Cardno
Shaping the Future

Packham North

Groundwater Monitoring Report

Prepared for City of Cockburn

May 2010

Project Number V8070

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Executive Summary

The Packham North study area (hereafter referred to as the "study area") is comprised of approximately 62ha of historically agricultural land situated within the City of Cockburn (CoC). The study area is bounded by a residential development to the south, Rockingham Road to the east, the railway line to the north and Cross Road to the west. The study area is currently zoned 'Rural' in the CoC's *Town Planning Scheme (TPS) No.3* (CoC 2002). The study area has been historically used for agriculture and stock agistment purposes. There are also some special use and light industry areas in the north and north-west. Therefore, much of the study area has historically been cleared.

Cardno has been engaged to develop a Sampling and Analysis Plan (SAP) to provide baseline groundwater quality and levels within the study area prior to development. The objective of collecting this data is to characterise the pre-development hydrological environment. The SAP captured groundwater levels and quality from October 2008 to March 2010. Physiochemical parameters were measured on a monthly basis over the monitoring period and nutrient and nutrient species were measured quarterly over the same period (i.e. 6 occasions).

The minimum surface to groundwater separation distance recorded was 2.05m at bore MW9, located centrally along the northern boundary of the study area. Through analysis of the groundwater depths of the ten installed bores it can be inferred that the study area has a moderate depth to groundwater in the central valley areas which increases to the east and west. The maximum groundwater levels (MGLs) recorded in 2008 were used to generate groundwater contours. These groundwater contours indicate that the ground water flow is in a westerly direction. The 2008 MGLs were used as 2008 was an above average rainfall year. Annual average maximum groundwater levels (AAMGLs) were unable to be generated as DoW bores within a 1.5km radius could not be referenced as they were either; not monitored over the same period, or within 150m of the coast and affected by sea levels.

Groundwater quality in relation to nutrient concentrations varied across the ten bores, with the southern portion of the study area generally displaying the highest concentrations. NO_X consistently recorded 'very high' readings. The spatial distribution of these readings suggest there is an inherently high level of NO_X in the vicinity of (and including) the study area, rather than a point source within the study area. NO_x comprises the oxides of nitrogen, nitrite (NO^2) and nitrate (NO^3). Elevated NO_x concentrations are potentially a concern as NO_x is known to have a correlation with accelerated algal growth, and because NO_2 is toxic to some aquatic species. TN and NO_X are the most significant nutrients and nutrient species as they recorded average concentrations up to and greater than ten times the ANZECC guideline values (2000). TN concentrations are at their highest in the south of the study area with the majority of these readings comprised of NO_X.

TP values were generally 'moderate' throughout the site. The TP concentration distribution mapping does not have a significant relationship with the direction of groundwater flow. Ortho P (the reactive form of phosphorous) was generally found in 'low' concentrations.

This report concludes the scope of work with regards to hydrological monitoring of the study area. As no inherent deficiencies have been identified, the monitoring parameters and methodology are considered to be adequate to have achieved the aims of the pre-development hydrological investigation. As such, Cardno is of the opinion that the current dataset is robust and comprehensive enough to assist in future planning of the proposed development.

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1 Introduction

1.1 Project Background

The Packham North study area (hereafter referred to as the "study area") is comprised of approximately 62ha of historically agricultural land situated within the City of Cockburn (CoC). The locality of the study area is shown in **Figure 1**. The study area is bounded by a residential development to the south, Rockingham Road to the east, the railway line to the north and Cross Road to the west. These boundaries are shown in **Figure 2**. Cardno was engaged to develop a groundwater Sampling and Analysis Plan (SAP) to provide baseline water quality data and groundwater levels within the study area prior to development.

The study area is currently zoned 'Rural' in the CoC's *Town Planning Scheme (TPS) No.3* (CoC 2002). The historical use of the study area has been for market garden agriculture, pasture growth and stock agistment purposes. There are also some special use and light industry areas in the north and north-west. Therefore, much of the study area has historically been cleared.

The study area is proposed to be developed for residential purposes. Such a land use change can have implications for the types and quantity of pollutants released to local surface water and groundwater, which can in turn affect the ecological health of downstream receiving environments.

1.2 Monitoring Objective

Cardno has been engaged to gather baseline data within the study area prior to development. The objective of collecting this data is to characterise the pre-development hydrological environment of the study area. To achieve this objective, Cardno developed the SAP detailed in the following sections of this report. It was determined that in order to achieve the project objective, the SAP would need to:

- Identify and quantify nutrient hotspots so that appropriate management measures can be implemented to avoid exacerbating the current situation;
- Determine groundwater quality to provide baseline data against which the effectiveness of future urban stormwater management and development impacts can be compared; and
- Understand the groundwater levels within the study area to determine if fill is required to achieve satisfactory separation distance.

Baseline data will be used to inform the future design process and will ensure that any future development is able to fulfil the stormwater management requirements of the Department of Water (DoW).

1.3 Purpose of this Report

This report documents the results of the groundwater quality and groundwater levels monitoring that was undertaken between October 2008 and March 2010.

2 Sampling and Analysis Plan Rationale

2.1 Key Documents and Inputs

There are a number of published guidelines and standards available which provide direction regarding the discharge characteristics that residential development should aim to achieve. These were key inputs utilised for development of the SAP, and include:

- *National Water Quality Management Strategy* (ANZECC 2000).
- *Stormwater Management Manual for Western Australia* (DOW 2007).
- *Development of Sampling and Analysis Programs* (DOE 2001).
- *Better Urban Water Management* (WAPC 2008).

The guidance documents detailed above were reviewed to determine the likely data requirements for the study area. These documents point to the need for accurate baseline data prior to development. Additionally, existing groundwater levels have potential implications for the stormwater management measures and the extent of earthworks/ fill that will be required to facilitate development.

2.2 Groundwater Methodology

Ten shallow groundwater bores were installed within the study site at locations which would provide the best representation of anticipated shallow/ perched groundwater systems. These locations will allow for the identification of nutrient hotspots and development of underlying groundwater contours. The locations of these groundwater bores are shown in **Figure 2**.

The groundwater bores were constructed of 50mm threaded PVC slotted screen and blank casing sections. A 3m screened section was installed in each of the bores to approximately bisect the observed groundwater level. Graded gravel pack was placed around the screened section extending at least 0.5m above the top of the screened section. A bentonite seal was placed above the gravel pack and the bore annulus was backfilled with any available cuttings and concrete to the surface. Each bore was completed with approximately 0.5m of PVC casing extending above the ground surface and a protective steel casing. All bores were logged for hydro-geological parameters on installation. Bore completion log sheets are contained in **Appendix A.**

2.2.1 Groundwater Levels

Groundwater levels were measured on a monthly basis for 18 months on all installed bores. The bores were measured using an audible dip meter to record standing water levels. All bores have been surveyed to provide an accurate elevation, thereby allowing accurate calculation of groundwater contours.

2.2.2 Groundwater Quality

A clear understanding of the existing groundwater quality is important to determine whether the quality of water in the superficial aquifer is slowly improving with time or at least not degrading as a result of development. Groundwater quality sampling for physiochemical parameters was conducted

on a monthly basis for a period of 18 months following installation of the monitoring bores. Groundwater quality sampling for nutrient concentrations was conducted on a quarterly basis over the same period (i.e. 6 occasions).

Bores were purged using an electric pump prior to sampling. A Hydrolab Quanta water quality meter was used to collect field chemical data. Purging of the well was continued for approximately five minutes before samples were collected for *in situ* physiochemical and laboratory analysis. Physiochemical parameters measured *in situ* include:

- pH.
- Temperature.
- Salinity.
- Electrical Conductivity (EC).
- Oxidation-Reduction Potential (Eh).

Upon collection, groundwater samples are placed directly into laboratory prepared and supplied containers. The samples are then placed on ice immediately following collection and transported to the laboratory under standard Chain of Custody procedures. Samples are submitted to a National Association of Testing Authority (NATA) accredited laboratory for analysis. The parameters selected for groundwater analysis include:

- Total Nitrogen (TN).
- Total Phosphorous (TP).
- Ortho-Phosphorous (Ortho P).
- Oxides of Nitrogen (NO_x).
- Total Kjeldahl Nitrogen (TKN).
- Ammonium (NH_4).

2.2.2.1 Chain of Custody

Standard Chain of Custody forms are completed for all samples transferred to the laboratory, detailing the sample identification, collection date and the requested analysis. Upon receipt of the samples the laboratory completes the Chain of Custody forms and provides a copy to Cardno for confirmation. Completed Chain of Custody forms for sampling undertaken are provided in **Appendix B.**

2.2.2.2 Laboratory Analysis

All laboratory analysis was conducted by a NATA accredited laboratory with all primary and QA/QC samples submitted to a NATA accredited laboratory for analysis. Laboratory certificates of analysis are included in **Appendix B**.

3 Assessment Criteria

In order to provide an indication of the relative concentration of nutrient levels and physiochemical parameters within groundwater, comparison with the 'default trigger values for slightly disturbed ecosystems (lowland river) in South Western Australia' (ANZECC 2000) is made in the following sections. While the default trigger values are applicable to nutrient concentrations within surface water features, they are not specifically intended for application to groundwater nutrient concentrations. However, as there are no nationally published trigger values available for groundwater quality, a comparison of nutrient concentrations and some physiochemical parameters are made to the 'default trigger values' to provide some context to the measured concentrations. As such, the 'default trigger values' are hereafter referred to as the 'guideline values'. These guideline values are shown in **Table 3.1**.

