

QUARTERLY GROUNDWATER MONITORING THE SCONE WASTE LANDFILL

THE SCONE WASTE LANDFILL

Noblet Road
Scone
NSW 2337

Upper Hunter Shire Council

DLH1186/0450054_H001709

April 2018

PROJECT NAME	Scone Waste Landfill Groundwater Monitoring
PROJECT ID	DLH1186/0450054
DOCUMENT CONTROL NUMBER	H001709
PREPARED FOR	Upper Hunter Shire Council
APPROVED FOR RELEASE BY	Stephen Challinor
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DOCUMENT CONTROL

VERSION	DATE	COMMENT	PREPARED BY	REVIEWED BY
H001709	14.05.2018		Tobias Scheid	Stephen Challinor

ERM Services Australia Pty Ltd: ABN 80 601 661 634

ADELAIDE

5 Peel Street
Adelaide, SA, 5000
Ph: +61 8 8332 0960
Fax: +61 7 3844 5858

BRISBANE

Level 4, 201 Leichardt Street
Brisbane, Qld 4000
Ph: +61 7 3004 6400

MELBOURNE

Level 10, 224 Queen Street
Melbourne, Vic 3000
Ph: +61 3 9036 2637
Fax: +61 2 9870 0999

PERTH

Level 18, 140 St Georges Terrace
Perth, WA 6000
Ph: +61 8 9481 4961

NEWCASTLE

Level 4, 45 Watt St
Newcastle NSW 2300
Ph: +61 2 4933 0001

MELBOURNE

Level 6, 99 King Street
Melbourne, Vic 3000
Ph: +61 3 9036 2637
Fax: +61 2 9870 0999

SYDNEY

Unit 11 Macquarie Link, 227 Lane Cove Rd
Macquarie Park, NSW 2113
Ph: +61 2 9476 1765
Fax: +61 2 9476 1557

309 Kent Street
North Sydney, NSW 2000
Ph: +61 2 9870 0900
Fax: +61 2 9870 0999

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ABBREVIATIONS

ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
DEC	Department of Environment and Conservation (NSW)
DLA	DLA Environmental Services
EC	Electrical Conductivity
EPA	Environment Protection Authority (NSW)
ERM	Environmental Resources Management (formerly DLA Environmental Services)
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
NSW	New South Wales
OCP	Organochlorine Pesticides
TOC	Total Organic Carbon

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1.0 INTRODUCTION

1.1 General

ERM Services Australia (ERM) was engaged by Upper Hunter Shire Council (the Client) to conduct annual and quarterly surface and groundwater monitoring of the following area:

Scone Waste Facility Area
Noblet Road Scone NSW 2337 (the Site).

Refer to **Figure 1: Site Location Regional** and **Figure 2: Site Location Local**.

The Groundwater Monitoring Report provides an overview of the current condition of groundwater at the Site in relation to the Site Criteria and satisfies the groundwater monitoring requirements of the New South Wales (NSW) Environmental Protection Authority (EPA) Environmental Protection Licence 5863.

The report has been prepared utilising information obtained as part of the investigation process, from previous monitoring reports and from experience, knowledge, and current industry practice in the monitoring of similar sites. It is anticipated that quarterly monitoring will be undertaken in April, July and October with annual reporting undertaken in the January reporting period.

Quarterly groundwater monitoring was undertaken on Tuesday 10th April 2018 by staff of ERM.

1.2 Scope of Works

The scope of work provided by Upper Hunter Shire Council indicates that annual and quarterly groundwater monitoring is required at the following groundwater sampling locations:

- MWA;
- MWB;
- MWC;
- MWD (landfill leachate monitoring well); and
- MWE.

Refer to **Figure 3: Site Layout with Sample Locations**.

2.0 MONITORING PARAMETERS

The following sample analysis parameters and monitoring frequency were provided by Upper Hunter Shire Council for the groundwater wells. Threshold Criteria are primarily sourced from *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000), *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)* ('NEPM', NEPC 2013), and the *Australian Drinking Water Guidelines* (NHMRC / NRMCC, 2011).

Table 2a: Analytes, Threshold Criteria and Monitoring Frequency for Groundwater Monitoring Wells

Analytes	Units	Threshold Criteria	
		NEPM 2013 / ANZECC 2000 Fresh Water 95%	Monitoring Frequency
Calcium	mg/L	NA	Quarterly
Alkalinity (total)	mg/L	NA	Quarterly
Chloride	mg/L	NA	Quarterly
Fluoride	mg/L	NA	Quarterly
Iron	mg/L	0.3 ^B	Quarterly
Magnesium	mg/L	NA	Quarterly
Manganese	mg/L	1.9 ^A	Quarterly
Organochlorine pesticides (OCP)	mg/L	0.00001 ^C	Quarterly
Potassium	mg/L	410 ^D	Quarterly
pH	pH	6.5 – 8	Quarterly
Sodium	mg/L	NA	Quarterly
Ammonia	mg/L	0.9 ^A	Quarterly
Nitrate	mg/L	0.7	Quarterly
Sulfate	mg/L	NA	Quarterly
Total organic carbon (TOC)	mg/L	4	Quarterly
Total phenolics	mg/L	0.32	Quarterly
Electrical conductivity (EC)	µS/cm	NA	Quarterly

A – Trigger value may not protect key species from chronic toxicity, refer to ANZECC & ARMCCANZ (2000) for further guidance

B - Interim working level, in absence of reliable trigger value

C - Trigger value for DDT used in absence of trigger value for total OCP

D – Poor (acceptable) drinking water criteria, World Health Organisation Guidelines for Drinking-water Quality 2009

3.0 SAMPLING METHODOLOGY

3.1 Groundwater Sampling

Groundwater samples were collected from well locations MWA, MWB, MWC, MWD and MWE. Purging and sampling of monitoring wells was conducted in accordance with the NEPM (NEPC, 2013) and the *Guidelines for the Assessment and Management of Groundwater Contamination* (NSW DEC, 2007).

Wells were purged using a disposable bailer whilst being measured for physiochemical stability to indicate the flow of formation water. Physiochemical properties were measured at regular intervals following the purging of each equipment volume using a YSI Quatro Pro Plus Water Quality Meter and a flow through cell. Stable conditions were indicated by monitoring the following parameters for three consecutive readings of:

- pH \pm 0.1 unit;
- Electrical Conductivity \pm 5%;
- Temperature \pm 0.20;
- Redox Potential \pm 10%; and
- Dissolved Oxygen \pm 10%.

