Ardill Payne & PARTNERS

ENGINEERS PLANNERS SURVEYORS ENVIRONMENTAL PROJECT MANAGEMENT

PRELIMINARY CONTAMINATED SITE INVESTIGATION

Submission to Byron Shire Council

Lot 38 DP 1059938
31 Alidenes Road, Wilsons Creek

for:
St Savior Investments Pty. Ltd.

December 2018

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1. Executive Summary

Ardill Payne and Partners has been engaged by St Savior Investments Pty. Ltd. to undertake a Stage 1 Preliminary Contaminated Site Investigation for Lot 38 DP 1059938, 31 Alidenes Rd, Wilsons Creek, to determine if the site is suitable for the proposed rezoning with or without remediation.

A desk-top site history review was undertaken of the site and surrounding properties to determine the historical land uses and to ascertain whether potentially contaminating activities had occurred historically. The desktop study was compiled using maps, aerial photography and on-line resources.

2. Objective & Scope of Works

The objective of this report is to determine if the subject site has been contaminated by prior or current land uses and subsequently if it is suitable for a proposed rezoning to R5 – Large Lot Residential.

Section 7(1) of the NSW State Environment Planning Policy No. 55 – Remediation of Land states that:

"A consent authority must not consent to the carrying out of any development on land unless:

a) *it has considered whether the land is contaminated; and*

b) *if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out; and*

c) *if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose."*

This contaminated site investigation is a Stage 1 – Preliminary Investigation, in accordance with the *Managing Land Contamination Planning Guidelines* (DUAP & EPA, 1998).

The purpose of this investigation is to:

- identify all past and present potentially contaminating activities
- identify potential contamination types
- discuss the site conditions
- provide a preliminary assessment of site contamination
- assess the need for further investigations

This report has been written in accordance with the NSW EPA (2000, reprinted 2011) *Guidelines for Consultants Reporting on Contaminated Sites.*

3. Proposed Development & Site Identification

The investigation is to confirm that Lot 38 DP 1059938 is suitable for the proposed rezoning of the land to R5 – Large Lot Residential.

Table 1 describes the details and characteristics of the site and a site locality plan is provided overleaf as Figure 1.

Table 1 – Subject Lot Identification Details

Site Address	31 Alidenes Road, Wilsons Creek
Site Area	12.27ha
Title	Lot 38 DP 1059938
Local Government Area	Byron Shire Council
Zoning (BLEP 2012)	RU2 – Rural Landscape under Byron Local Environmental Plan 2014 (BLEP)
Site Features	The site consists of cleared land with some paddock trees and scattered strands of vegetation. Yankee Creek as well as another unnamed watercourse runs through the site.
Elevation	~20m – 42m AHD
Site Location Co-ordinates	Latitude: -28.569588 Longitude: 153.452587
Existing Land Use	Rural
Surrounding Environment	The site is bounded by rural and rural residential properties with the Mullumbimby Hydro-electric Power Station Complex located to the south.

Figure 1: Site Locality (Google Earth 2018)

4. Site Condition and Surrounding Environment

4.1. Geology & Hydrogeology

The soils of the subject site are mapped by Morand 1994 as 'Billinudgel (bi)' soil landscape grouping, viz:

- Billinudgel (bi)
  - Landscape – low rolling hills on metamorphics of the Neranleigh-Fernvale Group. Relief 50-100m, slopes 10-20% and locally >33%. Slopes are generally moderately long (100-300 m). Ridges and crests are narrow (100-150m). Partly cleared open eucalypt forest. Littoral closed-forest at Brunswick and Broken Heads.
  - Soils – shallow to moderately deep (100cm), moderately well-drained Yellow Podzolic Soils and Yellow Podzolic Soil/Soloth integrades (Dy5.21, Dy3.11, Dy4.11) on crests and slopes. Deep (>100cm), moderately well-drained Yellow Podzolic Soils (Dy5.21, Dy4.11) and Red Podzolic Soil/Red Earths (Dr5.21) on siltstone.

5. Site History

A desktop site history review was undertaken to determine the chronological history of site uses and any possible sources and locations of contamination.

5.1. Land Use Investigation Methods

Prior land uses have been determined from:

- On-line records search:
  - NSW Primary Industries Science and Research: Cattle dip site locator
  - NSW Office of Environment and Heritage Contaminated Land: POEO Public Register
  - NSW Office of Environment and Heritage Contaminated Land: Record of Notices
- Reviewing historical aerial photographs
- Reviewing Torrens Title History

5.2. Online Records Search Outcomes

5.2.1. Cattle Dip Sites

There are no dip sites recorded for 'Wilsons Creek'. A search of 'Mullumbimby' returned 11 results. No dip sites were located within 250m of the subject site. None of the dips in the register were located within 2km of the closest lot boundary (being the south-western boundary).

5.2.2. POEO Register

The suburb of 'Wilsons Creek' did not return any results in the POEO Public Register.

5.2.3. Contaminated Land Register

A search of the NSW Office of Environment & Heritage Contaminated Land Records was undertaken for all notice types, which include:

- Declaration of Significant Contaminated Land
- Approved Voluntary Management Proposal
- Management Order

- On-going Maintenance Order
- Repeal, Revocation and Variation Notice
- Site Audit Statement

None of the abovementioned notice types were listed for the suburb of 'Wilsons Creek'.

5.3. Aerial Photographs

Table 2 presents a summary of the review of historical aerial photographs relating to the site. Copies of aerial photographs are presented below, with the approximate cadastral features of the site being shown for reference on appropriate aerials.

Table 2 – Summary of Aerial Photograph Observations

Year	Description
1966	Predominantly cleared land with some paddock trees and established vegetation. Evidence of a well-defined paddock within focus area. Permanent watercourse transecting the site evident. Access road transects eastern portion of the lot. Dwelling house and 'farm shed' located on eastern portion of the lot as well as potential other pursuits.
1987	Predominantly cleared land with some paddock trees and established vegetation. Permanent watercourse transecting the site evident. Access road transects eastern portion of the lot. Dwelling house and 'farm shed' located on eastern portion of the lot.
2006	Predominantly cleared land with some paddock trees and established vegetation. Permanent watercourse transecting the site evident. Access road transects eastern portion of the lot. Dwelling house and 'farm shed' located on eastern portion of the lot.
2016	Predominantly cleared land with some paddock trees and established vegetation. Permanent watercourse transecting the site evident. Access road transects eastern portion of the lot. Dwelling house and 'farm shed' located on eastern portion of the lot.

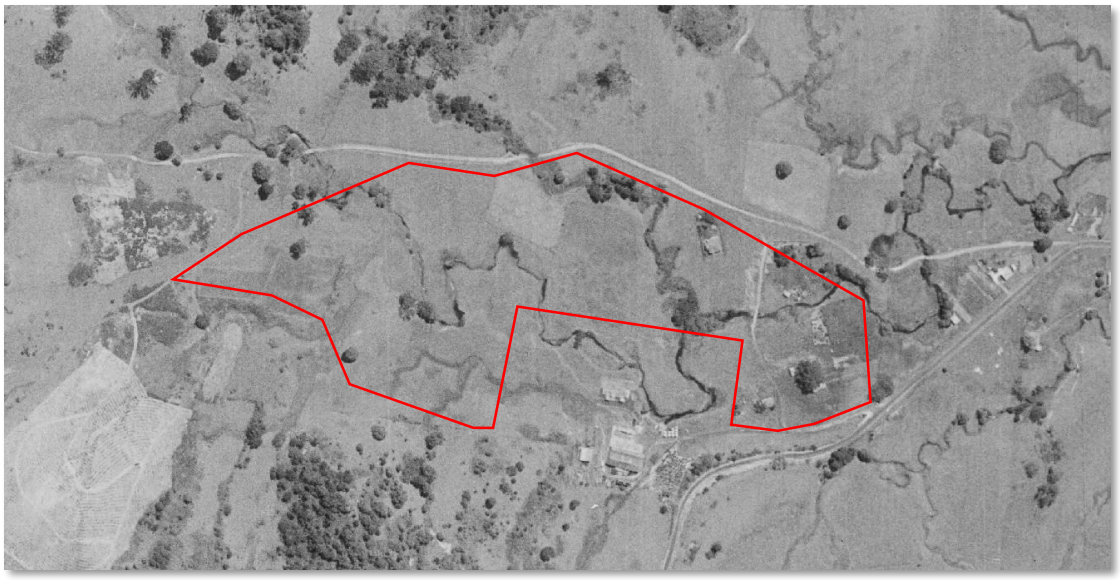


Figure 2: Historical Aerial of Subject Site with Indicative Site Boundary (1966)

Figure 3: Historical Aerial of Subject Site with Indicative Site Boundary (1987)

Figure 4: Historical Aerial of Subject Site with Indicative Site Boundary (2006)

Figure 5: Historical Aerial of Subject Site with Indicative Site Boundary (2016)

5.4. Discussion of Site History

Below are the concluded findings of the site history search:

- No dip sites in the vicinity of the subject site.
- The POEO search returned no sites of concern.
- The Contaminated Land Register returned no results for the subject site or surrounds.
- The aerial photographs of the subject site and surrounds show possible contaminating activities in the form of agricultural pursuits (cattle grazing and/or dairying) due to the nature and extent of the cleared land evident from 1966 onward as well as the structures located on site including the dwelling and associated buildings.