Table 3.1 ANZECC Guideline Values

TN (µg/L)	TP (µg/L)	Ortho P (µg/L)	NH_4 (µg/L)	NO_X (µg/L)	DO (%)	pH	Salinity (µS/cm)
1,200	65	40	80	150	80-120	6.5-8.0	120-300

Discussion of nutrient concentrations in the following sections refers to their relative concentration compared to the guideline values. The terms 'low', 'moderate', high' and 'very high' are used in the following manner:

- 'Low' – nutrient concentration below, equal to or marginally above default trigger value;
- 'Moderate' – nutrient concentration up to five times the default trigger value;
- 'High' – nutrient concentration between five and 10 times the default trigger value; and
- 'Very High' – nutrient concentrations more than 10 times the default trigger value.

Principally, comparison is made for the TN and TP concentrations. However, some comment is also provided for nutrient species (Ortho P, NH_4, NO_X) where these form a substantial portion of the overall nutrient concentrations.

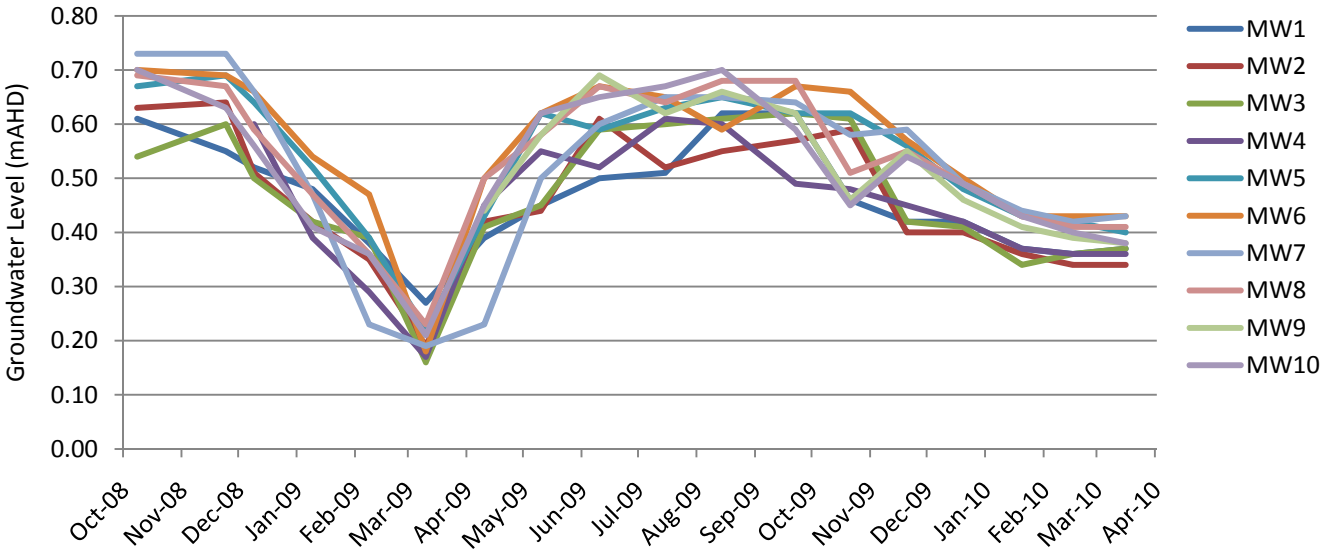
4 Monitoring Results

4.1 Groundwater Levels

The groundwater levels, and survey data for each bore are shown in **Appendix C**. Depth to groundwater for the ten bores was measured monthly from October 2009 to March 2010. The depth to groundwater ranged from 2.05mBGS (Bore MW9, June 2009) to 14.28mBGS (Bore MW3, March 2009).

Analysis of DoW groundwater bore level data across Perth and in a 10km radius of the study area indicate that groundwater levels are typically at their lowest in March/ April and at their highest in October, with seasonal fluctuations of up to approximately 2m. **Figure 4.1**

Figure 4.1 Groundwater Hydrograph



As shown in **Figure 4.1**, maximum groundwater levels were generally observed in October 2008 while the minimum groundwater levels were recorded in March 2009. **Table 4.1** shows the maximum groundwater levels observed during each year monitoring occurred.

Table 4.1 Maximum Groundwater Levels

Groundwater Bore	Maximum Groundwater Level (mAHD)	
	2008	2009
MW1	0.61	0.62
MW2	0.64	0.61
MW3	0.60	0.62
MW4	0.60	0.61
MW5	0.69	0.65
MW6	0.70	0.67
MW7	0.73	0.65
MW8	0.69	0.68
MW9	-	0.66
MW10	0.70	0.70

The maximum groundwater levels (MGLs) recorded in 2008, shown in **Table 4.1**, were used to generate the groundwater contours shown in **Figure 2**. The 2008 MGLs were used as 2008 was and above average rainfall year. Annual average maximum groundwater levels (AAMGLs) were unable to be generated as DoW bores within a 1.5km radius could not be referenced as they were either; not monitored over the same period, or within 150m of the coast and would be influenced by sea levels. Analysis of the groundwater contours shown in **Figure 2** indicate that the ground water flow is in a westerly direction.

4.2 Groundwater Quality

Groundwater quality monitoring was conducted between October 2009 and March 2010. Physiochemical parameters were measured *in situ* on a monthly basis (except for November 2009, when samples were not taken due to equipment failure) while nutrients and nutrient species were measured on a quarterly basis by a NATA accredited laboratory. A summary of the average results are shown in **Table 4.2.1**. The complete analysis of results is shown in **Appendix D**.

Table 4.2.1 Summary of Groundwater *in situ* and Laboratory Analysis Results

	Trigger Values	MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW8	MW9	MW10
Field Chemistry Parameters											
Temp (°C)	-	20.9 (1.0)	21.0 (1.1)	21.1 (1.1)	21.4 (1.0)	20.4 (4.6)	21.3 (1.8)	20.6 (1.1)	20.7 (1.0)	20.5 (1.7)	21.8 (1.5)
Salinity (mS/cm)	0.12-0.3	0.6 (0.1)	0.5 (0.1)	1.0 (0.2)	1.0 (0.2)	0.8 (0.2)	1.0 (0.3)	0.6 (0.2)	0.6 (0.2)	1.3 (0.2)	0.7 (0.1)
DO (%)	80-120	69.1 (9.9)	91.7 11.7)	57.3 (9.7)	38.7 (8.5)	43.3 (15.6)	32.7 (12.6)	74.1 (13.7)	26.8 (13.8)	47.0 (19.8)	81.8 (13.7)
pH	6.5-8.0	7.3 (0.6)	7.4 (0.4)	7.4 (0.1)	7.3 (0.1)	7.4 (0.2)	7.4 (7.4)	7.6 (0.5)	7.2 (0.1)	7.3 (0.7)	7.3 (0.2)
Redox	-	138.6 (49.4)	146.6 (48.4)	136.8 (35.4)	130.5 (33.7)	127.7 (30.9)	124.1 (25.4)	130.6 (28.5)	123.1 (21.4)	151.8 (42.3)	135.8 (41.4)
Laboratory Analytes											
TN (µg/L)	1,200	4,083 (504)	2,183 (306)	10,280 (923)	12,300 (1,942)	8,217 (662)	17,983 (6,116)	3,483 (1,165)	4,050 (2,190)	2,793 (4,345)	11,633 (776)
TP (µg/L)	65	137 (159)	88 (115)	186 (139)	52 (40.7)	71 (78.9)	159 (300)	115 (161)	95 (117)	63 (55.0)	186 (133)
Ortho-P (µg/L)	40	5.8 (3.7)	6.3 (3.4)	7.4 (4.0)	9.5 (4.5)	10.7 (4.5)	12.5 (6.5)	9.0 (5.2)	9.3 (5.0)	14.3 (6.1)	11.2 (6.5)
NH_4 (µg/L)	80	12.5 (13.9)	12.0 (11.8)	11.2 (8.6)	16.2 (14.7)	10.8 (9.9)	41.3 (53.1)	20.3 (30.0)	14.2 (13.5)	23.5 (17.4)	15.7 (22.0)
NO_2+NO_3 (µg/L)	150	3,675 (539)	2,060 (333)	9,800 (1,142)	11,733 (1,537)	7,960 (912)	16,050 (6,108)	3,160 (1,129)	3,837 (2,132)	2,442 (4,574)	11,300 (992)
TKN (µg/L)	-	417 (172)	200 (63.2)	480 (295)	733 (665)	350 (176)	2,150 (2,192)	333 (121)	267 (121)	475 (289)	483 (366)

Note: the above statistics are 'average'/'standard deviation'. Trigger values are for Lowland Rivers in South Western Australia, as classified by ANZECC (2000).

As shown in **Table 4.2.1**, comparison of the physiochemical parameters and nutrient concentrations with the ANZECC guideline values indicates:

- 'Moderate' to 'Very High' TN concentrations;
- 'Low' to 'Moderate' TP concentrations;
- 'Low' Ortho P and NH_4 concentrations;
- 'Very high' NO_X concentrations;
- Salinity values that exceed the guideline range at all monitoring locations;
- pH values within the guideline range; and
- DO readings within or below the guideline range.

The spatial mapping of the average TN and TP concentrations are shown in **Figures 3** and **4** respectively. The TN distribution mapping shows 'very high' concentrations centred near Bore MW6 and MW4. The TN distribution mapping shows groundwater in the northern portion contains significantly lower TN concentrations than the southern portion of the study area. As shown in **Table 4.2.1**, the majority of the TN concentrations are comprised of very high concentrations of the nitrous oxides (NO_2 and NO_3) across the entire study area. Analysis of the raw data shown in **Appendix D**

indicates that the majority of the low concentrations of TN and NO_X were recorded in July whereas the high concentrations were primarily recorded in October and January.

The TP concentrations are significantly lower than the TN and NO_X concentrations. TP distribution mapping shows localised 'moderate' concentrations around bores MW3, MW6 and MW10, however the TP mapping does not show a significant relationship with the direction of groundwater flow.