Samples were obtained using a dedicated disposable bailer which was changed between each monitoring well to minimise the potential for cross contamination. Sampling equipment was cleaned prior to sampling and between sample locations to prevent cross contamination. The cleaning procedure included:

- Washing and brush scrub with phosphate free laboratory grade detergent;
- Rinsing with water of a potable quality; and
- Rinsing with deionised water.

Groundwater samples were collected into laboratory prepared and supplied sample containers for specific analytes (i.e. into a combination of plastic unpreserved, plastic preserved, glass amber unpreserved and preserved glass vials). Samples were collected and filled into the respective sample containers so no head space remained in the sample container, with no loss of any preservation agents, where present. Groundwater samples collected for metals analysis were filtered through 0.45 μ m filter. Samples were placed immediately into a chilled cooler to minimise the likelihood for the loss of potential volatile components.

It is opinion of ERM that decontamination procedures were appropriate during groundwater sampling and no cross contamination can be inferred.

4.0 RESULTS

All wells were sampled during the April 2018 sampling event, results are detailed below.

Refer to **Table 4a – Table 4e** for a tabulated summary of the laboratory results.

Refer to **Figure 3** for sampling locations.

Table 4a – Groundwater Results Comparison April 2018

Sampling Parameter	Units	Threshold Criteria (mg/L)	MWA July 2017	MWA Oct 2017	MWA Jan 2018	MWA Apr 2018
Calcium	mg/L	NA	640	600	590	640
Alkalinity (total)	mg/L	NA	470	470	490	490
Chloride	mg/L	NA	7900	7600	7200	7100
Fluoride	mg/L	NA	0.12	0.14	0.13	0.13
Iron	mg/L	0.3 ^B	ND	0.034	ND	ND
Magnesium	mg/L	NA	1200	1100	1200	1200
Manganese	mg/L	1.9 ^A	0.007	0.014	0.010	0.02
OCP	mg/L	0.00001 ^C	ND	ND	ND	ND
Potassium	mg/L	410 ^D	4.3	4.9	4.9	4.4
pH	pH	6.5 – 8	7.0	6.6	7.0	6.9
Sodium	mg/L	NA	2200	2000	2000	2100
Ammonia	mg/L	0.9 ^A	0.07	0.42	0.12	0.16
Nitrate	mg/L	0.7	0.24	0.41	ND	ND
Sulfate	mg/L	NA	42	43	40	41
TOC	mg/L	4.0	8.0	5.0	5.6	3.6
Total phenolics	mg/L	0.32	ND	ND	ND	0.02
EC	µS/cm	NA	21000	20000	20000	21000

Samples highlighted in **Bold** exceed threshold criteria

ND = No Detection above Laboratory LOR

A – Trigger value may not protect key species from chronic toxicity, refer to ANZECC & ARM CANZ (2000) for further guidance

B - Interim working level, in absence of reliable trigger value

C - Trigger value for DDT used in absence of trigger value for total OCP

D – Poor (acceptable) drinking water criteria, World Health Organisation Guidelines for Drinking-water Quality 2009

NA – Not Applicable

Table 4b – Groundwater Results Comparison April 2018

Sampling Parameter	Units	Threshold Criteria (mg/L)	MWB July 2017	MWB Oct 2017	MWB Jan 2018	MWB Apr 2018
Calcium	mg/L	NA	640	610	600	650
Alkalinity (total)	mg/L	NA	390	380	420	390
Chloride	mg/L	NA	6000	6000	5400	5700
Fluoride	mg/L	NA	0.26	0.26	0.24	0.28
Iron	mg/L	0.3 ^B	ND	0.005	ND	ND
Magnesium	mg/L	NA	820	790	810	810
Manganese	mg/L	1.9 ^A	0.01	0.009	0.005	0.01
OCP	mg/L	0.00001 ^C	ND	ND	ND	ND
Potassium	mg/L	410 ^D	4.0	4.1	3.6	3.6
pH	pH	6.5 – 8	7.0	6.7	7.0	7.2
Sodium	mg/L	NA	1800	1600	1700	1700
Ammonia	mg/L	0.9 ^A	0.21	0.09	0.09	0.09
Nitrate	mg/L	0.7	0.83	0.75	ND	0.46
Sulfate	mg/L	NA	75	70	66	70
TOC	mg/L	4.0	8.2	6.3	6.2	4.8
Total phenolics	mg/L	0.32	ND	ND	ND	ND
EC	µS/cm	NA	16000	16000	16000	16000

Samples highlighted in **Bold** exceed threshold criteria

ND = No Detection above Laboratory LOR

A – Trigger value may not protect key species from chronic toxicity, refer to ANZECC & ARMCANZ (2000) for further guidance

B - Interim working level, in absence of reliable trigger value

C - Trigger value for DDT used in absence of trigger value for total OCP

D – Poor (acceptable) drinking water criteria, World Health Organisation Guidelines for Drinking-water Quality 2009

NA – Not Applicable

Table 4c – Groundwater Results Comparison April 2018

Sampling Parameter	Units	Threshold Criteria (mg/L)	MWC July 2017	MWC Oct 2017	MWC Jan 2018	MWC Apr 2018
Calcium	mg/L	NA	26	35	200	270
Alkalinity (total)	mg/L	NA	640	720	580	550
Chloride	mg/L	NA	370	500	2400	3200
Fluoride	mg/L	NA	0.46	0.41	0.26	0.31
Iron	mg/L	0.3 ^B	0.008	ND	ND	ND
Magnesium	mg/L	NA	52	73	330	440
Manganese	mg/L	1.9 ^A	4.6	4.6	12	15
OCP	mg/L	0.00001 ^C	ND	ND	ND	ND
Potassium	mg/L	410 ^D	0.8	0.9	1.8	1.8
pH	pH	6.5 – 8	7.2	7.1	6.9	6.9
Sodium	mg/L	NA	430	490	1100	1400
Ammonia	mg/L	0.9 ^A	0.33	0.41	0.16	0.22
Nitrate	mg/L	0.7	0.005	ND	1.7	2.5
Sulfate	mg/L	NA	90	110	110	130
TOC	mg/L	4.0	23	19	12	9.0
Total phenolics	mg/L	0.32	ND	ND	ND	ND
EC	µS/cm	NA	2400	3000	8700	11000

Samples highlighted in **Bold** exceed threshold criteria

ND = No Detection above Laboratory LOR

A – Trigger value may not protect key species from chronic toxicity, refer to ANZECC & ARMCANZ (2000) for further guidance