6. Areas of Environmental Concern

A number of potential contaminants could be located on the site as a result of the agricultural activities that may have been undertaken on the site (due to the extent of cleared land and common undertaking in the region) and the dwelling and associated structures. The potential contaminants of concern are discussed below.

6.1. Potential Contaminants of Concern

6.1.1. Heavy Metals

Due to the findings of the site history investigation, the site has the potential to be affected by heavy metal contamination. Heavy metals include lead and arsenic as a result of pesticides and herbicides used commonly in the 1940's to 1980's.

6.1.2. Pesticides

The site also has the potential to be affected by organochlorine and organophosphate pesticides.

7. Preliminary Sampling and Analysis Plan

A preliminary site investigation including sampling was undertaken in February 2017. Sampling focused on the lower lying, northern portion of the lot.

7.1. Sampling Rationale

A soil sampling regime was employed to determine the presence of potential contaminants of concern, being:

- A systematic soil sampling pattern was employed – samples taken at surface (0-150mm)
- 24 soil samples taken
- Soil samples sent to the NATA accredited Environmental Analysis Laboratory, Lismore.
- 24 samples were composited into 8 samples by the laboratory
- The sample results enabled an assessment of background contamination in the vicinity of the sampling site and whether further, more specific testing is justified.

The pattern and density of sampling was determined using 'Environmental Protection Authority NSW: *Contaminated Sites – Sampling Design Guidelines*' 1995.

7.2. Sampling Methodology

Sampling was carried out with a hand auger. Equipment was cleaned with potable water and phosphate free detergent (Decon 90), with demineralised water being used for a final rinse before each sample was taken. Samples were placed in new snap-lock containers and were stored and transported on ice to the Environmental Analysis Laboratory (EAL) at Southern Cross University (Lismore Campus) for analysis. Chain of Custody documentation is appended.

7.3. Quality Assurance and Quality Control

7.3.1. Field QA/QC

Samples were collected in the field by suitably qualified and experienced staff members. Cross-contamination was prevented by thoroughly washing the auger with phosphate free detergent and wearing fresh gloves between collecting each sample.

Due to the preliminary nature of this investigation and the small number of samples collected, no duplicate samples or rinsate blanks were collected during this sampling regime.

Samples were stored in an esky with ice bricks and then taken to the EAL once sampling had been completed. Chain of Custody (COC) documents were recorded for each sample and are included in Attachment 2. COC indicates the sample number, storage method and analytical requirements.

7.3.2. Laboratory QA/QC

The Environmental Analysis Laboratory (EAL) at Southern Cross University is a NATA accredited Laboratory. Details of analytical methods are described in the laboratory certificates included in Attachment 2.

Due to the preliminary nature of this investigation and the small number of samples analysed (<25), inter- and intra-laboratory duplicate testing was not conducted.

7.4. Results

All eight composite samples analysed by the laboratory had concentrations of manganese greater than the adopted composite health investigation level (HIL-A) and composite sample C8 had elevated concentrations of arsenic and cobalt. No organochlorine pesticides were present above the limit of detection.

The *Contaminated Land Management Act 1997* clearly identifies contamination as 'above the concentration at which the substance is normally present in, on or under land in the same locality' confirming that the elevated naturally occurring Mn and Co concentrations in North Coast soils is not identified as 'contamination' and hence does not warrant further investigation or remediation.

Furthermore, *Assessment of Total Soil Manganese and Chromium in Basaltic Soils of the North Coast, NSW* (Lancaster, 2006) states that:

> *"All Mn and Cr analysis results in North Coast soils need to be disregarded unless an identifiable source of Mn or Cr soil contamination has been identified."*

Anthropological activities associated with chromium contamination include leather, textile, and steel manufacturing. As none of the abovementioned industries were located on or near the site, there is no identifiable source of the contamination. Elevated chromium and manganese are present around the Northern Rivers and are attributed to the heavy volcanic activity in the area approximately 23 million years ago.

The individual samples comprising C8 were analysed for arsenic and cobalt. Both arsenic and cobalt levels for all individual samples analysed were below the individual HIL-A. Results are summarized below and included in Attachment 2.

Table 3 – Preliminary Individual Soil Sample Results

	C8			HIL-A
	S22	**S23**	**S24**	
Arsenic	66	9	21	100
Cobalt	48	29	10	100

Sources of environmental cobalt are both natural and anthropogenic. Natural sources include erosion, weathering of rocks and soil, seawater spray, volcanoes, forest fires, extraction by plants and continental and marine biogenic emissions (Kim et. al., 2006). The major anthropogenic sources of environmental cobalt include mining and processing (smelting) of cobalt-bearing ores, the use of cobalt-containing sludge or phosphate fertilizers on soil, the disposal of cobalt-containing waste, and atmospheric deposition from activities such as burning of fossil fuels and smelting and refining of metals.

The only anthropogenic source of elevated cobalt that is likely to have occurred on site is the use of phosphate fertilisers on soil. No other anthropogenic sources of contamination were located on or near the site and given the low concentrations, it is considered that the source of cobalt is naturally occurring and would be present across the site. The most likely cause for the elevated levels is the heavy volcanic activity in the area approximately 23 million years ago, which also causes elevated levels of chromium and manganese (discussed above). No further investigation into the elevated cobalt is proposed.

8. Conclusion & Recommendations

Ardill Payne & Partners (APP) has undertaken a Preliminary Contaminated Site Investigation to determine if the subject lot is suitable for a proposed rezoning and has not been contaminated from current or prior land uses.

The desk-top site history review found a number of potentially contaminating activities on the site resulting from possible agricultural pursuits on the land and surrounds and the dwelling house and associated structures.

Site sampling undertaken in 2017 indicated that composite samples had elevated concentrations of manganese, arsenic and cobalt. Manganese levels are naturally occurring in the northern rivers and are attributed to the volcanic activity approximately 23 million years ago and therefore considered to be within background levels. The individual samples that made up the composite sample with elevated arsenic and cobalt (C8), were analysed individually with the results indicating all individual samples had concentrations less than the adopted individual HIL-A, the most stringent health investigation level.

Additionally, it should be noted that sampling was taken on one of the lower lying sections of the site, presumably, based on the topography of the site, where runoff would concentrate potential contaminants. None were detected in this location.

It is therefore concluded that the site is suitable to the proposed rezoningand no further investigation is proposed unless evidence of contamination is observed on site.

9. References

Kim, JH, Gibb, HJ, Howe, PD 2006, *Concise International Chemical Assessment Document 69: Cobalt and Inorganic Cobalt Compounds*, WHO, Geneva, Switzerland

Lancaster, G 2006, *Assessment of Total Soil Manganese and Chromium in Basaltic Soils of the North Coast, NSW*, EAL, Lismore, New South Wales

10. General Notes

General

Geotechnical and environmental reports present the results of investigations carried out for a specific project and usually for a specific phase of the project (e.g. preliminary design). The report is based specific criteria, such as the nature of the project, underground utilities or scope of service limitations imposed by the Client. The report may not be relevant for other phases of the project (e.g. construction), after some time or where project details and clients change.

Soil and Rock Description

Soil and rock descriptions are based on AS1726-1993 using visual and tactile assessment except at discrete locations where field and/or laboratory tests have been carried out. Refer to the terms and symbols sheet for definitions.

Groundwater

The water levels indicated are taken at the time of measurement and depending on material permeability may not reflect the actual groundwater level at those specified locations. Also groundwater levels can vary with time due to seasonal or tidal fluctuation, construction activities and other external factors.

Interpretation of Results

The discussion and recommendations in the accompanying report are based on extrapolation/interpolation from data obtained at discrete locations and other external sources and guidelines. The actual interface between the materials may be far more gradual or abrupt than indicated. Also actual conditions in areas not sampled may differ from those predicted.