5 Discussion

The SAP was able to capture groundwater levels and quality from October 2008 to March 2010. Physiochemical parameters were measured on a monthly basis over the monitoring period (except for November 2009, when physiochemical parameters were unable to sampled due to equipment failure) and nutrient and nutrient species were measured quarterly over the same period (i.e. 6 occasions).

Groundwater contours were generated from the 2008 MGLs and indicate a westerly groundwater flow. The minimum surface to groundwater separation distance recorded was 2.05m at bore MW9, located centrally along the northern boundary of the study area. Through analysis of the groundwater depths of the ten installed bores it can be concluded that the study area has a moderate depth to groundwater in the valley areas where the bores are installed. No suitable DoW reference bore is located within a 1.5km radius of the study area. For this reason AAMGLs have not been calculated for the study area. The close proximity to sea level (approximately 0mAHD) provides some context to the MGLs recorded.

Groundwater quality in relation to nutrient concentrations varied across the ten bores, with the southern portion of the study area generally displaying the highest concentrations. NO_X consistently recorded 'very high' readings. The spatial distribution of these readings suggest there is an inherently high level of NO_X in the vicinity of (and including) the study area, rather than a point source within the study area. NO_x comprises the oxides of nitrogen, nitrite (NO^2) and nitrate (NO^3). Elevated NO_x concentrations are potentially a concern as NO_x is known to have a correlation with accelerated algal growth, and because NO_2 is toxic to some aquatic species. TN and NO_X are the most significant nutrients and nutrient species as they recorded average concentrations up to and greater than ten times the ANZECC guideline values (2000). TN concentrations are at their highest in the south of the study area with the majority of these readings comprised of NO_X.

TP values were generally 'moderate' throughout the site. The TP concentration distribution mapping does not have a significant relationship with the direction of groundwater flow. Ortho P (the reactive form of phosphorous) was generally found in 'low' concentrations.

6 Conclusion

This report concludes the scope of work with regards to hydrological monitoring of the study area. As no inherent deficiencies have been identified, the monitoring parameters and methodology are considered to be adequate to have achieved the aims of the pre-development hydrological investigation. As such, Cardno is of the opinion that the current dataset is robust and comprehensive enough to assist in future planning of the proposed development.

7 References

Australian and New Zealand Environment and Conservation Council (ANZECC), 2000, *National Water Quality Management Strategy,* Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

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Western Australian Planning Commission (WAPC), 2008, *Better Urban Water Management*, WAPC, Perth.

Figures

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD

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Scale: **1:10,000**

0 125 250 500 750 1,000 Metres

PROJECT **Hamilton Road Groundwater Monitoring**

DRAWING TITLE **FIGURE 1 : Locality Plan**

PRINCIPAL **City of Cockburn**

Project Number **V8070**

Original **A4**

Drawing Number **SK01**

Revision

Designed SLC

Checked DPC

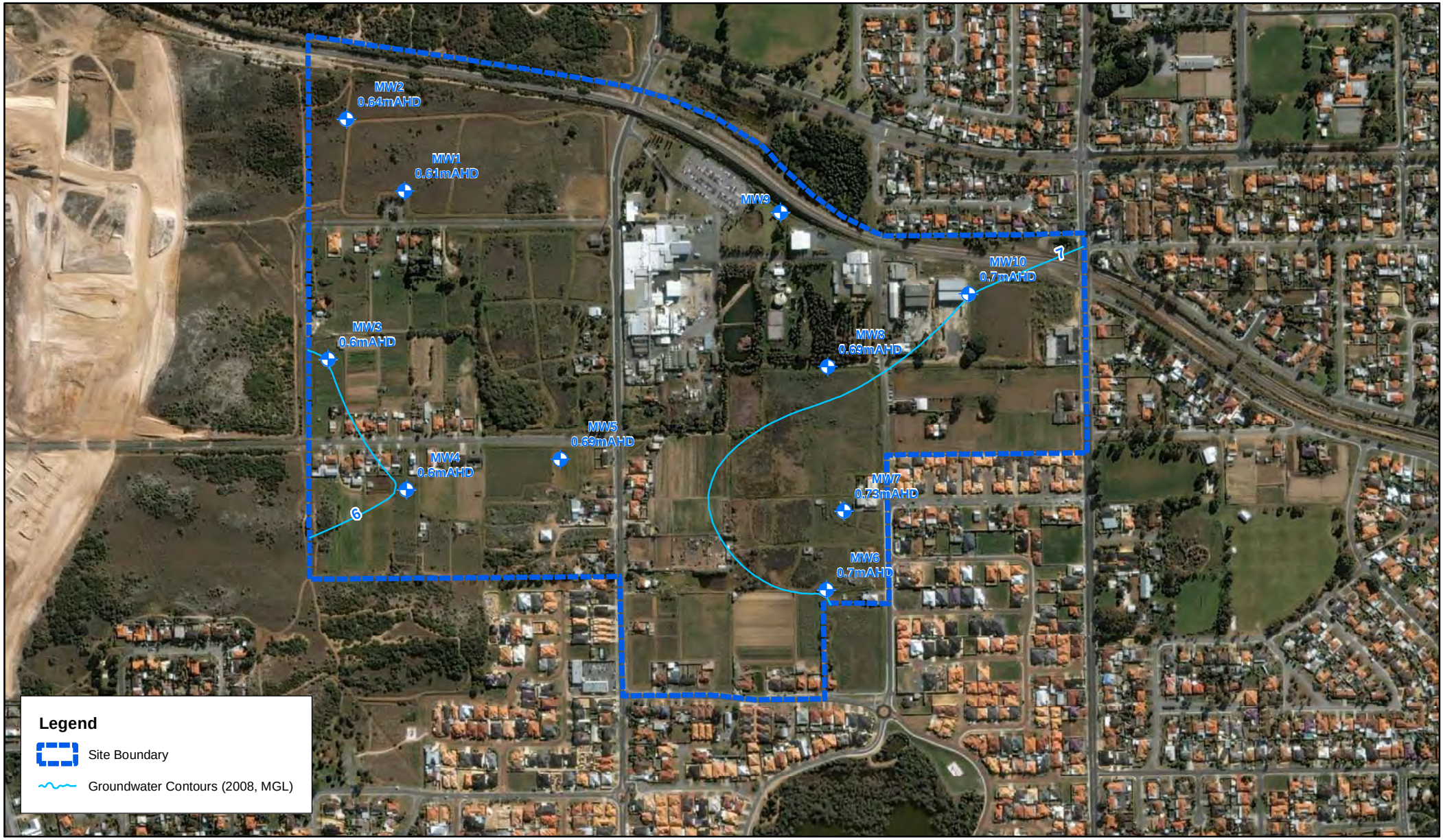
Drawn MGW

Approved DPC

Local Authority City of Cockburn

Sheet 1 of 1

Date 11/12/09



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DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD

PROJECT **Hamilton Road Groundwater Monitoring**

DRAWING TITLE **FIGURE 2 : Study Site , Bore Locations and Groundwater Contours (2008, MGL)**

PRINCIPAL **City of Cockburn**

Scale: **1:8,000**

0 50 100 200 300 400 500 600 700 800 Meters

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V8070	SK15	00	A4

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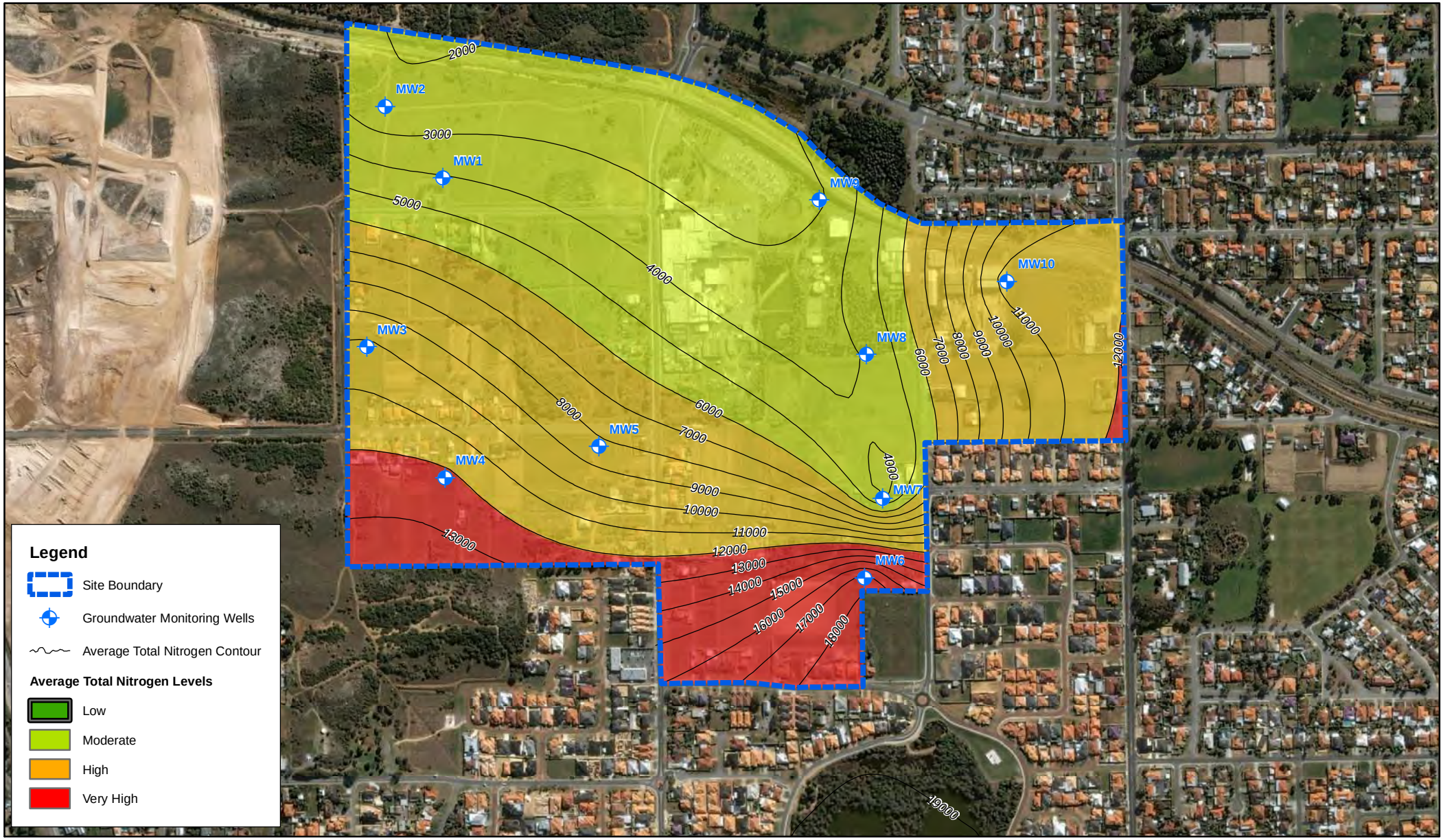

