LOCAL WATER MANAGEMENT STRATEGY

Cockburn Central West





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Disclaimer

SUMMARY

The Better Urban Water Management (BUWM) framework (WAPC October 2008) established the requirement for a Local Water Management Strategy (LWMS) to be prepared to support a Structure Plan application. This LWMS has therefore been developed on behalf of LandCorp to support the Cockburn Central West Structure Plan.

An inventory of the key elements for inclusion in a LWMS report, together with a cross-reference to the relevant section in this document is presented in Table 1 below.

Table 1: Inventory of Key LWMS Elements

Key DWMS Elements	Compliance to Objectives
Introduction (Section 1.0)	▪ LandCorp is seeking Structure Plan approvals for a 35 ha parcel of land known as Cockburn Central West. ▪ The development will serve as an activity centre for the Cockburn Central development, with the main land uses including active POS and mixed use urban development consisting of residential, retail, commercial and community facilities. ▪ The site is located immediately west of the existing Cockburn Central East town centre. ▪ The site was historically cleared for agricultural land uses.
Topography (Section 2.3.1)	▪ The site slopes relatively steeply from the south-west corner of the site to the north-east. Elevation in the south-west corner of the site is approximately 40 mAHD and slopes down to approximately 23 mAHD in the central eastern part of the site and northern boundary. The central low point corresponds with a low wetland area.
Soil Types (Section 2.3.2)	▪ The site lies within the Bassendean Sands landform and soil complex of the Swan Coastal Plain, characterised by sand dunes and sandplains with flats and swamps ▪ A Geotechnical Investigation has recently been completed for the site.
Surface Hydrology and Wetlands (Section 2.4)	▪ The site is located within the Jandakot Arterial Drainage Scheme area with a main drain located along the site's northern boundary conveying flows to Lake Yangebup. ▪ The dominant hydrological process at the site is rainfall infiltration and recharge to the Superficial groundwater aquifer. ▪ A Resource Enhancement wetland is located within the site.
Hydrogeology (Section 2.5)	▪ Groundwater monitoring of six bores has occurred to establish groundwater trends at the site. ▪ Groundwater mapping shows groundwater flows in a westerly direction and AAMGLs of 22.75 m AHD to 24.25 m AHD occur at the site. ▪ On-site monitoring data has been calibrated to DoW bore JM17, which has 39 years of monitoring data.
Water and Wastewater Servicing (Section 3.0)	▪ The site will be serviced by the Water Corporation for potable water supply and wastewater disposal. ▪ Groundwater will be used for irrigation of POS and playing fields. ▪ A groundwater allocation report from the DoW indicates the Superficial aquifer is currently 33% allocated. ▪ A 5C licence to take water has been lodged and assessed by the Department of Water. It will be issued by the DoW following endorsement of this LWMS.

Key DWMS Elements	Compliance to Objectives
Wetland Approval Process (Section 4.0)	▪ A Section 38 Referral was lodged with the Office of the EPA in December 2013. ▪ The wetland concept plan and management was presented in the S38 Referral. ▪ The EPA will not be formally assessing the site against the EP Act. ▪ The S38 Referral was completed to allow the proposed wetland works to occur. ▪ The City of Cockburn subsequently endorsed the Cockburn Central West Structure Plan following a suitable level of consultation with the EPA, DPaW and local community organisations.
Water Conservation Strategy (Section 5.0)	▪ The water conservation strategy will rely on the use of water efficient appliances within the dwellings and appropriate landscaping design and irrigation scheduling.
Stormwater Management (Section 6.2)	▪ All commercial and residential lots are required to collect and contain stormwater for infiltration using soakwells. ▪ Flows from Cockburn Central East will be conveyed to the wetland in events that exceed the 5-year ARI event. The flows will enter the wetland at two points to reduce water velocities and will enter the wetland via bubble up pits. ▪ The drainage system focuses on stormwater retention and infiltration at source with streetscape swales (preferably planted) and soakwells connected to underground stormtech cells to be used throughout the site. ▪ The stormtech cells will be placed within road reserves and will be designed to retain the 5-year ARI event. Major events (greater than 5-year ARI) will be conveyed via overland flow to the playing field (not AFL oval) or wetland. ▪ A small catchment on the north-eastern boundary will be directed to the existing open drain adjacent to North Lake Road via suitably sized culverts in events that exceed the 5-year ARI event. ▪ The wetland will include the use of bio-filtration swales located on the perimeter of the wetland. The swales will treat the first flush and be set between AAMGL and MGL to allow for stormwater infiltration where possible. ▪ The swales cannot be positioned any higher than currently shown without impacting on the survival and retention of existing wetland vegetation.
Water Quality Treatment (Section 6.3)	▪ The use of fertilisers and pesticides will be minimised using native vegetation and appropriate fertiliser operation and maintenance in the POS areas and playing fields. ▪ The drainage system will be vegetated where possible to reduce nitrogen loading from run-off, prior to infiltrating to groundwater. ▪ Bio-filtration swales will be located on the perimeter of the wetland for treatment and infiltration of the first flush.
Groundwater Management (Section 6.4)	▪ Cut to fill will occur at the site. ▪ As part of the Water Corporation's Southern Lakes Main Drainage system, stormwater pumps to control the rise of water in Yangebup Lake above a predetermined level have been provided since 2000 that help to control groundwater levels regionally.
Monitoring and Reporting (Section 7.0)	▪ Post-development monitoring of the wetland and bio-filtration swales will occur on a quarterly basis. ▪ Monitoring will include water quality analysis and visual inspection to ensure the bio-filtration basins and wetland are functioning as intended. ▪ The extent, locations, and frequency of post-development monitoring will be confirmed in the Urban Water Management Plan(s) when the final design of the wetland and streetscape swales is confirmed.
Future Areas to be Investigated Post-LWMS (Section 9.1)	▪ A number of commitments for investigations after the LWMS have been made.

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1.0 INTRODUCTION

1.1 Background

Strategic planning undertaken over the past decade for the South West Corridor identified the Cockburn Central locality as an important regional centre. Structure Planning approvals and construction of the town centre component of the Cockburn Central development commenced in 2006 and is heading towards completion. LandCorp is therefore now seeking Local Structure Planning (LSP) approvals to develop a 35-hectare (ha) parcel of land located to the west of the town centre, known as Cockburn Central West.

The LSP includes Lots 1, 53 and 55 North Lake Road, Lots 804, 1001 and 9504 Beeliar Drive and Lot 544 Poletti Road, Cockburn Central.

The Better Urban Water Management framework (WAPC October 2008) established the requirement for a Local Water Management Strategy (LWMS) to be prepared to support a Structure Plan application. This LWMS has therefore been developed on behalf of LandCorp to support the Cockburn Central West Structure Plan.

1.2 Planning Background

Cockburn Central West formed part of the Cockburn Central (Thompson's Lake) draft Regional Centre Structure Plan, prepared by Cardno BSD in mid-2001 (Cardno BSD 2001). The draft Structure Plan was advertised concurrently with the advertising of MRS Amendments 1038/33 (Thompsons Lake Regional Centre) and 1032/33 (South West Metropolitan Transit Route) in February 2002.

The City of Cockburn (CoC) resolved in March 2002 to support the draft Regional Centre Structure Plan. The Department for Planning (the then Department for Planning and Infrastructure) subsequently advised that the draft Structure Plan was acceptable as the basis for more detailed planning in the area and in 2002, Amendment 1038/33 was gazetted. In August 2004, the CoC initiated Amendment 1 to Town Planning Scheme No. 3 to rezone the site to "Regional Centre".

Subsequently, the Cockburn Central Structure Plan and Detailed Area Plan were developed concurrently in late 2006 with construction commencing shortly after.

As a majority of Cockburn Central has now been constructed, LandCorp is aiming to receive Structure Planning approval for Cockburn Central West.

1.3 Local Structure Planning Approval

Urbis was commissioned by LandCorp in 2013 to undertake a peer review of the Cockburn Central West Structure Plan originally prepared by Cardno BSD. The intent of the peer review was to identify potential opportunities, challenges and areas for improvement of the draft Structure Plan. The result of this review led to the development of the Cockburn Central West Structure Plan that was originally presented to the City of Cockburn Council in September 2013.

The City of Cockburn Council chose to defer this plan and requested modifications, including a need to retain the wetland located on site. Following this request, LandCorp produced a revised Structure Plan that included the retention of the wetland. This resulted in a number of challenges particularly around vehicular permeability, stormwater treatment and finished floor levels of the development sites. However, the revised plan received conditional approval by the City of Cockburn at their Ordinary Council meeting held on 14 November 2013.

A condition of approval included a need to update the LWMS to reflect the revised Structure Plan and receive final endorsement of the LWMS from the Department of Water (DoW) and City of Cockburn before final sign off on the Structure Plan from the Western Australian Planning Commission (WAPC). This LWMS has therefore been prepared to support the Structure Plan endorsed by the City of Cockburn in November 2013.

1.4 Proposed Local Structure Plan

The LSP illustrated in Figure 1 has been developed with the vision to provide an area of high recreational and aesthetic value to the community. The development will serve as an Activity Centre for the Cockburn Central Development, with the major land uses being active public open space (POS) and mixed use urban development consisting of residential, retail, commercial and community land uses.

The site has been assigned for Integrated Sports and Recreation facilities that may include:

- Public Open Space areas
- the Fremantle Football Club administration and training facilities
- community aquatic centre
- community gym
- indoor elite training centre/indoor community sporting hall
- football ovals
- university health science facilities
- conference centre
- other commercial/community facilities such as cafes.

The western portion of the site is occupied by overhead power transmission lines and land use in that area will be restricted to car parking and a dual use path.

1.5 Design Objectives

This LWMS has been prepared in accordance with *State Planning Policy 2.9: Water Resources* (Government of Western Australia 2006) and has been developed with reference to the following guidance documents:

- Better Urban Water Management (WAPC 2008)
- Interim: Developing a Local Water Management Strategy (Department of Water 2008)
- Western Australian State Water Plan (Government of Western Australia 2007)
- Stormwater Management Manual for Western Australia (Department of Water 2004–2007).

The LWMS will detail the integrated water management strategies to facilitate future urban water management planning. The LWMS will achieve integrated water management through the following design objectives:

- Promote infiltration of stormwater water close to source to minimise the risk of water quality degradation of the existing wetland and to mimic the dominant pre-development hydrological process of rainfall infiltration.
- Implement best management practices in regards to urban stormwater management including the use of roadside swales and underground stormtech cells.
- Incorporate where possible, low maintenance, cost-effective landscaping and stormwater treatment systems.
- Maintain and if possible improve water quality (surface and groundwater) within the development in relation to pre-development water quality.
- Reduce potable water consumption within both public and private spaces using practical and cost-effective measures.

1.6 Previous Studies

The following studies have been undertaken for the site to assist with the development of the LSP and identification of management requirements:

- Geotechnical Investigation, Proposed Development Cockburn Central West, WA. (Douglas Partners Pty Ltd March 2014)
- Section 38 of the *Environmental Protection Act 1986* Referral: Cockburn Central West and Impact on EPP Lake (RPS 2013)
- Acid Sulfate Soils and Dewatering Management Plan – Cockburn Central: Stage 2 Drainage Basins (RPS 2012a)
- Flora and Fauna Survey Report, Lots 1, 35 and 55 North Lake Road, Lot 54 Poletti Road and Lots 54, 804 and 9504 Beeliar Drive, Cockburn Central (RPS 2012b)
- Cockburn Central & Solomon Road Development Areas Arterial Drainage Scheme Review (David Wills and Associates 2004).

2.0 EXISTING ENVIRONMENT

2.1 Site Location and Context

Cockburn Central West (CCW) is located in the City of Cockburn (CoC), approximately 24 km south of the Perth CBD. The existing Cockburn Central development is located directly to the east, along with the Cockburn Central train station and Kwinana Freeway. The Gateways Shopping Centre precinct is located to the south of the site.

The site is bound by North Lake Road to the north and east, Beeliar Drive to the south and Poletti Road to the west. The site is approximately 35 hectares in size and consists of Lots 1, 53 and 55 North Lake Road, Lot 54 Poletti Road, and Lots 804 and 9504 Beeliar Drive, Cockburn. The site location is shown on Figure 2.

2.2 Historical Land Use

The site was historically cleared for agricultural purposes. The land is currently vacant and does not contain any buildings.

2.3 Topography, Soils and Geology

2.3.1 Topography

The site slopes relatively steeply from the south-west corner of the site to the north-east. Elevation in the south-west corner of the site is approximately 40 m AHD and slopes down to approximately 23 m AHD in the central-eastern part of the site and northern boundary. The central low point corresponds with a low wetland area. Topography is illustrated in Figure 3.

2.3.2 Soils

The site lies within the Bassendean Dune System and soil complex of the Swan Coastal Plain, characterised by sand dunes and sandplains with flats and swamps. Figure 3 illustrates that the elevated areas of the site are characterised by fine to medium grained sand that is grey in colour at the surface and yellow at depth.

The lower lying areas in the north-east are characterised by a thin veneer of sand overlying brown silt and clay. An area of dark brown–grey sandy silt is mapped on the central eastern boundary that roughly corresponds with the wetland area located on site.

2.3.3 Geotechnical Investigation

A Geotechnical Investigation for the site was completed by Douglas Partners in March 2014, a copy is provided in Appendix 1. The purpose of the investigation was to determine the subsurface conditions beneath the site and to provide advice relating to the required geotechnical parameters for development of the site to occur.

The investigation included the excavation of 24 test pits, one hand augured borehole, 12 cone penetrometer tests (CPTs), the installation of eight standpipe peizometers, six in-situ permeability tests and laboratory testing of selected samples.

Ground conditions encountered or inferred at the test locations were as follows:

- Topsoil (sand) – grey-brown and dark grey-brown, fine to medium-grained sandy topsoil with some silt and roots to depths of between 0.1 m and 0.2 m.
- Filling (sand) – generally loose to very dense, varying shades of grey, grey–brown and yellow–brown, fine to medium-grained sand filling with varying amounts of gravel and cobbles to depths of between 0.1 m and 1.1 m.
- Sand – generally medium dense to dense, with some surficial loose zones, varying shades of grey, grey–brown and yellow–brown, fine to medium-grained sand with a trace of silt to test termination depths of up to 3.0 m at all test pit locations and up to 15.2 m at all CPT locations.

2.3.4 Permeability Testing

In-situ permeability tests were carried out at six test pits at depths of between 0.5 m and 1.5 m. Permeability values were also derived using grading results from laboratory testing, results are summarised below.

Table 2: In-situ Permeability Testing and Derived Values

Test	Depth (m)	Measured Permeability (m/s)	Derived Permeability (m/s)	Material
TP3	0.5	1.1×10^{-3}	9.6×10^{-4}	Sand with trace of silt
TP7	0.5	6.0×10^{-4}	5.8×10^{-4}	Sand filling with a trace of silt
TP10	0.7	1.5×10^{-3}	6.3×10^{-4}	Sand with trace of silt
TP12	1.5	8.0×10^{-4}	3.2×10^{-4}	Sand with trace of silt
TP14	0.8	1.7×10^{-3}	1.0×10^{-3}	Sand with trace of silt
TP22	1.1	1.3×10^{-3}	9.6×10^{-4}	Sand with trace of silt

2.4 Surface Hydrology and Wetlands

2.4.1 Drainage

Geographically, the site is located along the northern boundary of the coastal catchment of the Peel–Harvey Estuary. Hydrologically however, an open drainage system exists outside the site's northern boundary along North Lake Road from Kentucky Court to Berrigan Drive that discharges into Lake Yangebup as part of the Jandakot – Arterial Drainage Scheme.

The region has historically consisted of large semi-rural and commercial lots, which have existing shallow and informal drainage outfall systems to Lake Yangebup. These drains are relatively shallow and water logged throughout winter as they pick up both surface and groundwater flows from the general area. The drainage channel located along the sites northern boundary (North Lake Road) conveys major flows from the area to Lake Yangebup, which is located outside the surface water catchment of the Peel Harvey Estuary.

As a majority of the site has significant clearance to groundwater and sandy soils, rainfall recharge is likely to occur during the common rainfall events. Rainfall during the larger events is likely to flow across the site to the central depression associated with the wetland located on the site's central eastern boundary.

The existing drainage design in the area aims to maximise the recharge of rainfall into the groundwater at the point of collection, whilst the larger open drainage channels are used to convey major stormwater events when required to Lake Yangebup.

2.4.2 Wetlands

Figure 4 indicates that a Resource Enhancement Sumpland (UFI 6659) is located in the central eastern portion of the site.

This area was originally excavated as part of land clearing in the late 1950s and the topography of the wetland depression was altered to provide summer grazing for dairy cattle. Because of the historical clearing and agricultural land uses, the native vegetation surrounding the wetland has been largely replaced by weed species.

Further, since the 1960s the wetland's original extent was dissected by the construction of North Lake Road in the early 1990s and the subsequent construction of the Cockburn Central development. However, some limited wetland environmental attributes remain.

Sections of the RE wetland are identified in the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (Lakes EPP). Wetlands included within the Lakes EPP were based on areas of standing water on the record date, rather than environmental value.

The site was zoned "Urban" as part of the Metropolitan Region Scheme (MRS) Amendment 1038/33 in 2002. In 2001, the Environmental Protection Authority determined the environmental impacts from MRS Amendment 1038/33 did not warrant a formal assessment under Part IV of the *Environmental Protection Act 1986* (EP Act). Instead, the EPA set an informal level of assessment and provided advice on the key environmental factors, which included the wetland in question.

A Section 38 Referral to the Office of the EPA (RPS 2013), confirmed development within the wetland does not require formal assessment under the EP Act.

2.5 Hydrogeology

2.5.1 Groundwater Levels and Flow

The site is located in the Jandakot Groundwater Area.

Six groundwater monitoring bores were installed in 2010 to monitor groundwater levels and quality. Groundwater levels were sampled monthly from September 2010 to November 2011 and a one off event was recorded in September 2012.

Two bores (CC-1 and CC-4) are located within the low-lying areas of the site and four bores (CC-2, CC-3, CC-5 and CC-6) were installed in the neighbouring Cockburn Central development. Monitoring bores were not installed throughout the remainder of the site as this area has significant clearance to groundwater (>10 m).

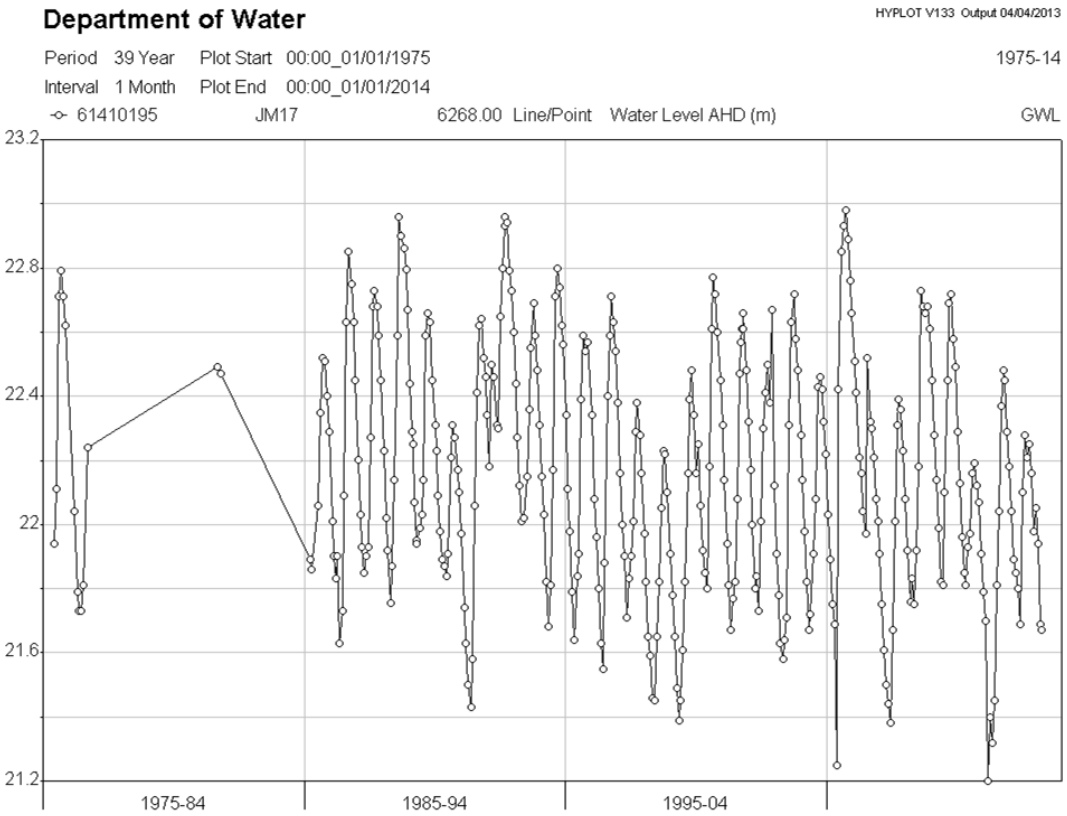
Figure 5 illustrates the monitoring bore locations, which also indicates that a DoW bore (JM-17) is located approximately 80 m west of the site, which has also been used to complete an assessment of groundwater trends at the site.

The Perth Groundwater Atlas (historical max.) indicates that groundwater generally flows in a westerly direction and ranges in elevation between 24 m AHD to 25 m AHD. This supports the fact that a majority of the site has significant clearance to groundwater of >10 m.

The average annual maximum groundwater level (AAMGL) and maximum groundwater level (MGL) were calculated at the site using the on-site monitoring data and calibrated with data from DoW bore JM-17 which has 39 years of monitoring data. Figures 5 and 6 indicate that groundwater flows in a westerly direction and the AAMGL at the site ranges from approximately 22.75 m AHD to 24.25 m AHD, while the MGL ranges from approximately 23 m AHD to 24.75 m AHD.

The on-site groundwater monitoring data is provided in Appendix 2, along with tables demonstrating the AAMGL and MGL calibration to DoW bore JM17.

The hydrograph from DoW bore JM-17 is shown in Graph 1 below. The hydrograph suggests that annual peak groundwater elevations in the monitoring period were within ± 50 cm of the AAMGL for the last 10 years in this bore.



Graph 1: Hydrograph for WIN Bore JM 17

As part of the Water Corporation's Southern Lakes Main Drainage system, stormwater pumps to control the rise of water in Yangebup Lake above a predetermined level have been provided since 2000.

2.5.2 Groundwater Quality

Groundwater quality was sampled on a quarterly basis at the six bores for nutrient parameters: ammonia (NH_4-N) nitrogen oxides (NO_x-N), total nitrogen (TN), total phosphorus (TP) and reactive phosphorus (FRP). The average annual nutrient concentrations for each bore are presented in Table 3 below.

Table 3: Average Groundwater Nutrient Concentrations

Bore	Annual Averages				
	TN (mg/L)	NO_x-N (mg/L)	NH_4-N (mg/L)	TP (mg/L)	FRP (mg/L)
ANZECC FWG*	**1.5**	**0.1**	**0.04**	**0.06**	**0.03**
CC1	0.80	0.01	**0.22**	**0.08**	0.01
CC2	1.20	0.04	**0.40**	**0.06**	0.01

Bore	Annual Averages				
	TN (mg/L)	NO_x-N (mg/L)	NH_4-N (mg/L)	TP (mg/L)	FRP (mg/L)
CC3	**7.98**	**7.53**	0.04	0.04	0.01
CC4	1.45	**0.17**	**0.43**	0.05	0.01
CC5	**3.20**	**0.86**	**0.33**	**0.35**	**0.13**
CC6	**5.70**	**5.70**	-	0.05	0.01
JM17	**1.83**	**1.04**	**0.31**	**0.41**	**0.16**

All values in mg/L
*Fresh and Marine Water Quality (ANZECC 2000) Guidelines for Wetlands in South-west Australia (FWG)

The results indicate that the pre-development groundwater quality is relatively poor, particularly total nitrogen and inorganic forms of nitrogen (NOx and NH_4). This is indicative of regional groundwater quality and historical land uses in the catchment including agriculture and market gardening where fertilisers high in nitrogen have been used to promote plant and pasture growth.

2.6 Vegetation

2.6.1 Vegetation Complexes

According to mapping by Heddle et al. (1980), the vegetation of the site is considered representative of the Bassendean Complex – Central and South:

- **Bassendean Complex – Central and South** – vegetation ranges from woodland of *Eucalyptus marginate – Allocasuarina fraseriana, Banksia* spp. to low woodland of *Melaleuca* spp., and sedgelands on moister sites.

A Flora and Fauna survey was completed over the site by RPS in July 2012 in which no Threatened or Priority Ecological communities or Threatened Rare Flora were identified on site.

Following the Level 2 Survey, RPS undertook a detailed wetland survey in March 2013 to map the wetland boundary and vegetation units and to produce a plant species list of all plants identified within the wetland.

2.7 Acid Sulfate Soils

The WA Atlas identifies the majority of the site as being within a Class 2 area, which is defined as moderate to low ASS disturbance risk at less than three metres from the ground surface. A small section of the site, within the vicinity of the Resource Enhancement wetland is classified as high to moderate risk.

An Acid Sulfate Soils and Dewatering Management Plan (ASSDMP) was therefore prepared by RPS (2012a) that details existing site conditions and potential management arrangements. The ASSDMP concludes that several locations exhibited characteristics of Potential Acid Sulfate Soils potentially requiring management during construction activities. Depending on the final drainage design and earthworks required, the ASSDMP commits to making revisions where necessary and referring to the Department of Environment Regulation (DER) for approval.

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3.0 WATER AND WASTEWATER SERVICING

3.1 Potable Water Supply

The Cockburn Central West development is to be serviced by the Water Corporation potable water reticulation scheme. It is anticipated that the existing reticulation network infrastructure along Poletti Road and Midgegooroo Avenue will have sufficient capacity to service the development. All Cockburn Central West lots will have a domestic service connection to the reticulation network in addition to access to fire service connections located throughout the development in accordance with Water Corporation standards.

3.2 Wastewater Servicing

All lots within the development will be serviced by a gravity sewer reticulation network, in accordance with Water Corporation standards. The gravity sewer system will connect to the existing sewer main on North Lake Road.

3.3 POS Irrigation

Public Open Space (POS) and recreational areas will be irrigated with groundwater. The site includes a total of approximately 6.9 ha of public open space including 3.45 ha of ovals/playing fields and a main POS which will have a multi-purpose aesthetic, public open space and drainage function.

A groundwater allocation report was obtained from DoW in May 2014 and is summarised below in Table 4. The Superficial aquifer at the site has approximately 736,745 kilolitres per year (kL/yr) remaining for allocation and is 33.3% allocated.

Table 4: Department of Water Groundwater Allocation Summary

Groundwater Area	Sub-area	Aquifer	Allocation Limit (kL/year)	Total Allocated (kL/year)	Committed Volume	Remaining Volume (kL)
Jandakot	Jandakot Confined	Perth – Yarragadee North	0	0	0	0
	South Lakes	Perth – Superficial Swan	1,104,800	361,055	7,000	736,745

The groundwater allocation report demonstrates that there is groundwater available for allocation for irrigation of POS and the playing fields at the site. LandCorp lodged a 5C license to take groundwater with the DoW for an allocation of 90,000 kL/yr. CADsult have recently been contracted to finalise the licence to take water and construct a bore

through the DoW for both irrigation of POS and to complete civil works. CADsult have been advised by the DoW that LandCorp's 5C application has been processed and is ready for issue following endorsement of this LWMS. CADsult will complete a review of water requirements for irrigation and construction and amend the water licence if necessary.

4.0 WETLAND APPROVALS

4.1 Section 38 Referral

The proposed partial infilling and redevelopment works associated with the Resource Enhancement wetland (also Environmental Protection Policy (EPP) lake) located on site was referred to the Office of the EPA in December 2013.

The purpose of the Section 38 Referral was to present the Office of the EPA with the Cockburn Central West Structure Plan and proposed Wetland Concept Plan in order for the EPA to decide whether the development would be subject to the environmental impact assessment process.

The EPA considered that the proposal is not likely to have a significant impact on the environment and does not warrant a formal environmental impact assessment. The wetland concept plan was referred to the EPA so that development in the wetland may be authorised as required by the Lakes EPP.

RPS' Section 38 Referral and EPA correspondence is provided in Appendix 3.

4.2 Wetland Concept Plan

The Wetland Concept Plan was originally developed by Urbis in 2013. This plan and the stormwater and landscaping treatments detailed below in Sections 4.2.1 to 4.3.3 were contained in the RPS Section 38 Referral (Appendix 3).

The Wetland Concept Plan presented in Appendix 4 of this LWMS is consistent with the Urbis design. Ecoscape were recently contracted by LandCorp to be the landscape architects for the project, hence the EPA supported Wetland Concept Plan, originally prepared by Urbis, has been used as the basis of design and minor modifications to the swale inverts and swale shapes have occurred only to improve the wetland performance and to meet the drainage design requirements. The wetland boundaries and design concepts have not been altered.

4.2.1 Contamination / Run-off

Stormwater will be filtered using bio-filtration swales located around the periphery of the wetland, nutrients are removed by filtration through the use of native wetland vegetation and uptake by plant biomass.

Once treated through the bio-filtration swales, water will infiltrate and only overtop the swales and flow into the main body of the wetland through rock weirs in larger rainfall events (greater than the 1 in 1 year ARI).

4.2.2 Flood Events / Submerge Habitat

4.2.2.1 No Rain

Wetland will contain water/groundwater all year round, as it currently does. Bio-filtration swales on the periphery of the wetland are intended to be dry for a majority of the year.

4.2.2.2 1:1 Year Rain Event

All stormwater will initially enter the bio-filtration swales, which are designed to store, treat and infiltrate the 1 in 1 year event. The common rainfall events will not flow into the wetland core.

4.2.2.3 1:5 Year Rain Event

Will flow into the wetland core once capacity in the bio-filtration swales is exceeded; it is anticipated the event will infiltrate within 1.5 days.

4.2.2.4 1:100 Year Rain Event

Will flood the entire extent of the wetland boundary and is anticipated to recede within four days.

4.2.3 Enhancement to the Wetland

The intent is to revegetate degraded areas, protect existing flora and fauna by removing weeds, preventing uncontrolled access by people, traffic and bikes; remove rubbish and increase community access and appreciation of the wetland.

Wetland swales will provide additional habitat; local native wetland species typically found on the periphery of wetlands will be planted in the bio-filtration swales, providing habitat, refuge and water quality treatment.

Key design criteria of the wetland design will be for the wetland to continue and operate in perpetuity.

4.3 Wetland Management Approval Requirements

LandCorp will be finalising, to the satisfaction of CoC (on advice from DoW) the following:

- Wetland Management Plan (Condition of subdivision)
- Local Water Management Strategy.

4.3.1 Wetland Management Plan

LandCorp as the proponent will be required (as a subdivision condition) to revegetate and landscape the retained wetland as outlined in the Wetland Concept Plan. LandCorp will be required to maintain the wetland for a period, approximately two years following construction (to be confirmed with CoC). The wetland will be landscaped and functioning to an agreed level prior to hand over to the CoC who will assume long-term management responsibility.

4.3.2 Water Management

This LWMS is being updated to support the revised Cockburn Central West Structure Plan, which was endorsed by the CoC in November 2013. The LWMS presents details on the wetland concept designs, landscaping and stormwater management designs and design criteria.

An Urban Water Management Plan (UWMP) will be required as a condition of subdivision. The UWMP will provide all the final detailed engineering and landscaping plans for the stormwater management system and wetland design. It includes final monitoring locations, time frames and responsibilities for implementing the UWMP.

4.3.3 Consultation

The Cockburn Central West Structure Plan was advertised for a three-week period and subject to extensive community review in particular with regard to the wetland. Key advisory departments including the Department of Parks and Wildlife (Karen Sanders) and DoW (Brett Dunn) were consulted during the modification to the Structure Plan. LandCorp has also met with the Wildflower Society and the Cockburn Wetlands Education Centre to discuss the key modifications to the Structure Plan.

The CoC decided to endorse the revised Cockburn Central West Structure Plan at their November Council meeting, once it was demonstrated that a suitable level of consultation and resultant modifications to the Structure Plan had occurred.

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5.0 WATER CONSERVATION STRATEGIES

5.1 Building Design

All building applications must comply with the following water efficiency measures:

- All dwellings must have a hot water system that has a minimum five star rating or is a solar hot water system (that is either gas boosted or electric boosted with a timer).
- All dwellings are to install AAA rated showerheads.

The following water efficiency measures are not mandatory for all dwellings but will be encouraged using educational material:

- installation of AAA water efficient appliances including washing machines and rain water tanks
- installation of waterwise gardens.

5.2 POS Design and Landscaping

The Cockburn Central West development includes medium to high density living. This style of development reduces private gardens and increases courtyard style gardens and street front treatments. Therefore, the water quality collected through the drainage system from the built lots is expected to be of a higher quality, when compared to a traditional lower density urban development.

The preliminary Landscape Plans are contained in Appendix 4. The concept wetland plan is consistent with the design presented to the EPA. The POS and wetland design will be subject to more design iterations, in consultation with CoC and DPaW as the development progresses to subdivision.

A Wetland Management Plan will be prepared as a condition of subdivision. A separate Landscape Plan, outlining the required maintenance will be developed for the POS and playing fields to ensure compliance with development design guidelines and water management strategies. POS designs and plans will be subject to review as a condition of sub division and will be developed and maintained to a minimum standard for two summer periods. Further information will be included in any subsequent UWMP.

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6.0 SURFACE WATER AND GROUNDWATER MANAGEMENT

6.1 Drainage Plan

The site will effectively manage stormwater through the implementation of Water Sensitive Urban Design (WSUD) principles and Best Management Practices (BMPs) to control water quality and quantity from both minor and major storm events.

A series of stormwater management measures are to be implemented throughout the site to manage stormwater as close to source and to facilitate the infiltration of stormwater where possible.

In accordance with the Stormwater Management Manual for Western Australia (DoW 2004–2007), the drainage system will aim to achieve the following objectives:

- Maintain the existing hydrological regime of rainfall infiltration and minimise fill requirements by encouraging at source stormwater infiltration throughout the site.
- Improve stormwater quality through the use of structural and non-structural controls.
- Follow water sensitive urban design principles by managing minor and major rainfall events separately.
- The minor drainage system will cater for events up to the 1 in 1 year ARI using mandatory soakwells for lots. Drainage of road surfaces will primarily occur to planted streetscape swales and pits connected to stormtech cells for retention and infiltration.
- Larger events up to 1 in 100-year ARI will be serviced by overland flow paths to underground storage structures and retention in the playing fields or the wetland area.

6.2 Stormwater Management

The engineering design has been developed by consulting engineers Arup with advice from RPS where necessary. Arup's engineering drawings illustrating the proposed drainage and earthworks design are contained in Appendix 5.

6.2.1 Minor Events

The post-development drainage design involves maximising at-source infiltration of stormwater wherever possible to promote the dispersed recharge of stormwater to the water table. To this end, all the commercial and residential lots will be required to

manage their own stormwater using soakwells. No lot connections have been accounted for.

The intent, as shown on the Landscaping Plans provided in Appendix 4, is to incorporate streetscape swales (preferably planted), within road median strips and roadsides specifically surrounding the wetland and playing oval. Design drawings have recently been provided to the CoC; the final locations and design are to be negotiated with the City and final details will be provided in the future UWMP.

The management of stormwater from the road reserves will be consistent with the strategy adopted in Cockburn Central whereby a conventional pit and pipe system with a capacity to convey the 5-year ARI will collect stormwater.

The pits/soakwells located in the road reserves will be connected to shallow stormtech infiltration chambers for collection and infiltration of stormwater generated in events up to and including the 5-year ARI event. Further details provided below in Section 6.2.2.

6.2.2 Major Events

6.2.2.1 Cockburn Central East

Sub division approvals and the drainage design of Cockburn Central East relied on stormwater being discharged to the wetland located on Cockburn West in events exceeding the 5-year ARI event.

The existing 5-year ARI storm flows from Cockburn Central East will continue to flow through Cockburn West and into the wetland, however they will be redirected and enter the wetland at two locations via a bubble up pit, rather than a single location originally proposed. The two outfalls via bubble up pits will reduce erosion compared to a single point and provide two critical functions; they will retain and reduce the flows and velocities in the minor storm events and will raise the water outflow point such that stormwater can enter bio-filtration swales located around the periphery of the wetland.

The intent of the wetland bio-filtration swales will be to retain and treat the first flush (1 year 1 hr ARI storms). In order to infiltrate successfully, these basins need to be above the MGL and the AAMGL, hence the introduction of the bubble up pit. The storage required for the first flush storm has been calculated as approximately 1,050 m^3. This volume has been allowed for in the basins around the wetland, which have been proposed to be interconnected with weirs and swales. The larger design storms, such as the 5-year ARI will also pass through the same outfall and basin system, but will overtop the swales and enter the wetland.

6.2.2.2 Cockburn West

Because of the flows entering Cockburn West from the neighbouring development (Cockburn Central East), an alternative to the conventional piped system is required to minimise the volume of stormwater entering the wetland located on site.

This has led to the use of a fully self-contained roadway drainage system where the 5-year ARI design storm is captured and infiltrated as close to source as possible. In order to achieve this, it is proposed that regular grated gully pits be placed at the standard regular spacing along the roadways and within soft-planted swales in the road reserve. In lieu of piping, a system of infiltration units will be connected such that all flows are detained and infiltrated into the sandy soil which from on-site geotechnical investigations (Douglas Partners 2014), display good infiltration properties.

It is recognised that the maximum groundwater level (MGL) is high in close proximity to the wetland; however, the design can adhere to DoW guidelines requiring clearance to the MGL. To achieve this, the proposed stormtech system, which assists with storage and infiltration, will consist of shallower linear stormtech structures in contrast to a regular deeper soakwell system.

Once the stormtech system has exceeded capacity (greater than the 5-year ARI), stormwater will bubble up and follow an overland flow path via the road reserves for discharge to either the proposed playing fields in the north or to the wetland.

Stormwater entering the wetland will initially enter the bio-filtration swales located on the perimeter, which will be sized to contain the first flush. The swales will be connected through a series of weir structures and will overtop into the main body of the wetland at dispersed rock pitched locations to control erosion and increase opportunities for stormwater treatment. The swales will be set at various levels ranging between slightly above MGL to AAMGL. Further details are presented in Section 6.4.1.

A small road catchment in the north east of the site will discharge to the existing open drain adjacent to North Lake Road via suitably sized culverts. Due to the rare occurrence of this happening, this design approach has been discussed with and agreed to by the CoC.

All stormwater from the proposed AFL oval and playing fields will be contained within their boundary; no stormwater from these areas will enter the wetland.

The drainage plans and calculations are provided in Appendix 5.

6.3 Water Quality Treatment

6.3.1 Vegetation

Vegetation will be included in all suitable stormwater structural controls where possible to help prevent erosion, maintain soil infiltration, restrict water flows and remove particulate and soluble pollutants, particularly nitrogen. The plants will mainly be associated with the streetscape swales and wetland bio-filtration swales and will be appropriately selected based on their intended function using native endemic vegetation where possible and suitable.

A combination of underground stormtech cells and streetscapes swales are to be used to encourage at source stormwater infiltration throughout the site. The final design and location of the streetscape swales is to be negotiated with the CoC, however should preferably contain vegetation wherever possible.

The wetland plant species list produced during the detailed wetland survey in March 2013 will be used as a guide by Ecoscape in developing the landscaping strategy for the wetland and surrounding POS design. The plant species used within the structural devices and irrigation requirements will be confirmed within the subsequent UWMPs.

6.3.2 Gross Pollutants Traps and Hydrocarbon Trap

Gross pollutant traps placed prior to infiltration areas will be used to collect rubbish and coarse sediment from stormwater and a hydrocarbon trap will be installed to remove any oil or grease that may be washed from road surfaces during the first flush event.

6.4 Groundwater Management

6.4.1 Groundwater Levels

Groundwater levels have been monitored from the six bores shown in Figures 5 and 6 through 2010–2011 and a single winter event in 2012. The monitoring data and DoW bore JM-17 have been used to calculate the AAMGL and MGL at the site.

As discussed above, the drainage design relies on stormwater entering bio-filtration swales located around the perimeter of the wetland. To encourage stormwater treatment and infiltration within the swales, every effort has been made to raise the wetland bio-filtration swales as high as practicably possible.

Preliminary estimates indicate that the invert of the wetland swales will be set between AAMGL and MGL. The swales in the south of the wetland in particular have the least clearance to groundwater due to the presence of mature wetland vegetation and trees occurring in this location.

The south of the wetland and POS in this location cannot be raised any further than what has been shown in the landscaping and earthworks plans without compromising the vegetation in this location. Preserving the vegetation in the area was seen to be a greater priority than filling this location to create swales that provide clearance to the MGL.

Table 5 details the average preliminary swale inverts and AAMGL and MGL at each location. The Landscape Plan is presented in Appendix 4 for reference.

Table 5: Preliminary Wetland Bio-filtration Swale Inverts and AAMGL and MGL Comparison

Wetland Swale Location	Invert	AAMGL	MGL	Top Water Level
North	24.3	23.8	24.3	24.8
North	24.45	24.0	24.4	24.8
North-east	24.55	24.0	24.5	24.8
East	24.65	24.1	24.6	24.8
East	24.75	24.2	24.7	24.8
East	24.7	24.2	24.6	24.8
South-east	24.6	24.3	24.6	24.8
South	24.4	24.0	24.4	24.8
South	24.3	23.9	24.3	24.8

6.4.2 Groundwater Quality

Many of the proposed stormwater measures will improve stormwater quality and subsequently groundwater quality through the following mechanisms. These have been detailed in Section 6 and are summarised below:

- increasing biological uptake through vegetating the POS and wetland area with native and or waterwise vegetation
- reducing water velocities by diverting water through streetscape swales and bio-filtration swales and bubble up pits on the perimeter of the wetland
- minimise and control the levels of fertilisers and pesticides applied to the site through appropriate plant selection and operation and maintenance
- monitoring water quality and levels within the wetland system to verify that suitable values are being maintained.

6.4.3 Fill Management

The site currently slopes down quite steeply in a general north-easterly direction with the wetland area being the lowest part of the site.

Earthwork requirements at the site are complicated, as the site needs to connect to the existing drainage infrastructure and finish levels of the Cockburn Central East development. In addition the earthworks strategy is further complicated by having to protect the existing wetland and vegetation, connect to the existing external road network, as well as having to provide large flat areas that are suitable to the high standards required for the AFL oval and playing fields.

In general, the higher areas of the site, typically on the south-western boundary will be cut slightly to fill the lower lying areas of the site. In addition, further fill will be imported to provide a suitable clearance to maximum groundwater levels in the east of the site.