B - Interim working level, in absence of reliable trigger value

C - Trigger value for DDT used in absence of trigger value for total OCP

D – Poor (acceptable) drinking water criteria, World Health Organisation Guidelines for Drinking-water Quality 2009

NA – Not Applicable

Table 4d – Groundwater Results Comparison April 2018

Sampling Parameter	Units	Threshold Criteria (mg/L)	MWD	MWD	MWD	MWD
			(leachate) July 2017	(leachate) Oct 2017	(leachate) Jan 2018	(leachate) Apr 2018
Calcium	mg/L	NA	150	190	160	120
Alkalinity (total)	mg/L	NA	2500	2500	2400	2500
Chloride	mg/L	NA	2800	3700	3100	3600
Fluoride	mg/L	NA	0.35	0.32	0.30	0.34
Iron	mg/L	0.3 ^B	1.6	0.3	1.1	1.1
Magnesium	mg/L	NA	230	260	270	290
Manganese	mg/L	1.9 ^A	0.42	0.28	0.29	0.18
OCP	mg/L	0.00001 ^C	ND	ND	ND	ND
Potassium	mg/L	410 ^D	180	210	220	200
pH	pH	6.5 – 8	7.5	7.2	7.7	7.7
Sodium	mg/L	NA	1700	1800	1900	1900
Ammonia	mg/L	0.9 ^A	310	350	330	320
Nitrate	mg/L	0.7	ND	ND	ND	ND
Sulfate	mg/L	NA	100	240	93	110
TOC	mg/L	4.0	320	320	340	340
Total phenolics	mg/L	0.32	0.05	0.03	0.03	0.05
EC	µS/cm	NA	12000	13000	13000	14000

Samples highlighted in **Bold** exceed threshold criteria

ND = No Detection above Laboratory LOR

A – Trigger value may not protect key species from chronic toxicity, refer to ANZECC & ARM CANZ (2000) for further guidance

B - Interim working level, in absence of reliable trigger value

C - Trigger value for DDT used in absence of trigger value for total OCP

D – Poor (acceptable) drinking water criteria, World Health Organisation Guidelines for Drinking-water Quality 2009

NA – Not Applicable

As MWD is within the perched landfill leachate water table, the Threshold Criteria are only applicable as indicators of general water quality for comparison to the wells surrounding the landfill. Exceedances of the Threshold Criteria for MWD are expected and do not indicate contamination is leaving the Site.

Table 4e – Groundwater Results Comparison April 2018

Sampling Parameter	Units	Threshold Criteria (mg/L)	MWE July 2017	MWE Oct 2017	MWE Jan 2018	MWE Apr 2018
Calcium	mg/L	NA	60	56	56	59
Alkalinity (total)	mg/L	NA	1200	1100	1200	1200
Chloride	mg/L	NA	340	310	280	280
Fluoride	mg/L	NA	0.5	0.51	0.47	0.56
Iron	mg/L	0.3 ^B	0.077	0.015	0.01	ND
Magnesium	mg/L	NA	65	55	55	53
Manganese	mg/L	1.9 ^A	0.14	0.055	0.24	0.14
OCP	mg/L	0.00001 ^C	ND	ND	ND	ND
Potassium	mg/L	410 ^D	1.5	1.4	1.6	1.2
pH	pH	6.5 – 8	7.5	7.4	7.4	7.4
Sodium	mg/L	NA	570	520	520	550
Ammonia	mg/L	0.9 ^A	0.1	0.38	0.04	0.07
Nitrate	mg/L	0.7	ND	ND	ND	ND
Sulfate	mg/L	NA	99	110	91	85
Total Organic	mg/L	4.0	26	17	15	7.9
Total phenolics	mg/L	0.32	ND	ND	ND	ND
EC	µS/cm	NA	3100	3000	3000	3200

Samples highlighted in **Bold** exceed threshold criteria

ND = No Detection above Laboratory LOR

A – Trigger value may not protect key species from chronic toxicity, refer to ANZECC & ARMCANZ (2000) for further guidance

B - Interim working level, in absence of reliable trigger value

C - Trigger value for DDT used in absence of trigger value for total OCP

D – Poor (acceptable) drinking water criteria, World Health Organisation Guidelines for Drinking-water Quality 2009

NA – Not Applicable

5.0 DISCUSSION

Due to the sites topography, the inferred hydraulic gradient is generally to the west. Wells MWA, MWB and MWC are located down-hydraulic gradient of the landfill. Well MWE is considered to be up-hydraulic gradient of the landfill. Well MWD is located within the perched landfill water table, being the leachate within the landfill.

The water sampled from well MWD is landfill leachate and as such the Threshold Criteria is not used as a comparison, only as an indicator of current conditions. MWD is to be used as a general indicator of water quality within the landfill for comparison to the external monitoring wells.

The following is a summary of the results of the April 2018 sampling event in relation to the Threshold Criteria. The following exceedances of the Threshold Criteria occurred:

- Nitrate in MWC exceeded the Threshold Criteria (0.7 mg/L) with a concentration of 2.5 mg/L. Nitrate concentrations have been reporting an increasing trend with a concentration of 1.7 mg/L in January 2018 and a non-detection in October 2017. There has been no nitrate detected in leachate well MWD which suggests that the landfill is not the source of the nitrate. The nitrate may be migrating onto the Site through groundwater from the adjoining farmland.
- Manganese in MWC exceeded the Threshold Criteria (1.9 mg/L) with a concentration of 15.0 mg/L. Manganese concentrations have been reporting an increasing trend since July 2017 with concentrations of 12 mg/L in January 2018 and 4.6 mg/L in October and July 2017. Manganese concentrations in leachate well MWD have been consistently below the Threshold Criteria which suggests that the landfill is not the source of the Manganese.
- Total Organic Carbon (TOC) exceeds the Threshold Criteria (4 mg/L) in monitoring wells MWB, MWC, MWD and MWE, as follows:
 - TOC in MWB reported a concentration of 4.8 mg/L, decreasing from 6.2 mg/L reported in January 2018;
 - TOC in MWC is displaying an increasing trend, reporting a concentration of 9 mg/L, down from 12 mg/L reported in Jan 2018 and 19mg/L in October 2017;
 - TOC in MWD reported a concentration of 340 mg/L which is equivalent to the concentration reported in January 2018, and;
 - TOC in MWE reported a concentration of 7.9 mg/L, decreasing from 15 mg/L reported in January 2018.