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PROJECT **Hamilton Road Groundwater Monitoring**

DRAWING TITLE **FIGURE 3 : Average Total Nitrogen Mapping**

PRINCIPAL **City of Cockburn**

Scale: **1:8,000**

0 50 100 200 300 400 500 600 700 800 Meters

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DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD

PROJECT **Hamilton Road Groundwater Monitoring**

DRAWING TITLE **FIGURE 4 : Average Total Phosphorous Mapping**

PRINCIPAL **City of Cockburn**

Scale: **1:8,000**

0 50 100 200 300 400 500 600 700 800 Meters

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V8070	SK14	00	A4

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Sheet 1 of 1

Appendix A

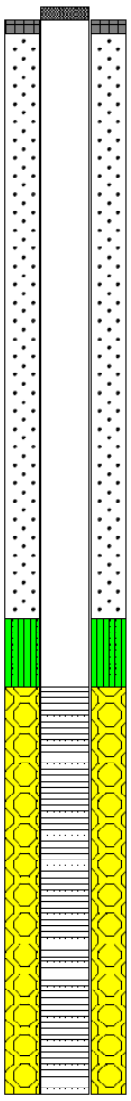
Bore Logs

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

Cardno

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW1
BORE LOCATION:
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8051
DATE: 18/9/08
TOTAL DEPTH: 8
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
0	0		Sand: SAND - Brown/ orange, Fine to medium particles, Medium level organic content, Moist. Firm, Even.	Moist.	Sand: Changed abruptly to Limestone from sand layers			
			Sand: SAND - Pale Brown, Fine to course particles, low level organic content, Moist. Firm, Even.	Moist.				
1	-1			Dry				
			Sand: SAND - Brown & pale tan mottle, Fine to course particles, Dry. Firm, Even.	Dry				
2	-2		Sand: SAND - Tan & pale yellow mottle, Medium to course particles, Dry. Firm, Even. Flecked with small sized limestone pieces (4 - 8mm)	Dry	Limestone: Limestone milled by drilling method. Hard layers, hardness defined by sizes of limestone pieces.			
				Dry				
3	-3		Limestone: LIMESTONE - Pale tan, Fine to course grain, Dry. Flecked with small sized limestone pieces (4 - 8mm). Hard, Even.	Dry				
			Limestone: LIMESTONE - Pale tan, Fine to course grain, Dry. Flecked with medium sized limestone pieces (8 - 12mm). Hard, Even.	Dry				
4	-4			Dry				
			Limestone: LIMESTONE - Pale tan, Fine to course grain, Dry. Flecked with medium sized limestone pieces (8 - 12mm). Hard, Even.	Dry				
5	-5			Moist				
			Limestone: LIMESTONE - Pale tan, Fine to course grain, Dry. Flecked with small to medium sized limestone pieces (4 - 12mm). Hard, Even.	Moist				
6	-6		Limestone: LIMESTONE - Pale tan, Fine to course grain, Dry. Flecked with small to medium sized limestone pieces (4 - 12mm). Hard, Even.	Saturated				
				Saturated				
7	-7		Limestone: LIMESTONE - Pale tan, Fine to course grain, Dry. Flecked with small to medium sized limestone pieces (4 - 12mm). Hard, Even.	Moist				
				Moist				
8	-8		Limestone: LIMESTONE - Pale tan, Fine to course grain, Moist. Flecked with small to medium sized limestone pieces (4 -					

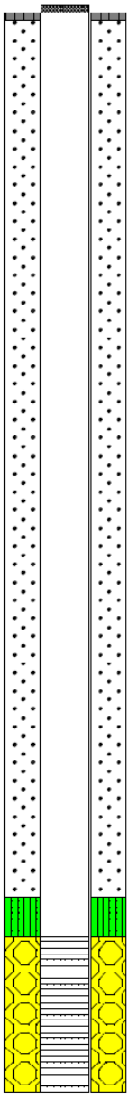
NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

Cardno

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW2
BORE LOCATION:
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 18/9/08
TOTAL DEPTH: 14
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
0	0		Sand: SAND - Reddy/ brown, Fine to medium particles, Medium level organic content (twiggs, roots), Moist. Firm, Even.	Moist.	Sand: Changed abruptly to Limestone from sand layers			
1	-1		Sand: SAND - Reddy/ brown. Fine to medium particles, Moist. Medium organic content - twigs, roots. Even, Soft.	Moist.				
2	-2		Sand: SAND - Orangy/red brown. Medium to course particles, Dry. Firm, Even. Flecked with small to medium sized sized limestone pieces (4 - 12mm)	Dry				
3	-3		Sand: SAND - Orange red with pale tan/ white mottle. Medium to course particles, Dry. Firm, Even. Flecked with small to large sized sized limestone pieces (4 - 20mm)	Dry				
4	-4		Sand: SAND - Orange with pale tan/ white mottle. Medium to course particles, Dry. Firm, Even. Flecked with small to large sized sized limestone pieces (4 - 20mm)	Dry				
5	-5		Limestone: LIMESTONE - Pale tan, Fine to course grain, Dry. Flecked with medium sized limestone pieces (8 - 12mm). Hard.	Dry	Limestone: Limestone milled by drilling method. Hard layers, hardness defined by sizes of limestone pieces.			
6	-6		Limestone: LIMESTONE - Pale tan, Fine to course grain, Dry. Flecked with medium sized limestone pieces (8 - 12mm). Hard.	Dry				
7	-7		Limestone: LIMESTONE - Pale grey/ brown, course grain, Dry. Flecked with small to medium sized limestone pieces (4 - 12mm). Hard.	Dry				
8	-8		Limestone: LIMESTONE - Pale grey/ brown, course grain, Dry. Flecked with small to medium sized limestone pieces (4 - 12mm). Hard.	Dry				
9	-9		Sand: SAND - Orange/ red, fine to medium grain. Hard, Even, Moist.	Moist				
10	-10		Sand : SAND - Orange/ red, fine to medium grain. Hard, Even, Moist.	Moist				
11	-11		Sand: Sand - yellow orange bassendean sands, medium to	Saturated				
12	-12			Saturated				
13	-13			Saturated				
14	-14							

NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW2
BORE LOCATION:
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 18/9/08
TOTAL DEPTH: 14
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
			course grain, Saturated, even, flecked with limestone pieces, smal to medium (4 - 8mm).					
			Sand: Sand - yellow bassendean sands, medium to course grain, Saturated, even, flecked with limestone pieces, smal to medium (4 - 8mm).					
			Sand : Sand - Pale yellow bassendean sands, medium to course grain, Saturated, even.					

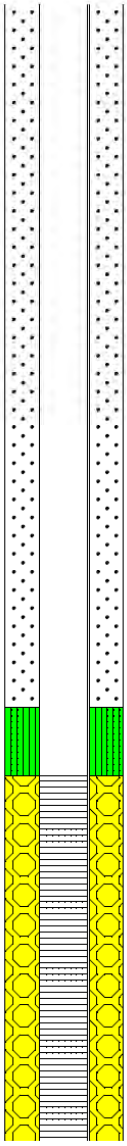
NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW3
BORE LOCATION:
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 17
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
9	-9		LIMESTONE - Pale yellow, Dry. Dust only very hard layer.	Dry				
10	-10		LIMESTONE - Pale yellow, Dry. Dust only very hard layer.	Dry				
11	-11		LIMESTONE - Pale yellow/ white, Dry. Dust only very hard layer.	Dry				
12	-12		LIMESTONE - Pale tan, Fine to course grain, Dry. Dust only very hard layer.	Dry				
13	-13		LIMESTONE - Pale yellow, Moist. Dust and medium to large pieces of limestone (8 - 20mm).	Moist				
14	-14		LIMESTONE - Pale yellow/ white, Mud as Saturated. very hard layer.	Saturated				
15	-15		SAND - Yellow / white mottled sands. Fine to medium particles, Saturated, Flecked with small to large sized sized limestone pieces (4 - 20mm)	Saturated				
16	-16		SAND - Yellow sands. Fine to medium particles, Moist, Flecked with small to large sized sized limestone pieces (4 - 20mm)	Moist				

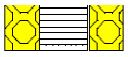


NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW3
BORE LOCATION:
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 17
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

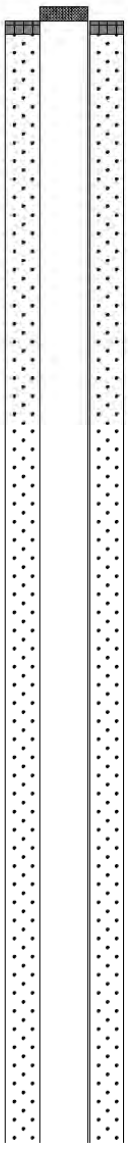
DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
17	-17							

NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW4
BORE LOCATION:
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 12
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
0	0		SAND - Sandy loam, medium brown, Fine to medium particles, low level organic content (twiggs, roots), Moist. Soft, Even.	Moist.				
1	-1		SAND - Orange/ brown. Fine to medium particles, Moist. Even, Soft.	Moist.				
2	-2		SAND - Light orange/ brown. Fine to medium particles, Moist. Even, Soft.	Moist				
3	-3		SAND - Pale orange with pale tan/ white mottle. Fine to medium particles, Dry, Flecked with small to large sized sized limestone pieces (4 - 20mm)	Dry				
4	-4		SAND - Pale orange with pale tan/ white mottle. Fine to medium particles, Dry, Flecked with small to large sized sized limestone pieces (4 - 20mm)	Dry				
5	-5		SAND - Pale orange with pale tan/ white mottle. Medium particles, Dry Flecked with small to large sized sized limestone pieces (4 - 20mm)	Dry				
6	-6		SAND - Pale orange with pale tan/ white mottle. Medium particles, Dry, Flecked with small to large sized sized limestone pieces (4 - 20mm)	Dry				
7	-7		SAND - Pale orange with pale tan/ white mottle. Medium to course particles, Moist. Firm, Flecked with small to large sized sized limestone pieces (4 - 20mm)	Moist				
8	-8		LIMESTONE - Pale tan, Fine to course grain, Dry. Dust only very	Dry				

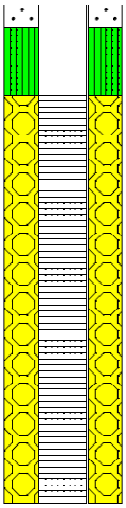
NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW4
BORE LOCATION:
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 12
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
			hard layer.					
9	-9		LIMESTONE - Pale yellow, Dry. Dust only very hard layer.	Dry				
10	-10		LIMESTONE - Pale yellow/ white, Mud as Saturated. very hard layer.	Saturated				
11	-11		LIMESTONE - Pale yellow/ white, Mud as Saturated. very hard layer.	Saturated				
12	-12							



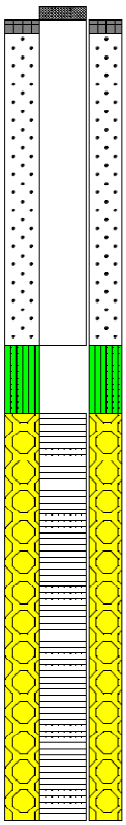
NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW5
BORE LOCATION:
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 6
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
0	0		SAND - Sandy loam, Orange brown, Fine to medium particles, low level organic content (twiggs, roots), Moist. Soft, Even.	Moist.				
1	-1		SAND - Brown with tan mottle. Fine grain particles, Flecked with limestone pieces small to medium size (4-8mm), Moist, Soft.	Moist.				
2	-2		LIMESTONE - Pale orange, Fine to v. course grain, Moist. medium pieces of limestone (8 - 20mm) only very hard layer.	Moist				
3	-3		LIMESTONE - Pale yellow, Dry. Dust only very hard layer.	Dry				
4	-4		LIMESTONE - Pale yellow, Moist. Dust and medium to large pieces of limestone (8 - 20mm).	Moist				
5	-5		LIMESTONE - Pale yellow/ white, Mud as Saturated. very hard layer.	Saturated				
6	-6							

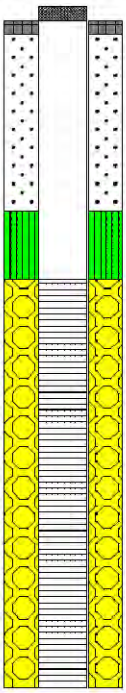


NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW6
BORE LOCATION: 50H0384749/6446893
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 5
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
0	0		SAND - Sandy loam, Dark brown, Fine to medium particles, low level organic content (twiggs, roots), Moist. Soft, Even.	Moist.				
1	-1		SAND - Orange brown mottle, Fine to medium grain particles, Moist, Soft.	Moist.				
2	-2		LIMESTONE - Pale orange, Fine to course grain, Moist.	Moist				
3	-3		LIMESTONE - Pale yellow, Moist. Fine to medium pieces - very hard layer.	Moist				
4	-4		SAND - Yellow/ brown, Saturated. Fine to medium grain.	Saturated				
5	-5							

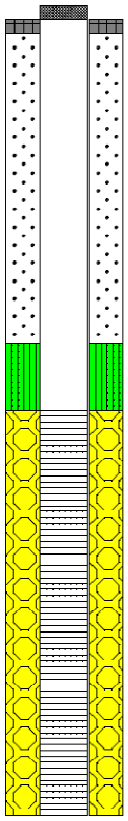
NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW7
BORE LOCATION: 50H0394778/6447007
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 6
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
0	0		SAND - Sandy loam, Dark brown, Fine to medium particles, low level organic content (twiggs, roots), Moist. Soft, Even.	Moist.				
1	-1		SAND - Orange brown mottle with limestone pieces (small to medium 4- 8mm). Fine to medium grain particles, Moist, Hard.	Moist.				
2	-2		LIMESTONE - Pale orange/ yellow limestone. dry. Dust as hard layer.	Dry				
3	-3		SAND - Orange brown mottle with limestone dust & pieces fine to medium size (4 - 8mm) Fine to medium grain particles, Dry, Hard.	Dry				
4	-4		SAND - Yellow/ brown, Very course grain sand stone with high quartz content. Limestone pieces (small 4 - 8mm) Moist. Fine to medium grain.	Moist				
5	-5		SAND - Orange brown sandstone as previous layer without limestone influence. Fine to course grain particles, Saturated, Soft.	Saturated				
6	-6							

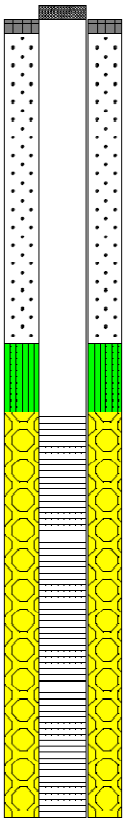


NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW8
BORE LOCATION: 50H0384752/6447231
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 6
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

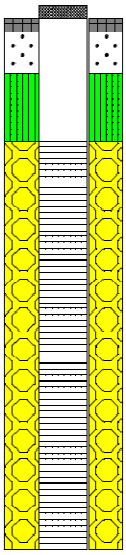
DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
0	0		SAND - Sandy loam, Dark brown, Fine to medium particles, low level organic content (twiggs, roots), Moist. Soft, Even.	Moist.				
1	-1		SAND - Orange brown. Fine to medium grain particles, Moist, Soft.	Moist.				
2	-2		SAND - Orange. Fine to medium grain particles, Moist, Soft. Even	Moist				
3	-3		SAND - Orange medium grain, Moist, Even.	Moist				
4	-4		SAND - Yellow/ orange, Course grain sand stone with high quartz content. Moist.	Moist				
5	-5		SAND - Orange brown sandstone as previous layer. Fine to course grain particles, Saturated, Soft.	Saturated				
6	-6							

NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW9
BORE LOCATION: 50H0384669/6447459
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 4
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

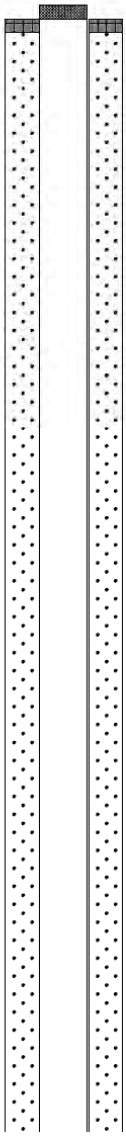
DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
0	0		SAND - Sandy loam, Dark brown, Fine to medium particles, low level organic content (twiggs, roots), Moist. Soft, Even.	Moist.				
1	-1		SAND - Orange brown. Fine to medium grain particles, Moist, Soft.	Moist.				
2	-2		SAND - Orange/ yellow. Fine to medium grain particles, Saturated, Soft. Even	Saturated				
3	-3		SAND - Orange medium grain, Saturated, Even.	Saturated				
4	-4							

NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW10
BORE LOCATION: 50H0384963/6447340
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 15
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
0	0		SAND - Sandy loam, Orange brown, Course to medium particles, low level organic content (twiggs, roots), Moist. Soft, Even.	Moist.				
1	-1		SAND - Orange brown. Fine to medium grain particles, Moist, Soft.	Moist.				
2	-2		SAND - Lighter orange/ brown. Fine to medium grain particles, Moist, Soft. Even	Moist				
3	-3		SAND - Orange medium grain, Dry, Limestone pieces (small to medium size 4 - 12mm) Mottled.	Dry				
4	-4		SAND - Pale orange fine to medium grain, Dry, Limestone pieces (small to medium size 4 - 12mm) Mottled.	Dry				
5	-5		LIMESTONE - layers of pale white to yellow limestone - dust until 12m. Dry hard layers. Even.	Dry/ Slightly moist further down.				
6	-6							
7	-7							
8	-8							

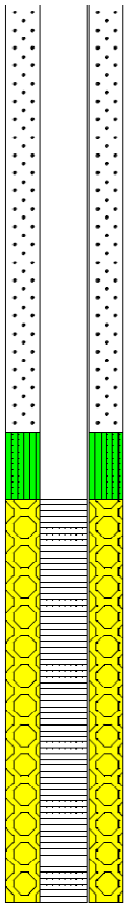
NOTES:

MONITORING WELL LOG & CONSTRUCTION DESCRIPTIONS

PROJECT: Hamilton Rd, Spearwood
BORE NAME: MW10
BORE LOCATION: 50H0384963/6447340
DATUM: GDA94
DRILLING METHOD: Auger
CASING DIAMETER: 50mm

JOB NUMBER: V8070
DATE: 19/9/08
TOTAL DEPTH: 15
RL TOP OF CASING: TBA
RL NATURAL SURFACE: TBA
LOGGED BY: KMc

DEPTH mBGS	DEPTH mAHD	SOIL PROFILE	SOIL DESCRIPTION	MOISTURE CONTENT	COMMENTS/ OBSERVATIONS	DTW	WELL CONSTRUCTION	WELL DESCRIPTION
9	-9							
10	-10							
11	-11							
12	-12		LIMESTONE - layers of pale white to yellow limestone - Saturated. Even.	Saturated				
13	-13		LIMESTONE - layers of pale white to yellow limestone - Moist. Even.	Moist				
14	-14							
15	-15							



NOTES:

Appendix B

Laboratory Certificates of Analysis and Chain of Custody Forms

Marine and Freshwater
Research Laboratory
Environmental Science

Telephone: (08) 9360 2907 Facsimile: (08) 9360 6613

NATA
Accreditation Number: 10603
This document is issued in accordance with NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025.

