Keighery (1994) condition rating scale) through a combination of recent aerial photography and field surveys to ground-truth
  - a list of all native and non-native plant species recorded from opportunistic sampling of vegetation types identified from each site
  - a list of significant species recorded in the DEC's database occurring in the vicinity of each site. The location of any significant species (Declared Rare and Priority Flora) identified on site will be recorded using a handheld GPS
  - a description of the vegetation types, floristic community types, vegetation condition and presence of any Threatened Ecological Community(s) (TECs) occurring on the site
  - an assessment of the potential impact of clearing on flora and vegetation.
- Land Capability Assessment
- A review of relevant assessment reports conducted in the vicinity of the project area
- An assessment of the impacts likely to occur as a result of clearing and review of those impacts against the DEC's ten clearing principles
- An assessment of the environmental impacts of the project that are likely to be of interest to the DEC
- An assessment of matters of National Environmental Significance likely to require referral of the proposal to the Department of Environment, Water, Heritage, and Arts under the *Environmental Protection and Biodiversity Conservation Act (EPBC) (1999)*.

1.2 Previous Studies

- Ecoscape (2008) Shire of Waroona Town Planning Scheme No 7 Amendments No 4 & 17 Environmental Review (EPA Assessment nos 1281 & 1567). Report No: 5350-1570-06R Rev 4. Prepared for the Shire of Waroona.
- Coffey Environments (2007) Preston Beach (North) Flora and Vegetation Assessment. Prepared for Mirvac (WA) Pty Ltd.
- ENV (2006) Environmental Assessment Lot 2942 Old Bunbury Road, Lake Clifton. Report 05.186/RP001. Prepared for DEVX Developing Excellence Pty Ltd.

2.0 Description of the Proposal

2.1 Study Area

The study area is located within the Shire of Waroona approximately 100km south of the Perth Central Business District. The combined area of Lots 19 – 21 is roughly 11 ha, of which approximately 40% is vegetated. The vegetated portion of the site is predominantly 'parkland cleared'.

The regional location of study area is presented in **Figure 1.**

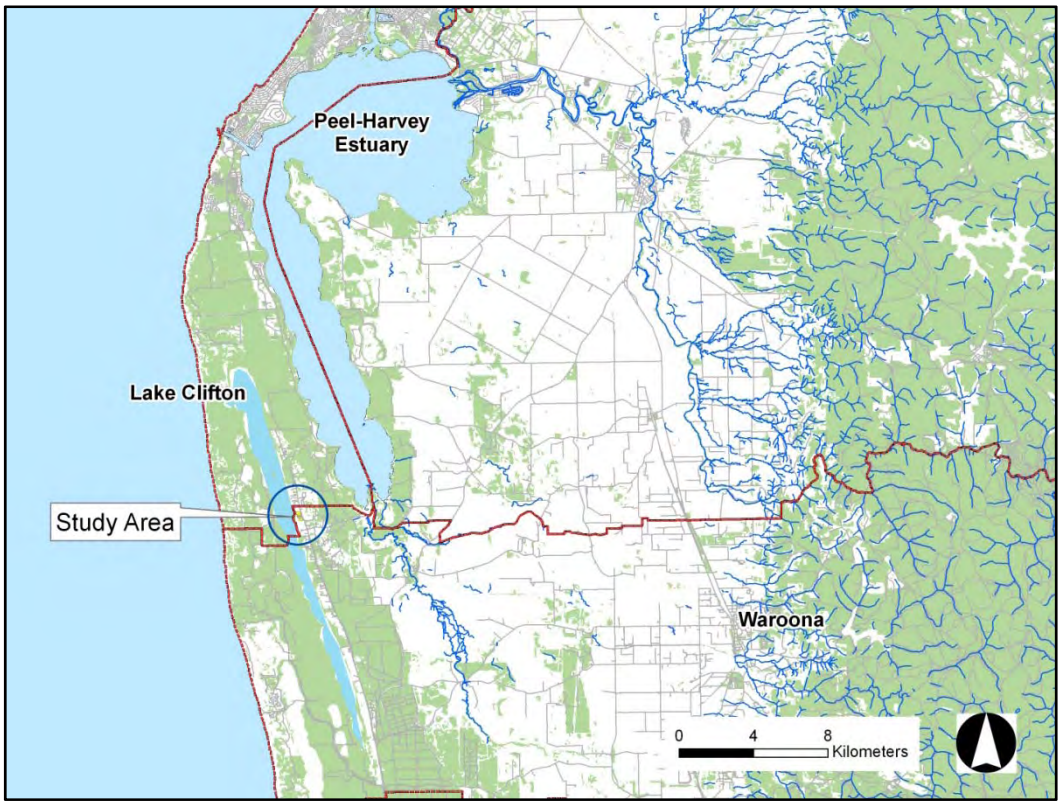

Figure 1: Regional Location of Study Area

2.2 Proposal

The proposal considered in this EIA is the redevelopment of an existing tavern, caravan and former service station located on Lots 19 – 21 Old Coast Road, Lake Clifton into a commercial development and Park Home Estate, as detailed in the current development plan prepared by Doepel Marsh (**Figure 2**).

Figure 2: Development Plan for Lots 19 – 21 Old Coast Road, Lake Clifton

3.0 Existing Environment and Expected Impacts

3.1 Physical Environment

3.1.1 Climate

The Peel region experiences a Mediterranean type climate of hot dry summers and mild wet winters. The climate varies seasonally, with rainfall, temperature and winds following a well-defined annual cycle. The summer weather pattern, from September to March, usually produces hot, dry easterly winds from high-pressure systems crossing the state in a westerly direction. In winter, the high-pressure systems move north allowing cold fronts to cross the coast. Summer rainfall is scant, but occasional thunderstorms and decaying tropical cyclones can produce occasional heavy rainfalls (Peel Development Commission & Peel Harvey Catchment Council 2003). The majority of the rainfall occurs in the winter months with 90% falling between April and October.

Historic temperature and rainfall records from the Mandurah Park weather station, located approximately 35 km north of the study area are presented in **Figure 3** below**.** July has the lowest temperatures with average daily minimum and maximum temperatures of 8.6 °C and 17.3 °C, respectively. February has the highest temperatures with an average daily minimum and maximum temperatures of 17 °C and 29.6 °C, respectively. The average annual rainfall for the site is 875.1 mm (Bureau of Meteorology 2009).

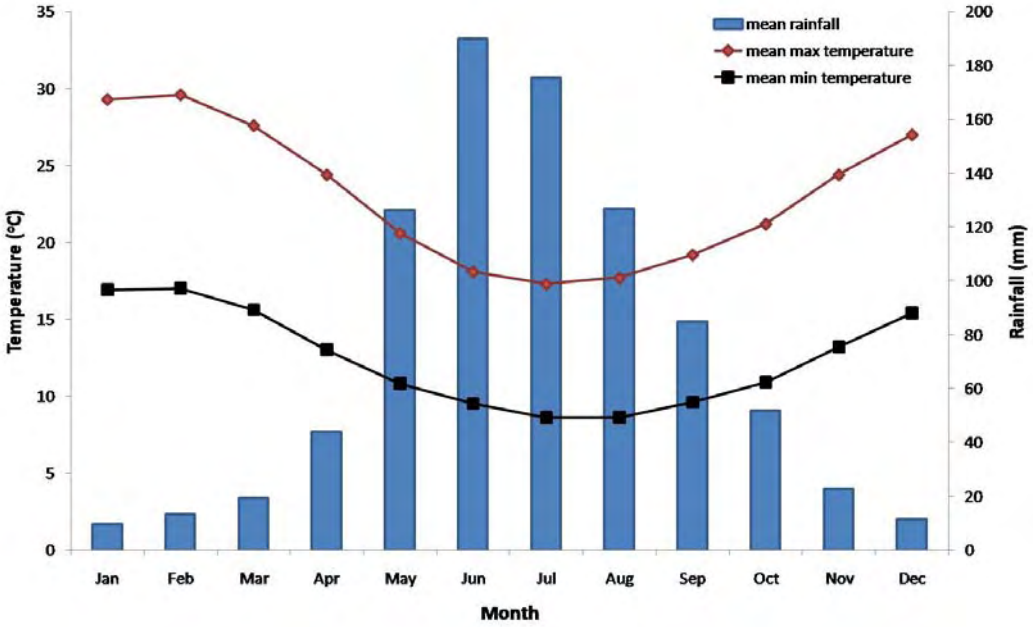

Figure 3: Mean monthly temperature and rainfall at Mandurah Park weather station

3.1.2 Topography

Topography across the study area can broadly be described as flat to very gently undulating sandplain with outcropping limestone on low crests. Elevation ranges from a minimum of 2 m up to 10 m AHD (Australian Height Datum) (Government of Western Australia & Commonwealth of Australia 2008).

3.1.3 Geology

The Geological Survey of Western Australia and Gozzard (1987) identified the superficial geology of the site as predominantly Tamala Limestone (LS1), with areas of sand derived from Tamala Limestone (S7) and LS5 Limestone (**Map 1** in **Appendix One**).

- LS1 - Tamala Limestone, is described as light yellowish-brown, fine to coarse-grained, sub-angular to well-rounded, calcarenite composed largely of fossil skeletal fragments (mainly foraminifera and mollusc) with various amounts of quartz and trace feldspar (Biggs et al. 1980; Gozzard 1987)
- S7 - Sand derived from Tamala Limestone (S_7) is similar though has negligible carbonate (shell) content, and is pale to olive yellow in colour
- LS5 Limestone is very pale yellowish brown, vuggy, fine to medium; sub-angular quartz and shell debris, generally friable (Gozzard 1987).

Tamala Limestone occurs discontinuously throughout the Swan Coastal Plain and forms ridges roughly parallel to the coast. The formation was originally accumulated as coastal sand dunes and the ridges in which it now occurs represent successive lines of Late Pleistocene dunes. The most extensive, delineated by series of limestone-capped 'peaks' such as Reabold Hill, Shire View Hill and Mount Brown, forms part of the Spearwood Dune System (Biggs et al. 1980).

3.1.4 Landform and Soils

The study area is located within the Cottesloe unit of the Spearwood Dunes (Churchward & McArthur 1980). The Spearwood Dunes are of aeolian origin, and are intermediate in age between the older Bassendean Dunes to the east, and the younger Quindalup Dunes to the west (McArthur & Bettenay 1960). The system consists of a core of Tamala Limestone with a hard capping of calcite (cap-rock) overlain by a variable depth of yellow to brown sands (McArthur 1991). The Cottesloe unit runs along the western extent of the Spearwood Dunes, consisting of shallow yellow brown sands and exposed limestone (Churchward & McArthur 1980).

The Spearwood S4b soil phase (Map unit - 211Sp_S4b) occurs across the entirety of the study area according to Soil-Landscape mapping published by the Department of Agriculture and Food (DAWFA) (2007) (**Map 2** in **Appendix One**). The soil phase is described as flat to gently undulating sandplain with shallow to moderately deep siliceous yellow-brown and grey-brown sands with minor limestone outcrop.

Field Assessment

Preliminary investigation of DAFWA soil data (2007) determined that the site is mapped as a single soil phase. To verify accuracy of the soil phase mapping two shallow soil pits (to a depth of approximately 50 cm) were dug by Ecoscape Environmental Scientists in conjunction within inspection of an existing vertical exposure (**Plate 1** in **Appendix Four**) to confirm that soil characteristics. Location of these observation points are shown in **Map 3** in **Appendix One**.

Soil texture and colour descriptions follow those as described by McDonald *et al*.(1998) and Munsell soil colour charts (2000).

Soil texture and colour descriptions for the two soil pits on-site are presented below in ***Table 1.***

Table 1: ***Field observations of soil profile.***

Profile Depth (cm)	Texture	Colour
Site 1		
0 – 5 cm	Loamy Sand	10YR 3/2
5 – 30 cm	Sand	10YR 3/6
Site 2		
0 – 5cm	Loamy Sand	10YR 3/2
5 – 30 cm	Sand	10YR 3/6

Based on site observations of yellow-brown sands, of variable depth, with minor limestone outcrop, soil type was considered to be consistent with descriptions of the Spearwood S4b soil phase as outlined in DAFWA (2007), and similar to the yellow sands occurring on hills within the Cottesloe landform (reference soil SCP 8) as described by McArthur (1991).

3.1.5 Land Capability

Soil data from the DAFWA (2007) was used to interpret the sites surface soil map unit for the purpose of Land Capability assessment (Department of Agriculture and Food 2002). Land capability was assessed by following the guidelines for assessing land qualities and land capability as outlined in DAFWA (2005). These guidelines cover the assessment of land

for suitability of septic systems, aspects of which are still relevant to alternative treatment units (ATUs).

The guidelines for assessing land qualities and land capability states that land capability for septic tanks should be a minimum requirement in the case of rural residential developments. The land qualities to be considered in this assessment are:

- ease of excavation
- flood hazard
- land instability
- microbial purification ability
- soil absorption ability
- waterlogging / inundation risk.

Risks/ratings for the above land qualities for each of the proportionally mapped land units within the S4b soil map unit were interpreted from the AGMAPS – Land Manager CD-ROM for the shires of Serpentine-Jarrahdale, Kwinana, Rockingham, Mandurah, Murray, Boddington, Waroona and Harvey (DAFWA 2005). Each land unit represent areas of similar soil, slope and drainage, and cover the variation of soils and landscapes within a given map unit. These risks/ratings were then converted into a land capability class according to the matrix for septic tanks for rural and residential developments presented in **Table 2.** Explanation of each land capability class is provided in **Table 3**.

Table 2: ***Land capability for the installation of septic tanks for rural residential developments (DAFWA 2005).***

Land quality and (capability subscript)	Land capability class				
	1	2	3	4	5
Ease of excavation *(x)*	H	M	L	VL	
Flood hazard *(f)*	N		L	M	H
Land instability *(c)*	N	VL	L	M	H
Microbial purification ability *(p)*	H	M	L	VL	
Soil absorption *(zj)*	H	M	L	VL	
Waterlogging *(i)*	N, VL	L	M	H	VH

H=High, M=Moderate, L=Low, VL=Very Low, N=Nil

Table 3: ***Assessment of overall land capability rating (DAFWA 2005).***

Capability class	General description
1 Very high	Very few physical limitations present and easily overcome. Risk of land degradation is negligible
2 High	Minor physical limitations affecting either productive land use and/or risk of degradation. Limitations overcome by careful planning.
3 Fair	Moderate physical limitations significantly affecting productive land use and/or risk of degradation. Careful planning and conservation measures required
4 Low	High degree of physical limitation not easily overcome by standard development techniques and/or resulting in high risk of degradation. Extensive conservation measures and careful ongoing management required.
5 Very low	Severe limitations. Use is usually prohibitive in terms of development costs or the associated risk of degradation.

The overall land capability rating for each land unit, as presented in **Table 4,** was determined by the land quality with the lowest land capability class. Full analysis of land qualities for each land unit is provided in **Table 17** in **Appendix Two**.

Table 4: ***Overall Land Capability Class for each Land Unit within the S4b soil map unit in regards to installation of septic tanks for rural residential developments.***

Land Unit				
Soil Group	**Qualifier**	**Land attribute**	**Typical %**	**Overall Land Capability Class**
Bare Rock	differentiation not required	Well drained flat	5	**4**
Yellow/brown shallow sand	Good sand, deep rock substrate	Well drained flat	30	**4**
Yellow/brown shallow sand	Very shallow rock substrate	Well drained flat	10	**4**
Pale deep sand	Good sand, very deep	Well drained flat	25	**3**
Pale deep sand	Good sand, very deep	Low rise <2 m	10	**3**
Yellow deep sand	Good sand, very deep	Well drained flat	20	**3**

According to the land capability analysis, 55% of the S4b map unit has a Class 3 (Fair) rating, while the remaining 45% has a Class 4 (Low) rating.

The land capability of study site for septic tank installation was determined to be Class 4 (Low), according to the similarity of the yellow/brown shallow sand land units as outlined in **Table 4,** with the observed soil type, both from field samples, desktop investigation and geological data. Class 4 land can be utilised by management and construction techniques, such as ATUs and drainage attenuation. In Accordance with the Shire of Waroona's Local Planning Strategy for the Lake Clifton Precinct all effluent systems for the proposed development are to be ATUs.

3.1.6 Phosphorus Retention Index

Phosphorus is one of the key pollutants of concern to the Peel-Harvey Estuary. High levels of phosphorus can lead to algal blooms and fish deaths. Management of phosphorus should be a key element of any proposal to develop in the Peel-Harvey System. This is likely to include an assessment of the capability of the soils to retain phosphorus (Peel Development Commission 2006).

Phosphorus Retention Index (PRI) is a commonly used laboratory-based measure of the potential for a soil to adsorb and bind phosphorus. PRI is defined as the ratio P ads : P eq where P ads is the amount of phosphorus adsorbed by soil (µg P/g) and Peq is the equilibrium concentration of phosphorus remaining in solution (ug P/mL). The phosphorus fixation properties of soil may be described by the following PRI values:

- negative = desorbing
- 0 - 2 = weakly adsorbing
- 2 - 20 = moderately adsorbing
- 20 - 100 = strongly adsorbing
- >100 = very strongly adsorbing

Soils associated with sandy rises and slopes of the Spearwood soil system, typically comprise of sands and loams with a significant sesquioxide (iron and aluminium oxide) content. These soils are referred to locally to as 'yellow or brown sands' in reference to their colouration by iron oxides. The amount of iron and aluminium coating the sand grains also increases the capacity of the sands to retain phosphorus (Bolland 1998). The positively charged surfaces of these sesquioxides sorb anions such as phosphate, resulting in moderate to high PRI values (>15) (Peel Development Commission 2006).

Field Assessment

To identify the phosphorus retention capacity of the soils on site, samples were taken from the two soil pits and sent to the WA Chemistry Centre for PRI analysis. The soil sampled from site 1 was taken from the top 10 cm of the profile, including the transition zone between the A11 and A12 horizons. While at site 2 the sample was taken between depths of 20 to 30 cm within the A12 horizon. Results of Chemistry Centre's analysis are provided in **Table 5** and **Appendix Three.**

Table 5: ***PRI results for soil samples***

Site	Soil Horizon	Depth of sample	PRI
1	A11 / A12	0 – 10cm	20
2	A12	20 – 30 cm	24

Both samples had PRI of 20 or higher, classifying them as moderately to highly adsorbing. This moderate to high phosphorus retention 'potential' capacity in conjunction with the requirement for all effluent systems to be ATUs with high phosphorus retention capabilities as per the Shire of Waroona's Local Planning Strategy for the Lake Clifton Precinct and EPA Guidance Statement No. 28 - *Protection of the Lake Clifton Catchment* (EPA 1998), indicates that the potential for the proposal to contribute to nutrient loading of Lake Clifton is low.

3.1.7 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are generally naturally occurring soils containing sulfides that have reacted with oxygen to produce acids. Passive Acid Sulfate Soils (PASS) contain sulfides that have not reacted with oxygen, usually due to being permanently waterlogged. They produce acids when exposed to air by excavation, filling, creation of artificial water courses, or groundwater abstraction/dewatering.

The impacts associated with acid sulfate soils can be associated with the increase in acidity and/or the release of heavy metals into the environment. This can result in:

- wetlands degradation
- localised reduction in habitat and biodiversity
- deterioration of surface and groundwater quality
- loss of groundwater for irrigation
- increased health risks associated with arsenic and heavy metals contamination in surface and groundwater, and acid dust
- risk of long-term infrastructure damage through corrosion of sub-surface pipes and foundations by acid water

- invasion by acid tolerant waterplants and dominance of acid tolerant plankton species causing loss of biodiversity.

The Department of Water *Perth Groundwater Atlas* mapping data set (DOW 2008) was examined to determine the level of potential Acid Sulfate Soils risk. The mapping revealed there is a High Risk of ASS or PASS less than 3m from soil surface (Class 1) across the entirety of the site (**Figure 4**). This risk has been identified due to the site's immediate proximity to Lake Clifton.

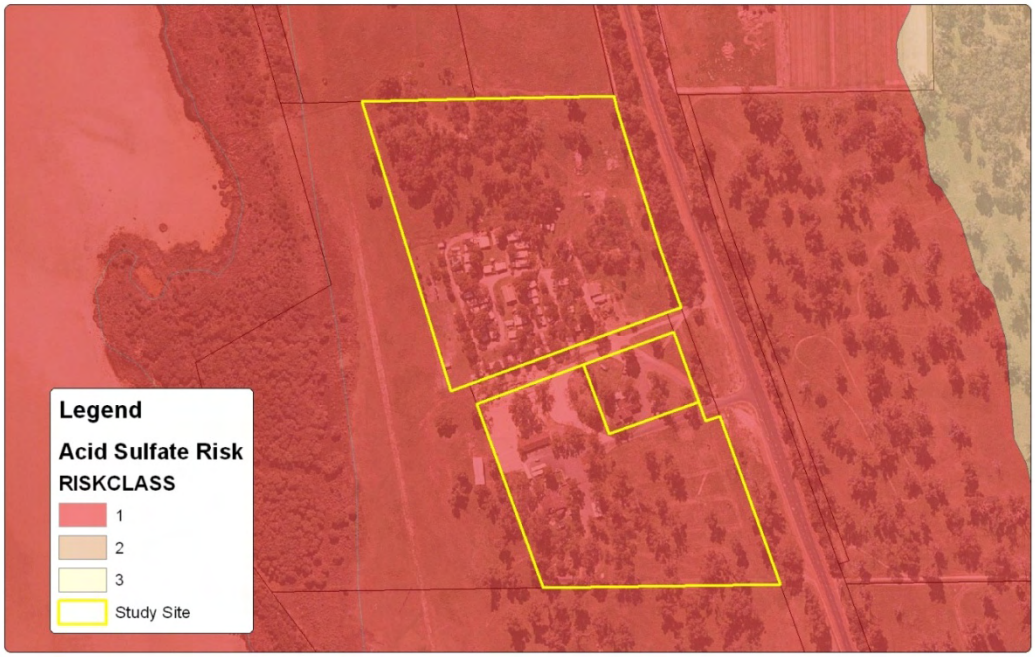

Figure 4: Acid Sulfate Risk

The extensive occurrence of Tamala limestone across the site is likely to preclude the occurrence of actual ASS. However, it is recommended that ASS Assessment be carried out in accordance with the guidelines outlined in *Identification and Investigation of Acid Sulfate Soils* as prepared by the Department of Environment (2006). These guidelines provide recommendations on the type and nature of the site investigations, the number of soil profiles required for assessment and the recommended laboratory analysis techniques and interpretation of results. If acid sulfate soils are confirmed to be present and are to be disturbed by a proposed activity, an Acid Sulphate Soil Management Plan (ASSMP) should be developed. The ASSMP should outline all potential environmental impacts and include any potential impacts to the proposed development/infrastructure, and detail appropriate mitigation strategies (Peel Development Commission 2006).

3.1.8 Hydrology

Surface

The Coastal and Lakelands Planning Strategy (WAPC 1999) identifies the site as being a within the Yalgorup Coastal Catchment, and the "administrative" EPA Lake Clifton Catchment. There are no mapped surface drainage lines on site (DOW 2008). A constructed dam is located in the southeast of Lot 21.

Groundwater

The *Perth Groundwater Atlas* of the DoW (2008) was interrogated for hydrological data covering the study site and the presence of any Public Drinking Water Source Areas (PDWSA).

The Atlas indicates that the site is not included in a PDWSA, and groundwater salinity is between 3000 – 7000 mg/L TDS (brackish to saline). Further information relating to depth to groundwater and groundwater risk could not be gathered as the mapping for these elements does not extend to Lake Clifton.

Regional hydrogeological studies covering the strategy area were undertaken in the 1980s by Commander (1988) and Deeney (1989) of the Geological Survey of Western Australia. Deeney (1989) identified the Yanget and Mialla groundwater mounds, and the Waroona, Myalup and Serpentine Flow Systems in the vicinity of the southern half of Lake Clifton and beyond Lake Preston to the Collie River. The study site is located within the Waroona flow system (Deenay 1989) with groundwater on site flowing approximately to the west towards Lake Clifton (Commander 1988, Deenay 1989). Groundwater contours indicate that groundwater level beneath the site to be less than 1m AHD (Deeney 1989).

In the absence of accurate groundwater level or quality information for the site, it is recommended that monitoring bores be installed on site prior to development to collect baseline level and water quality data. Ongoing monitoring is likely to be a condition of approval of the development.