The Threshold Criteria used for TOC is intended for drinking water, not groundwater. Due to the magnitude of the exceedances and the intention of the Threshold Criteria used,

these exceedances are regarded as minor. The TOC concentration in MWE indicates that TOC is likely to be elevated in the local groundwater.

All other analytes in all other wells reported detections which were within the Threshold Criteria.

The following notable changes occurred within the groundwater analytes in landfill leachate well MWD:

- Ammonia in MWD exceeded the Threshold Criteria (0.9mg/L) with a concentration of 320 mg/L. The concentration of ammonia in MWD have remained elevated, 330 mg/L in January 2018 and 350 mg/L in October 2017. Concentrations of Ammonia in MWD have consistently been substantially higher than in the surrounding wells.
- Iron in MWD exceeded the Threshold Criteria (0.3mg/L) with a concentration of 1.1mg/L. Iron concentrations in MWD have fluctuated over its recent history, but displayed the same elevated result of 1.1mg/L in January 2018.

Refer to **Attachment 3** – Data Log.

The data will be viewed on a trending basis as more results become available.

6.0 CONCLUSIONS

The results of laboratory analysis of the samples collected from the Scone Waste Landfill during the April 2018 quarterly sampling event confirmed several exceedances of the Threshold Criteria in the wells external to the landfill. The Threshold Criteria are sourced from the ANZECC 2000 Guidelines for Fresh Water 95% level of protection, NEPM 2013 and Australian Drinking Water Guidelines 2011.

The following analytes exceeded the Threshold Criteria during the April 2018 sampling event: nitrate and manganese in MWC, and TOC in MWB, MWC and MWE. There were no other exceedances of the Threshold Criteria in the wells surrounding the landfill.

Some exceedances have been explained by local conditions or regarded as minor due to the criteria being Australian Drinking Water Guidelines. Trending of these analytes over time may indicate a seasonal fluctuation of regional groundwater conditions. All remaining exceedances are in MWD which is the leachate monitoring well. Exceeding concentrations in MWD are substantially higher than other wells, this indicates that it is unlikely that releases of landfill leachate into the local groundwater are occurring.

The elevated concentrations of nitrate, manganese and TOC in the monitoring wells external to the landfill do not necessarily indicate the concentrations are due to the landfill leachate, future testing and trending of data will allow for appropriate comparisons. Further monitoring may reveal the source and extent of elevated concentrations of particular analytes. As more data becomes available, it will become clearer which analytes are consistently elevated and may allow for determining the source of contamination.

The next water sampling event will be the quarterly monitoring event undertaken in July 2018.

7.0 REFERENCES

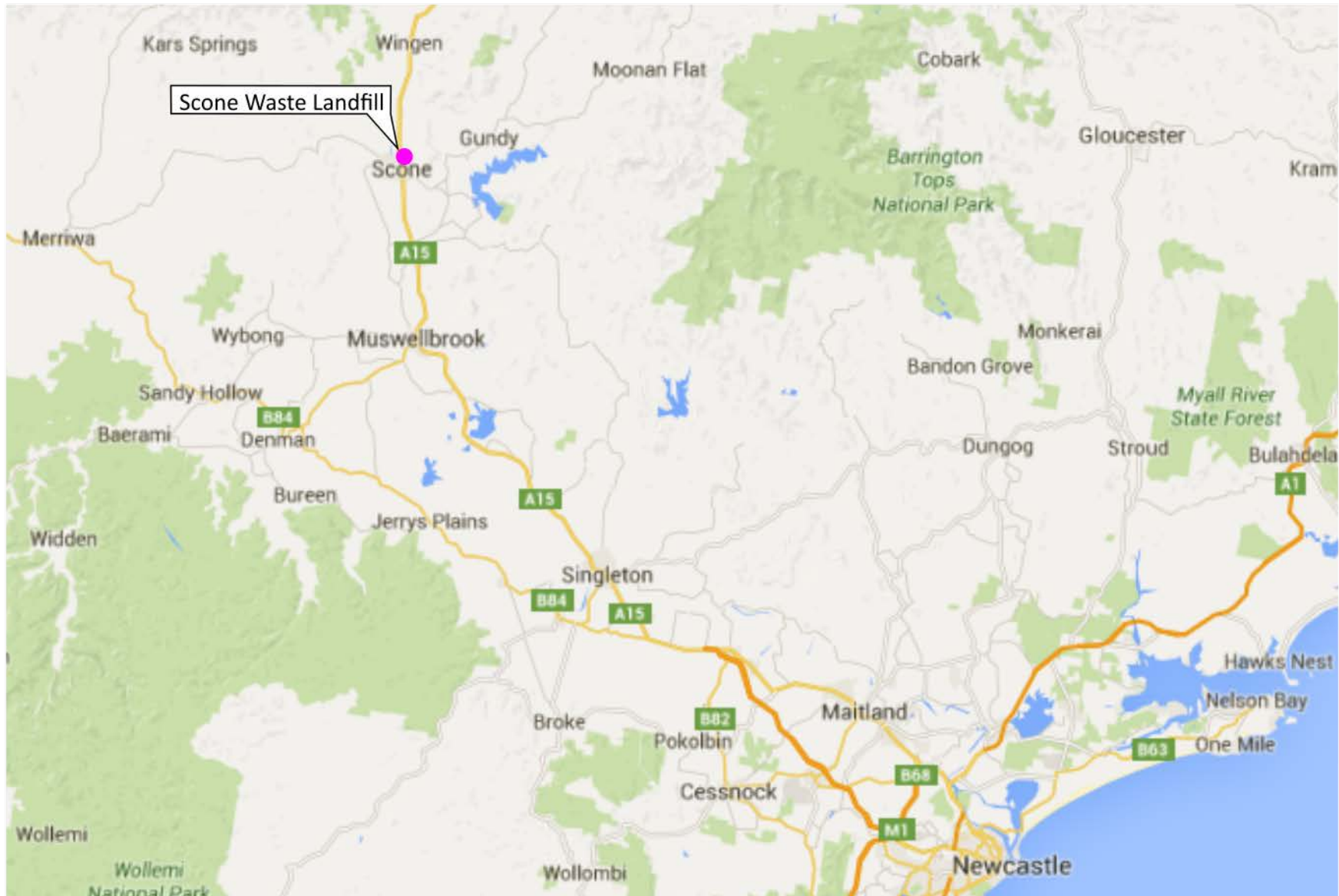
ANZECC/ARMCANZ (2000). *Australian Water Quality Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, October 2000.