The southern development lots will achieve a minimum clearance of 6 m to the MGL, the western boundary of the site will have a clearance of approximately 3 m to the MGL and the centre of the site will achieve a clearance of approximately 2 m to the MGL, while the north-eastern boundary will achieve the lowest clearance of approximately 1.9 m to the MGL.

There is an isolated lot in the north-east corner of the site, which at this stage is to be set at 25.4 m AHD, which will have a limited clearance to the MGL of approximately 1.0 m. This lot has been raised as high as possible however is constrained by having to tie in with the surrounding road network and drainage infrastructure from Cockburn Central East, please refer to the engineering drawings provided in Appendix 5 for further details.

7.0 MONITORING

7.1 Pre-development

Groundwater monitoring has been completed to determine the baseline conditions at the site and to allow for a direct comparison both during and after development.

Pre-development monitoring at six groundwater monitoring bores commenced in September 2010 to November 2011 and a one-off event was recorded in September 2012.

Pre-development groundwater monitoring parameters included:

- water levels
- water quality
  - in situ: pH, EC, temperature and DO
  - laboratory analysis of nutrients (TP, FRP, TN, NO_x-N, NH_4-N).

7.2 Post-development

Water quality sampling and visual inspections of the wetland will occur on a quarterly basis following construction until hand over to CoC to ensure the wetland is functioning as intended.

Water quality sampling will occur within the wetland bio-filtration swales and main body of the wetland.

The exact locations will be determined in the respective UWMPs when the detailed drainage and landscaping design has been completed. Surface water quality will be measured for the same water quality parameters as the pre-development groundwater monitoring to allow for a direct comparison.

7.3 Performance Values

The final baseline and trigger values will be determined when the final design of the wetland and POS is available and reported on in future UWMPs. No pre-development monitoring of the wetland on site has been completed. As the wetland contains exposed groundwater for a majority of the year, it is likely that the average groundwater quality results detailed in Section 2.5.2 will inform the water quality trigger values.

7.4 Contingency Plans

In an event where the post-development monitoring exceeds the performance values by 20% on two consecutive monitoring occasions, the CoC and DoW will be notified and an investigation will be undertaken to determine the cause of the exceedence, the potential impacts and the required contingency measures.

Contingency measures may include:

- identification of the pollution source
- removal of the pollution source, if possible
- soil amendment in infiltration areas
- increased planting of nutrient stripping vegetation in infiltration areas
- increasing public awareness.

8.0 CONSTRUCTION MANAGEMENT

A Site Construction and Management Plan (CMP) will be completed prior to starting works and it will include the following:

- acid sulfate soils and dewatering management
- noise and vibration management
- dust management
- construction waste management
- training, including site induction
- communication with adjacent landholders.

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9.0 IMPLEMENTATION OF LWMS

9.1 Further Work

The preparation of UWMPs will be required as a condition of subdivision clearances and will include the following design measures in more detail:

- compliance with this LWMS criteria and objectives to the satisfaction of the CoC and DoW
- in-depth stormwater drainage design including confirmed streetscape swale designs and locations.
- detailed information on structural and non-structural BMPs to be implemented within each subdivision
- final subdivision layout including final cut and fill levels, minor and major drainage layouts and overland flow paths
- management of subdivisional works, including details of licence application for irrigation, dewatering or dust suppression if required
- POS management, including fertiliser regimes and irrigation scheduling
- detailed monitoring program for the wetland including sampling locations
- finalised monitoring performance values and list of likely contingency measures
- finalised implementation plan including roles and responsibilities of all parties involved.

9.2 Implementation Plan

The effectiveness of this LWMS will rely on the system's regular maintenance and grouped knowledge. The following operation and maintenance program is proposed (Table 6).

Table 6: LWMS Roles and Responsibilities

Principles	Role	Responsibility	Time-scale
Water Quality	Wetland	The proponent	Quarterly, until two years after practical completion of the wetland or until hand over to CoC
Public Open Space	Fertiliser application	The proponent	As required during revegetation and ongoing maintenance until hand over to CoC
	Plant establishment (via planting and irrigation regime)	The proponent	One to two years after planting
	Irrigation scheduling	The proponent	As required following planting until hand over to CoC
Drainage Infrastructure	Maintenance of drainage infrastructure	The proponent	As required until two years after completion of the development. The extent of the maintenance commitment will be confirmed with the CoC at the UWMP stage of the development.
Subdivision Management	Construction and site works management	The proponent	As required during construction until hand over to CoC
	Erosion control	The proponent	As required during construction
	Waste and pollution management	The proponent	As required during construction until hand over to CoC

10.0 REFERENCES

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FIGURES

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LEGEND

ZONES

- MIXED USE (RESIDENTIAL, RETAIL AND COMMERCIAL)
- MIXED USE (RESIDENTIAL/COMMERCIAL)
- MIXED USE (RETAIL/COMMERCIAL)

RESERVES

Public Purposes

- COMMUNITY (INTEGRATED COMMUNITY FACILITY & PRIMARY AFL OVAL)
- UTILITIES/INFRASTRUCTURE (CAR PARK, ROADS AND POWER LINE INFRASTRUCTURE)

Parks and Recreation

- PARKS AND RECREATION
- DRAINAGE

OTHER

- GAS PIPELINE EASEMENT
- PREFERENCE FOR ACTIVE COMMERCIAL LAND USES AT GROUND/UPPER LEVELS
- PREFERENCE FOR ACTIVE RETAIL LAND USES AT GROUND LEVEL
- STRUCTURE PLAN BOUNDARY
- WIDE LOCAL ACCESS ROAD
- SLOW SPEED MIXED TRAFFIC ZONE
- SHARED PEDESTRIAN CYCLING PATH
- BUS ROUTE
- * LANDMARK SITES

REFER TO PART 1 OF THE STRUCTURE PLAN TEXT IN RESPECT OF RESPONSIBILITIES FOR INFRASTRUCTURE UPGRADES ASSOCIATED WITH THE IMPLEMENTATION OF THE STRUCTURE PLAN.

BUCKLEY ST
SPENCER ST
ROAD
POLE 111
COOPER RD
DAVISON RD
NORTH LAKE ROAD
LEFT IN LEFT OUT ACCESS ONLY
FULL MOVEMENT T-INTERSECTION
4-WAY INTERSECTION
PARCEL 1
PARCEL 2
PARCEL 3
PARCEL 4
PARCEL 5
PARCEL 6
PARCEL 7
PARCEL 8
PARCEL 9
PARCEL 10
PARCEL 11
PARCEL 12
PARCEL 13
PARCEL 14
PARCEL 15
PLAYING FIELDS
INDICATIVE ROAD LAYOUT (SUBJECT TO DETAILED DESIGN)
INDICATIVE ROAD LAYOUT (SUBJECT TO DETAILED DESIGN)
LEFT IN LEFT OUT ACCESS ONLY
JUNCTION BOULEVARD
MIDGEGOOROO AVENUE
THIS PARKS AND RECREATION RESERVE WILL BE USED FOR DRAINAGE FUNCTIONS
SIGNALISED PEDESTRIAN INTERSECTION
SIGNAL TERRACE
LEFT IN LEFT OUT ACCESS ONLY
STOCKTON BEND
BUFFER LANE
FULL MOVEMENT T-INTERSECTION
BEELIAR DRIVE
WENTWORTH PARADE
0
125m

RPS

Job Number: D11221-002
Date: 26.06.14
Scale: 1:2,500 @ A3
Revision: A
Created by: MA
Source: Cardno P5002-STR02 Rev J 24.10.13

GDA 1994 MGA Zone 50

0 25 50 100 150 200 metres

Figure 1

Local Structure Plan

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LEGEND

Site Boundary

Cadastre

SITE LOCATION

NORTH LAKE RD

TEA TREE CL

KENTUCKY CT

BEELIAR DR

JUNCTION BVD

SIGNAL TCE

STOCKTON BEND

MIDGEGOOROO AV

POINTSWY

POLETTI RD

BUFFER L

LINKAGE WY

PETTLER L

PERTH

STIRLING

MORLEY

MIDLAND

PARKERVILLE

KALAMUNDA

CANNINGTON

FREMANTLE

ARMADALE

BYFORD

KWINANA

ROCKINGHAM

MUNDIJONG

0 2.5 5 10 15 20 km

0 15 30 60 90 120 m

Job Number: D12211-001
Date: 05.04.13
Scale: 1:3500 @ A3, Overview Map: 1:400000
Version: A
Drafted by: HT
Source: Cadastre - Landgate, 2013 Orthophoto - Landgate, 2012

RPS

Figure 2

Site Location

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LEGEND

Site Boundary

Cadastre

Contour (mAHD)

Geology

Ms5; SANDY SILT - dark brownish grey silt, with disseminated fine-grained quartz sand, firm, variable clay content, of lacustrine origin

S8; SAND - very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin

S10; SAND - as S8 as relatively thin veneer over strong, blocky, brown silts and clays

NORTH LAKE RD
BUCKLEY ST
SPENCER ST
POLETTI RD
DAVISON RD
COOPER RD
RIDGE RD
ABBEY CT
BEELIAR DR
WENTWORTH PDE
MIDGEGOOROO AV
STOCKTON BEND
BUFFER L
JUNCTION BVD
SIGNAL TCE
KENTUCKY CT
TEA TREE CL
S10
S8
Ms5
25
30
35
40

RPS

Job Number: D12211-003
Date: 05.04.12
Scale: 1:2500 @ A3
Version: A
Drafted by: HT
Source: Cadastre & Orthophoto - Landgate, 2011 Geology - DoIR, 1999

0 12.5 25 50 75 100 m

Figure 3

Topography and Geology

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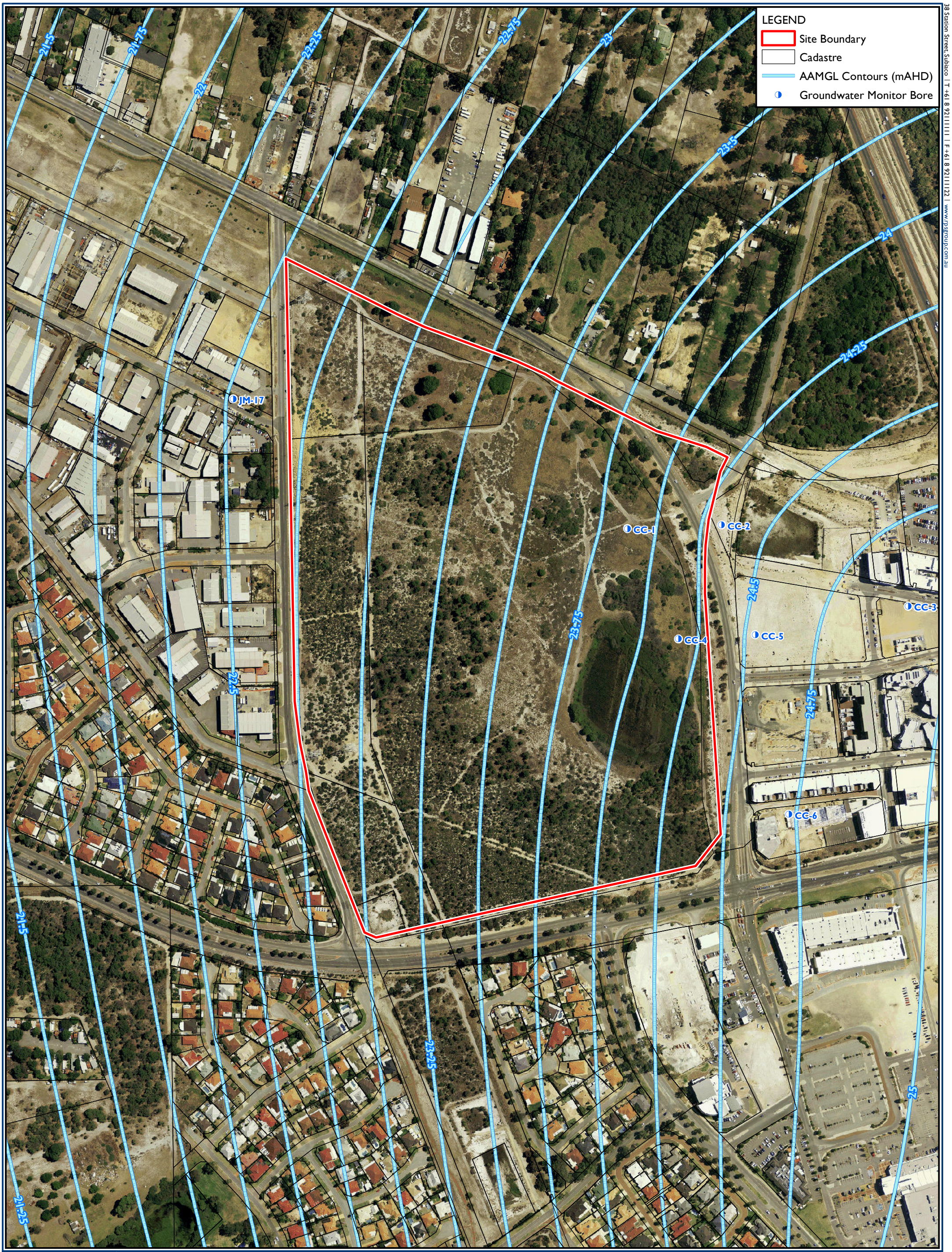
RPS

Job Number: D12211-004
Date: 05.04.13
Scale: 1:3000 @ A3
Version: A
Drafted by: HT
Source: Cadastre & Orthophoto - Landgate, 2012. Wetlands - DEC 2011, EPP Lakes, DEC 1992

0 15 30 60 90 120 m

Figure 4

Existing Wetlands



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RPS

Job Number: D12211-005
Date: 05.04.13
Scale: 1:4,000 @ A3
Revision: A
Created by: HT
Source: Cadastre - Landgate, 2012 Orthophoto - Landgate, 2012

GDA 1994 MGA Zone 50

0 25 50 100 150 200 metres

Figure 5
Groundwater Monitoring Locations and AAMGL Contours

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RPS

Job Number: D12211-006
Date: 27.05.14
Scale: 1:4,000 @ A3
Revision: A
Created by: MA
Source: Cadastre - Landgate, 2012 Orthophoto - Landgate, 2014

GDA 1994 MGA Zone 50

0 25 50 100 150 200 metres

Figure 6
Groundwater Monitoring Locations and MGL Contours

RPS

APPENDIX 1

Geotechnical Investigation (Douglas Partners 2014)

Douglas Partners

Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on Geotechnical Investigation

Proposed Development
Cockburn Central West, WA

Prepared for
LandCorp

Project 82241
March 2014

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

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Document status and review

Revision	Prepared by	Reviewed by	Date issued
1	Y. Chen/D. Rubenis	M.J. Thom	27 March 2014

Distribution of copies

Revision	Electronic	Paper	Issued to
1	1	1	Ms. Mariam Yaqub, LandCorp

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author	Y. Chen	27-3-14
Reviewer	P.P.	27-3-14

NCS INTERNATIONAL CERTIFIED QUALITY MANAGEMENT SYSTEM

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Table of Contents

Report on Geotechnical Investigation
Proposed Development
Cockburn Central West, WA

1. Introduction

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for a proposed development located at Cockburn Central West, Western Australia. The investigation was commissioned in an email dated 13 February 2014, by Mr Peter Hale of LandCorp, and was undertaken in accordance with DP's proposal dated 12 February 2014.

The purpose of this investigation was to determine the sub-surface conditions beneath the site and thus provide:

- Comments on the suitability of the site for the proposed development.
- A description of the sub-surface conditions including identification of areas of unsuitable soils for building requirements, presence of rock, and suitability of in situ material for re-use as structural filling.
- An appropriate site classification in accordance with the requirements of AS 2870-2011, and recommendations on site works to improve the classification to achieve 'Class A' conditions at finished lot levels.
- An earthquake site soil classification, in accordance with AS 1170.4.
- Recommendations on site preparation, compaction, earthworks and specifications for imported filling.
- Recommend geotechnical parameters for the design of retaining structures and batter slopes.
- Provide suitable parameters for pavement design, including a suitable California bearing ratio (CBR) of the likely pavement subgrade materials.
- Comment on the permeability of the soils, the suitability for on-site stormwater disposal and comments on site drainage.
- Assess the depth to groundwater, if encountered.
- The risk of acid sulphate soils based upon readily available desktop information and limited sampling and analysis.

The investigation included the excavation of 24 test pits, drilling of one hand auger borehole, 12 cone penetration tests (CPT), the installation of eight standpipe piezometers, six in situ permeability tests and laboratory testing of selected samples.

Details of the field work and the results of the investigation are presented in this report together with recommendations on the issues listed above.

2. Site Description

The site comprises an irregularly shaped area of approximately 30 ha and is identified as Cockburn Central West, Western Australia. It is bounded by North Lake Road and Tea Tree Close to the north and north east, Midgegooroo Avenue to the east, Beeliar Drive to the south and a Western Power easement covered by bush land to the west.

At the time of the investigation, the site was vacant. Vegetation comprised of long grass and small to large trees, up to approximately 20 m in height, scattered across the site. Fly tipped waste including large household appliances, corrugated fencing pieces and a car wreck were observed in various parts of the site as outlined in Drawing 1. A wetland area was observed approximately near the centre of the eastern boundary of the site. Sand tracks generally run traverse the perimeter of the site and also through parts of the site. Two areas where surface vegetation had been cleared were observed in the north eastern part of the site. It is understood that these areas where once developed and that the buildings have since been removed. A recent fire had burnt across part of the site and destroyed most of the vegetation in these areas.

Based on available survey information, the surface level falls towards the north east to approximately RL 24 m AHD (Australian Height Datum) and RL 25 m AHD near the northern and north eastern site boundaries respectively from high points at approximately RL 40 m AHD and RL 34 m AHD near the south western and south eastern boundaries of the site respectively.

The Fremantle 1:50 000 Environmental Geology sheet indicates that the shallow subsurface conditions at the site comprise Bassendean sand, thin Bassendean sand overlying clayey materials of the Guildford Formation and sandy silty swamp deposits.

The Perth Groundwater Atlas (2004) indicates that the groundwater level was at approximately RL 23 m AHD (approximately between 1 m and 17 m below existing ground level) in May 2003.

Published acid sulphate soil risk maps indicates that the site is located within areas of “Moderate to low risk of acid sulphate soils occurring within 3m of natural soil surface” and includes an area of “High to moderate of acid sulphate soil potential occurring within 3m of natural soil surface” across the eastern mid-section of the site.

3. Field Work Methods

Field work was carried out on 24 to 26 February 2014 and comprised:

- The excavation of 24 test pits;
- The drilling of one borehole;
- 12 cone penetration tests;
- The installation of eight standpipe piezometers;
- Perth sand penetrometer (PSP) testing adjacent to each test pit and borehole location; and
- Six in situ permeability tests.

The test pits (TP1 to TP4 and TP6 to TP25) were excavated to a maximum depth of 3.0 m using a 5 tonne excavator equipped with a 600 mm wide toothed bucket. Borehole (BH5) was drilled to a depth of 2.0 m using a 110 mm diameter hand auger. The test pits and borehole were logged in general accordance with AS1726-1993 by a suitably experienced geotechnical engineer from DP. Soil samples were recovered from selected locations for subsequent laboratory testing.

The CPTs (CPT26 to CPT37) were carried out by using a 36 mm diameter instrumented cone with a following 130 mm long friction sleeve attached to rods of the same diameter, pushed continuously at a rate of 20 mm/sec into the soil by hydraulic thrust from a ballasted truck mounted rig. Strain gauges in the cone and sleeve measure resistance to penetration and friction along the sleeve. This data is recorded on a computer and analysed to allow the assessment of the type, properties and condition of the materials penetrated. The CPTs were pushed to depths of between 6.6 m and 15.2 m. Standpipe piezometers, constructed from 32 mm diameter PVC, were installed at test locations CPT28 to CPT33, CPT35 and CPT37 to a maximum depth of 6 m.

The PSP tests were carried out adjacent to the test pit and borehole locations and in accordance with AS 1289.6.3.3, to assess the in situ density of the shallow soils.

Test locations were determined using a hand held GPS and are marked on Drawing 1 in Appendix A. Surface elevations at each test location were interpolated from a survey plan provided by the client.

Soil samples were also collected at 0.5 m depth intervals from test locations TP1, TP2, TP6, TP8 to TP13, and TP15 to TP25 for laboratory analysis of acid sulphate soils. These soils were quickly placed in air tight plastic sample bags and chilled in insulated coolers. The following sample handling and transport procedures were employed:

- Snap lock bags were labelled with individual and unique identification, including project number and sample number.
- Samples were placed in insulated coolers during field work and subsequently frozen until transported to the analytical laboratory.
- Chain-of-custody documentation was maintained at all times and countersigned by the receiving laboratory on transfer of samples.
- A National Association of Testing Authorities (NATA) accredited laboratory was engaged to conduct the analysis.

4. Field Work Results

4.1 Ground Conditions

Detailed logs of the ground conditions and results of the field testing are presented in Appendix A, together with notes defining descriptive terms and classification methods. A summary of the ground conditions encountered or inferred at the test locations is given below:

- **Topsoil (Sand)** – grey-brown and dark grey-brown, fine to medium grained sandy topsoil with some silt and some roots to depths of between 0.1 m and 0.2 m at test locations TP1 to TP4, TP8, TP10, TP11, TP13 to TP18 and TP21 to TP25. Topsoil is filling at TP3 and TP4.
- **Filling (Sand)** – generally dense to very dense, varying shades of grey, grey-brown and yellow-brown, fine to medium grained sand filling with varying amounts of gravel and cobbles to depths of between 0.1 m and 1.1 m at test locations TP4 to TP7, TP9 and TP19. A piece of brick was found in the filling at TP4 and some organics in the filling at TP19. Possible filling and inferred filling at CPT27, CPT34 and CPT35 to depths of up to 2.6 m.
- **Sand** – generally medium dense to dense, with some surficial loose zones, varying shades of grey, grey-brown and yellow-brown, fine to medium grained sand with a trace of silt to test termination depths of up to 3.0 m at all test pit locations and up to 15.2 m at all CPT locations. Sand was observed to be loose to a depth of 0.45 m at TP24 and to depths of between 0.5 m and 2.7 m at CPT26 to CPT34, CPT36 and CPT37. The density of the soil was generally observed to increase with depth from medium dense to very dense; CPT refusal was observed at depths of between 7.1 m and 12.9 m below the surface at CPT27 to CPT29, CPT31 to CPT32 and CPT34 to CPT37.

4.2 Groundwater

Groundwater was observed at 11 test locations undertaken on 24 to 26 February 2014. The test pits and borehole were immediately backfilled following sampling, which precluded longer-term monitoring of groundwater levels. An attempt to measure groundwater levels at CPT locations was made following the extraction of cone testing equipment, however collapse of the side walls restricted the depth of measurements in some locations. Groundwater levels encountered on 24 to 26 February 2014 are summarised in Table 1 and are on the test pit, borehole and CPT logs.

Table 1: Summary of Groundwater Level on 24 to 26 February 2014

Test Location	Surface Level [1] (m AHD)	Groundwater Depth (m)	Groundwater Level [2] (RL m AHD)
TP1	24.1	2.2	21.9
BH5	26.0	1.5	24.5
TP6	25.0	1.7	23.3
TP7	24.1	1.6	22.5
TP8	24.6	2.0	22.6
TP9	24.9	2.6	22.3
TP18	25.1	1.5	23.6
TP19	26.0	1.9	24.1
CPT32	24.6	1.0	23.6
CPT34	26.0	2.8	23.2
CPT35	24.9	2.1	22.8

Notes for Table 1 - [1]: Surface level interpolated from survey plan provided by the client.
[2]: Groundwater Level = Interpolated Surface Level – Groundwater Depth.

Groundwater levels at the standpipe locations were recorded on 13 March 2014. The groundwater levels encountered on 13 March 2014 are summarised in Table 2.

Table 2: Summary of Groundwater Level on 13 March 2014

Test Location	Surface Level [1] (m AHD)	Groundwater Depth (m)	Groundwater Level [2] (RL m AHD)
CPT28	33.0	Dry to 5.84	< 27.16
CPT29	33.0	Dry to 6.03	< 26.97
CPT30	25.3	2.37	22.93
CPT31	26.1	3.51	22.59
CPT32	24.6	1.13	23.47
CPT33	24.3	1.61	22.69
CPT35	24.9	2.16	22.74
CPT37	26.7	4.31	22.39

Notes for Table 2 - [1]: Surface level interpolated from survey plan provided by the client.
[2]: Groundwater Level = Interpolated Surface Level – Groundwater Depth.

4.3 In Situ Permeability Testing

In situ permeability tests were carried out at TP3, TP7, TP10, TP12, TP14 and TP22 at depths of between 0.5 m and 1.5 m. Field permeability values were estimated using the Hvorslev method. Permeability values were also derived using grading results from the laboratory testing and Hazen's formula which applies for sand in a loose state. Results of the permeability analysis are summarised in Table 3.

Table 3: Summary of the In Situ Permeability Testing and Derived Values

Test	Depth (m)	Measured Permeability (m/s) [1]	Derived Permeability (m/s) [2]	Material
TP3	0.5	1.1×10^{-3}	9.6×10^{-4}	Sand with a trace of silt
TP7	0.5	6.0×10^{-4}	5.8×10^{-4}	Sand filling with a trace of silt
TP10	0.7	1.5×10^{-3}	6.3×10^{-4}	Sand with a trace of silt
TP12	1.5	8.0×10^{-4}	3.2×10^{-4}	Sand with a trace of silt
TP14	0.8	1.7×10^{-3}	1.0×10^{-3}	Sand with a trace of silt
TP22	1.1	1.3×10^{-3}	9.6×10^{-4}	Sand with a trace of silt

Notes: [1]: Hvorslev's method.
[2]: Hazen's method.

5. Geotechnical Laboratory Testing

A geotechnical laboratory testing programme was carried out on selected soil samples by a NATA registered laboratory. Testing included the determination of the:

- particle size distribution on nine samples,
- organic content on one sample,
- modified maximum dry density on two samples,
- California bearing ratio on two samples.

Detailed test report sheets are given in Appendix B and the results are summarised in Table 4 and 5.

Table 4: Results of Laboratory Testing for Soil Classification

Test	Depth (m)	Fines (%)	d_{10} (mm)	d_{60} (mm)	OC (%)	Material
TP1	0.5	2	0.32	0.55	-	Sand with a trace of silt
TP3	0.5	1	0.31	0.53	-	Sand with a trace of silt
TP6	0.5	2	0.20	0.47	-	Sand with a trace of silt
TP7	0.5	2	0.24	0.54	-	Sand filling with a trace of silt
TP10	0.7	1	0.25	0.52	-	Sand with a trace of silt
TP12	1.5	2	0.18	0.45	-	Sand with a trace of silt
TP14	0.8	1	0.32	0.53	-	Sand with a trace of silt
TP19	0.3	9	0.15	0.57	5.9	Sand filling with some silt and some organics
TP22	1.1	1	0.31	0.50	-	Sand with a trace of silt

Where: - The % fines is the proportion of particles smaller than 75 µm.
- A d_{10} of 0.17 mm means that 10% of the sample particles are finer than 0.17 mm.
- A d_{60} of 0.23 mm means that 60% of the sample particles are finer than 0.23 mm.
- OC: organic content

Table 5: Results of Laboratory Testing for Pavement Design Parameters

Test	Depth (m)	MMDD (t/m^3)	CBR (%)	OMC (%)	Material
TP1	0.5	1.71	16	11.5	Sand
TP6	0.5	1.72	9	10.5	Sand

Where:
- MMDD: modified maximum dry density. - CBR: California bearing ratio. - OMC: optimum moisture content.

6. Acid Sulphate Soil Laboratory Testing

Acid sulphate soil screening tests were undertaken on all soil samples retrieved from test locations TP1, TP2, TP6, TP8 to TP13, and TP15 to TP25.

Samples were tested by MPL Laboratories in accordance with the method as described in Ahern CR, McElnea AE, Sullivan LA (2004), Acid Sulphate Soils Laboratory Methods Guidelines. The screening tests comprised measurement of pH of the soil in water (pH_F) and the pH of the soil after oxidation with a 30% solution of hydrogen peroxide (pH_{FOX}).

Following the screening tests, as required by the Department of Environment Regulation (DER), testing was commissioned on selected soil samples for the Suspension Peroxide Oxidation Combined

Acidity and Sulphate (SPOCAS) suite. Soil samples were submitted for laboratory analysis with due consideration of the following:

- Lowest reported pH_{FOX} within a soil strata at each test location.
- Reported reaction strength.
- Visual identification of the soils encountered.

The screening results and laboratory testing for the SPOCAS suite are presented in Table C-1 in Appendix C together with the detailed laboratory reports and associated chain of custody reports. The results are evaluated and discussed in Section 8.

7. Comments

7.1 Proposed Development

It is understood that the proposed development will comprise medium to high density residential buildings, playing fields and recreational facilities and the possible creation of an enhanced water body.

It is understood that wetland area has been nominated to provide stormwater disposal for the current development and the adjoining Cockburn Central Town Centre. However should the high groundwater level in the eastern part of the site limit the infiltration capacity of the wetland the North Lake Road drainage infrastructure may be used to direct stormwater into Lake Yangebup.

7.2 Site Classification

The shallow ground conditions beneath the site generally comprise sand, however apparently moderately compacted sand filling overlying sand was encountered in parts of the site. At the time of preparing this report, no record of the placement of the filling was made available to DP and thus the filling should be considered as uncontrolled filling. The filling across the majority of the site is considered suitable for reuse as structural filling however the filling observed at and around TP19 is considered unsuitable. Loose sand was also observed at TP24, CPT26 to CPT34, CPT36 and CPT37. No testing was undertaken within the wetland area of the site, so any site classification should exclude this area. Based on the encountered ground conditions the site in its current condition should be classified as 'Class P' in strict accordance with AS 2870-2011, owing to the presence of uncontrolled filling at TP19 and loose soils.

Based on field observations, the sand filling is apparently moderately compacted but will need to be compacted to conform to the requirements of suitable filling materials outlined in AS3798 – 2011. Therefore, the site excluding the wetland area could be classified as 'Class A', provided site preparation and recommendations as outlined in Section 7.4 are carried out.

It should be noted that AS 2870 - 2011 applies to single houses, townhouses and the like classified as Class 1 and 10a under the Building Code of Australia. It also applies to light industrial and commercial

buildings if they are similar in size, loading and superstructure flexibility to those designs included in AS 2870 - 2011.

7.3 Earthquake Site Classification

Based on the encountered ground conditions of medium dense to dense sand while rock was not directly encountered it is considered that a class Ce applies for the site in accordance with AS 1170.4-2007. Nine of the twelve CPTs reached refusal at depths of between 7.1 m and 12.9 m below the surface and nearby historical boreholes suggest that limestone is likely to be encountered at around 40 m below the surface. These observations are within the maximum soil depth of 45 m to 55 m for medium dense to dense cohessionless soil allowed for a classification of Ce in AS 1170.4-2007.

7.4 Site Preparation

Prior to excavation for foundations and/or placement of filling, all deleterious material, including vegetation, topsoil and fly tipped materials should be stripped from the proposed building and car park footprints, and removed from site. Topsoil could be re-used for landscaping purposes. It should be noted that the filling at TP19 was found to have an organic content of 5.9% and is considered unsuitable for use as structural filling at the site. This layer should be excavated and either screened, blended with another material with a lower organic content, used for landscaping purposes or removed from site. The estimated extent of the filling layer at TP19 is defined in Drawing 1.

Tree roots remaining from any clearing operations within the proposed building envelopes and pavement areas, should be completely removed and the excavations backfilled with material of similar geotechnical properties to the surrounding ground and compacted. With the exception of the filling layer identified at TP19 and defined in Drawing 1 on site soils should be suitable for reuse as structural filling. It is suggested that if imported filling is to be used across the site it should comprise free draining cohesionless sand with less than 5% by weight of particles passing a 0.075 mm sieve. The material should also be free from organic matter and particles greater than 150 mm in size.

Following the above works, it is recommended that the exposed subgrade beneath the building envelopes and pavement areas be compacted using a heavy (minimum of 12 tonne) vibrating smooth drum roller. Any areas that show signs of excessive deformation during compaction should be compacted until deformation ceases or, alternatively, the poor quality material could be excavated and replaced with suitably compacted approved structural filling. Additional filling should be placed in loose lift thickness of not more than 300 mm, within 2% of its optimum moisture content with each layer compacted to achieve not less than 10 blows per 300 mm rod penetration when tested using a PSP. Care should be taken not to operate heavy plant immediately adjacent to existing buildings and services.

As indicated in Sections 4.1 and 7.2, filling was encountered at some test locations. Therefore, following the above works and excavation of foundation, the base of the foundation excavations should be inspected by an experienced engineer to assess the consistency of the material with the results of this investigation.

All proposed building envelopes and pavement areas should be compacted to achieve the minimum penetration resistance as above to a depth of not less than 1.0 m below foundation level.

During construction, some loosening of the surface sands in foundation excavations is expected. Therefore the top 300 mm in the base of any excavation should be re-compacted using a vibratory plate compactor prior to construction of any footings.

7.5 Foundation Design

Shallow foundation systems comprising slab, pad and strip footings should be suitable to support the proposed structures including multi-storey buildings up to around six storeys based on DP's experience within the neighbouring Cockburn Central site which encountered similar ground conditions. It is recommended that site specific geotechnical investigations are undertaken during the detailed design phase for the larger structures to confirm these values. Footings of buildings covered by AS 2870-2011 should be designed to satisfy the requirements of this standard for 'Class A' conditions, provided that site preparation is carried out in accordance with Section 7.4.

If the proposed building is not covered by AS 2870-2011 then the foundation should be designed using engineering principles. A maximum allowable bearing pressure of 250 kPa is suggested for foundation design of strip footings founded at a minimum depth of 0.5 m in at least medium dense or denser sand. This value should ensure that total and differential settlements will be less than 10 mm.

7.6 Design Parameters for Earth Retaining Systems

It is anticipated that mass gravity retaining walls, constructed from limestone blocks, will be used at the site.

Design of permanent retaining structures in sands can be based on a bulk unit weight for the retained material of 20 kN/m^2, a friction angle of 32^o and an active earth pressure coefficient Ka of 0.31. In addition to the soil pressure, wall design should also allow for external loads such as buildings and live loads.

It is recommended that batter slopes in sand are no steeper than 1.5:1 (H:V), if they are vegetated to prevent erosion. This batter angle is valid provided no load applies at the top of the slope. Any excavation that is adjacent to existing buildings and below the level of existing footings should be supported or the footings underpinned to a level below the influence of the excavation.

7.7 Pavement Design Parameters

Based on the results of the field investigation and laboratory testing it is recommended that a California bearing ratio (CBR) of 10% be used for the design of flexible pavement on the sand subgrade encountered at the site, provided the sand is compacted to achieve a dry density ratio of not less than 95% relative to modified compaction.

7.8 Soil Permeability

The shallow soil conditions beneath the site generally comprise sand and it is therefore considered that the site may be suitable for on-site stormwater disposal such as soakwells and infiltration basins.

Based on field observations and permeability test results, a design permeability of 5.0×10^{-4} m/s is suggested for the shallow sand in the development areas. No specific testing was undertaken in the wetland area to assess the infiltration capacity of this area.

It is emphasised that a lower permeability value than that indicated may be appropriate for a long-term design value which takes into account long term biological build-up and/or siltation of the infiltration surface. It is also recommended that the base of any soakwells are positioned at least 0.5 m above the groundwater level.

8. Acid Sulphate Soil Evaluation

8.1 Adopted Assessment Criteria

The screening test results were assessed for the possible presence of actual acid sulphate soil (AASS) or potential acid sulphate soil (PASS) on the basis of the following guidance indicators specified in DEC (2009) namely:

- $pH_F \leq 4$ strongly indicates oxidation has occurred in the past and that AASS are likely to be present.
- $pH_{FOX} < 3$, plus a pH_{FOX} reading at least one pH unit below the corresponding pH_F, plus a strong reaction with peroxide, strongly indicates the presence of PASS.

The Department of Environment Acid Sulphate Soil Guideline Series 'Identification and Investigation of Acid Sulphate Soils, Perth, Western Australia,' May 2009 specifies texture-based action criteria to initiate management of acid sulphate soils. These are summarised in Table 6.

Table 6: Texture-Based Action Criteria

Type of Material		Net Acidity Action Criteria	
		< 1,000 tonnes of material is disturbed	**> 1,000 tonnes of material is disturbed**
Texture range McDonald et al (1990)	Approx. Clay content (%)	Equivalent sulphur (%S)	Equivalent sulphur (%S)
Coarse texture sands to loamy sands	< 5	0.03	0.03
Medium texture sandy loams to light clays	5 – 40	0.06	0.03
Fine texture medium to heavy clays and silty clays	> 40	0.1	0.03

Notes:

Table adopted from DER's Identification and Investigation of Acid Sulphate Soils, Perth, Western Australia, May 2009

If the net acidity, calculated from the results of the titratable actual acidity (TAA) and the peroxide oxidisable sulphur (S_{POS}) is greater than the action criterion, it is considered that acid sulphate soils are present and excavations/dewatering within this material would require specific management.

Net acidity using the SPOCAS suite of analysis is calculated as follows:

Net Acidity ($\%_{sulphur}$) = S_{POS} + TAA + S_{RT} – ANCe/FF
whereby:

- TAA - titratable actual acidity.
- S_{POS} – peroxide oxidisable sulphur.
- S_{RT} - retained acidity (reported for pH_{kCl} < 4.5).
- ANC_E – excess acid neutralising capacity (reported for pH_{kCl} > 6.5).
- FF – fineness factor (assumed by the laboratory to be 1.5).

Chromium suite of testing was undertaken on sample BH19 at a depth of 0.5 m given the material was described as dark grey-brown with some silt. Chromium reducible sulphur is the preferred method of testing for soils with a higher organic content as SPOCAS testing can overestimate the net acidity in soils

For the purposes of assessing the laboratory results and in the absence of detailed information on proposed excavations, it is assumed that more than 1,000 tonnes of material would be disturbed during site development. Therefore, an action criterion of 0.03% has been adopted for the assessment.

8.2 Assessment of Analytical Results

Screening Test Results
The screening test results presented in Table C-1, Appendix C indicate the following:

- The results for pH_F are not strongly indicative of actual acid sulphate soils conditions.
- The results for pH_{FOX} are not strongly indicative of potential acid sulphate soil conditions, with the exception of test location TP19 at a depth of 0.5 m the sample collected recorded a pH_{FOX} of 2.8.

It should be noted that the screening tests undertaken by MPL are indicative only and inferences made from these results should be confirmed by laboratory testing.

Laboratory Results and Discussion
The results of laboratory testing on selected soil samples summarised in Table C-1, Appendix C indicate that the calculated net acidity is below the adopted action criterion of 0.03% S for all samples submitted for analysis.

8.3 Conclusion on Acid Sulphate Soils

Based upon the results of the investigation, DP concludes that the risk of acid sulphate soils to depths of up to 2.0 m is considered to be low.

Further detailed investigation for acid sulphate soils would be required for the following:

- Satisfy a WAPC condition in relation to acid sulphate soils; or
- Dewatering for construction is required.

9. References

1. Australian Standard AS 1289-2000, Methods of Testing Soils for Engineering Purposes.
2. 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.
3. Geological Survey of Western Australia (1986), Fremantle 1:50,000 Sheet.
4. Australian Standard AS 1726-1996, Geotechnical Site Investigation.
5. Australian Standard AS 2870-2011, Residential Slabs and Footings
6. Australian Standard AS 3798-1996, Guidelines on Earthworks for Commercial and Residential Developments.
7. Department of Environment, Perth Groundwater Atlas, Second Edition, December 2004.
8. Australian Standard AS 1170.4-2007, Structural Design Actions – Earthquake Actions in Australia

10. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for a proposed development at Cockburn Central West, WA in accordance with DP's proposal dated 12 February 2014 and acceptance from Mr Peter Hale of LandCorp dated 13 February 2014. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of LandCorp for this project only and for the purposes described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Subsurface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached 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 unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About this Report
Location of Tests
Results of Field Work

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations 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.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report 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 or excavation. 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 and test pits 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 or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole 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; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements 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.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP 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 conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

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

About this Report

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, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report 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. DP 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 and environmental 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.

Cone Penetration Tests

Douglas Partners

Introduction

The Cone Penetration Test (CPT) is a sophisticated soil profiling test carried out in-situ. A special cone shaped probe is used which is connected to a digital data acquisition system. The cone and adjoining sleeve section contain a series of strain gauges and other transducers which continuously monitor and record various soil parameters as the cone penetrates the soils.

The soil parameters measured depend on the type of cone being used, however they always include the following basic measurements

- Cone tip resistance q_c
- Sleeve friction f_s
- Inclination (from vertical) i
- Depth below ground z

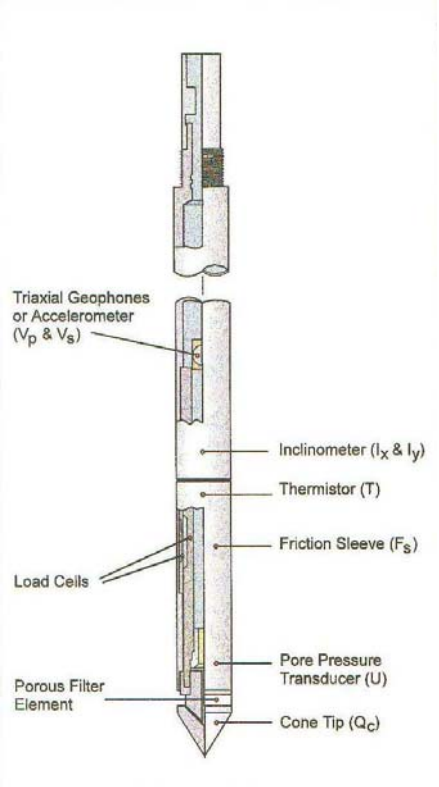

Figure 1: Cone Diagram

The inclinometer in the cone enables the verticality of the test to be confirmed and, if required, the vertical depth can be corrected.

The cone is thrust into the ground at a steady rate of about 20 mm/sec, usually using the hydraulic rams of a purpose built CPT rig, or a drilling rig. The testing is carried out in accordance with the Australian Standard AS1289 Test 6.5.1.

Figure 2: Purpose built CPT rig

The CPT can penetrate most soil types and is particularly suited to alluvial soils, being able to detect fine layering and strength variations. With sufficient thrust the cone can often penetrate a short distance into weathered rock. The cone will usually reach refusal in coarse filling, medium to coarse gravel and on very low strength or better rock. Tests have been successfully completed to more than 60 m.