The report is based on significant background details that only the authors can be aware off, and therefore implementation of the recommendations by others may lead to misinterpretation and complications. Therefore this company should be consulted to explain the reports implications to other involved parties.

Reporting relies on interpretation of often limited factual information based on judgement and opinion which has a level of uncertainty and ambiguity attached to it, and is far less exact than other design disciplines. This should be considered by users of the report when assessing the implications of the recommendations.

Change in Conditions

Subsurface conditions can change with time and can vary between test locations. Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations can also affect subsurface conditions.

11. Scope of Engagement

This report has been prepared by Ardill Payne & Partners (APP) at the request of ST Savior Investments Pty. Ltd. for the purpose of a Preliminary Contaminated Site Investigation and is not to be used for any other purpose or by any other person or corporation.

This report has been prepared from the information provided to us and from other information obtained as a result of enquiries made by us. APP accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this document for a purpose other than that described above.

APP declares that it does not have, nor expects to have, a beneficial interest in the subject project.

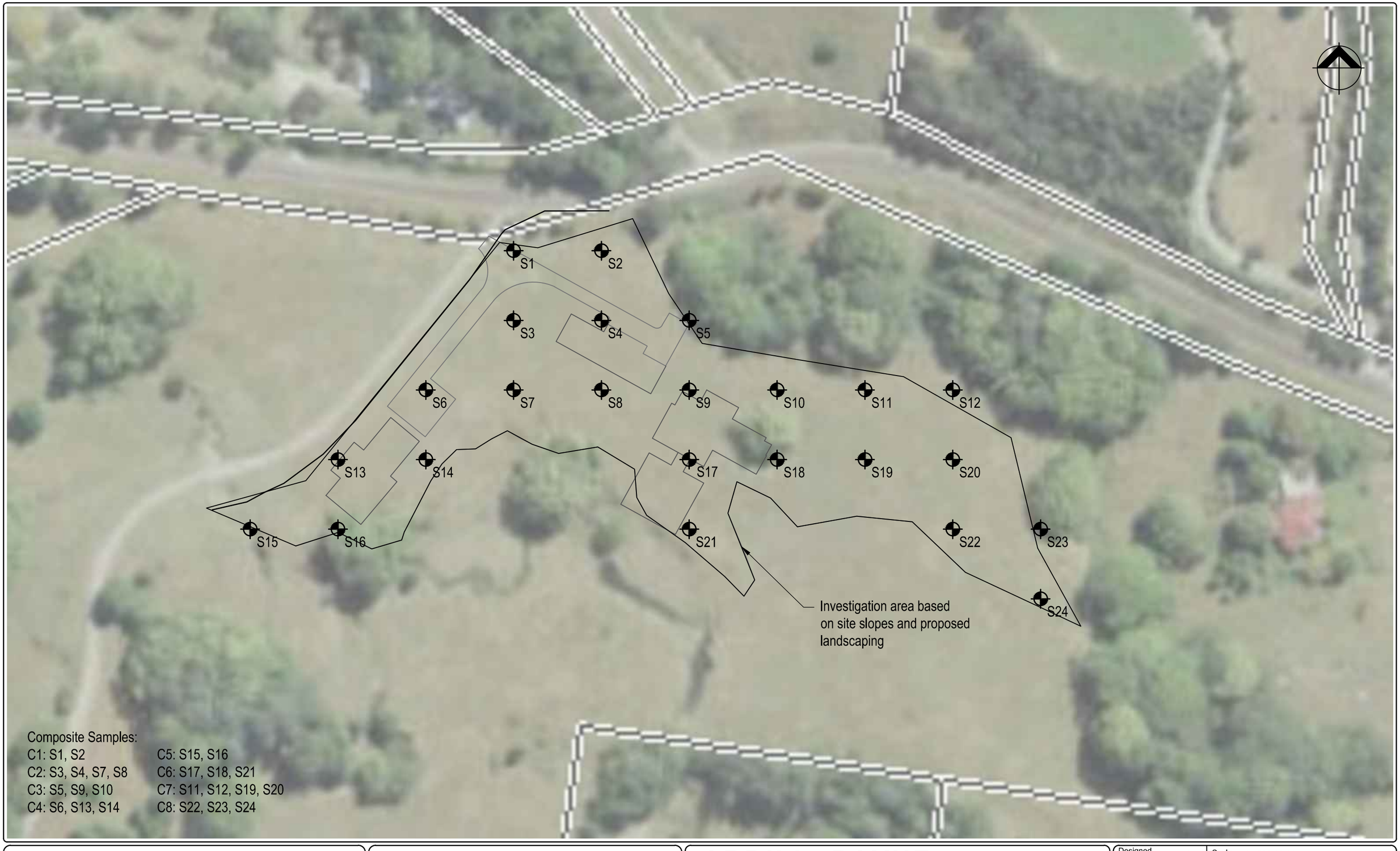
To avoid this advice being used inappropriately it is recommended that you consult with APP before conveying the information to another who may not fully understand the objectives of the report. This report is meant only for the subject site/project and should not be applied to any other.

12. Attachments

Attachment 1	Site Sampling Map
Attachment 2	Laboratory Results
Attachment 3	*Assessment of Total Soil Manganese and Chromium in Basaltic Soils of the North Coast, NSW* (Lancaster, 2006)

ATTACHMENT 1

Attachment 1: Site Sampling Map



Project:
Proposed Dual Occupancy
Lot 38 DP 1059938

Client: A. & D. Payn

Title: Contaminated Site Investigation
Indicative Sampling Map

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Designed	RMcG	Scale	1:1000 @ A3
Drawn	RMcG		0 10 20 30 40 50
Checked	DR	File Name	8247 SEPP55.dwg
Approved	DR	Date	06/02/2017
		Datum	-
Job No.	8247	Dwg No.	FIG.1
		Issue	

ATTACHMENT 2

Attachment 2: Laboratory Results

F6750 x 24 Soil

CHAIN OF CUSTODY

eal Environmental Analysis Laboratory
Division of Research, Southern Cross University

PO Box 157 (Military Road)
LISMORE NSW 2480
P| 02 6620 3678 F| 02 6620 3957
eal@scu.edu.au, www.scu.edu.au/eal

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Payment Method:
☐ Purchase Order
☐ Cheque
☒ Invoice (prior approval required)
☐ Credit Card Mastercard / Visa No: _____/_____/_____/_____

Exp. Date: Name on Card: CVV: by phone

	Date	Signed
Relinquished By: RMcleary	8/2/17	R.McCleary
Preservation: None / Ice / Ice bricks / Acidified / Filtered / Other:		
Received By: KC	8/2/17	
Condition on receipt: Ambient / Cool / Frozen / Other:		

Comments: please composite:

C1: S1, S2 C4: 6, 13, 14 C7: 11, 12, 19, 20
C2: 3, 4, 7, 8 C5: S15, S16 C8: 22, 23, 24.
C3: 5, 9, 10 C6: 17, 18, 21

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

thankyou.

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	SS-PACK-908									
	C1	SURF	7/2/17	8247.	—	SOIL	X									
	C2	↓	↓	↓	↓	↓	X									
	C3						X									
	C4						X									
	C5						X									

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Comments:

see composites on other page.

Marketing Survey – where did you find us?

☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Lab Sample No.	Sample ID	Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)	Sample Analysis Request Price List Code (e.g. SW-PACK-06) SS-PACK-008
	C6	SURF	7/2/17	8247	—	SOIL	X
	C7	↓	↓	↓	↓	↓	X
	C8	↓	↓	↓	↓	↓	X

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Comments:

Marketing Survey – where did you find us?
☐ Word of mouth ☐ Magazine ☐ Google search ☐ Other

Lab Sample No.	Sample ID		Sample Depth	Sampling Date	Your Client	Crop ID	Sample Type (e.g. water, leaf, soil)
1	S1	C1					
2	S2						
3	S3						
4	S4	C2					
5	S7						
6	S8						
7	S5						
8	S9	C3					
9	S10						
10	S6						
11	S13	C4					
12	S14						
13	S15						
14	S16	C5					
15	S17						
16	S18	C6					
17	S21						
18	S11						
19	S12						
20	S19	C7					
21	S20						
22	S22						
23	S23	C8					

Sample Analysis Request

Price List Code (e.g. SW-PACK-06)

RESULTS OF SOIL ANALYSIS

24 soil samples supplied by Ardill Payne & Partners on 8th February, 2017 - Lab Job No. F6750
Soil samples supplied were composited by EAL into 8 composite samples for analysis
Analysis requested by Rowena McGeary. Your Job: 8247
(PO Box 20 BALLINA NSW 2478).