3.1.9 Wetlands

Wetland Function and Values

Wetlands are one of the most notable features of the Swan Coastal Plain (SCP) (Hill et al. 1996). Apart from channel wetlands (such as rivers and streams), the majority of Swan Coastal Plain wetlands are groundwater dependant in their natural form. These wetlands occur where the ground surface intersects the groundwater table. Due to variations in topography and geomorphology, these wetlands vary from deep, permanent wetlands to

shallow seasonal wetlands, through to wetlands with little or no surface water where the water table is at or slightly below the ground surface.

Wetlands perform a number of ecological, hydrological and social functions. Ecologically wetlands provide:

- food webs
- drought refuges for waterbirds
- summer feeding areas for trans-equatorial migratory wading birds
- habitats for plants, animals and communities that are considered to be rare or possess restricted occurrence or distribution
- limited capacity to assimilate nutrients, pollutants, sediment and litter

Hydrologically, wetlands also play an important flood control function by acting as a compensation or retention basin. The vegetation fringing lakes and wetlands partially act as filters that assimilate nutrients, sediments and pollutants from adjacent land surface runoff (EPA 1993).

Wetlands can play a variety of social functions. There can be historical or archaeological values such as aboriginal sites. There are nature study, education values and access to wildlife values, such as bird watching. There is also an overall aesthetic consideration to the local community (EPA 1993).

Wetlands in the Swan Coastal Plain have been classified by Hill et al (1996) as being *Conservation, Resource Enhancement* or *Multiple Use*, according to a management category. Management priorities for these categories are outlined in **Table 6**.

Table 6: ***Management categories and objectives and recommendations for change***

Category	Wetland description	Management Priorities
Conservation (C category) wetlands	Wetlands which support high levels of attributes and functions	To preserve wetland attributes and functions through reservation in parks, crown reserves, state owned land and protection under environmental protection policies
Resource Enhancement (R category) wetlands	Wetlands which have been partly modified but still support substantial functions and attributes	To restore wetlands through maintenance and enhancement of wetland functions and attributes by protection in crown reserves, state or local government owned land and by environmental protection policies, or in private property by sustainable management
Multiple Use (M category) wetlands	Wetlands with few attributes which still provide important wetland functions	Use, development and management should be considered in the context of water (catchment/strategic drainage planning), town (land use) and environmental planning through landcare

(Hill et al. 1996)

The DEC recommends separation and management to mitigate potential impacts (threatening processes) for Conservation Category Wetlands (CCWs) by providing a

minimum 50m buffer zone from the edge of any fringing wetland vegetation (Hill et al. 1996).

Existing Wetlands

Lake Clifton (UFI 3089) is classified in the DEC (2007b) *Geomorphic Wetlands Swan Coastal Plain* dataset as a Conservation Category Wetland and is located approximately 100m to the west of the study area (**Map 4** in **Appendix One**).

3.1.10 Wetland Significance

International Significance

Lake Clifton is listed and protected under the Ramsar Convention (Australian Government 2009). Ramsar sites (1996-2007) are identified as wetlands of international importance. Designated Ramsar wetlands are sites containing representative, rare or unique wetland types or those that are important for conserving biological diversity to the List of Wetlands of International Importance. These sites need to be managed to ensure their special ecological values are maintained or improved (DEWHA 2009).

National Siginificance

The EPBC Act *(*1999) enhances the management and protection of Australia's Ramsar wetlands, as 'Matters of National Environmental Significance' protected under sections 16 and 17b of the Act. A 'declared Ramsar wetland' is an area that has been designated under Article 2 of the Ramsar Convention or declared by the Minister to be a declared Ramsar wetland under the EPBC Act. Consequently, an action that has, will have, or is likely to have, a significant impact on the ecological character of a Ramsar wetland must be referred to the Minister and undergo an environmental assessment and approval process. An action is a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things.

State Significance

Lake Clifton (wetland UFI 3089) is a declared Environmentally Sensitive Area (ESA) under the Government of Western Australia (2005) *Environmental Protection (Environmentally Sensitive Areas) Notice*. An ESA defines those areas where priority flora and fauna species, wetlands or TECs are likely to occur and as such are subject to strict land clearing regulations.

The *Geographical Atlas* (DEC 2008b) also defines Wetland UFI 3089 as a *Conservation Category* Wetland (CCW) identified by the *Geomorphic Wetlands Swan Coastal Plain* dataset. The conservation status means these wetlands have a high degree of naturalness

with a management priority directed towards protecting and enhancing the natural features of the wetland (Hill et al. 1996). A minimum 50m buffer from the wetland boundary (i.e. the extent of wetland dependent vegetation) is recommended by the DEC for preserving the wetlands from habitat modification unless a site-specific buffer requirement determines the site suitability for a small buffer distance (EPA 2008).

Lake Clifton is also protected under the Western Australian E*nvironmental Protection (Swan Coastal Plain Lakes) Policy 1992,* meaning that it is an offence under the *Environmental Protection Act* (1986) to excavate, modify or drain into or out of an EPP wetland (EPA 1992).

Regional Significance

The site is of regional significance as it is one of a small number of wetlands in the region that maintain significant natural values for wildlife. It acts as a buffer, filtering excess nutrients and pollutants, as well as providing food and habitat to a variety of fauna species. Waterways also provide one of the main opportunities for ecological linkages in developed areas, therefore it is desirable to increase the foreshore reserve width to enhance connectivity between remnant vegetation (EPA 2005).

It is recommended that an Urban Water Management Plan be developed and implemented for the proposed development to ensure the values and ecological functions of Lake Clifton are maintained. Also in accordance with the shire of Waroona's local planning strategy for the Lake Clifton precinct, all dwellings will be located at least 150m from the high water mark of Lake Clifton.

3.1.11 Contaminated Sites

The proposed development site was not listed on the Contaminated Sites Register of the DEC (2007). Investigation revealed that potential soil contamination sources from the former service station have been remediated. No other sources of potential contamination were identified from the site.

3.2 Biological Context

3.2.1 Bioregional Context

The Interim Biogeographic Regionalisation for Australia (IBRA) Version 6.1 divides the Australian continent into bioregions and sub-regions based areas with like geology, landform, vegetation, fauna and climate (Australian Government 2008). Western Australia supports 53 biogeographical subregions within the IBRA. The study area is located within in the Swan Coastal Plain 2 (SWA2) subregion. The subregion is composed of colluvial and aeolian sands, alluvial river flats, and coastal limestone. Typical Vegetation patterns include Heath and/or Tuart woodlands on limestone, *Banksia* and Jarrah-*Banksia* woodlands on Quaternary dune systems, and Marri woodlands on colluvial and alluvials. The region also includes a complex series of seasonal wetlands (Mitchell et al. 2002).

3.2.2 Vegetation

Vegetation Complexes

Heddle et al (1980) mapped and described the vegetation of the Darling System in Western Australia, according to a system of twenty eight complexes, each with had shared distinctive characteristics such as flora species composition, soil types and landform. A total of two of the Heddle *et al* (1980) vegetation complexes are known to occur in the study area (**Map 5** in **Appendix One**).

Cottesloe Complex – Central and South - Mosaic of woodland of *Eucalyptus gomphocephala* and open forest of *Eucalyptus gomphocephala - Eucalyptus marginata - Corymbia calophylla*; closed heath on the limestone outcrops.

Yoongarillup Complex - Woodland to tall woodland of *Eucalyptus gomphocephala* with *Agonis flexuosa* in the second storey. Less consistently an open forest of *Eucalyptus gomphocephala - Eucalyptus marginata - Corymbia calophylla.*

Local and Regional Significance

The extent remaining of each vegetation complex occuring in the study area is summarised in **Table 7.**

Table 7: ***Current extent of Vegetation Complexes on Swan Coastal Plain (EPA 2006)***

Vegetation Complex	Present extent (1997/98) in the System 6 / part System 1		Remaining in Secure Tenure (2002)	
	Area (ha)	% Remaining of pre-1750 Extent	Area (ha)	% Remaining of pre-1750 Extent
Cottesloe Complex-Central and South	18 474	41.1	3 951	8.8
Yoongarillup Complex	11 140	45	3 449	13.9

EPA Guidance Statement No 10 (EPA 2006) using 1997/1998 data, has the Cottesloe Complex-Central and South, and the Yoongarillup vegetation complexes as having 41.1% and 45% of the original extent remaining, respectively. The EPA (2006) has identified several levels to describe the status of a vegetation complex within the metropolitan region and southwest. These are:

- **Threshold level** – 30% of the pre-clearing extent is the level at which species loss appears to accelerate exponentially at an ecosystem level
- **Endangered level –** 10% of the original extent is regarded as being a level representing "endangered".

Both vegetation complexes have more than 30% of the original extent remaining, which is the level the EPA (2000), in *Position Statement No. 2 – Environmental Protection of Native Vegetation in Western Australia, Clearing of Native Vegetation with Particular Reference to the Agricultural Area,* has adopted in as a minimum required to protect biodiversity in the System 6 area.

Field Evaluation

The entire site was assessed on 22nd January 2009 to describe vegetation type and determine bushland condition using the methodology of Keighery (1994), as outlined in **Tables 8** and **9.**

Table 8: ***Classification system used to describe vegetation structure (Keighery 1994)***

Life form/height class	Canopy cover (%)			
	100 – 70	70 – 30	30 – 10	10 – 2
Trees over 30m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland
Trees 10 – 30m	Closed forest	Open forest	Woodland	Open woodland
Trees under 10m	Low closed forest	Low open forest	Low woodland	Low open woodland
Tree Mallee	Closed tree Mallee	Tree Mallee	Open tree Mallee	Very open tree Mallee
Shrub Mallee	Closed shrub Mallee	Shrub Mallee	Open shrub Mallee	Very open shrub Mallee
Shrubs over 2m	Closed tall scrub	Tall open scrub	Tall shrubland	Tall open shrubland
Shrubs 1 – 2m	Closed heath	Open heath	Shrubland	Open shrubland
Shrubs under 1m	Closed low heath	Open low heath	Low shrubland	Low open shrubland
Grasses	Closed grassland	Grassland	Open grassland	Very open grassland
Herbs	Closed herbland	herbland	Open herbland	Very open herbland
Sedges	Closed sedgeland	Sedgeland	Open sedgeland	Very open sedgeland

Table 9: ***Keighery (1994) bushland condition scale***

Condition	Keighery Criteria
Pristine	No obvious signs of disturbance
Excellent	Vegetation structure intact, disturbance only affecting individual species and weeds are non-aggressive species
Very Good	Vegetation structure altered, obvious signs of disturbance e.g: repeated fires, aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure altered, obvious signs of disturbance. Retains basic vegetation structure or ability to regenerate it. The presence of very aggressive weeds at high density, partial clearing, dieback, logging and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Requires intensive management. The presence of very aggressive weeds at high density, partial clearing, dieback, logging and grazing.
Completely Degraded	Vegetation structure is no longer intact and the area is completely or almost completely without native flora. 'Parkland Cleared'.

Only one vegetation type was recorded for the site, which could be described as *Eucalyptus gomphocephala* (Tuart) Woodland, over *Agonis flexuosa (*Peppermint) Low Open Woodland*.* The extent of the vegetation type on site is illustrated in **Map 5** in **Appendix One**. The understorey, which was predominantly 'parkland cleared', was dominated by non-native grasses and other pasture/disturbance weeds (**Plates 2-5** in **Appendix Four**). There was variation in density of the various species within the community, which is reflected in the descriptions of the two floristic descriptions, as observed at sites 1 and 2 (**Map 3** in **Appendix One**) is outlined below:

- *Site 1*
    - *Eucalyptus gomphocephala* (Tuart) Woodland to 20m over *Agonis flexuosa* (Peppermint) Low Woodland to 8m over *Avena fatua** Closed Grassland and *Euphorbia terracina** Very Open Herbland to 0.5m (**Plate 2 & 3**)
- *Site 2*
    - *Eucalyptus gomphocephala* (Tuart) Woodland to 20m over *Agonis flexuosa* (Peppermint) Low Open Woodland to 8m over *Eragrostis curvula** Closed Grassland and *Trachyandra divaricata** Very Open Herbland to 0.5m (**Plate 4 & 5**)

Planted, non-endemic *Eucalyptus* spp. were located within and along the boundary of the Caravan Park (**Plate 6** in **Appendix Four**).

More than 90% of study area was considered to be *completely degraded* with little or no native understorey remaining. A less disturbed variant of the vegetation type retaining a level of native understorey was located over an area of limestone ridge/outcrop to the east of Site 1. This area accounted for less than approximately 10% of total area, and was considered to be *degraded*.

Local and Regional Significance

Tuart (*Eucalyptus gomphocephala*)

Tuart is endemic to the Swan Coastal Plain of WA, growing near the coast in a 400-kilometre band from Jurien Bay on the Plain's north to the Sabina River, east of Busselton (Keighery et al 2002). It is generally confined to two the Quindalup and Spearwood Dunes, although there is a series of outlying populations near the Murray, Serpentine, Swan and Canning Rivers.

It is estimated that prior to European arrival there was more than 111,600 hectares of Tuart woodlands (Hopkins et al. 1996) on the SCP. Since that time this extent has been greatly reduced by agriculture, industrial, and urban development. Many of the remaining tuart woodlands have been disturbed by grazing, altered fire regimes and past timber harvesting (Tuart Response Group 2004).

The values of tuart woodlands include conserving biodiversity, protecting ecosystem function and providing connectivity between remnant vegetation. Tuart woodlands provide important landscape, cultural, social and economic values. Processes that threaten the integrity of tuart values include habitat loss, fragmentation and alteration caused by changes in natural and human induced vegetation disturbance regimes (Tuart Response Group 2004).

The extent of Tuart within the Shire of Waroona is outlined by land category in **Table 10.**

Table 10: ***Tuart extent summary by land category within the Waroona Local Government Area (CALM 2003)***

Local Government	Land Categories*									
	NP	NR	CP	SF	s.5(g) s.5(h)	UCL	UMR	Other Reserves	Freehold	Total
	CALM managed lands (ha)							(ha)	(ha)	(ha)
Waroona	1555.4	0	0	1094.3	7.6	74.8	1.9	66.9	1858	4658.9

* NP: National Park
NR: Nature Reserve
CP: Conservation Park
SF: State Forest, CALM Executive Director freehold lands, miscellaneous CALM managed reserves
UCL: Unallocated Crown Land
UMR: Unmanaged reserve
s.5(g); s.5(h): CALM Act (1984) Sections 5(g) and Section 5(h) reserves
Other reserves: Other Crown reserves not vested in Conservation Commission, including reserves vested with local governments and other agencies such as roads and water resources.

The development plan proposed for the site has endeavoured to retain, wherever possible, the majority of Tuarts within the site.

3.2.3 Threatened Ecological Communities

Threatened Ecological Communities (TECs) are categorised at both State level (DEC 2008c) and Commonwealth Level (DEWHA 1999) as outlined in **Table 18** in **Appendix Five.**

Database searches of the DEC's TEC and PEC databases were interrogated to determine the presence of any TECs or PECS within the study area and the immediate vicinity. Any TEC/PECs identified from these searches were considered during the field assessment. The *EPBC Act 1999* Protected Matters Online Search Tool (Australian Government 2009) was also used to determine if any of the TEC/PECs returned from the DEC database search were also federally listed.

A total of four DEC Listed TECs (DEC 2008c) & PECs (DEC 2008d) are known to occur within 8km of the study area:

- Crictically Endangered Clifton-microbialite community - Stromatolite like freshwater microbialite community of coastal brackish lakes
- Endangered Limestone ridges (SCP 26a) community - *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges
- Priority 3 SCP 29a community - Coastal shrublands on shallow sands

- Priority 3 SCP 29b community - Acacia shrublands on taller dunes.

There were no recorded EPBC listed TECs within 8km of the study area (DEWHA 2009)

The floristic community types identified during the site assessment were not considered to be representative of any of the TEC/PECs described above. Since all stormwater generated is to be retained on site, it is considered that the proposed development will have no direct or in direct impacts on the stromatolite community.

3.2.4 Native Flora

Flora Inventory

The site was traversed on foot on the 22nd of January 2009 to verify results from the desktop investigation. The survey was conducted in accordance with EPA *Guidance Statement No. 51* Level 1 requirements (EPA 2004b)

A full inventory of flora recorded on site from opportunistic observations is presented in **Table 23** in **Appendix Six**.

In total, 27 vascular plant species were observed in the survey area. Of these, 17 were introduced.

The plant families with the highest representation on site were the POACEAE (the grass family) (7 species all non-native), PAPILIONACEAE (the Peas) (4 species including one non-native), and MYRTACEAE (the Eucalyptus family) (3 species all native).

State and Commonwealth Significance

Database searches of the DEC's Declared Rare Flora (DRF) and Priority Species databases were requested to determine the presence of any such species within the study area and the immediate vicinity. Species returned from these searches were considered in field searches conducted during the field survey. Information in relation to these species was compiled from FloraBase (DEC 2009) to assist in field searches. The *EPBC Act Protected Matters Online Search Tool* (Australian Government 2009) was also used to determine if any of the threatened flora listed by DEC were federally listed.

Flora species are classified Declared Rare Flora (DRF) or Priority listed where populations are geographically restricted or threatened by local processes. The DEC enforce regulations under Government of Western Australia's *Wildlife Conservation Act* (GWA 1950) to conserve DRF and protect significant populations. Rare flora species are gazetted under Sub-Section 2 of Section 23F of the *Wildlife Conservation Act*, thereby making it an offence

to remove or damage rare flora without Ministerial approval. All Declared and Priority flora are listed in DEC (2008a) *Declared Rare and Priority Flora List*. There are six categories of priority flora covering these listed species, which are described in **Table 19** in **Appendix Five**.

Flora are also classified and protected at a federal level through the DEWHA (1999) under the *EPBC Act 1999.* There are five categories of protected flora covering the federally listed species, which are described in **Table 20** in **Appendix Five**.

Results of the EPBC Protected Matters Search and the DEC database searches are presented in **Table 11.** A total of four DRF species, two of which *Caladenia huegelii* and *Diuris purdiei* are listed as Endangered under the EPBC Act (1999), and 18 Priority Species were identified from the DEC database searches.

Table 11: ***EPBC Protected Matters Search Results and DRF / Priority species listed from DEC database searches for the study area, including a 5km buffer.***

Scientific Name	Common Name	DEC Status	DEWHA Status
Angianthus drummondii		P3	
Blennospora doliiformis		P3	
Boronia juncea subsp. *juncea*		P1	
Caladenia huegelii	Grand Spider Orchid	R	Endangered
Carex tereticaulis		P1	
Conostylis pauciflora subsp *pauciflora*		P4	
Dillwynia dillwynioides		P3	
Diuris purdiei	Purdie's Donkey Orchid	R	Endangered
Eryngium subdecumbens		P3	
Eucalyptus argutifolia	Wabling Hill Mallee	R	
Gastrolobium sp. Harvey		P2	
Hakea sp. Yalgorup		P4	
Haloragis aculeolata		P2	
Haloragis scoparia		P1	
Hibbertia spicata subsp *leptotheca*		P3	
Lasiopetalum membranaceum		P3	
Lepidium pseudotasmanicum		P4	
Platysace ramosissima		P3	
Pterostylis frenchii		P2	
Stylidium maritimum		P3	
Synaphea sp. Fairbridge		R	
Tripterococcus paniculatus		P1	

No Declared Rare or Priority Flora were observed on the site during the 22nd January field assessment. Although the timing of the site visit was outside of that recommended for flora surveys in the south-west of WA, the completely degraded nature of the site, absence of native understorey species, and past land use allows for a degree of certainty that these species are highly unlikely to be present on site.

3.2.5 Weeds

Field Evaluation

The entire site was traversed on foot on the 22nd of January 2009 and all observed weed species identified and recorded (**Table 12**).

Weed Significance

The priority rating of each recorded weed species was determined after examining:

- the ratings under the *Environmental Weed Strategy of Western Australia* (EWSWA) (Department of Conservation and Land Management 1999)
- whether it was listed under the DAFWA *Agricultural and Related Resources Protection Act 1976* (ARRPA)
- whether it was listed as a *Weed of National Significance* (WONS) (Weeds Australia 2008).

The role of EWSWA is to highlight which weed species pose significant environmental risk in Western Australia. The EWSWA rating provides a basis for determining which weeds are most critical to control. The three characteristics used for determining the EWSWA rating are:

- *invasiveness* – ability to invade bushland in good to excellent condition, and waterways
- *distribution* – wide current or potential distribution including consideration of known history of wide distribution elsewhere in the world
- *environment impacts* – ability to change the structure, composition and function of ecosystems, in particular to form a monoculture in a vegetation community.

EWSWA weed species were rated accordingly:

- *High* - have all three of the characteristics
- *Moderate* - have two of the characteristics
- *Mild* - have one of the characteristics
- *Low* - not deemed to have any of the characteristics.

The type of control for ARRPA declared weed species are listed below:

- *P1* – Prohibits movement of plants or their seeds within the State. This prohibits the movement of contaminated machinery and produce including livestock and feed.
- *P2* – Eradicate infestation to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
- *P3* - Control infestation in such a way that prevents the spread of seed or plant parts within and form the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants.
- *P4* – Prevent the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on all plants.

WONS was jointly declared by the Minister for Forestry and Conservation, the Minister for Agriculture, Fisheries and Forestry and the Minister for The Environment in 1999 as part of the *National Weeds Strategy*. The four characteristics used for determining where the species was of national significance were:

- invasiveness
- impacts
- potential for spread
- socioeconomic and environmental values.

None of the species observed were listed under the ARRPA or a WONS. Five of species have been rated as *high* risk according ENSWA (**Table 12)**. Weeds that are *high* risk are those that have the ability to invade bushland in *good* to *excellent* condition, have a wide current or potential distribution, and have the ability to change the structure, composition and function of ecosystems, often forming monocultures (CALM 1999).

Table 12: ***Weed species observed during field evaluation***

Scientific Name	Common Names	ENSWA Rating
Avena fatua	Wild Oat	Moderate
Bromus diandrus	Great Brome	High
Carduus sp.	Thistle	-
Cynodon dactylon	Couch	Moderate
Disa bracteata		-
Ehrharta longiflora	Annual Veldgrass	Moderate
Eragrostis curvula	African Love Grass	High
Euphorbia terracina	Geraldton Carnation Weed	High
Ficus carica	Edible Fig	Moderate
Gomphocarpus fruticosus	Swan Plant or Narrowleaf Cottonbush	Moderate
Lagurus ovatus	Hares Tail Grass	High
Lupinus cosentinii	Sandplain Lupin	High
Pennisetum clandestinum	Kikuyu	Moderate
Phytolacca octandra	Ink Weed, Red Ink Plant	Mild
Solanum nigrum	Black Nightshade	Moderate
Soncus asper	Prickly Sowthistle	Moderate
Trachyandra divaricata	Strap Lily, Dune Onion Weed	Mild

3.2.6 Fauna

Fauna Inventory

A desktop study was undertaken at the commencement of the assessment to gather information on the fauna species likely to inhabit the area of the survey. Sources used to conduct the search and produce a list of potential species were:

- DEC Threatened Fauna Database (database search request)
- DEWHA (2008) *EPBC Protected Matters Search Tool*
- The Western Australian Museum (WAM) (2008) online *FaunaBase* database

A field survey was undertaken on the 22nd of January 2009 by an Ecoscape Senior Zoologist, to verify results from the desktop investigation and involved traversing the site on foot. The survey was conducted in accordance with EPA *Guidance Statement No. 56* Level 1 requirements (EPA 2004a). The field survey focussed on the presence of potential habitat, fauna presence, and signs of fauna including tracks, bones, scats and diggings, particularly in respect to conservation significant species.

Significant Fauna

The conservation status of fauna species is assessed under Commonwealth and State Acts being the *EPBC Act (1999)* and the *Western Australian Wildlife Conservation Act* (1950). The significance levels for fauna used in the EPBC Act are those recommended by the

International Union for the Conservation of Nature and Natural Resources (IUCN). EPBC Categories are listed in **Table 20** in **Appendix Five.** The Western Australian *Wildlife Conservation Act* (1950) uses a set of Schedules but also classifies species using some of the IUCN categories. The *Wildlife Conservation Act* (1950) Schedule definitions are listed in **Table 21** in **Appendix Five**.