MURDOCH UNIVERSITY
PERTH, WESTERN AUSTRALIA

WATER QUALITY DATA

Contact: Kylie McKay
Customer: Cardno BSD
Address: 2 Bagot Road, Subiaco, WA 6008

Date of Issue: 4/12/2008
Date Received: 7/10/2008
Our Reference: CAR08-26
Your Reference: V8070

METHOD SAMPLE CODE	Sampling Date	2000 AMMONIA µg.N/L	4100 ORTHO-P µg.P/L	2100 NO3+NO2 µg.N/L	4700 TOTAL-P µg.P/L	2700 TOTAL-N µg.N/L	2700-2100 TKN calculated µg.N/L
Reporting Limit		<3	<2	<2	<5	<50	<200
File			08102401-08111701			08103101-08112001	
Spearwood 1	7/10/2008	11	<2	4500	260	4900	400
Spearwood 2	7/10/2008	<3	<2	2600	220	2600	<200
Spearwood 3	7/10/2008	<3	<2	11000	35	11000	<200
Spearwood 4	7/10/2008	27	3	11000	32	11000	<200
Spearwood 5	7/10/2008	10	6	8700	200	8400	<200
Spearwood 6	7/10/2008	140	5	9900	35	16000	6200
Spearwood 7	7/10/2008	12	2	3100	170	3500	400
Spearwood 8	7/10/2008	8	3	4400	230	4500	<200
Spearwood 10	7/10/2008	<3	4	11000	33	11000	<200
QA	7/10/2008	<3	4	11000	27	12000	1000

ENTERED 16/12/08 JLN.

Signatory: [signature]
Date: 4/12/08

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

Cardno08-26.

CHAIN OF CUSTODY

Marine and Freshwater Research Laboratory

Murdoch University
Environmental Science
Murdoch, Western Australia 6150

Phone: 93602907, Fax: 93606613

To: MAFRAL.	From: Cardno BSD.
Address: Murdoch University	Address: 2 Bagot Rd. Subiaco
Phone: 93602907 Fax:	Phone: 9273 3888 Fax:
Email:	Email:
Courier Details:	Job Number: V8070 PO/ Account #: V8070

Sample Preservation: None / Warm / Cool / (On Ice) / Frozen / Acidified / Filtered / Other: _____

Sample Type: Water / (Bore) / Fresh / Estuarine / Marine / Brine / Plant / Sediment / Soil / Other: _____

No	Sample Code	Sampling Date	Analysis Required							
			TP/TKN	ANP						
1	Spearwood 1	7/10/08	✓	✓						
2	" 2	"	✓	✓						
3	" 3	"	✓	✓						
4	" 4	"	✓	✓						
5	" 5	"	✓	✓						
6	" 6	"	✓	✓						
7	" 7	"	✓	✓						
8	" 8	"	✓	✓						
9	~~NA~~ 9									
10	" 10	"	✓	✓						
11	QA.	"	✓	✓						
12										
13										
14										
15										
16										
17										
18										
19										
20										

Relinquished by:	Date:	Time:	Received by:	Date:	Time	Job Number:
			SL	7/10	1400	
Sample Condition:						

Please acknowledge receipt of samples by signing where appropriate, quoting job number and returning to the sender by fax.

Marine and Freshwater
Research Laboratory
Environmental Science

Telephone: (08) 9360 2907 Facsimile: (08) 9360 6613

NATA

Accreditation Number: 10603
This document is issued in accordance with NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025.

MURDOCH UNIVERSITY
PERTH, WESTERN AUSTRALIA

WATER QUALITY DATA

Contact: Jorma Nolan
Customer: Cardno BSD
Address: 2 Bagot Road, Subiaco, WA 6008

Date of Issue: 2/02/2009
Date Received: 9/01/2009
Our Reference: CAR09-3
Your Reference: V8070

METHOD SAMPLE CODE	Sampling Date	2000 AMMONIA µg.N/L	4100 ORTHO-P µg.P/L	2100 NO3+NO2 µg.N/L	4700 TOTAL-P µg.P/L	2700 TOTAL-N µg.N/L	2700-2100 TKN calculated µg.N/L
Reporting Limit		<3	<2	<2	<5	<50	<200
File			09012101-09013001			09012002-09012802	
MW1	9/01/2009	8	2	2900	400	3400	500
MW2	9/01/2009	23	3	2000	250	2200	<200
MW3	9/01/2009	22	5	10000	320	11000	500
MW4	9/01/2009	14	6	12000	130	12000	200
MW5	9/01/2009	9	6	8700	140	8900	200
MW6	9/01/2009	32	9	14000	770	14000	500
MW7	9/01/2009	4	4	2700	420	2800	<200
MW8	9/01/2009	39	4	2600	260	2900	300
MW10	9/01/2009	12	4	11000	280	11000	<200
QA	9/01/2009	8	2	3700	240	4000	300

ENTERED JLN

RECEIVED Cardno
Subiaco Office 10 FEB 2009
SIGNED
FILE

Signatory: G Edmund
Date: 2/2/2009

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

~~CHAIN~~ OF CUSTODY FORM _____ Page __1__ of __1_

From: Cardno BSD 2 Bagot Road SUBIACO WA 6008 Phone: (08) 9273 3888 Fax: (08) 9388 3831 Email: jorma.nolan@cardno.com.au	Order No: TATime: 24 hr /48 hr / 3 -5 days/10-14days (Circle)	To: Marine and Freshwater Research Laboratories Murdoch University Phone: (08) 9360 2907 Fax: ()
Project Manager: David Coremans	Job Location/Name: [redacted] HAMILTON ROAD	Contact:
Contact: Jorma Nolan	Job Number: [redacted] V8070	Sample Collection Date: 9/1/09

Laboratory Sample No.	Sample Identification	Sample Type		Preservation Method			No. of Containers		Analyses Requested							Comments
		Soil	Water	Ice	Acid	None	Glass	Plastic	TN	TP	TKN	Ortho-P	NH4	NO2 + N03	Turbidity	
1	MW1		Y	Y				2	y	y	y	y	y	y		Unfiltered
2	MW2		Y	Y				2	Y	y	y	y	y	y		Unfiltered
3	MW3		Y	Y				2	Y	y	Y	Y	Y	Y		Unfiltered
4	MW4		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
5	MW5		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
6	MW6		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
7	MW7		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
8	MW8		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
9	MW10		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
10	QA 1		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered

Relinquished by : JORMA NOLAN	Date : 9/1/09 Time :	Received by JW	Date : 9/1/09 Condition: Time : 1500	Signature :

* Pb, As, Cd, Hg, Cu, Cr, Zn, Ni

Other _____

Marine and Freshwater
Research Laboratory
Environmental Science

Telephone: (08) 9360 2907 Facsimile: (08) 9360 6613

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Accreditation Number: 10603
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MURDOCH
UNIVERSITY
PERTH, WESTERN AUSTRALIA

WATER QUALITY DATA

Contact:Jorma Nolan
Customer: Cardno BSD
Address: 2 Bagot Road, Subiaco, WA 6008

Date of Issue: 17/06/2009
Date Received: 28/04/2009
Our Reference: CAR09-14
Your Reference: V8070

ENTERED 17/6

METHOD SAMPLE CODE	Sampling Date	2000 AMMONIA µg.N/L	4100 ORTHO-P µg.P/L	2100 NO3+NO2-N µg.N/L	4700 TOTAL-P µg.P/L	2700 TOTAL-N µg.N/L	2700-2100 TKN calculated µg.N/L
Reporting Limit		<3	<2	<2	<5	<50	<200
File			09050502-060901			09061101	
MW 1	28/04/2009	<3	4	4000	78	4100	<200
MW 2	28/04/2009	<3	6	1900	18	2000	<200
MW 3	28/04/2009	18	8	10000	36	10000	<200
MW 4	28/04/2009	<3	12	12000	14	12000	<200
MW 5	28/04/2009	<3	15	8900	18	9000	<200
MW 6	28/04/2009	<3	19	15000	25	15000	<200
MW 7	28/04/2009	<3	12	3600	50	3800	<200
MW 8	28/04/2009	5	13	6600	17	6800	200
MW 9	28/04/2009	36	14	170	140	940	800
MW 10	28/04/2009	3	13	12000	120	12000	<200
QA	28/04/2009	<3	5	3900	21	4100	<200

RECEIVED
21 JUN 2009

Signatory:

Date: 17/6/09

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

CHAIN OF CUSTODY FORM

From: Cardno BSD 2 Bagot Road SUBIACO WA 6008 Phone: (08) 9273 3888 Fax: (08) 9388 3831 Email: jorma.nolan@cardno.com.au	Order No: TATime: 24 hr /48 hr / 3 -5 days/10-14days (Circle)	To: Marine and Freshwater Research Laboratories Murdoch University Phone: (08) 9360 2907 Fax: () Contact:
Project Manager: David Coremans Contact: Jorma Nolan	Job Location/Name: Hamilton Rd Job Number: V8070	Sample Collection Date: 28/4/09

Laboratory Sample No.	Sample Identification	Sample Type		Preservation Method			No. of Containers		Analyses Requested							Comments
		Soil	Water	Ice	Acid	None	Glass	Plastic	TN	TP	TKN	Ortho-P	NH4	NO2 + N03	~~Turbidity~~	
1	MW1		Y	Y				2	y	y	y	y	y	y		Unfiltered
2	MW2		Y	Y				2	Y	y	y	y	y	y		Unfiltered
3	MW3		Y	Y				2	Y	y	Y	Y	Y	Y		Unfiltered
4	MW4		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
5	MW5		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
6	MW6		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
7	MW7		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
8	MW8		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
9	MW9		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered
10	MW10		Y	Y				1	Y	Y	Y	Y	Y	Y		Unfiltered
11	QA		Y	Y				2	Y	Y	Y	Y	Y	Y		Unfiltered

Relinquished by : Jorma Nolan	Date : 28/4/09 Time : 14:20	Received by Dallen	Date : 28/4/09 Condition: Approp. Time : 2:30	Signature :

* ~~Pb, As, Cd, Hg, Cu, Cr, Zn, Ni~~

Other _____

Marine and Freshwater
Research Laboratory
Environmental Science

Telephone: (08) 9360 2907 Facsimile: (08) 9360 6613

NATA
Accreditation Number: 10603
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Accredited for compliance with ISO/IEC 17025.

MURDOCH
UNIVERSITY
PERTH, WESTERN AUSTRALIA

WATER QUALITY DATA

Contact: Jorma Nolan
Customer: Cardno BSD
Address: 2 Bagot Road, Subiaco, WA 6008

Date of Issue: 3/09/2009
Date Received: 15/7/2009
Our Reference: CAR09-26
Your Reference: V8070

METHOD SAMPLE CODE	Sampling Date	2000 AMMONIA µg.N/L	4100 ORTHO-P µg.P/L	2100 NO3+NO2 µg.N/L	4700 TOTAL-P µg.P/L	2700 TOTAL-N µg.N/L	2700-2100 TKN calculated µg.N/L
Reporting Limit		<3	<2	<2	<5	<50	<200
File			09081301		09081201		
MW1	15/07/2009	<3	7	3500	20	4000	400
MW2	15/07/2009	<3	7	1600	18	1700	<200
MW3	15/07/2009	<3	12	7900	280	8800	900
MW4	15/07/2009	<3	16	9200	33	10000	1200
MW5	15/07/2009	<3	17	6900	30	7500	600
MW6	15/07/2009	<3	22	11000	66	12000	1400
MW7	15/07/2009	<3	16	2600	28	2900	300
MW8	15/07/2009	<3	16	2800	33	2800	<200
MW9	15/07/2009	8	23	16	50	330	300
MW10	15/07/2009	6	14	9600	310	11000	1100
QA	15/07/2009	<3	8	1700	17	1700	<200

ENTERED 18/9/09

Signatory:

Date: 3/9/2009

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

CHAIN OF CUSTODY FORM

From: Cardno BSD 2 Bagot Road SUBIACO WA 6008 Phone: (08) 9273 3888 Fax: (08) 9388 3831 Email: jorma.nolan@cardno.com.au	Order No: TATime: 24 hr /48 hr / 3 -5 days/10-14days (Circle)	To: Marine and Freshwater Research Laboratories Murdoch University Phone: (08) 9360 2907 Fax: ()
Project Manager: David Coremans Contact: Jorma Nolan	Job Location/Name: Hamilton Rd Job Number: V8070	Contact: Sample Collection Date: 15/7/09

Laboratory Sample No.	Sample Identification	Sample Type		Preservation Method			No. of Containers		Analyses Requested							Comments
		Soil	Water	Ice	Acid	None	Glass	Plastic	TN	TP	TKN	Ortho-P	NH4	NO2 + N03	Turbidity	
1	MW1		Y	Y					y	y	y	y	y	y		Unfiltered
2	MW2		Y	Y					Y	y	y	y	y	y		Unfiltered
3	MW3		Y	Y					Y	y	Y	Y	Y	Y		Unfiltered
4	MW4		Y	Y					Y	Y	Y	Y	Y	Y		Unfiltered
5	MW5		Y	Y					Y	Y	Y	Y	Y	Y		Unfiltered
6	MW6		Y	Y					Y	Y	Y	Y	Y	Y		Unfiltered
7	MW7		Y	Y					Y	Y	Y	Y	Y	Y		Unfiltered
8	MW8		Y	Y					Y	Y	Y	Y	Y	Y		Unfiltered
9	MW10		Y	Y					Y	Y	Y	Y	Y	Y		Unfiltered
10	QA		Y	Y					Y	Y	Y	Y	Y	Y		Unfiltered

Relinquished by : JORMA NOLAN	Date : 15/7/09 Time : 1445	Received by Hanna	Date : 15/7/09 Condition: Time : 14:45	Signature :

* Pb, As, Cd, Hg, Cu, Cr, Zn, Ni

Other

CERTIFICATE OF ANALYSIS

Work Order	: **EP0906036**	Page	: 1 of 5
Client	: **CARDNO (WA) PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR JORMA NOLAN	Contact	: Michael Sharp
Address	: PO BOX 155 SUBIACO WA, AUSTRALIA 6904	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: jorma.nolan@cardno.com.au	E-mail	: michael.sharp@alsenviro.com
Telephone	: +61 08 9273 3888	Telephone	: +61-8-9209 7655
Facsimile	: +61 08 9388 3831	Facsimile	: +61-8-9209 7600
Project	: V8070	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 22-OCT-2009
Sampler	: JLN	Issue Date	: 29-OCT-2009
Site	: Spearwood		
		No. of samples received	: 11
Quote number	: EP-379-09	No. of samples analysed	: 11

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Perth Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **LOR raised for TKN/TP due to sample matrix**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: MW1	MW2	MW3	MW4	MW5
				Client sampling date / time: 21-OCT-2009 15:00	21-OCT-2009 15:00	21-OCT-2009 15:00	21-OCT-2009 15:00	21-OCT-2009 15:00
				EP0906036-001	EP0906036-002	EP0906036-003	EP0906036-004	EP0906036-005
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.01**	<0.01	**0.01**	<0.01	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**3.66**	**2.05**	**10.1**	**12.4**	**7.02**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.7**	**0.3**	**0.6**	**0.8**	**0.5**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**4.3**	**2.3**	**10.6**	**13.2**	**7.5**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.07**	<0.01	**0.26**	<0.05	<0.02
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: MW6	MW7	MW8	MW9	MW10
				Client sampling date / time: 21-OCT-2009 15:00	21-OCT-2009 15:00	21-OCT-2009 15:00	21-OCT-2009 15:00	21-OCT-2009 15:00
				EP0906036-006	EP0906036-007	EP0906036-008	EP0906036-009	EP0906036-010
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	**0.08**	**0.01**	<0.01	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**20.4**	**1.83**	**0.90**	**9.30**	**11.9**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**2.8**	**0.5**	**0.2**	<0.5	<0.5
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**23.1**	**2.3**	**1.1**	**9.3**	**11.9**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.01	<0.01	<0.05	**0.32**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: QA	----	----	----	----
				Client sampling date / time: 21-OCT-2009 15:00	----	----	----	----
				EP0906036-011	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	----	----	----	----
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**2.16**	----	----	----	----
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.2	----	----	----	----
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**2.2**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.02	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	**0.01**	----	----	----	----

CHAIN OF CUSTODY DOCUMENTATION

ALS Laboratory Group

CLIENT: Cardno	SAMPLER: JLN
ADDRESS / OFFICE: 2 Bagot Rd, Subiaco	MOBILE:
PROJECT MANAGER (PM): Dave Coremans	PHONE:
PROJECT ID: V8070	EMAIL REPORT TO: jorma.nolan@cardno.com.au
SITE: Spearwood P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (**Date**): ASAP QUOTE NO.: EP/379/09	

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE:
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Notes:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		Suite 1										
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles											
1	MW1		21/10/2009				X										unfiltered
2	MW2		21/10/2009				X										unfiltered
3	MW3		21/10/2009				X										unfiltered
4	MW4		21/10/2009				X										unfiltered
5	MW5		21/10/2009				X										unfiltered
6	MW6		21/10/2009				X										unfiltered
7	MW7		21/10/2009				X										unfiltered
8	MW8		21/10/2009				X										unfiltered
9	MW9		21/10/2009				X										unfiltered
10	MW10		21/10/2009				X										unfiltered
11	QA		21/10/2009				X										unfiltered

Environmental Division
Perth
Work Order
EP0906036

Telephone : +61-8-9209 7655

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: Jorma Nolan	Date:22/10/09	Name: Jah	Date: 22/10/09	Con' Note No:
Of: Cardno	Time: 0900	Of: AW	Time: 10:09	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

ALS LABORATORY GROUP

COC Page ___ of ___

ENFM (204/5)

Analytical Charges

Suite 1

Parameter	ALS Method/ Package Code	Technique/ Method Reference	Limit of Reporting (mg/L) (or as indicated)	Price per Sample ($)
Nitrogen - Ammonia as N	EK055G	APHA 4500-NH_3 H	0.01	20.00
Total Nitrogen *(incl TKN + NO_x)* + Total Phosphorus	**NT-11**	EK062, EK061, EK057, EK058, EK067	0.01 (TN, TKN - 0.1)	50.00
Phosphorus – Reactive	EK071G	APHA 4500-P G	0.01	12.00
TOTAL SUITE COST FOR WATER SAMPLES:				**82.00**