ANALYTE	METHOD REFERENCE	Composite Sample 1 C1 (S1,S2)	Composite Sample 2 C2 (S3,S4,S7,S8)	Composite Sample 3 C3 (S5,S9,S10)	Composite Sample 4 C4 (S6,S13,S14)	Composite Sample 5 C5 (S15,S16)	Composite Sample 6 C6 (S17,S18,S21)	Composite Sample 7 C7 (S11,S12,S19,S20)	Composite Sample 8 C8 (S22,S23,S24)	*RESIDENTIAL A Guideline Limit*		*COMMERCIAL/ INDUSTRIAL D Guideline Limit*		*Background*
										Composite - Column A	*Individual - Column A*	*Composite - Column D*	*Individual - Column D*	*Range*
	Job No.	*F6750/1*	*F6750/2*	*F6750/3*	*F6750/4*	*F6750/5*	*F6750/6*	*F6750/7*	*F6750/8*	*See note 1a*	*See note 1a*	*See note 1d*	*See note 1d*	*See note 2*
TEXTURE (SAND, CLAY, SILT)	** inhouse	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt	..	..	..	..	..
MOISTURE %	** c	15	15	12	16	14	14	13	14	..	..	..	..	..
SILVER (mg/Kg DW)	*a*	<1	<1	<1	<1	<1	<1	<1	<1	*na*	*na*	*na*	*na*	*na*
ARSENIC (mg/Kg DW)	*a*	4	4	5	2	5	4	10	34	*25*	*100*	*750*	*3,000*	*0.2-30*
LEAD (mg/Kg DW)	*a*	15	14	17	13	14	12	12	18	*75*	*300*	*375*	*1,500*	*<2-200*
CADMIUM (mg/Kg DW)	*a*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	*5*	*20*	*225*	*900*	*0.04-2.0*
CHROMIUM (mg/Kg DW)	*a*	8	7	6	12	8	6	6	6	*(<25)*	*(<100)*	*(<900)*	*(<3,600)*	*0.5-110*
COPPER (mg/Kg DW)	*a*	10	9	9	12	8	9	7	8	*1,500*	*6,000*	*60,000*	*240,000*	*1-190*
MANGANESE (mg/Kg DW)	*a*	3620	3916	4676	2369	2015	2080	3108	4910	*950*	*3,800*	*15,000*	*60,000*	*4 - 12,600*
NICKEL (mg/Kg DW)	*a*	7	7	6	6	7	5	4	5	*100*	*400*	*1,500*	*6,000*	*2-400*
SELENIUM (mg/Kg DW)	*a*	1	1	1	1	1	1	1	1	*50*	*200*	*2,500*	*10,000*	*na*
ZINC (mg/Kg DW)	*a*	73	45	44	65	41	39	40	37	*1,850*	*7,400*	*100,000*	*400,000*	*2-180*
MERCURY (mg/Kg DW)	*a*	0.07	0.11	0.08	0.09	0.10	0.09	0.09	0.08	*10*	*40*	*183*	*730*	*0.001-0.1*
IRON (% DW)	*a*	2.02	2.00	2.12	1.77	2.15	1.86	1.85	2.02	*na*	*na*	*na*	*na*	*na*
ALUMINIUM (% DW)	*a*	1.35	1.31	1.34	1.08	1.74	1.16	1.03	1.10	*na*	*na*	*na*	*na*	*na*
BERYLLIUM (mg/Kg DW)	*a*	1	<1	<1	1	1	<1	<1	<1	*15*	*60*	*125*	*500*	*na*
BORON (mg/Kg DW)	*a*	<1	1	2	2	2	<1	3	1	*1,125*	*4,500*	*75,000*	*300,000*	*na*
COBALT (mg/Kg DW)	*a*	21	24	28	16	25	15	20	38	*25*	*100*	*1,000*	*4,000*	*na*
PESTICIDE ANALYSIS SCREEN														
DDT+DDE+DDD (mg/Kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*60*	*240*	*900*	*3,600*	*<0.1*
Aldrin + Dieldrin (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*2*	*6*	*11*	*45*	*<0.1*
Chlordane (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*13*	*50*	*133*	*530*	*<0.1*
Endosulfan (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*68*	*270*	*500*	*2,000*	*<0.1*
Endrin (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*3*	*10*	*25*	*100*	*<0.1*
Heptachlor (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*2*	*6*	*13*	*50*	*<0.1*
HCB (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*3*	*10*	*20*	*80*	*<0.1*
Methoxychlor (mg/kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	*75*	*300*	*625*	*2,500*	*<0.1*
Other Organochlorine Pesticides (mg/Kg)	*c*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	..	..	..	..	*<0.1*

METHODS REFERENCE

a. [1:3]Nitric/HCl digest - APHA 3125 ICPMS
b. [1:3]Nitric/HCl digest - APHA 3120 ICPOES
c. Analysis sub-contracted - Envirolab report no. 161658
*** denotes these test procedure or calculation are as yet not NATA accredited but quality control data is available*

NOTES

1a. HIL A - Residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake (no poultry), also includes childcare centres, preschools and primary schools.
1b. HIL B - Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.
1c. HIL C - Public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and footpaths. This does not include undeveloped public open space.
1d. HIL D - Commercial/industrial, includes premises such as shops, offices, factories and industrial sites.
(REFERENCE: Health Investigation Guidelines from NEPM (National Environmental Protection, Assessment of Site Contamination, Measure), 2013; Schedule B1).
2. Environmental Soil Quality Guidelines, Page 40, ANZECC, 1992.

NATA
Accreditation No. 14960.
Accredited for compliance with ISO/IEC 17025.

Additional NOTES

DW = Dry Weight. na = no guidelines available

Organochlorine pesticide (OC's) screen: (HCB, alpha-BHC, gamma-BHC, Heptachlor, delta-BHC, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, Endosulfan 1, pp-DDE, Dieldrin, Endrin, pp-DDD, Endosulfan 2, pp-DDT, Endrin Aldehyde, Endosulfan Sulphate, Methoxychlor)

Environmental Analysis Laboratory, Southern Cross University,
Tel. 02 6620 3678, website: scu.edu.au/eal

checked:.....

RESULTS OF SOIL ANALYSIS

24 soil samples supplied by Ardill Payne & Partners on 8th February, 2017 - Lab Job No. F6750
Soil samples supplied were composited by EAL into 8 composite samples for analysis
Analysis requested by Rowena McGeary. Your Job: 8247
(PO Box 20 BALLINA NSW 2478).

ANALYTE	METHOD REFERENCE	Sample 22 S22	Sample 23 S23	Sample 24 S24
	Job No.	*F6750/22*	*F6750/23*	*F6750/24*
ARSENIC (mg/Kg DW)	*a*	66	9	21
COBALT (mg/Kg DW)	*a*	48	29	10

ANALYTE	METHOD REFERENCE	Sample 1 S1	Sample 2 S2	Sample 3 S3	Sample 4 S4	Sample 5 S7	Sample 6 S8	Sample 7 S5	Sample 8 S9	Sample 9 S10	Sample 10 S6	Sample 11 S13	Sample 12 S14
	Job No.	*F6750/1*	*F6750/2*	*F6750/3*	*F6750/4*	*F6750/5*	*F6750/6*	*F6750/7*	*F6750/8*	*F6750/9*	*F6750/10*	*F6750/11*	*F6750/12*
MANGANESE (mg/Kg DW)	*a*	2,261	3,491	2,917	9,251	1,821	6,461	2,945	10,054	2,916	1,939	3,495	4,928

ANALYTE	METHOD REFERENCE	Sample 13 S15	Sample 14 S16	Sample 15 S17	Sample 16 S18	Sample 17 S21	Sample 18 S11	Sample 19 S12	Sample 20 S19	Sample 21 S20	Sample 22 S22	Sample 23 S23	Sample 24 S24
	Job No.	*F6750/13*	*F6750/14*	*F6750/15*	*F6750/16*	*F6750/17*	*F6750/18*	*F6750/19*	*F6750/20*	*F6750/21*	*F6750/22*	*F6750/23*	*F6750/24*
MANGANESE (mg/Kg DW)	*a*	931	3,660	5,423	3,074	6,049	6,142	1,321	7,339	4,625	6,762	3,347	1,396

METHODS REFERENCE

a. [1:3]Nitric/HCl digest - APHA 3125 ICPMS

NOTES

DW = Dry Weight

NATA
WORLD RECOGNISED ACCREDITATION
Accreditation No. 14960.
Accredited for compliance with ISO/IEC 17025.

checked:.....