NEPC (1999). *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1)*. National Environment Protection Council.

NHMRC / NRMCC (2011). *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*. National Health and Medical Research Council, National Resource Management Ministerial Council.

NSW DEC (2007). *Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination*. New South Wales Department of Environment and Conservation.

FIGURE 1 – SITE LOCATION REGIONAL

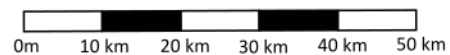


Legend

● Site location - Noblet Rd, Scone



Approximate Scale



Sydney Office
Phone (02) 9476 1765
Fax (02) 9476 1557

Maitland Office
Phone (02) 4933 0001

Title
Site location regional

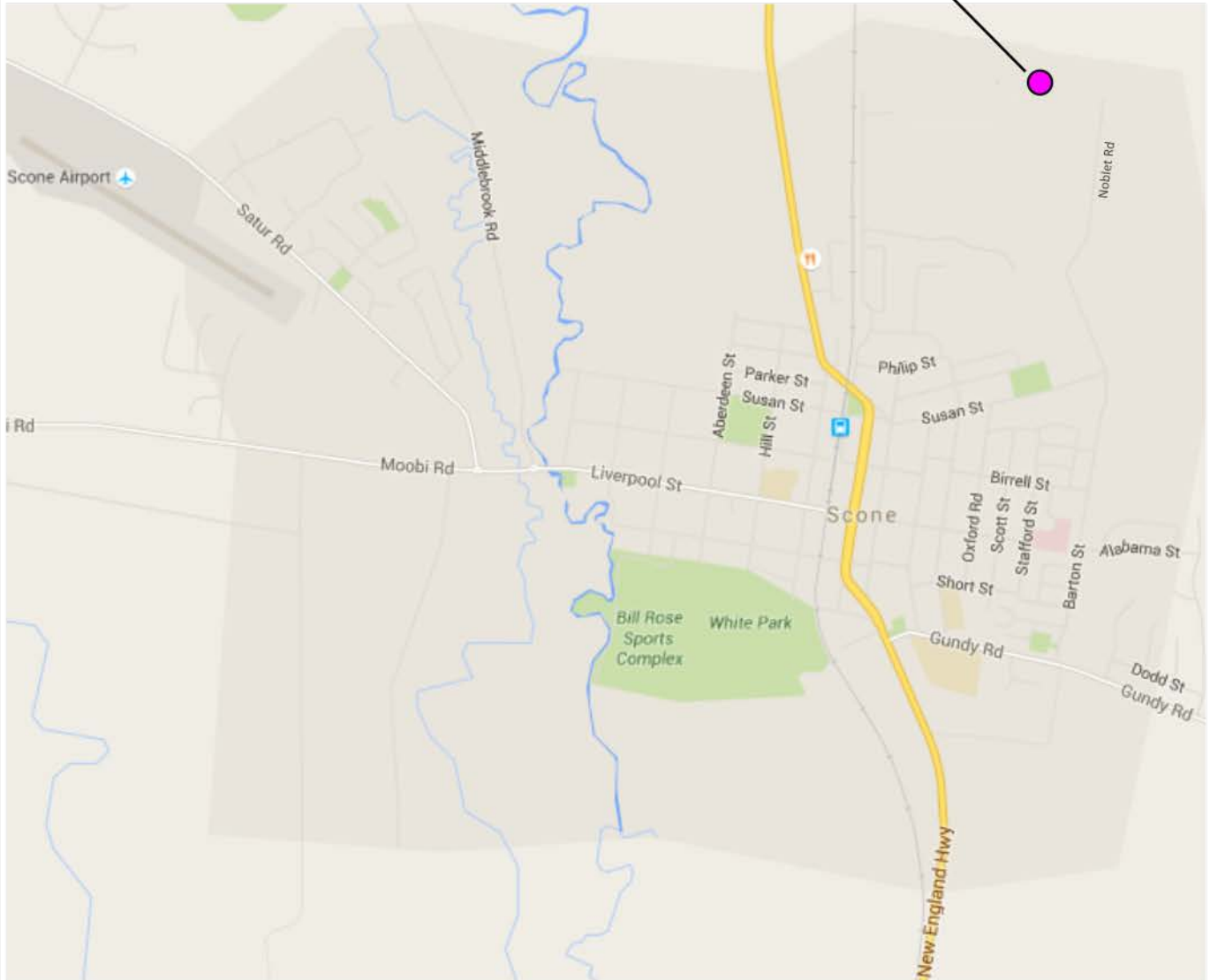
Client Upper Hunter Shire Council	Project No. DLH1186	Figure No 1	Date 15/5/2018
Scale As Shown	Compiled KS	Revision R02	

FIGURE 2 – SITE LOCATION LOCAL

FIGURE 3 – SITE LAYOUT WITH SAMPLE LOCATIONS



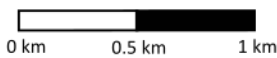
Scone Waste Landfill



Legend

● Site Location - Noblet Rd, Scone

Approximate Scale



Sydney Office Phone (02) 9476 1765
 Maitland Office Phone (02) 4933 0001
 Fax (02) 9476 1557

Title
Site location local

Client		Figure No	Date
Upper Hunter Shire Council		2	15/5/2018
Project No.	Scale	Compiled	Revision
DLH1186	As Shown	KS	R02

ATTACHMENT 1 – NATA CERTIFIED ANALYTICAL RESULTS

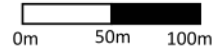


Legend

● Groundwater well location



Approximate Scale



Sydney Office
Phone (02) 9476 1765
Fax (02) 9476 1557

Maitland Office
Phone (02) 4933 0001

Title
Site layout with sample locations

Client Upper Hunter Shire Council	Project No. DLH1186	Figure No 3	Date 15/5/2018
	Scale As Shown	Compiled KS	Revision R02

CLIENT DETAILS

LABORATORY DETAILS

Contact Stephen Challinor
 Client DLA ENVIRONMENTAL SERVICES PTY LTD
 Address Level 4, 45 Watt Street
 Newcastle
 NSW 2300

Telephone 61 2 4933 0001
 Facsimile 61 2 98700999
 Email stephen.challinor@erm.com

Project **DLH0450054**
 Order Number (Not specified)
 Samples 5

Manager Huong Crawford
 Laboratory SGS Alexandria Environmental
 Address Unit 16, 33 Maddox St
 Alexandria NSW 2015

Telephone +61 2 8594 0400
 Facsimile +61 2 8594 0499
 Email au.environmental.sydney@sgs.com

SGS Reference **SE177839 R0**
 Date Received 12/4/2018
 Date Reported 19/4/2018

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

Ion Chromatography - The Limit of Reporting (LOR) has been raised for Nitrate-Nitrogen (NO3-N) due to high conductivity of the sample requiring dilution.