Types of CPTs

Douglas Partners (and its subsidiary GroundTest) owns and operates the following types of CPT cones:

Type	Measures
Standard	Basic parameters (q_c, f_s, i & z)
Piezocone	Dynamic pore pressure (u) plus basic parameters. Dissipation tests estimate consolidation parameters
Conductivity	Bulk soil electrical conductivity (σ) plus basic parameters
Seismic	Shear wave velocity (V_s), compression wave velocity (V_p), plus basic parameters

Strata Interpretation

The CPT parameters can be used to infer the Soil Behaviour Type (SBT), based on normalised values of cone resistance (Qt) and friction ratio (Fr). These are used in conjunction with soil classification charts, such as the one below (after Robertson 1990)

Cone Penetration Tests

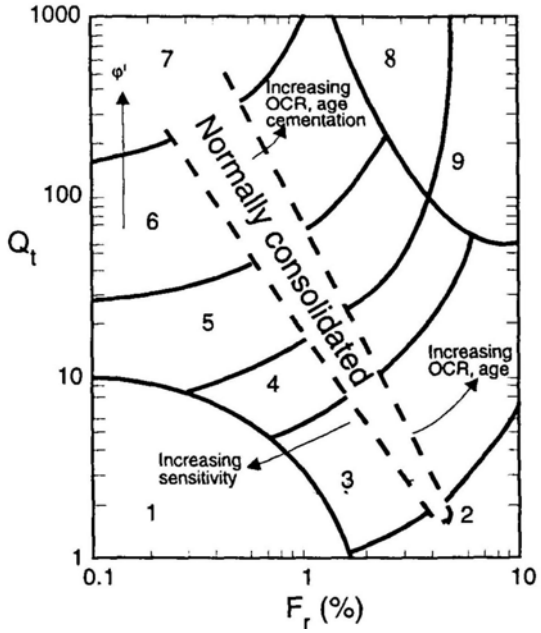

Figure 3: Soil Classification Chart

DP's in-house CPT software provides computer aided interpretation of soil strata, generating soil descriptions and strengths for each layer. The software can also produce plots of estimated soil parameters, including modulus, friction angle, relative density, shear strength and over consolidation ratio.

DP's CPT software helps our engineers quickly evaluate the critical soil layers and then focus on developing practical solutions for the client's project.

Engineering Applications

There are many uses for CPT data. The main applications are briefly introduced below:

Settlement

CPT provides a continuous profile of soil type and strength, providing an excellent basis for settlement analysis. Soil compressibility can be estimated from cone derived moduli, or known consolidation parameters for the critical layers (eg. from laboratory testing). Further, if pore pressure dissipation tests are undertaken using a piezocone, in-situ consolidation coefficients can be estimated to aid analysis.

Pile Capacity

The cone is, in effect, a small scale pile and, therefore, ideal for direct estimation of pile capacity. DP's in-house program ConePile can analyse most pile types and produces pile capacity versus depth plots. The analysis methods are based on proven static theory and empirical studies, taking account of scale effects, pile materials and method of installation. The results are expressed in limit state format, consistent with the Piling Code AS2159.

Dynamic or Earthquake Analysis

CPT and, in particular, Seismic CPT are suitable for dynamic foundation studies and earthquake response analyses, by profiling the low strain shear modulus G_0. Techniques have also been developed relating CPT results to the risk of soil liquefaction.

Other Applications

Other applications of CPT include ground improvement monitoring (testing before and after works), salinity and contaminant plume mapping (conductivity cone), preloading studies and verification of strength gain.

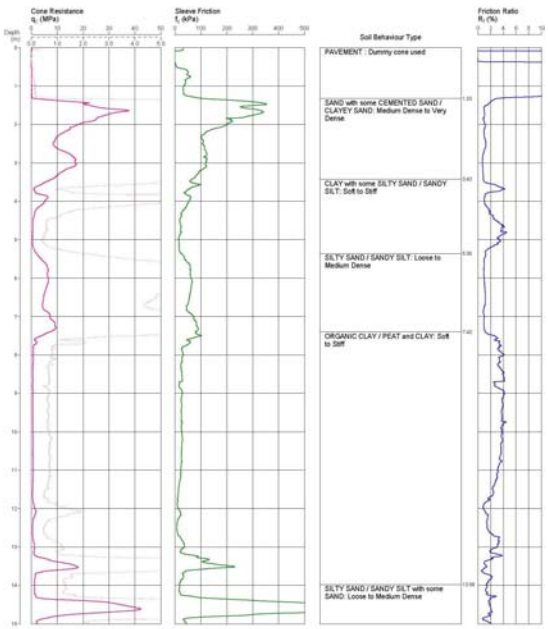

Figure 4: Sample Cone Plot

Sampling

Sampling is carried out during drilling or test pitting 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 it to obtain 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.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally 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 samples.

Continuous Spiral Flight Augers

The borehole 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 sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud 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 the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils 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 before the full penetration depth, 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 SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. 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 types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

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Description and Classification Methods

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

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

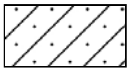
Soils


Topsoil

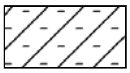

Peat


Clay

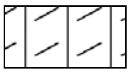

Silty clay

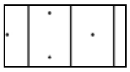

Sandy clay

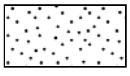

Gravelly clay

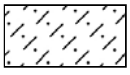

Shaly clay

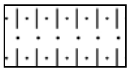

Silt


Clayey silt


Sandy silt

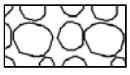

Sand

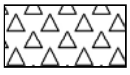

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

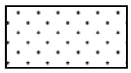

Talus

Sedimentary Rocks

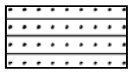

Boulder conglomerate

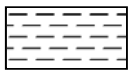

Conglomerate


Conglomeratic sandstone

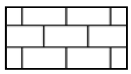

Sandstone


Siltstone


Laminite

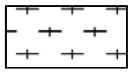

Mudstone, claystone, shale

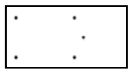

Coal


Limestone

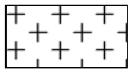
Metamorphic Rocks

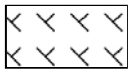

Slate, phyllite, schist

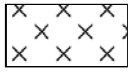

Gneiss

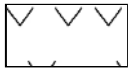

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

CADASTRAL SOURCE: Landgate, March 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2013.
CONTOURS SOURCE: Whelans, Dwg No. 20045-001-002-00, 03/02/2014.
PROPOSED DEVELOPMENT SOURCE: ARUP, Dwg No. C-SKE-0-001 Rev F, 20/02/14.

Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Test Locations**
Proposed Development
Cockburn Central West, WA

CLIENT: LandCorp	PROJECT No.: 82241	DRAWING No.: 1	REVISION: A

OFFICE: Perth
DRAWN BY: Y. Chen
DATE: 11 Mar 2014
SCALE: As shown

82241-d01.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 24.1 m AHD*
EASTING: 391541
NORTHING: 6445400

PIT No: 1
PROJECT No: 82241
DATE: 24/2/2014
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)
24	0.2	TOPSOIL (SAND) - dark grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, grey-brown, fine to medium grained sand with a trace of silt, dry to moist.		B E	0.5				
23	1			E	1.0				
		- becoming wet from 1.6 m depth.		E	1.5				
22	2			E	2.0				
	2.2	Pit discontinued at 2.2m (Test pit collapse)						24-02-14	
21	3								

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

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: Groundwater observed at 2.2 m depth.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 25.9 m AHD*
EASTING: 391519
NORTHING: 6445338

PIT No: 2
PROJECT No: 82241
DATE: 24/2/2014
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)
25	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
	1	- 10 mm to 50 mm diameter roots observed to 0.9 m depth.		E	1.0				1
				E	1.5				
24	2			E	2.0				2
				E	2.5				
	2.6	Pit discontinued at 2.6m (Test pit collapse)							
23	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 25.3 m AHD*
EASTING: 391618
NORTHING: 6445306

PIT No: 3
PROJECT No: 82241
DATE: 24/2/2014
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)
25	0.2	FILLING (TOPSOIL) - grey-brown, fine to medium grained sandy topsoil with some silt, some gravel and roots, dry to moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry to moist.		D E	0.5				
24	1			E	1.0				1
				E	1.5				
23	2			E	2.0				2
	2.3	Pit discontinued at 2.3m (Test pit collapse)							
22	3								3

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

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 24.9 m AHD*
EASTING: 391725
NORTHING: 6445321

PIT No: 4
PROJECT No: 82241
DATE: 24/2/2014
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)
24	0.1	FILLING (TOPSOIL) - dark grey-brown, fine to medium grained sandy topsoil with some silt, some gravel and roots, dry to moist.							
		FILLING (SAND) - dense, dark grey-brown and light grey, fine to medium grained sand with some gravel and a trace of silt, moist. Piece of brick found in filling.							
		- becoming very dense from 0.45 m depth.		D E	0.5				
	0.7	SAND - light grey, fine to medium grained sand with a trace of silt, moist.							
	1			E	1.0				1
		-10 mm to 20 mm diameter roots observed to 1.2 m depth.							
23				E	1.5				
		- becoming grey-brown from 1.6 m depth.							
	2			E	2.0				2
		- becoming wet from 2.2 m depth.							
	2.3	Pit discontinued at 2.3m (Test pit collapse)							
22	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 26.0 m AHD*
EASTING: 391847
NORTHING: 6445255
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 82241
DATE: 25/2/2014
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)
26		FILLING (SAND) - grey-brown and light grey, fine to medium grained sand with some gravel and some silt, dry to moist.		E	0.2				
	0.3	SAND - medium dense, grey-brown, fine to medium grained sand with some silt, moist.		E	0.5				
25	1	- becoming wet from 1.2 m depth.		E	1.0				
				E	1.5			25-02-14	
24	2	2.0 Bore discontinued at 2.0m (Borehole collapse)		E	2.0				
23	3								

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

RIG: 110 mm hand auger. **DRILLER:** YC **LOGGED:** YC **CASING:**

TYPE OF BORING: Hand auger.

WATER OBSERVATIONS: Groundwater observed at 1.5 m depth.

REMARKS: *Surface level obtained from the Perth Groundwater Atlas.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 25.0 m AHD*
EASTING: 391846
NORTHING: 6445130

PIT No: 6
PROJECT No: 82241
DATE: 24/2/2014
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)
25	0.1	FILLING (SAND) - dark grey-brown and grey-brown, fine to medium grained sand with a trace of silt, moist.							
		SAND - dense, grey-brown, fine to medium grained sand with a trace silt, moist.		B E	0.5				
24	1	- becoming wet from 0.9 m depth.		E	1.0				1
				E	1.5			24-02-14	
23	2	- becoming grey-brown and brown from 2.2 m depth.		E	2.0				2
				D E	2.3				
	2.4	Pit discontinued at 2.4m (Test pit collapse)							
22	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: Groundwater observed at 1.7 m depth.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 24.1 m AHD*
EASTING: 391788
NORTHING: 6445145

PIT No: 7
PROJECT No: 82241
DATE: 24/2/2014
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)
24	0	FILLING (SAND) - dense, grey-brown, fine to medium grained sand with some gravel, some limestone cobbles and a trace of silt, moist.		D E	0.5				
	1			E	1.0				1
23	1.1	SAND - light brown, fine to medium grained sand with a trace of silt, moist.							
		- becoming wet from 1.5 m depth.		E	1.5			▼ 24-02-14	
22	2			E	2.0				2
	2.3	Pit discontinued at 2.3m (Test pit collapse)							
21	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: Groundwater observed at 1.6 m depth.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 24.6 m AHD*
EASTING: 391716
NORTHING: 6445145

PIT No: 8
PROJECT No: 82241
DATE: 24/2/2014
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)
24	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
	1			E	1.0				1
23		- becoming wet and light grey-brown from 1.6 m depth.		E	1.5				
	2			E	2.0			24-02-14	2
	2.2	Pit discontinued at 2.2m (Test pit collapse)							
22	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: Groundwater observed at 2.0 m depth.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 24.9 m AHD*
EASTING: 391638
NORTHING: 6445216

PIT No: 9
PROJECT No: 82241
DATE: 24/2/2014
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	FILLING (SAND) - grey-brown, fine to medium grained sand with some silt, dry to moist.							
		FILLING (SANDY GRAVEL) - very dense, grey-brown and yellow-brown, fine to coarse sized sandy gravel with some cobbles, dry to moist.		E	0.2		PSP recommenced at 0.3 m depth.		
	0.3	FILLING (SAND) - dense, dark grey-brown, fine to medium grained sand with some silt and roots, moist.		E	0.3				
				E	0.5				
	0.6	SAND - dense, light grey-brown, fine to medium grained sand with a trace of silt, moist.							
24	1			E	1.0				1
		- becoming medium dense from 1.0 m depth.							
				E	1.5				
23		- becoming wet from 1.8 m depth.							
	2			E	2.0				2
				E	2.5			▼ 24-02-14	
	2.8	Pit discontinued at 2.8m (Test pit collapse)							
22	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: Groundwater observed at 2.6 m depth.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 27.9 m AHD*
EASTING: 391485
NORTHING: 6445226

PIT No: 10
PROJECT No: 82241
DATE: 24/2/2014
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 (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, light yellow-brown, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
				D	0.7				
		- becoming dense from 0.75 m depth.							
27	1			E	1.0				1
		- becoming yellow-brown from 1.2 m depth.							
				E	1.5				
26	2			E	2.0				2
				E	2.5				
25	3	3.0 Pit discontinued at 3.0m (Target depth)		E	3.0				3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 26.0 m AHD*
EASTING: 391530
NORTHING: 6445139

PIT No: 11
PROJECT No: 82241
DATE: 24/2/2014
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)
26	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sand with some silt and roots, dry to moist.							
		SAND - medium dense, light grey-brown, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
		- becoming light grey from 0.8 m depth.							
25	1			E	1.0				1
				E	1.5				
	1.8	Pit discontinued at 1.8m (Test pit collapse)							
24	2								2
23	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 27.7 m AHD*
EASTING: 391497
NORTHING: 6445058

PIT No: 12
PROJECT No: 82241
DATE: 24/2/2014
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)
27	0	SAND - medium dense, yellow-brown, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
		- roots observed to 0.2 m depth.							
	1			E	1.0				1
				D E	1.5				
26	2			E	2.0				2
				E	2.5				
25	3								3
	3.0	Pit discontinued at 3.0m (Target depth)		E	3.0				

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

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 25.2 m AHD*
EASTING: 391663
NORTHING: 6445057

PIT No: 13
PROJECT No: 82241
DATE: 24/2/2014
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)
25	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sand with some silt and roots, dry to moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
	1			E	1.0				1
24		- becoming light grey-brown from 1.4 m depth.		E	1.5				
	2			E	2.0				2
23	2.2	Pit discontinued at 2.2m (Test pit collapse)							
	3								3
22									

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 26.8 m AHD*
EASTING: 391619
NORTHING: 6444988

PIT No: 14
PROJECT No: 82241
DATE: 24/2/2014
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)
26	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sand with some silt and roots, dry to moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
	1			D	0.8				
				E	1.0				1
25				E	1.5				
	2			E	2.0				2
	2.3	Pit discontinued at 2.3m (Test pit collapse)							
24	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 30.7 m AHD*
EASTING: 391557
NORTHING: 6444940

PIT No: 15
PROJECT No: 82241
DATE: 24/2/2014
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)
30	0.2	TOPSOIL (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
		- 50 mm diameter roots observed to 0.8 m depth.							
	1			E	1.0				1
29				E	1.5				
	2			E	2.0				2
	2.2	Pit discontinued at 2.2m (Test pit collapse)							
28	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 27.6 m AHD*
EASTING: 391652
NORTHING: 6444917

PIT No: 16
PROJECT No: 82241
DATE: 24/2/2014
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)
27	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
		- roots and rootlets observed to 0.8 m depth.							
	1			E	1.0				1
26				E	1.5				
	2			E	2.0				2
	2.3	Pit discontinued at 2.3m (Test pit collapse)							
25	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 24.6 m AHD*
EASTING: 391707
NORTHING: 6444930

PIT No: 17
PROJECT No: 82241
DATE: 24/2/2014
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)
24	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, light grey-brown, fine to medium grained sand with a trace of silt, dry to moist.		B E	0.5				
	1			E	1.0				1
23		- becoming wet from 1.5 m depth.		E	1.5				
	2			E	2.0				2
	2.1	Pit discontinued at 2.1m (Test pit collapse)							
22	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 25.1 m AHD*
EASTING: 391766
NORTHING: 6444877

PIT No: 18
PROJECT No: 82241
DATE: 24/2/2014
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)
25	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, light grey-brown, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
24	1			E	1.0				
		- becoming wet from 1.3 m depth.		E	1.5			▼ 24-02-14	
	2 2.0	Pit discontinued at 2.0m (Test pit collapse)							
23									
22	3								

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: Groundwater observed at 1.5 m depth.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 26.0 m AHD*
EASTING: 391884
NORTHING: 6444871

PIT No: 19
PROJECT No: 82241
DATE: 24/2/2014
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)
26	0	FILLING (SAND) - dense, dark grey-brown and light grey, fine to medium grained sand with some silt and some organics, dry to moist.		D	0.3				
				E	0.5				
		- becoming medium dense from 0.75 m depth.							
25	1			E	1.0				1
	1.3	SAND - light grey-brown, fine to medium grained sand with a trace of silt, moist.							
				E	1.5				
		- becoming wet from 1.6 m depth.						▼ 24-02-14	
24	2			E	2.0				2
	2.2	Pit discontinued at 2.2m (Test pit collapse)							
23	3								3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: Groundwater observed at 1.9 m depth.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 30.0 m AHD*
EASTING: 391826
NORTHING: 6444801

PIT No: 20
PROJECT No: 82241
DATE: 26/2/2014
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)
30		SAND - medium dense, light brown, fine to medium grained sand with a trace of silt, dry to moist.							
				E	0.5				
		- 10 mm to 30 mm diameter roots observed to 0.6 m depth.							
29	1			E	1.0				1
		- becoming yellow-brown from 1.1 m depth.							
				E	1.5				
28	2			E	2.0				2
				E	2.5				
27	3 3.0	Pit discontinued at 3.0m (Target depth)		E	3.0				3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 30.2 m AHD*
EASTING: 391732
NORTHING: 6444820

PIT No: 21
PROJECT No: 82241
DATE: 26/2/2014
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)
30	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry to moist.							
		- 10 mm to 50 mm diameter roots observed to 0.5 m depth.		E	0.5				
29	1			E	1.0				1
				E	1.5				
28	2			E	2.0				2
	2.2	Pit discontinued at 2.2m (Test pit collapse)							
27	3								3

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

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 33.4 m AHD*
EASTING: 391673
NORTHING: 6444819

PIT No: 22
PROJECT No: 82241
DATE: 26/2/2014
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)
33	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry to moist.							
		- 5 mm to 10 mm diameter roots observed to 0.5 m depth.		E	0.5				
	1			E	1.0				1
				D	1.1				
32				E	1.5				
	2			E	2.0				2
	2.3	Pit discontinued at 2.3m (Test pit collapse)							
31									
	3								3
30									

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 35.5 m AHD*
EASTING: 391574
NORTHING: 6444839

PIT No: 23
PROJECT No: 82241
DATE: 26/2/2014
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 (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, yellow-brown, fine to medium grained sand with a trace of silt, dry to moist.							
35		- 10 mm to 50 mm diameter roots observed to 0.5 m depth.		E	0.5				
	1			E	1.0				1
34				E	1.5				
	2			E	2.0				2
33				E	2.5				
	3	3.0 Pit discontinued at 3.0m (Target depth)		E	3.0				3

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 38.1 m AHD*
EASTING: 391591
NORTHING: 6444771

PIT No: 24
PROJECT No: 82241
DATE: 26/2/2014
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)
38	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - loose, light yellow-brown, fine to medium grained sand with a trace of silt, dry to moist.							
		- becoming medium dense from 0.45 m depth.		B E	0.5				
		- becoming yellow-brown from 0.9 m depth.							
37	1			E	1.0				1
				E	1.5				
36	2			E	2.0				2
				E	2.5				
	2.7	Pit discontinued at 2.7m (Test pit collapse)							
35	3								3

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

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LandCorp
PROJECT: Proposed Development
LOCATION: Cockburn Central West, WA

SURFACE LEVEL: 39.2 m AHD*
EASTING: 391691
NORTHING: 6444726

PIT No: 25
PROJECT No: 82241
DATE: 26/2/2014
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)
39	0.1	TOPSOIL (SAND) - grey-brown, fine to medium grained sandy topsoil with some silt and roots, dry to moist.							
		SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry to moist.		E	0.5				
	1	- 10 mm to 20 mm diameter roots observed to 0.9 m depth.		E	1.0				1
38				E	1.5				
	2			E	2.0				2
37	2.2	Pit discontinued at 2.2m (Test pit collapse)							
	3								3
36									

RIG: 5 tonne excavator equipped with a 600 mm wide toothed bucket.
LOGGED: YC
SURVEY DATUM:

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

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

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

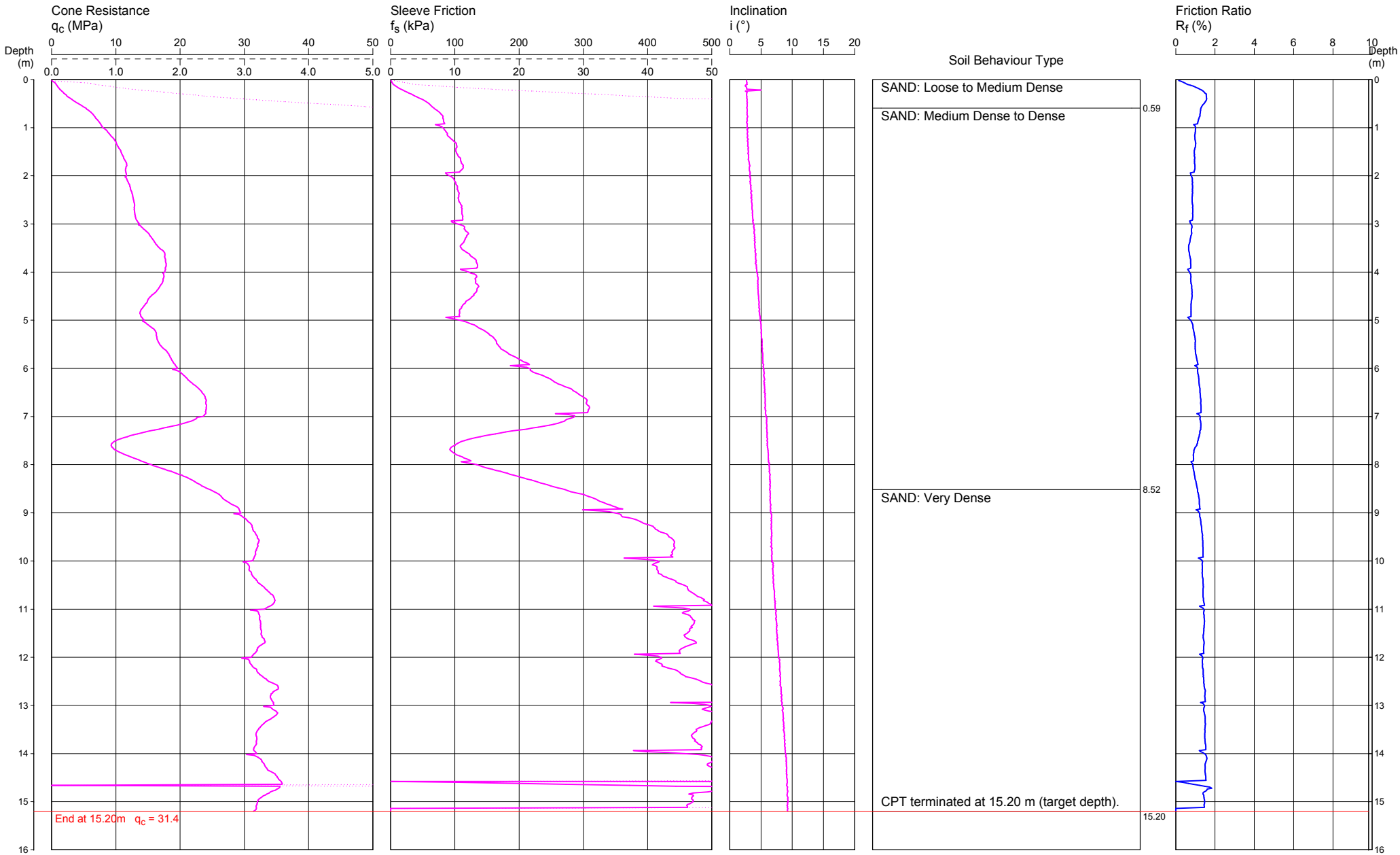
REDUCED LEVEL: RL 37.5 m AHD*

COORDINATES: 391662 6444765

CPT 26

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client. **File:** P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 26.CP5

Cone ID: Probedrill **Type:** EC25

ConePlot Version 5.9.1

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CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

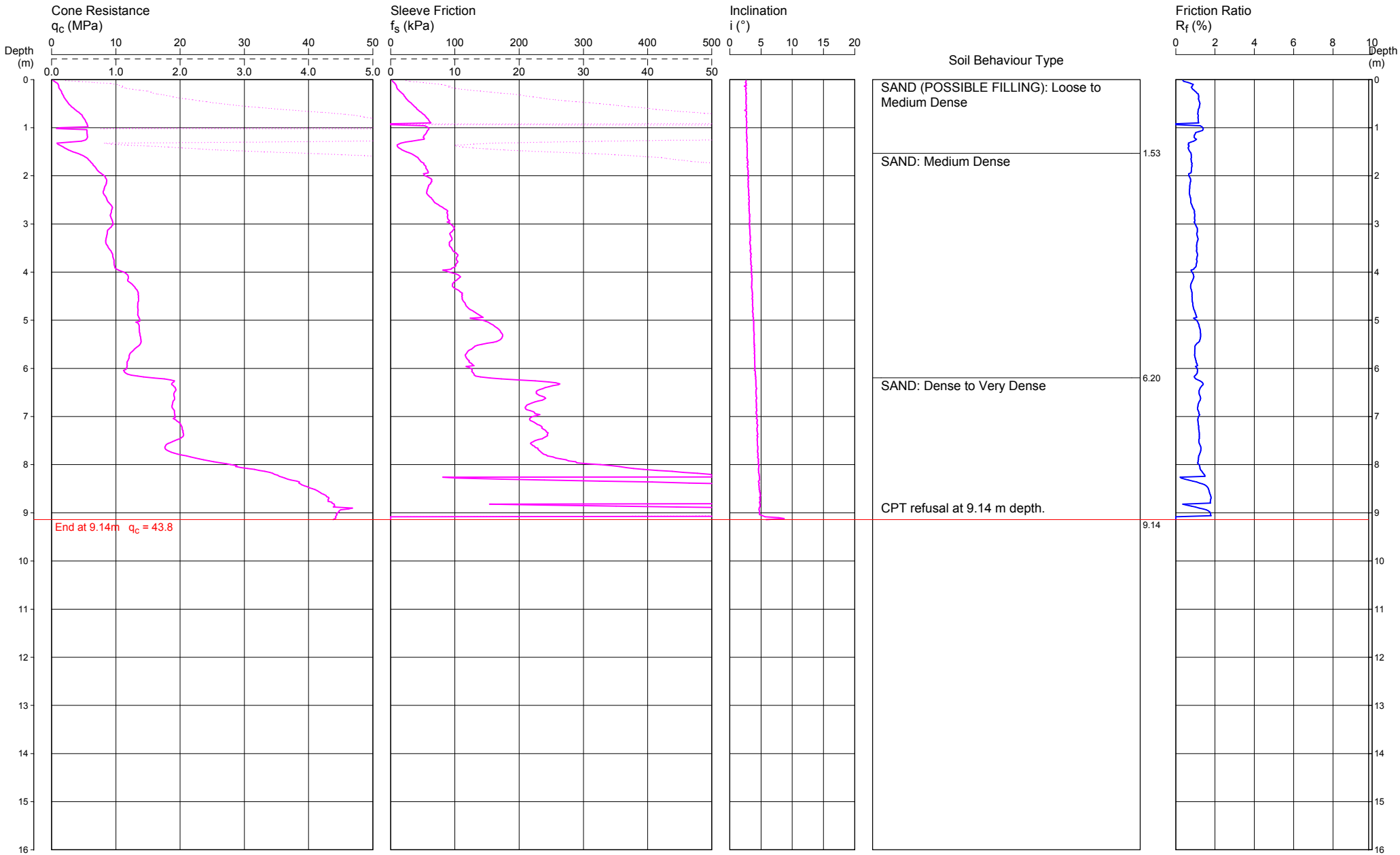
REDUCED LEVEL: RL 28.6 m AHD*

COORDINATES: 391784 6444825

CPT 27

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client. **File:** P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 27.CP5

Cone ID: Probedrill **Type:** EC25

ConePlot Version 5.9.1

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CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

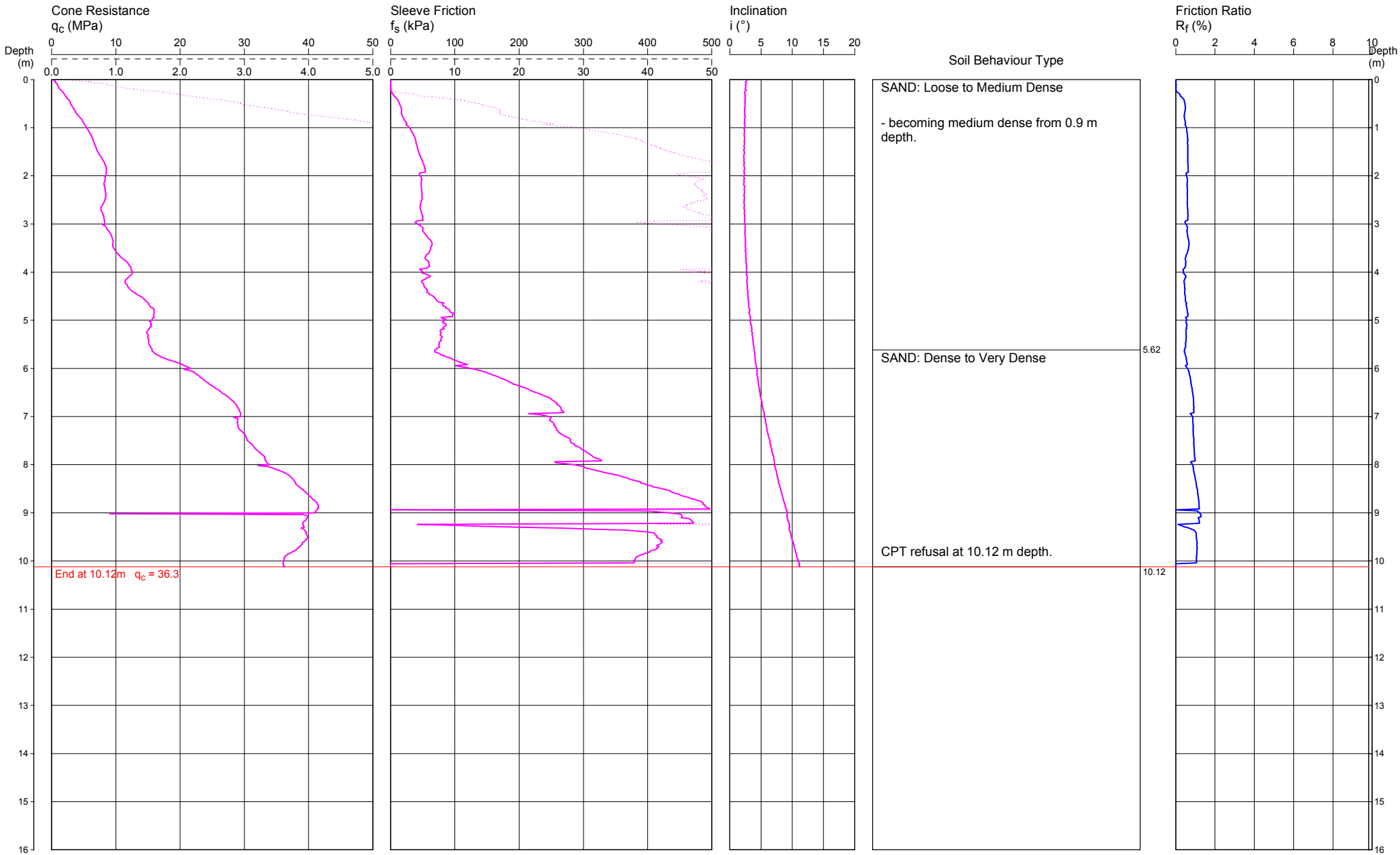
REDUCED LEVEL: RL 33.0 m AHD*

COORDINATES: 391580 6444881

CPT 28

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client. **File:** P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 28.CP5

Cone ID: Probedrill **Type:** EC36

ConePlot Version 5.9.1

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CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

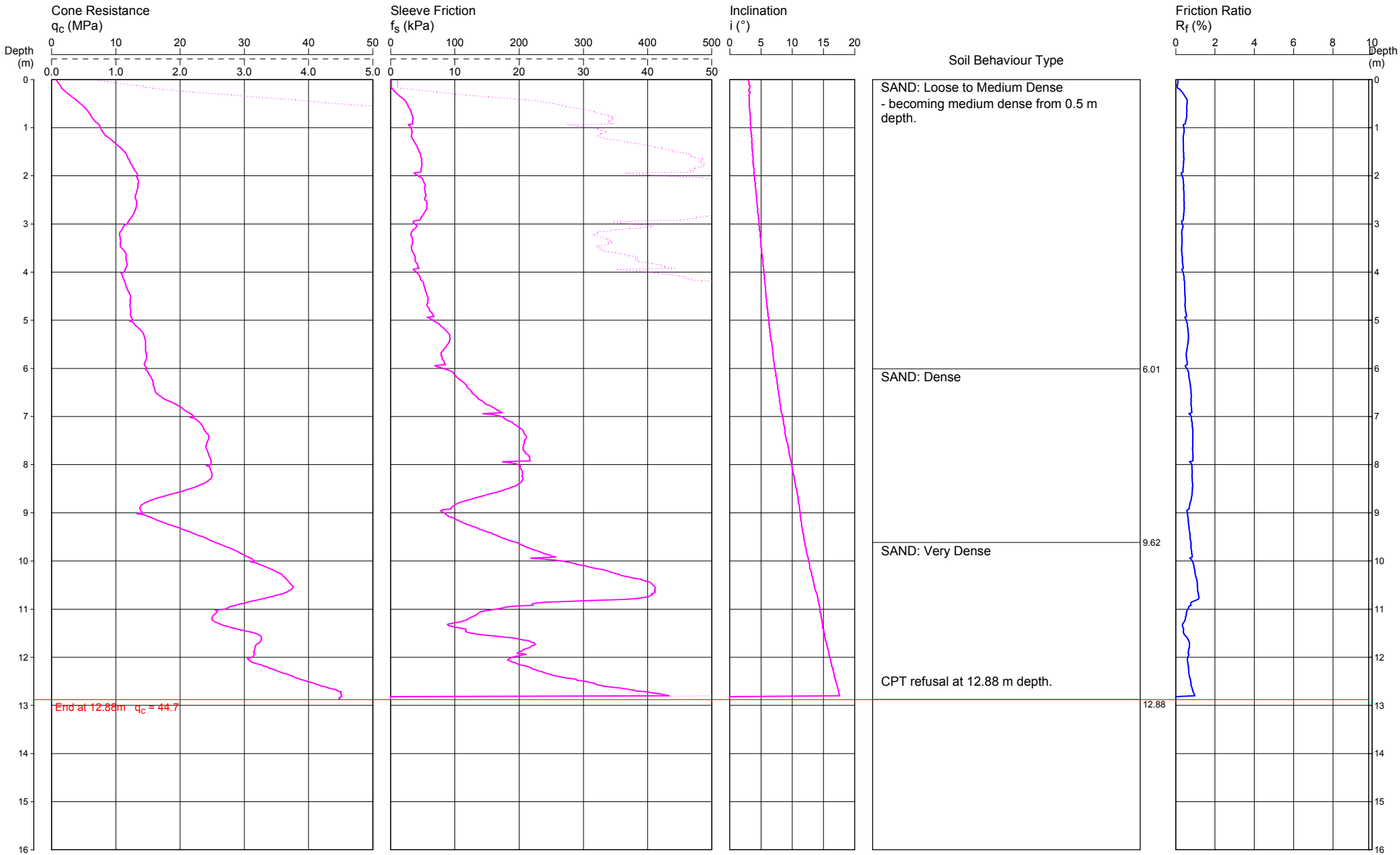
REDUCED LEVEL: RL 33.0 m AHD*

COORDINATES: 391499 6444918

CPT 29

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client. **File:** P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 29.CP5

Cone ID: Probedrill **Type:** EC36

ConePlot Version 5.9.1

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CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

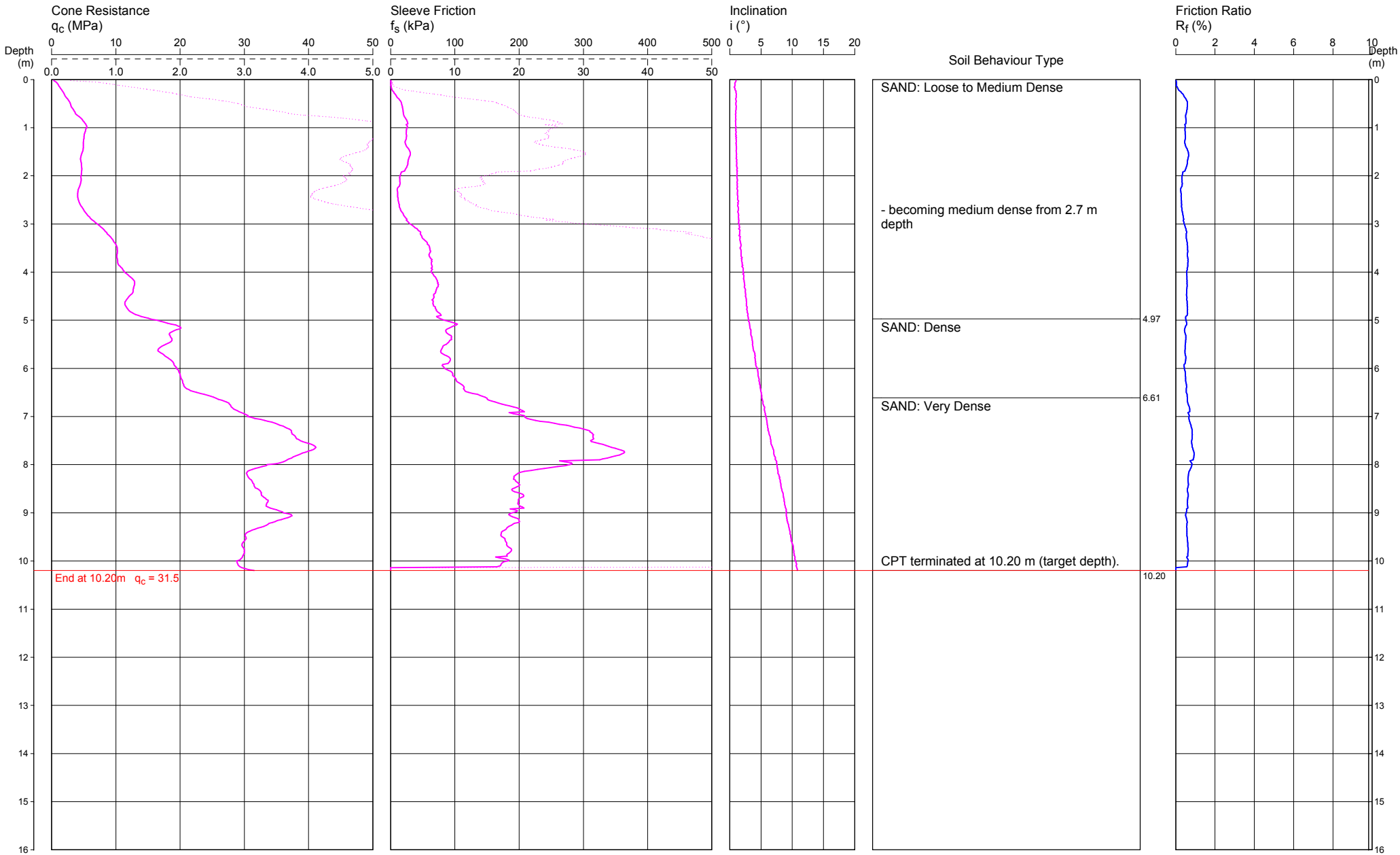
REDUCED LEVEL: RL 25.3 m AHD*

COORDINATES: 391667 6445016

CPT 30

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client. **File:** P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 30.CP5

Cone ID: Probedrill **Type:** EC36

ConePlot Version 5.9.1

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CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

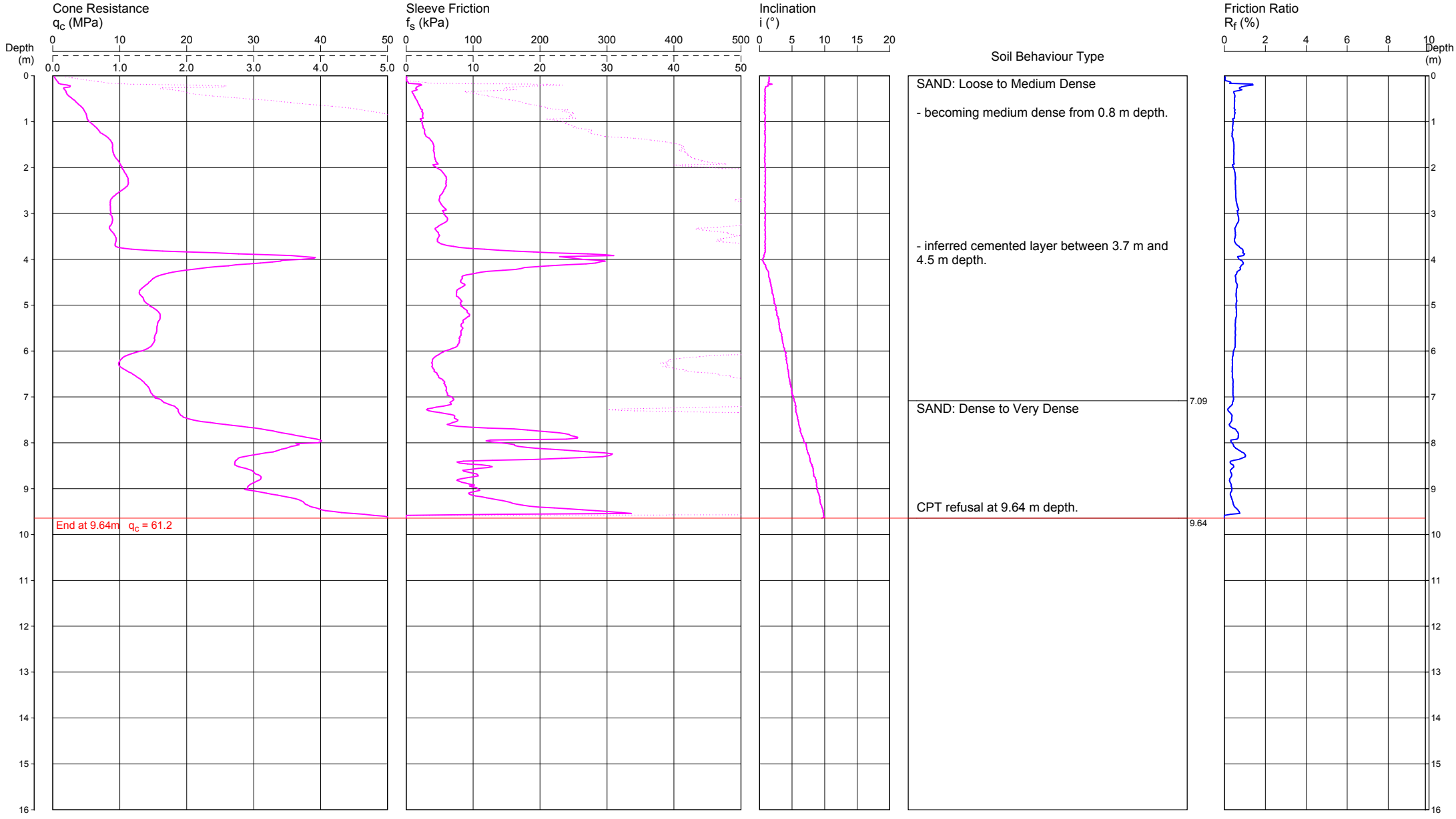
REDUCED LEVEL: RL 26.1 m AHD*

COORDINATES: 391592E 6445066N

CPT 31

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client.