ATTACHMENT 3

Attachment 3: *Assessment of Total Soil Manganese and Chromium in Basaltic Soils of the North Coast, NSW* (Lancaster, 2006)

ASSESSMENT OF TOTAL SOIL MANGANESE AND CHROMIUM IN BASALTIC SOILS OF THE NORTH COAST, NSW

An assessment of Manganese and Chromium possible soil contamination
as required for State Environmental Planning Policy 55

PREPARED BY: GRAHAM LANCASTER
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SCHOOL OF ENVIRONMENTAL SCIENCE AND MANAGEMENT
ENVIRONMENTAL ANALYSIS LABORATORY

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FOR: NEWTON DENNY CHAPELLE
REPORT NO.: **Contamination Reports**
DATE: July, 2006

EXECUTIVE SUMMARY

The objective of the investigation is to assess typical and average soil total manganese (Mn) and chromium (Cr) concentrations in North Coast soils, NSW (ie. Grafton to the south, Kyogle to the west, Mullumbimby to the North and Ballina to the east). These soils are typically of a basaltic origin and these volcanic soils are shown to be naturally elevated in some metals.

The assessment of Mn and Cr assessment in North Coast soils has been conducted on a random 200 composite soil samples, which is equivalent to 800 individual soils. This number of soils is considered representative of North Coast soils and for the assessment of average metal concentrations.

The results of the soil analysis were compared with Column 1 of the NSW EPA (1998) '*Contaminated Sites – Guidelines for the NSW Site Auditor Scheme'*. Column 1 presented Human - Based Investigation Levels (HBIL) for developments being 'residential with gardens and accessible soil'. The guidelines are also typically modified by dividing them by the number of samples that make up the composite sample (ie. typically the guideline divided by four).

The average Mn in the 800 soils is 1800ppm Mn with a standard deviation of 1162ppm. These levels are 'naturally' well above the guideline level of 1500ppm or 375ppm Mn for composite samples (ie. 92% of the 200 composite soils analysed exceed the 375ppm guideline).

The average Cr in the 800 soils is 56ppm Cr with a standard deviation of 32ppm. These levels are 'naturally' well above the composite guideline level of 25ppm Cr (ie. 91% of the 200 composite soils analysed exceed the 25ppm guideline).

The background levels of metals analysed, obtained from ANZECC and NHMRC (1992) Table 3 "Environmental Soil Quality Guidelines" page 40, state that background levels of Mn range from 4 – 12,600ppm and total Cr from 0.5 – 110ppm. This large range for background Mn and Cr in soils further confirms the results obtained for naturally elevated Mn and Cr in North Coast soils.

All Mn and Cr analysis results in North Coast soils need to be disregarded unless an identifiable source of Mn or Cr soil contamination has been identified. The Contaminated Land Management Act 1997 clearly identifies contamination as 'above the concentration at which the substance is normally present in, on or under land in the same locality' and hence confirming that the elevated naturally occurring Mn and Cr concentrations in North Coast soils is not identified as 'contamination' and hence does not warrant further investigation or remediation.

1.0 INTRODUCTION

The Environmental Analysis Laboratory has been commissioned by Newton Denny Chapelle to undertake a investigation for Contaminated Lands in regard to soil total Mn and Cr concentrations.

The objective of the investigation is to assess typical and average soil total Mn and Cr concentrations in North Coast soils, NSW (ie. Grafton to the south, Kyogle to the west, Mullumbimby to the North and Ballina to the east). These soils are typically of a basaltic origin and these volcanic soils are shown to be naturally elevated in some metals.

The purpose of this report is to determine if north coast soils are contaminated from current or past land usage or have 'naturally' occurring Cr and Mn. To determine if a site has been contaminated, soil samples have been collected and analysed for a range of contaminants. A large number of soil composite samples from random sites were collated for this assessment. If contaminated, the results of the analysis are required to be higher than that of the relevant EPA acceptable levels. Most of the contamination reports involve residential and hence the soil analysis results are compared with the NSW EPA (1998) Columns 1 of the Table "Soil Investigation Levels for Urban Redevelopment Sites in NSW" page 30 and ANZECC and National Health and Medical Research Council (1992) Table 2 "Environmental Soil Quality Guidelines" page 40.

This investigation is Stage 1 of the *Managing Land Contamination Planning Guidelines* (DUAP and EPA, 1998). If contamination levels exceed the EPA acceptable levels, a detailed investigation is then required in accordance with DUAP and EPA (1998), being Stage 2. If the contamination levels are below the relevant acceptable levels and information gathered as part of the investigation also supports that contamination was unlikely to have occurred, Stage 1 would only be required.

2.0 METHODOLOGY

The assessment of Mn and Cr in North Coast soils has been conducted on a random 200 composite soil samples, which is equivalent to 800 individual soils. This number of soils is considered representative of North Coast soils and for the assessment of average metal concentrations.

Samples were analysed for a full range of heavy metals and the data analysed in this review is the total Mn, Cr, iron (Fe) and aluminium (Al).

2.1 Sampling Methodology

Samples were collected using a hand auger and spade, with soil being placed in plastic sample bags.

All soil samples were placed into an esky with ice bricks, and delivered to the Environmental Analysis Laboratory at Southern Cross University, Lismore. Metals analysis was conducted by the Environmental Analysis Laboratory (EAL) and quality control included blanks, duplicates and certified NIST reference soil in every batch. Analysis is conducted using a Perkin Elmer DV4300 ICPOES (Inductively Coupled Plasma Optical Emission Spectrometry) with confirmation and level analysis of all samples using a Perkin Elmer ELAN6000 ICPMS (Inductively Coupled Plasma Mass Spectrometry).

Chain of custody forms, laboratory quality assurance and laboratory quality control documentation are available on request.

3.0 BASIS FOR ASSESSMENT CRITERIA

The acceptable limits of the parameters tested are based on the NSW EPA (1998) *Contaminated Sites - Guidelines for the NSW Site Auditor Scheme*. In particular Column 1 of table "Soil Investigation Levels for Urban Redevelopment Sites in NSW" page 30. Column 1 relates to "Residential with gardens and accessible soil including children's daycare centres, preschools, primary schools, town houses or villas". The tested parameters are presented in Table 1.

Table 1: Soil Investigation Levels for Urban Redevelopment Sites in NSW: Column 1 "Residential with gardens and accessible soil including children's daycare centres, preschools, primary schools, town houses or villas" (NSW EPA 1998)

Substance	Acceptable Limit Column 1 (mg/kg)	Modified Acceptable Limit Column 1 (mg/kg) (divided by 4 for composites of 4 samples)
Arsenic	100	**25**
Cadmium	20	**5**
Chromium (VI)	100	**25**
Copper	1000	**250**
Manganese	1500	**375**
Nickel	600	**150**
Lead	300	**75**
Zinc	7000	**1750**
Mercury	15	**3.75**
OC's (aldrin and dieldrin)	10	**2.5**
OC's (DDT)	200	**50**

Background Levels

Metals occur naturally within soils and are a natural constituent of geological materials that erode and assist in the formation of soils. The background levels of metals analysed, obtained from ANZECC and NHMRC (1992) Table 3 "Environmental Soil Quality Guidelines" page 40, are presented in Table 2.

Table 2: Background Ranges for Potential Contaminants

Pollutant	Background Range (mg/kg)
Arsenic	0.2 – 30
Lead	<2 – 200
Cadmium	0.04-2
Copper	1-190
Nickel	2-400
Zinc	2-180
Manganese	4 – 12,600
Chromium	0.5 – 110 *(possible underestimate)*
Mercury	0.001-0.1

Table 3: Average Abundance of Manganese and Chromium in Basalt and other minerals

AVERAGE ABUNDANCE OF ELEMENTS IN THE EARTHS CRUST AND IN THREE COMMON ROCKS
(IN PARTS PER MILLION) (10,000ppm = 1%)

ELEMENT	CRUST	GRANITE	BASALT (Crusher Dust)	SHALE
O	464,000	485,000	441,000	495,000
Si	**282,000**	**323,000**	**230,000**	**238,000**
Al	81,000	77,000	84,000	92,000
Fe	**54,000**	**27,000**	**86,000**	**47,000**
Ca	**41,000**	**16,000**	**72,000**	**25,000**
Na	24,000	28,000	19,000	9,000
Mg	**23,000**	**4,000**	**45,000**	**14,000**
K	**21,000**	**32,000**	**8,000**	**25,000**
Ti	5,000	2,100	9,000	4,500
H	1,400	..	..	..
P	**1,100**	**700**	**1,400**	**750**
Mn	**1,000**	**500**	**1,700**	**850**
F	650	800	400	600
Ba	500	700	300	600
Sr	375	300	450	400
S	**300**	**300**	**300**	**2,500**
C	**220**	**320**	**120**	**1,000**
Zr	165	180	140	180
Cl	130	200	60	170
V	110	50	250	130
Cr	100	20	200	100
Rb	90	150	30	140
Ni	75	0.8	150	80
Zn	**70**	**50**	**100**	**90**
Ce	70	90	30	70
Cu	**50**	**12**	**100**	**50**
Y	35	40	30	35
La	35	55	10	40
Nd	30	32	20	30
Co	**22**	**3**	**48**	**20**
Li	20	30	12	60
N	**20**	**20**	**20**	**60**
Sc	20	8	35	15
Nb	20	20	20	15
Ga	18	18	18	25
Pb	12.5	20	3.5	20
B	**10**	**15**	**5**	**100**
Th	8.5	20	1.5	12