Please note: *to receive analysis at the above cost, the ALS quotation number must be referenced on the COC.*

Suite 2

Parameter	ALS Method/ Package Code	Technique/ Method Reference	Limit of Reporting (mg/L) (or as indicated)	Price per Sample ($)
Nitrogen - Ammonia as N	EK055G	APHA 4500-NH_3 H	0.01	20.00
Total Nitrogen *(incl TKN + NO_x)* + Total Phosphorus	**NT-11**	EK062, EK061, EK057, EK058, EK067	0.01 (TN, TKN - 0.1)	50.00
Phosphorus – Reactive	EK071G	APHA 4500-P G	0.01	12.00
Dissolved Metals by ICPMS – As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe	EG020F	USEPA 6020 ICPMS	0.0001 - 0.01	22.00
Total Recoverable Metals by ICPMS (incl digest) – As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe	EG020T	USEPA 6020 ICPMS	0.0001 - 0.01	28.00
Mercury – **Dissolved**	EG035F	APHA 3112 Hg-B CV/FIMS	0.0001	10.00
Mercury – **Total Recoverable**	EG035T	APHA 3112 Hg-B CV/FIMS	0.0001	10.00
TPH (C6-C36) [19]	EP080/ EP071	USEPA 5030/8260 USEPA 3510/8015 P&T-GC/MS/FID	20-100 µg/L	49.00
OC/OP Pesticides	**W-12**	GC/ECD/FPD-MS	0.5-2 µg/L	65.00
TOTAL SUITE COST FOR WATER SAMPLES:				**266.00**

Please note: *to receive analysis at the above cost, the ALS quotation number must be referenced on the COC.*

Where metals suites are stipulated '**T**' denotes Total metals analysis (eg. W-2 T = 8 Total Metals). Where no '**T**' is present in the suite code, this denotes dissolved/filtered metals.

For metals in waters, field filtration status must be clearly indicated on the bottle label (via tick) indicating whether total or dissolved metals are required.

Package Prices apply only when specific ALS Group Codes ('W' & 'NT' suites) are selected on COCs. Standard LORs apply for suites.

Administration Charges

An administration fee of $30.00 is applicable to each submission of samples submitted regardless of the size of the submission.

CERTIFICATE OF ANALYSIS

Work Order	: **EP1000436**	Page	: 1 of 4
Client	: **CARDNO (WA) PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR NATHAN COCKS	Contact	: Michael Sharp
Address	: PO BOX 155 SUBIACO WA, AUSTRALIA 6904	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: nathan.cocks@cardno.com.au	E-mail	: michael.sharp@alsenviro.com
Telephone	: +61 08 9273 3888	Telephone	: +61-8-9209 7655
Facsimile	: +61 08 9388 3831	Facsimile	: +61-8-9209 7600
Project	: V8070	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 27-JAN-2010
Sampler	: NTC	Issue Date	: 04-FEB-2010
Site	: Hamilton Road, Spearwood		
		No. of samples received	: 10
Quote number	: EP-379-09	No. of samples analysed	: 10

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Perth Inorganics
Kim McCabe	Senior Inorganic Chemist	Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **LOR raised for TP for certain samples due to matrix effects.**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: MW1	MW2	MW4	MW5	MW6
				Client sampling date / time: 27-JAN-2010 15:00	27-JAN-2010 15:00	27-JAN-2010 15:00	27-JAN-2010 15:00	27-JAN-2010 15:00
				EP1000436-001	EP1000436-002	EP1000436-003	EP1000436-004	EP1000436-005
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.04**	**0.03**	**0.04**	**0.03**	**0.06**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**3.49**	**2.21**	**13.8**	**7.54**	**26.0**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.3**	**0.1**	**1.8**	**0.4**	**1.8**
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	0.1	mg/L	**3.8**	**2.3**	**15.6**	**8.0**	**27.8**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.01**	**0.01**	<0.05	<0.02	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	**0.01**	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: MW7	MW8	MW9	MW10	QA
				Client sampling date / time: 27-JAN-2010 15:00	27-JAN-2010 15:00	27-JAN-2010 15:00	27-JAN-2010 15:00	27-JAN-2010 15:00
				EP1000436-006	EP1000436-007	EP1000436-008	EP1000436-009	EP1000436-010
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.02**	**0.02**	**0.04**	**0.06**	**0.06**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**5.13**	**5.72**	**0.28**	**12.3**	**4.48**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.4**	**0.5**	**0.3**	**0.7**	**0.3**
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	0.1	mg/L	**5.6**	**6.2**	**0.6**	**12.9**	**4.8**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.01**	<0.02	<0.01	<0.05	<0.02
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	**0.02**	<0.01

CHAIN OF CUSTODY DOCUMENTATION

ALS Laboratory Group

CLIENT: Cardno	SAMPLER: NTC
ADDRESS / OFFICE: 2 Bagot Rd, Subiaco, WA 6008	MOBILE: 0415 431 628
PROJECT MANAGER (PM): Dave Coremans	PHONE:
PROJECT ID: V8070	EMAIL REPORT TO: nathan.cocks@cardno.com.au
SITE: Hamilton Road, Spearwood P.O. NO.:	EMAIL INVOICE TO: (if different to report)
RESULTS REQUIRED (**Date**): ASAP QUOTE NO.: EP/379/09	*

FOR LABORATORY USE ONLY
COOLER SEAL (circle appropriate)
Intact: Yes No N/A
SAMPLE TEMPERATURE:
CHILLED: Yes No

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

SAMPLE INFORMATION (note: S = Soil, W=Water)					CONTAINER INFORMATION		suite 1	Notes:
ALS ID	SAMPLE ID	MATRIX	DATE	Time	Type / Code	Total bottles		
1	MW1		27/01/2010			2	X	
2	MW2		27/01/2010			2	X	unfiltered
3	MW4		27/01/2010			2	X	
4	MW5		27/01/2010			2	X	
5	MW6		27/01/2010			2	X	
6	MW7		27/01/2010			2	X	
7	MW8		27/01/2010			2	X	
8	MW9		27/01/2010			2	X	
9	MW10		27/01/2010			2	X	
10	QA		27/01/2010			2	X	

Environmental Division
Perth
Work Order
EP1000436

Telephone : +61-8-9209 7655

RELINQUISHED BY:		RECEIVED BY		METHOD OF SHIPMENT
Name: Nathan Cocks	Date:27/1/2010	Name: Ross	Date: 27/1/10	Con' Note No:
Of: Cardno	Time:1530	Of: ALS	Time: 17:00	
Name:	Date:	Name:	Date:	Transport Co:
Of:	Time:	Of:	Time:	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; V = VOA Vial HCl Preserved; VS = VOA Vial Sulphuric Preserved; SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

Analytical Charges

Suite 1

Parameter	ALS Method/ Package Code	Technique/ Method Reference	Limit of Reporting (mg/L) (or as indicated)	Price per Sample ($)
Nitrogen - Ammonia as N	EK055G	APHA 4500-NH_3 H	0.01	20.00
Total Nitrogen *(incl TKN + NO_x)* + Total Phosphorus	**NT-11**	EK062, EK061, EK057, EK058, EK067	0.01 (TN, TKN - 0.1)	50.00
Phosphorus – Reactive	EK071G	APHA 4500-P G	0.01	12.00
TOTAL SUITE COST FOR WATER SAMPLES:				**82.00**

Please note: *to receive analysis at the above cost, the ALS quotation number must be referenced on the COC.*

Suite 2

Parameter	ALS Method/ Package Code	Technique/ Method Reference	Limit of Reporting (mg/L) (or as indicated)	Price per Sample ($)
Nitrogen - Ammonia as N	EK055G	APHA 4500-NH_3 H	0.01	20.00
Total Nitrogen *(incl TKN + NO_x)* + Total Phosphorus	**NT-11**	EK062, EK061, EK057, EK058, EK067	0.01 (TN, TKN - 0.1)	50.00
Phosphorus – Reactive	EK071G	APHA 4500-P G	0.01	12.00
Dissolved Metals by ICPMS – As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe	EG020F	USEPA 6020 ICPMS	0.0001 - 0.01	22.00
Total Recoverable Metals by ICPMS (incl digest) – As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe	EG020T	USEPA 6020 ICPMS	0.0001 - 0.01	28.00
Mercury – **Dissolved**	EG035F	APHA 3112 Hg-B CV/FIMS	0.0001	10.00
Mercury - **Total Recoverable**	EG035T	APHA 3112 Hg-B CV/FIMS	0.0001	10.00
TPH (C6-C36) [19]	EP080/ EP071	USEPA 5030/8260 USEPA 3510/8015 P&T-GC/MS/FID	20-100 µg/L	49.00
OC/OP Pesticides	**W-12**	GC/ECD/FPD-MS	0.5-2 µg/L	65.00
TOTAL SUITE COST FOR WATER SAMPLES:				**266.00**

Please note: *to receive analysis at the above cost, the ALS quotation number must be referenced on the COC.*

Where metals suites are stipulated '**T**' denotes Total metals analysis (eg. W-2 T = 8 Total Metals). Where no '**T**' is present in the suite code, this denotes dissolved/filtered metals.

For metals in waters, field filtration status must be clearly indicated on the bottle label (via tick) indicating whether total or dissolved metals are required.

Package Prices apply only when specific ALS Group Codes ('W' & 'NT' suites) are selected on COCs. Standard LORs apply for suites.

Administration Charges

An administration fee of $30.00 is applicable to each submission of samples submitted regardless of the size of the submission.