File: P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 31.CP5
Cone ID: Probedrill **Type:** EC36

ConePlot Version 5.9.2

Douglas Partners
Geotechnics | Environment | Groundwater

CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

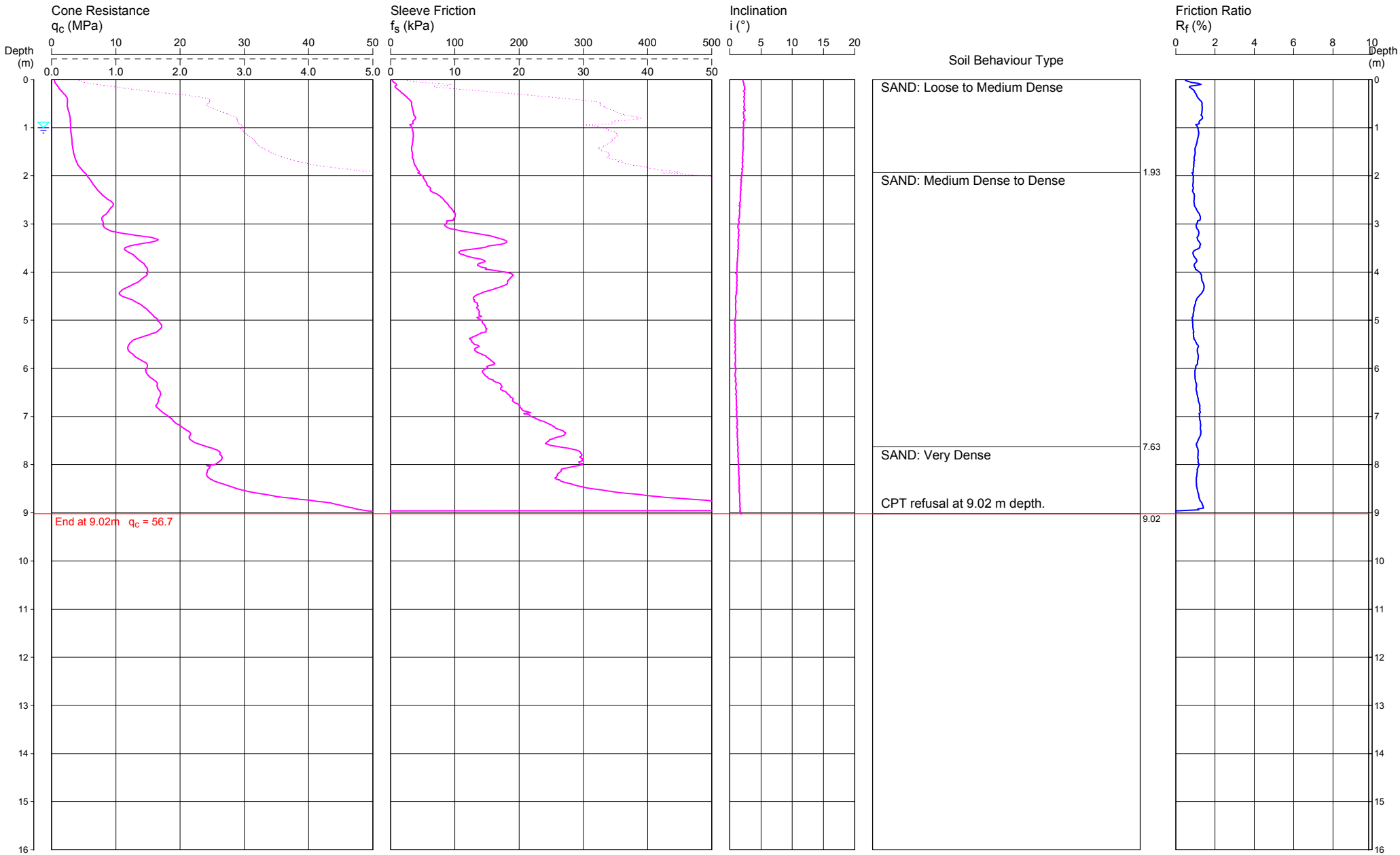
REDUCED LEVEL: RL 24.6 m AHD*

COORDINATES: 391826 6445060

CPT 32

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client. **File:** P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 32.CP5

Cone ID: Probedrill **Type:** EC25

Water depth after test: 1.00m depth (measured)

ConePlot Version 5.9.1

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

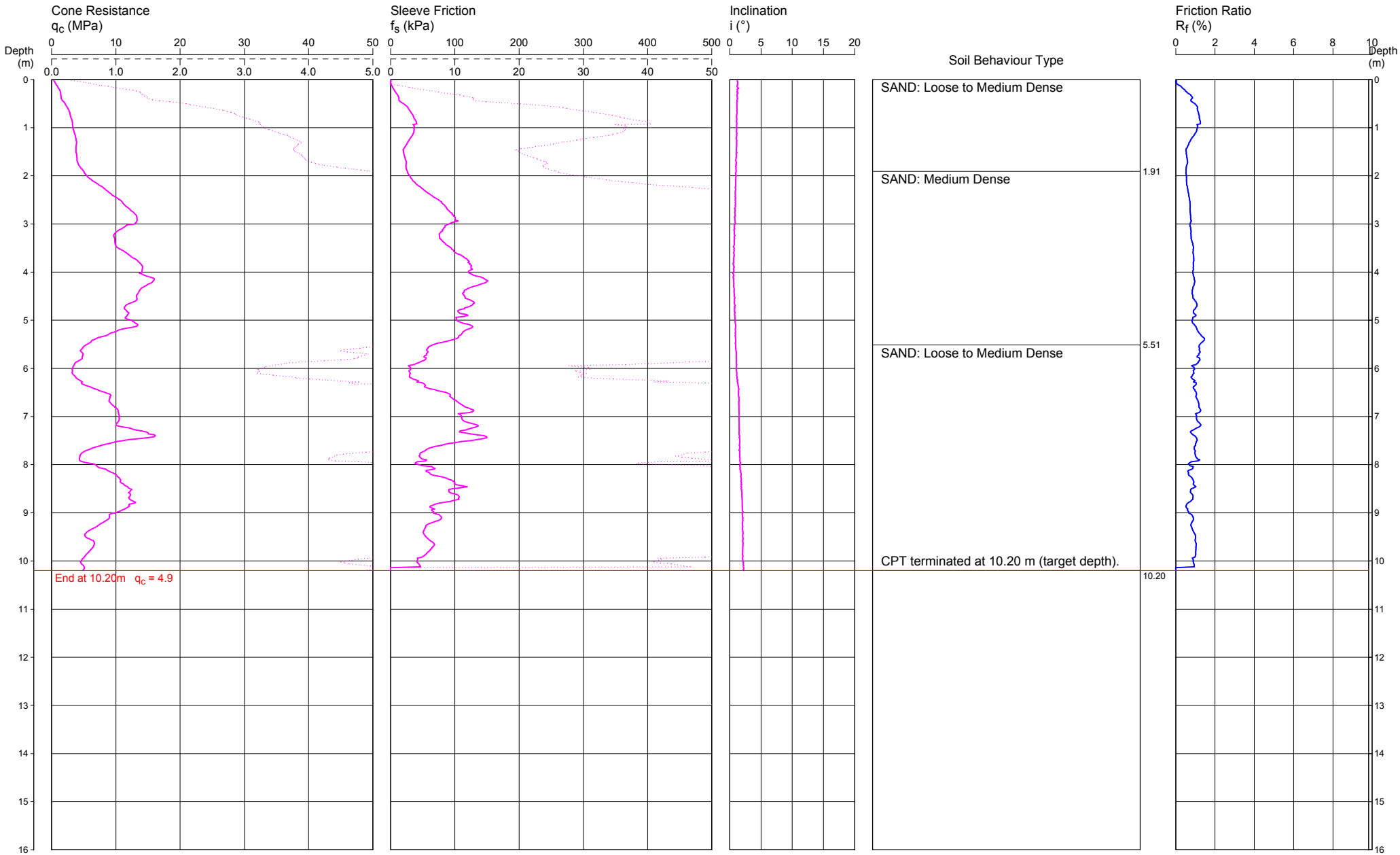
REDUCED LEVEL: RL 24.3 m AHD*

COORDINATES: 391686 6445117

CPT 33

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client. **File:** P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 33.CP5

Cone ID: Probedrill **Type:** EC36

ConePlot Version 5.9.1

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

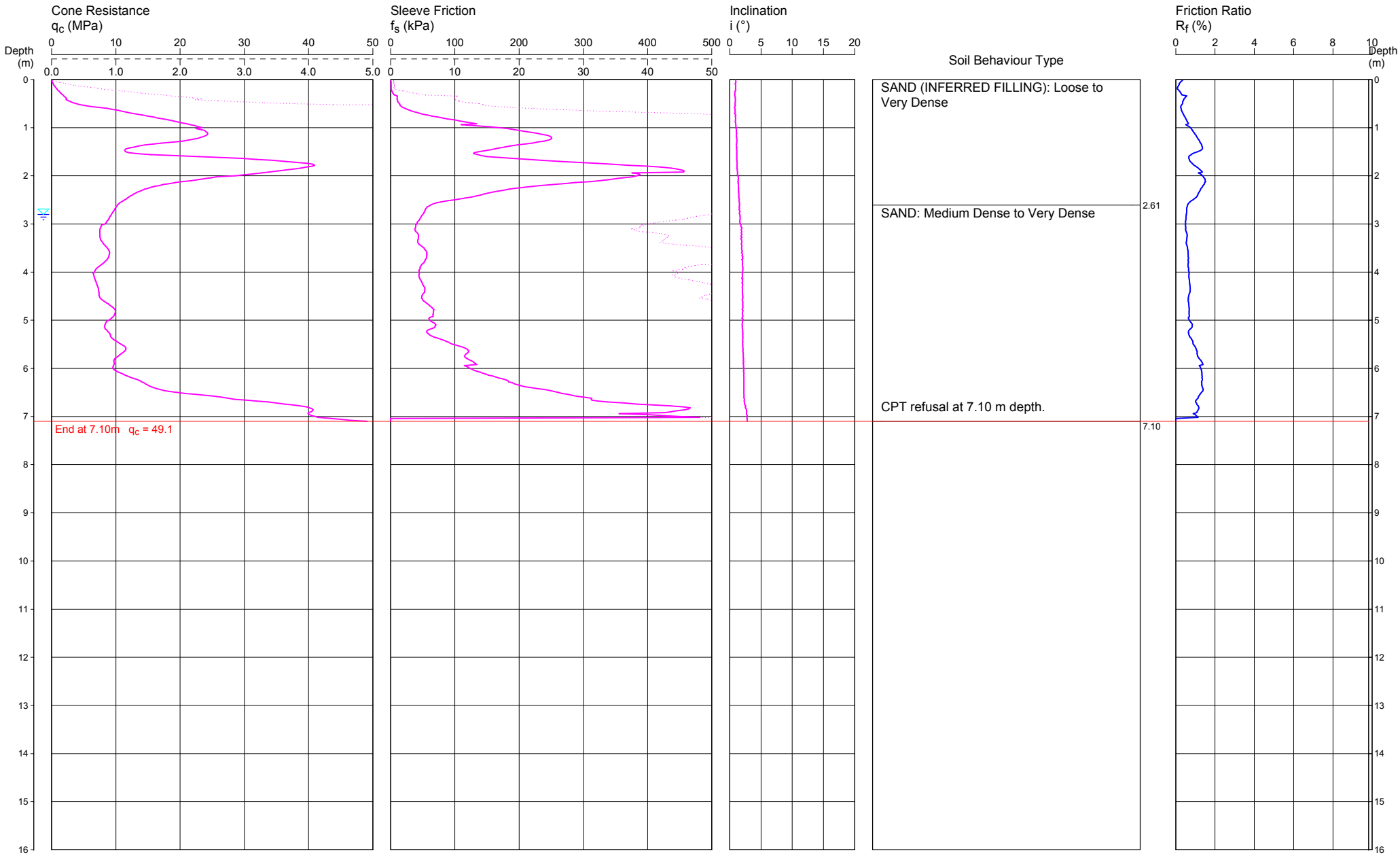
REDUCED LEVEL: RL 26.0 m AHD*

COORDINATES: 391817 6445211

CPT 34

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client.

File: P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 34.CP5

Cone ID: Probedrill **Type:** EC36

Water depth after test: 2.80m depth (measured)

ConePlot Version 5.9.1

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

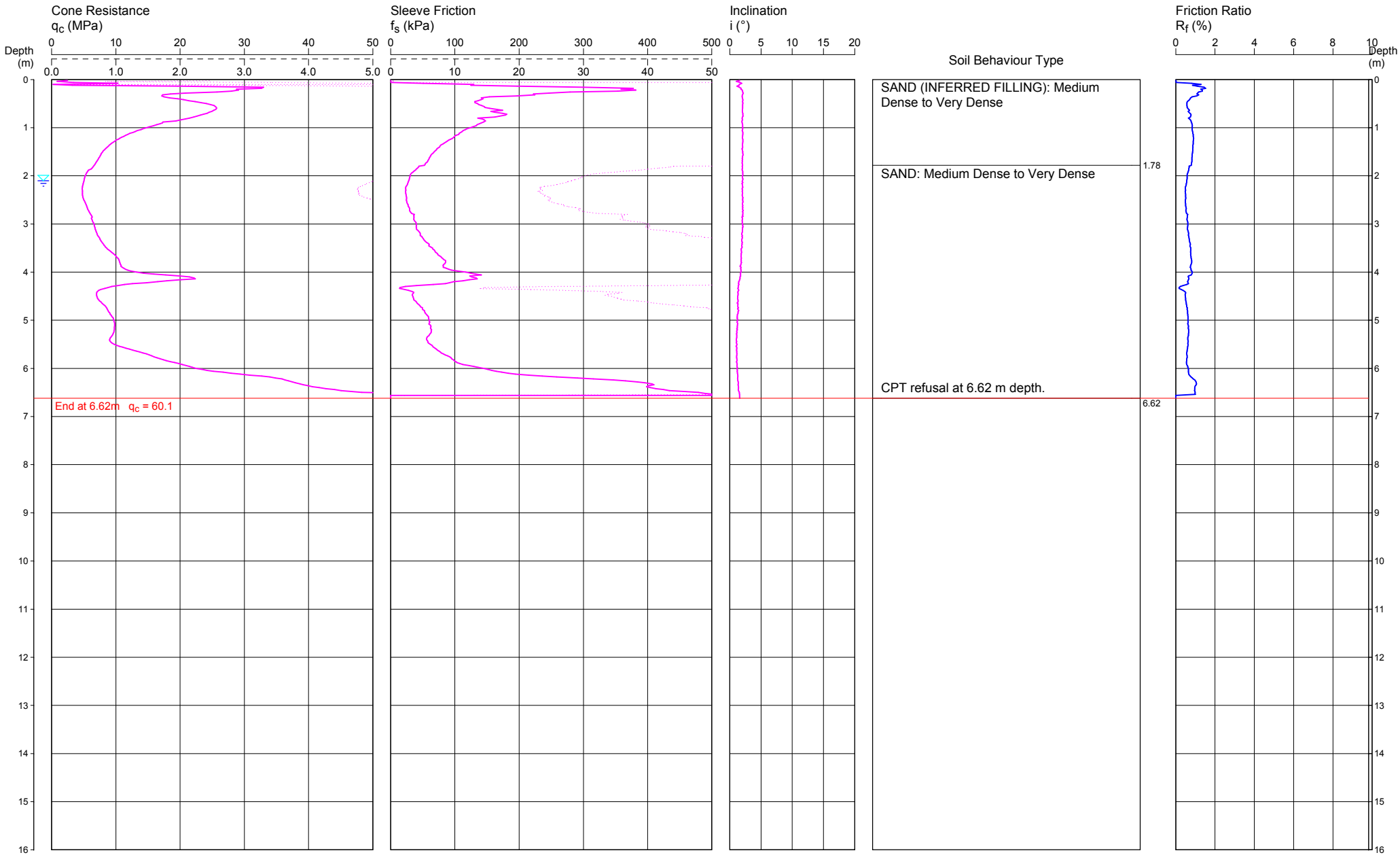
REDUCED LEVEL: RL 24.9 m AHD*

COORDINATES: 391688 6445269

CPT 35

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client. **File:** P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 35.CP5

Cone ID: Probedrill **Type:** EC36

Water depth after test: 2.10m depth (measured)

ConePlot Version 5.9.1

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

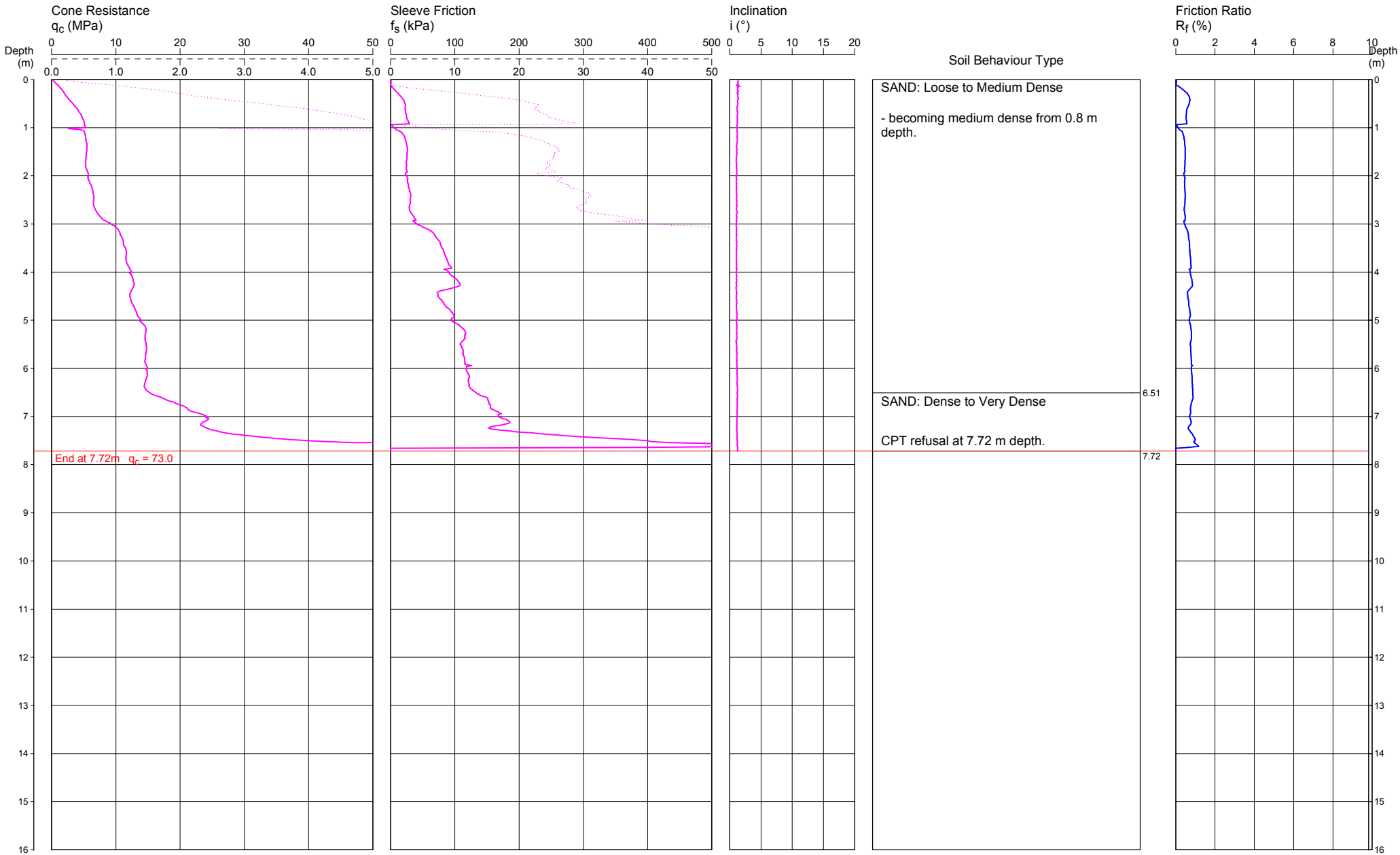
REDUCED LEVEL: RL 27.0 m AHD*

COORDINATES: 391483 6445168

CPT 36

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client.

File: P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 36.CP5

Cone ID: Probedrill **Type:** EC36

ConePlot Version 5.9.1

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: LandCorp

PROJECT: Proposed Development

LOCATION: Cockburn Central West, WA

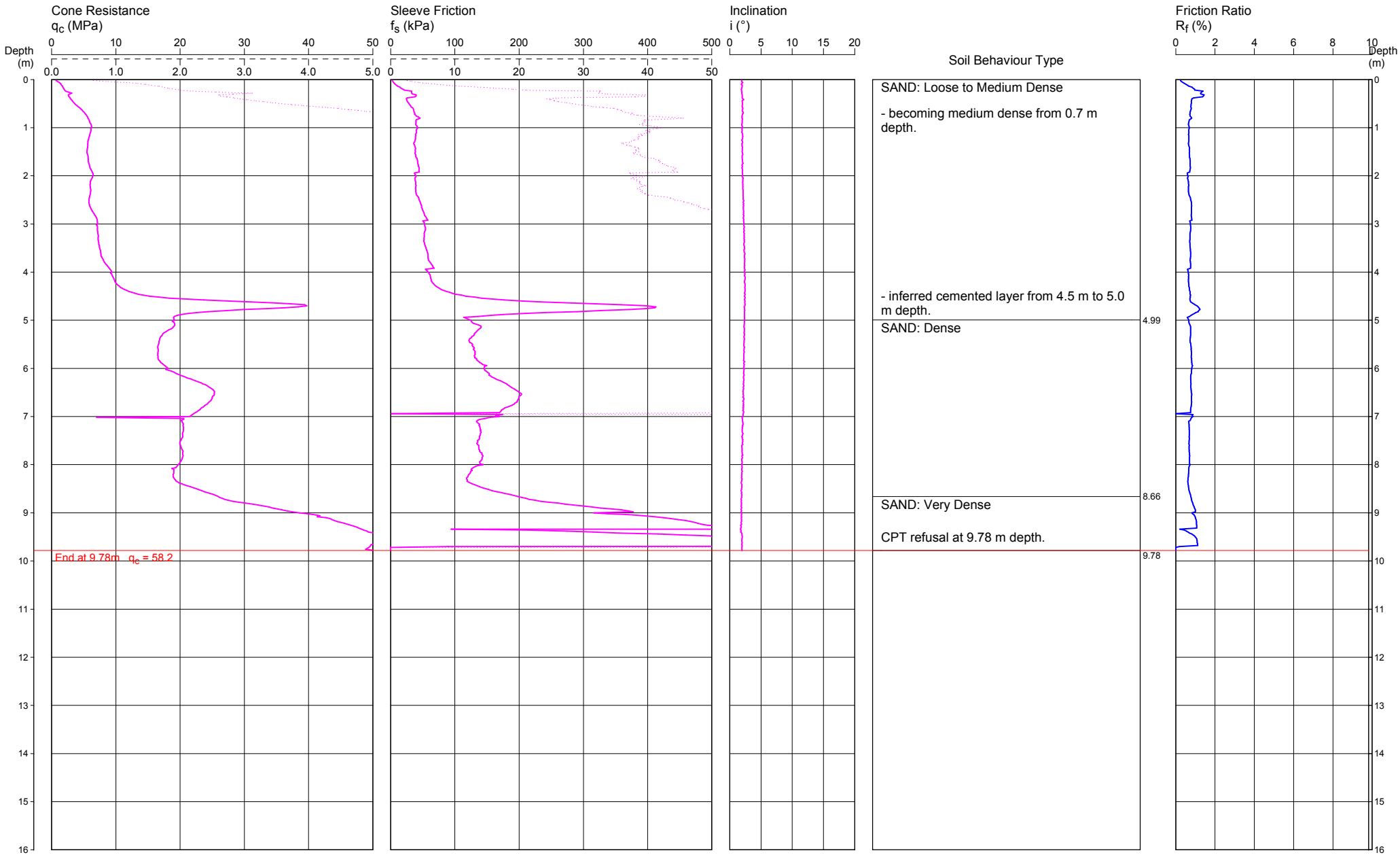
REDUCED LEVEL: RL 26.7 m AHD*

COORDINATES: 391538 6445306

CPT 37

DATE 25/02/2014

PROJECT No: 82241



REMARKS: *Surface level interpolated from a survey plan provided by the client. **File:** P:\82241 Cockburn Central West\Field\CPT\82241 - CPT 37.CP5

Cone ID: Probedrill **Type:** EC36

ConePlot Version 5.9.1

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix B

Laboratory Testing

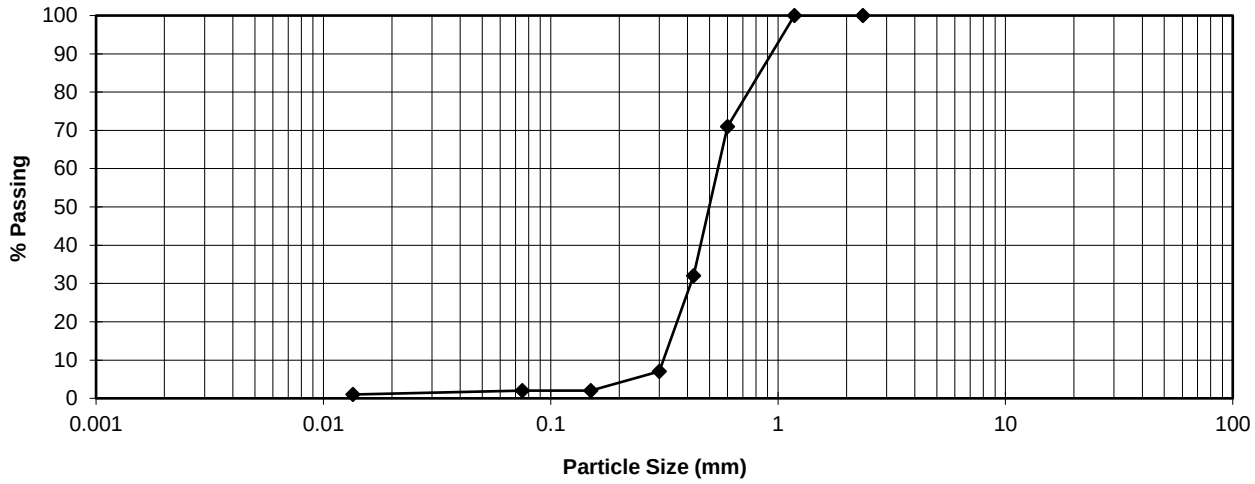
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/587
Sample No:	P14/587
Issue Date:	11 March 2014

Client: LandCorp
Project: Proposed Development
Location: Cockburn Central West, WA

Sample location: TP1
Sample Depth(m): 0.50



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	71
0.425	32
0.300	7
0.150	2
0.075	2
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	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

Approved signature

Matthew van Herk

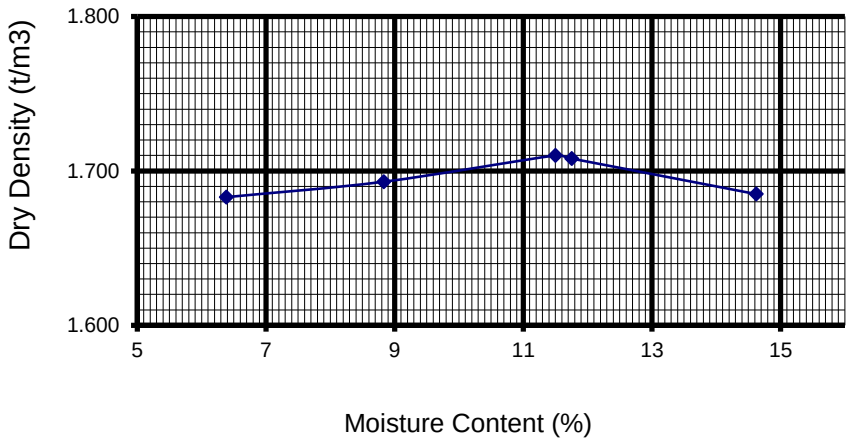
Mining &
Civil
Geotest Pty Ltd
Unit 1/1 Pusey Road, JANDAKOT WA 6164
Ph (08) 9414 8022
Fax (08)9414 8011
Email matt@mcgeotest.com.au

Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60017-P14/587	**Project:**	Proposed Development
Sample No:	P14/587	**Client:**	LandCorp
Location:	Cockburn Central West, WA	**Date of Issue:**	11 Febuary 2014
	TP1 0.5	**Job No:**	60017

Maximum Dry Density t/m^3:	1.71	**Conditions at Test**	
Optimum Moisture Content %:	11.5	Soaking Period (Days)	4
Desired Conditions:	95/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	12.3
Mass of hammer kg	4.9	Entire Moisture Ratio %	107.0
Number of layers	5	Top 30mm Moisture Content %	11.4
Number of blows/layer	13	Top 30mm Moisture Ratio %	99.0
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.625	C.B.R. at 2.5 mm Penetration %	16
Moisture Content %	11.7	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.625
Moisture Ratio %	102.1	Moisture Content %	14.1
Soaked / Unsoaked	Soaked	Dry Density Ratio %	95.0
		Moisture Ratio %	122.5

Comments:



Client address: 36 O'Malley St, Osborne Park

ASMDD-CBR June 2009

Approved Signature Matthew van Herk

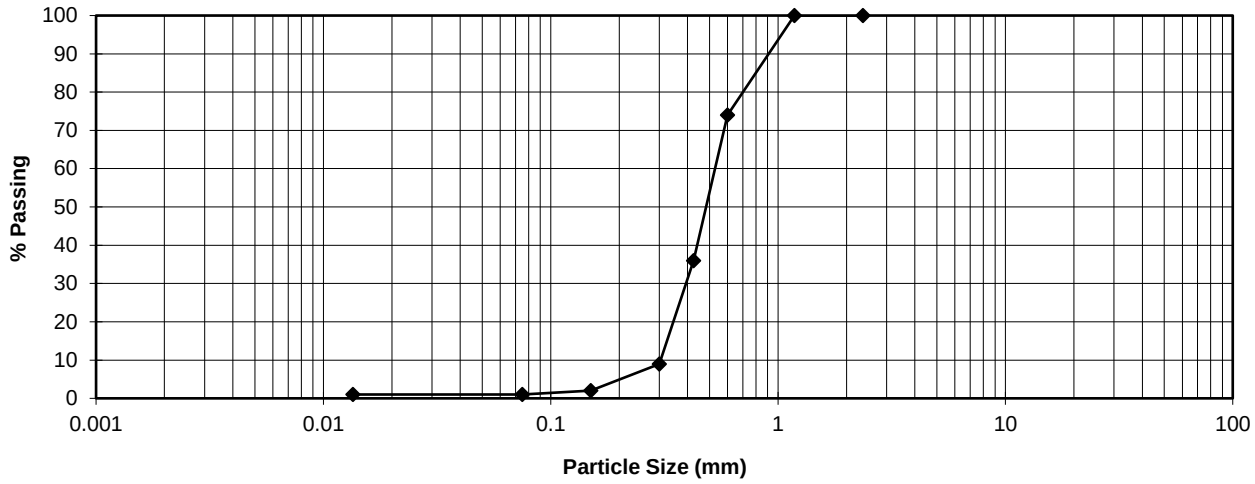
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/588
Sample No:	P14/588
Issue Date:	11 March 2014

Client: LandCorp
Project: Proposed Development
Location: Cockburn Central West, WA

Sample location: TP3
Sample Depth(m): 0.50



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	74
0.425	36
0.300	9
0.150	2
0.075	1
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	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

Approved signature

Matthew van Herk

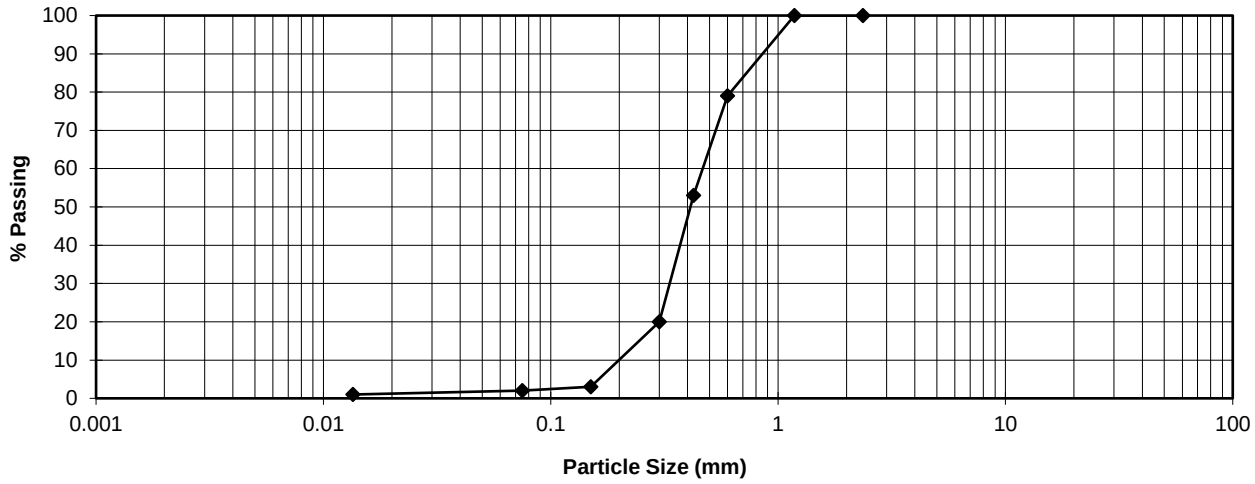
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/589
Sample No:	P14/589
Issue Date:	11 March 2014

Client: LandCorp
Project: Proposed Development
Location: Cockburn Central West, WA

Sample location: TP6
Sample Depth(m): 0.50



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	79
0.425	53
0.300	20
0.150	3
0.075	2
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	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

Approved signature

Matthew van Herk
AS PSDPI May 2009

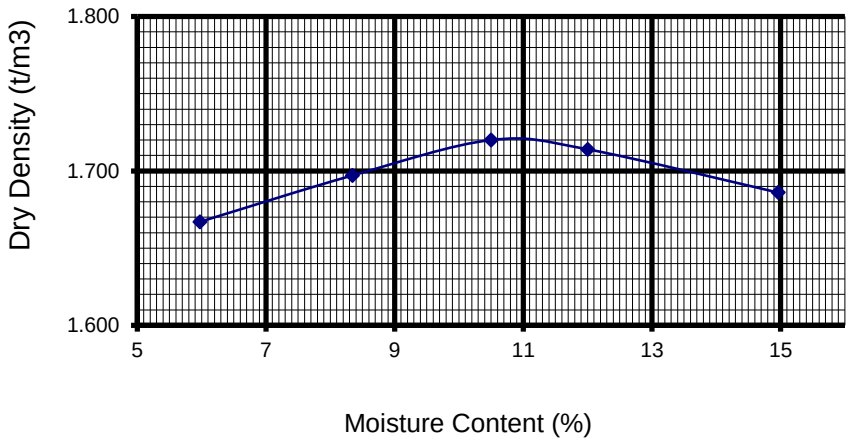
Mining &
Civil
Geotest Pty Ltd
Unit 1/1 Pusey Road, JANDAKOT WA 6164
Ph (08) 9414 8022
Fax (08)9414 8011
Email matt@mcgeotest.com.au

Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60017-P14/589	**Project:**	Proposed Development
Sample No:	P14/589	**Client:**	LandCorp
Location:	Cockburn Central West, WA	**Date of Issue:**	11 Febuary 2014
	TP6 0.5	**Job No:**	60017

Maximum Dry Density t/m^3:	1.72	**Conditions at Test**	
Optimum Moisture Content %:	10.5	Soaking Period (Days)	4
Desired Conditions:	95/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	18.0
Mass of hammer kg	4.9	Entire Moisture Ratio %	171.5
Number of layers	5	Top 30mm Moisture Content %	15.5
Number of blows/layer	10	Top 30mm Moisture Ratio %	148.0
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.637	C.B.R. at 5.0 mm Penetration %	9
Moisture Content %	10.3	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.637
Moisture Ratio %	98.5	Moisture Content %	17.7
Soaked / Unsoaked	Soaked	Dry Density Ratio %	95.0
		Moisture Ratio %	169.0

Comments:



Client address: 36 O'Malley St, Osborne Park

ASMDD-CBR June 2009

Approved Signature Matthew van Herk

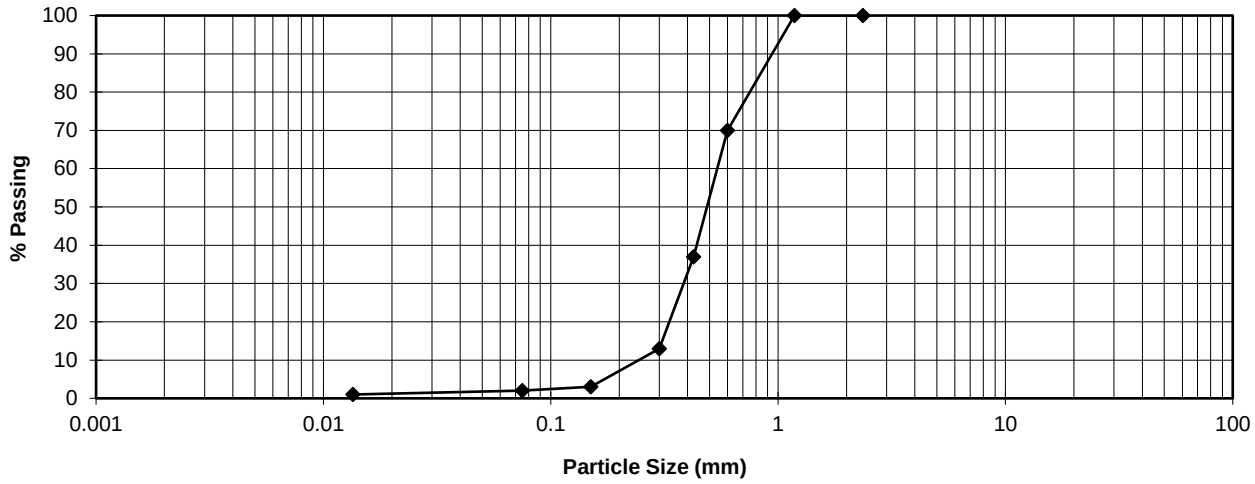
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/590
Sample No:	P14/590
Issue Date:	11 March 2014

Client: LandCorp
Project: Proposed Development
Location: Cockburn Central West, WA

Sample location: TP7
Sample Depth(m): 0.50



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	70
0.425	37
0.300	13
0.150	3
0.075	2
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	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

Approved signature

Matthew van Herk

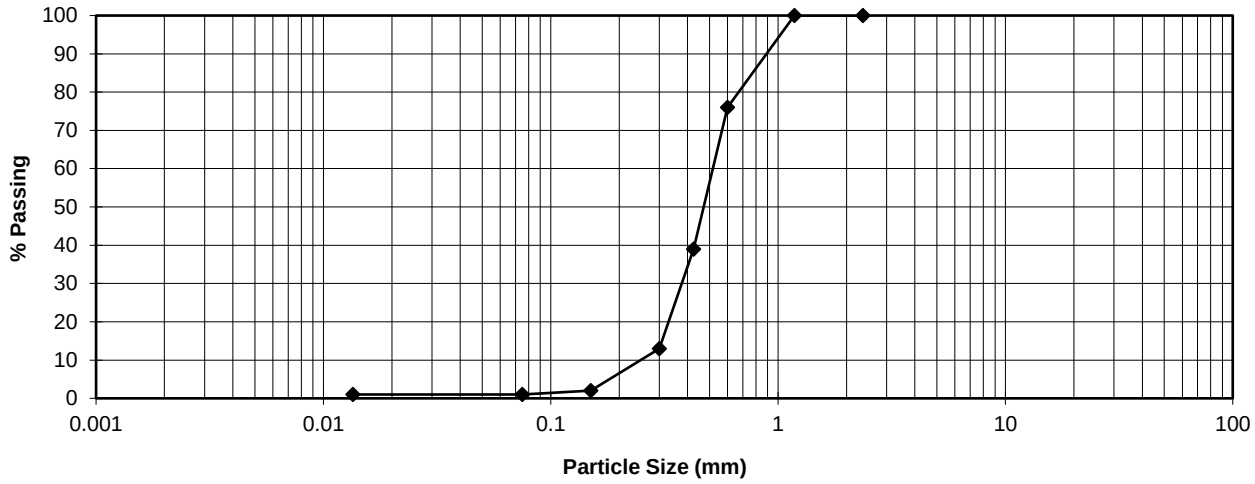
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/591
Sample No:	P14/591
Issue Date:	11 March 2014

Client: LandCorp
Project: Proposed Development
Location: Cockburn Central West, WA

Sample location: TP10
Sample Depth(m): 0.70



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	76
0.425	39
0.300	13
0.150	2
0.075	1
0.0135	1