ELEMENT	CRUST	GRANITE	BASALT (Crusher Dust)	SHALE
Pr	8	10	4	9
Sm	7	9	5	7
Gd	7	8	6	6
Dy	6	6.5	4	5
Er	3.5	4.5	3	3.5
Yb	3.5	4	2.5	3.5
Be	3	5	0.5	3
Cs	3	5	1	7
Hf	3	4	1.5	4
U	2.7	5	0.5	3.5
Br	2.5	0.5	0.5	5
Sn	2.5	3	2	6
Ta	2	3.5	1	2
As	1.8	1.5	2	10
Ge	1.5	1.5	1.5	1.5
Mo	**1.5**	**1.5**	**1**	**2**
Ho	1.5	2	1	1.5
Eu	1.2	1	1.5	1.4
W	1.2	1.5	0.8	1.8
Tb	1	1.5	0.8	1
Tl	0.8	1.2	0.2	1
Lu	0.6	0.7	0.5	0.6
Tm	0.5	0.6	0.5	0.6
Sb	0.2	0.2	0.2	1.5
I	0.2	0.2	0.1	1
Cd	0.15	0.1	0.2	0.3
Bi	0.15	0.2	0.1	0.2
In	0.06	0.05	0.07	0.06
Ag	0.07	0.04	0.1	0.1
Se	0.05	0.05	0.05	0.6
Hg	0.02	0.03	0.01	0.3
Au	0.003	0.002	0.004	0.003

Reference: Krauskopf, K, 1996. Introduction to Geochemistry, McGraw-Hill Internation.

4.0 RESULTS

The results from the soil testing regime are graphically represented on the following pages.
The raw data table with over 200 entries and identifiable job numbers is presented in Exhibit 1.