In Western Australia, the DEC has produced a supplementary list of Priority Fauna, listed using priority codes, which are species that are not considered Threatened under the *Wildlife Conservation Act* but for which the DEC feels there is cause for concern. Some Priority species, however, are also assigned to the IUCN Conservation Dependent category. DEC Priority categories definitions are shown in **Table 22** in **Appendix Five.** It is important to recognise that such Priority Lists have no statutory standing, but are used to assist DEC when considering which fauna are most in need of more surveys or other investigations, in order to establish their status in the wild.

The results of the WAM (2008) *FaunaBase* database search for the local area included many wetland restricted species (ie shore and wading birds), therefore only those species considered relevant to the local area have been considered. The relevant species are listed in **Table 23** in **Appendix Six**.

The search results of the DEC threatened fauna databases (**Table 13)** and the EPBC Act databases (**Table 14**), indicated four *Wildlife Conservation Act* (1950) Scheduled or Priority fauna species, and 26 EPBC Act (1999) listed species, have been recorded within 5km of the study area. The field survey failed to observe any signs of presence for any of these listed species within the study area.

Table 13: ***DEC Threatened Fauna Database Search Results for study area including 5km buffer.***

Scientific name	Common Name	DEC Status	DEWHA Status
Mammals			
Pseudocheirus occidentalis	Western Ringtail Possum	Schedule 1	Vulnerable
Birds			
Calyptorhynchus baudinii	Baudin's Black Cockatoo	Schedule 1	Vulnerable
Charadrius rubricollis	Hooded Plover	Priority 4	Marine
Reptiles			
Lerista lineata	Lined Skink	Priority 3	

Table 14: ***EPBC Protected Matters Search Results for Protected Fauna with 5km of study area****

Scientific Name	Common Name	DEWHA Status
Threatened Species		
Mammals		
Dasyurus geoffroii	Chuditch	Vulnerable
Phascogale calura	Red-tailed Phascogale	Endangered
Setonix brachyurus	Quokka	Vulnerable
Birds		
Calyptorhynchus baudinii	Baudin's Black-Cockatoo	Vulnerable
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	Endangered
Diomedea exulans gibsonii	Gibson's Albatross	Vulnerable
Macronectes giganteus	Southern Giant-Petrel	Endangered
Macronectes halli	Northern Giant-Petrel	Vulnerable
Thalassarche cauta cauta	Shy Albatross	Vulnerable
Migratory Terrestrial Species		
Haliaeetus leucogaster	White-bellied Sea-Eagle	Migratory
Merops ornatus	Rainbow Bee-eater	Migratory
Migratory Wetland Species		
Ardea alba	Great Egret, White Egret	Migratory
Ardea ibis	Cattle Egret	Migratory
Calidris acuminata	Sharp-tailed Sandpiper	Migratory
Calidris ferruginea	Curlew Sandpiper	Migratory
Calidris ruficollis	Red-necked Stint	Migratory
Pluvialis squatarola	Grey Plover	Migratory
Tringa nebularia	Common Greenshank	Migratory
Tringa stagnatilis	Marsh Sandpiper	Migratory
Migratory Marine Birds		
Apus pacificus	Fork-tailed Swift	Migratory
Ardea alba	Great Egret, White Egret	Migratory
Ardea ibis	Cattle Egret	Migratory
Diomedea gibsoni	Gibson's Albatross	Migratory
Macronectes giganteus	Southern Giant-Petrel	Migratory
Macronectes halli	Northern Giant-Petrel	Migratory
Thalassarche cauta (sensu stricto)	Shy Albatross	Migratory

* Marine Species identified from search have not been included. Listed Marine Species are outlined in the *EPBC Act (1999)* Protected Matters Search Report provided in **Appendix Eight.**

Species likely to inhabit the study site or utilise nesting or feeding resources present would include the following species, as identified from the database searches of both the *Wildlife Conservation Act (1950)* and *EPBC Act (1999):*

- *Pseudocheirus occidentalis* (Western Ringtail Possum) there is a small likelihood of transient dispersing possums occurring on the site however the site does not

possess suitable habitat for resident individuals being present. The lack of a significant number of trees with hollows and large areas of dense Peppermint woodlands precludes the likelihood of a resident population.

- *Calyptorhynchus baudinii* (Baudin's Black-Cockatoo) which is potentially able to use nesting hollows that may be present in the Tuart trees on site. Potential habitat trees as identified during the 22nd January field survey are presented in **Map 3** in **Appendix One**. The development plan proposed for the site has endeavoured to retain, wherever possible, the majority of Tuarts on the site.
- *Charadrius rubricollis* (Hooded Plover) this species is likely to be found along the margins of Lake Clifton and although close to the study site is not strictly within the proposed development boundary.

Table 15 below, lists the fauna species recorded during the field survey.

Table 15: ***Fauna Observations***

Scientific name	Common Name	Detection Method
Mammal		
Oryctolagus cuniculus	European wild rabbit*	Observed/Diggings
Bird		
Aquila audax	Wedge-tailed eagle	Observed
Aquila morphnoides	Little Eagle	Observed
Cacatua roseicapilla	Galah	Observed
Columba livia	Domestic Pigeon	Observed
Corvus coronoides	Australian Raven	Observed
Cracticus tibicen dorsalis	Australian Magpie	Observed
Dacelo novaeguineae	Laughing Kookaburra	Heard
Daphoenositta chrysoptera	Sittella	Observed
Phaps elegans	Brush Bronzewing	Observed
Strepera versicolor	Grey Currawong	Observed
Platycercus zonarius semitorquatus	Twenty-eight Parrot	Observed

Potential impacts to the Baudin's Black-Cockatoo can be managed by protection and minimisation of disturbance to the Tuart trees existing on the site. The development plan proposed for the site has endeavoured to retain, wherever possible, the majority of Tuart s on the site. Post development revegetation with local flora species would also enhance the ability of the site to provide temporary habitat for any dispersing young of these species.

3.3 Social

3.3.1 Planning and Status

The study area is currently zoned as Rural under the Peel Region Scheme (Western Australian Planning Commission 2003). It is located within the Peel-Harvey Coastal Plain Catchment where the provisions of the Statement of Planning Policy No. 2 (SPP No.2) apply (GWA 2009). It is also within the Lake Clifton Precinct of the Shire of Waroona's Local Planning Strategy.

3.3.2 Heritage

Aboriginal Heritage

The Department of Indigenous Affairs (DIA 2008) *Sites and Surveys Enquiry System* was reviewed for any registered indigenous heritage values that may occur in the local area of the study site. The DIA database has no recorded indigenous heritage sites within the study area. Areas located within approximately 5km of the study area are presented in **Table 16**. A full copy of the results, including a map and co-ordinates is presented in **Appendix Seven.**

Table 16: ***DIA Heritage Sites Located within 5 km of the study area.***

Site ID	Site Name	Type	Site no.
351	Boundary Lake	Man-Made Structure, Fish Trap	S02963
3253	Harvey Estuary 23:farmers	Artefacts/Scatter	S00322
3254	Harvey Estuary 24:swamp	Artefacts/Scatter	S00323
3257	Lake Clifton 3		S00326
3258	Harvey Estuary 26:pine	Artefacts/Scatter	S00327
3451	Island Point		S02676
17275	Little Harvey 02/Black Bream Pool	Modified Tree, Artefacts/Scatter	
17276	Little Harvey 03	Artefacts/Scatter, Historical	

European Heritage

The Heritage Council of Australia *Online Database*, and the Heritage Council of WA Sites spatial layer (as provided on the online WA Atlas (GWA 2009)), and the online EPBC Protected Matters Search Tool (Australian Government 2009) (**Appendix Eight**) were interpreted for any registered heritage values within or near the study site. No sites were found inside of or within a 5km radius of the study area.

4.0 Conclusions & Recommendations

4.1 Land Capability Assessment

- The land capability of study site for septic tank installation was determined to be Class 4 (Low). Class 4 land is considered to have a high degree of physical limitation not easily overcome by standard development techniques and/or resulting in high risk of degradation.
- Class 4 land can be utilised by careful management and construction techniques, such ATUs and drainage attenuation.

4.2 Phosphorus Retention Index

- Both soil samples collected on site had PRI of 20 or higher. This classifying them as moderate to high potential to retain phosphorus.
- This moderate to high phosphorus retention 'potential' capacity in conjunction with the requirement for all effluent systems to be ATUs with high phosphorus retention capabilities indicates the potential for the proposal to contribute to nutrient loading of Lake Clifton is low.

4.3 Acid Sulfate Soils Risk

- Risk mapping revealed there is a High Risk of ASS or PASS less than 3m from soil surface (Class 1) across the entirety of the site. The extensive occurrence of Tamala limestone across the site is likely to preclude the occurrence of actual Acid Sulfate Soils.
- An Acid Sulphate Soil Assessment should be carried out in accordance with the guidelines outlined in *Identification and Investigation of Acid Sulfate Soils.*

4.4 Hydrology

- The Coastal and Lakelands Planning Strategy (WAPC 1999) identifies the site as being a within the Yalgorup Coastal Catchment, and the "administrative" EPA Lake Clifton Catchment.
- The study site is located within the Waroona flow system with groundwater on site flowing approximately to the west towards Lake Clifton.
- Groundwater contours indicate that groundwater level beneath the site to be less than 1m AHD.
- In the absence of accurate groundwater level or quality information for the site, it is recommended that monitoring bores be installed on site prior to development to

collect baseline level and water quality data. Ongoing monitoring is likely to be a condition of approval of the development.

4.5 Wetlands

- Lake Clifton (UFI 3089) is classified in the DEC (2007b) *Geomorphic Wetlands Swan Coastal Plain* dataset is located approximately 100m to the west of the study area.
- Lake Clifton forms part a Ramsar wetland and is protected as a Matter of National Environmental Significance under sections 16 and 17b of the EPBC Act 1999.
- Lake Clifton, is a declared Environmentally Sensitive Area (ESA) under the Government of Western Australia (2005) *Environmental Protection (Environmentally Sensitive Areas) Notice*.
- Lake Clifton (Wetland UFI 3089) is defined as a *Conservation Category* Wetland (CCW) identified by the *Geomorphic Wetlands Swan Coastal Plain* dataset.
- Lake Clifton is also protected under the Western Australian E*nvironmental Protection (Swan Coastal Plain Lakes) Policy 1992,* meaning that it is an offence under the *Environmental Protection Act* (1986) to excavate, modify or drain into or out of an EPP wetland (EPA 1992).
- A minimum 50m buffer from the wetland boundary (i.e. the extent of wetland dependent vegetation) is recommended by the DEC for preserving the wetlands from habitat modification unless a site-specific buffer requirement determines the site suitability for a small buffer distance (EPA 2008).
- It is recommended that an Urban Water Management Plan be developed and implemented for the proposed development to ensure the values and ecological functions of Lake Clifton are maintained. Also in accordance with the shire of Waroona's local planning strategy for the Lake Clifton precinct, all dwellings will be located at least 150m from the high water mark of Lake Clifton.

4.6 Vegetation and Flora

- The Cottesloe – Central and South, and Yoongarillup Vegetation Complexes are mapped within the study area. According to *EPA Guidance Statement No 10* (2006) in 2002 these complexes have 41.1% and 45% remaining on the Swan Coastal Plain respectively.
- One vegetation community was recorded for the site, described as *Eucalyptus gomphocephala* (Tuart) Woodland, over *Agonis flexuosa (*Peppermint) Low Open Woodland.
- Over 90% of the vegetation was considered to be *completely degraded* with little or no native understorey remaining. A less disturbed variant of the vegetation type

retaining a level of native understorey was located over an area of limestone ridge/outcrop to the east of Site 1 and was considered to be *degraded*.

- Tuarts are locally/regionally significant and therefore are to be retained, wherever possible, across the site.
- DEC has recorded two Threatened Ecological Communities and two Priority Ecological Communities within 8km of the site. None were identified during the field survey and subsequent analysis.
- A total of 27 vascular plant species were found in the survey area including 17 weeds. 5 of these weeds were *high* risk according the Environmental Weed Strategy for Western Australia.
- DEC has recorded four Declared Rare and 22 Priority Flora species within 5km of the site. No Declared Rare Flora species were recorded during the field survey.

4.6.1 Application of Clearing Principles

A discussion of the ten clearing principles, as applied to native vegetation, is in the subsections below.

(a) Native vegetation should not be cleared if it comprises a high level of biological diversity

Clearing and developing this area is **unlikely to be at variance** with this principle.

The survey of the site did not reveal a high level of biological diversity. The lack of a significant number of trees with hollows and areas of dense vegetation precludes the likelihood of high biodiversity.

(b) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia

Clearing and developing this area is **unlikely to be at variance** with this principle.

The lack of a significant number of trees with hollows and large areas of dense Peppermint woodlands precludes the likelihood of a resident population *of Pseudocheirus occidentalis* (Western Ringtail Possum.

Calyptorhynchus baudinii (Baudin's Black-Cockatoo) which is potentially able to use nesting hollows that may be present in the Tuart trees on site. The development plan proposed for the site has endeavoured to retain, wherever possible, the majority of Tuart s on the site.

Charadrius rubricollis (Hooded Plover) this species is likely to be found along the margins of Lake Clifton and although close to the study site is not strictly within the proposed development boundary.

(c) Native vegetation should not be cleared if it includes or is necessary for the continued existence of, rare flora

Clearing and developing this area is **unlikely to be at variance** with this principle.

No Declared Rare Flora species listed under the Western Australian *Wildlife Conservation Act* (1950) or the Commonwealth *EPBC Act* (Australian Government 1999) were identified during the survey.

(d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a threatened ecological community

Clearing and developing this area is **unlikely to be at variance** with this principle.

No TECs were identified on the study site during the site assessment. Since all stormwater generated is to be retained on site, it is considered that the proposed development will have no direct or in-direct impacts on the stromatolite community.

(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared

Developing this area is **unlikely to be at variance** with this principle.

The significance of the vegetation has been assessed in terms of Vegetation Complex. **Table 7** shows that 41.1% of the Cottesloe – Central and South complex and 45%, of the Yoongarillup complex remain uncleared (in 2002) on the SCP. Both are above the 30% remaining minimum threshold.

The development plan proposed for the site has endeavoured to retain, wherever possible, the majority of Tuart s on the site.

(f) Native vegetation should not be cleared if it is growing, or in association with, an environment associated with a watercourse or wetland

Developing this area is **unlikely to be at variance** with this principle.

The developer is aware that the vegetated areas within the 50m buffer of Lake Clifton cannot be cleared.

(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation

Developing this area is **unlikely to be at variance** with this principle.

The vegetated area on site exists pre-dominantly on very gentle slopes and well drained flats, so there is little likelihood of wind or water erosion causing degradation.

(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area

Clearing and developing this area is **unlikely to be at variance** with this principle.

Lake Clifton is the nearest conservation area located approximately 100m to the west of the study site. Applying a 50m clearing buffer to Lake Clifton should prevent any impact on this conservation area.

(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water

Clearing and developing this area is **unlikely to be at variance** with this principle.

The study area is located on the Spearwood dunes, which are free-draining in upland areas, and are therefore not likely to have significant runoff that would impact on surface water. Any surface runoff from hard surface areas (roads and roofs) would need to be managed within the site. Appropriate water management practices will prevent any impact on surface water quality.

The study area is not located within any Public Drinking Water Source Area (PDWSA).

(j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding

Clearing and developing this area is **unlikely to be at variance** with this principle.

There is not expected to be any impact on the incidence of flooding arising from development of this area with the application of standard water management practices.

4.7 Fauna

- The search results of the DEC threatened fauna databases and the EPBC Act databases, indicated four *Wildlife Conservation Act* (1950) Scheduled or Priority fauna species, and 26 EPBC Act (1999) listed species, have been recorded within 5km of the study area. The field survey failed to observe any signs of presence for any of these listed species within the study area.
- Species likely to inhabit the study site or utilise nesting or feeding resources present would include the following species, as identified from the database searches of both the Wildlife Conservation Act (1950) and EPBC Act (1999)

- *Pseudocheirus occidentalis* (Western Ringtail Possum)
- *Calyptorhynchus baudinii* (Baudin's Black-Cockatoo)
- *Charadrius rubricollis* (Hooded Plover)

- Potential impacts to the Baudin's Black-Cockatoo can be managed by protection and minimisation of disturbance to the Tuart trees existing on the site.

4.8 Heritage

4.8.1 European Sites

- No registered European Heritage sites were identified inside of or within 5km of the study area.

4.8.2 Indigenous Sites

- The DIA database has no recorded indigenous heritage sites within the study area, although, eight sites are located within approximately 5km of the study area.

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Appendix One:
Maps

Environmental Impact Assessment for Lots 19 – 21 Old Coast Road, Lake Clifton

Legend

- Study Site
- Tamala Limestone (LS1) - light yellowish-brown, fine to coarse-grained, sub-angular to well-rounded, calcarenite composed largely of fossil skeletal fragments (mainly foraminifera and mollusc) with various amounts of quartz and trace feldspar
- Limestone (LS5) - very pale yellowish brown, vuggy, fine to medium; sub-angular quartz and shell debris, generally friable
- Sand derived from Tamala Limestone (S7) - similar to Tamala Limestone though has negligible carbonate (shell) content, and is pale to olive yellow in colour

Map 1

Feb 2009

Environmental Impact Assessment for Lots 19 - 21 Old Coast Road, Lake Clifton

Superficial Geology of Study Site

prepared for Beck Advisory

0 10 20 30 40 Meters

Project No. 2216-08

ecoscape

Legend

Study Site

Soil Phase

Spearwood 4b

Vasse 3

Vasse 4

Vasse 5

Environmental Impact Assessment for Lots 19 - 21 Old Coast Road, Lake Clifton

Map 2

Location of DAFWA (2007) Soil Phases

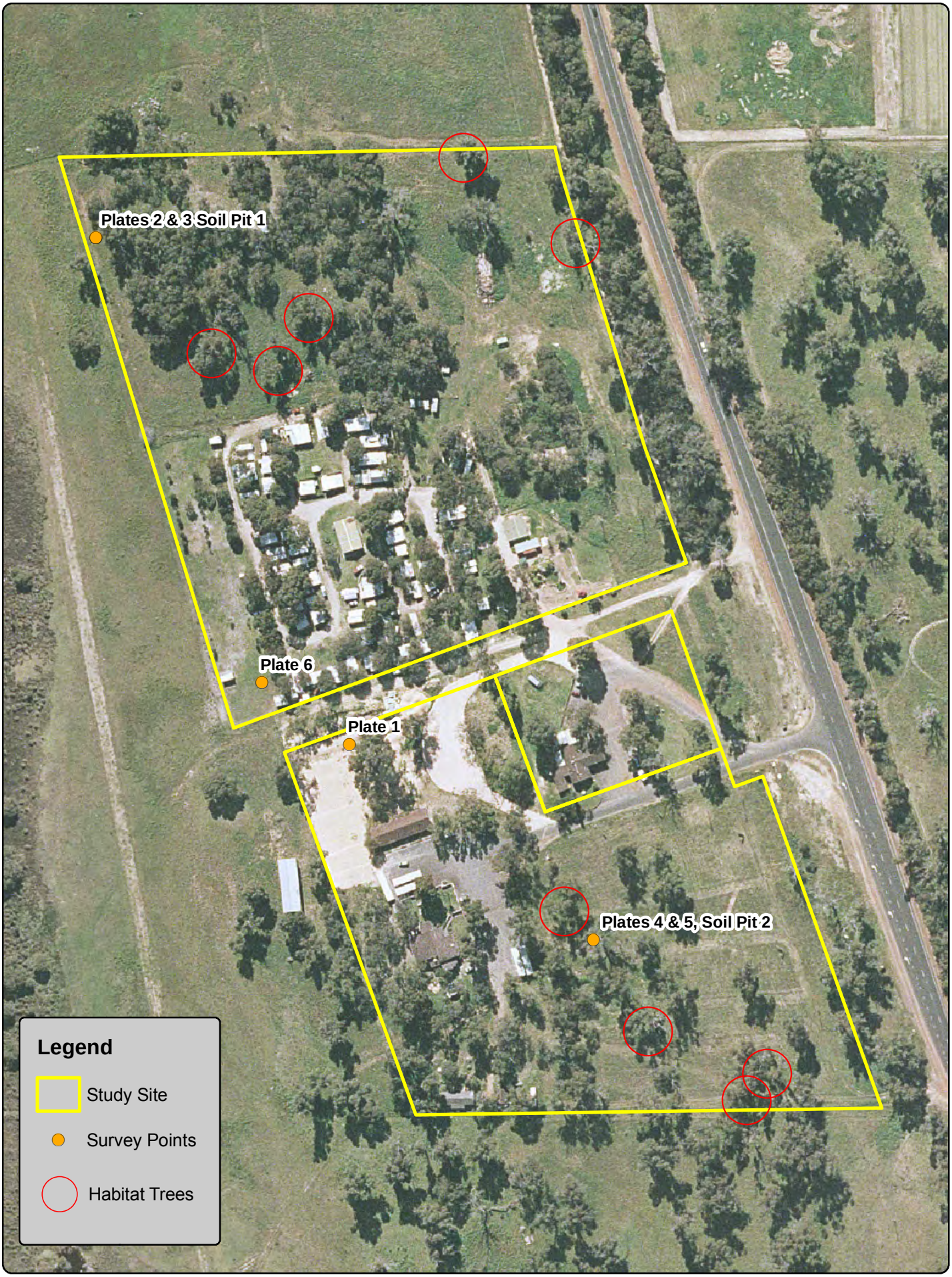
Feb 2009

prepared for Beck Advisory

0 9 18 27 36 Meters

Project No. 2216-08

ecoscape



Environmental Impact Assessments for Lots 19 - 21 Old Coast Road, Lake Clifton

Map 3

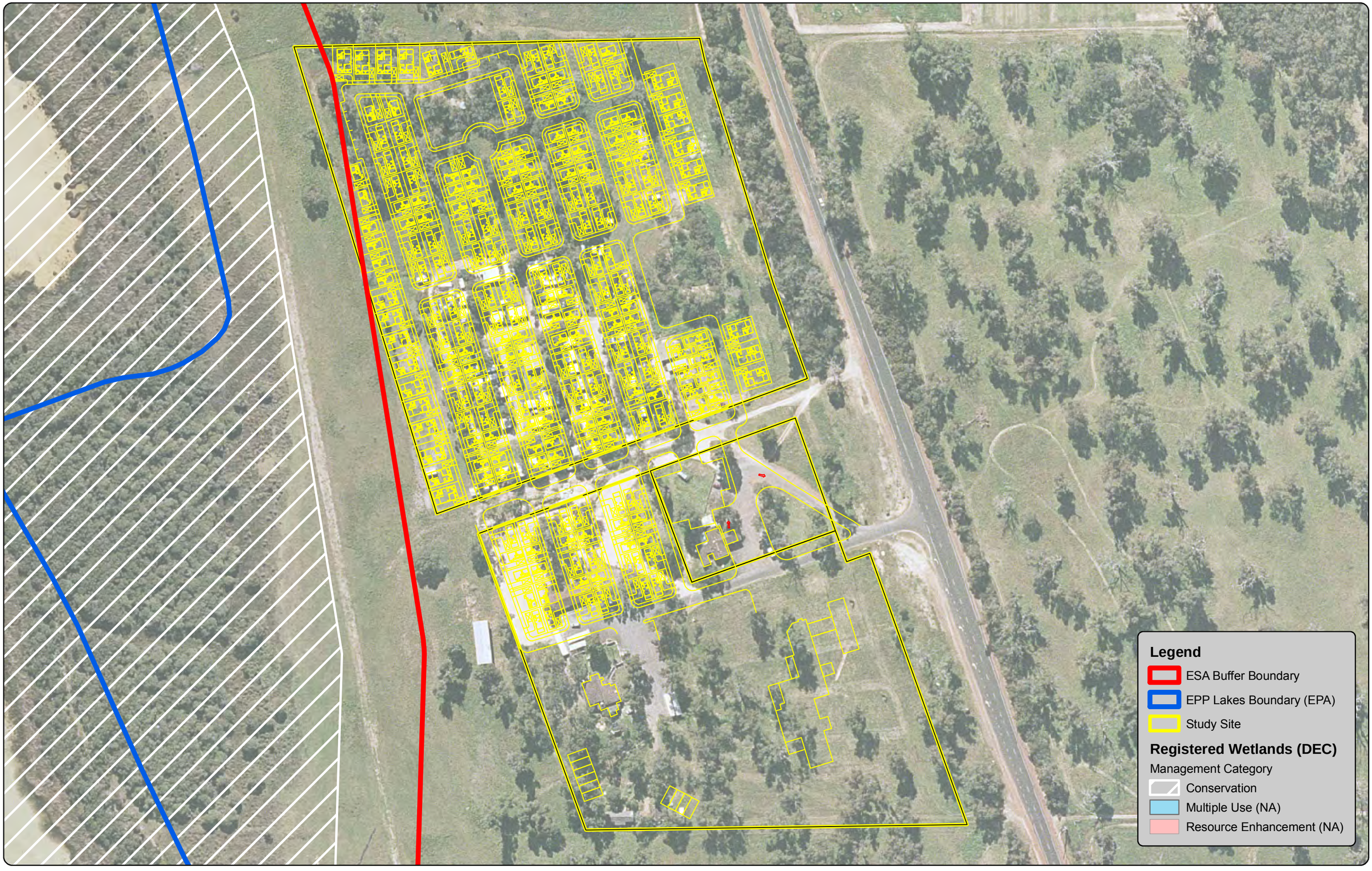
Habitat Trees, Photo Points, and Soil Pit Locations