Plasticity index tests
AS 1289

Liquid limit 3.9.1	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

Approved signature

Matthew van Herk

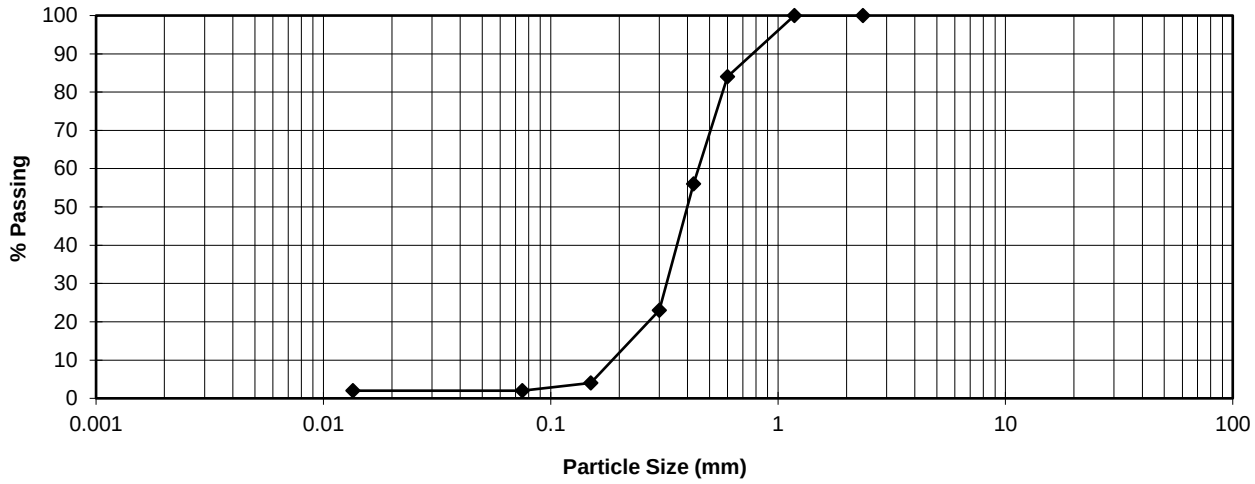
Particle Size Distribution & Plasticity Index tests

Mining &
Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/592
Sample No:	P14/592
Issue Date:	11 March 2014

Client: LandCorp
Project: Proposed Development
Location: Cockburn Central West, WA

Sample location: TP12
Sample Depth(m): 1.50



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	84
0.425	56
0.300	23
0.150	4
0.075	2
0.0135	2

Plasticity index tests
AS 1289

Liquid limit 3.9.1	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

Approved signature

Matthew van Herk

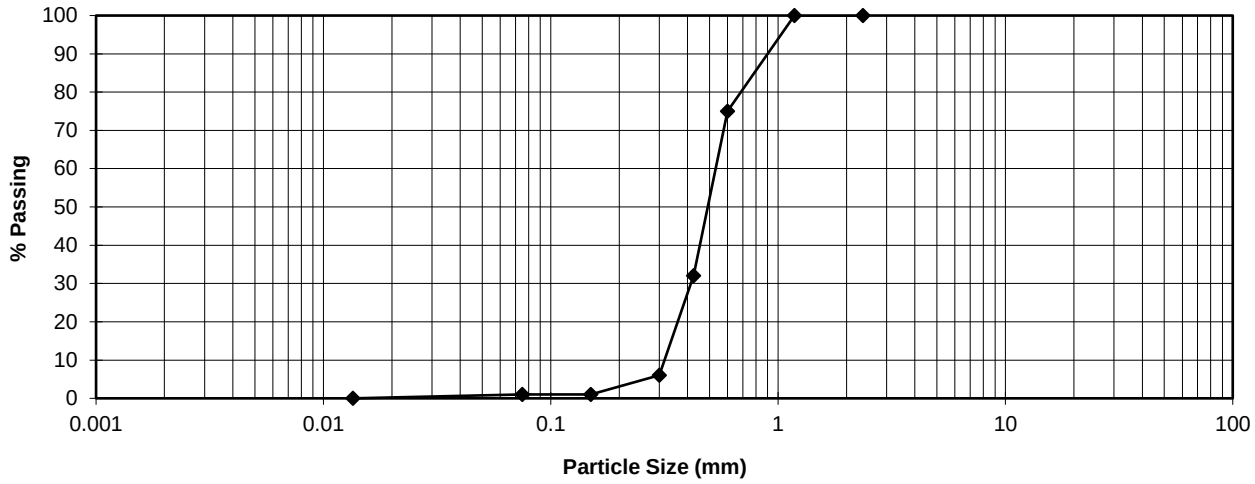
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/593
Sample No:	P14/593
Issue Date:	11 March 2014

Client: LandCorp
Project: Proposed Development
Location: Cockburn Central West, WA

Sample location: TP14
Sample Depth(m): 0.80



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	75
0.425	32
0.300	6
0.150	1
0.075	1
0.0135	0

Plasticity index tests
AS 1289

Liquid limit 3.9.1	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

Approved signature

Matthew van Herk
AS PSDPI May 2009

Mining & Civil Geotest Pty Ltd

Ph (08) 9414 8022 Fax (08) 9414 8011

Email matt@mcgeotest.com.au

Unit 1/1 Pusey Road, JANDAKOT WA 6164

Organic content of Soils ASTM: D 2974-07a Test Method C

Job No: 60017

Report No: 60017-P14/594

Date of issue: 11 March 2014

Client:	LandCorp	Date tested:	5 March 2014
Project:	Proposed Development	Tested by:	M Sehic
Location:	Cockburn Central West, WA	Checked:	M van Herk

Sample Number	Sample Identification	Ash content %	Organic content %
P14/594	TP19 0.3	94.1	5.9
Tested as received	Furnace temperature 440^{oc}		

Organic content April 2009

Approved Signature Matthew van Herk

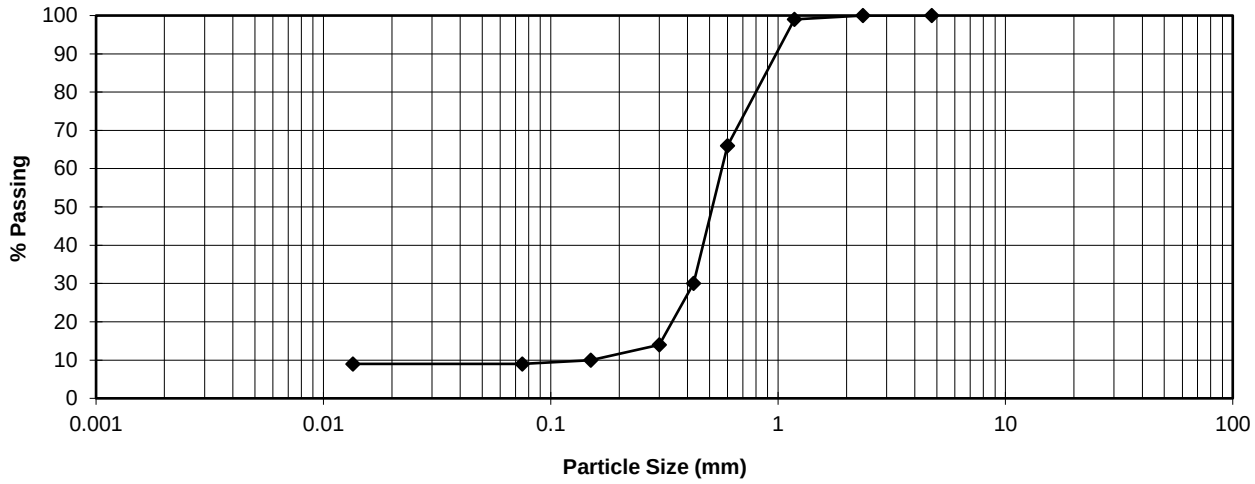
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/594
Sample No:	P14/594
Issue Date:	11 March 2014

Client: LandCorp
Project: Proposed Development
Location: Cockburn Central West, WA

Sample location: TP19
Sample Depth(m): 0.30



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	100
1.18	99
0.600	66
0.425	30
0.300	14
0.150	10
0.075	9
0.0135	9

Plasticity index tests
AS 1289

Liquid limit 3.9.1	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

Matthew van Herk

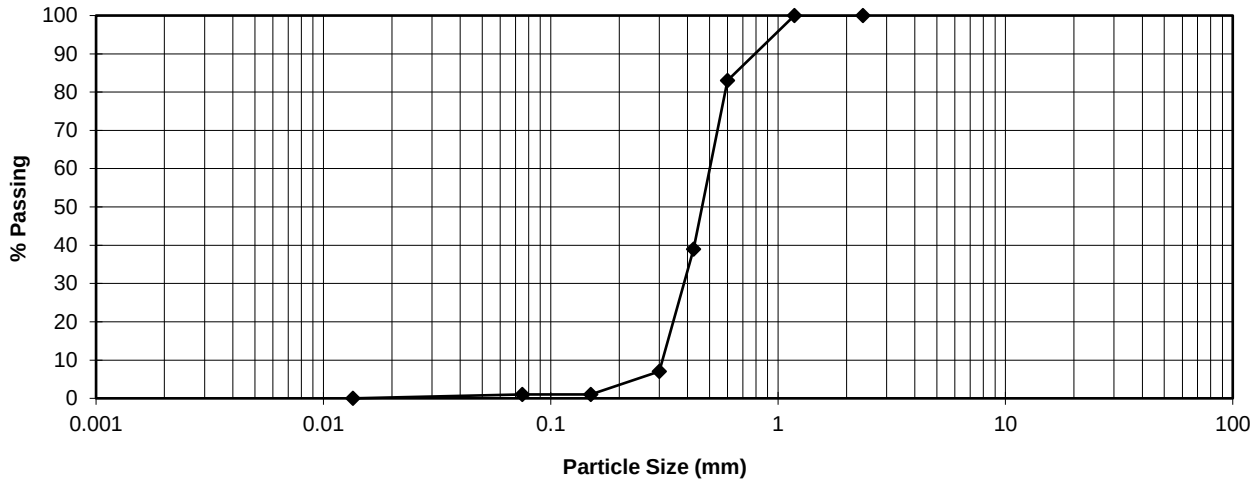
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/595
Sample No:	P14/595
Issue Date:	11 March 2014

Client: LandCorp
Project: Proposed Development
Location: Cockburn Central West, WA

Sample location: TP22
Sample Depth(m): 1.10



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	83
0.425	39
0.300	7
0.150	1
0.075	1
0.0135	0

Plasticity index tests
AS 1289

Liquid limit 3.9.1	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

Approved signature

Matthew van Herk
AS PSDPI May 2009

Appendix C

Table C-1: Summary of Screening and SPOCAS Suite of Testing Laboratory Reports and Chain of Custody Forms

Table C-1: Summary of Screening and SPOCAS Results

Test Location	Sample ID	Depth (m)	Soil Description	Screening				SPOCAS Suite of Testing							
						Strength	Δ			TAA [4] (%S)	(%S)	[6] (%S)	[7] (%S)	(%S)	Net [9] Acidity (%S)
TP1	1	0.5	SAND - grey-brown	4.3	3.2	Low	1.1	-	-	-	-	-	-	-	-
TP1	2	1.0	SAND - grey-brown	4.4	3.2	Low	1.2	5.9	3.2	<0.01	<0.01	<0.005		NT	<0.01
TP1	3	1.5	SAND - grey-brown	4.6	3.4	Low	1.2	-	-	-	-	-	-	-	-
TP1	4	2.0	SAND - grey-brown	4.5	3.5	Low	1.0	5.9	3.3	<0.01	<0.01	<0.005		NT	<0.01
TP2	7	0.5	SAND - light grey	4.7	4.1	Low	0.6	-	-	-	-	-	-	-	-
TP2	8	1.0	SAND - light grey	5.2	4.1	Low	1.1	5.9	3.5	<0.01	<0.01	<0.005		NT	<0.01
TP2	9	1.5	SAND - light grey	4.8	4.5	Low	0.3	-	-	-	-	-	-	-	-
TP2	10	2.0	SAND - light grey	4.9	4	Low	0.9	-	-	-	-	-	-	-	-
TP2	11	2.5	SAND - light grey	4.8	4.2	Low	0.6	6.1	5.4	<0.01	<0.01	<0.005		NT	<0.01
TP3	13	0.5	SAND - light grey	6.6	4.9	Low	1.7	-	-	-	-	-	-	-	-
TP3	14	1.0	SAND - light grey	6.2	4.9	Low	1.3	-	-	-	-	-	-	-	-
TP3	15	1.5	SAND - light grey	6.3	5	Low	1.3	-	-	-	-	-	-	-	-
TP3	16	2.0	SAND - light grey	6	5	Low	1.0	-	-	-	-	-	-	-	-
TP4	19	0.5	FILLING (SAND) - dark grey-brown/light grey	7.6	5.2	Low	2.4	-	-	-	-	-	-	-	-
TP4	20	1.0	SAND - light grey	7.6	5.9	Low	1.7	-	-	-	-	-	-	-	-
TP4	21	1.5	SAND - light grey	7.1	5	Low	2.1	-	-	-	-	-	-	-	-
TP4	22	2.0	SAND - grey-brown	7.5	5.8	Low	1.7	-	-	-	-	-	-	-	-
BH5	152	0.2	FILLING (SAND) - grey-brown/light grey	8.2	5.6	Low	1.2	-	-	-	-	-	-	-	-
BH5	25	0.5	SAND - grey-brown	5	3.5	Low	2.6	-	-	-	-	-	-	-	-
BH5	26	1.0	SAND - grey-brown	5.8	4.5	Low	1.5	-	-	-	-	-	-	-	-
BH5	27	1.5	SAND - grey-brown	6.5	4.8	Low	1.3	-	-	-	-	-	-	-	-
BH5	28	2.0	SAND - grey-brown	6.9	5.1	Low	1.7	-	-	-	-	-	-	-	-
TP6	31	0.5	SAND - grey-brown	5.3	3.8	Low	1.8	-	-	-	-	-	-	-	-
TP6	32	1.0	SAND - grey-brown	5.3	4.2	Low	1.5	6.1	3.8	<0.01	<0.01	<0.005		NT	<0.01
TP6	33	1.5	SAND - grey-brown	6.8	5.1	Low	1.1	-	-	-	-	-	-	-	-
TP6	34	2.0	SAND - grey-brown	6.8	4.9	Low	1.7	-	-	-	-	-	-	-	-
TP6	35	2.3	SAND - grey-brown and brown	6.7	4.4	Low	1.9	5.8	3.4	<0.01	0.013	0.008		NT	<0.01

Table C-1: Summary of Screening and SPOCAS Results

Test Location	Sample ID	Depth (m)	Soil Description	Screening				SPOCAS Suite of Testing							
						Strength	Δ			TAA [4] (%S)	(%S)	[6] (%S)	[7] (%S)	(%S)	Net [9] Acidity (%S)
TP7	37	0.5	FILLING (SAND) - grey-brown	7.8	6.1	Low	2.3	-	-	-	-	-	-	-	-
TP7	38	1.0	FILLING (SAND) - grey-brown	8	4.3	Low	1.7	-	-	-	-	-	-	-	-
TP7	39	1.5	SAND - light brown	7.7	4.9	Low	3.7	-	-	-	-	-	-	-	-
TP7	40	2.0	SAND - light brown	6.4	4.5	Low	2.8	-	-	-	-	-	-	-	-
TP8	43	0.5	SAND - light grey	5.4	3.7	Low	1.9	-	-	-	-	-	-	-	-
TP8	44	1.0	SAND - light grey	6.1	4.2	Low	1.7	6.1	3.9	<0.01	<0.01	<0.005		NT	<0.01
TP8	45	1.5	SAND - light grey	6.8	4.8	Low	1.9	-	-	-	-	-	-	-	-
TP8	46	2.0	SAND - light grey-brown	5.7	4	Low	2.0	5.9	3.7	<0.01	<0.01	<0.005		NT	<0.01
TP9	151	0.2	FILLING (SANDY GRAVEL) - grey-brown/yellow-brown	8.4	6.8	Medium	2.3	-	-	-	-	-	-	-	-
TP9	49	0.5	FILLING (SAND) - dark grey-brown	4.6	3.1	Low	1.7	-	-	-	-	-	-	-	-
TP9	50	1.0	SAND - light grey-brown	4.9	3.2	Low	1.6	-	-	-	-	-	-	-	-
TP9	51	1.5	SAND - light grey-brown	4.8	3.6	Low	1.5	5.9	3.6	<0.01	<0.01	<0.005		NT	<0.01
TP9	52	2.0	SAND - light grey-brown	5	3.8	Low	1.7	-	-	-	-	-	-	-	-
TP9	53	2.5	SAND - light grey-brown	5.5	4	Low	1.2	6	3.6	<0.01	<0.01	<0.005		NT	<0.01
TP10	55	0.5	SAND - light yellow-brown	5.9	4.1	Low	1.2	-	-	-	-	-	-	-	-
TP10	56	1.0	SAND - light yellow-brown	6	4.6	Low	1.5	-	-	-	-	-	-	-	-
TP10	57	1.5	SAND - yellow-brown	5.8	4.5	Low	1.8	6	5.4	<0.01	<0.01	<0.005		NT	<0.01
TP10	58	2.0	SAND - yellow-brown	6.2	4.6	Low	1.4	-	-	-	-	-	-	-	-
TP10	59	2.5	SAND - yellow-brown	6.1	4.6	Low	1.3	-	-	-	-	-	-	-	-
TP10	60	3.0	SAND - yellow-brown	6.1	4.4	Low	1.6	6.1	5.4	<0.01	<0.01	<0.005		NT	<0.01
TP11	61	0.5	SAND - light grey-brown	5.7	3.7	Low	1.5	-	-	-	-	-	-	-	-
TP11	62	1.0	SAND - light grey	5.6	4.3	Low	1.7	-	-	-	-	-	-	-	-
TP11	63	1.5	SAND - light grey	5.5	4.5	Low	2.0	6	4.6	<0.01	<0.01	<0.005		NT	<0.01
TP12	67	0.5	SAND - yellow-brown	6.4	4.1	Low	1.3	-	-	-	-	-	-	-	-
TP12	68	1.0	SAND - yellow-brown	6.4	4.6	Low	1.0	-	-	-	-	-	-	-	-

Table C-1: Summary of Screening and SPOCAS Results

Test Location	Sample ID	Depth (m)	Soil Description	Screening				SPOCAS Suite of Testing							
						Strength	Δ			TAA [4] (%S)	(%S)	[6] (%S)	[7] (%S)	(%S)	Net [9] Acidity (%S)
TP12	69	1.5	SAND - yellow-brown	6.2	4.6	Low	2.3	6.2	5.4	<0.01	<0.01	<0.005		NT	<0.01
TP12	70	2.0	SAND - yellow-brown	6.2	4.3	Low	1.8	-	-	-	-	-	-	-	-
TP12	71	2.5	SAND - yellow-brown	6	4.5	Low	1.6	-	-	-	-	-	-	-	-
TP12	72	3.0	SAND - yellow-brown	5.8	4.4	Low	1.9	6.1	5.4	<0.01	<0.01	<0.005		NT	<0.01
TP13	73	0.5	SAND - light grey	5.5	3.8	Low	1.5	-	-	-	-	-	-	-	-
TP13	74	1.0	SAND - light grey	5.5	4	Low	1.4	-	-	-	-	-	-	-	-
TP13	75	1.5	SAND - light grey-brown	5.2	4	Low	1.7	-	-	-	-	-	-	-	-
TP13	76	2.0	SAND - light grey-brown	5.2	3.9	Low	1.5	6	4.2	<0.01	<0.01	<0.005		NT	<0.01
TP14	79	0.5	SAND - light grey	5.6	3.9	Low	1.2	-	-	-	-	-	-	-	-
TP14	80	1.0	SAND - light grey	5.7	4.4	Low	1.3	-	-	-	-	-	-	-	-
TP14	81	1.5	SAND - light grey	5.5	4	Low	1.7	-	-	-	-	-	-	-	-
TP14	82	2.0	SAND - light grey	5.2	4.3	Low	1.3	-	-	-	-	-	-	-	-
TP15	85	0.5	SAND - light grey	5.7	3.4	Low	1.5	-	-	-	-	-	-	-	-
TP15	86	1.0	SAND - light grey	6	4	Low	0.9	5.8	4.6	<0.01	<0.01	<0.005		NT	<0.01
TP15	87	1.5	SAND - light grey	5.7	4.2	Low	2.3	-	-	-	-	-	-	-	-
TP15	88	2.0	SAND - light grey	5.7	3.4	Low	2.0	5.9	4.2	<0.01	<0.01	<0.005		NT	<0.01
TP16	91	0.5	SAND - light grey	5.2	3.4	Low	1.5	-	-	-	-	-	-	-	-
TP16	92	1.0	SAND - light grey	5.4	3.5	Low	2.3	5.7	3.6	<0.01	<0.01	<0.005		NT	<0.01
TP16	93	1.5	SAND - light grey	5.1	3.6	Low	1.8	-	-	-	-	-	-	-	-
TP16	94	2.0	SAND - light grey	4.8	4	Low	1.9	6	4.6	<0.01	<0.01	<0.005		NT	<0.01
TP17	97	0.5	SAND - light grey-brown	5.4	3.6	Low	1.5	-	-	-	-	-	-	-	-
TP17	98	1.0	SAND - light grey-brown	6	4.2	Low	0.8	-	-	-	-	-	-	-	-
TP17	99	1.5	SAND - light grey-brown	6.2	3.1	Low	1.8	5.9	4.6	<0.01	<0.01	<0.005		NT	<0.01
TP17	100	2.0	SAND - light grey-brown	6.6	3.4	Low	1.8	-	-	-	-	-	-	-	-
TP18	103	0.5	SAND - light grey-brown	5.8	3.1	Low	3.1	-	-	-	-	-	-	-	-
TP18	104	1.0	SAND - light grey-brown	6.4	3.9	Low	3.2	6	5.1	<0.01	<0.01	<0.005		NT	<0.01
TP18	105	1.5	SAND - light grey-brown	6.5	4.7	Low	2.7	-	-	-	-	-	-	-	-
TP19	109	0.5	FILLING (SAND) - dark grey-brown/light grey	5	**2.8**	Low	2.5	N/A	N/A	N/A	N/A	<0.	N/A	N/A	<0.

Table C-1: Summary of Screening and SPOCAS Results

Test Location	Sample ID	Depth (m)	Soil Description	Screening				SPOCAS Suite of Testing							
						Strength	Δ			TAA [4] (%S)	(%S)	[6] (%S)	[7] (%S)	(%S)	Net [9] Acidity (%S)
TP19	110	1.0	FILLING (SAND) - dark grey-brown/light grey	5	3.2	Medium	1.8	-	-	-	-	-	-	-	-
TP19	111	1.5	SAND - light grey-brown	6.4	4.1	Medium	2.2	-	-	-	-	-	-	-	-
TP19	112	2.0	SAND - light grey-brown	6	4	Medium	1.8	5.6	3.5	<0.01	<0.01	0.009		NT	0.014
TP20	115	0.5	SAND - light brown	5.5	3.1	Low	2.3	-	-	-	-	-	-	-	-
TP20	116	1.0	SAND - light brown	6	3.8	Low	2.0	-	-	-	-	-	-	-	-
TP20	117	1.5	SAND - yellow-brown	6.4	4.1	Low	2.4	5.8	4.6	<0.01	<0.01	<0.005		NT	<0.01
TP20	118	2.0	SAND - yellow-brown	5.7	4.3	Low	2.2	-	-	-	-	-	-	-	-
TP20	119	2.5	SAND - yellow-brown	6.3	4.7	Low	2.3	-	-	-	-	-	-	-	-
TP20	120	3.0	SAND - yellow-brown	6.2	4.7	Low	1.4	6	4.9	<0.01	<0.01	<0.005		NT	<0.01
TP21	121	0.5	SAND - light grey	5.3	3	Low	1.6	-	-	-	-	-	-	-	-
TP21	122	1.0	SAND - light grey	5.2	3.2	Low	1.5	-	-	-	-	-	-	-	-
TP21	123	1.5	SAND - light grey	5.6	3.6	Low	2.3	6	4.5	<0.01	<0.01	<0.005		NT	<0.01
TP21	124	2.0	SAND - light grey	5.6	4	Low	2.0	-	-	-	-	-	-	-	-
TP22	127	0.5	SAND - light grey	5.5	3	Low	2.0	5.3	3.2	<0.01	<0.01	<0.005		NT	<0.01
TP22	128	1.0	SAND - light grey	5.5	3.1	Low	1.6	-	-	-	-	-	-	-	-
TP22	129	1.5	SAND - light grey	5.5	3	Low	2.5	5.8	4.1	<0.01	<0.01	<0.005		NT	<0.01
TP22	130	2.0	SAND - light grey	5.4	3.7	Low	2.4	-	-	-	-	-	-	-	-
TP23	133	0.5	SAND - yellow-brown	6.3	4.5	Low	2.5	-	-	-	-	-	-	-	-
TP23	134	1.0	SAND - yellow-brown	5.9	4.5	Low	1.7	5.8	5	<0.01	<0.01	<0.005		NT	<0.01
TP23	135	1.5	SAND - yellow-brown	6.1	4.6	Low	1.8	-	-	-	-	-	-	-	-
TP23	136	2.0	SAND - yellow-brown	6.2	4.9	Low	1.4	6	5.1	<0.01	<0.01	<0.005		NT	<0.01
TP23	137	2.5	SAND - yellow-brown	6.4	4.9	Low	1.5	-	-	-	-	-	-	-	-
TP23	138	3.0	SAND - yellow-brown	5.9	4.8	Low	1.3	-	-	-	-	-	-	-	-
TP24	139	0.5	SAND - light yellow-brown	5.9	3.4	Low	1.5	5.6	4.1	<0.01	<0.01	<0.005		NT	<0.01
TP24	140	1.0	SAND - yellow-brown	6.5	4.8	Low	1.1	-	-	-	-	-	-	-	-
TP24	141	1.5	SAND - yellow-brown	5.3	4	Low	2.5	-	-	-	-	-	-	-	-
TP24	142	2.0	SAND - yellow-brown	5.4	4	Low	1.7	-	-	-	-	-	-	-	-
TP24	143	2.5	SAND - yellow-brown	5.5	4.3	Low	1.3	5.8	4.6	<0.01	<0.01	<0.005		NT	<0.01

Table C-1: Summary of Screening and SPOCAS Results

Test Location	Sample ID	Depth (m)	Soil Description	Screening				SPOCAS Suite of Testing							
						Strength	Δ			TAA [4] (%S)	(%S)	[6] (%S)	[7] (%S)	(%S)	Net [9] Acidity (%S)
TP25	145	0.5	SAND - light grey	5.4	3.6	Low	1.4	-	-	-	-	-	-	-	-
TP25	146	1.0	SAND - light grey	5.2	4.1	Low	1.2	-	-	-	-	-	-	-	-
TP25	147	1.5	SAND - light grey	6.1	3.8	Low	1.8	6	4.2	<0.01	<0.01	<0.005		<0.005	<0.01
TP25	148	2.0	SAND - light grey	5.9	4.7	Low	1.1	-	-	-	-	-	-	-	-

Notes:

1. Screening Tests undertaken by MPL Laboratories
2. Slight – indicates no or slight effervescence in hydrogen peroxide, Moderate – indicates moderate effervescence in hydrogen peroxide, High – indicates vigorous effervescence in hydrogen peroxide
3. **Δ pH** – -
4. TAA – titratable actual acidity
5. TPA – titratable peroxide acidity;
6. Spos – peroxide oxidisable sulphur
7. – retained acidity (reported for pHkCl < 4.5)
8. ANC – acid neutralising capacity (reported for pHkCl > 6.5).
9. Net Acidity = TAA + Spos + NASS. (It should be noted that ANC is excluded as per WA Guidelines)
10. Chromium reducible sulphure test undertaken.
11. N/A – Not applicable.
12. NR – Not Reported
13. **0.03** = exceedence of adopted criterion

Part of the Envirolab Group

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Envirolab Services (WA) Pty Ltd ABN 53 140 099 207

SAMPLE RECEIPT ADVICE

Client:

Douglas Partners Perth
36 O'Malley St
Osborne Park WA 6017

ph: 08 9204 3511
Fax: 08 9204 3522

Attention: Rob Shapland

Sample log in details:

Your reference:	**82241**
MPL Reference:	**147052**
Date received:	27/02/2014
Date results expected to be reported:	**5/03/14**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	Soil
Turnaround time requested:	Standard
Temperature on receipt °C	Frozen
Cooling Method:	Ice Pack
Sampling Date Provided:	Yes
Purchase order number:	112492

Comments:

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples. Perishable samples and dust filters are not retained, unless specifically requested.

Contact details:

Please direct any queries to Joshua Lim or Meredith Conroy
ph: 08 9317 2505 fax: 08 9317 4163
email: jlim@mpl.com.au or mconroy@mpl.com.au

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CERTIFICATE OF ANALYSIS 147052

Client:
Douglas Partners Perth
36 O'Malley St
Osborne Park
WA 6017

Attention: Rob Shapland

Sample log in details:

Your Reference:	**82241**
No. of samples:	Soil
Date samples received:	27/02/2014
Date completed instructions received:	27/02/2014
Location	Cockburn Central West, WA

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:	5/03/14
Date of Preliminary Report:	N/A
Issue Date:	4/03/14

Results Approved By:

Stacey Hawkins
Acid Soils/Acid Mine Drainage Supervisor

sPOCAS field test						
Our Reference:	UNITS	147052-1	147052-2	147052-3	147052-4	147052-5
Your Reference	----------	1	2	3	4	7
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	4.3	4.4	4.6	4.5	4.7
pH_{FOX} (field peroxide test)*	pH Units	3.2	3.2	3.4	3.5	4.1
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-6	147052-7	147052-8	147052-9	147052-10
Your Reference	----------	8	9	10	11	13
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	5.2	4.8	4.9	4.8	6.6
pH_{FOX} (field peroxide test)*	pH Units	4.1	4.5	4.0	4.2	4.9
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-11	147052-12	147052-13	147052-14	147052-15
Your Reference	----------	14	15	16	19	20
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	6.2	6.3	6.0	7.6	7.6
pH_{FOX} (field peroxide test)*	pH Units	4.9	5.0	5.0	5.2	5.9
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-16	147052-17	147052-18	147052-19	147052-20
Your Reference	----------	21	22	25	26	27
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	7.1	7.5	5.0	5.8	6.5
pH_{FOX} (field peroxide test)*	pH Units	5.0	5.8	3.5	4.5	4.8
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-21	147052-22	147052-23	147052-24	147052-25
Your Reference	----------	28	31	32	33	34
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	6.9	5.3	5.3	6.8	6.8
pH_{FOX} (field peroxide test)*	pH Units	5.1	3.8	4.2	5.1	4.9
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-26	147052-27	147052-28	147052-29	147052-30
Your Reference	----------	35	37	38	39	40
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	6.7	7.8	8.0	7.7	6.4
pH_{FOX} (field peroxide test)*	pH Units	4.4	6.1	4.3	4.9	4.5
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-31	147052-32	147052-33	147052-34	147052-35
Your Reference	----------	43	44	45	46	49
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	5.4	6.1	6.8	5.7	4.6
pH_{FOX} (field peroxide test)*	pH Units	3.7	4.2	4.8	4.0	3.1
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-36	147052-37	147052-38	147052-39	147052-40
Your Reference	----------	50	51	52	53	55
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	4.9	4.8	5.0	5.5	5.9
pH_{FOX} (field peroxide test)*	pH Units	3.2	3.6	3.8	4.0	4.1
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-41	147052-42	147052-43	147052-44	147052-45
Your Reference	----------	56	57	58	59	60
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	6.0	5.8	6.2	6.1	6.1
pH_{FOX} (field peroxide test)*	pH Units	4.6	4.5	4.6	4.6	4.4
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-46	147052-47	147052-48	147052-49	147052-50
Your Reference	----------	61	62	63	67	68
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	5.7	5.6	5.5	6.4	6.4
pH_{FOX} (field peroxide test)*	pH Units	3.7	4.3	4.5	4.1	4.6
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-51	147052-52	147052-53	147052-54	147052-55
Your Reference	----------	69	70	71	72	73
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	6.2	6.2	6.0	5.8	5.5
pH_{FOX} (field peroxide test)*	pH Units	4.6	4.3	4.5	4.4	3.8
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-56	147052-57	147052-58	147052-59	147052-60
Your Reference	----------	74	75	76	79	80
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	5.5	5.2	5.2	5.6	5.7
pH_{FOX} (field peroxide test)*	pH Units	4.0	4.0	3.9	3.9	4.4
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-61	147052-62	147052-63	147052-64	147052-65
Your Reference	----------	81	82	85	86	87
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	5.5	5.2	5.7	6.0	5.7
pH_{FOX} (field peroxide test)*	pH Units	4.0	4.3	3.4	4.0	4.2
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-66	147052-67	147052-68	147052-69	147052-70
Your Reference	----------	88	91	92	93	94
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	5.7	5.2	5.4	5.1	4.8
pH_{FOX} (field peroxide test)*	pH Units	3.4	3.4	3.5	3.6	4.0
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-71	147052-72	147052-73	147052-74	147052-75
Your Reference	----------	97	98	99	100	103
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	5.4	6.0	6.2	6.6	5.8
pH_{FOX} (field peroxide test)*	pH Units	3.6	4.2	3.1	3.4	3.1
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-76	147052-77	147052-78	147052-79	147052-80
Your Reference	----------	104	105	109	110	111
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	6.4	6.5	5.0	5.0	6.4
pH_{FOX} (field peroxide test)*	pH Units	3.9	4.7	2.8	3.2	4.1
Reaction Rate*	-	Low	Low	Low	Medium	Medium

sPOCAS field test						
Our Reference:	UNITS	147052-81	147052-82	147052-83	147052-84	147052-85
Your Reference	----------	112	115	116	117	118
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	6.0	5.5	6.0	6.4	5.7
pH_{FOX} (field peroxide test)*	pH Units	4.0	3.1	3.8	4.1	4.3
Reaction Rate*	-	Medium Medium	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-86	147052-87	147052-88	147052-89	147052-90
Your Reference	----------	119	120	121	122	123
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	6.3	6.2	5.3	5.2	5.6
pH_{FOX} (field peroxide test)*	pH Units	4.7	4.7	3.0	3.2	3.6
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-91	147052-92	147052-93	147052-94	147052-95
Your Reference	----------	124	127	128	129	130
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	5.6	5.5	5.5	5.5	5.4
pH_{FOX} (field peroxide test)*	pH Units	4.0	3.0	3.1	3.0	3.7
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-96	147052-97	147052-98	147052-99	147052-100
Your Reference	----------	133	134	135	136	137
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	6.3	5.9	6.1	6.2	6.4
pH_{FOX} (field peroxide test)*	pH Units	4.5	4.5	4.6	4.9	4.9
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-101	147052-102	147052-103	147052-104	147052-105
Your Reference	----------	138	139	140	141	142
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	5.9	5.9	6.5	5.3	5.4
pH_{FOX} (field peroxide test)*	pH Units	4.8	3.4	4.8	4.0	4.0
Reaction Rate*	-	Low Low	Low	Low	Low	Low

sPOCAS field test						
Our Reference:	UNITS	147052-106	147052-107	147052-108	147052-109	147052-110
Your Reference	----------	143	145	146	147	148
Date Sampled	----------	24/02/2014	24/02/2014	24/02/2014	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil	Frozen soil	Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014	27/02/2014	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014	28/02/2014	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	5.5	5.4	5.2	6.1	5.9
pH_{FOX} (field peroxide test)*	pH Units	4.3	3.6	4.1	3.8	4.7
Reaction Rate*	-	Low	Low	Low	Low	Low

sPOCAS field test			
Our Reference:	UNITS	147052-111	147052-112
Your Reference	----------	151	152
Date Sampled	----------	24/02/2014	24/02/2014
Type of sample		Frozen soil	Frozen soil
Date prepared	-	27/02/2014	27/02/2014
Date analysed	-	28/02/2014	28/02/2014
pH_F (field pH test)*	pH Units	8.4	8.2
pH_{FOX} (field peroxide test)*	pH Units	6.8	5.6
Reaction Rate*	-	Medium Medium	Low

Method ID	Methodology Summary
INORG-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL sPOCAS field test	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD
Date prepared	-			[NT]	147052-1	27/02/2014 || 27/02/2014
Date analysed	-			[NT]	147052-1	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units		INORG-063	[NT]	147052-1	4.3 || 4.3 || RPD: 0
pH_{FOX} (field peroxide test)*	pH Units		INORG-063	[NT]	147052-1	3.2 || 3.2 || RPD: 0

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-11	27/02/2014 || 27/02/2014
Date analysed	-	147052-11	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-11	6.2 || 6.4 || RPD: 3
pH_{FOX} (field peroxide test)*	pH Units	147052-11	4.9 || 4.9 || RPD: 0

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-21	27/02/2014 || 27/02/2014
Date analysed	-	147052-21	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-21	6.9 || 6.9 || RPD: 0
pH_{FOX} (field peroxide test)*	pH Units	147052-21	5.1 || 5.1 || RPD: 0

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-31	27/02/2014 || 27/02/2014
Date analysed	-	147052-31	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-31	5.4 || 5.1 || RPD: 6
pH_{FOX} (field peroxide test)*	pH Units	147052-31	3.7 || 3.6 || RPD: 3

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-41	27/02/2014 || 27/02/2014
Date analysed	-	147052-41	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-41	6.0 || 6.0 || RPD: 0
pH_{FOX} (field peroxide test)*	pH Units	147052-41	4.6 || 4.5 || RPD: 2

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-51	27/02/2014 || 27/02/2014
Date analysed	-	147052-51	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-51	6.2 || 6.2 || RPD: 0
pH_{FOX} (field peroxide test)*	pH Units	147052-51	4.6 || 4.8 || RPD: 4

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-61	27/02/2014 || 27/02/2014
Date analysed	-	147052-61	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-61	5.5 || 5.5 || RPD: 0
pH_{FOX} (field peroxide test)*	pH Units	147052-61	4.0 || 3.7 || RPD: 8
QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-71	27/02/2014 || 27/02/2014
Date analysed	-	147052-71	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-71	5.4 || 5.5 || RPD: 2
pH_{FOX} (field peroxide test)*	pH Units	147052-71	3.6 || 3.5 || RPD: 3
QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-81	27/02/2014 || 27/02/2014
Date analysed	-	147052-81	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-81	6.0 || 6.1 || RPD: 2
pH_{FOX} (field peroxide test)*	pH Units	147052-81	4.0 || 4.1 || RPD: 2
QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-91	27/02/2014 || 27/02/2014
Date analysed	-	147052-91	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-91	5.6 || 5.6 || RPD: 0
pH_{FOX} (field peroxide test)*	pH Units	147052-91	4.0 || 4.0 || RPD: 0
QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-101	27/02/2014 || 27/02/2014
Date analysed	-	147052-101	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-101	5.9 || 5.9 || RPD: 0
pH_{FOX} (field peroxide test)*	pH Units	147052-101	4.8 || 4.8 || RPD: 0
QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147052-111	27/02/2014 || 27/02/2014
Date analysed	-	147052-111	28/02/2014 || 28/02/2014
pH_F (field pH test)*	pH Units	147052-111	8.4 || 8.4 || RPD: 0
pH_{FOX} (field peroxide test)*	pH Units	147052-111	6.8 || 6.8 || RPD: 0

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	[NT]	[NT]
Date analysed	-	[NT]	[NT]
pH F (field pH test)*	pH Units	[NT]	[NT]
pH FOX (field peroxide test)*	pH Units	[NT]	[NT]

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	[NT]	[NT]
Date analysed	-	[NT]	[NT]
pH F (field pH test)*	pH Units	[NT]	[NT]
pH FOX (field peroxide test)*	pH Units	[NT]	[NT]

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	[NT]	[NT]
Date analysed	-	[NT]	[NT]
pH F (field pH test)*	pH Units	[NT]	[NT]
pH FOX (field peroxide test)*	pH Units	[NT]	[NT]

QUALITY CONTROL sPOCAS field test	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	[NT]	[NT]
Date analysed	-	[NT]	[NT]
pH F (field pH test)*	pH Units	[NT]	[NT]
pH FOX (field peroxide test)*	pH Units	[NT]	[NT]

Report Comments:

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

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.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable
For VOCs in water samples, three vials are required for duplicate or spike analysis
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;
10-140% for SVOC and Speciated Phenols; and 40-120% for low level organics is acceptable.
Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.
In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.
When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Cockburn Central West, WA
Project No: 82241
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPL
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes											NOTES
					pH_F	pH_{FOX}										
1	24/2/14	S	Ice/Frozen		x	x										
2	24/2/14	S	Ice/Frozen		x	x										
3	24/2/14	S	Ice/Frozen		x	x										
4	24/2/14	S	Ice/Frozen		x	x										
7	24/2/14	S	Ice/Frozen		x	x										
8	24/2/14	S	Ice/Frozen		x	x										
9	24/2/14	S	Ice/Frozen		x	x										
10	24/2/14	S	Ice/Frozen		x	x										
11	24/2/14	S	Ice/Frozen		x	x										
13	24/2/14	S	Ice/Frozen		x	x										
14	24/2/14	S	Ice/Frozen		x	x										
15	24/2/14	S	Ice/Frozen		x	x										
16	24/2/14	S	Ice/Frozen		x	x										
19	24/2/14	S	Ice/Frozen		x	x										
PQL (S)																
PQL (W)																

mpi ENVIROLAB GROUP
Job No. - 147052
Date Rec - 27.2.14
Time Rec - 15:10
Rec By -
TAT Req - 24/48/72/STD
Temp - Cool/ambient
Cooling - Ice/ice pack/None
Security Seal - Yes / No

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: Y Chen Relinquished By: Y Chen Sign: Y.Chen Date/Time: 27/2//2014
Received By: L Vest Relinquished By: Sign: L Vest Date/Time: 27.2.14.