Figure 1- Graphical presentation of Manganese Soil Results

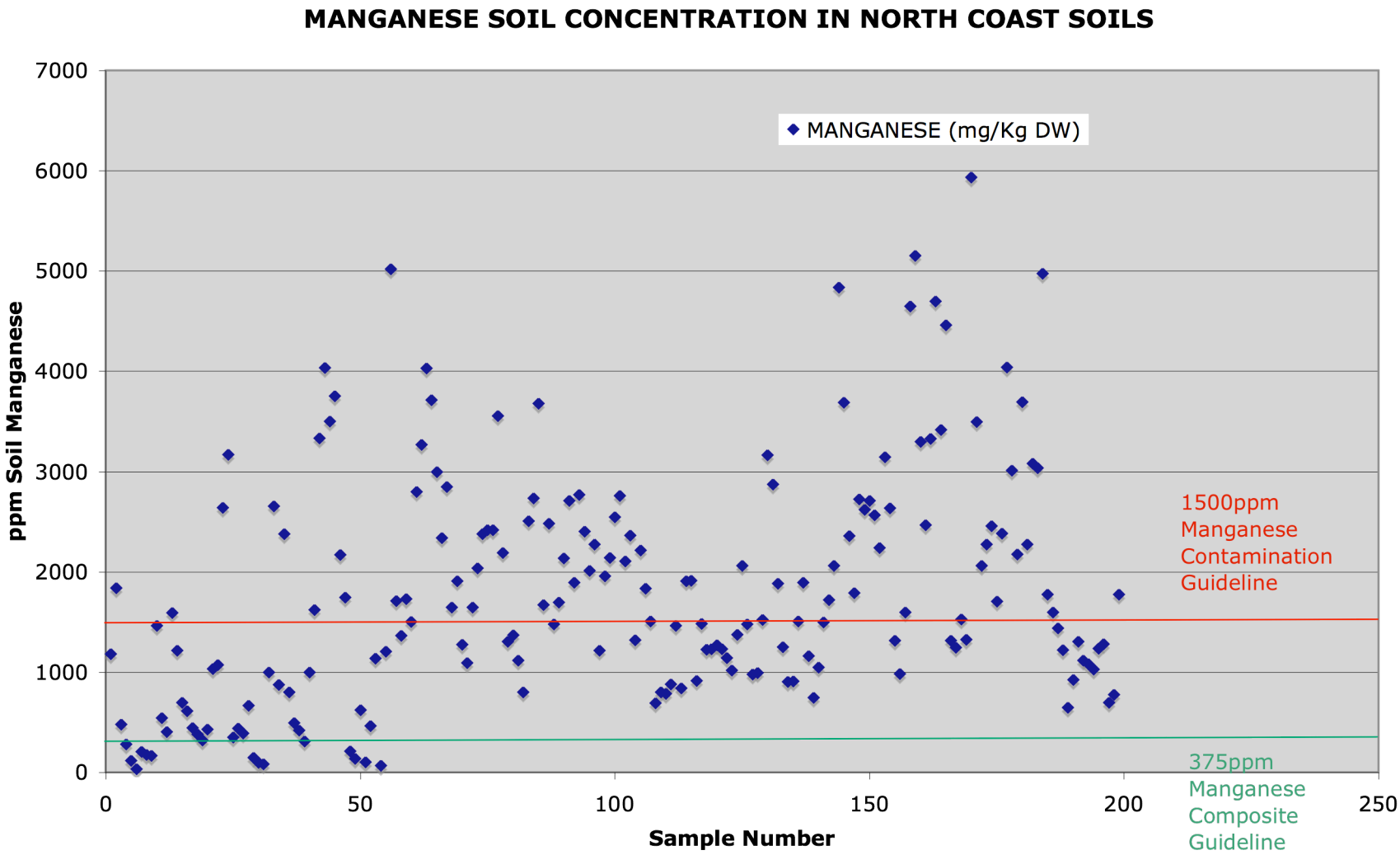


Figure 2- Graphical presentation of Chromium Soil Results

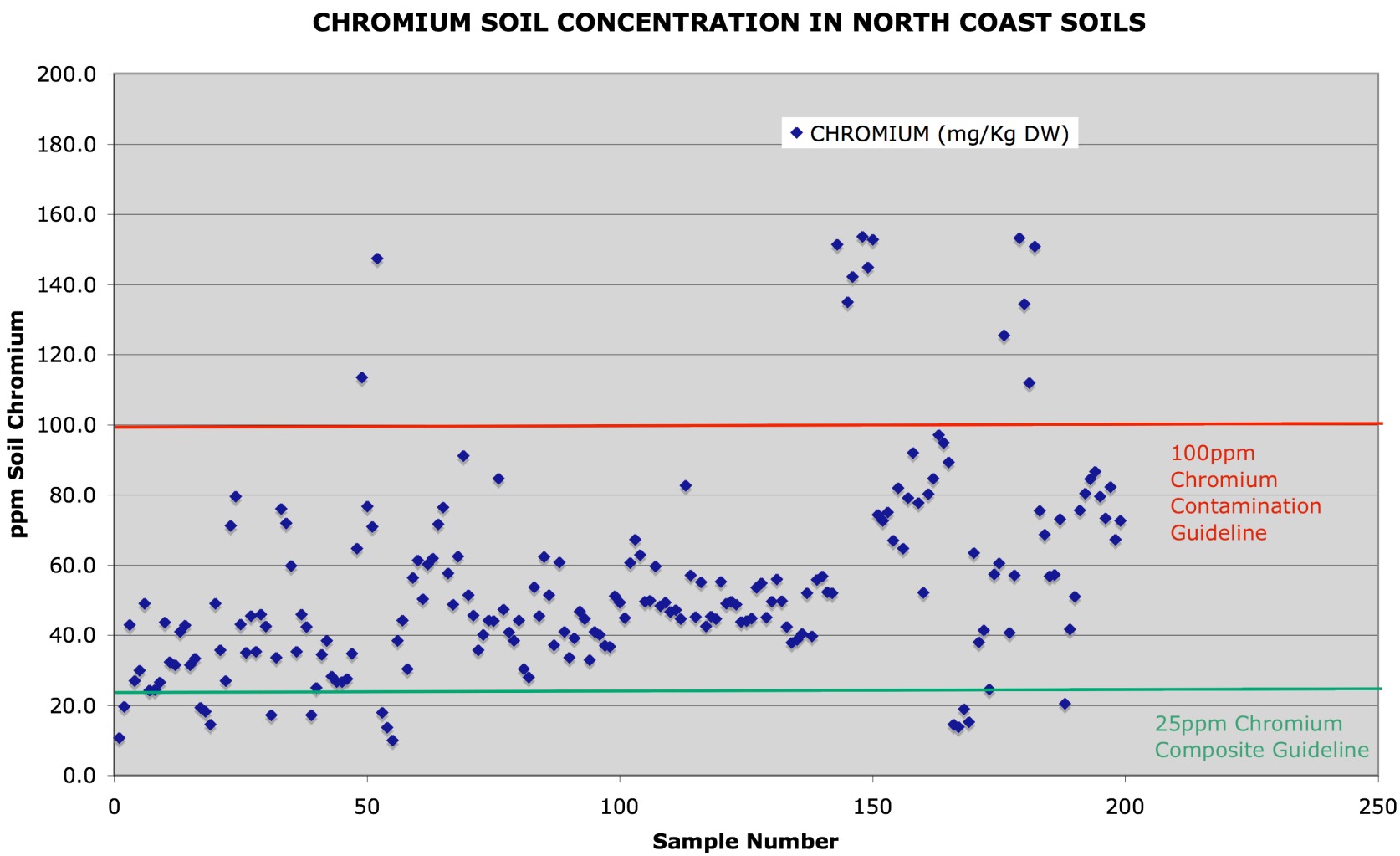


Figure 3- Relationship between Iron and Manganese in North Coast Soils

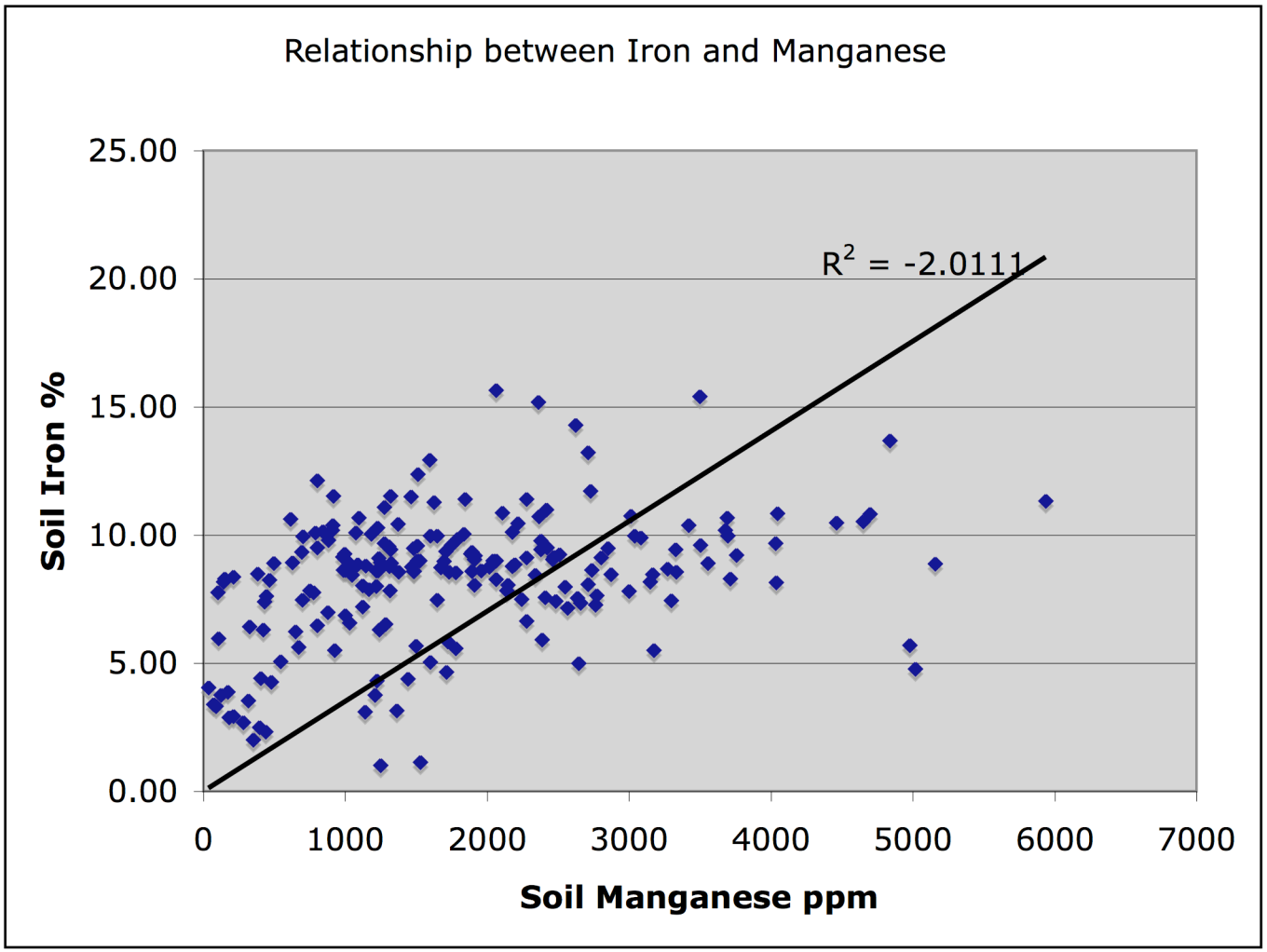
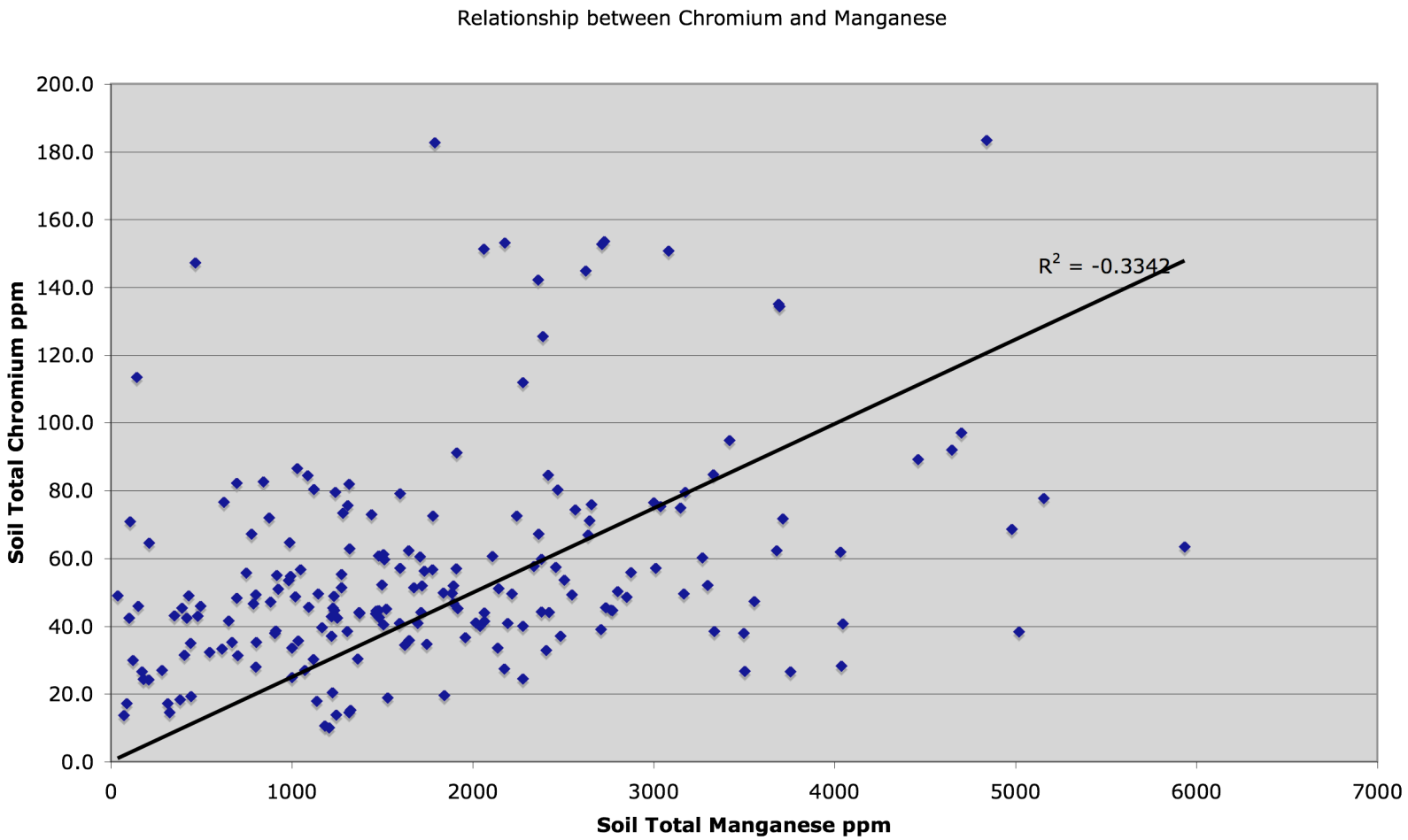


Figure 4- Relationship between Chromium and Manganese in North Coast Soils



5.0 DISCUSSION

The assessment of Mn and Cr assessment in North Coast soils has been conducted on a random 200 composite soil samples, which is equivalent to 800 individual soils. This number of soils is considered representative of North Coast and for the assessment of average metal concentrations.