Feb 2009

prepared for Beck Advisory

0 10 20 30 40 Meters
1:2,500 @ A4
Project No. 2216-08

ecoscape



Map 4

March 2009

Environmental Impact Assessment for Lots 19 - 21 Old Coast Road, Lake Clifton

Location of DEC Wetlands, EPP Lakes and ESA Buffer

prepared for Beck Advisory

0 25 50 75 100 Meters

Project No. 2216-08

ecoscape

Environmental Impact Assessment for Lots 19 - 21 Old Coast Road, Lake Clifton

Map 5

Vegetation

Feb 2009

prepared for Beck Advisory

0 20 40 60 80 Meters

Project No. 2216-08

ecoscape

Appendix Two:
Land Capability Assessment

Table 17: ***Breakdown of land units within the Spearwood S4b soil phase, with related land quality risks/ratings (converted to land capability class in brackets) relevant to septic tank installation for rural/residential development.***

Land Unit				Land Quality						Overall Land Capability Class
Soil Group	Qualifier	Land attribute	Typical %	Ease of excavation	Flood risk	Land instability	Microbial purification ability	Soil adbsorption	Waterlogging / inundation risk	
Bare Rock	differentiation not required	Well drained flat	5	Very Low (4)	Nil (1)	Nil (1)	Very Low (4)	Very Low (4)	Low (2)	**4**
Yellow/brown shallow sand	Good sand, deep rock substrate	Well drained flat	30	Low (3)	Nil (1)	Nil (1)	Very Low (4)	Very Low (4)	Low (2)	**4**
Yellow/brown shallow sand	Very shallow rock substrate	Well drained flat	10	Very Low (4)	Nil (1)	Nil (1)	Very Low (4)	Very Low (4)	Low (2)	**4**
Pale deep sand	Good sand, very deep	Well drained flat	25	High (1)	Nil (1)	Nil (1)	Low (3)	High (1)	Very Low (1)	**3**
Pale deep sand	Good sand, very deep	Low rise <2 m	10	High (1)	Nil (1)	Nil (1)	Low (3)	High (1)	Very Low (1)	**3**
Yellow deep sand	Good sand, very deep	Well drained flat	20	High (1)	Nil (1)	Nil (1)	Low (3)	Moderate (2)	Very Low (1)	**3**

Appendix Three:
Results of PRI Analysis (WA Chemistry Centre)

Report of Examination

Your Ref
Our Ref 08A0402
Enquiries Peter McCafferty
Telephone 08 9222 3017

Jared Nelson
.
Ecoscape
9 Stirling Highway
North Fremantle WA 6159

Report on 2 samples of soil
Received on 22/01/2009

Analyte P
Method PRI
Unit mL/g

CCWA ID	Client ID	
001	SITE1HNA	20
002	SITE2HNB	24

Analyte	Method	Description
P	PRI	Phosphorus Retention Index by method S15

Phosphorus Retention Index (PRI) is a measure of the ability of soil to retain or leach applied phosphate.

PRI is defined as the ratio P ads : P eq where P ads is the amount of phosphorus adsorbed by soil (µg P/g) and P eq is the equilibrium concentration of phosphorus in solution (ug P/mL) following equilibration of soil with a solution initially
containing 10 µg P/mL in 0.02 M KCl and 0.25% chloroform at 22°C (1:20 soil:solution ratio).

The phosphorus fixation properties of soil may be described by the following PRI values :

PRI
a. negative desorbing
b. 0 - 2 weakly adsorbing
c. 2 - 20 moderately adsorbing
d. 20 - 100 strongly adsorbing
e. >100 very strongly adsorbing

Peter McCafferty
Chief
Natural Resources Chemistry

04/02/2009

08A0402
04/02/2009 Page 1 of 1

Appendix Four:
Photos

Plate 1: Existing Vertical Exposure Illustrating Typical Soil Profile

Plate 2: Site 1 facing South-west

Plate 3: Site 1 facing North-west

Plate 4: Site 2 facing South

Plate 5: Site 2 facing North

Plate 6: Planted Eucalyptus spp. running along western extent of Caravan Park

Appendix Five:
Status Tables

Table 18: ***Definitions and criteria for TECs and PECs (DEC 2007a)***

Criteria	Definition
Threatened Ecological Communities	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B) All occurrences recorded within the last 50 years have since been destroyed
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B) Current distribution is limited, and one or more of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i) the estimated geographic range, and/or total area occupied and/or number of

Criteria	Definition
	discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B) Current distribution is limited, and one or more of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority Ecological Communities	
Priority One	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, state forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities, but do not meet adequacy of survey requirements, and / or are not well defined, and appear to be under threat from known threatening processes.
Priority Three	i. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or; ii. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; iii. Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities, but do not meet adequacy of survey requirements and / or are not well defined, and known threatening processes exist that could affect them.
Priority Four	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. a. ***Rare***. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change These communities are usually represented on conservation lands.

Criteria	Definition
	b. ***Near Threatened***. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c. Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five	*Conservation Dependent Ecological Communities* Ecological Communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Table 19: ***DEC Definitions of Declared Rare and Priority Flora***

Code	DEC Rating	Definition
R	Declared Rare Flora - Extant Taxa	Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
X	Declared Rare Flora - Presumed Extinct Taxa	Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.
1	Priority One - Poorly known Taxa	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
2	Priority Two - Poorly Known Taxa	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
3	Priority Three - Poorly Known Taxa	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.
4	Priority Four - Rare Taxa	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Table 20: ***EPBC Act categories***

EPBC Act Category	Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

EPBC Act Category	Definition
Endangered	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Table 21: ***DEC schedules and definitions for declaration of specially protected fauna (GWA 2006)***

Schedule	Definition
Schedule 1	Fauna that is rare or likely to become extinct, are declared to be fauna that is in need of special protection
Schedule 2	Fauna that is presumed to be extinct, are declared to be fauna that is in need of special protection
Schedule 3	Birds that are subject to an agreement between the Governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be fauna that is in need of special protection
Schedule 4	Declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned in Schedules 1 to 3 (mentioned above)

Table 22: ***DEC Definitions of Priority Fauna***

Code	DEC Rating	Definition
1	Priority One - Taxa with few, poorly known populations on threatened lands	Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
2	Priority Two - Taxa with few, or poorly known populations on conservation lands	Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Code	DEC Rating	Definition
3	Priority Three - Taxa with several, poorly known populations, some on conservation lands	Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
4	Priority Four - Taxa in need of monitoring	Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
5	Priority Five - Taxa in need of monitoring	Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix Six:
Native Flora and Fauna

Table 23: ***Flora Species List for Study Area***

Family		Scientific Name
POACEAE	*	*Avena* sp.
	*	*Bromus diandrus*
	*	*Cynodon dactylon*
	*	*Ehrharta longiflora*
	*	*Eragrostis curvula*
	*	*Lagurus ovatus*
	*	*Pennisetum clandestinum*
RESTIONACEAE		*Desmocladus* sp.
PHORMIACEAE		*Dianella revoluta*
ASPHODELACEAE	*	*Trachyandra divaricata*
ORCHIDACEAE	*	*Disa bracteata*
MORACEAE	*	*Ficus carica*
PHYTOLACCACEAE	*	*Phytolacca octandra*
MIMOSACEAE		*Acacia lasiocarpa*
		Acacia rostellifera
PAPILIONACEAE		*Hardenbergia comptoniana*
		Jacksonia furcellata
		Kennedia prostrata
	*	*Lupinus cosentinii*
EUPHORBIACEAE	*	*Euphorbia terracina*
MYRTACEAE		*Agonis flexuosa*
		Eucalyptus gomphocephala
		Melaleuca huegelii
ASCLEPIADACEAE	*	*Gomphocarpus fruticosus*
SOLANACEAE	*	*Solanum nigrum*
ASTERACEAE	*	*Carduus* sp.
	*	*Sonchus asper*

Table 24: ***FaunaBase Results for Study area including an approximate 5km buffer.***

Family	Scientific Name	Common Name	Introduced	DEC status	DEWHA status
Mammals					
DASYURIDAE	*Phascogale tapoatafa tapoatafa*	Brush-tailed Phascogale			
MACROPODIDAE	*Macropus irma*	Western Brush Wallaby			
Birds					
CHARADRIIDAE	*Charadrius rubricollis*	Hooded Plover			Marine
HALCYONIDAE	*Dacelo novaeguineae*	Laughing Kookaburra	X		
PARDALOTIDAE	*Pardalotus striatus*	Striated Pardalote			
PHASIANIDAE	*Coturnix ypsilophora*	Brown Quail			
PROCELLARIIDAE	*Macronectes giganteus*	Southern Giant Petrel			
PSITTACIDAE	*Calyptorhynchus latirostris*	Carnaby's Cockatoo		Schedule 1	Endangered
	Platycercus icterotis	Western Rosella			
	Platycercus zonarius	Australian Ringneck			
STRIGIDAE	*Ninox novaeseelandiae*	Boobook Owl			Marine
Reptiles					
SCINCIDAE	*Acritoscincus trilineatum*	Southwestern Cool Skink			
	Morethia lineoocellata	South-western Crevice Skink			
Amphibia					
MYOBATRACHIDAE	*Crinia insignifera*	Squelching Froglet			

Government of Western Australia
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Aboriginal Heritage Inquiry System

Register of Aboriginal Sites

DEPARTMENT OF INDIGENOUS AFFAIRS

Search Criteria

8 sites in a search polygon. The polygon is formed by these points (in order):

MGA Zone 50	
Northing	Easting
6375134	373163
6367925	372064
6367602	379064
6374477	379683

Government of Western Australia
Department of Indigenous Affairs

Aboriginal Heritage Inquiry System

Register of Aboriginal Sites

DEPARTMENT OF INDIGENOUS AFFAIRS

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

Legend

Restriction		Access	
N	No restriction	C	Closed
M	Male access only	O	Open
F	Female access	V	Vulnerable

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

L	Lodged	IR	Insufficient Information (as assessed by Site Assessment Group)
I	Insufficient Information	PR	Permanent register (as assessed by Site Assessment Group)
P	Permanent register	SR	Stored data (as assessed by Site Assessment Group)
S	Stored data		

Site Assessment Group (SAG)

Sites lodged with the Department are assessed under the direction of the Registrar of Aboriginal Sites. These are not to be considered the final assessment.

Final assessment will be determined by the Aboriginal Cultural Material Committee (ACMC).

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code "closed" or "vulnerable". Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Government of Western Australia
Department of Indigenous Affairs

Aboriginal Heritage Inquiry System

Register of Aboriginal Sites

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
351	P	O	N	Boundary Lake	Man-Made Structure, Fish Trap		*Registered Informant names available from DIA.	373639mE 6373648mN Zone 50 [Unreliable]	S02963
3253	S	O	N	Harvey Estuary 23:farmers.	Artefacts / Scatter	Camp, [Other: ?]		377639mE 6373648mN Zone 50 [Unreliable]	S00322
3254	S	O	N	Harvey Estuary 24:swamp.	Artefacts / Scatter	Camp, [Other: ?]		377639mE 6372648mN Zone 50 [Unreliable]	S00323
3257	L	O	N	Lake Clifton 3				377639mE 6369648mN Zone 50 [Unreliable]	S00326
3258	P	O	N	Harvey Estuary 28:pine.	Artefacts / Scatter	Camp, [Other: ?]		379639mE 6370648mN Zone 50 [Unreliable]	S00327
3451	I	O	N	Island Point		Camp	*Registered Informant names available from DIA.	377351mE 6373730mN Zone 50 [Reliable]	S02676
17275	I	O	N	Little Harvey 02/black Bream Pool	Modified Tree, Artefacts / Scatter	[Other: Probable Fish trap.]	*Registered Informant names available from DIA.	379394mE 6370381mN Zone 50 [Reliable]	
17276	I	O	N	Little Harvey 03	Artefacts / Scatter, Historical		*Registered Informant names available from DIA.	379376mE 6370518mN Zone 50 [Reliable]	

Report created 13 Feb 2009 11:47:43. Identifier: 547543.

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Aboriginal Heritage Inquiry System

Register of Aboriginal Sites

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Protected Matters Search Tool

You are here: Environment Home > EPBC Act > Search

2 February 2009 12:10

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

The Australian Natural Resources Atlas at http://www.environment.gov.au/atlas may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

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Search Type: Area

Buffer: 5 km

Coordinates: -32.785569,115.672667, -32.789935,115.674393, -32.789935,115.671782, -32.788151,115.671101, -32.788238,115.670898, -32.785540,115.669984, -32.785511,115.672609

Report Contents:

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance: (Ramsar Sites)	1
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	19
Migratory Species:	27

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by

Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Places on the RNE:	3
Listed Marine Species:	42
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Other Commonwealth Reserves:	None
Regional Forest Agreements:	None

Details

Matters of National Environmental Significance

Wetlands of International Significance [Dataset Information]
(Ramsar Sites)

PEEL-YALGORUP SYSTEM

Threatened Species [Dataset Information]	Status	Type of Presence
Birds		

Calyptorhynchus baudinii Baudin's Black-Cockatoo, Long-billed Black-Cockatoo	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo	Endangered	Species or species habitat likely to occur within area
Diomedea exulans gibsoni Gibson's Albatross	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus Blue Whale	Endangered	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale	Endangered	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale	Vulnerable	Congregation or aggregation known to occur within area
Neophoca cinerea Australian Sea-lion	Vulnerable	Species or species habitat may occur within area
Phascogale calura Red-tailed Phascogale	Endangered	Species or species habitat may occur within area
Setonix brachyurus Quokka	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle	Endangered	Foraging known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population)	Vulnerable	Species or species habitat may occur within area
Carcharodon carcharias Great White Shark	Vulnerable	Species or species habitat may occur within area
Rhincodon typus Whale Shark	Vulnerable	Species or species habitat may occur within area
Plants		
Caladenia huegelii	Endangered	Species or species habitat likely to

King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid		occur within area
Diuris purdiei Purdie's Donkey-orchid	Endangered	Species or species habitat likely to occur within area
Migratory Species [Dataset Information]	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Migratory Wetland Species		
Birds		
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper	Migratory	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper	Migratory	Species or species habitat likely to occur within area
Calidris ruficollis Red-necked Stint	Migratory	Species or species habitat likely to occur within area
Pluvialis squatarola Grey Plover	Migratory	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank	Migratory	Species or species habitat likely to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank	Migratory	Species or species habitat likely to occur within area
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross	Migratory	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel	Migratory	Species or species habitat may occur within area

Macronectes halli Northern Giant-Petrel	Migratory	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross	Migratory	Species or species habitat may occur within area
Migratory Marine Species		
Mammals		
Balaenoptera edeni Bryde's Whale	Migratory	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale	Migratory	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale	Migratory	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale	Migratory	Species or species habitat known to occur within area
Lagenorhynchus obscurus Dusky Dolphin	Migratory	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale	Migratory	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca	Migratory	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle	Migratory	Foraging known to occur within area
Sharks		
Carcharodon carcharias Great White Shark	Migratory	Species or species habitat may occur within area
Rhincodon typus Whale Shark	Migratory	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Dataset Information]	Status	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine	Species or species habitat may occur within area

	area	
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper	Listed	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper	Listed - overfly marine area	Species or species habitat likely to occur within area
Calidris ruficollis Red-necked Stint	Listed - overfly marine area	Species or species habitat likely to occur within area
Diomedea gibsoni Gibson's Albatross	Listed	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel	Listed	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel	Listed	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Pluvialis squatarola Grey Plover	Listed - overfly marine area	Species or species habitat likely to occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross	Listed	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank	Listed - overfly marine area	Species or species habitat likely to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank	Listed - overfly marine area	Species or species habitat likely to occur within area
Mammals		
Arctocephalus forsteri	Listed	Species or species habitat may

New Zealand Fur-seal		occur within area
Neophoca cinerea Australian Sea-lion	Listed	Species or species habitat may occur within area
Ray-finned fishes		
Acentronura australe Southern Pygmy Pipehorse	Listed	Species or species habitat may occur within area
Campichthys galei Gale's Pipefish	Listed	Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish	Listed	Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse	Listed	Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse	Listed	Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse	Listed	Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish	Listed	Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish	Listed	Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish	Listed	Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish	Listed	Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish	Listed	Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish	Listed	Species or species habitat may occur within area
Nannocampus subosseus Bony-headed Pipefish	Listed	Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon	Listed	Species or species habitat may occur within area
Phyllopteryx taeniolatus Weedy Seadragon, Common Seadragon	Listed	Species or species habitat may occur within area
Pugnaso curtirostris Pug-nosed Pipefish	Listed	Species or species habitat may occur within area
Solegnathus lettiensis Indonesian Pipefish, Gunther's Pipehorse	Listed	Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish	Listed	Species or species habitat may occur within area

Stigmatopora nigra Wide-bodied Pipefish, Black Pipefish	Listed	Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish	Listed	Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish	Listed	Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish	Listed	Species or species habitat may occur within area
Vanacampus poecilolaemus Australian Long-snout Pipefish, Long-snouted Pipefish	Listed	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle	Listed	Foraging known to occur within area
Disteira kingii Spectacled Seasnake	Listed	Species or species habitat may occur within area
Whales and Other Cetaceans [Dataset Information]	Status	Type of Presence
Balaenoptera acutorostrata Minke Whale	Cetacean	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale	Cetacean	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale	Cetacean	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale	Cetacean	Species or species habitat may occur within area
Delphinus delphis Common Dolphin	Cetacean	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale	Cetacean	Species or species habitat known to occur within area
Grampus griseus Risso's Dolphin, Grampus	Cetacean	Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin	Cetacean	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale	Cetacean	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca	Cetacean	Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin	Cetacean	Species or species habitat may occur within area

Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	Cetacean	Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin	Cetacean	Species or species habitat may occur within area

Places on the RNE [Dataset Information]
Note that not all Indigenous sites may be listed.

Natural

Harvey Estuary Nature Reserve WA

Peel - Harvey Estuarine System WA

Yalgorup National Park WA

Extra Information

State and Territory Reserves [Dataset Information]

Kooljerrenup Nature Reserve, WA

Yalgorup National Park, WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the migratory and marine provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection
- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia

- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUCliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Last updated: Thursday, 20-Nov-2008 14:17:56 EST

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Appendix Six: Groundwater Monitoring Results

Results of water level sampling - Lake Clifton

Depth to groundwater (m bTOC)

Site	8/04/2010	25/06/2010	2/09/2010	18/11/2010	24/02/2011	30/05/2011	30/08/2011
MB01	5.05	4.9	4.74	4.81	5.06	4.95	4.68
MB02	3.43	3.28	3.12	3.25	3.44	3.33	3.05
MB03	7.13	6.95	6.83	6.95	7.14	7.04	6.75
MB04	3.09	2.94	2.77	2.95	3.1	3	2.7
MB05	4.19	4.05	3.89	4.18	4.21	4.11	3.82
MB06	3.57	3.42	3.26	3.39	3.58	3.48	3.19

Surveyed top of casing levels

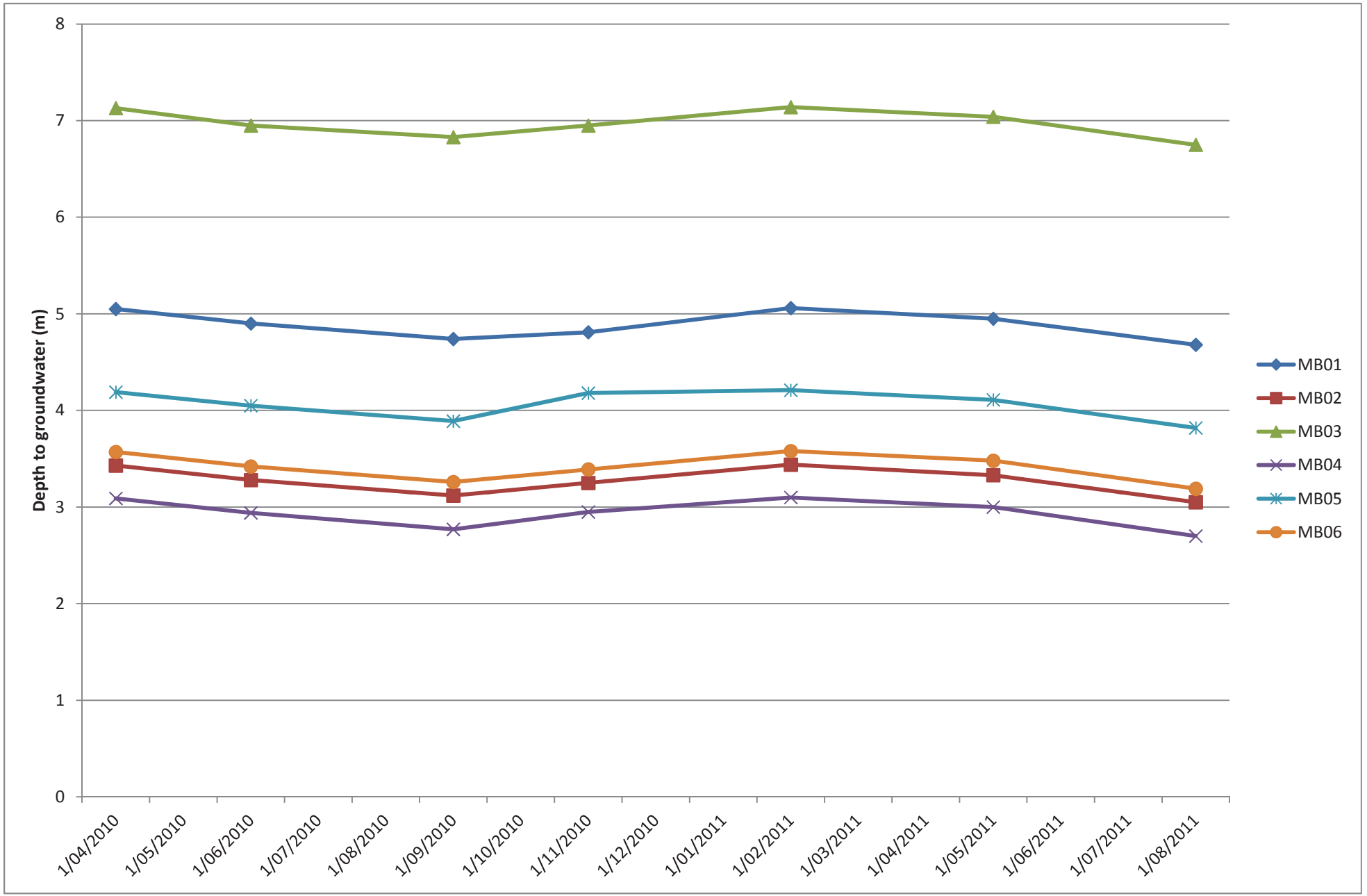
Location	Lake Clifton	Lake Clifton	Lake Clifton	Lake Clifton	Lake Clifton	Lake Clifton
ID	MB01	MB02	MB03	MB04	MB05	MB06
AHD (m) T.O.C.	5.071	3.441	7.151	3.104	4.226	3.614
Ground level	4.471	2.841	6.551	2.504	3.626	3.014