** Please send results to rob.shapland@douglasparters.com.au **

Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
Fax: (08) 9204 3522

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CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Cockburn Central West, WA
Project No: 82241
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPL
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes											NOTES
					pH_F	pH_{FOX}										
20	24/2/14	S	Ice/Frozen		x	x										
21	24/2/14	S	Ice/Frozen		x	x										
22	24/2/14	S	Ice/Frozen		x	x										
25	25/2/14	S	Ice/Frozen		x	x										
26	25/2/14	S	Ice/Frozen		x	x										
27	25/2/14	S	Ice/Frozen		x	x										
28	25/2/14	S	Ice/Frozen		x	x										
31	24/2/14	S	Ice/Frozen		x	x										
32	24/2/14	S	Ice/Frozen		x	x										
33	24/2/14	S	Ice/Frozen		x	x										
34	24/2/14	S	Ice/Frozen		x	x										
35	24/2/14	S	Ice/Frozen		x	x										
37	24/2/14	S	Ice/Frozen		x	x										
38	24/2/14	S	Ice/Frozen		x	x										
PQL (S)																
PQL (W)																

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: Y Chen Relinquished By: Y Chen Sign: Y. Chen Date/Time: 27/2//2014

Received By: NGA Relinquished By: Sign: Date/Time: 27.2.14

** Please send results to rob.shapland@douglasparters.com.au **

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CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Cockburn Central West, WA
Project No: 82241
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPL
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes											NOTES
					pH_F	pH_{FOX}										
39	24/2/14	S	Ice/Frozen		x	x										
40	24/2/14	S	Ice/Frozen		x	x										
43	24/2/14	S	Ice/Frozen		x	x										
44	24/2/14	S	Ice/Frozen		x	x										
45	24/2/14	S	Ice/Frozen		x	x										
46	24/2/14	S	Ice/Frozen		x	x										
49	24/2/14	S	Ice/Frozen		x	x										
50	24/2/14	S	Ice/Frozen		x	x										
51	24/2/14	S	Ice/Frozen		x	x										
52	24/2/14	S	Ice/Frozen		x	x										
53	24/2/14	S	Ice/Frozen		x	x										
55	24/2/14	S	Ice/Frozen		x	x										
56	24/2/14	S	Ice/Frozen		x	x										
57	24/2/14	S	Ice/Frozen		x	x										
PQL (S)																
PQL (W)																

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: Y Chen Relinquished By: Y Chen Sign: Y. Chen Date/Time: 27/2//2014

Received By: NCS Relinquished By: Sign: Date/Time: 27.2.14

** Please send results to rob.shapland@douglasparters.com.au **

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OSBORNE PARK 6017
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CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Cockburn Central West, WA
Project No: 82241
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPL
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes												NOTES
					pH_F	pH_{FOX}											
58	24/2/14	S	Ice/Frozen		x	x											
59	24/2/14	S	Ice/Frozen		x	x											
60	24/2/14	S	Ice/Frozen		x	x											
61	24/2/14	S	Ice/Frozen		x	x											
62	24/2/14	S	Ice/Frozen		x	x											
63	24/2/14	S	Ice/Frozen		x	x											
67	24/2/14	S	Ice/Frozen		x	x											
68	24/2/14	S	Ice/Frozen		x	x											
69	24/2/14	S	Ice/Frozen		x	x											
70	24/2/14	S	Ice/Frozen		x	x											
71	24/2/14	S	Ice/Frozen		x	x											
72	24/2/14	S	Ice/Frozen		x	x											
73	24/2/14	S	Ice/Frozen		x	x											
74	24/2/14	S	Ice/Frozen		x	x											
PQL (S)																	
PQL (W)																	

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: Y Chen Relinquished By: Y Chen Sign: Y.Chen Date/Time: 27/2//2014

Received By: JLCA Relinquished By: Sign: Date/Time: 27.2.14

** Please send results to rob.shapland@douglasparters.com.au **

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CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Cockburn Central West, WA
Project No: 82241
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPL
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes											NOTES
					pH_F	pH_{FOX}										
75	24/2/14	S	Ice/Frozen		x	x										
76	24/2/14	S	Ice/Frozen		x	x										
79	24/2/14	S	Ice/Frozen		x	x										
80	24/2/14	S	Ice/Frozen		x	x										
81	24/2/14	S	Ice/Frozen		x	x										
82	24/2/14	S	Ice/Frozen		x	x										
85	24/2/14	S	Ice/Frozen		x	x										
86	24/2/14	S	Ice/Frozen		x	x										
87	24/2/14	S	Ice/Frozen		x	x										
88	24/2/14	S	Ice/Frozen		x	x										
91	24/2/14	S	Ice/Frozen		x	x										
92	24/2/14	S	Ice/Frozen		x	x										
93	24/2/14	S	Ice/Frozen		x	x										
94	24/2/14	S	Ice/Frozen		x	x										
PQL (S)																
PQL (W)																

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: Y Chen Relinquished By: Y Chen Sign: Y. Chen Date/Time: 27/2//2014

Received By: Relinquished By: Sign: Date/Time: 27.2.14

** Please send results to rob.shapland@douglasparters.com.au **

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36 O'Malley Street
OSBORNE PARK 6017
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CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Cockburn Central West, WA
Project No: 82241
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPI
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes											NOTES
					pH_F	pH_{FOX}										
97	24/2/14	S	Ice/Frozen		x	x										
98	24/2/14	S	Ice/Frozen		x	x										
99	24/2/14	S	Ice/Frozen		x	x										
100	24/2/14	S	Ice/Frozen		x	x										
103	24/2/14	S	Ice/Frozen		x	x										
104	24/2/14	S	Ice/Frozen		x	x										
105	24/2/14	S	Ice/Frozen		x	x										
109	24/2/14	S	Ice/Frozen		x	x										
110	24/2/14	S	Ice/Frozen		x	x										
111	24/2/14	S	Ice/Frozen		x	x										
112	24/2/14	S	Ice/Frozen		x	x										
115	24/2/14	S	Ice/Frozen		x	x										
116	24/2/14	S	Ice/Frozen		x	x										
117	24/2/14	S	Ice/Frozen		x	x										
PQL (S)																
PQL (W)																

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: Y Chen Relinquished By: Y Chen Sign: Y. Chen Date/Time: 27/2//2014

Received By: Relinquished By: Sign: Date/Time: 27 2 14

** Please send results to rob.shapland@douglasparters.com.au **

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36 O'Malley Street
OSBORNE PARK 6017
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Geotechnics - Environment - Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Cockburn Central West, WA
Project No: 82241
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPL
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes											NOTES
					pH_F	pH_{FOX}										
118	24/2/14	S	Ice/Frozen		x	x										
119	24/2/14	S	Ice/Frozen		x	x										
120	24/2/14	S	Ice/Frozen		x	x										
121	24/2/14	S	Ice/Frozen		x	x										
122	24/2/14	S	Ice/Frozen		x	x										
123	24/2/14	S	Ice/Frozen		x	x										
124	24/2/14	S	Ice/Frozen		x	x										
127	24/2/14	S	Ice/Frozen		x	x										
128	24/2/14	S	Ice/Frozen		x	x										
129	24/2/14	S	Ice/Frozen		x	x										
130	24/2/14	S	Ice/Frozen		x	x										
133	24/2/14	S	Ice/Frozen		x	x										
134	24/2/14	S	Ice/Frozen		x	x										
135	24/2/14	S	Ice/Frozen		x	x										
PQL (S)																
PQL (W)																

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: Y Chen Relinquished By: Y Chen Sign: Y. Chen Date/Time: 27/2//2014

Received By: Relinquished By: Sign: Date/Time: 27.2.14

** Please send results to rob.shapland@douglasparters.com.au **

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Douglas Partners
Geotechnics - Environment - Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Cockburn Central West, WA
Project No: 82241
DP Contact Person: Rob Shapland
Prior Storage: Ice /Frozen

To: MPL
16-18 Hayden Court
Myaree, WA 6154
Ph: 9317 2505
Attn:

Sample ID	Sampling Time / Date	Sample Type S-soil W-water	Preservation	Lab ID	Analytes											NOTES
					pH_F	pH_{FOX}										
136	24/2/14	S	Ice/Frozen		x	x										
137	24/2/14	S	Ice/Frozen		x	x										
138	24/2/14	S	Ice/Frozen		x	x										
139	24/2/14	S	Ice/Frozen		x	x										
140	24/2/14	S	Ice/Frozen		x	x										
141	24/2/14	S	Ice/Frozen		x	x										
142	24/2/14	S	Ice/Frozen		x	x										
143	24/2/14	S	Ice/Frozen		x	x										
145	24/2/14	S	Ice/Frozen		x	x										
146	24/2/14	S	Ice/Frozen		x	x										
147	24/2/14	S	Ice/Frozen		x	x										
148	24/2/14	S	Ice/Frozen		x	x										
151	24/2/14	S	Ice/Frozen		x	x										
152	24/2/14	S	Ice/Frozen		x	x										
PQL (S)																
PQL (W)																

PQL = practical quantification limit, *As per Laboratory Method Detection Limit

Sampled By: Y Chen Relinquished By: Y Chen Sign: Y. Chen Date/Time: 27/2//2014

Received By: Relinquished By: Sign: Date/Time: 27.2.14

** Please send results to rob.shapland@douglasparters.com.au **

Douglas Partners Pty Ltd
36 O'Malley Street
OSBORNE PARK 6017
Ph: (08) 9204 3511
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Part of the Envirolab Group

16 - 18 Hayden Court, Myaree, Western Australia 6154
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email: laboratory@mpl.com.au
www.envirolabservices.com.au
Envirolab Services (WA) Pty Ltd ABN 53 140 099 207

CERTIFICATE OF ANALYSIS 147257

Client:
Douglas Partners Perth
36 O'Malley St
Osborne Park
WA 6017

Attention: Rob Shapland

Sample log in details:

Your Reference:	**82241**
No. of samples:	Dried Soil
Date samples received:	27/02/2014
Date completed instructions received:	05/03/2014
Location:	Cockburn Central West, WA

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:	14/03/14
Date of Preliminary Report:	N/A
Issue Date:	13/03/14

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Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Stacey Hawkins
Acid Soils/Acid Mine Drainage Supervisor

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	147257-1 2 24/02/2014 Dried soil	147257-2 4 24/02/2014 Dried soil	147257-3 8 24/02/2014 Dried soil	147257-4 11 24/02/2014 Dried soil	147257-5 32 24/02/2014 Dried soil
Date prepared	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
Date analysed	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
pH $_{kcl}$	pH units	5.9	5.9	5.9	6.1	6.1
TAA	moles H^+/t	<5	<5	<5	<5	<5
pH $_{Ox}$	pH units	3.2	3.3	3.5	5.4	3.8
TPA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
S_{KCl}	%w/w S	0.007	0.007	<0.005	0.006	<0.005
Ca_{KCl}	%w/w	0.023	0.014	0.012	<0.005	<0.005
Mg_{KCl}	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
S_P	%w/w	0.009	0.010	0.007	<0.005	0.006
Ca_P	%w/w	0.023	0.014	0.014	0.008	0.006
Mg_P	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
a-ANC_E	moles H^+/t	NT	NT	NT	NT	NT
S_{HCl}	%w/w S	NT	NT	NT	NT	NT
TSA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-TAA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TPA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TSA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	% $CaCO_3$	NT	NT	NT	NT	NT
s-ANC_E	%w/w S	NT	NT	NT	NT	NT
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	NT	NT	NT	NT	NT
a-S_{NAS}	moles H^+/t	NT	NT	NT	NT	NT
s-S_{NAS}	%w/w S	NT	NT	NT	NT	NT
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
Net Acidity (WA)	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+/t	<10	<10	<10	<10	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- -	147257-6 35 24/02/2014 Dried soil	147257-7 44 24/02/2014 Dried soil	147257-8 46 24/02/2014 Dried soil	147257-9 51 24/02/2014 Dried soil	147257-10 53 24/02/2014 Dried soil
Date prepared	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
Date analysed	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
pH $_{kcl}$	pH units	5.8	6.1	5.9	5.9	6.0
TAA	moles H^+/t	<5	<5	<5	<5	<5
pH $_{ox}$	pH units	3.4	3.9	3.7	3.6	3.6
TPA	moles H^+/t	8.3	<5.0	<5.0	<5.0	<5.0
S_{KCl}	%w/w S	0.006	0.006	0.005	0.006	0.007
Ca_{KCl}	%w/w	0.005	0.006	<0.005	0.006	0.007
Mg_{KCl}	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
S_P	%w/w	0.014	<0.005	0.005	0.006	<0.005
Ca_P	%w/w	0.006	0.006	<0.005	0.007	0.007
Mg_P	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
a-ANC_E	moles H^+/t	NT	NT	NT	NT	NT
S_{HCl}	%w/w S	NT	NT	NT	NT	NT
TSA	moles H^+/t	7.1	<5.0	<5.0	<5.0	<5.0
s-TAA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TPA	%w/w S	0.013	<0.01	<0.01	<0.01	<0.01
s-TSA	%w/w S	0.011	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	0.008	<0.005	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	%$CaCO_3$	NT	NT	NT	NT	NT
s-ANC_E	%w/w S	NT	NT	NT	NT	NT
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	NT	NT	NT	NT	NT
a-S_{NAS}	moles H^+/t	NT	NT	NT	NT	NT
s-S_{NAS}	%w/w S	NT	NT	NT	NT	NT
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
Net Acidity (WA)	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+/t	<10	<10	<10	<10	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	147257-11 57 24/02/2014 Dried soil	147257-12 60 24/02/2014 Dried soil	147257-13 63 24/02/2014 Dried soil	147257-14 69 24/02/2014 Dried soil	147257-15 72 24/02/2014 Dried soil
Date prepared	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
Date analysed	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
pH $_{kcl}$	pH units	6.0	6.1	6.0	6.2	6.1
TAA	moles H^+/t	<5	<5	<5	<5	<5
pH $_{ox}$	pH units	5.4	5.4	4.6	5.4	5.4
TPA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
S_{KCl}	%w/w S	<0.005	0.005	<0.005	0.006	0.007
Ca_{KCl}	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_{KCl}	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
S_P	%w/w	0.006	0.006	0.007	0.008	0.006
Ca_P	%w/w	<0.005	0.007	<0.005	0.005	<0.005
Mg_P	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
a-ANC_E	moles H^+/t	NT	NT	NT	NT	NT
S_{HCl}	%w/w S	NT	NT	NT	NT	NT
TSA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-TAA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TPA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TSA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	%$CaCO_3$	NT	NT	NT	NT	NT
s-ANC_E	%w/w S	NT	NT	NT	NT	NT
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	NT	NT	NT	NT	NT
a-S_{NAS}	moles H^+/t	NT	NT	NT	NT	NT
s-S_{NAS}	%w/w S	NT	NT	NT	NT	NT
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
Net Acidity (WA)	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+/t	<10	<10	<10	<10	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	147257-16 76 24/02/2014 Dried soil	147257-17 86 24/02/2014 Dried soil	147257-18 88 24/02/2014 Dried soil	147257-19 92 24/02/2014 Dried soil	147257-20 94 24/02/2014 Dried soil
Date prepared	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
Date analysed	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
pH $_{kcl}$	pH units	6.0	5.8	5.9	5.7	6.0
TAA	moles H^+/t	<5	<5	<5	<5	<5
pH $_{ox}$	pH units	4.2	4.6	4.2	3.6	4.6
TPA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
S_{KCl}	%w/w S	<0.005	<0.005	0.006	<0.005	0.005
Ca_{KCl}	%w/w	<0.005	<0.005	<0.005	0.006	<0.005
Mg_{KCl}	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
S_P	%w/w	<0.005	<0.005	<0.005	0.007	<0.005
Ca_P	%w/w	<0.005	<0.005	<0.005	0.008	0.005
Mg_P	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
a-ANC_E	moles H^+/t	NT	NT	NT	NT	NT
S_{HCl}	%w/w S	NT	NT	NT	NT	NT
TSA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-TAA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TPA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TSA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	%$CaCO_3$	NT	NT	NT	NT	NT
s-ANC_E	%w/w S	NT	NT	NT	NT	NT
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	NT	NT	NT	NT	NT
a-S_{NAS}	moles H^+/t	NT	NT	NT	NT	NT
s-S_{NAS}	%w/w S	NT	NT	NT	NT	NT
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
Net Acidity (WA)	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+/t	<10	<10	<10	<10	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- -	147257-21 99 24/02/2014 Dried soil	147257-22 104 24/02/2014 Dried soil	147257-23 112 24/02/2014 Dried soil	147257-24 117 24/02/2014 Dried soil	147257-25 120 24/02/2014 Dried soil
Date prepared	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
Date analysed	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
pH $_{kcl}$	pH units	5.9	6.0	5.6	5.8	6.0
TAA	moles H^+/t	<5	<5	<5	<5	<5
pH $_{ox}$	pH units	4.6	5.1	3.5	4.6	4.9
TPA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
S_{KCl}	%w/w S	<0.005	<0.005	0.005	0.006	0.006
Ca_{KCl}	%w/w	<0.005	<0.005	0.012	0.005	<0.005
Mg_{KCl}	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
S_P	%w/w	0.008	<0.005	0.014	0.006	0.006
Ca_P	%w/w	0.006	<0.005	0.014	0.007	<0.005
Mg_P	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
a-ANC_E	moles H^+/t	NT	NT	NT	NT	NT
S_{HCl}	%w/w S	NT	NT	NT	NT	NT
TSA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-TAA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TPA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TSA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	<0.005	<0.005	0.009	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	5.4	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	% $CaCO_3$	NT	NT	NT	NT	NT
s-ANC_E	%w/w S	NT	NT	NT	NT	NT
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	NT	NT	NT	NT	NT
a-S_{NAS}	moles H^+/t	NT	NT	NT	NT	NT
s-S_{NAS}	%w/w S	NT	NT	NT	NT	NT
s-Net Acidity	%w/w S	<0.01	<0.01	0.014	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
Net Acidity (WA)	%w/w S	<0.01	<0.01	0.014	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+/t	<10	<10	<10	<10	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	147257-26 123 24/02/2014 Dried soil	147257-27 127 24/02/2014 Dried soil	147257-28 129 24/02/2014 Dried soil	147257-29 134 24/02/2014 Dried soil	147257-30 136 24/02/2014 Dried soil
Date prepared	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
Date analysed	-	05/04/2014	05/04/2014	05/04/2014	05/04/2014	05/04/2014
pH $_{kcl}$	pH units	6.0	5.3	5.8	5.8	6.0
TAA	moles H^+/t	<5	<5	<5	<5	<5
pH $_{ox}$	pH units	4.5	3.2	4.1	5.0	5.1
TPA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
S_{KCl}	%w/w S	0.005	<0.005	<0.005	0.005	0.006
Ca_{KCl}	%w/w	<0.005	0.011	<0.005	<0.005	<0.005
Mg_{KCl}	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
S_P	%w/w	0.006	0.007	<0.005	<0.005	<0.005
Ca_P	%w/w	<0.005	0.011	<0.005	<0.005	<0.005
Mg_P	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
a-ANC_E	moles H^+/t	NT	NT	NT	NT	NT
S_{HCl}	%w/w S	NT	NT	NT	NT	NT
TSA	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-TAA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TPA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
s-TSA	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
S_{POS}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005	<0.005	<0.005
a-Mg_A	moles H^+/t	<5.0	<5.0	<5.0	<5.0	<5.0
s-Mg_A	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
ANC_E	% $CaCO_3$	NT	NT	NT	NT	NT
s-ANC_E	%w/w S	NT	NT	NT	NT	NT
Fineness Factor		2	2	2	2	2
S_{NAS}	%w/w S	NT	NT	NT	NT	NT
a-S_{NAS}	moles H^+/t	NT	NT	NT	NT	NT
s-S_{NAS}	%w/w S	NT	NT	NT	NT	NT
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
Net Acidity (WA)	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+/t	<10	<10	<10	<10	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75

Client Reference: 82241

sPOCAS Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	147257-31 139 24/02/2014 Dried soil	147257-32 143 24/02/2014 Dried soil	147257-33 147 24/02/2014 Dried soil
Date prepared	-	05/04/2014	05/04/2014	05/04/2014
Date analysed	-	05/04/2014	05/04/2014	05/04/2014
pH $_{kcl}$	pH units	5.6	5.8	6.0
TAA	moles H^+/t	<5	<5	<5
pH $_{ox}$	pH units	4.1	4.6	4.2
TPA	moles H^+/t	<5.0	<5.0	<5.0
S_{KCl}	%w/w S	0.008	<0.005	<0.005
Ca_{KCl}	%w/w	0.006	<0.005	<0.005
Mg_{KCl}	%w/w	<0.005	<0.005	<0.005
S_P	%w/w	<0.005	<0.005	<0.005
Ca_P	%w/w	0.006	<0.005	<0.005
Mg_P	%w/w	<0.005	<0.005	<0.005
a-ANC_E	moles H^+/t	NT	NT	<5
S_{HCl}	%w/w S	NT	NT	<0.005
TSA	moles H^+/t	<5.0	<5.0	<5.0
s-TAA	%w/w S	<0.01	<0.01	<0.01
s-TPA	%w/w S	<0.01	<0.01	<0.01
s-TSA	%w/w S	<0.01	<0.01	<0.01
S_{POS}	%w/w S	<0.005	<0.005	<0.005
a-S_{POS}	moles H^+/t	<5.0	<5.0	<5.0
Ca_A	%w/w Ca	<0.005	<0.005	<0.005
a-Ca_A	moles H^+/t	<5	<5	<5
s-Ca_A	%w/w S	<0.005	<0.005	<0.005
Mg_A	%w/w Mg	<0.005	<0.005	<0.005
a-Mg_A	moles H^+/t	<5.0	<5.0	<5.0
s-Mg_A	%w/w S	<0.005	<0.005	<0.005
ANC_E	%$CaCO_3$	NT	NT	<0.05
s-ANC_E	%w/w S	NT	NT	<0.005
Fineness Factor		2	2	2
S_{NAS}	%w/w S	NT	NT	<0.005
a-S_{NAS}	moles H^+/t	NT	NT	<5
s-S_{NAS}	%w/w S	NT	NT	<0.01
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75
Net Acidity (WA)	%w/w S	<0.01	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+/t	<10	<10	<10
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	<0.75	<0.75

Method ID	Methodology Summary
INORG-064	Suspension Peroxide Oxidation Combined Acidity and Sulphate (SPOCAS) using ASSMAC guidelines.

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD
Date prepared	-			[NT]	147257-1	05/04/2014 || 05/04/2014
Date analysed	-			[NT]	147257-1	05/04/2014 || 05/04/2014
pH $_{kcl}$	pH units		INORG-064	[NT]	147257-1	5.9 || 5.9 || RPD: 0
TAA	moles H^+/t	5	INORG-064	[NT]	147257-1	<5 || <5
pH $_{Ox}$	pH units		INORG-064	[NT]	147257-1	3.2 || 3.2 || RPD: 0
TPA	moles H^+/t	5	INORG-064	[NT]	147257-1	<5.0 || <5.0
S_{KCl}	%w/w S	0.005	INORG-064	[NT]	147257-1	0.007 || 0.006 || RPD: 15
Ca_{KCl}	%w/w	0.005	INORG-064	[NT]	147257-1	0.023 || 0.023 || RPD: 0
Mg_{KCl}	%w/w	0.005	INORG-064	[NT]	147257-1	<0.005 || <0.005
S_P	%w/w	0.005	INORG-064	[NT]	147257-1	0.009 || 0.007 || RPD: 25
Ca_P	%w/w	0.005	INORG-064	[NT]	147257-1	0.023 || 0.023 || RPD: 0
Mg_P	%w/w	0.005	INORG-064	[NT]	147257-1	<0.005 || <0.005
a-ANC_E	moles H^+/t	5	INORG-064	[NT]	147257-1	NT || NT
S_{HCl}	%w/w S	0.005	INORG-064	[NT]	147257-1	NT || NT
TSA	moles H^+/t	5	INORG-064	[NT]	147257-1	<5.0 || <5.0
s-TAA	%w/w S	0.01	INORG-064	[NT]	147257-1	<0.01 || <0.01
s-TPA	%w/w S	0.01	INORG-064	[NT]	147257-1	<0.01 || <0.01
s-TSA	%w/w S	0.01	INORG-064	[NT]	147257-1	<0.01 || <0.01
S_{POS}	%w/w S	0.005	INORG-064	[NT]	147257-1	<0.005 || <0.005
a-S_{POS}	moles H^+/t	5	INORG-064	[NT]	147257-1	<5.0 || <5.0
Ca_A	%w/w Ca	0.005	INORG-064	[NT]	147257-1	<0.005 || <0.005
a-Ca_A	moles H^+/t	5	INORG-064	[NT]	147257-1	<5 || <5
s-Ca_A	%w/w S	0.005	INORG-064	[NT]	147257-1	<0.005 || <0.005
Mg_A	%w/w Mg	0.005	INORG-064	[NT]	147257-1	<0.005 || <0.005
a-Mg_A	moles H^+/t	5	INORG-064	[NT]	147257-1	<5.0 || <5.0
s-Mg_A	%w/w S	0.005	INORG-064	[NT]	147257-1	<0.005 || <0.005
ANC_E	% $CaCO_3$	0.05	INORG-064	[NT]	147257-1	NT || NT
s-ANC_E	%w/w S	0.005	INORG-064	[NT]	147257-1	NT || NT
Fineness Factor			INORG-064	[NT]	147257-1	2 || 2 || RPD: 0
S_{NAS}	%w/w S	0.005	INORG-064	[NT]	147257-1	NT || NT

QUALITY CONTROL sPOCAS	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD
a-S_{NAS}	moles H^+/t	5	INORG-064	[NT]	147257-1	NT ll NT
s-S_{NAS}	%w/w S	0.01	INORG-064	[NT]	147257-1	NT ll NT
s-Net Acidity	%w/w S	0.01	INORG-064	[NT]	147257-1	<0.01 ll <0.01
a-Net Acidity	moles H^+/t	10	INORG-064	[NT]	147257-1	<10 ll <10
Liming rate	kg $CaCO_3$ /t	0.75	INORG-064	[NT]	147257-1	<0.75 ll <0.75
Net Acidity (WA)	%w/w S	0.01	INORG-064	[NT]	147257-1	<0.01 ll <0.01
a-Net Acidity without ANCE	moles H^+/t	10	INORG-064	[NT]	147257-1	<10 ll <10
Liming rate without ANCE	kg $CaCO_3$ /t	0.75	INORG-064	[NT]	147257-1	<0.75 ll <0.75

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147257-11	05/04/2014 ll 05/04/2014
Date analysed	-	147257-11	05/04/2014 ll 05/04/2014
pH $_{kcl}$	pH units	147257-11	6.0 ll 6.1 ll RPD: 2
TAA	moles H^+/t	147257-11	<5 ll <5
pH $_{Ox}$	pH units	147257-11	5.4 ll 5.4 ll RPD: 0
TPA	moles H^+/t	147257-11	<5.0 ll <5.0
S_{KCl}	%w/w S	147257-11	<0.005 ll 0.006
Ca_{KCl}	%w/w	147257-11	<0.005 ll <0.005
Mg_{KCl}	%w/w	147257-11	<0.005 ll <0.005
S_P	%w/w	147257-11	0.006 ll 0.005 ll RPD: 18
Ca_P	%w/w	147257-11	<0.005 ll 0.005
Mg_P	%w/w	147257-11	<0.005 ll <0.005
a-ANC_E	moles H^+/t	147257-11	NT ll NT
S_{HCl}	%w/w S	147257-11	NT ll NT
TSA	moles H^+/t	147257-11	<5.0 ll <5.0
s-TAA	%w/w S	147257-11	<0.01 ll <0.01
s-TPA	%w/w S	147257-11	<0.01 ll <0.01
s-TSA	%w/w S	147257-11	<0.01 ll <0.01
S_{POS}	%w/w S	147257-11	<0.005 ll <0.005
a-S_{POS}	moles H^+/t	147257-11	<5.0 ll <5.0
Ca_A	%w/w Ca	147257-11	<0.005 ll <0.005

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
a-Ca_A	moles H^+/t	147257-11	<5 || <5
s-Ca_A	%w/w S	147257-11	<0.005 || <0.005
Mg_A	%w/w Mg	147257-11	<0.005 || <0.005
a-Mg_A	moles H^+/t	147257-11	<5.0 || <5.0
s-Mg_A	%w/w S	147257-11	<0.005 || <0.005
ANC_E	% $CaCO_3$	147257-11	NT || NT
s-ANC_E	%w/w S	147257-11	NT || NT
Fineness Factor		147257-11	2 || 2 || RPD: 0
S_{NAS}	%w/w S	147257-11	NT || NT
a-S_{NAS}	moles H^+/t	147257-11	NT || NT
s-S_{NAS}	%w/w S	147257-11	NT || NT
s-Net Acidity	%w/w S	147257-11	<0.01 || <0.01
a-Net Acidity	moles H^+/t	147257-11	<10 || <10
Liming rate	kg $CaCO_3$ /t	147257-11	<0.75 || <0.75
Net Acidity (WA)	%w/w S	147257-11	<0.01 || <0.01
a-Net Acidity without ANCE	moles H^+/t	147257-11	<10 || <10
Liming rate without ANCE	kg $CaCO_3$ /t	147257-11	<0.75 || <0.75

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147257-21	05/04/2014 || 05/04/2014
Date analysed	-	147257-21	05/04/2014 || 05/04/2014
pH $_{kcl}$	pH units	147257-21	5.9 || 6.0 || RPD: 2
TAA	moles H^+/t	147257-21	<5 || <5
pH $_{Ox}$	pH units	147257-21	4.6 || 4.6 || RPD: 0
TPA	moles H^+/t	147257-21	<5.0 || <5.0
S_{KCl}	%w/w S	147257-21	<0.005 || <0.005
Ca_{KCl}	%w/w	147257-21	<0.005 || <0.005
Mg_{KCl}	%w/w	147257-21	<0.005 || <0.005
S_P	%w/w	147257-21	0.008 || 0.006 || RPD: 29
Ca_P	%w/w	147257-21	0.006 || <0.005
Mg_P	%w/w	147257-21	<0.005 || <0.005

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QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
a-ANC$_E$	moles H^+/t	147257-21	NT || NT
S$_{HCl}$	%w/w S	147257-21	NT || NT
TSA	moles H^+/t	147257-21	<5.0 || <5.0
s-TAA	%w/w S	147257-21	<0.01 || <0.01
s-TPA	%w/w S	147257-21	<0.01 || <0.01
s-TSA	%w/w S	147257-21	<0.01 || <0.01
S$_{POS}$	%w/w S	147257-21	<0.005 || <0.005
a-S$_{POS}$	moles H^+/t	147257-21	<5.0 || <5.0
Ca$_A$	%w/w Ca	147257-21	<0.005 || <0.005
a-Ca$_A$	moles H^+/t	147257-21	<5 || <5
s-Ca$_A$	%w/w S	147257-21	<0.005 || <0.005
Mg$_A$	%w/w Mg	147257-21	<0.005 || <0.005
a-Mg$_A$	moles H^+/t	147257-21	<5.0 || <5.0
s-Mg$_A$	%w/w S	147257-21	<0.005 || <0.005
ANC$_E$	% $CaCO_3$	147257-21	NT || NT
s-ANC$_E$	%w/w S	147257-21	NT || NT
Fineness Factor		147257-21	2 || 2 || RPD: 0
S$_{NAS}$	%w/w S	147257-21	NT || NT
a-S$_{NAS}$	moles H^+/t	147257-21	NT || NT
s-S$_{NAS}$	%w/w S	147257-21	NT || NT
s-Net Acidity	%w/w S	147257-21	<0.01 || <0.01
a-Net Acidity	moles H^+/t	147257-21	<10 || <10
Liming rate	kg $CaCO_3$/t	147257-21	<0.75 || <0.75
Net Acidity (WA)	%w/w S	147257-21	<0.01 || <0.01
a-Net Acidity without ANCE	moles H^+/t	147257-21	<10 || <10
Liming rate without ANCE	kg $CaCO_3$/t	147257-21	<0.75 || <0.75

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QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147257-31	05/04/2014 || 05/04/2014
Date analysed	-	147257-31	05/04/2014 || 05/04/2014
pH $_{kcl}$	pH units	147257-31	5.6 || 5.6 || RPD: 0
TAA	moles H^+/t	147257-31	<5 || <5
pH $_{Ox}$	pH units	147257-31	4.1 || 4.1 || RPD: 0
TPA	moles H^+/t	147257-31	<5.0 || <5.0
S_{KCl}	%w/w S	147257-31	0.008 || 0.006 || RPD: 29
Ca_{KCl}	%w/w	147257-31	0.006 || 0.005 || RPD: 18
Mg_{KCl}	%w/w	147257-31	<0.005 || <0.005
S_P	%w/w	147257-31	<0.005 || 0.008
Ca_P	%w/w	147257-31	0.006 || 0.006 || RPD: 0
Mg_P	%w/w	147257-31	<0.005 || <0.005
a-ANC_E	moles H^+/t	147257-31	NT || NT
S_{HCl}	%w/w S	147257-31	NT || NT
TSA	moles H^+/t	147257-31	<5.0 || <5.0
s-TAA	%w/w S	147257-31	<0.01 || <0.01
s-TPA	%w/w S	147257-31	<0.01 || <0.01
s-TSA	%w/w S	147257-31	<0.01 || <0.01
S_{POS}	%w/w S	147257-31	<0.005 || <0.005
a-S_{POS}	moles H^+/t	147257-31	<5.0 || <5.0
Ca_A	%w/w Ca	147257-31	<0.005 || <0.005
a-Ca_A	moles H^+/t	147257-31	<5 || <5
s-Ca_A	%w/w S	147257-31	<0.005 || <0.005
Mg_A	%w/w Mg	147257-31	<0.005 || <0.005
a-Mg_A	moles H^+/t	147257-31	<5.0 || <5.0
s-Mg_A	%w/w S	147257-31	<0.005 || <0.005
ANC_E	% $CaCO_3$	147257-31	NT || NT
s-ANC_E	%w/w S	147257-31	NT || NT
Fineness Factor		147257-31	2 || 2 || RPD: 0
S_{NAS}	%w/w S	147257-31	NT || NT
a-S_{NAS}	moles H^+/t	147257-31	NT || NT
s-S_{NAS}	%w/w S	147257-31	NT || NT

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
s-Net Acidity	%w/w S	147257-31	<0.01 || <0.01
a-Net Acidity	moles H^+/t	147257-31	<10 || <10
Liming rate	kg $CaCO_3$/t	147257-31	<0.75 || <0.75
Net Acidity (WA)	%w/w S	147257-31	<0.01 || <0.01
a-Net Acidity without ANCE	moles H^+/t	147257-31	<10 || <10
Liming rate without ANCE	kg $CaCO_3$/t	147257-31	<0.75 || <0.75

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147257-1	05/04/2014 || 05/04/2014
Date analysed	-	147257-1	05/04/2014 || 05/04/2014
pH $_{kcl}$	pH units	147257-1	5.9 || 5.9 || RPD: 0
TAA	moles H^+/t	147257-1	<5 || <5
pH $_{Ox}$	pH units	147257-1	3.2 || 3.2 || RPD: 0
TPA	moles H^+/t	147257-1	<5.0 || <5.0
S_{KCl}	%w/w S	147257-1	0.007 || 0.006 || RPD: 15
Ca_{KCl}	%w/w	147257-1	0.023 || 0.023 || RPD: 0
Mg_{KCl}	%w/w	147257-1	<0.005 || <0.005
S_P	%w/w	147257-1	0.009 || 0.007 || RPD: 25
Ca_P	%w/w	147257-1	0.023 || 0.023 || RPD: 0
Mg_P	%w/w	147257-1	<0.005 || <0.005
a-ANC_E	moles H^+/t	147257-1	NT || NT
S_{HCl}	%w/w S	147257-1	NT || NT
TSA	moles H^+/t	147257-1	<5.0 || <5.0
s-TAA	%w/w S	147257-1	<0.01 || <0.01
s-TPA	%w/w S	147257-1	<0.01 || <0.01
s-TSA	%w/w S	147257-1	<0.01 || <0.01
S_{POS}	%w/w S	147257-1	<0.005 || <0.005
a-S_{POS}	moles H^+/t	147257-1	<5.0 || <5.0
Ca_A	%w/w Ca	147257-1	<0.005 || <0.005
a-Ca_A	moles H^+/t	147257-1	<5 || <5
s-Ca_A	%w/w S	147257-1	<0.005 || <0.005

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Mg_A	%w/w Mg	147257-1	<0.005 || <0.005
a-Mg_A	moles H^+/t	147257-1	<5.0 || <5.0
s-Mg_A	%w/w S	147257-1	<0.005 || <0.005
ANC_E	% $CaCO_3$	147257-1	NT || NT
s-ANC_E	%w/w S	147257-1	NT || NT
Fineness Factor		147257-1	2 || 2 || RPD: 0
S_{NAS}	%w/w S	147257-1	NT || NT
a-S_{NAS}	moles H^+/t	147257-1	NT || NT
s-S_{NAS}	%w/w S	147257-1	NT || NT
s-Net Acidity	%w/w S	147257-1	<0.01 || <0.01
a-Net Acidity	moles H^+/t	147257-1	<10 || <10
Liming rate	kg $CaCO_3$ /t	147257-1	<0.75 || <0.75
Net Acidity (WA)	%w/w S	147257-1	<0.01 || <0.01
a-Net Acidity without ANCE	moles H^+/t	147257-1	<10 || <10
Liming rate without ANCE	kg $CaCO_3$ /t	147257-1	<0.75 || <0.75

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147257-11	05/04/2014 || 05/04/2014
Date analysed	-	147257-11	05/04/2014 || 05/04/2014
pH $_{kcl}$	pH units	147257-11	6.0 || 6.1 || RPD: 2
TAA	moles H^+/t	147257-11	<5 || <5
pH $_{Ox}$	pH units	147257-11	5.4 || 5.4 || RPD: 0
TPA	moles H^+/t	147257-11	<5.0 || <5.0
S_{KCl}	%w/w S	147257-11	<0.005 || 0.006
Ca_{KCl}	%w/w	147257-11	<0.005 || <0.005
Mg_{KCl}	%w/w	147257-11	<0.005 || <0.005
S_P	%w/w	147257-11	0.006 || 0.005 || RPD: 18
Ca_P	%w/w	147257-11	<0.005 || 0.005
Mg_P	%w/w	147257-11	<0.005 || <0.005
a-ANC_E	moles H^+/t	147257-11	NT || NT
S_{HCl}	%w/w S	147257-11	NT || NT

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
TSA	moles H^+/t	147257-11	<5.0 || <5.0
s-TAA	%w/w S	147257-11	<0.01 || <0.01
s-TPA	%w/w S	147257-11	<0.01 || <0.01
s-TSA	%w/w S	147257-11	<0.01 || <0.01
S_{POS}	%w/w S	147257-11	<0.005 || <0.005
a-S_{POS}	moles H^+/t	147257-11	<5.0 || <5.0
Ca_A	%w/w Ca	147257-11	<0.005 || <0.005
a-Ca_A	moles H^+/t	147257-11	<5 || <5
s-Ca_A	%w/w S	147257-11	<0.005 || <0.005
Mg_A	%w/w Mg	147257-11	<0.005 || <0.005
a-Mg_A	moles H^+/t	147257-11	<5.0 || <5.0
s-Mg_A	%w/w S	147257-11	<0.005 || <0.005
ANC_E	% $CaCO_3$	147257-11	NT || NT
s-ANC_E	%w/w S	147257-11	NT || NT
Fineness Factor		147257-11	2 || 2 || RPD: 0
S_{NAS}	%w/w S	147257-11	NT || NT
a-S_{NAS}	moles H^+/t	147257-11	NT || NT
s-S_{NAS}	%w/w S	147257-11	NT || NT
s-Net Acidity	%w/w S	147257-11	<0.01 || <0.01
a-Net Acidity	moles H^+/t	147257-11	<10 || <10
Liming rate	kg $CaCO_3$/t	147257-11	<0.75 || <0.75
Net Acidity (WA)	%w/w S	147257-11	<0.01 || <0.01
a-Net Acidity without ANCE	moles H^+/t	147257-11	<10 || <10
Liming rate without ANCE	kg $CaCO_3$/t	147257-11	<0.75 || <0.75

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QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147257-21	05/04/2014 || 05/04/2014
Date analysed	-	147257-21	05/04/2014 || 05/04/2014
pH $_{kcl}$	pH units	147257-21	5.9 || 6.0 || RPD: 2
TAA	moles H^+/t	147257-21	<5 || <5
pH $_{Ox}$	pH units	147257-21	4.6 || 4.6 || RPD: 0
TPA	moles H^+/t	147257-21	<5.0 || <5.0
S_{KCl}	%w/w S	147257-21	<0.005 || <0.005
Ca_{KCl}	%w/w	147257-21	<0.005 || <0.005
Mg_{KCl}	%w/w	147257-21	<0.005 || <0.005
S_P	%w/w	147257-21	0.008 || 0.006 || RPD: 29
Ca_P	%w/w	147257-21	0.006 || <0.005
Mg_P	%w/w	147257-21	<0.005 || <0.005
a-ANC_E	moles H^+/t	147257-21	NT || NT
S_{HCl}	%w/w S	147257-21	NT || NT
TSA	moles H^+/t	147257-21	<5.0 || <5.0
s-TAA	%w/w S	147257-21	<0.01 || <0.01
s-TPA	%w/w S	147257-21	<0.01 || <0.01
s-TSA	%w/w S	147257-21	<0.01 || <0.01
S_{POS}	%w/w S	147257-21	<0.005 || <0.005
a-S_{POS}	moles H^+/t	147257-21	<5.0 || <5.0
Ca_A	%w/w Ca	147257-21	<0.005 || <0.005
a-Ca_A	moles H^+/t	147257-21	<5 || <5
s-Ca_A	%w/w S	147257-21	<0.005 || <0.005
Mg_A	%w/w Mg	147257-21	<0.005 || <0.005
a-Mg_A	moles H^+/t	147257-21	<5.0 || <5.0
s-Mg_A	%w/w S	147257-21	<0.005 || <0.005
ANC_E	% $CaCO_3$	147257-21	NT || NT
s-ANC_E	%w/w S	147257-21	NT || NT
Fineness Factor		147257-21	2 || 2 || RPD: 0
S_{NAS}	%w/w S	147257-21	NT || NT
a-S_{NAS}	moles H^+/t	147257-21	NT || NT
s-S_{NAS}	%w/w S	147257-21	NT || NT

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
s-Net Acidity	%w/w S	147257-21	<0.01 || <0.01
a-Net Acidity	moles H^+/t	147257-21	<10 || <10
Liming rate	kg $CaCO_3$/t	147257-21	<0.75 || <0.75
Net Acidity (WA)	%w/w S	147257-21	<0.01 || <0.01
a-Net Acidity without ANCE	moles H^+/t	147257-21	<10 || <10
Liming rate without ANCE	kg $CaCO_3$/t	147257-21	<0.75 || <0.75

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	147257-31	05/04/2014 || 05/04/2014
Date analysed	-	147257-31	05/04/2014 || 05/04/2014
pH $_{kcl}$	pH units	147257-31	5.6 || 5.6 || RPD: 0
TAA	moles H^+/t	147257-31	<5 || <5
pH $_{Ox}$	pH units	147257-31	4.1 || 4.1 || RPD: 0
TPA	moles H^+/t	147257-31	<5.0 || <5.0
S_{KCl}	%w/w S	147257-31	0.008 || 0.006 || RPD: 29
Ca_{KCl}	%w/w	147257-31	0.006 || 0.005 || RPD: 18
Mg_{KCl}	%w/w	147257-31	<0.005 || <0.005
S_P	%w/w	147257-31	<0.005 || 0.008
Ca_P	%w/w	147257-31	0.006 || 0.006 || RPD: 0
Mg_P	%w/w	147257-31	<0.005 || <0.005
a-ANC_E	moles H^+/t	147257-31	NT || NT
S_{HCl}	%w/w S	147257-31	NT || NT
TSA	moles H^+/t	147257-31	<5.0 || <5.0
s-TAA	%w/w S	147257-31	<0.01 || <0.01
s-TPA	%w/w S	147257-31	<0.01 || <0.01
s-TSA	%w/w S	147257-31	<0.01 || <0.01
S_{POS}	%w/w S	147257-31	<0.005 || <0.005
a-S_{POS}	moles H^+/t	147257-31	<5.0 || <5.0
Ca_A	%w/w Ca	147257-31	<0.005 || <0.005
a-Ca_A	moles H^+/t	147257-31	<5 || <5
s-Ca_A	%w/w S	147257-31	<0.005 || <0.005

QUALITY CONTROL sPOCAS	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Mg_A	%w/w Mg	147257-31	<0.005 || <0.005
a-Mg_A	moles H^+/t	147257-31	<5.0 || <5.0
s-Mg_A	%w/w S	147257-31	<0.005 || <0.005
ANC_E	% $CaCO_3$	147257-31	NT || NT
s-ANC_E	%w/w S	147257-31	NT || NT
Fineness Factor		147257-31	2 || 2 || RPD: 0
S_{NAS}	%w/w S	147257-31	NT || NT
a-S_{NAS}	moles H^+/t	147257-31	NT || NT
s-S_{NAS}	%w/w S	147257-31	NT || NT
s-Net Acidity	%w/w S	147257-31	<0.01 || <0.01
a-Net Acidity	moles H^+/t	147257-31	<10 || <10
Liming rate	kg $CaCO_3$ /t	147257-31	<0.75 || <0.75
Net Acidity (WA)	%w/w S	147257-31	<0.01 || <0.01
a-Net Acidity without ANCE	moles H^+/t	147257-31	<10 || <10
Liming rate without ANCE	kg $CaCO_3$ /t	147257-31	<0.75 || <0.75

Report Comments:

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;
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.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for Physical and Aggregate Tests are not applicable
For VOCs in water samples, three vials are required for duplicate or spike analysis
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;
10-140% for SVOC and Speciated Phenols; and 40-120% for low level organics is acceptable.
Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.
In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.
When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Stacey Hawkins

From: Rob Shapland [Rob.Shapland@douglaspartners.com.au]
Sent: Wednesday, 5 March 2014 1:12 PM
To: Stacey Hawkins
Subject: SPOCAS Suite - Work Order 147052 (Cockburn)
Attachments: image001.jpg; 147052 COC.pdf; PO - SPOCAS.pdf

Hi Stacey,

Please find attached a purchase order to undertake SPOCAS suite of testing on the following sample ID's held under work order 147052:

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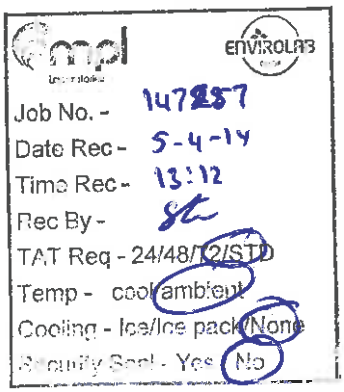

Kind regards,

Part of the Envirolab Group

16 - 18 Hayden Court, Myaree, Western Australia 6154
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 147941

Client:
Douglas Partners Perth
36 O'Malley St
Osborne Park
WA 6017

Attention: Rob Shapland

Sample log in details:

Your Reference:	**82241**
No. of samples:	Dried soil
Date samples received:	27/02/2014
Date completed instructions received:	19/03/2014
Location:	Cockburn Central West, WA

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:	20/03/14
Date of Preliminary Report:	N/A
Issue Date:	20/03/14

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Stacey Hawkins
Acid Soils/Acid Mine Drainage Supervisor

Chromium Reducible Sulphur		
Our Reference:	UNITS	147941-1
Your Reference	----------	109
Date Sampled	----------	24/02/2014
Type of sample		Dried soil
Chromium Reducible Sulfur	%w/w	<0.005

Method ID	Methodology Summary
INORG-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

Client Reference: 82241

QUALITY CONTROL Chromium Reducible Sulphur	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD
Chromium Reducible Sulfur	%w/w	0.005	INORG-068	[NT]		<0.005 II <0.005

QUALITY CONTROL Chromium Reducible Sulphur	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Chromium Reducible Sulfur	%w/w	147941-1	<0.005 II <0.005

Report Comments:

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;
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.