The results of the soil analyses were compared with Column 1 of the NSW EPA (1998) '*Contaminated Sites – Guidelines for the NSW Site Auditor Scheme'*. Column 1 presented Human - Based Investigation Levels (HBIL) for developments being 'residential with gardens and accessible soil'. The guidelines are also typically modified by dividing them by the number of samples that make up the composite sample (ie. typically the guideline divided by four).

The average Mn in the 800 soils is 1800ppm Mn with a standard deviation of 1162ppm (refer Figure 1). These levels are 'naturally' well above the guideline level of 1500ppm or 375ppm Mn for composite samples(ie. 92% of the 200 composite soils analysed exceed the 375ppm guideline). Table 3 provides the average Mn in basalt rock at 1700ppm Mn. Basalt is the bedrock mineral for the formation of most North Coast soils. The Mn ranges from 37 to 5934ppm in the soils analysed and hence an explanation for the elevated Mn in some soils is required.

The physical features of Mn oxides and hydroxides, such as small size of crystals and large surface area has important geochemical implications. Mn^{2+} is known to replace the sites of some divalent cations (Fe^{2+}, Mg^{2+}) in silicates and oxides. Also, during weathering Mn compounds are oxidised and the released Mn oxides are reprecipitated and readily concentrated in the form of secondary Mn minerals (Alina Kabata-Pendias, 1985). Both of these processes account for the accumulation of Mn at various sites on the North Coast. Higher Mn levels are often reported in soils rich in iron and/or organic matter, which is also characteristic of North Coast soils (refer Figure 3). Mn is detected in the field by the presence of small, hard, characteristically dark-coloured nodules and identified by a vigorous effervescence with hydrogen peroxide.

The average total Cr in the 800 soils is 56ppm Cr with a standard deviation of 32ppm (refer Figure 2). These levels are 'naturally' well above the composite guideline level of 25ppm Cr (ie. 91% of the 200 composite soils analysed exceed the 25ppm guideline). The Cr ranges from 10 to 183ppm in the soils analysed. No data is available for hexavalent Cr (Cr (VI)) in North Coast soils but this valiancy of Cr is expected to show much lower concentrations than total Cr. The guidelines do relate to the Cr (VI) hence total Cr analysis is a 'worst case' scenario for contamination. Accumulation of total Cr in soils can occur with similar reasons to above but to a far lesser extent. A relationship between Mn and Cr is evident (refer to Figure 4).

The background levels of metals analysed, obtained from ANZECC and NHMRC (1992) Table 3 "Environmental Soil Quality Guidelines" page 40, state that background levels of Mn range from 4 – 12,600ppm and total Cr from 0.5 – 110ppm. This large range for background Mn and Cr in soils further confirms the results obtained for naturally elevated Mn and Cr in North Coast soils.

The Mn and Cr in North Coast soils are considered to be tightly bound to the clays and organic matter, which typically have very high cation exchange. The soils of the North Coast are typically acidic and hence lithiophorite $(Al,Li)MnO_2(OH)_2$ is the most likely Mn mineral present in the soils (Alina Kabata-Pendias, 1985). Human health impacts from total Mn and Cr have not been clearly identified and if this was considered an issue, than a very large percentage of the North Coast including all towns and residential areas would need to be assessed and investigated. Human health effects from Mn are historically from breathing airborne particles of Mn ores during mining ores such as pyrolusite, MnO_2, and causing acute respiratory disease and a severe chronic neurotoxicity ("manganism") (Crosby, 1998). Manganism also resulted from drinking water that contained 16-18ppm of dissolved Mn.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The average Mn in the 800 soils is 1800ppm Mn with a standard deviation of 1162ppm. These levels are 'naturally' well above the guideline level of 1500ppm or 375ppm Mn for composite samples. The average Cr in the 800 soils is 56ppm Cr with a standard deviation of 32ppm. These levels are 'naturally' well above the composite guideline level of 25ppm Cr.

The background levels of metals analysed, obtained from ANZECC and NHMRC (1992) Table 3 "Environmental Soil Quality Guidelines" page 40, state that background levels of Mn range from 4 – 12,600ppm and total Cr from 0.5 – 110ppm. This large range for background Mn and Cr in soils further confirms the results obtained for naturally elevated Mn and Cr in North Coast soils.

All Mn and Cr analysis results in North Coast soils need to be disregarded unless an identifiable source of Mn or Cr soil contamination has been identified. The Contaminated Land Management Act 1997 clearly identifies contamination as 'above the concentration at which the substance is normally present in, on or under land in the same locality' and hence confirming that the elevated naturally occurring Mn and Cr concentrations in North Coast soils is not identified as 'contamination' and hence does not warrant further investigation or remediation.

The Mn and Cr in North Coast soils are considered to be tightly bound to the clays and organic matter which typically have very high cation exchange. Human health impacts from total Mn and Cr have not been clearly identified and if this was considered an issue, than a very large percentage of the North Coast including all towns and residential areas would need to be assessed and investigated.

7.0 REFERENCES

Alina Kabata-Pendias, (1985). *Trace Elements in Soils and Plants*. CRC Press, Florida, USA.

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NSW EPA (1994). *Service Station Guidelines for Sensitive Landuse – Soils*

NSW EPA (1995). *Contaminated Sites – Sampling Design Guidelines*. NSW EPA, Chatswood, 35p.

NSW EPA (1997) *Guidelines for Consultants Reporting Contaminated Sites.* NSW EPA, Chatswood, 22p.

NSW EPA (1998) *Contaminated Sites – Guidelines for the NSW Site Auditor Scheme.* NSW EPA, Sydney South, 57p.

Summary of Experience and Qualifications.

The Environmental Analysis Laboratory, which is part of Southern Cross University, consists of a large range of analysts, chemists, environmental managers and scientists. The qualifications, held by the persons of the company, include:

- Doctorate of Applied Science (Environmental Management)
- Bachelor of Applied Science (Coastal Management)
- Honours in Applied Science
- Diploma in Chemistry

We have a wide range of experience and worked on a number of varied projects, which include:

- Contamination Assessment Reports for Residential, Industrial and Commercial Sites
- Acid Sulfate soil assessment and management
- Petrochemical assessment and rehabilitation
- Analysis and Rehabilitation of dipsites
- Assessment of former banana plantations
- Assessment of disposal and reuse of Biosolids
- Assessment of general agricultural and residential sites.

Southern Cross University has the following Public/ Professional Liability:

UNIMUTUAL
Agent: ANZU MUTUAL ASSOCIATION LTD
Certificate of Entry No: UL SCU 06

DISCLAIMER

The Environmental Analysis Laboratory (EAL) as part of Southern Cross University has conducted work concerning the environmental status of the property, which is the subject of this report, and has prepared this report on the basis of that assessment.

The work was conducted, and the report has been prepared, in response to specific instructions from the client or a representative of the client to whom this report is addressed, within the time and budgetary requirements of the client, and in reliance on certain data and information made available to EAL. The analysis, evaluations, opinions and conclusions presented in this report are based on that information, and they could change if the information is in fact inaccurate or incomplete.

EAL has made no allowance to update this report and has not taken into account events occurring after the time its assessment was conducted.

This report is intended for the sole use of the client and only for the purpose for which it was prepared. Any representation contained in the report is made only to the client unless otherwise noted in the report. Any third party who relies on this report or on any representation contained in it does so at their own risk.

EXHIBIT 1: RAW DATA