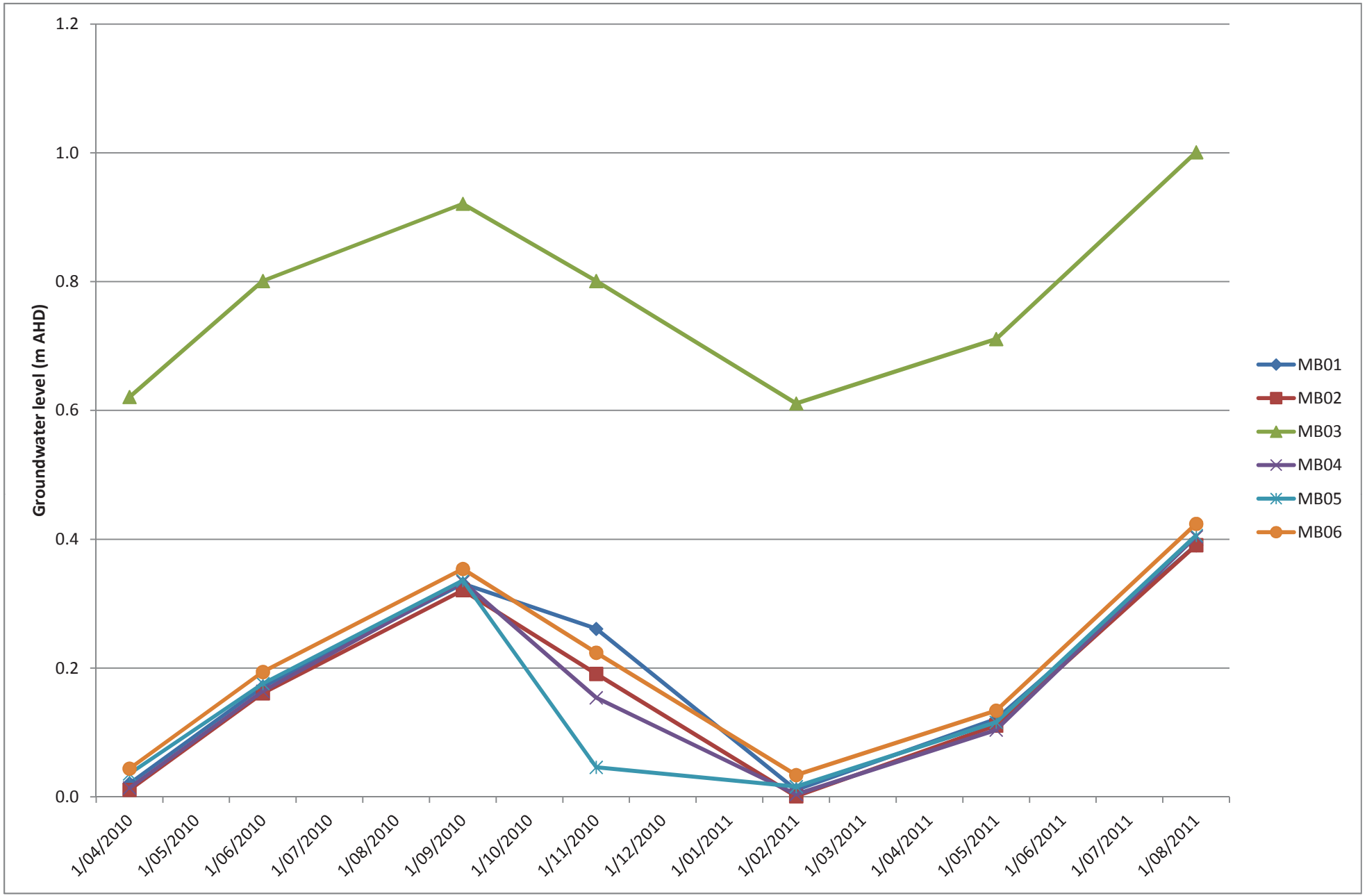
Depth to groundwater (m bgl)

Site	8/04/2010	25/06/2010	2/09/2010	18/11/2010	24/02/2011	30/05/2011	30/08/2011
MB01	4.45	4.3	4.14	4.21	4.46	4.35	4.08
MB02	2.83	2.68	2.52	2.65	2.84	2.73	2.45
MB03	6.53	6.35	6.23	6.35	6.54	6.44	6.15
MB04	2.49	2.34	2.17	2.35	2.5	2.4	2.1
MB05	3.59	3.45	3.29	3.58	3.61	3.51	3.22
MB06	2.97	2.82	2.66	2.79	2.98	2.88	2.59

Groundwater level (m AHD)

Site	8/04/2010	25/06/2010	2/09/2010	18/11/2010	24/02/2011	30/05/2011	30/08/2011
MB01	0.021	0.171	0.331	0.261	0.011	0.121	0.391
MB02	0.011	0.161	0.321	0.191	0.001	0.111	0.391
MB03	0.621	0.801	0.921	0.801	0.611	0.711	1.001
MB04	0.014	0.164	0.334	0.154	0.004	0.104	0.404
MB05	0.036	0.176	0.336	0.046	0.016	0.116	0.406
MB06	0.044	0.194	0.354	0.224	0.034	0.134	0.424


Depth to groundwater (m)
8
7
6
5
4
3
2
1
0
1/04/2010
1/05/2010
1/06/2010
1/07/2010
1/08/2010
1/09/2010
1/10/2010
1/11/2010
1/12/2010
1/01/2011
1/02/2011
1/03/2011
1/04/2011
1/05/2011
1/06/2011
1/07/2011
1/08/2011
MB01
MB02
MB03
MB04
MB05
MB06

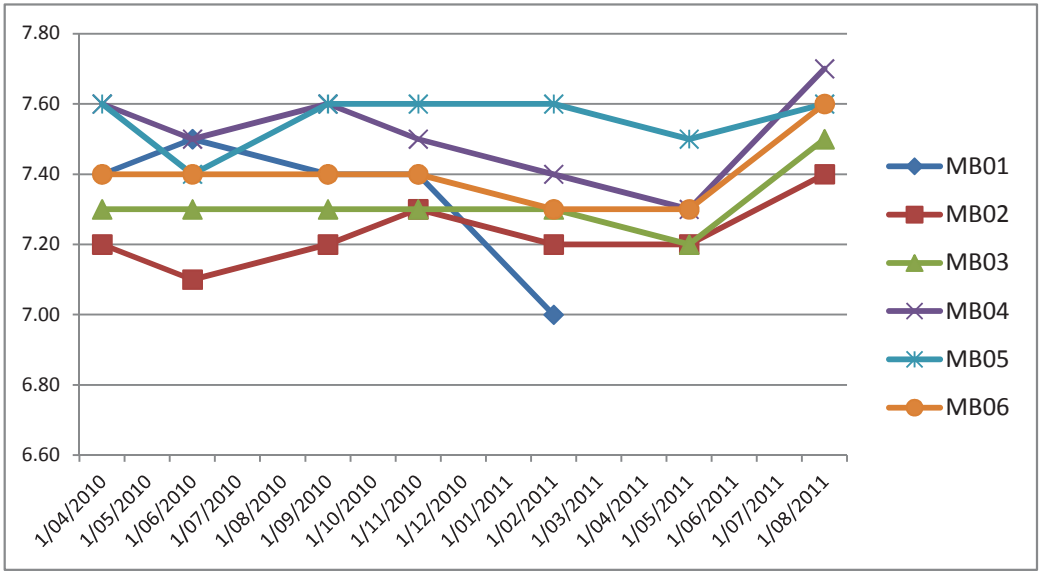

Groundwater level (m AHD)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/04/2010
1/05/2010
1/06/2010
1/07/2010
1/08/2010
1/09/2010
1/10/2010
1/11/2010
1/12/2010
1/01/2011
1/02/2011
1/03/2011
1/04/2011
1/05/2011
1/06/2011
1/07/2011
1/08/2011
MB01
MB02
MB03
MB04
MB05
MB06

Surveyed bore locations and heights

			GDA94 (MGA50)										
Location	**ID**	**Description**	**Easting (m)**	**Horizontal Accuracy (m)**	**Northing (m)**	**Horizontal Accuracy (m)**	**Vertical Accuracy (m)**	**AHD (m) T.O.C.**	**Height Pipe A.G.L. (m)**	**Surface Elevation (m)**	**SWL (m)**	**RWL (m)**	**Notes**
Lake Clifton	MB01	Piezometer	375483.683	0.010	6371635.304	0.010	0.010	5.071	0.600	4.471		5.071	
Lake Clifton	MB02	Piezometer	375534.000	5.000	6371459.000	5.000	0.010	3.441	0.600	2.841		3.441	Spirit Levelled. XY = Handheld.
Lake Clifton	MB03	Piezometer	375604.389	0.010	6371323.061	0.010	0.010	7.151	0.600	6.551		7.151	
Lake Clifton	MB04	Piezometer	375836.090	0.010	6371243.177	0.010	0.010	3.104	0.600	2.504		3.104	
Lake Clifton	MB05	Piezometer	375751.155	0.010	6371541.084	0.010	0.010	4.226	0.600	3.626		4.226	
Lake Clifton	MB06	Piezometer	375710.093	0.010	6371676.233	0.010	0.010	3.614	0.600	3.014		3.614	

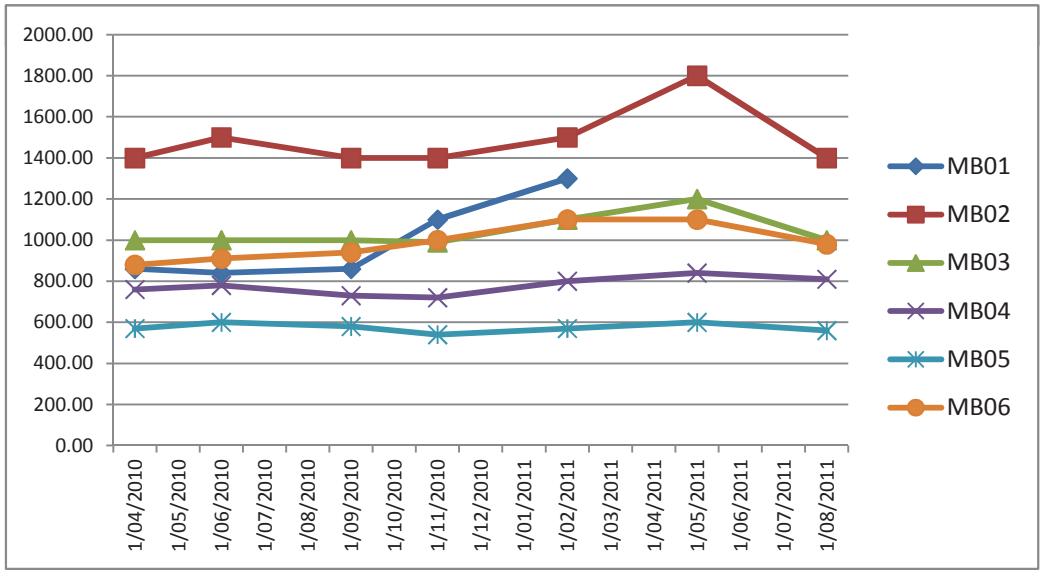
pH

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	7.40	7.20	7.30	7.60	7.60	7.40
25/06/2010	7.50	7.10	7.30	7.50	7.40	7.40
2/09/2010	7.40	7.2	7.3	7.6	7.6	7.4
18/11/2010	7.4	7.3	7.3	7.5	7.6	7.4
24/02/2011	7	7.2	7.3	7.4	7.6	7.3
1/05/2011		7.2	7.2	7.3	7.5	7.3
31/08/2011		7.4	7.5	7.7	7.6	7.6
Max	7.50	7.40	7.50	7.70	7.60	7.60
Min	7.00	7.10	7.20	7.30	7.40	7.30
Median	7.40	7.20	7.30	7.50	7.60	7.40



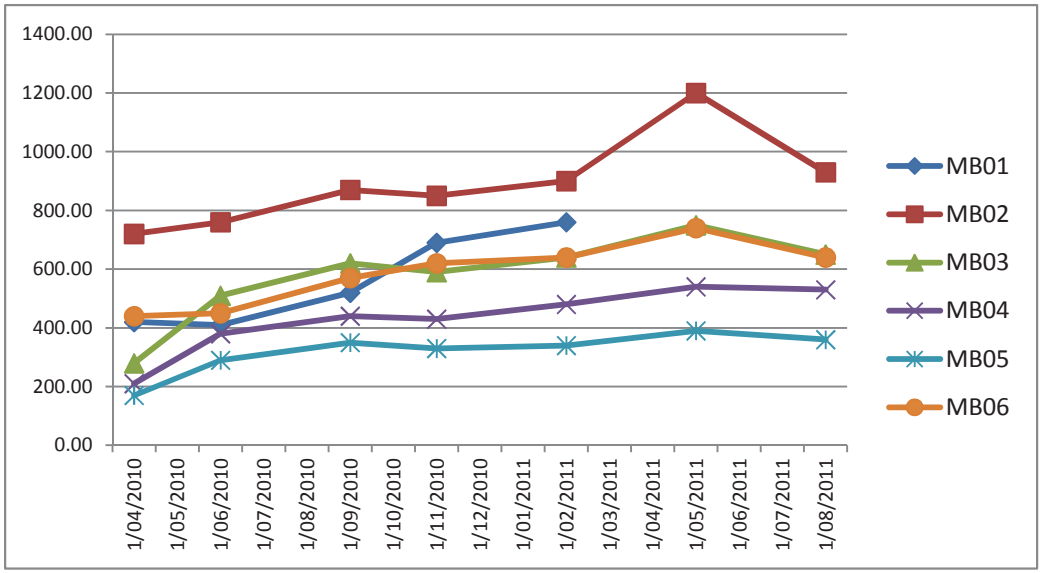
Conductivity (us/cm)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	860.00	1400.00	1000.00	760.00	570.00	880.00
25/06/2010	840.00	1500.00	1000.00	780.00	600.00	910.00
2/09/2010	860.00	1400	1000	730	580	940
18/11/2010	1100	1400	990	720	540	1000
24/02/2011	1300	1500	1100	800	570	1100
1/05/2011		1800	1200	840	600	1100
31/08/2011		1400	1000	810	560	980
Max	1300	1800	1200	840	600	1100
Min	840	1400	990	720	540	880
Median	860	1400	1000	780	570	980



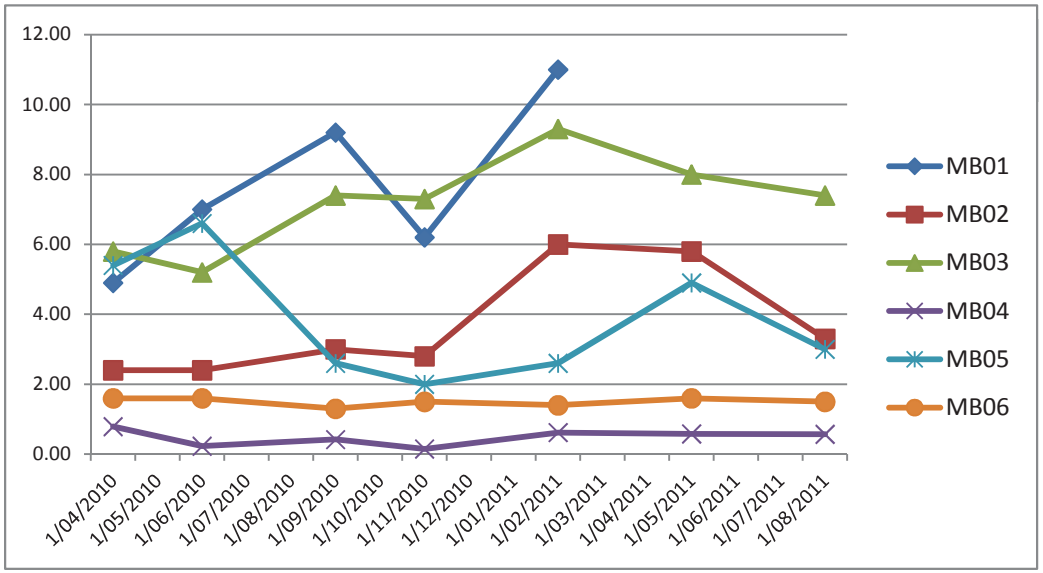
TDS (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	420.00	720.00	280.00	210.00	170.00	440.00
25/06/2010	410.00	760.00	510.00	380.00	290.00	450.00
2/09/2010	520.00	870	620	440	350	570
18/11/2010	690	850	590	430	330	620
24/02/2011	760	900	640	480	340	640
1/05/2011		1200	750	540	390	740
31/08/2011		930	650	530	360	640
Max	760	1200	750	540	390	740
Min	410	720	280	210	170	440
Median	520	870	620	440	340	620



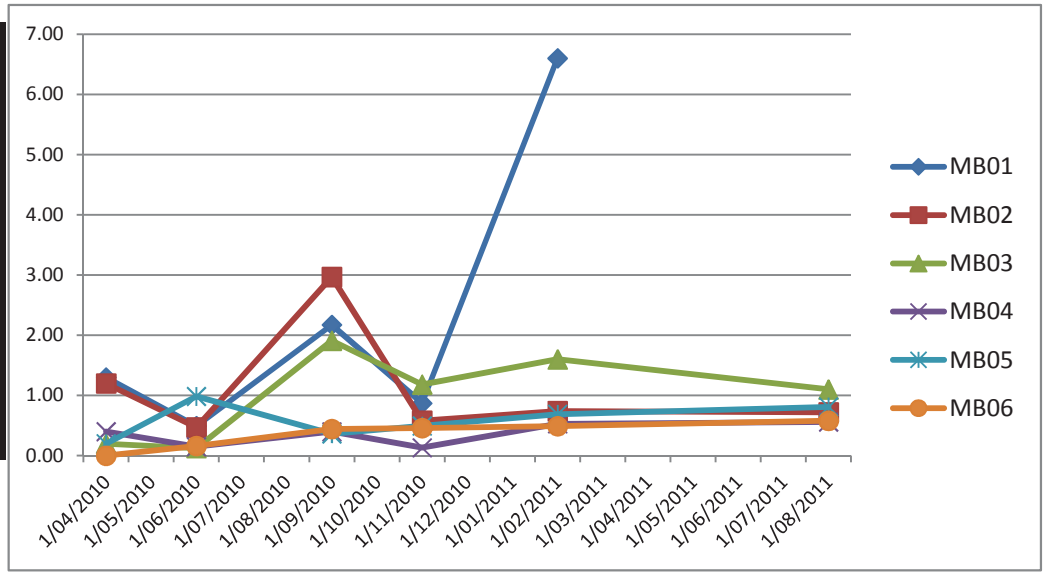
Total Nitrogen (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	4.90	2.40	5.80	0.79	5.40	1.60
25/06/2010	7.00	2.40	5.20	0.23	6.60	1.60
2/09/2010	9.20	3	7.4	0.42	2.6	1.3
18/11/2010	6.2	2.8	7.3	0.15	2	1.5
24/02/2011	11	6	9.3	0.62	2.6	1.4
1/05/2011		5.8	8	0.58	4.9	1.6
31/08/2011		3.3	7.4	0.57	3	1.5
Max	11	6	9.3	0.79	6.6	1.6
Min	4.9	2.4	5.2	0.15	2	1.3
Median	7	3	7.4	0.57	3	1.5



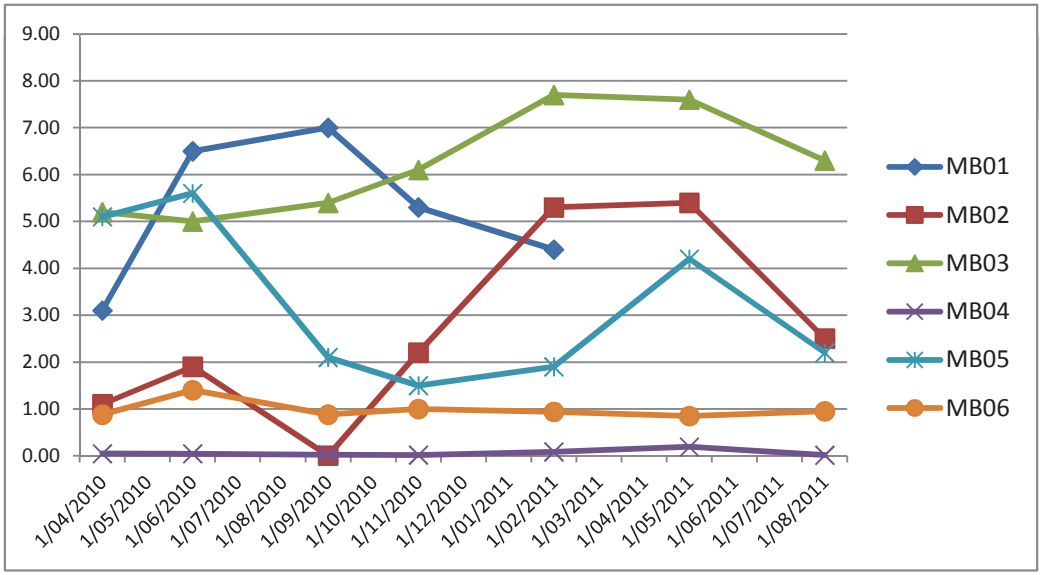
Organic Nitrogen (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	1.30	1.20	0.20	0.40	0.20	<0.2
25/06/2010	0.49	0.47	0.13	0.15	0.99	0.16
2/09/2010	2.17	2.968	1.91	0.398	0.364	0.443
18/11/2010	0.872	0.581	1.181	0.132	0.494	0.459
24/02/2011	6.6	0.74	1.6	0.53	0.69	0.49
31/08/2011		0.72	1.1	0.56	0.81	0.58
Max	6.6	2.968	1.91	0.56	0.985	0.58
Min	0.492	0.47	0.126	0.132	0.2	0.162
Median	1.3	0.73	1.1405	0.399	0.592	0.459



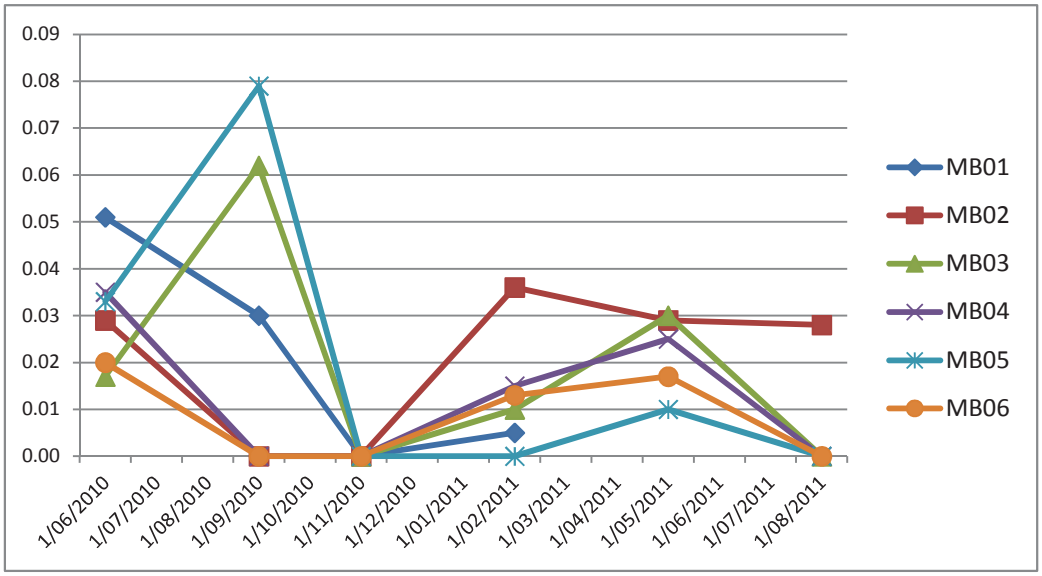
Nitrate/Nitrite Nitrogen, NOx as N (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	3.10	1.10	5.20	0.05	5.10	0.88
25/06/2010	6.50	1.90	5.00	0.05	5.60	1.40
2/09/2010	7.00	0.005	5.4	0.022	2.1	0.88
18/11/2010	5.3	2.2	6.1	0.018	1.5	1
24/02/2011	4.4	5.3	7.7	0.085	1.9	0.94
1/05/2011		5.4	7.6	0.19	4.2	0.85
31/08/2011		2.5	6.3	0.014	2.2	0.95
Max	7	5.4	7.7	0.19	5.6	1.4
Min	3.1	0.005	5	0.014	1.5	0.85
Median	5.3	2.2	6.1	0.046	2.2	0.94