SIGNATORIES



Akheeque Beniamen
 Chemist



Bennet Lo
 Senior Organic Chemist/Metals Chemist



Dong Liang
 Metals/Inorganics Team Leader



Shane McDermott
 Inorganic/Metals Chemist

OC Pesticides in Water [AN420] Tested: 17/4/2018

PARAMETER	UOM	LOR	MWA	MWB	MWC	MWD	MWE
			WATER - 10/4/2018 SE177839.001	WATER - 10/4/2018 SE177839.002	WATER - 10/4/2018 SE177839.003	WATER - 10/4/2018 SE177839.004	WATER - 10/4/2018 SE177839.005
Hexachlorobenzene (HCB)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Beta BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Delta BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Isodrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mirex	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Total Phenolics in Water [AN289] Tested: 18/4/2018

PARAMETER	UOM	LOR	MWA	MWB	MWC	MWD	MWE
			WATER - 10/4/2018 SE177839.001	WATER - 10/4/2018 SE177839.002	WATER - 10/4/2018 SE177839.003	WATER - 10/4/2018 SE177839.004	WATER - 10/4/2018 SE177839.005
Total Phenols	mg/L	0.01	0.02	<0.01	<0.01	0.05	<0.01

Forms of Carbon [AN190] Tested: 17/4/2018

PARAMETER	UOM	LOR	MWA WATER - 10/4/2018 SE177839.001	MWB WATER - 10/4/2018 SE177839.002	MWC WATER - 10/4/2018 SE177839.003	MWD WATER - 10/4/2018 SE177839.004	MWE WATER - 10/4/2018 SE177839.005
Total Organic Carbon as NPOC	mg/L	0.2	3.6	4.8	9.0	340	7.9

Ammonia Nitrogen by Discrete Analyser (Aquakem) [AN291] Tested: 16/4/2018

PARAMETER	UOM	LOR	MWA	MWB	MWC	MWD	MWE
			WATER - 10/4/2018 SE177839.001	WATER - 10/4/2018 SE177839.002	WATER - 10/4/2018 SE177839.003	WATER - 10/4/2018 SE177839.004	WATER - 10/4/2018 SE177839.005
Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	0.16	0.09	0.22	320	0.07

Anions by Ion Chromatography in Water [AN245] Tested: 16/4/2018

PARAMETER	UOM	LOR	MWA	MWB	MWC	MWD	MWE
			WATER - 10/4/2018 SE177839.001	WATER - 10/4/2018 SE177839.002	WATER - 10/4/2018 SE177839.003	WATER - 10/4/2018 SE177839.004	WATER - 10/4/2018 SE177839.005
Chloride	mg/L	1	7100	5700	3200	3600	280
Sulfate, SO4	mg/L	1	41	70	130	110	85
Fluoride	mg/L	0.1	0.13	0.28	0.31	0.34	0.56
Nitrate Nitrogen, NO3-N	mg/L	0.005	<0.10 †	0.46	2.5	<0.050 †	<0.025 †

pH in water [AN101] Tested: 13/4/2018

PARAMETER	UOM	LOR	MWA WATER - 10/4/2018 SE177839.001	MWB WATER - 10/4/2018 SE177839.002	MWC WATER - 10/4/2018 SE177839.003	MWD WATER - 10/4/2018 SE177839.004	MWE WATER - 10/4/2018 SE177839.005
pH**	No unit	-	6.9	7.2	6.9	7.7	7.4

Conductivity and TDS by Calculation - Water [AN106] Tested: 13/4/2018

PARAMETER	UOM	LOR	MWA	MWB	MWC	MWD	MWE
			WATER - 10/4/2018 SE177839.001	WATER - 10/4/2018 SE177839.002	WATER - 10/4/2018 SE177839.003	WATER - 10/4/2018 SE177839.004	WATER - 10/4/2018 SE177839.005
Conductivity @ 25 C	µS/cm	2	21000	16000	11000	14000	3200
Total Dissolved Solids (by calculation)	mg/L	2	12000	9900	6500	8500	1900

Alkalinity [AN135] Tested: 13/4/2018

PARAMETER	UOM	LOR	MWA	MWB	MWC	MWD	MWE
			WATER - 10/4/2018 SE177839.001	WATER - 10/4/2018 SE177839.002	WATER - 10/4/2018 SE177839.003	WATER - 10/4/2018 SE177839.004	WATER - 10/4/2018 SE177839.005
Bicarbonate Alkalinity as CaCO ₃	mg/L	5	490	390	550	2500	1200
Carbonate Alkalinity as CaCO ₃	mg/L	1	<1	<1	<1	<1	<1
Hydroxide Alkalinity as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Phenolphthalein Alkalinity as CaCO ₃ *	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	5	490	390	550	2500	1200

Acidity and Free CO₂ [AN140] Tested: 17/4/2018

PARAMETER	UOM	LOR	MWA	MWB	MWC	MWD	MWE
			WATER - 10/4/2018 SE177839.001	WATER - 10/4/2018 SE177839.002	WATER - 10/4/2018 SE177839.003	WATER - 10/4/2018 SE177839.004	WATER - 10/4/2018 SE177839.005
Acidity to pH 8.3	mg CaCO ₃ /L	5	170	150	160	270	93

Metals in Water (Dissolved) by ICPOES [AN320] Tested: 18/4/2018

PARAMETER	UOM	LOR	MWA	MWB	MWC	MWD	MWE
			WATER - 10/4/2018 SE177839.001	WATER - 10/4/2018 SE177839.002	WATER - 10/4/2018 SE177839.003	WATER - 10/4/2018 SE177839.004	WATER - 10/4/2018 SE177839.005
Calcium, Ca	mg/L	0.1	640	650	270	120	59
Magnesium, Mg	mg/L	0.1	1200	810	440	290	53
Sodium, Na	mg/L	0.1	2100	1700	1400	1900	550
Potassium, K	mg/L	0.2	4.4	3.6	1.8	200	1.2