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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.
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10-140% for SVOC and Speciated Phenols; and 40-120% for low level organics is acceptable.
Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.
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When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Stacey Hawkins

From: Rob Shapland [Rob.Shapland@douglaspartners.com.au]
Sent: Wednesday, 19 March 2014 11:12 AM
To: Stacey Hawkins
Subject: Scr Test - Work Order 147052
Attachments: 147052 COC.pdf

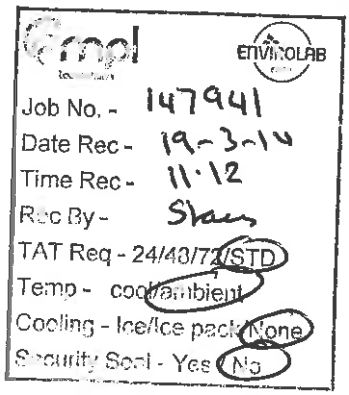
Importance: High

Hi Stacey,

Could you please undertake an SCR test on sample 109 held under work order 147052? Please reference previous purchase order (SPOCAS) for this one. It would be appreciate if you could arrange this ASAP.

Kind regards,

Rob Shapland | Environmental Chemist/Associate
Douglas Partners Pty Ltd | ABN 75 053 980 117 | www.douglaspartners.com.au
36 O'Malley Street Osborne Park WA 6017
P: 08 9204 3511 | F: 08 9204 3522 | M: 0412 448 485 | E: Rob.Shapland@douglaspartners.com.au



RPS

APPENDIX 2

Groundwater Monitoring Data

Cockburn West Groundwater Monitoring Data

Bore I.D.	Date	DTW (mbtoc)	DTB (mbtoc)	RL (at TOC)	GW Level (mAHD)
CC-1	16/09/2010	1.746	5.527	25.18	23.434
CC-1	28/10/2010	1.972		25.18	23.208
CC-1	23/11/2010	2.086	5.565	25.18	23.094
CC-1	14/12/2010	2.213	5.520	25.18	22.967
CC-1	19/01/2011	2.370		25.18	22.810
CC-1	21/02/2011	2.519	5.510	25.18	22.661
CC-1	22/03/2011	2.653	5.550	25.18	22.527
CC-1	28/04/2011	2.735	5.510	25.18	22.445
CC-1	16/05/2011	2.767	5.530	25.18	22.413
CC-1	22/06/2011	2.384	5.530	25.18	22.796
CC-1	13/07/2011	1.967	5.530	25.18	23.213
CC-1	18/08/2011	1.707	5.530	25.18	23.473
CC-1	6/10/2011	1.594	5.490	25.18	23.586
CC-1	10/11/2011	1.709	5.500	25.18	23.471
CC-1	20/09/2012	1.758		25.18	23.422
				AAMGL	23.481
				MGL	23.586

Bore I.D.	Date	DTW (mbtoc)	DTB (mbtoc)	RL (at TOC)	GW Level (mAHD)
CC-3	16/09/2010	7.389	9.665	32.01	24.621
CC-3	28/10/2010	7.553		32.01	24.457
CC-3	23/11/2010	7.622	9.680	32.01	24.388
CC-3	14/12/2010	7.759	9.680	32.01	24.251
CC-3	19/01/2011	7.900		32.01	24.110
CC-3	21/02/2011	8.056	9.660	32.01	23.954
CC-3	22/03/2011	8.230	9.650	32.01	23.780
CC-3	28/04/2011	8.373	9.670	32.01	23.637
CC-3	16/05/2011	8.404	9.660	32.01	23.606
CC-3	22/06/2011	8.181	9.660	32.01	23.829
CC-3	13/07/2011	7.846	9.660	32.01	24.164
CC-3	18/08/2011	7.588	9.660	32.01	24.422
CC-3	6/10/2011	7.333	9.580	32.01	24.677
CC-3	10/11/2011	7.393	9.630	32.01	24.617
CC-3	20/09/2012	7.329		32.01	24.681
				AAMGL	24.660
				MGL	24.681

Bore I.D.	Date	DTW (mbtoc)	DTB (mbtoc)	RL (at TOC)	GW Level (mAHD)
CC-5	16/09/2010	3.860	5.684	28.07	24.205
CC-5	28/10/2010	4.061		28.07	24.004
CC-5	23/11/2010	4.158	5.710	28.07	23.907
CC-5	14/12/2010	4.276	5.660	28.07	23.789
CC-5	19/01/2011	4.421		28.07	23.644
CC-5	21/02/2011	4.584	5.690	28.07	23.481
CC-5	22/03/2011	4.729	5.700	28.07	23.336
CC-5	28/04/2011	4.828	5.830	28.07	23.237
CC-5	16/05/2011	4.889	5.700	28.07	23.176
CC-5	22/06/2011	4.546	5.700	28.07	23.519
CC-5	13/07/2011	4.082	5.700	28.07	23.983
CC-5	18/08/2011	3.872	5.700	28.07	24.193
CC-5	6/10/2011	3.762	5.700	28.07	24.303
CC-5	10/11/2011	3.860	5.660	28.07	24.210
CC-5	20/09/2012	3.806		28.07	24.264
				AAMGL	24.257
				MGL	24.303

Bore I.D.	Date	DTW (mbtoc)	DTB (mbtoc)	RL (at TOC)	GW Level (mAHD)
CC-2	16/09/2010	2.503	5.688	26.53	24.029
CC-2	28/10/2010	2.767		26.53	23.765
CC-2	23/11/2010	2.194	5.695	26.53	24.338
CC-2	14/12/2010	3.032	5.680	26.53	23.500
CC-2	19/01/2011	3.174		26.53	23.358
CC-2	21/02/2011	3.336	5.680	26.53	23.196
CC-2	22/03/2011	3.503	5.710	26.53	23.029
CC-2	28/04/2011	3.490	5.680	26.53	23.042
CC-2	16/05/2011	3.613	5.680	26.53	22.919
CC-2	22/06/2011	3.198	5.680	26.53	23.334
CC-2	13/07/2011	2.695	5.680	26.53	23.837
CC-2	18/08/2011	2.386	5.680	26.53	24.146
CC-2	6/10/2011	2.360	5.680	26.53	24.172
CC-2	10/11/2011	2.512	5.630	26.53	24.018
CC-2	20/09/2012	2.430		26.53	24.098
				AAMGL	24.100
				MGL	24.172

Bore I.D.	Date	DTW (mbtoc)	DTB (mbtoc)	RL (at TOC)	GW Level (mAHD)
CC-4	16/09/2010	1.440	5.419	25.17	23.730
CC-4	28/10/2010	1.640		25.17	23.530
CC-4	23/11/2010	1.744		25.17	23.426
CC-4	14/12/2010	1.851	5.410	25.17	23.319
CC-4	19/01/2011	2.009		25.17	23.161
CC-4	21/02/2011	2.143	5.440	25.17	23.027
CC-4	22/03/2011	2.268	5.430	25.17	22.902
CC-4	28/04/2011	2.339	5.440	25.17	22.831
CC-4	16/05/2011	2.409	5.420	25.17	22.761
CC-4	22/06/2011	2.024	5.420	25.17	23.146
CC-4	13/07/2011	1.652	5.420	25.17	23.518
CC-4	18/08/2011	1.446	5.420	25.17	23.724
CC-4	6/10/2011	1.343	5.420	25.17	23.827
CC-4	10/11/2011	1.423	5.410	25.17	23.747
CC-4	20/09/2012	1.430		25.17	23.740
				AAMGL	23.766
				MGL	23.827

Bore I.D.	Date	DTW (mbtoc)	DTB (mbtoc)	RL (at TOC)	GW Level (mAHD)
CC-6	16/09/2010	7.818	9.668	32.38	24.564
CC-6	28/10/2010	7.973		32.38	24.409
CC-6	23/11/2010	8.044	9.650	32.38	24.338
CC-6	14/12/2010	8.150	9.650	32.38	24.232
CC-6	19/01/2011	8.292		32.38	24.090
CC-6	21/02/2011	8.447	9.630	32.38	23.935
CC-6	22/03/2011	8.603	9.650	32.38	23.779
CC-6	28/04/2011	8.765	9.640	32.38	23.617
CC-6	16/05/2011	8.778	9.660	32.38	23.604
CC-6	22/06/2011	8.597	9.660	32.38	23.785
CC-6	13/07/2011	8.356	9.660	32.38	24.026
CC-6	18/08/2011	8.099	9.660	32.38	24.283
CC-6	6/10/2011			32.38	
CC-6	10/11/2012			32.38	
				AAMGL	24.424
				MGL	24.564

Cockburn West Groundwater Monitoring Data - DoW Bore JM 17

Bore I.D.	Date	DTW (mbtoc)	DTB (mbtoc)	RL (at TOC)	GW Level (mAHD)
JM17	16/09/2010	11.821	19.610	33.99	22.167
JM17	28/10/2010	11.988		33.99	22.000
JM17	23/11/2010	12.072		33.99	21.916
JM17	14/12/2010	12.173	19.610	33.99	21.815
JM17	19/01/2011	12.297		33.99	21.691
JM17	21/02/2011	12.459	19.710	33.99	21.529
JM17	22/03/2011	12.605	19.700	33.99	21.383
JM17	28/04/2011	12.724	19.700	33.99	21.264
JM17	16/05/2011	12.774	19.700	33.99	21.214
JM17	22/06/2011	12.527	19.700	33.99	21.461
JM17	13/07/2011	12.200	19.300	33.99	21.788
JM17	18/08/2011	11.877	19.300	33.99	22.111
JM17	6/10/2011	11.589	19.300	33.99	22.399
JM17	10/11/2011	11.673	19.300	33.99	22.317
JM17	20/09/2012	11.875		33.99	22.117
				AAMGL	22.228
				MGL	22.399

AAMGL Calibrated to DoW Bore JM17

Bore	X	Y	AAMGL	last 10 years DoW data	JM17 error	corrected to match JM17 'error'
CC1	391779	6445168.000	23.481			23.803
CC2	391893	6445172.000	24.1			24.422
CC3	392117	6445075.000	24.66			24.982
CC4	391841	6445035.000	23.766			24.088
CC5	391933	6445040.000	24.257			24.579
CC6	391974	6444824.000	24.424			24.746
JM17	391305	6445324.000	22.228	22.55	0.322	22.55
JM13	390725	6446470.000		20.153		20.153
TD4	390445	6444570.000		17.597		17.597
JM51	392062	6444181.000		25.105		25.105
JM24	391115	6443954.000		20.967		20.967

Bore	X	Y	AAMGL 'calibrated'
CC1	391779	6445168.000	23.803
CC2	391893	6445172.000	24.422
CC3	392117	6445075.000	24.982
CC4	391841	6445035.000	24.088
CC5	391933	6445040.000	24.579
CC6	391974	6444824.000	24.746
JM17	391305	6445324.000	22.55
JM13	390725	6446470.000	20.153
TD4	390445	6444570.000	19.597
JM51	392062	6444181.000	25.105
JM24	391115	6443954.000	20.967

MGL Calibrated to DoW Bore JM17

Bore	X	Y	AAMGL	MGL (historical max)	JM17 error	corrected to match JM17 'error'
CC1	391779	6445168.000	23.481			24.233
CC2	391893	6445172.000	24.1			24.852
CC3	392117	6445075.000	24.66			25.412
CC4	391841	6445035.000	23.766			24.518
CC5	391933	6445040.000	24.257			25.009
CC6	391974	6444824.000	24.424			25.176
JM17	391305	6445324.000	22.228	22.98	0.752	22.98
JM13	390725	6446470.000		21.229		21.229
TD4	390445	6444570.000		17.873		17.873
JM51	392062	6444181.000		25.613		25.613
JM24	391115	6443954.000		21.41		21.41

Bore	X	Y	MGL 'calibrated'
CC1	391779	6445168.000	23.803
CC2	391893	6445172.000	24.422
CC3	392117	6445075.000	24.982
CC4	391841	6445035.000	24.088
CC5	391933	6445040.000	24.579
CC6	391974	6444824.000	24.746
JM17	391305	6445324.000	22.55
JM13	390725	6446470.000	20.153
TD4	390445	6444570.000	19.597
JM51	392062	6444181.000	25.105
JM24	391115	6443954.000	20.967

Cockburn West Calibrated AAMGL and MGL

Bore	X	Y	AAMGL
CC1	391779	6445168	23.803
CC2	391893	6445172	24.422
CC3	392117	6445075	24.982
CC4	391841	6445035	24.088
CC5	391933	6445040	24.579
CC6	391974	6444824	24.746
JM17	391305	6445324	22.55
JM13	390725	6446470	20.153
TD4	390445	6444570	17.597
JM51	392062	6444181	25.105
JM24	391115	6443954	20.967

Bore	X	Y	MGL
CC1	391779	6445168	24.233
CC2	391893	6445172	24.852
CC3	392117	6445075	25.412
CC4	391841	6445035	24.518
CC5	391933	6445040	25.009
CC6	391974	6444824	25.176
JM17	391305	6445324	22.98
JM13	390725	6446470	21.229
TD4	390445	6444570	17.873
JM51	392062	6444181	25.613
JM24	391115	6443954	21.41

APPENDIX 3

Section 38 Referral and EPA Correspondence

RPS

38 Station Street, Subiaco, WA 6008 • PO Box 465, Subiaco, Western Australia 6904
T +618 9211 1111 F +618 9211 1122 E environment@rpsgroup.com.au W rpsgroup.com.au

Our Ref: L11457

Email: john.halleen@rpsgroup.com.au
Date: 4 December 2013

Gary Williams
Principal Environmental Planning Officer
Environmental Planning Branch
Office of the Environmental Protection Authority
Locked Bag 10
EAST PERTH WA 6892

Dear Gary

SECTION 38 OF THE *ENVIRONMENTAL PROTECTION ACT 1986* REFERRAL: COCKBURN CENTRAL WEST AND IMPACT ON EPP LAKE

Further to the Office of the Environmental Protection Authority (OEPA) letter 23 November 2013, please accept enclosed a formal referral for the partial infilling and redevelopment works across a portion of a lake protected under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lake) on Lot 9504 Beeliar Drive.

The proposed partial infilling and redevelopment works of the EPP Lake is required to accommodate future planned development in accordance with the Cockburn Central West Structure Plan. The proposal summary is outlined in the table below.

Table 1: Project Summary Description

Project Component	Proposal Characteristic
Site Location	
Site location	City of Cockburn – Lots 1, 53 and 55 North Lake Road, Lot 54 Poleti Road and Lots 54, 804 and 9504 Beeliar Drive, Cockburn (Figure 1)
EPP Lake	Occurring over parts of Lot 9504 Beeliar Drive and Lots 5 and 8 (Figure 2)
Development Works	
Total area of Development Area within EPP Lake boundary	• 0.45 ha – directly impacted • 1.37 ha – subject to stormwater treatment design and landscaping (Figure 2)
Total area of Development Area within Resource Enhancement wetland boundary	1.99 ha (Figure 2)
Development Commencement	Early 2014 onwards
Land Use Zoning	
MRS; City of Cockburn TPS	Zoned "Urban"; Regional Centre
Cockburn Central Structure Plan	The Structure Plan proposes roads and mixed use development within the EPP Boundary (Figure 3)

RPS

Cockburn Central West Modified Structure Plan

The Cockburn Central West Modified Structure Plan which proposed to retain a portion of the EPP Lake and Resource Enhancement Wetland was endorsed by the City of Cockburn at its November 2013 meeting (Figure 3).

Key principles guiding the Cockburn Central West Modified Structure Plan include:

- integration of the wetland as part of the community
- achieve the required dimensions of the required recreational elements
- integrate the regional recreational facility as part of the new community
- maximise public interaction with a diversity of green open spaces
- establish strong pedestrian accessibility
- deliver the objectives of Directions 2031 and Activity Centres policies
- leverage the significant government investment in the southern suburbs railway
- extend the principle east–west streets from town centre and create interconnected internal streets
- extend intensity of development by adequately addressing Midgegooroo Avenue
- create a vibrant city centre through the provision of a critical mass of people, businesses and attractions.

Wetland Concept Plan

As a component of the Cockburn Central West Modified Structure Plan, LandCorp in collaboration with the City of Cockburn developed a draft Wetland Concept Plan (Figure 4). The Wetland Concept Plan designates the following stormwater and landscaping treatments:

- contamination / run-off
  - stormwater will be filtered through the use of bio filtration swales located around the periphery of the wetland, nutrients are removed by filtration through the use of native wetland vegetation and uptake by plant biomass
  - once treated through the bio filtration swales, water will infiltrate and only overtop the swales and flow into the main body of the wetland through rock weirs in larger rainfall events (greater than the 1 in 1 year ARI)
- flood events / submerge habitat
  - non-rain event – wetland will contain water/groundwater all year round, as it currently does. Bio filtration Swales on the periphery of the wetland are intended to be dry for a majority of the year

  - 1:1 year rain event – all stormwater will initially enter the bio filtration swales which are designed to store, treat and infiltrate the 1 in 1 year event. the common rainfall events will not flow into the wetland core
  - 1:5 year rain event – will flow into the wetland core once capacity in the bio filtration swales is exceeded; it is anticipated the event will infiltrate within 1.5 days
  - 1:100 year rain event – will flood the entire extent of the wetland boundary, is anticipated to recede within four days

- enhancement to the wetland
  - revegetate degraded areas, protect existing flora and fauna by removing weeds, preventing uncontrolled access by people, traffic and bikes, remove rubbish and increase community access and appreciation of the wetland
  - wetland swales will provide additional habitat with local native wetland species, typically found on the periphery of wetlands will be planted in the bio-filtration swales, providing habitat, refuge and water quality treatment
  - key design criteria of the wetland design will be for it to continue and operate in perpetuity.

Wetland Management Approval Requirements

Consistent with the EPA's Public Advice on the previous Section 38 approval LandCorp will be finalising to the satisfaction of the City of Cockburn (on advice from Department of Water) the following:

- Wetland Management Plan
- Local Water Management Strategy.

Wetland Management Plan

LandCorp as the proponent will be required (as a subdivision condition) to revegetate and landscape the retained wetland as outlined in the Concept Plan. LandCorp will be required to maintain the wetland for a period of time, approximately two years following construction (to be confirmed with the City of Cockburn). The wetland will be landscaped and functioning to an agreed level prior to hand over to the City of Cockburn who will assume long-term management responsibility.

Water Management

Local Water Management Strategy (LWMS) has been finalised in support the Structure Plan application. The LWMS will present details on the wetland concept designs, landscaping and stormwater management designs and design criteria.

Urban Water Management Plan (UWMP) will be required as a condition of subdivision. The UWMP provides all the final detailed engineering and landscaping plans for the stormwater management system and wetland design. It includes final monitoring locations and time frames.

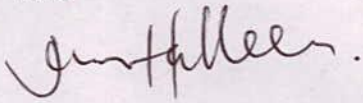
RPS

Consultation

The Cockburn Central West Structure Plan was advertised for a three-week period and subject to extensive community review in particular in regards to the wetland. Key advisory departments including the Department of Parks and Wildlife (Karen Sanders) and the Department of Water (Brett Dunne) were consulted during the modification to the Structure Plan. LandCorp has also met with the Wildflower Society and the Cockburn Wetlands Education Centre to discuss the key modifications to the Structure Plan.

Should you have any questions or concerns, please do not hesitate to contact the undersigned or Matt Bradley at LandCorp (Senior Development Manager on 9482 7554).

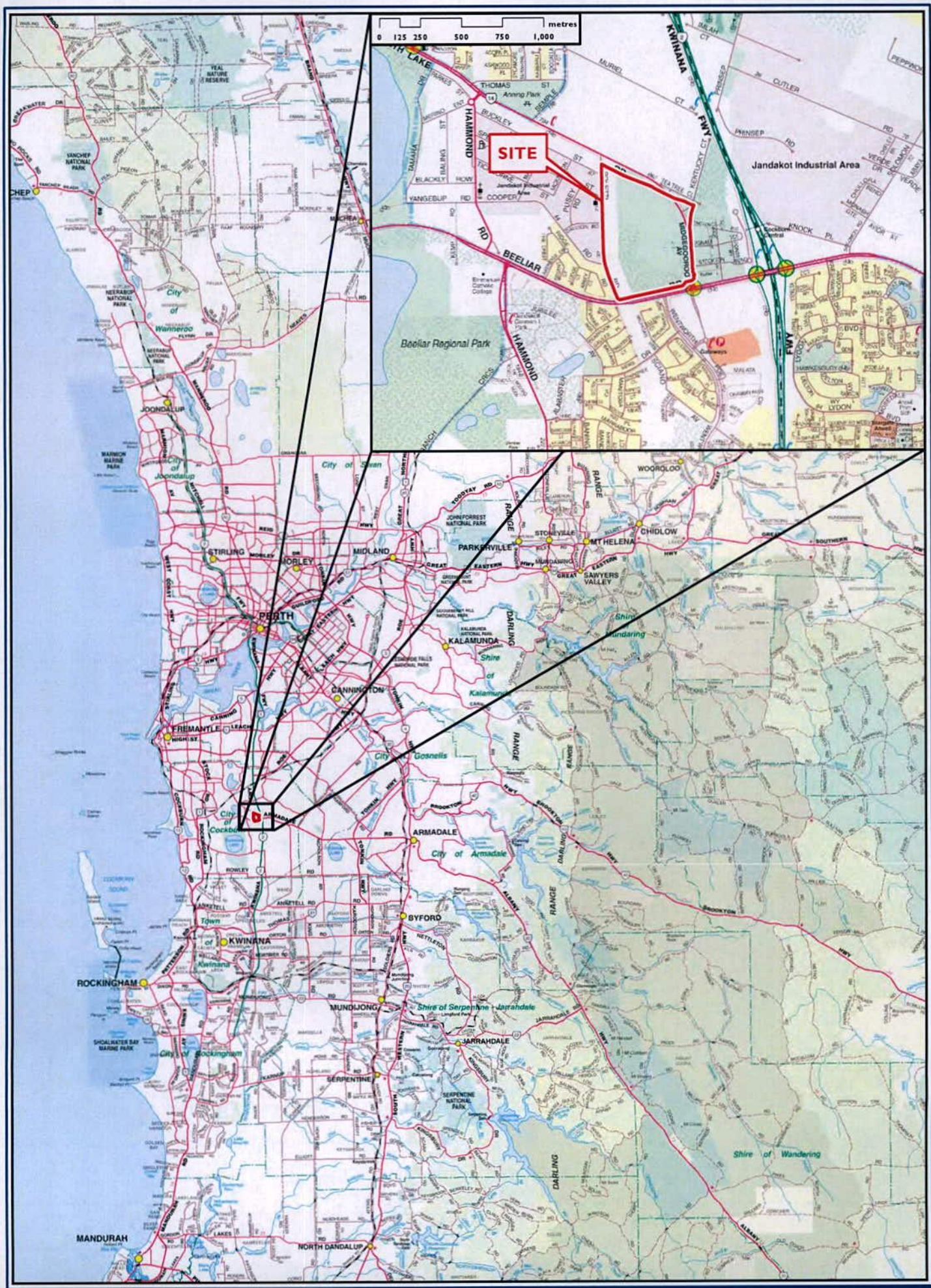
Yours sincerely
RPS



JOHN HALLEEN
Technical Director

enc: *Figures*
S.38 referral – Cockburn Central Structure Plan impacting on Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (EPP Lake)

cc: Matt Bradley, LandCorp



RPS

Job Number: L11457
Date: 03.04.13
Scale: Map 1:500k Inset 1:30000 @ A3
Revision: A
Created SC
Source: 2008 StreetSmart

GDA 1994 MGA Zone 50

0 2.5 5 10 15 20 km

Attachment 1

Site Location

38 Station Street, Subiaco | T +61 8 92111111 | F +61 8 92111122 | www.rpsgroup.com.au

38 Station Street, Subiaco | T +61 8 92111111 | F +61 8 92111122 | www.rpsgroup.com.au

RPS

Job Number: L11457
Doc Number: 002
Date: 29.11.13
Scale: 1: 3,000 @ A3
Drafted by: MA
Source: Cadastre & Orthophoto - Landgate, 2013 Wetlands - DEC, 2013 EPP Lakes - DEC 1992

0 5 10 20 30 40 m

Figure 2

Wetlands Mapping

LEGEND

ZONES

- MIXED USE (RESIDENTIAL, RETAIL AND COMMERCIAL)
- MIXED USE (RESIDENTIAL/COMMERCIAL)
- MIXED USE (RETAIL/COMMERCIAL)

RESERVES

Public Purposes

- COMMUNITY (INTEGRATED COMMUNITY FACILITY & PRIMARY AFL OVAL)
- UTILITIES/INFRASTRUCTURE (CAR PARK, ROADS AND POWER LINE INFRASTRUCTURE)

Parks, Recreation and Conservation

- PUBLIC OPEN SPACE
- DRAINAGE

OTHER

- GAS PIPELINE EASEMENT
- PREFERENCE FOR ACTIVE COMMERCIAL LAND USES AT GROUND/UPPER LEVELS
- PREFERENCE FOR ACTIVE RETAIL LAND USES AT GROUND LEVEL
- STRUCTURE PLAN BOUNDARY
- WIDE LOCAL ACCESS ROAD
- SLOW SPEED MIXED TRAFFIC ZONE
- SHARED PEDESTRIAN CYCLING PATH
- BUS ROUTE
- * LANDMARK SITES

BUCKLEY ST

LEFT IN LEFT OUT ACCESS ONLY

NORTH LAKE ROAD

PARCEL 1

FULL MOVEMENT T-INTERSECTION

PARCEL 2

PARCEL 4

SPENCER ST

ROAD

PARCEL 3

PLAYING FIELDS

PARCEL 5

PARCEL 6

INDICATIVE ROAD LAYOUT (SUBJECT TO DETAILED DESIGN)

4-WAY INTERSECTION

DAVISON RD

LEFT IN LEFT OUT ACCESS ONLY

JUNCTION BOULEVARD

POLETTI

PARCEL 15

PARCEL 14

MIDGEGOOROO AVENUE

SIGNALISED PEDESTRIAN INTERSECTION

SIGNAL TERRACE

COOPER RD

LEFT IN LEFT OUT ACCESS ONLY

STOCKTON BEND

PARCEL 7

PARCEL 10

BUFFER LANE

INDICATIVE ROAD LAYOUT (SUBJECT TO DETAILED DESIGN)

PARCEL 11

PARCEL 13

FULL MOVEMENT T-INTERSECTION

PARCEL 8

PARCEL 12

PARCEL 9

BEELIAR DRIVE

WENTWORTH PARADE

0 125 m

COCKBURN CENTRAL WEST STRUCTURE PLAN - PLAN 1

COCKBURN CENTRAL WEST

LANDCORP

NORTH

Cardno
11 Harvest Terrace
P.O. Box 447
West Perth 6872
Telephone (08) 9273 3888
Facsimile (08) 9486 8664

DATE:	24/10/13	SCALE AT A3:	1:2500
DESIGNED:	LE	CHECKED:	LVE
DRAWN:	ZF	APPROVED:	LVE

LOCAL AUTHORITY
CITY OF COCKBURN

PROJECT-PHASE-PLAN NUMBER: P5002 - STR02

REVISION: H

DRAFT CONCEPT ONLY

Subject to further design, study, engineering input, survey and council approval.

SPOT HEIGHTS

All spot heights noted on the plan are from the existing survey. Proposed contouring and spot heights require further engineering input.

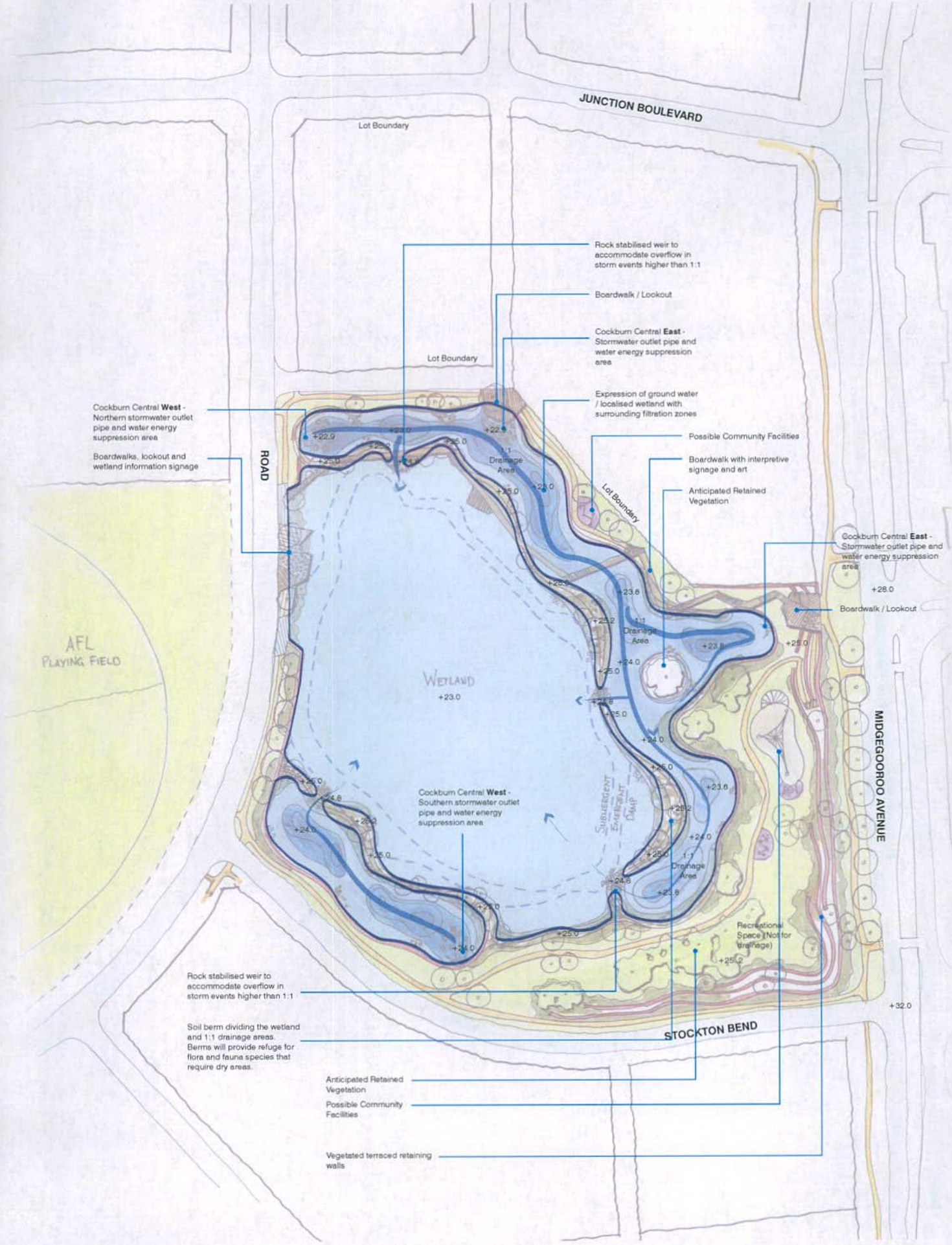
urbis
Perth
Level 1, 55 St Georges Terrace
Perth WA 6000
T 08 9346 0500
Urbis Pty Ltd ABN 50 105 256 228

Cockburn West

DRAFT Wetland Concept

SCALE 1:500 @ A1

PROJECT NO: PD-0909
DATE: 30-10-2013
ISSUE: CONCEPT
DRAWING NO: CP01
REV: E



DRAFT CONCEPT ONLY

Subject to further design, study, engineering Input, survey and council approval.

SPOT HEIGHTS

All spot heights noted on the plan are from the existing survey. Proposed contouring and spot heights require further engineering input.

urbis
Perth
Level 1, 55 St Georges Terrace
Perth WA 6000
T 08 9346 0500
Urbis Pty Ltd ABN 50 105 256 228

Cockburn West

DRAFT Wetland Concept - Drainage Strategy

PROJECT NO: PD0597
DATE: 30.10.2013
ISSUE: CONCEPT
DRAWING NO: CP02
REV: E

SCALE: 1:500 @ A1

DRAFT CONCEPT ONLY

Subject to further design, study, engineering Input, survey and council approval.

SPOT HEIGHTS

All spot heights noted on the plan are from the existing survey. Proposed contouring and spot heights require further engineering input.

urbis
Perth
Level 1, 55 St Georges Terrace
Perth WA 6000
T 08 9346 0500
Urbis Pty Ltd ABN 50 105 256 228

Cockburn West

DRAFT Wetland Concept - Drainage Strategy

SCALE: 1:500 @ A1

PROJECT NO: PD-0997
DATE: 30-10-2013
ISSUE: CONCEPT
DRAWING NO: CP03
REV: B

GOVERNMENT OF WESTERN AUSTRALIA

Environmental Protection Authority

EPA REFERRAL FORM PROPONENT

Referral of a Proposal by the Proponent to the Environmental Protection Authority under Section 38(1) of the *Environmental Protection Act 1986*.

PURPOSE OF THIS FORM

Section 38(1) of the *Environmental Protection Act 1986* (EP Act) provides that where a development proposal is likely to have a significant effect on the environment, a proponent may refer the proposal to the Environmental Protection Authority (EPA) for a decision on whether or not it requires assessment under the EP Act. This form sets out the information requirements for the referral of a proposal by a proponent.

Proponents are encouraged to familiarise themselves with the EPA's *General Guide on Referral of Proposals* [see Environmental Impact Assessment/Referral of Proposals and Schemes] before completing this form.

A referral under section 38(1) of the EP Act by a proponent to the EPA must be made on this form. A request to the EPA for a declaration under section 39B (derived proposal) must be made on this form. This form will be treated as a referral provided all information required by Part A has been included and all information requested by Part B has been provided to the extent that it is pertinent to the proposal being referred. Referral documents are to be submitted in two formats – hard copy and electronic copy. The electronic copy of the referral will be provided for public comment for a period of 7 days, prior to the EPA making its decision on whether or not to assess the proposal.

CHECKLIST

Before you submit this form, please check that you have:

	Yes	No
Completed all the questions in Part A (essential).	x	
Completed all applicable questions in Part B.	x	
Included Attachment 1 – location maps.	x	
Included Attachment 2 – additional document(s) the proponent wishes to provide (if applicable).	x	
Included Attachment 3 – confidential information (if applicable).		x
Enclosed an electronic copy of all referral information, including spatial data and contextual mapping but excluding confidential information.	x	

Following a review of the information presented in this form, please consider the following question (a response is optional).

Do you consider the proposal requires formal environmental impact assessment?		
☐ Yes	☒ No	☐ Not sure
If yes, what level of assessment?		
☐ Assessment on Proponent Information	☐ Public Environmental Review	

PROPONENT DECLARATION (to be completed by the proponent)

I, SUSAN ANITA OOSTHUIZEN, *(full name)* declare that I am authorised on behalf of LANDCORP (being the person responsible for the proposal) to submit this form and further declare that the information contained in this form is true and not misleading.

Signature [signature]	Name (print) SUSAN OOSTHUIZEN
Position MANAGER ACTIVITY CENTRES	Company - LandCorp
Date 4/12/2013	

PART A - PROPONENT AND PROPOSAL INFORMATION

(All fields of Part A must be completed for this document to be treated as a referral)

1 PROPONENT AND PROPOSAL INFORMATION

1.1 Proponent

Name	LandCorp
Joint Venture parties (if applicable)	
Australian Company Number (if applicable)	
Postal Address (where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State)	Level 6 Wesfarmers House 40 The Esplanade PERTH WA 6000
Key proponent contact for the proposal: • name • address • phone • email	• Susan Oosthuizen • As above • 9482 7558 • Susan.Oosthuizen@landcorp.com.au
Consultant for the proposal (if applicable): • name • address • phone • email	• John Halleen • 38 Station Street, Subiaco WA 6008 • 9211 1111 • john.halleen@rpsgroup.com.au

1.2 Proposal

Title	Cockburn Central Structure Plan impacting on *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lake).
Description	Cockburn Central development impacting on EPP Lake.
Extent (area) of proposed ground disturbance.	EPP Lake area – 1.82 ha Resource Enhancement wetland (UFI 6659) area – 1.99
Timeframe in which the activity or development is proposed to occur (including start and finish dates where applicable).	Bulk earthworks anticipated to commence in 2014.
Details of any staging of the proposal.	Single stage
Is the proposal a strategic proposal?	No
Is the proponent requesting a declaration that the proposal is a derived proposal? If so, provide the following information on the strategic assessment within which the referred proposal was identified: • title of the strategic assessment; and • Ministerial Statement number.	No
Please indicate whether, and in what way, the proposal is related to other proposals in the	No. The EPA in 2012 previously approved a s. 38 referral to

region.	amendment this EPP Lake to facilitate stormwater drainage from the existing Cockburn Central development (referral A504682).
Does the proponent own the land on which the proposal is to be established? If not, what other arrangements have been established to access the land?	WAPC owned. Project is supported by WAPC – LandCorp is appointed as the Development Manager for the project.
What is the current land use on the property, and the extent (area in hectares) of the property?	Wetland area historically used for agricultural purposes (watering area for cattle), currently unmanaged.

1.3 Location

Name of the Shire in which the proposal is located.	City of Cockburn
For urban areas: • street address; • lot number; • suburb; and • nearest road intersection.	• 9504 Beeliar Drive • Lot 9504 • Cockburn Central • Midgegooroo Ave and Beeliar Drive
For remote localities: • nearest town; and • distance and direction from that town to the proposal site.	
Electronic copy of spatial data - GIS or CAD, geo-referenced and conforming to the following parameters: • GIS: polygons representing all activities and named; • CAD: simple closed polygons representing all activities and named; • datum: GDA94; • projection: Geographic (latitude/longitude) or Map Grid of Australia (MGA); • format: Arcview shapefile, Arcinfo coverages, Microstation or AutoCAD.	Enclosed?: Yes

1.4 Confidential Information

Does the proponent wish to request the EPA to allow any part of the referral information to be treated as confidential?	No
If yes, is confidential information attached as a separate document in hard copy?	

1.5 Government Approvals

Is rezoning of any land required before the proposal can be implemented? If yes, please provide details.		No	
Is approval required from any Commonwealth or State Government agency or Local Authority for any part of the proposal? If yes, please complete the table below.		Yes	
Agency/Authority	Approval required	Application lodged Yes / No	Agency/Local Authority contact(s) for proposal
City of Cockburn and the WAPC	Local Structure Plan	Yes (endorsed by the City of Cockburn in November 2013)	• Roberto Colalillo (City of Cockburn)

			• Paul Sewell (Department of Planning)
City of Cockburn and the WAPC	Subdivision Approval	No	
City of Cockburn	Development Application	No	

PART B - ENVIRONMENTAL IMPACTS AND PROPOSED MANAGEMENT

2. ENVIRONMENTAL IMPACTS

Describe the impacts of the proposal on the following elements of the environment, by answering the questions contained in Sections 2.1-2.11:

2.1 flora and vegetation;

2.2 fauna;

2.3 rivers, creeks, wetlands and estuaries;

2.4 significant areas and/ or land features;

2.5 coastal zone areas;

2.6 marine areas and biota;

2.7 water supply and drainage catchments;

2.8 pollution;

2.9 greenhouse gas emissions;

2.10 contamination; and

2.11 social surroundings.

These features should be shown on the site plan, where appropriate.

For all information, please indicate:

(a) the source of the information; and

(b) the currency of the information.

2.1 Flora and Vegetation

2.1.1 Do you propose to clear any native flora and vegetation as a part of this proposal?

[A proposal to clear native vegetation may require a clearing permit under Part V of the EP Act (Environmental Protection (Clearing of Native Vegetation) Regulations 2004)]. Please contact the Department of Environment and Conservation (DEC) for more information.

(please tick) ☒ Yes **If yes**, complete the rest of this section.

☐ No **If no**, go to the next section

2.1.2 How much vegetation are you proposing to clear (in hectares)?

EPP Lake area – 0.45 ha

2.1.3 Have you submitted an application to clear native vegetation to the DEC (unless you are exempt from such a requirement)?

☐ Yes ☒ No **If yes**, on what date and to which office was the application submitted of the DEC?

2.1.4 Are you aware of any recent flora surveys carried out over the area to be disturbed by this proposal?

☒ Yes ☐ No **If yes**, please attach a copy of any related survey reports and provide the date and name of persons / companies involved in the survey(s).

If no, please do not arrange to have any biological surveys conducted prior to consulting with the DEC.

Flora report previously provided to OEPA.

2.1.5 Has a search of DEC records for known occurrences of rare or priority flora or threatened ecological communities been conducted for the site?

☒ Yes ☐ No If you are proposing to clear native vegetation for any part of your proposal, a search of DEC records of known occurrences of rare or priority flora and threatened ecological communities will be required. Please contact DEC for more information.

2.1.6 Are there any known occurrences of rare or priority flora or threatened ecological communities on the site?

☐ Yes ☒ No **If yes**, please indicate which species or communities are involved and provide copies of any correspondence with DEC regarding these matters.

2.1.7 If located within the Perth Metropolitan Region, is the proposed development within or adjacent to a listed Bush Forever Site? (You will need to contact the Bush Forever Office, at the Department for Planning and Infrastructure)

☐ Yes ☒ No **If yes**, please indicate which Bush Forever Site is affected (site number and name of site where appropriate).

2.1.8 What is the condition of the vegetation at the site?

Very Good to Degraded (Figure 6).

2.2 Fauna

2.2.1 Do you expect that any fauna or fauna habitat will be impacted by the proposal?

(please tick) ☒ Yes **If yes**, complete the rest of this section.

☐ No **If no**, go to the next section.

2.2.2 Describe the nature and extent of the expected impact.

The Structure Plan proposes to partially infill and re-develop/landscape a portion of the EPP Lake and therefore, result in a loss of the following broad fauna habitat types:

- Thick scrub in the emergent to damp zone consisting of *Melaleuca preissiana* over Closed Tall Scrub over Sedgeland over Open to Closed Herbland
- Low Open Forest of *Melaleuca preissiana* and *Banksia littoralis* over shrubland and herbland

However, due to the degraded nature of this vegetation within the wetland, it is not considered likely that any significant fauna would use these habitats.

There is the potential for temporary impacts during construction works to the following vegetation units:

- Submergent wetland area consisting of shallow permanent water with reeds and herbs
- Grassland and sedgeland of **Ehrharta calycina* and *Baumea juncea*
- Open Shrubland over Sedgeland over Closed Herbland in the emergent zone.

A Wetland Management Plan will be prepared and finalised to the satisfaction of the City of Cockburn as a condition of subdivision. The Wetland Management Plan will define the rehabilitation objectives, methodology and completion criteria for re-vegetation of the wetland consistent with the wetland concept plan.

2.2.3 Are you aware of any recent fauna surveys carried out over the area to be disturbed by this proposal?

☒ Yes ☐ No **If yes**, please attach a copy of any related survey reports and provide the date and name of persons / companies involved in the survey(s).

If no, please do not arrange to have any biological surveys conducted prior to consulting with the DEC.

Fauna report previously provided to OEPA.

2.2.4 Has a search of DEC records for known occurrences of Specially Protected (threatened) fauna been conducted for the site?

☒ Yes ☐ No (please tick)

2.2.5 Are there any known occurrences of Specially Protected (threatened) fauna on the site?

☐ Yes ☒ No **If yes**, please indicate which species or communities are involved and provide copies of any correspondence with DEC regarding these matters.

2.3 Rivers, Creeks, Wetlands and Estuaries

2.3.1 Will the development occur within 200 metres of a river, creek, wetland or estuary?

(please tick) ☒ Yes **If yes**, complete the rest of this section.

☐ No **If no**, go to the next section.

2.3.2 Will the development result in the clearing of vegetation within the 200 metre zone?

☒ Yes ☐ No **If yes**, please describe the extent of the expected impact.

Development will occur within 200 m of the EPP Lake consistent with the approved Local Structure Plan and the 'Urban' and 'Regional Centre' approved land uses under the MRS and TPS.

2.3.3 Will the development result in the filling or excavation of a river, creek, wetland or estuary?

☒ Yes ☐ No **If yes**, please describe the extent of the expected impact.

2.3.4 Will the development result in the impoundment of a river, creek, wetland or estuary?

☐ Yes ☒ No **If yes**, please describe the extent of the expected impact.

2.3.5 Will the development result in draining to a river, creek, wetland or estuary?

☒ Yes ☐ No **If yes**, please describe the extent of the expected impact.

2.3.6 Are you aware if the proposal will impact on a river, creek, wetland or estuary (or its buffer) within one of the following categories? (please tick)

Conservation Category Wetland	☐ Yes	☒ No	☐ Unsure
Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998	☐ Yes	☒ No	☐ Unsure

Perth's Bush Forever site	☐ Yes	☒ No	☐ Unsure
Environmental Protection (Swan & Canning Rivers) Policy 1998	☐ Yes	☒ No	☐ Unsure
The management area as defined in s4(1) of the *Swan River Trust Act 1988*	☐ Yes	☒ No	☐ Unsure
Which is subject to an international agreement, because of the importance of the wetland for waterbirds and waterbird habitats (e.g. Ramsar, JAMBA, CAMBA)	☐ Yes	☒ No	☐ Unsure

2.4 Significant Areas and/ or Land Features

2.4.1 Is the proposed development located within or adjacent to an existing or proposed National Park or Nature Reserve?

☐ Yes ☒ No **If yes**, please provide details.

2.4.2 Are you aware of any Environmentally Sensitive Areas (as declared by the Minister under section 51B of the EP Act) that will be impacted by the proposed development?

☒ Yes ☐ No **If yes**, please provide details.

The Environmentally Sensitive Area is associated with Resource Enhancement wetland UFI 6659

2.4.3 Are you aware of any significant natural land features (e.g. caves, ranges etc) that will be impacted by the proposed development?

☐ Yes ☒ No **If yes**, please provide details.

2.5 Coastal Zone Areas (Coastal Dunes and Beaches)

2.5.1 Will the development occur within 300metres of a coastal area?

(please tick) ☐ Yes **If yes**, complete the rest of this section.

☒ No **If no**, go to the next section.

2.5.2 What is the expected setback of the development from the high tide level and from the primary dune?

2.5.3 Will the development impact on coastal areas with significant landforms including beach ridge plain, cuspate headland, coastal dunes or karst?

☐ Yes ☐ No **If yes**, please describe the extent of the expected impact.

2.5.4 Is the development likely to impact on mangroves?

☐ Yes ☐ No **If yes**, please describe the extent of the expected impact.

2.6 Marine Areas and Biota

2.6.1 Is the development likely to impact on an area of sensitive benthic communities, such as seagrasses, coral reefs or mangroves?

☐ Yes ☒ No **If yes**, please describe the extent of the expected impact.

2.6.2 Is the development likely to impact on marine conservation reserves or areas recommended for reservation (as described in *A Representative Marine Reserve System for Western Australia*, CALM, 1994)?

☐ Yes ☒ No **If yes**, please describe the extent of the expected impact.

2.6.3 Is the development likely to impact on marine areas used extensively for recreation or for commercial fishing activities?

☐ Yes ☒ No **If yes**, please describe the extent of the expected impact, and provide any written advice from relevant agencies (e.g. Fisheries WA).

2.7 Water Supply and Drainage Catchments

2.7.1 Are you in a proclaimed or proposed groundwater or surface water protection area?

(You may need to contact the Department of Water (DoW) for more information on the requirements for your location, including the requirement for licences for water abstraction. Also, refer to the DoW website)

☐ Yes ☒ No **If yes**, please describe what category of area.

2.7.2 Are you in an existing or proposed Underground Water Supply and Pollution Control area?

(You may need to contact the DoW for more information on the requirements for your location, including the requirement for licences for water abstraction. Also, refer to the DoW website)

☐ Yes ☒ No **If yes**, please describe what category of area.

2.7.3 Are you in a Public Drinking Water Supply Area (PDWSA)?

(You may need to contact the DoW for more information or refer to the DoW website. A proposal to clear vegetation within a PDWSA requires approval from DoW.)

☐ Yes ☒ No **If yes**, please describe what category of area.

2.7.4 Is there sufficient water available for the proposal?

(Please consult with the DoW as to whether approvals are required to source water as you propose. Where necessary, please provide a letter of intent from the DoW)

☒ Yes ☐ No (please tick)

2.7.5 Will the proposal require drainage of the land?

☐ Yes ☒ No **If yes**, how is the site to be drained and will the drainage be connected to an existing Local Authority or Water Corporation drainage system? Please provide details.

2.7.6 Is there a water requirement for the construction and/ or operation of this proposal?

(please tick) ☐ Yes **If yes**, complete the rest of this section.

☒ No **If no**, go to the next section.

2.7.7 What is the water requirement for the construction and operation of this proposal, in kilolitres per year?

2.7.8 What is the proposed source of water for the proposal? (e.g. dam, bore, surface water etc.)

2.8 Pollution

2.8.1 Is there likely to be any discharge of pollutants from this development, such as noise, vibration, gaseous emissions, dust, liquid effluent, solid waste or other pollutants?

(please tick) ☐ Yes **If yes**, complete the rest of this section.

☒ No **If no**, go to the next section.

2.8.2 Is the proposal a prescribed premise, under the Environmental Protection Regulations 1987?

(Refer to the EPA's *General Guide for Referral of Proposals to the EPA under section 38(1) of the EP Act 1986* for more information)

☐ Yes ☐ No **If yes**, please describe what category of prescribed premise.

2.8.3 Will the proposal result in gaseous emissions to air?

☐ Yes ☐ No **If yes**, please briefly describe.

2.8.4 Have you done any modelling or analysis to demonstrate that air quality standards will be met, including consideration of cumulative impacts from other emission sources?

☐ Yes ☐ No **If yes**, please briefly describe.

2.8.5 Will the proposal result in liquid effluent discharge?

☐ Yes ☐ No **If yes**, please briefly describe the nature, concentrations and receiving environment.

2.8.6 If there is likely to be discharges to a watercourse or marine environment, has any analysis been done to demonstrate that the State Water Quality Management Strategy or other appropriate standards will be able to be met?

☐ Yes ☐ No **If yes**, please describe.

2.8.7 Will the proposal produce or result in solid wastes?

☐ Yes ☐ No **If yes**, please briefly describe the nature, concentrations and disposal location/ method.

2.8.8 Will the proposal result in significant off-site noise emissions?

☐ Yes ☐ No **If yes**, please briefly describe.

2.8.9 Will the development be subject to the Environmental Protection (Noise) Regulations 1997?

☐ Yes ☐ No **If yes**, has any analysis been carried out to demonstrate that the proposal will comply with the Regulations?

Please attach the analysis.

2.8.10 Does the proposal have the potential to generate off-site, air quality impacts, dust, odour or another pollutant that may affect the amenity of residents and other "sensitive premises" such as schools and hospitals (proposals in this category may include intensive agriculture, aquaculture, marinas, mines and quarries etc.)?

☐ Yes ☐ No **If yes**, please describe and provide the distance to residences and other "sensitive premises".

2.8.11 If the proposal has a residential component or involves "sensitive premises", is it located near a land use that may discharge a pollutant?

☐ Yes ☐ No ☐ Not Applicable

If yes, please describe and provide the distance to the potential pollution source

2.9 Greenhouse Gas Emissions

2.9.1 Is this proposal likely to result in substantial greenhouse gas emissions (greater than 100 000 tonnes per annum of carbon dioxide equivalent emissions)?

☐ Yes ☒ No **If yes**, please provide an estimate of the annual gross emissions in absolute and in carbon dioxide equivalent figures.

2.9.2 Further, if yes, please describe proposed measures to minimise emissions, and any sink enhancement actions proposed to offset emissions.

2.10 Contamination

2.10.1 Has the property on which the proposal is to be located been used in the past for activities which may have caused soil or groundwater contamination?

☐ Yes ☒ No ☐ Unsure **If yes**, please describe.

2.10.2 Has any assessment been done for soil or groundwater contamination on the site?

☐ Yes ☒ No **If yes**, please describe.

2.10.3 Has the site been registered as a contaminated site under the *Contaminated Sites Act 2003*? (on finalisation of the CS Regulations and proclamation of the CS Act)

☐ Yes ☒ No **If yes**, please describe.

2.11 Social Surroundings

2.11.1 Is the proposal on a property which contains or is near a site of Aboriginal ethnographic or archaeological significance that may be disturbed?

☐ Yes ☒ No ☐ Unsure **If yes**, please describe.

2.11.2 Is the proposal on a property which contains or is near a site of high public interest (e.g. a major recreation area or natural scenic feature)?

☐ Yes ☒ No **If yes**, please describe.

2.11.3 Will the proposal result in or require substantial transport of goods, which may affect the amenity of the local area?

☐ Yes ☒ No **If yes**, please describe.

3. PROPOSED MANAGEMENT

3.1 Principles of Environmental Protection

3.1.1 Have you considered how your project gives attention to the following Principles, as set out in section 4A of the EP Act? (For information on the Principles of Environmental Protection, please see EPA Position Statement No. 7, available on the EPA website)

1. The precautionary principle.	☒ Yes	☐ No
2. The principle of intergenerational equity.	☒ Yes	☐ No
3. The principle of the conservation of biological diversity and ecological integrity.	☒ Yes	☐ No
4. Principles relating to improved valuation, pricing and incentive mechanisms.	☒ Yes	☐ No
5. The principle of waste minimisation.	☒ Yes	☐ No

3.1.2 Is the proposal consistent with the EPA's Environmental Protection Bulletins/Position Statements and Environmental Assessment Guidelines/Guidance Statements (available on the EPA website)?

☒ Yes ☐ No

3.2 Consultation

3.2.1 Has public consultation taken place (such as with other government agencies, community groups or neighbours), or is it intended that consultation shall take place?

☒ Yes ☐ No **If yes**, please list those consulted and attach comments or summarise response on a separate sheet.

The Cockburn Central West Structure Plan was advertised for a three week period and subject to extensive community review in particular in regards to the wetland. Key advisory departments including the Department of Parks and Wildlife (Karen Sanders) and the Department of Water (Brett Dunne) were consulted during the modification to the Structure Plan. LandCorp has also met with the Wildflower Society and the Cockburn Wetlands Education Centre to discuss the key modifications to the Structure Plan.

The Office of the EPA, the Department of Water and the Department of Parks and Wildlife has been briefed and informed in regards to the Cockburn Central Structure Plan and the rationale for the impact on the EPP Lake and Resource Enhancement wetland.

GOVERNMENT OF WESTERN AUSTRALIA

Environmental Protection Authority

Chief Executive Officer
LandCorp
Level 6, 40 The Esplanade
PERTH WA 6000

Our Ref 13-434689
Enquiries Gary Williams
Phone 6145 0821

Attn: Susan Oosthuizen

NOTICE UNDER SECTION 39A(3)
Environmental Protection Act 1986

PROPOSAL: **Cockburn Central West Wetland Concept Plan impacting on Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (EPP Lake)**
LOCATION: **Lot 9504 Beeliar Drive**
LOCALITY: **City of Cockburn**
PROPONENT: **LandCorp**
DECISION: **Not Assessed – Public Advice Given**

The Environmental Protection Authority (EPA) understands that you wish to undertake the above proposal which has been referred to the Authority for consideration of its potential environmental impact.

This proposal raises a number of environmental issues. However, the EPA has decided not to subject this proposal to the environmental impact assessment process and the subsequent setting of formal conditions by the Minister for Environment under Part IV of the *Environmental Protection Act 1986* (EP Act). Nevertheless, the EPA provides the attached advice to you as the proponent, and other relevant authorities on the environmental aspects of the proposal.

The EPA's decision to not assess the proposal is open to appeal. There is a 14-day period, closing 3 February 2014. Information on the appeals process is available through the Office of the Appeals Convenor's website, www.appealsconvenor.wa.gov.au, or by telephoning 6467 5190.

Darren Foster
Director
Strategic Policy and Planning Division

20 January 2014

Encl

Level 4, The Atrium, 168 St Georges Terrace, Perth, Western Australia 6000
Telephone 08 6145 0800 Facsimile 08 6145 0895 Email info@epa.wa.gov.au
Locked Bag 10, East Perth WA 6892
www.epa.wa.gov.au

PUBLIC ADVICE UNDER SECTION 39A(7)
Environmental Protection Act 1986

COCKBURN CENTRAL WEST WETLAND CONCEPT PLAN WITHIN AN ENVIRONMENTAL PROTECTION (SWAN COASTAL PLAIN LAKES) POLICY 1992

SUMMARY

The Environmental Protection Authority (EPA) has received a referral from RPS Group, on behalf of Landcorp, to undertake development (stormwater management and landscaping) within the Cockburn Central West wetland in accordance with the *Cockburn Central West Wetland Concept Plan* (30 October 2013) (Attachment 1).

Although the proposal raises environmental issues, the EPA considers that the proposal is not likely to have a significant impact on the environment and does not warrant formal environmental impact assessment and the subsequent setting of formal conditions by the Minister for Environment under the *Environmental Protection Act 1986* (EP Act). The EPA considers that any potential environmental impacts of the proposal can be adequately managed by government departments through relevant legislation and planning processes.

PROPOSAL AND POTENTIAL ENVIRONMENTAL IMPACTS

The Cockburn Central West wetland is protected under the *Environmental Protection Swan Coastal Plain Lakes Policy 1992* (Lakes EPP). The Lakes EPP prohibits the filling, excavation, mining, discharging or disposal of effluent; alterations to water levels or drainage of water into or out of the lake unless "authorised" under the *Environmental Protection Act 1986* (EP Act).

"Authorised" includes being informed by the Environmental Protection Authority (EPA) that a proposal does not need to be assessed under Part IV of the EP Act, or authorised by a condition under section 45 of the EP Act. To be authorised the proposal first needs to be referred to the EPA pursuant to section 38 of the EP Act.

The Cockburn Central West wetland is also classified as "Resource Enhancement" wetland in the Geomorphic Wetlands Swan Coastal Plain dataset.

The *Cockburn Central West Wetland Concept Plan* was referred to the EPA by Landcorp, on 6 December 2013, so that development in the wetland may be authorised as required by the Lakes EPP.

The EPA considers that the main environmental issue associated with the proposal is Inland Water Environmental Quality.

A local water management strategy (LWMS) has been finalised in support of the structure plan. An Urban Water Management Plan (UWMP) will also be required as a condition of subdivision. The UWMP will provide the final detailed engineering and landscaping plans for the stormwater management system and wetland design. It also includes final monitoring locations and time frames.

EPA CONSIDERATION AND ADVICE

The EPA considers that development within the Cockburn Central West wetland can be managed through the planning process, in accordance with the Cockburn Central West Wetland Concept Plan (30 October 2013), to meet the EPA's environmental objective for Inland Water Environmental Quality without the need for environmental assessment or Ministerial conditions under Part IV of the EP Act.

The EPA recommends the proponent work closely in consultation with other government departments including but not limited to:

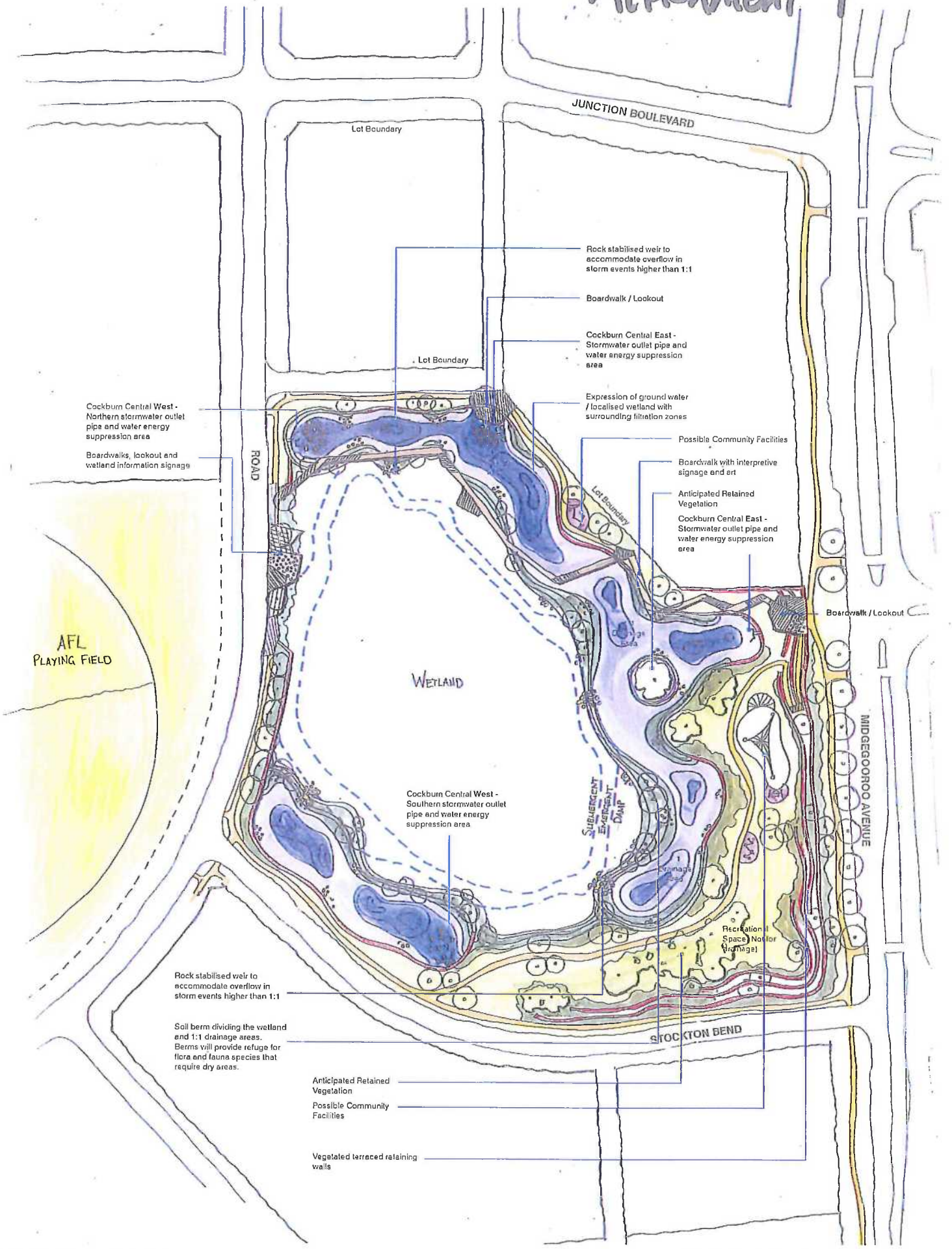
- Department of Water;
- Department of Parks and Wildlife; and
- City of Cockburn.

The EPA expects the relevant decision-making authorities to consider and implement this advice through approvals processes.

Potential impacts posed by increased nutrient loading from residential fertiliser use can be addressed through local government education programs and incentives regarding appropriate fertilisers and plant species located near wetlands.

From 1 January 2013, the existing regulations on phosphorus in domestic-use garden fertiliser have been strengthened to reduce the concentration from 2.5 to 2 percent. The amount of phosphorus in all-purpose and lawn fertiliser is limited to one percent. Controlled release and processed organic fertilisers, such as 'blood and bone', composts and composted chicken manure-based products also need to comply with these requirements.

Attachment 1



RAFT CONCEPT ONLY
ıbject to further design, study,
ıgineering input, survey and council
ıproval.

SPOT HEIGHTS
All spot heights noted on the plan are from the existing survey. Proposed contouring and spot heights require further engineering input.

Perth
Level 1, 66 St George's Terrace
Perth WA 6000
ABN 50 105 256 228
Urbis Pty Ltd ABN 50 105 256 228

Cockburn West
DRAFT Wetland Concept

RPS

APPENDIX 4

Ecoscape Landscaping Plans

Allocasuarina fraseriana

Banksia attenuata

Banksia grandis

Banksia ilicifolia

Banksia menziesii

Corymbia calophylla

Delonix regia

Eucalyptus gomphocephala

Eucalyptus rudis

Eucalyptus marginata

Jacaranda mimosifolia

Melaleuca rhaphiophylla

Nuytsia floribunda

ecoscape
9 Stirling Hwy.
North Fremantle WA 6159
ph: (08) 9430 8955
web: www.ecoscape.com.au

AUTHOR: TC QA: IU PROJECT NO: 3160-14

SCALE 1:1250 @ A1

0 100 200m

COCKBURN CENTRAL WEST

LANDCORP

STREET TREE MASTER PLAN

SK03-C

LEGEND

SOFTWORKS

- TURF
- DRYLAND PLANTING
- DAMPLAND PLANTING
- EMERGENT PLANTING
- PLANTED SWALE
- RETAINED EXISTING TREE
- PROPOSED TREE

HARDWORKS

- PAVING
- BOARDWALK
- SOFTFALL
- ROADSIDE FOOTPATH
- RETAINING WALL
- PLAY EQUIPMENT
- SHELTER WITH BBQ & PICNIC FACILITIES
- BENCH
- DRINK FOUNTAIN

INDICATIVE PLANT PALETTE

SPECIES	COMMON NAME	FORM
Acacia saligna 'prostrate'	Golden Wreath Wattle	Groundcover
Banksia dallanneyi		Groundcover
Carpobrotus viriscens	Pig Face	Groundcover
Dampiera linearis	Common Dampiera	Groundcover
Eremophila glabra 'prostrate'	Tar Bush	Groundcover
Grevillea crithmifolia 'prostrate'		Groundcover
Hemiandra pungens	Snake Bush	Groundcover
Kennedia prostrata	Running Postman	Groundcover
Melaleuca huegelii 'Flat'	Dwarf Chenille Honeymyrtle	Groundcover
Thryptomene baeckeacea	Kalbarri Cascade	Groundcover
Baumea juncea	Bare Twig Rush	Sedge
Baumea preissii	Broad Twig Sedge	Sedge
Bolboschoenus caldwellii	Marsh Club Rush	Sedge
Carex appressa	Tall Sedge	Sedge
Eleocharis sphacelata	Tall Spikerush	Sedge
Ficinia nodosa	Knotted Club Rush	Sedge
Juncus pallidus	Pale Rush	Sedge
Lepidosperma longitudinale	Pithy Sword-sedge	Sedge
Schoenoplectus validus	Lake Club Rush	Sedge
Acacia sessilis 'prostrate'		Shrub
Allocasuarina humilis	Dwarf Sheoak	Shrub
Anigozanthos humilus	Cat's Paw	Shrub
Anigozanthos manglesii	Mangle's Kangaroo Paw	Shrub
Banksia nivea	Couch Honeypot	Shrub
Beaufortia elegans		Shrub

SPECIES	COMMON NAME	FORM
Calothamnus quadrifidus	One-sided Bottlebrush	Shrub
Eremaea pauciflora		Shrub
Grevillea preissii 'Seaspray'	Green Seaspray	Shrub
Hovea pungens	Devil's Pins	Shrub
Hypocalymma angustifolium	White Myrtle	Shrub
Macrozamia riedlei	Zamia Palm	Shrub
Melaleuca pentagona var. latifolia	Little Penta	Shrub
Orthrosanthus laxus	Morning Iris	Shrub
Patersonia occidentalis	Purple Flag	Shrub
Pimelea rosea	Rose Banjine	Shrub
Templetonia retusa	Cockies Tongues	Shrub
Xanthorrhoea preissii	Grass Tree	Shrub
Agonis flexuosa	WA Peppermint	Tree
Allocasuarina fraseriana	Sheoak	Tree
Banksia attenuata	Slender Banksia	Tree
Banksia grandis	Bull Banksia	Tree
Banksia littoralis	Swamp Banksia	Tree
Corymbia calophylla	Marri	Tree
Eucalyptus decipiens		Tree
Eucalyptus gomphocephala	Tuart	Tree
Eucalyptus marginata	Jarrah	Tree
Eucalyptus rudis	Flooded Gum	Tree
Eucalyptus todtiana	Coastal Blackbutt	Tree
Eucalyptus wandoo	Wandoo	Tree
Melaleuca argentea	Silver Cadjeput	Tree
Melaleuca preissiana	Moonah	Tree
Melaleuca rhaphiophylla	Swamp Paperbark	Tree

NOTE: WETLAND CONCEPT IS INDICATIVE ONLY AND SUBJECT TO FURTHER DETAIL DESIGN

ecoscape
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North Fremantle WA 6159
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web: www.ecoscape.com.au

AUTHOR: TC QA: PJ PROJECT NO: 3160-14

SCALE 1:625 @ A1

0 15 30m

COCKBURN CENTRAL WEST

LANDCORP

WETLAND CONCEPT PLAN

SK03-A

APPENDIX 5

Arup Engineering Plans

DRAFT ISSUE
22/05/14

Issue	Description	Date	By	Chkd	Appd
A	For Information	22/05/14	PS	SS	LH

LEGEND:

- SITE BOUNDARY
- 30 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- CATCHMENT AREA
- 32.50 PROPOSED LEVELS
- OVERLAND FLOW ARROW
- INLET AND STORMTECH INFILTRATION CHAMBERS

ARUP
Level 7, Wellington Central, 836 Wellington Street
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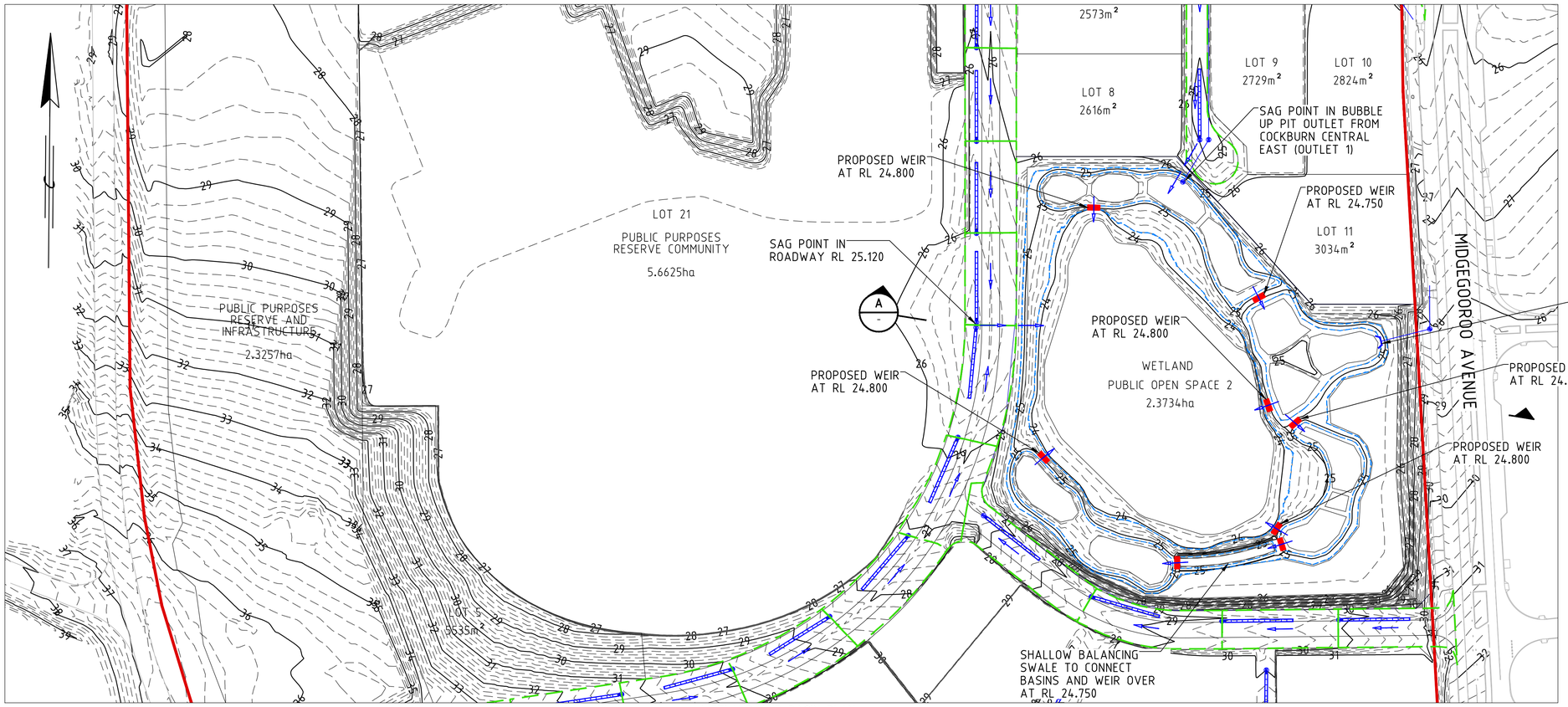
Tel +61 (08) 9327 8300 Fax +61 (08) 9481 1334
www.arup.com.au
CONSULT AUSTRALIA Member Firm
Arup Pty Ltd ABN 18 000 966 165

Client: LANDCORP

Job Title: Cockburn Central West

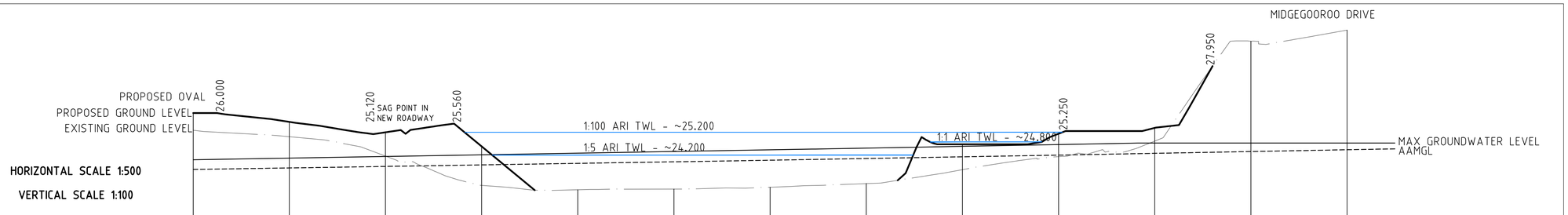
Drainage Catchments and Flow Paths Layout Plan

Scale at A1: 1:1000
Discipline: Civil
Job No: 233960-00
Drawing Status: Information
Drawing No: C-DR-DRG-0-0001
Issue: A



WETLAND AND BASIN PLAN
SCALE 1:1000

WETLAND	
TOTAL IMPERVIOUS AREA	9.65ha
TOTAL PERVIOUS AREA	0.51ha
100yr STORAGE REQUIRED	20020m³
AREA AT TWL (100yr)	17715m²
RL (TWL) (100yr)	25.20m AHD
5yr STORAGE REQUIRED	7260m³
AREA AT TWL (5yr)	13860m²
RL (TWL) (5yr)	24.20m AHD
1yr STORAGE REQUIRED	1180m³
AREA AT TWL (1yr)	4680m²
RL (TWL) (1yr)	24.80m AHD
PEAK OUTFLOW (100yr)	0.0L/s
LWL	23.50m AHD
AAMGL	23.90m



DATUM 20.0

CHAINAGE	0	20	40	60	80	100	120	140	160	180	200	220	240
DESIGN LEVELS	26	25.633	25.199	24.613				24.7	25.139	25.384			
EXISTING SURFACE	25.285	25.018	24.21	22.992	22.81	22.837	22.915	23.066	23.645	24.189	24.834	28.987	
AAMGL	23.655	23.717	23.78	23.844	23.908	23.972	24.039	24.109	24.18	24.25	24.325	24.399	24.474
MAX GWL	24.059	24.127	24.196	24.264	24.333	24.402	24.47	24.542	24.615	24.689	24.75	24.75	24.75

SECTION A
SCALE 1:10

DRAFT ISSUE
22/05/14

Issue	Description	Date	By	Chkd	Appd
A	For Information	22/05/14	PS	SS	LH

LEGEND:
- SITE BOUNDARY
- 30 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- CATCHMENT AREA
- PROPOSED WEIR
- OVERLAND FLOW ARROW
- INLET AND STORMTECH INFILTRATION CHAMBERS

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Tel +61 (08) 9327 8300 Fax +61 (08) 9481 1334
www.arup.com.au
CONSULT AUSTRALIA Member Firm
Arup Pty Ltd ABN 18 000 966 165

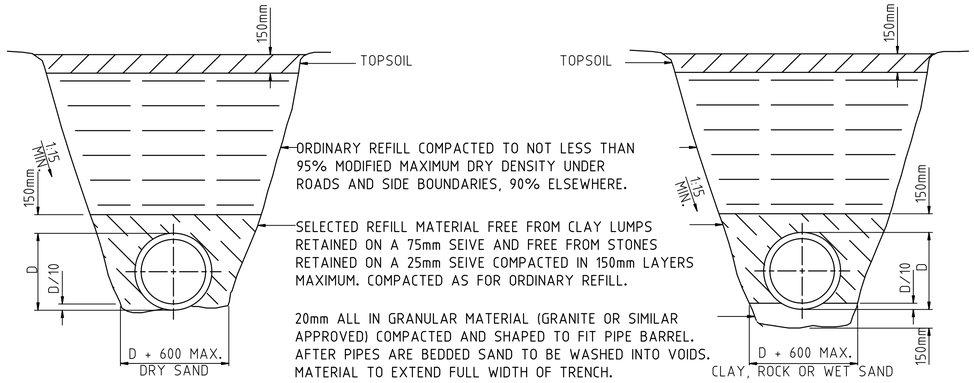
Client: LANDCORP

Job Title: Cockburn Central West

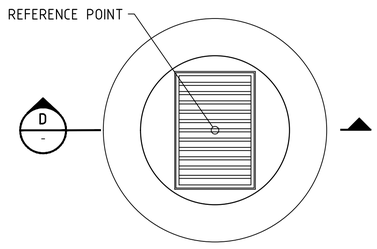
Basins and Wetland Treatment Layout Plan

Scale at A1: 1:1000
Discipline: Civil
Job No: 233960-00
Drawing Status: Information
Drawing No: C-DR-DRG-0-0002
Issue: A

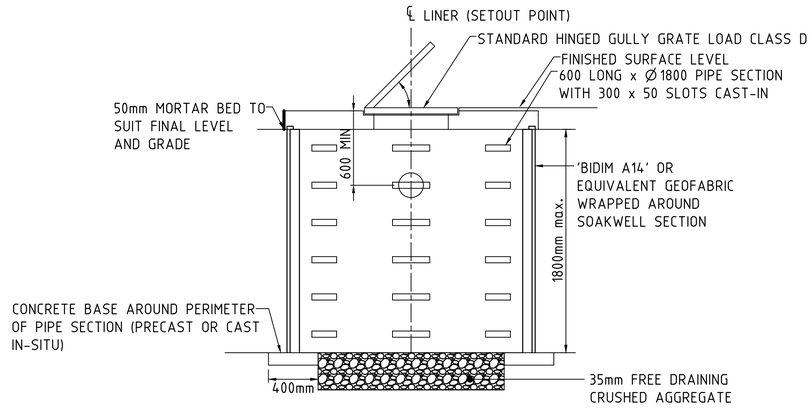
Do not scale



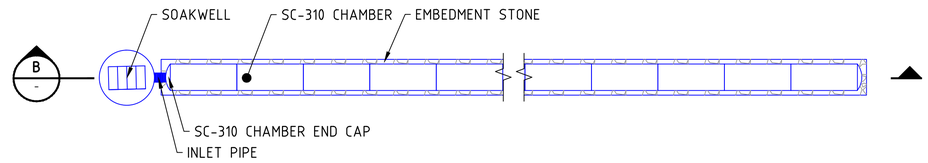
PIPE BEDDING AND BACKFILL DETAIL
N.T.S



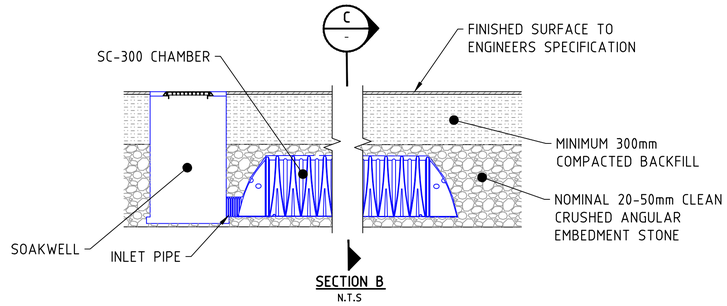
PLAN - GULLY/SOAKWELL PIT (SW)
N.T.S



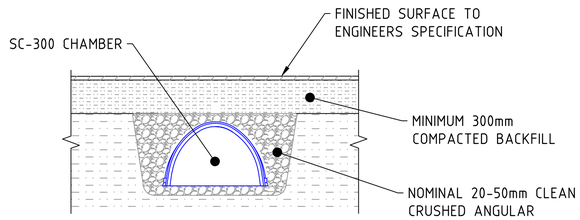
SECTION D - TYPICAL Ø1800 GULLY/SOAKWELL DETAIL (SW)
N.T.S



INLET & STORMTECH INFILTRATION CHAMBERS TYPICAL ARRANGEMENT
SCALE 1:100



SECTION B
N.T.S



SECTION C
N.T.S

DRAFT ISSUE
22/05/14

Issue	Description	Date	By	Chkd	Appd
A	For Information	22/05/14	HE	SS	LH

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CONSULT AUSTRALIA Member Firm
Arup Pty Ltd ABN 18 000 966 165

Client: LANDCORP

Job Title: Cockburn Central West

Drainage Details

Scale at A1: 1:1000
Discipline: Civil
Job No: 233960-00
Drawing Status: Information
Drawing No: C-DR-DRG-0-0003
Issue: A

Do not scale