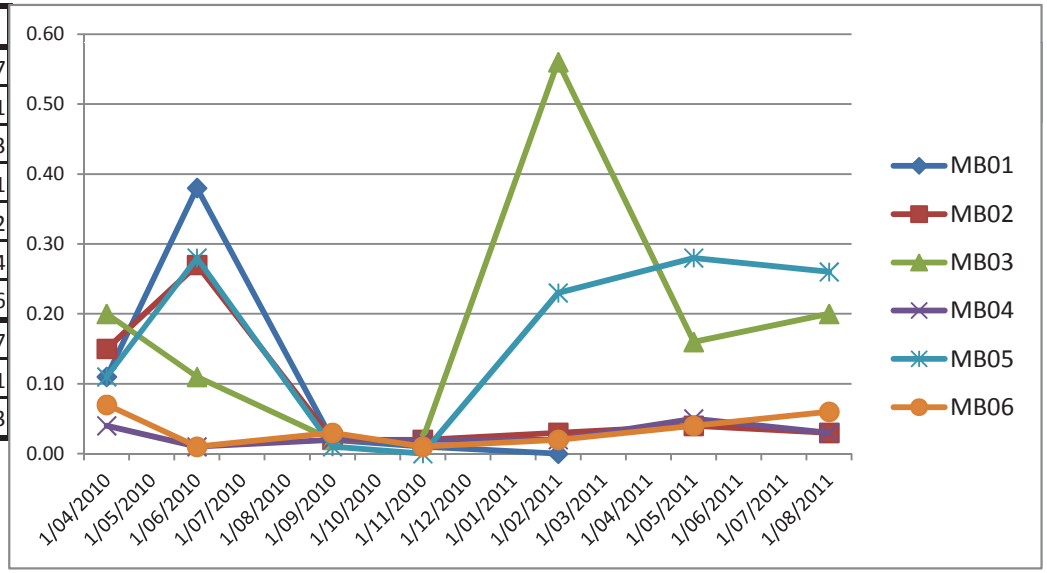
Ammonia Nitorgen, NH_3 as N (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	0.50	0.10	0.30	0.30	0.10	0.60
25/06/2010	0.05	0.03	0.02	0.04	0.03	0.02
2/09/2010	0.03	<0.005	0.062	<0.005	0.079	<0.005
18/11/2010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
24/02/2011	0.005	0.036	0.01	0.015	<0.005	0.013
1/05/2011		0.029	0.03	0.025	0.01	0.017
31/08/2011		0.028	<0.005	<0.005	<0.005	<0.005
Max	0.5	0.1	0.3	0.3	0.1	0.6
Min	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Median	0.03	0.028	0.02	0.025	0.01	0.013



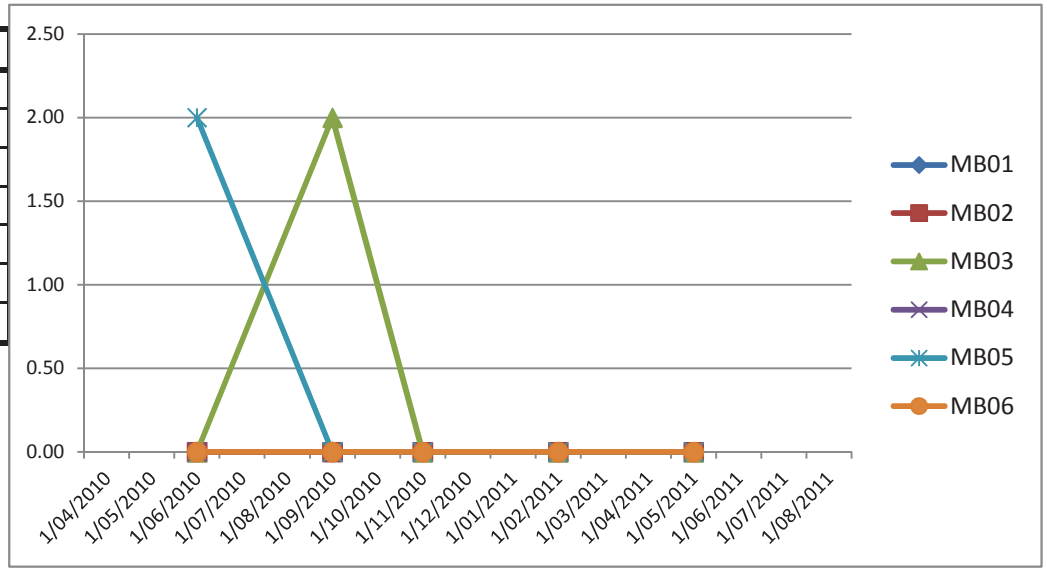
Total Phosphorus (mg/L)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010	0.11	0.15	0.20	0.04	0.11	0.07
25/06/2010	0.38	0.27	0.11	0.01	0.28	0.01
2/09/2010	0.02	0.02	0.02	0.02	0.01	0.03
18/11/2010	0.01	0.02	0.02	0.02	<0.01	0.01
24/02/2011	-	0.03	0.56	0.02	0.23	0.02
1/05/2011		0.04	0.16	0.05	0.28	0.04
31/08/2011		0.03	0.2	0.03	0.26	0.06
Max	0.38	0.27	0.56	0.05	0.28	0.07
Min	0.01	0.02	0.02	0.01	<0.01	0.01
Median	0.065	0.03	0.16	0.02	0.25	0.03



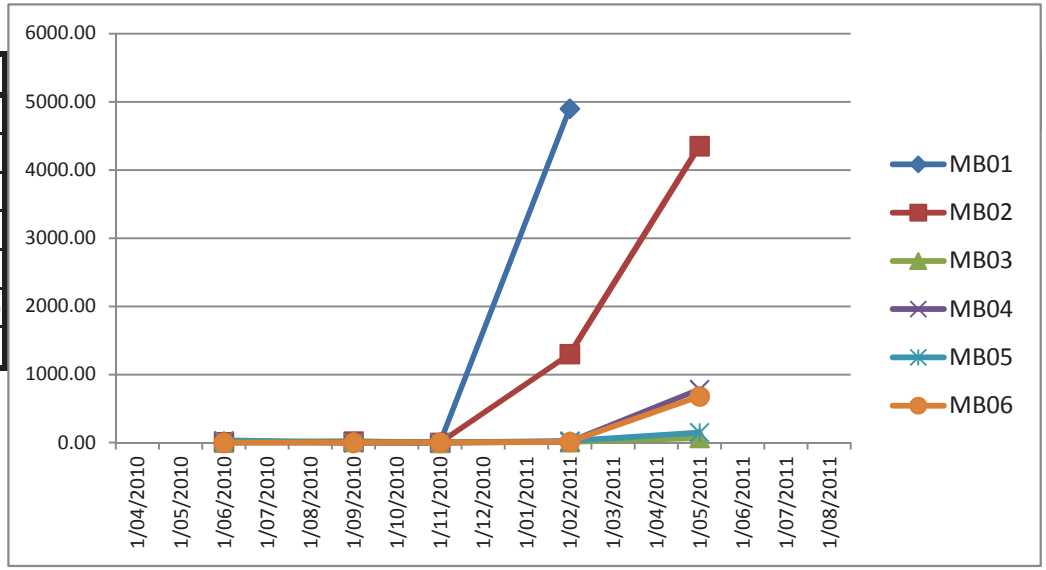
EColi in Water (MPN/100 mL)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010						
25/06/2010	<2	<2	<2	<2	2.00	<2
2/09/2010	<2	<2	2	<2	<2	<2
18/11/2010	<1	N.A.	<1	N.A.	<1	N.A.
24/02/2011	<1	<1	<1	<1	<1	<1
1/05/2011		<10	<10	<10	<10	<10
31/08/2011						



Total Coliforms in Water (MPN/100 mL)

Date	MB01	MB02	MB03	MB04	MB05	MB06
9/04/2010						
25/06/2010	<2	8.00	11.00	23.00	33.00	<2
2/09/2010	<2	17.00	22	<2	<2	<2
18/11/2010	3.10	N.A.	3.10	N.A.	<1	N.A.
24/02/2011	4900	1300	11	16	25	11
1/05/2011		4350.00	70.00	780.00	150.00	680.00
31/08/2011						



Heavy Metals (mg/L)

	MB01		MB02		MB03		MB04		MB05		MB06	
	9/04/2010	31/08/2011	9/04/2010	31/08/2011	9/04/2010	31/08/2011	9/04/2010	31/08/2011	9/04/2010	31/08/2011	9/04/2010	31/08/2011
Total Arsenic	0.1	-	<0.02	<0.02	0.029	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Cadmium	0.001	-	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005	<0.001	<0.005
Total Chromium	0.58	-	0.009	<0.005	0.14	<0.005	0.04	<0.005	0.06	<0.005	0.05	<0.005
Total Copper	0.13	-	0.07	0.006	0.064	<0.005	0.015	<0.005	0.032	<0.005	0.04	<0.005
Total Lead	0.059	-	0.005	<0.005	0.056	<0.005	0.054	<0.005	0.047	<0.005	0.084	<0.005
Total Nickel	0.02	-	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	0.006	<0.005	<0.005	<0.005
Total Zinc	0.06	-	0.02	0.02	0.04	<0.01	0.01	<0.01	0.03	<0.01	0.02	<0.01
Mercury	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Appendix Seven: Geotechnical Investigation

Douglas Partners
Geotechnics • Environment • Groundwater

Integrated Practical Solutions

REPORT
ON
PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL SUBDIVISION
LOTS 19 – 21 OLD COAST ROAD
LAKE CLIFTON, WA

Prepared for
TONY SCOLARO FAMILY TRUST

Project 76038
August 2010

Douglas Partners
Geotechnics • Environment • Groundwater

REPORT
ON
PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL SUBDIVISION
LOTS 19 – 21 OLD COAST ROAD
LAKE CLIFTON, WA

Prepared for
TONY SCOLARO FAMILY TRUST

Project 76038
August 2010

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RDS:DR
Project: 76038
18 August 2010

REPORT ON PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL SUBDIVISION
LOTS 19 – 21 OLD COAST ROAD, LAKE CLIFTON, WA

1. INTRODUCTION

This report presents the results of a geotechnical investigation undertaken for a proposed residential subdivision at Lots 19 - 21 Old Coast Road, Lake Clifton. This investigation was commissioned in a fax dated 18 June 2010 by Hamish Beck of Beck Advisory on behalf of Tony Scolaro Family Trust and was undertaken in accordance with Douglas Partners' proposal dated 12 May 2010.

The purpose of the investigation is to assess the sub surface conditions beneath the site and thus provide factual information on:

- the ground conditions encountered during the investigation;
- depth to groundwater, if encountered at the time of the investigation;
- depth to limestone, if encountered; and
- the nutrient retention capacity of the soils.

Details of the field work and laboratory testing are presented in this report.

2. SITE DESCRIPTION

The site comprises a rectangular shaped area of approximately 17.3 ha. It is bounded by Old Coast Road to the east, vacant land to the north and south and Lake Clifton to the west of the (Refer to Drawing 1, Appendix A).

At the time of the investigation the site generally comprised vacant land covered with grass, small shrubs and large trees. A small caravan park, a petrol station and a few residential houses occupy the central portion of the site. Limestone outcrop was observed in many locations.

The site is generally flat with surface levels of between RL 2 m and 5 m AHD, and two high points at around RL 8 m to 10 m AHD in the north-western and south-western corners.

The Lake Clifton–Hamel 1:50 000 Environmental Geology sheet indicates that shallow sub surface conditions beneath the site comprise sand derived from Tamala Limestone overlying limestone, possibly at shallow depth.

3. FIELD WORK METHODS

Field work was carried out on 16 July 2010 and comprised the excavation of eight test pits (TP1 to TP8) and 5 boreholes (BH9 to BH13).

The test pits were excavated using a Komatsu 5 tonne excavator equipped with a 600 mm toothed bucket. The boreholes were drilled using a 110 mm diameter hand auger. Each test location was logged in general accordance with AS1726 – 1993 by a suitably experienced representative from Douglas Partners. Representative soil samples were recovered from selected locations for subsequent laboratory testing. Perth Sand Penetrometer (PSP) tests were carried out adjacent to selected test locations in accordance with AS1289.6.3.3 to assess the *in situ* conditions of the shallow soils.

All test locations were determined using existing site features and are shown on Drawing 1, Appendix A. Surface elevations at each test location were interpolated from a contour plan provided by the client and are quoted in metres above Australian Height Datum (AHD).

4. FIELD WORK RESULTS

4.1 Ground Conditions

Detailed logs of the ground conditions and results of the field testing are presented in Appendix B, together with notes defining descriptive terms and classification methods.

The ground conditions encountered at the test locations generally comprise topsoil overlying sand and limestone. A summary of the conditions encountered is provided below:

TOPSOIL - dark grey silty sandy topsoil with rootlets to depths of between 0.1 m and 0.2 m;

SAND - generally medium dense, orange-brown sand with a trace of silt to depths of between 0.3 m and 1.1 m; and

LIMESTONE - low to medium strength, light yellowish brown limestone underlying the sand at all test locations to the depth of investigation.

The depths below existing surface level and relative levels of the top of the limestone at each test location are summarised in Table 1, below.

Table 1 – Summary of Limestone Depths and Levels

Test Location	Interpolated Surface Level (m AHD)	Depth to Top of Limestone (m)	Interpolated Level of Top of Limestone (m AHD)
TP1	6.0	0.6	5.4
TP2	2.8	0.6	2.2
TP3	5.0	0.4	4.6
TP4	3.2	0.3	2.9
TP5	2.4	1.1	1.3
TP6	5.9	0.8	5.1
TP7	4.8	0.4	4.4
TP8	3.0	0.4	2.6
BH9	3.2	0.4	2.8
BH10	2.6	0.4	2.2
BH11	3.2	0.6	2.6
BH12	3.5	0.7	2.8
BH13	2.7	0.5	2.2

4.2 Groundwater

No free groundwater was observed within any of the test pits or boreholes on 16 July 2010 to RL 0.9 m AHD.

5. LABORATORY TESTING RESULTS

A geotechnical laboratory testing programme was carried out by a NATA registered laboratory and comprised the determination of the particle size distribution on two sand samples and the point load index on five irregular lump samples of limestone.

The results of the testing are summarised in Table 2 and test certificates are presented in Appendix C.

Table 2 – Summary of Geotechnical Laboratory Test Results

Test	Depth (m)	Soil Type	% fines	d_{10} (mm)	d_{60} (mm)	Is50 (MPa)
TP1	0.7	LIMESTONE – light yellow-brown	-	-	-	1.23
TP2	0.8	LIMESTONE – light yellow-brown	-	-	-	0.24
TP4	0.4	LIMESTONE – light yellow-brown	-	-	-	0.74
TP5	1.2	LIMESTONE – light yellow-brown	-	-	-	0.32
TP8	0.8	LIMESTONE – light yellow-brown	-	-	-	0.35
BH9	0.3	SAND – orange-brown	3	0.08	0.22	-
BH12	0.5	SAND – orange-brown	4	0.08	0.19	-

Notes:
- The %Fines is the amount of particles smaller than 75 µm;
- A d_{10} of 0.10 mm means that 10 % of the sample particles are finer than 0.10 mm;
- A d_{60} of 0.38 mm means that 60 % of the sample particles are finer than 0.38 mm;
- Is50: Point load index; and
- '-' means not tested.

A suite of chemical analyses was also undertaken on five selected samples by a NATA registered laboratory and comprised the determination of:

- pH;
- electrical conductivity;
- cation exchange capacitys; and
- phosphorus retention indexs.

The results of the testing are summarised in Table 3 and test certificates are presented in Appendix C.

Table 3 – Summary of Chemical Laboratory Test Results

Test	Depth (m)	Soil Type	pH	EC (µS/cm)	PRI (mL/g)	CEC (meq/100g)
TP1	0.5	SAND – orange-brown	6.4	1,400	11	2.9
TP4	0.2	SAND – orange-brown	7.3	1,500	18	4.3
TP7	0.3	SAND – orange-brown	7.4	1,600	9.2	2.4
BH11	0.2	SAND – orange-brown	7.2	1,500	7.8	9.5
BH13	0.5	SAND – orange-brown	7.4	1,200	19	7.7

Notes:
- EC: Electrical conductivity;
- PRI: Phosphorus retention index;
- CEC: Cation exchange capacity.

6. LIMITATIONS

Douglas Partners (DP) has prepared the factual report for this project at Lots 19 – 21 Old Coast Road, Lake Clifton in accordance with DP's proposal dated 12 May 2010 and acceptance received from Tony Scolaro Family Trust dated 18 June 2010. This report is provided for the exclusive use of Tony Scolaro Family Trust for the specific project and purpose as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party.

The results provided in the report are considered to be indicative of the sub-surface conditions on the site only to the depths investigated at the specific sampling and/or testing locations, and only at the time the work was carried out. Actual ground conditions and materials behaviour observed or inferred at the test locations may differ from those which may be encountered elsewhere on the site.

This report must be read in conjunction with the attached "Notes Relating to This Report" and any other attached explanatory notes and should be kept in its entirety without separation of

individual pages or sections. DP cannot be held re sponsible for interpretations or conclusions made by others which are not supported by an expressed statement, interpretation, outcome or conclusion stated in this report. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

7. REFERENCES

Australian Standard AS 1289-2000, Methods of Testing Soils for Engineering Purposes

Australian Standard AS 1289.6.3.3-1999, Soil Strength and Consolidation Tests-Determination of the Penetration Resistance of a Soil – Perth Sand Penetrometer Test.

Australian Standard AS 1726-1996, Geotechnical Site Investigation.

DOUGLAS PARTNERS PTY LTD

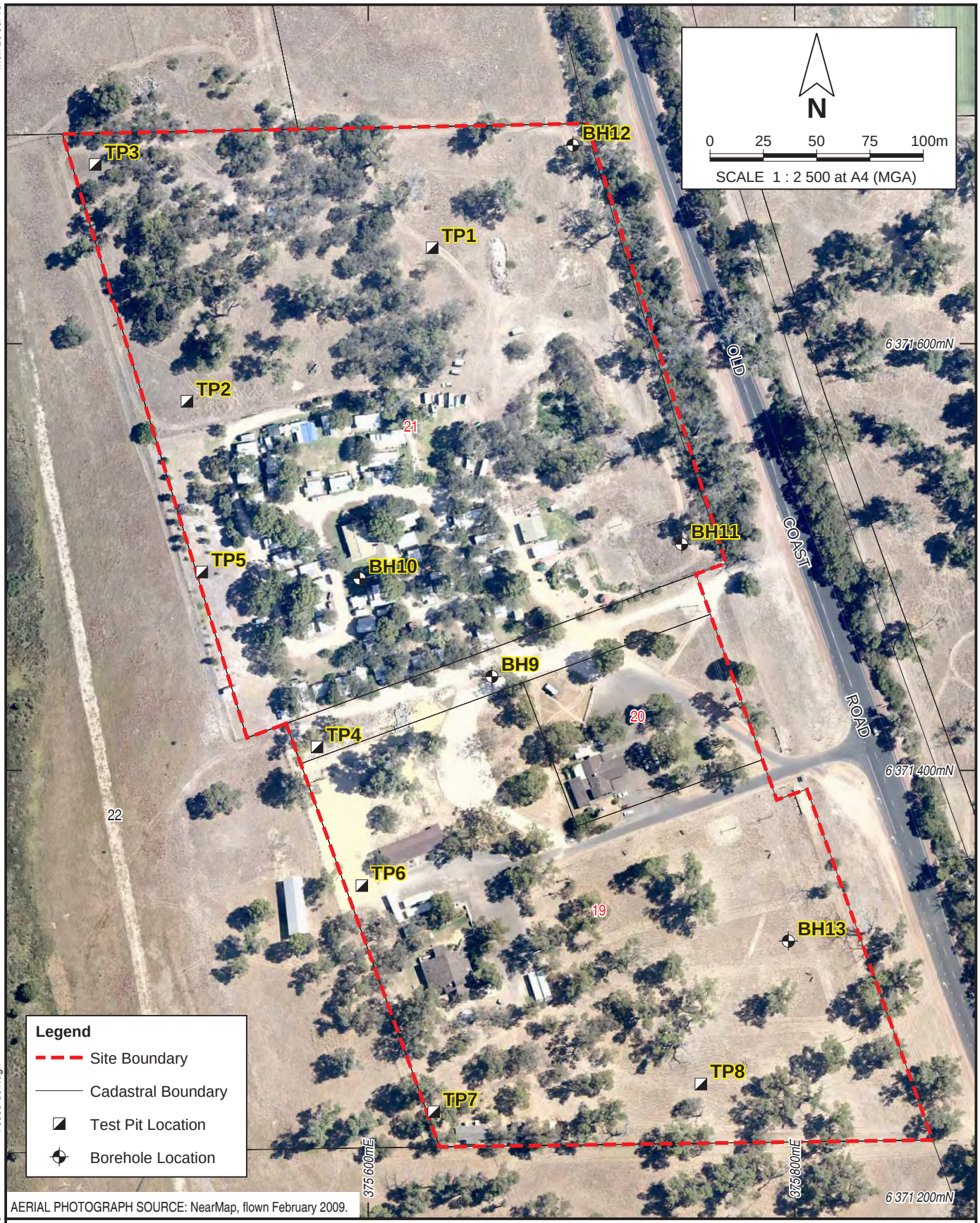
Reviewed by:

Daniel Reaveley
Geo-Environmental Scientist

pp Michael J Thom
Principal

APPENDIX A

Site Plan and Test Locations



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Title: LOTS 19-21 OLD COAST ROAD, LAKE CLIFTON

TEST LOCATION PLAN

Client:	TONY SCOLARO FAMILY TRUST			Office: PERTH	
Drawn By:	R. DA SILVA	Scale: 1 : 2 500	Project No: 76038	DRAWING 1	Revision: A
Approved By:	--		Date: 26-07-10		

APPENDIX B

Results of Field Work

Notes Relating to this Report

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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in

clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

  as 4, 6, 7
  N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

  as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

q_c (MPa) = (0.4 to 0.6) N (blows per 300 mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

q_c = (12 to 18) c_u

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section

is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 2.8 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 2
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.2	TOPSOIL - dark brown, silty sandy topsoil.							
	0.6	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.							
2	0.9	LIMESTONE - low strength, light yellow-brown limestone.		D	0.8				
1		Pit discontinued at 0.9m (due to slow progress)							1

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

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TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 5.0 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 3
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.2	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.							
	0.4	LIMESTONE - low to medium strength, light yellow-brown limestone.		D	0.6				
	0.9	Pit discontinued at 0.9m (due to refusal)							
4	1								1

Dynamic Penetrometer Test (blows per 150mm): 5 10 15 20

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▽ Water level

CHECKED	
Initials:	
Date:	19.8.10

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TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 3.2 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 4
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.15	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.		D	0.2				
	0.3	LIMESTONE - low to medium strength, light yellow-brown limestone.		D	0.4				
	0.5	Pit discontinued at 0.5m (due to refusal)							

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 15.8.10

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TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 2.4 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 5
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.15	SAND - medium dense, grey mottled dark grey, fine to medium grained, humid sand with some silt.							
		- becoming light grey with some shells from 0.6m.							
		- becoming light grey from 0.9m.		D	1.0				1
	1.1	LIMESTONE - low to medium strength, very light yellow-brown limestone.		D	1.2				
	1.5	Pit discontinued at 1.5m (due to slow progress)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 5.9 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 6
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
5	0.0	FILLING (SAND) - medium dense, light orange-brown, fine to medium grained, humid sand with trace of silt.							1
	0.8	LIMESTONE - low strength, light yellow-brown limestone.							
4	1.4	Pit discontinued at 1.4m (due to slow progress)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: R
Date: 14.8.10

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 4.8 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 7
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.2	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.		D	0.3				
	0.4	LIMESTONE - low to medium strength, light yellow-brown limestone with some sand infill to 1.8m.							
4									
	1			D	1.2				1
3	1.8	Pit discontinued at 1.8m (due to slow progress)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 3.0 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 8
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.2	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.							
	0.4	LIMESTONE - low to medium strength, light yellow-brown limestone with some sand infill to 1.0m.		D	0.8				
~1	1.0	Pit discontinued at 1.0m (due to slow progress)							1

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 2.6 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH 10
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.05	TOPSOIL - dark grey, silty sandy topsoil.							
		SAND - orange-brown, fine to medium grained, humid sand with some silt.		D	0.3				
	0.4	Bore discontinued at 0.4m (due to refusal on limestone)							

RIG: 110mm Hand Auger **DRILLER:** R Da Silva **LOGGED:** R Da Silva **CASING:**
TYPE OF BORING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

Douglas Partners
Geotechnics · Environment · Groundwater

BOREHOLE LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 3.2 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH 11
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
3	0.1	TOPSOIL - dark grey, silty sandy topsoil.							
		SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt and charcoal fragments.		D	0.2				1
2	0.6	Bore discontinued at 0.6m (due to refusal on limestone)							
1									

RIG: 110mm Hand Auger
DRILLER: R Da Silva
LOGGED: R Da Silva
CASING:

TYPE OF BORING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 16.7.10

Douglas Partners
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BOREHOLE LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 3.5 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH 12
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
3	0.1	TOPSOIL - dark grey, silty sandy topsoil.							
		SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.		D	0.5				
	0.7	Bore discontinued at 0.7m (due to refusal on limestone)							
2	1								1

RIG: 110mm Hand Auger **DRILLER:** R Da Silva **LOGGED:** R Da Silva **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U$_x$	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: M
Date: 19.8.10

Douglas Partners
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BOREHOLE LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 2.7 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH 13
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	TOPSOIL - dark grey, silty sandy topsoil.							
		SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.							
	0.5	Bore discontinued at 0.5m (due to refusal on limestone)		D	0.5				

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 110mm Hand Auger **DRILLER:** R Da Silva **LOGGED:** R Da Silva **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.8.10

Douglas Partners
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BOREHOLE LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 3.2 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH 9
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
3	0.2	TOPSOIL - dark grey, silty sandy topsoil.							
		SAND - orange-brown, fine to medium grained, humid sand with some silt.		D	0.3				
	0.4	Bore discontinued at 0.4m (due to refusal on limestone)							
2	1								1

RIG: 110mm Hand Auger **DRILLER:** R Da Silva **LOGGED:** R Da Silva **CASING:**
TYPE OF BORING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 19.7.10

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Tony Scolaro Family Trust
PROJECT: Lots 19-21 Old Coast Road
LOCATION: Lake Clifton, WA

SURFACE LEVEL: 6.0 m AHD *
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

PIT No: TP 1
PROJECT No: 76038
DATE: 16 Jul 10
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
									5 10 15 20
		TOPSOIL - dark brown, silty sandy topsoil.							
	0.15	SAND - medium dense, orange-brown, fine to medium grained, humid sand with some silt.		D	0.5				
	0.6	LIMESTONE - medium strength, light yellow-brown limestone.		D	0.7				
	0.9	Pit discontinued at 0.9m (due to refusal)							
5	1								1

RIG: 5 Tonne Komatsu Excavator (600mm toothed bucket)
LOGGED: R Da Silva

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials: AL
Date: 19.8.10

Douglas Partners
Geotechnics · Environment · Groundwater

APPENDIX C

Laboratory Testing Results

Point Load Strength Index
AS 4133.4.1

Mining and Civil Geotest Pty Ltd
Unit 1, No. 1 Pusey Road
Jandakot WA 6164

Client:	Tony Scalaro Family Trust	Report No.	60017-P10/1838-1842
Project:	Lots 19-21 Old Coast Road	Date Tested:	30/07/2010
Location:	Lake Clifton	Tested By:	S Sandilands
Date of Sampling and Sampling Method:	Tested as received	Client No.:	60017

Sample No. P10/	Sample	Rock Type	Moisture	Test Type	L (mm)	W (mm)	D (mm)	P (kN)	Is (MPa)	Is50 (MPa)	Remarks
1838	TP 1, 0.7m	Limestone	M	L	70	85	40	4.69	1.08	1.23	
1839	TP 2, 0.8m	Limestone	M	L	60	100	41	1.05	0.20	0.24	
1840	TP 4, 0.4m	Limestone	M	L	80	140	46	4.67	0.57	0.74	
1841	TP 5, 1.2m	Limestone	M	L	90	100	50	1.63	0.26	0.32	
1842	TP 8, 0.8m	Limestone	M	L	100	100	48	1.73	0.28	0.35	

Comments

KEY:

Moisture	**Test Type**
D - Dry	L - Lump
M - Moist	A - Axial
W - Wet	D - Diametral

Approved Signatory :

Kevin M Jones

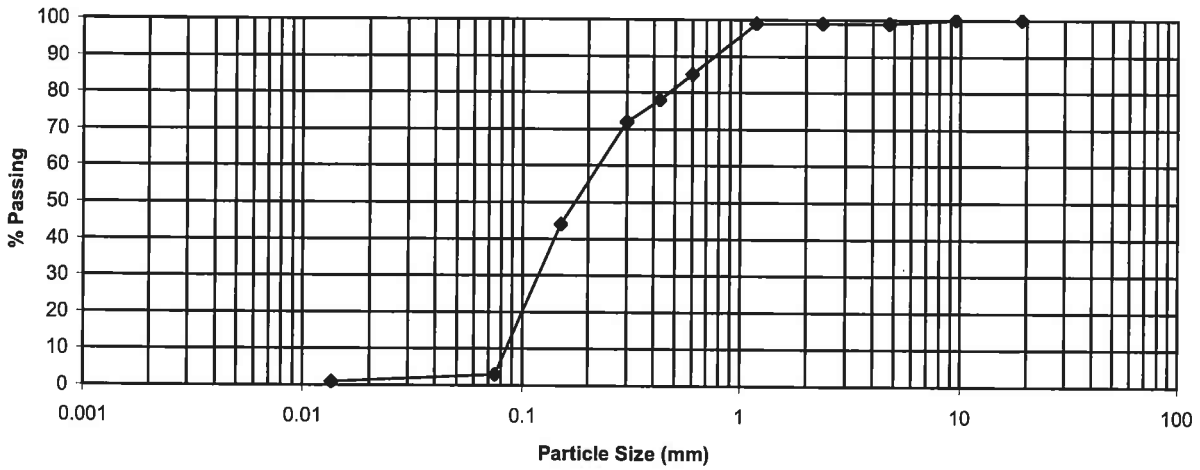
C:\Laboratory\Reports\Douglas 60017\60017-P10.1838-1842 PLI.xls

Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P10/1843**
Sample No:	**P10/1843**
Issue Date:	**30 July 2010**
Sample Location:	**BH 9**
Depth (m):	**0.3**

Client: **Tony Scolaro Family Trust**
Project: **Lots 19 - 21 Old Coast Road**
Location: **Lake Clifton**



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	100
9.5	100
4.75	99
2.36	99
1.18	99
0.600	85
0.425	78
0.300	72
0.150	44
0.075	3
0.0135	1

Plasticity index tests
Australian Standard 1289.

Liquid limit 3.1.1	na	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

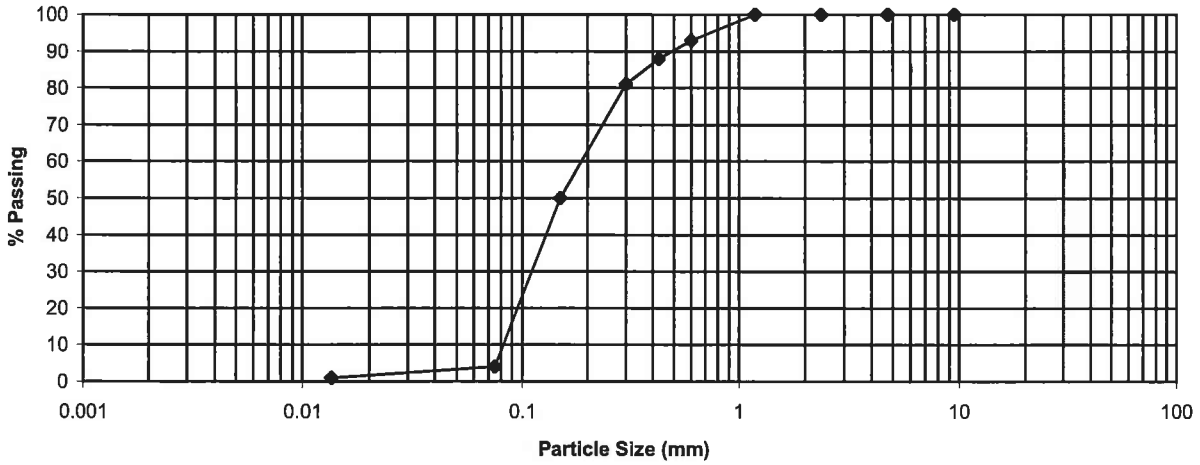
Approved signature

Kevin M Jones

Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

		Job No:	**60017**
		Report No:	**60017-P10/1844**
		Sample No:	**P10/1844**
		Issue Date:	**30 July 2010**
Client:	**Tony Scolaro Family Trust**	Sample Location:	**BH 12**
Project:	**Lots 19 - 21 Old Coast Road**	Depth (m):	**0.5**
Location:	**Lake Clifton**		



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	100
4.75	100
2.36	100
1.18	100
0.600	93
0.425	88
0.300	81
0.150	50
0.075	4
0.0135	1

Plasticity index tests
Australian Standard 1289.

Liquid limit 3.1.1	na	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Kevin M Jones

mpl Laboratories
Part of the Envirolab Group ENVIROLAB GROUP

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www.envirolabservices.com.au
Envirolab Services (WA) Pty Ltd ABN 53 140 099 207

CERTIFICATE OF ANALYSIS 104222

Client:
Douglas Partners Perth
36 O'Malley St
Osbourne Park
WA 6017

Attention: Rob Shapland

Sample log in details:

Your Reference:	**76038, Lot 19-21 Old Coast Rd**
No. of samples:	5 Soils
Date samples received:	21/7/10
Date completed instructions received:	21/7/10
Location:	Lake Clifton

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	2/08/10
Date of Preliminary Report:	Not issued
Issue Date:	2/08/10

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Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Joshua Lim
Reporting Supervisor

MPL Reference: 104222
Revision No: R 00

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Miscellaneous Inorg - soil						
Our Reference:	UNITS	104222-1	104222-2	104222-3	104222-4	104222-5
Your Reference	----------	TP1	TP4	TP7	BH11	BH13
Depth	----------	0.5	0.2	0.3	0.2	0.5
Date Sampled		16/07/2010	16/07/2010	16/07/2010	16/07/2010	16/07/2010
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	27/7/10	27/7/10	27/7/10	27/7/10	27/7/10
Date analysed	-	27/7/10	27/7/10	27/7/10	27/7/10	27/7/10
pH 1:5 soil:water	pH Units	6.4	7.3	7.4	7.2	7.4
Electrical Conductivity soil	µS/cm	1,400	1,500	1,600	1,500	1,200
Phosphorus Retention Index	mL/g	11	18	9.2	7.8	19

ESP/CEC Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	104222-1 TP1 0.5 16/07/2010 Soil	104222-2 TP4 0.2 16/07/2010 Soil	104222-3 TP7 0.3 16/07/2010 Soil	104222-4 BH11 0.2 16/07/2010 Soil	104222-5 BH13 0.5 16/07/2010 Soil
Exchangeable Ca*	meq/100g	2.6	4.0	1.8	8.9	7.1
Exchangeable K*	meq/100g	0.08	0.05	0.09	0.08	0.03
Exchangeable Mg*	meq/100g	0.21	0.20	0.33	0.40	0.43
Exchangeable Na*	meq/100g	0.05	0.06	0.18	0.06	0.08
Cation Exchange Capacity*	meq/100g	2.9	4.3	2.4	9.5	7.7

Method ID	Methodology Summary
WILAB.5A	pH - Measured using pH meter and electrode in accordance with APHA 21st ED, 4500-H+.
WILAB.5A	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA2510 21st ED and Rayment & Higginson.
Ext-028	Subcontracted to Chemistry Centre (WA)
Ext-054	Analysed by Envirolab Services Sydney, accreditation number 2901

Client Reference: 76038, Lot 19-21 Old Coast Rd

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			27/7/10	104222-1	27/7/10 || 27/7/10	LCS	27/7/10
Date analysed	-			27/7/10	104222-1	27/7/10 || 27/7/10	LCS	27/7/10
pH 1:5 soil:water	pH Units		WILAB.5A	[NT]	104222-1	6.4 || 6.4 || RPD: 0	LCS	99%
Electrical Conductivity soil	µS/cm	1	WILAB.5A	<1.0	104222-1	1400 || [N/T]	LCS	96%
Phosphorus Retention Index	mL/g		Ext-028	[NT]	104222-1	11 || [N/T]	[NR]	[NR]
QUALITY CONTROL ESP/CEC	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Exchangeable Ca*	meq/100 g	0.01	Ext-054	<0.01	104222-1	2.6 || 2.6 || RPD: 0	LCS	95%
Exchangeable K*	meq/100 g	0.01	Ext-054	<0.01	104222-1	0.08 || 0.07 || RPD: 13	LCS	96%
Exchangeable Mg*	meq/100 g	0.01	Ext-054	<0.01	104222-1	0.21 || 0.21 || RPD: 0	LCS	92%
Exchangeable Na*	meq/100 g	0.01	Ext-054	<0.01	104222-1	0.05 || 0.06 || RPD: 18	LCS	86%
Cation Exchange Capacity*	meq/100 g	1	Ext-054	<1.0	104222-1	2.9 || 2.9 || RPD: 0	[NR]	[NR]

Report Comments:

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform & E.coli levels are less than 1cfu/100mL.
The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC& ARMC 2004.

Asbestos was analysed by Approved Identifier: Not applicable for this job
Airborne fibres were analysed by Approved Counter: Not applicable for this job

INS: Insufficient sample for this test; NT: Not tested; PQL: Practical Quantitation Limit; <: Less than; >: Greater than
RPD: Relative Percent Difference; NA: Test not required; LCS: Laboratory Control Sample; NR: Not requested
NS: Not specified; NEPM: National Environmental Protection Measure
DOL: Sample rejected due to particulate overload

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however were analysed at a frequency to meet of exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD a matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spike and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and Speciated Phenols is acceptable.
Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.

Appendix Eight: Wetland Buffer Study

ecoscape

Wetland Buffer Definition Study

Beck Advisory

science+design

Quality Assurance
Ecoscape (Australia) has implemented a comprehensive range of quality control measures on all aspects of the company's operation and has Quality Assurance certification to ISO 9001.

An internal quality review process has been applied to each project task undertaken by us. Each document is carefully reviewed by senior members of the consultancy team and signed off prior to issue to the client. Draft documents are submitted to the client for comment and acceptance prior to final production.

Limitations Statement
This report has been exclusively drafted for the needs of Beck Advisory. No express or implied warranties are made by Ecoscape (Australia) Pty Ltd regarding the research findings and data contained in this report. All of the information details included in this report are based upon the existent land area conditions, research provided and obtained, and so forth at the time Ecoscape (Australia) Pty Ltd conducted its analysis into the area. Ecoscape (Australia) Pty Ltd will not be responsible for the application of its recommended strategies by Beck Advisory

Please note that the strategies devised in this report may not be directly applicable towards another client's needs or any other specific land area requiring management strategies. We would also warn against the environmental dangers of adapting this report's strategies to another land area which has not been researched and analysed by Ecoscape (Australia) Pty Ltd. Instead, please contact Ecoscape (Australia) Pty Ltd to provide a tailored report for your area's needs. Otherwise, Ecoscape (Australia) Pty Ltd accepts no liability whatsoever for a third party's use of, or reliance upon, this specific report.

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Summary

Ecoscape undertook a study to determine the appropriate wetland buffer, or separation distance, between a proposed park home redevelopment and Lake Clifton in the Shire of Waroona. The study used relevant reference material from Government guidelines to identify the wetland function area, the threatening processes likely to impact on the wetland and the ability of the buffer to achieve the protection of wetland values.

The study was identified by the Office of the Environmental Protection Authority (OEPA) as a requirement to allow assessment of proposed redevelopment.

It is acknowledged that Lake Clifton is an important conservation category wetland containing habitat for protected water birds and a threatened ecological community of thrombolites. As such the threatening processes identified through this study have been addressed to maintain the current condition of Lake Clifton by providing a 50 m buffer distance.

The proposed development is located approximately 80 - 100 m to the east of the fringing water dependent native vegetation of the Lake and sits on sandy dryland soils. The separation distance is comprised of previously cleared land with no native vegetation cover and a gentle slope to the Lake edge.

1.0 Introduction

1.1 Background

Beck Advisory originally engaged Ecoscape to undertake an Environmental Impact Assessment (EIA) for the redevelopment of an existing tavern, caravan park and former service station into a Commercial Development and Park Home Estate on Lots 19 – 21 Old Coast Road, Lake Clifton. The development proposal has been referred to the Office of the Environmental Protection Authority (OEPA) for assessment, out of which the level of assessment was set at an Environment Protection Statement (EPS) document, as specified under Part IV of the *Environmental Protection Act (1986)*. As a condition of the EPS a wetland buffer study was required to identify the relevant values, functions and processes and to determine an appropriate separation requirement distance between the proposed development and the wetland. Lake Clifton (UFI 3089) lies approximately 80 - 100m to the west of the proposed development (**Map 1, Appendix One**).

Lake Clifton is classified as a Conservation Category Wetland (CCW) within the Department of Environment and Conservation (DEC) *Geomorphic Wetlands Swan Coastal Plain* dataset and is also listed and protected under the Ramsar Convention (Australian Government 2009) as being a wetland of international importance. The *EPBC Act (1999)* enhances the management and protection of Australia's Ramsar wetlands, identifying them as 'Matters of National Environmental Significance'. Consequently, any action that has, will have, or is likely to have, a significant impact on the ecological character of a Ramsar wetland must be referred to the Commonwealth Minister for the Environment and undergo an environmental assessment and approval process. An action is a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things (Australian Government 1999).

1.2 Study Area Location

The study area is located within the Shire of Waroona approximately 100 km south of the Perth Central Business District (**Figure 1**). The proposed development consists of Lots 19 – 21 and is approximately 11 ha in extent, of which approximately 40% is vegetated but is predominantly 'parkland cleared'. To the west of these Lots lies Lake Clifton. The study area included the area between the Lot boundaries and the Lake boundary (**Map 1**).

Figure 1: Study Area Location.

1.3 Objectives

The objectives of this Wetland Buffer Study were to:

- undertake the study following the Western Australian Planning Commission (WAPC) guidelines *Guideline for the Determination of Wetland Buffer Requirements* (WAPC 2005)
- define the wetland buffer based on vegetation and soil characteristics and identify the relevant wetland values, functions and threatening processes
- discuss the results of the assessment in terms of potential impacts from proposed change in land use and the relationship of the appropriate buffer.

1.4 Planning Policies And Documentation

There are both State and Federal documents relating to the definition, protection and management of wetlands in Western Australia. The following were reviewed as part of this study.

1.4.1 WATER NOTES, WETLAND BUFFERS (WRC 2000)

This document was produced by the Waters and Rivers Commission (WRC) as part of a series of information fact sheets. It discusses the importance of buffers around wetlands to ensure that

healthy wetland ecosystems are maintained and protected. The width for wetland buffers depends on the purpose for separation and includes objectives such as:

- maintain ecological processes and major food-webs
- protection from nuisance insects
- reduce nutrient inputs
- pollution protection (heavy metals)
- protection from rising salinity
- minimise sedimentation
- protection of groundwater.

The buffer widths provided are only guidelines and do not represent statutory requirements of the Commission.

1.4.2 POSITION STATEMENT: WETLANDS (WRC, 2001)

This position statement was prepared to clarify the Commission's position on the management and protection of wetlands of the Swan Coastal Plain and how this relates to development in the region.

It provides information relating to wetland type, evaluation and management based on the systems developed by the Semeniuk Research Group for wetland classification on the Swan Coastal plain (Hill *et al.* 1996). It also discusses wetland buffers and land use with recommendations for buffer widths depending on the purpose of the buffer and the surrounding land use.

1.4.3 POSITION STATEMENT 4; ENVIRONMENTAL PROTECTION OF WETLANDS (EPA, 2004)

This position statement on wetland protection defines important values and functions of wetlands and establishes principles for the environmental protection of wetlands in general (EPA 2004).

It also provides a set of principles for the protection of wetlands to be used by natural resource managers, landowners and managers when addressing wetland impacts and management.

1.4.4 DRAFT GUIDELINE FOR THE DETERMINATION OF WETLAND BUFFER REQUIREMENTS (WAPC, 2005)

This guideline was developed by the Western Australian Planning Commission (WAPC) to assist landowners, developers, planners and architects to identify an appropriate buffer between wetlands and land uses (WAPC 2005).

It can be used where a change in land use or development is proposed in the immediate vicinity of a wetland or where the future use is likely to conflict with the established wetland management objective. The guideline recognises that the planning process must consider other relevant factors together with the environmental factors in decision making (WAPC 2005).

1.4.5 GUIDANCE STATEMENT 33 ENVIRONMENTAL GUIDANCE FOR PLANNING AND DEVELOPMENT PART B4:WETLANDS (EPA, 2008)

The purpose of this guidance statement is to provide an overview of environmental protection processes and information to assist in land use planning and development in Western Australia. In order to do this it describes the referral and environmental impact assessment processes under Part IV of the *Environmental Protection Act (1986)* and in particular the procedures applied to schemes. It also provides advice as directed by the OEPA on a range of environmental factors to assist participants in land use planning and development to protect, conserve and enhance the environment.

Part B4 relating to wetlands is of relevance to this project and outlines the OEPA's principles for the protection of wetlands including identification, mitigation and management.

1.4.6 PROTOCOLS FOR PROPOSING MODIFICATION TO THE 'GEOMORPHIC WETLANDS SWAN COASTAL PLAIN' DATASET (DEC, 2006)

This document outlines the DEC protocol for updating the Geomorphic Wetlands Swan Coastal Plain dataset. The dataset is identified and utilised by the OEPA and DPI as a basis to guide planning and decision making (DEC 2006).

2.0 Methods

2.1 Wetland Buffer Determination

The methodology used was consistent with the identification and delineation of a wetland buffer according to the WAPC *Guidelines for the Determination of Wetland Buffer Requirements* (WAPC 2005). The guidelines set out a seven step process to determine a buffer distance that appropriately protects wetland values. The process is set out as follows:

- Step 1: acknowledge the existence of the wetland
- Step 2: identify wetland attributes, wetland management category and establish management objectives (what aspects of the wetland require protection, such as threatened species and habitat values and what should management of the wetland buffer achieve)
- Step 3: define wetland function area (wetland boundary definition)
- Step 4: identify threatening processes (identify the potential impacts of the proposed land use)
- Step 5: identify role of separation (what is the role of separation in achieving the management objectives)
- Step 6: establish separation requirement (how much separation is required to achieve this role)
- Step 7: apply separation requirement to proposal and assess ability of separation to achieve management objectives (assess whether the separation requirement can be achieved).

2.1.1 STEP 1 - WETLAND EXISTENCE

Acknowledgement of the existence of the wetland is achieved by reviewing wetland mapping from the DEC and visually confirming the wetland's is located within the mapped boundary.

2.1.2 STEP 2 – WETLAND ATTRIBUTES

A field survey was undertaken to collect the necessary data and information to identify wetland attributes, confirm the status of the wetland category and establish management objectives.

2.1.3 STEP 3 – WETLAND FUNCTION AREA

The wetland function area means the area required to be protected to ensure the important values, processes, functions and attributes of the wetland can be maintained. This will typically include the wetland itself, associated wetland vegetation and any directly associated terrestrial fauna habitat (WAPC 2005). The function area was defined using the following techniques.

Visual justification

Photography of fringing wetland vegetation including within the wetland core and across the wetland boundary showing:

- all vegetation units
- the variety of vegetation condition of the wetland
- any other relevant features

Hydric Soils

The presence of hydric soils, impervious layers or evidence of anthropogenic fill is a requirement when identifying the presence of a wetland or verifying the extent of a wetland. Soil samples were taken from eight locations across the study area (**Map 1**) including:

- within the known wetland boundary
- outside of the known wetland boundary
- within the wetland boundary thought to be inaccurately mapped.

Descriptions of the soil components from an auger sample at 10cm intervals were recorded and included information on soil type, soil texture and soil colour. The descriptions of soil texture were taken from McArthur (1991) and DAFWA (2002), while soil colour was distinguished using Munsell (2000). An analysis of the variation between wetland and dryland soil profiles was also undertaken.

Hydrology

A desktop assessment of the hydrology of the site was undertaken as part of the original EIA report to the OEPA and included information relating to surface water and groundwater. Groundwater monitoring bores were installed over Lots 19-21 to collect baseline groundwater levels and water quality data.

Vegetation

Vegetation descriptions were recorded based on the dominant vegetation within each type. Vegetation condition was also recorded across the whole study area (Keighery 1994). Vegetation descriptions and condition were recorded from six locations (

and **Map 2**).

2.1.4 STEP 4 – THREATENING PROCESSES

The WAPC guidelines were consulted for key threatening processes to conservation category wetlands. Each threatening process identified in the guidelines was assessed for impact from the proposed development to the identified wetland attributes.

2.1.5 STEP 5 – ROLE OF SEPARATION

It is important to identify the role of the separation requirement for each wetland attribute. This helps to assess the ability of the achievable separation requirement to meet the management objective of the wetland. The guideline of the WAPC lists roles for the threatening processes that can in part be mitigated by buffering in **Table 1**.

Table 1: Role of Separation for each Threatening Process (WAPC 2005)

Threatening Process	Role of Separation
alteration to water regime	Reduces rates of surface (unchannelised) and subsurface inflow and therefore reduces potential for elevated levels and prolonged flooding
	Resists channelisation, thus decreasing erosion and rate of water flow
	Increases interception and evapotranspiration, reducing excessive flooding
	Assists in adjustments to changing water levels via the expansion and contraction of plant communities
	Vegetated wetland fringes may affect the water regime through increasing evapotranspiration losses from the groundwater system supporting the wetland
habitat modification	Vegetated buffers are valuable in minimising disturbance to the wetland and reducing potential for colonisation by exotic species
	Fencing the perimeter of the buffer is effective in preventing access to the wetland by exotic terrestrial vertebrate fauna
	Adds to and maintains wildlife habitat of a wetland
	Firebreaks reduce potential for increased frequency of fire
inappropriate recreational use	Vegetated buffers can be used to enhance the aesthetics of a wetland, encouraging people to use that wetland rather than those of high conservation value
	Provides barrier to visual and noise pollution
	Minimises public access and activities in certain areas and/or wetlands
diminished water quality	Vegetated buffers assist in the reduction of nutrient inputs to wetlands through increased uptake and assimilation of surface and subsurface water-borne nutrients
	Reduces un-channelised surface water flow rates, allowing suspended material to settle prior to wetland entry
	Provides for management of drainage inputs (see Alteration to the water regime)
	Avoids eutrophic conditions in a wetland and reduces the dispersal and impact of midges on surrounding areas
	Hydrogeology within the catchment and immediately around and beneath the wetland has a significant influence on the effectiveness of a buffer with respect to water quality. The intensity of production of contaminants by the source is a major factor to be considered and managed

Desktop and field survey information was used to determine the appropriate threatening processes that may provide impact by the proposed development.

2.1.6 STEP 6 – SEPARATION REQUIREMENT

The recommended separation requirements are determined by the likely impacts of adjacent land uses on the wetland and its values (WAPC 2005). For each threatening process identified in Step 5 the guidelines have established recommendations for the management of wetland buffers, the management recommendations for Conservation category wetlands are listed in **Table 2**.

Table 2: WAPC Management Recommendations for Conservation Category Wetlands.

Key threatening process	Recommended Separation and/or management	Separation area management
Alteration to the water regime	Regulation of groundwater abstraction as catchment management measure	• Area to be vegetated with deep-rooted perennial vegetation • Preferably native plant communities • 6m firebreak minimum, inside of fence • Fence to limit vehicle, stock, exotic fauna access • Clear perimeter outside of fence (path, firebreak, road. • Fire control to maintain habitat and species diversity • Minimise track access/clearing, maximise native vegetation • Management for water quality outcomes as required
Habitat modification	•100 m weed infestation •Up to 100 m for bird habitat dependent on extent of use •6-50 m firebreak •Fence for controlling exotic fauna access •≥100 m to minimise edge effects	
Inappropriate recreational use	•≥ 50 m to improve aesthetics •≥ 50 m for barrier •Fence, paths for controlling access	
Diminished water quality	•Drainage inflows eliminated or managed •Where a proposal may affect wetland water quality, particularly through un-channelised flow, detailed site specific work should be undertaken to determine the specific separation measures required, including management measures	

2.1.7 STEP 7 – APPLICATION OF SEPARATION REQUIREMENT

This step involves the overlay of the separation requirement on the proposal to assess whether the recommended separation measures can be achieved. An aerial photograph was used for this step with the development boundary overlayed in GIS shapefile format (**Map 3**).

3.0 Results

3.1 Wetland Buffer Determination

3.1.1 STEP 1 WETLAND EXISTENCE

Wetland mapping by the DEC, using the Geomorphic Wetlands Swan Coastal Plain dataset, has identified Lake Clifton as a Conservation category wetland (

). The existence of a wetland is therefore confirmed.

3.1.2 STEP 2 WETLAND ATTRIBUTES

Wetland values are a measure or expression of worth placed by society on a particular function, use or attribute (WAPC 2005). Wetland functions are the physical, chemical and biological processes occurring within a wetland and an attribute of a wetland is some characteristic or combination of characteristics which is valued by a group, but does not necessarily provide a function or support a use (WAPC 2005).

Lake Clifton is a unique and significant feature of the Swan Coastal Plain. The presence of a threatened ecological community (TEC) of Thrombolites and the status of a RAMSAR Convention Wetland confirm the wetland/Lake status as being Conservation category.

The attributes that have been identified as being of importance for Lake Clifton are;

- presence of a TEC and the potential biological diversity associated with both the aquatic and terrestrial ecosystems associated with wetland
- water quality with a focus on nutrient inputs through both surface and groundwater
- fringing wetland native vegetation and the value this provides as fauna habitat, particularly for waterbirds and waders.

3.1.2.1 Management objectives

A critical step in determining buffering requirements is the identification and definition of the management objectives of the wetland. Management objectives have been identified for all wetlands on the Swan Coastal Plain, from Gingin to Dunsborough. Lake Clifton has been classified as a Conservation category wetland (Step 1) and the assigned management objective, for this classification type, is to preserve wetland (natural) attributes and functions (WAPC 2005).

The preservation of the identified attributes of water quality and the protection of the fringing wetland vegetation and TEC are therefore the focus of management objectives. Lake Clifton is a large permanent water body, the proposed development is adjacent to a small section of lake shoreline (approximately 500 m) and 150 m from the nearest water edge. The Thrombolite TEC has been mapped along almost the entire eastern shore of the Lake, including the shoreline adjacent to the proposal.

3.1.3 STEP 3 WETLAND FUNCTION AREA

Ecoscape applied the DEC protocols (DEC 2006) as well as reviewing the requirements of the WAPC guidelines to assist in the determination of an appropriate buffer area. Visual, soil and vegetation characteristics and values were used in the determination of the wetland function area. The wetland function area means the area required to be protected to ensure the important values, processes, functions and attributes of the wetland can be maintained. The wetland function area normally

would include the wetland itself, the wetland vegetation and any directly associated dependent terrestrial habitat (WAPC 2005).

3.1.3.1 Visual Justification

A series of photographs were taken of the study area in order to show the wetland boundary and the area between the development site and the wetland. Photographs were also taken within the wetland itself to show the condition of the vegetation.

This visual record is a requirement of the *Protocols for proposing modification to the 'Geomorphic Wetlands Swan Coastal Plain' dataset* (DEC 2006) and will be used to provide evidence of the location of the wetland function area. Photos taken are shown in **Appendix Two**.

3.1.3.2 Hydrology

Surface water

The Coastal and Lakelands Planning Strategy (WAPC 1999) identifies the site as being within the Yalgorup Coastal Catchment, and the "administrative" EPA Lake Clifton Catchment. There are no mapped surface drainage lines on site (Department of Water 2008). A constructed dam is located in the southeast of Lot 21.

Groundwater

The Perth Groundwater Atlas of the DoW (2008) was interrogated for hydrological data covering the study site and the presence of any Public Drinking Water Source Areas (PDWSA).

The Atlas indicates that the site is not included in a PDWSA, and groundwater salinity is between 3000 – 7000 mg/L TDS (brackish to saline). Further information relating to depth to groundwater and groundwater risk could not be gathered as the mapping for these elements does not extend to Lake Clifton.

Regional hydrogeological studies covering the strategy area were undertaken in the 1980s by Commander (1988) and Deeney (1989) of the Geological Survey of Western Australia. Deeney (1989) identified the Yanget and Mialla groundwater mounds, and the Waroona, Myalup and Serpentine Flow Systems in the vicinity of the southern half of Lake Clifton and beyond Lake Preston to the Collie River. The study site is located within the Waroona flow system (Deeney 1989) with groundwater on site flowing approximately to the west towards Lake Clifton (Commander 1988, Deeney 1989). Groundwater contours indicate that groundwater level beneath the site to be less than 1m AHD (Deeney 1989).

Groundwater monitoring bores were installed throughout Lots 19-21 and have been monitored for depth to groundwater as well as nutrients and other potential contaminants (**Map 3**). The results of the groundwater level monitoring are found in **Appendix Three**.

3.1.3.3 Hydric Soils

Using a hand auger, soil profiles at 10 cm intervals were taken at eight locations across the study area including; within the wetland boundary, outside the wetland boundary and, within the wetland boundary thought to be inaccurately mapped. The results of the soil samples are shown in **Table 3**.

Table 3: Soil Profile Descriptions

Soil point	Intervals (cm)	Soil Texture	Soil Colour	Comments
1	0-10	Sandy loam	Black	Peaty
WP2	10-20	Clayey sand	Very dark brown	
	20-30	Clayey sand	Very dark brown	
	30-40	Clayey sand	Very dark brown	
	40-50	Slightly pallid, loamy sand	Brown	Water
2	0-10	Clayey sand	Dark grayish brown	
WP3	10-20	Clayey sand	Dark grayish brown	
	20-30	Clayey sand	Dark grayish brown	A lot of shell material
	30-40	Clayey sand	Dark grayish brown	Water
	40-50	Clayey sand	Dark grayish brown	A lot of shell material
3	0-10	Loamy sand	Very dark brown	
WP4	10-20	Loamy sand	Very dark brown	
	20-30	Loamy sand	Dark grayish brown	
	30-40	Loamy sand	Dark grayish brown	
	40-50	Sand	Light brownish gray	limestone
4	0-10	Loam	Black	
WP9	10-20	Clayey sand	Very dark grayish brown	
	20-30	Clayey sand	Dark grayish brown	
	30-40	Clayey sand	Dark grayish brown	Shell fragments
	40-50	Sandy loam	Light brownish gray	Water
5	0-10	Loam	Black	
WP10	10-20	Clayey sand	Very dark grayish brown	
	20-30	Clayey sand	Very dark grayish brown	
	30-40	Clayey sand	Dark grayish brown	
	40-50	Clayey sand	Dark grayish brown	Water
6	0-10	Sand	Brown	
WP 11	10-20	Sand	Brown	
	20-30	Sand	Grayish brown	
	30-40	Sand	Grayish brown	
	40-50	Loamy sand	Light brownish gray	
	50-60	Loamy sand	Light brownish gray	

Soil point	Intervals (cm)	Soil Texture	Soil Colour	Comments
	60-70	Loamy sand	Light brownish gray	Consistent to 1m
7	0-10	Loamy sand	Very dark brown	
WP12	10-20	Loamy sand	Very dark brown	
	20-30	Loamy sand	Strong brown	
	30-40	Sand	Strong brown	
	40-50	Sand	Brown	Limestone
8	0-10	Loamy sand	Very dark brown	
WP13	10-20	Loamy sand	Very dark brown	
	20-30	Loamy sand	Very dark gray	
	30-40	Loamy sand	Gray	
	40-50	Loamy sand	Gray	
	50-60	Loamy sand	Gray	
	70-80	Loamy sand	Light gray	
	80-90	Loamy sand	Light gray	Limestone

3.1.3.4 Vegetation

The dominant vegetation structure was recorded from six points within the study area. Although the DEC document, 'Protocol for proposing modifications to the *Geomorphic Wetlands Swan Coastal Plain* dataset' (2006) states that the absence of wetland vegetation alone does not provide sufficient justification for an existing mapped wetland area to be modified, this information is still useful for the purpose of delineating wetland boundary and also the wetland function area.

The vegetation types of the study area are displayed on

and the areas under native vegetation cover are described as:

GfOS *Gahnia trifida, Juncus pallidus* and *Schoenus subfascicularis* Open Sedgeland and *Eragrostis curvula* Grassland and mixed introduced Very Open Herbland with *Gomphocarpus fruticosus* Scattered Tall Shrubs.

MrLOF *Melaleuca rhaphiophylla* Low Open Forest over *Gahnia trifida, Juncus pallidus* and *Schoenus subfascicularis* Closed Sedgeland with *Melaleuca priessii* Scattered Low Trees.

SsJpS *Schoenus subfascicularis* and *Juncus pallidus* Closed Sedgeland.

Bushland Condition scores for the vegetation types of the buffer area were recorded and are shown on **Map 2**. The area between the water dependent native vegetation and the development boundary was scored as Completely Degraded due to the clearing and highly modified nature. The areas under native vegetation were scored as Good and Excellent, the Good areas being the fringe between the cleared area and the Excellent native vegetation cover.

3.1.4 STEP 4 – THREATENING PROCESSES

The key threatening processes were identified based on consideration of the environmental risks associated with the various surrounding land uses (WAPC 2005). Threats identified through the application of the WAPC step process (**Table 1**) to Lake Clifton from the proposed development are;

- alteration to water regime
  - watertable rise through reduced rainfall interception and higher induced recharge
  - usage as drainage compensating basin
  - groundwater abstraction lowering water levels
- inappropriate recreational use
  - high population pressures
  - rubbish disposal
- diminished water quality
  - stormwater and drainage discharges carrying nutrients and inorganic and organic pollutants

These threats are applied to the proposed development in Step 5.

3.1.5 STEP 5 – ROLE OF SEPARATION

The proposed development was determined to have the potential to provide the following threatening processes:

- alteration to the water regime
- diminished water quality.

Inappropriate recreational use and habitat modification were deemed not relevant as threatening processes to the wetland from the proposed development. The buffer area can be isolated from recreational use by fencing and education of the residents. The habitat between the proposed development and the wetland has been highly modified and remains a cleared paddock of pasture grasses and therefore no habitat modification is possible. The buffer could be the focus of rehabilitation efforts to restore native vegetation which is a positive management outcome.

The role of the separation requirement is therefore focussed on the management of water regimes of both surface and groundwater inputs as shown in **Table 2**.

3.1.6 STEP 6 – SEPARATION REQUIREMENT

Lake Clifton has already been established as an important Conservation Category Wetland, both nationally and internationally, the separation requirements can be readily determined using the WAPC guidelines. Ecoscape has determined that to adequately protect the shore of Lake Clifton, from the range of identified threatening processes, a buffer or separation requirement of 50 m would be required.

Table 2 shows the WAPC recommended management to mitigate potential impacts for each of the threatening processes. Habitat modification and inappropriate recreational use were not considered key threatening processes as the proposal has no habitat modifying processes proposed for the wetland buffer and recreation use can be controlled through fencing and education.

3.1.7 STEP 7 – APPLICATION OF SEPARATION REQUIREMENT

Ecoscape determined the wetland boundary following the steps process outlined in Step 3 and using the DEC protocols (DEC 2006). The wetland boundary, indicated through the soil analysis, closely followed the line of wetland vegetation. This new proposed wetland boundary was overlayed onto an aerial photograph of the study area with the development footprint to determine the ability of the separation requirement to achieve the management objectives for Lake Clifton. The boundary of the wetland has been buffered by 50 m to achieve the separation requirements as per **Table 2**, being $\geq$ 50 m (**Map 3**).

From this overlay it is shown that the separation requirement is impacted by the development to a minimal extent. The level of impact is difficult to determine. However, by satisfactory treatment of surface water flows to reduce the level of nutrients entering the wetland area it is expected that impacts can be managed and maintained at low levels.

Surface water flows can be treated through the use of bioretention swales that utilise vegetation to uptake excess nutrients from the impounded water. This process effectively reduces the level of nutrients that are allowed to flow through to the wetland buffer (or separation requirement) of Lake Clifton.

4.0 Discussion

The Ecoscape study to define the wetland buffer area used both desktop and field investigation methods and looked at the extent of water dependent native vegetation, the soil characteristics both within and outside the wetland, and considered wetland values as defined by the guidelines of the WAPC and DEC.

The results of the study determined that the wetland boundary closely follows the edge of the existing water dependent native vegetation, based mainly on soil characteristics. The WAPC guidelines were consulted for the determination of the wetland function area, the threatening processes, the role of separation and the establishment of an appropriate separation requirement.

A 50 m separation requirement was determined and used to locate the extent of the buffer area required to adequately protect Lake Clifton.

The use of bioretention swales is advocated as an effective means to reduce the level of nutrients entering the wetland system through surface water flows. Water treatment systems are proposed to treat waste water from dwellings and to protect the groundwater table from receiving excess nutrients.

Map 3 shows the extent of the 50 m separation requirement as determined through this study. There is no overlap of the proposed development footprint with the separation requirement. .

References

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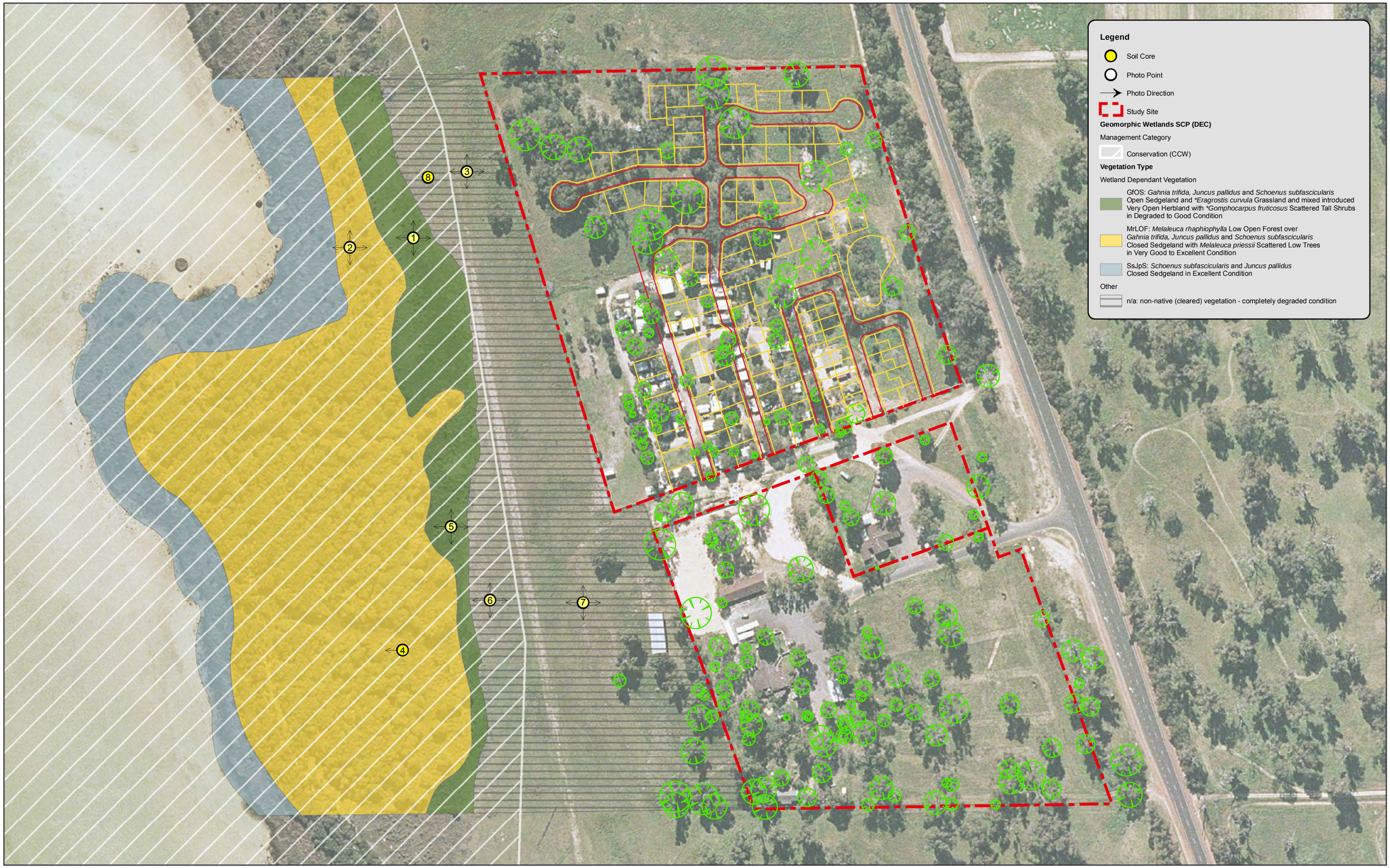
Appendix One: Maps



Map 1

Mar 2011

Wetland Buffer Study: Lots 19 - 21 Old Coast Road, Lake Clifton

Location of Wetland Dependant Vegetation, Soil Cores and Photo Points

prepared for Beck Advisory

0 20 40 60 80 100 Metres

1:2,200 @ A3

Project No. 2216-08V2

ecoscape

Map 2

Mar 2011

Wetland Buffer Study: Lots 19 - 21 Old Coast Road, Lake Clifton

Bushland Condition of Wetland Buffer

prepared for Beck Advisory

0 20 40 60 80 100 Metres

1:2,200 @ A3

Project No. 2216-08V2

ecoscape

MB01
Depth to Groundwater (m bgl) = 4.08
Groundwater level (mAHD) = 0.391

MB06
Depth to Groundwater (m bgl) = 2.59
Groundwater level (mAHD) = 0.424

MB05
Depth to Groundwater (m bgl) = 3.22
Groundwater level (mAHD) = 0.406

MB02
Depth to Groundwater (m bgl) = 2.45
Groundwater level (mAHD) = 0.391

MB03
Depth to Groundwater (m bgl) = 6.15
Groundwater level (mAHD) = 1.001

MB04
Depth to Groundwater (m bgl) = 2.1
Groundwater level (mAHD) = 0.404

1 2 3 4 5 6 7 8

Legend

- Soil Core
- Photo Point
- Photo Direction
- Groundwater Monitoring Bores (measurements taken 30/08/2011)
- Study Site
- Ecoscape Wetland Boundary
- 50 m Buffer of Ecoscape Wetland Boundary

Geomorphic Wetlands SCP (DEC)

Management Category

- Conservation (CCW)
- 50 m Buffer of CCW

Vegetation Type

Wetland Dependant Vegetation

- GfOS: *Gahnia trifida, Juncus pallidus* and *Schoenus subfascicularis* Open Sedgeland and **Eragrostis curvula* Grassland and mixed introduced Very Open Herbland with **Gomphocarpus fruticosus* Scattered Tall Shrubs in Degraded to Good Condition
- MrLOF: *Melaleuca rhaphiophylla* Low Open Forest over *Gahnia trifida, Juncus pallidus* and *Schoenus subfascicularis* Closed Sedgeland with *Melaleuca priessii* Scattered Low Trees in Very Good to Excellent Condition
- SsJpS: *Schoenus subfascicularis* and *Juncus pallidus* Closed Sedgeland in Excellent Condition

Other

- n/a: non-native (cleared) vegetation - completely degraded condition

Map 3

Wetland Buffer Study: Lots 19 - 21 Old Coast Road, Lake Clifton

Seperation Requirement

Mar 2012

prepared for Beck Advisory

0 20 40 60 80 100 Metres

1:2,200 @ A3

Project No. 2216-08V2

ecoscape

Appendix Two: Visual Record

Plate 1: Photo point 1 looking south.

Plate 2: Photo point 2 looking north.

Plate 3: Photo point 3 looking south.

Plate 4: Photo point 4 looking north.

Plate 5: Photo point 5 looking west.