Trace Metals (Dissolved) in Water by ICPMS [AN318] Tested: 16/4/2018

PARAMETER	UOM	LOR	MWA	MWB	MWC	MWD	MWE
			WATER - 10/4/2018 SE177839.001	WATER - 10/4/2018 SE177839.002	WATER - 10/4/2018 SE177839.003	WATER - 10/4/2018 SE177839.004	WATER - 10/4/2018 SE177839.005
Iron, Fe	µg/L	5	<5	<5	<5	1100	<5
Manganese, Mn	µg/L	1	20	11	15000	180	140

METHOD

METHODOLOGY SUMMARY

- AN020** Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
- AN101** pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
- AN106** Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
- AN106** Salinity may be calculated in terms of NaCl from the sample conductivity. This assumes all soluble salts present, measured by the conductivity, are present as NaCl.
- AN135** Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
- AN140** Acidity by Titration: The water sample is titrated with sodium hydroxide to designated pH end point. In a sample containing only carbon dioxide, bicarbonates and carbonates, titration to pH 8.3 at 25°C corresponds to stoichiometric neutralisation of carbonic acid to bicarbonate. Method reference APHA 2310 B.
- AN190** TOC and DOC in Water: A homogenised micro portion of sample is injected into a heated reaction chamber packed with an oxidative catalyst that converts organic carbon to carbon dioxide. The CO₂ is measured using a non-dispersive infrared detector. The process is fully automated in a commercially available analyser. If required a sugar value can be calculated from the TOC result. Reference APHA 5310 B.
- AN190** Chemical oxygen demand can be calculated/estimated based on the O₂/C relation as 2.67*NPOC (TOC). This is an estimate only and the factor will vary with sample matrix so results should be interpreted with caution.
- AN245** Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO₂, NO₃ and SO₄ are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B
- AN289** Analysis of Total Phenols in Soil Sediment and Water: Steam distillable phenols react with 4-aminoantipyrine at pH 7.9±0.1 in the presence of potassium ferricyanide to form a coloured antipyrine dye analysed by Discrete Analyser. Reference APHA 5530 B/D.
- AN291** Ammonia in solution reacts with hypochlorite ions from Sodium Dichloroisocyanate, and salicylate in the presence of Sodium Nitroprusside to form indophenol blue and measured at 670 nm by Discrete Analyser.
- AN318** Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
- AN320** Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components .
- AN320** Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements . Reference APHA 3120 B.
- AN420** SVOC Compounds: Semi-Volatile Organic Compounds (SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
- Calculation** Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported . APHA4500CO₂ D.

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
**	Indicative data, theoretical holding time exceeded.	NVL	Not validated.	LOR	Limit of Reporting.
		IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- a. 1 Bq is equivalent to 27 pCi
- b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : <http://www.sgs.com.au/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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ATTACHMENT 2 – YSI WATER QUALITY METER CALIBRATION CERTIFICATE

Multi Parameter Water Meter



airmet

Air-Met Scientific Pty Ltd
1300 137 067Instrument YSI Quatro Pro Plus
Serial No. 13D100015

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	1. pH	✓	
	2. mV	✓	
	3. EC	✓	
	4. D.O	✓	
	5. Temp	✓	
Alarms	Beeper		
	Settings		
Software	Version		
Data logger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
pH 10		pH 10.0		304261	pH 9.70
1. pH 7.00		pH 7.00		307928	pH 6.84
2. pH 4.00		pH 4.00		307927	pH 4.05
3. mV		231.8mV		306014/391901	231.8mV
4. EC		2.76mS		306341	2.76mS
5. D.O		0.00ppm		5253	0.00ppm
6. Temp		21°C		MultiTherm	20.6°C

Calibrated by:  Kylie Boardman

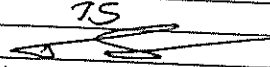
Calibration date: 29/03/2018

Next calibration due: 28/04/2018

ATTACHMENT 3 – DATA LOG

ATTACHMENT 4 – GROUNDWATER FIELD DATA SHEETS

GROUNDWATER FIELD DATA SHEET

DLA Project Code: DLH1186	Sample ID: MWA
Project: The Scone Waste Landfill	Well Collar RL:
Client: Upper Hunter Shire Council	Sampler(s): TS
Address: Noblet Rd, Scone NSW 2289	Signature: 
BH ID: MWA	Date: 10-4-18

Well Status

Monument damaged: YES <input checked="" type="radio"/> NO <input type="radio"/> N/A Locked well casing: YES <input checked="" type="radio"/> NO <input type="radio"/> N/A Cement footing damaged: YES <input checked="" type="radio"/> NO <input type="radio"/> N/A Standing water, vegetation around monument: YES <input checked="" type="radio"/> NO <input type="radio"/> N/A Well Damaged: YES <input checked="" type="radio"/> NO <input type="radio"/> N/A Nearby works: N/A	Well ID visible: YES <input checked="" type="radio"/> NO <input type="radio"/> N/A Cap on PVC casing: YES <input checked="" type="radio"/> NO <input type="radio"/> N/A Water in monument casing: YES <input checked="" type="radio"/> NO <input type="radio"/> N/A Internal obstruction in casing: YES <input checked="" type="radio"/> NO <input type="radio"/> N/A Odours from groundwater: YES <input checked="" type="radio"/> NO <input type="radio"/> N/A
Comments:	
Casing above ground: 0.89 m agl Standing water level: 6.77 (580) m bgl Total well depth: 15.65 m bgl Initial well volume: 19.14 L Water level after purging: 8.10 m bgl Volume of water purged: 11 L Water level at time of sampling: 15 above m bgl Well purged dry: YES <input checked="" type="radio"/> NO <input type="radio"/> Purging equipment: Bailor Sample equipment: " "	
Weather Conditions: Temperature: 15-20 <input type="checkbox"/> 20-25 <input checked="" type="checkbox"/> 25-30 <input checked="" type="checkbox"/> >30 <input type="checkbox"/> Clear <input type="checkbox"/> Partly cloudy <input type="checkbox"/> Overcast <input type="checkbox"/> Calm <input type="checkbox"/> Slight breeze <input type="checkbox"/> Moderate breeze <input type="checkbox"/> Windy <input type="checkbox"/> Fine <input type="checkbox"/> Showers <input type="checkbox"/> Rain <input type="checkbox"/>	

Note: 50mm internal diameter pipe = 1.96 L/m. All measurements below well collar

Water Quality Details:

Time am / pm	DO (mg/L ⁻¹)	EC (µS cm ⁻¹)	pH	Redox (mV)	Temp (°C)	Salinity (% Refract)	Comments
10:22	2.56	20453	7.49	100.30	22.1	12.19	
10:24	2.06	20462	7.29	103.4	22.8	12.20	
10:26	1.90	20418	7.20	103.9	23	12.22	

Additional Comments:

GROUNDWATER FIELD DATA SHEET

DLA Project Code: DLH1186		Sample ID: MWC
Project: The Scone Waste Landfill		Well Collar RL:
Client: Upper Hunter Shire Council		Sampler(s): TS
Address: Noblet Rd, Scone NSW 2289		Signature:
BH ID: MWC		Date: 10-4-18

Well Status

Monument damaged:	YES <input checked="" type="radio"/> NO <input type="radio"/> N/A	Well ID visible:	YES <input checked="" type="radio"/> NO <input type="radio"/> N/A
Locked well casing:	YES <input checked="" type="radio"/> NO <input type="radio"/> N/A	Cap on PVC casing:	YES <input checked="" type="radio"/> NO <input type="radio"/> N/A
Cement footing damaged:	YES <input checked="" type="radio"/> NO <input type="radio"/> N/A	Water in monument casing:	YES <input checked="" type="radio"/> NO <input type="radio"/> N/A
Standing water, vegetation around monument:	YES <input checked="" type="radio"/> NO <input type="radio"/> N/A	Internal obstruction in casing:	YES <input checked="" type="radio"/> NO <input type="radio"/> N/A
Well Damaged:	YES <input checked="" type="radio"/> NO <input type="radio"/> N/A	Odours from groundwater:	YES <input checked="" type="radio"/> NO <input type="radio"/> N/A
Nearby works:	NA		
Comments:	100m Both Orange Strata Sidement (heavy) no odour.		
Casing above ground:	0.75 m agl	Weather Conditions:	
Standing water level:	5.75 (5) m bgl	Temperature	15-20 <input type="checkbox"/> 20-25 <input type="checkbox"/>
Total well depth:	12.61 (12.36) m bgl		25-30 <input checked="" type="checkbox"/> >30 <input type="checkbox"/>
Initial well volume:	6.86 L	Clear <input checked="" type="checkbox"/>	Partly cloudy <input type="checkbox"/> Overcast <input type="checkbox"/>
Water level after purging:	5.29 (4.54) m bgl	Calm <input checked="" type="checkbox"/>	Slight breeze <input type="checkbox"/> Moderate breeze <input type="checkbox"/>
Volume of water purged:	4 L		Windy <input type="checkbox"/>
Water level at time of sampling:		Fine <input checked="" type="checkbox"/>	Showers <input type="checkbox"/> Rain <input type="checkbox"/>
Well purged dry:	YES / NO		
Purging equipment:			
Sample equipment:			

Note: 50mm internal diameter pipe = 1.96 L/m. All measurements below well collar

Water Quality Details:

Time am / pm	DO (mg/L ⁻¹)	EC (µS cm ⁻¹)	pH	Redox (mV)	Temp (°C)	Salinity (% Refract)	Comments
11:10	2.33	6340	7.37	84.20	22	3.46	
11:12	2.25	6329	7.25	84.20	22.1	3.46	
11:14	2.17	6336	7.06	83.60	22	3.46	

Additional Comments:

GROUNDWATER FIELD DATA SHEET

DLA Project Code: DLH1186	Sample ID: <u>MWE</u>
Project: The Scone Waste Landfill	Well Collar RL:
Client: Upper Hunter Shire Council	Sampler(s): <u>TS</u>
Address: Noblet Rd, Scone NSW 2289	Signature:
BH ID: MWE	Date: <u>10-4-16</u>

Well Status

Monument damaged:	YES / <input checked="" type="radio"/> NO / N/A	Well ID visible:	YES / <input checked="" type="radio"/> NO / N/A
Locked well casing:	YES / <input checked="" type="radio"/> NO / N/A	Cap on PVC casing:	YES / <input checked="" type="radio"/> NO / N/A
Cement footing damaged:	YES / <input checked="" type="radio"/> NO / N/A	Water in monument casing:	YES / <input checked="" type="radio"/> NO / N/A
Standing water, vegetation around monument:	YES / <input checked="" type="radio"/> NO / N/A	Internal obstruction in casing:	YES / <input checked="" type="radio"/> NO / N/A
Well Damaged:	YES / <input checked="" type="radio"/> NO / N/A	Odours from groundwater:	YES / <input checked="" type="radio"/> NO / N/A
Nearby works:		
Comments:	<u>N/A. no odour. Brown sediment.</u>		
Casing above ground:	<u>0.75</u> m agl	Weather Conditions:	
Standing water level:	<u>4.17 (3.42)</u> m bgl	Temperature	15-20 <input type="checkbox"/> 20-25 <input type="checkbox"/>
Total well depth:	<u>9.49 (8.74)</u> m bgl		<u>25-30</u> <input checked="" type="checkbox"/> >30 <input type="checkbox"/>
Initial well volume:	<u>10.44</u> L	<input checked="" type="radio"/> Clear <input type="radio"/>	Partly cloudy <input type="checkbox"/> Overcast <input type="checkbox"/>
Water level after purging:	<u>2.50</u> m bgl	<input checked="" type="radio"/> Calm <input type="checkbox"/>	Slight breeze <input type="checkbox"/> Moderate breeze <input type="checkbox"/>
Volume of water purged:	<u>279</u> L	<input type="checkbox"/>	Windy <input type="checkbox"/>
Water level at time of sampling: m bgl	<input checked="" type="radio"/> Fine <input type="checkbox"/>	Showers <input type="checkbox"/> Rain <input type="checkbox"/>
Well purged dry:	YES / NO		
Purging equipment:	<u>Boiler</u>		
Sample equipment:		

Note: 50mm internal diameter pipe = 1.96 L/m. All measurements below well collar

Water Quality Details:

Time am / pm	DO (mg/L ⁻¹)	EC (μS cm ⁻¹)	pH	Redox (mV)	Temp (°C)	Salinity (% Refract)	Comments
<u>11:58</u>	<u>2.37</u>	<u>3601</u>	<u>7.79</u>	<u>-9.0</u>	<u>22.5</u>	<u>1.89</u>	
<u>12:00</u>	<u>1.97</u>	<u>3585</u>	<u>7.69</u>	<u>-5.2</u>	<u>22.70</u>	<u>1.89</u>	
<u>12:02</u>	<u>1.69</u>	<u>3591</u>	<u>7.57</u>	<u>-7.90</u>	<u>22.70</u>	<u>1.89</u>	

Additional Comments:
