Golder Associates (NZ) Ltd

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20 September 2007 077813078 / 08

Broadfield Estate Ltd.
20 Bealey Avenue
PO Box 25 028
Christchurch

Attention: David Hobbs

Dear David

86A EDWARD STREET, LINCOLN: ADDITIONAL CONTAMINATION ASSESSMENT

Introduction

Golder Associates NZ Limited (Golder) undertook an initial ground investigation at the above site in July 2007 (Ref 077813078) in order assess the potential presence of contamination associated with former land use activities. The investigation was completed to ensure that soil quality on site was suitable for a proposed residential sub-division and provision of the investigation report was conditional to the sub-division consent approval process.

Based on historical records, the site was formerly used as an orchard and in order to assess the impact of this previous use (specifically, relating to the use of pesticide sprays used during this period), a series of composite samples were collected from each paddock across the site. The laboratory results of composite samples collected during this initial investigation indicated elevated heavy metal contamination within six former paddocks which exceeded the proposed land use criteria. Specifically lead, arsenic and copper concentrations were recorded as follows:

- Elevated Copper in Paddock 7, 13, 15, 16, 17 & 18
- Elevated Lead in Paddock 18
- Elevated arsenic in Paddock 14

The elevated concentrations were recorded in composite samples, each comprising five discrete sub-samples. The relevant guideline used when composite sampling is subsequently adjusted to compensate for each of the sub-samples potentially having all of the contamination present within a single sub-sample location. In this instance, in order to evaluate the composite data the relevant guideline value was divided by five – relating to the number of sub-samples in each composite. Therefore, although the composite sampling results provided useful average concentrations within a paddock, the composite adjusted guidelines identified areas of elevated heavy metal contamination in excess of the proposed land use criteria.

In light of the original results, a series of additional discrete samples were proposed by Golder in order to corroborate or invalidate the initial composite result findings.

The discrete sampling was undertaken at site on the morning of 4th of September 2007. A total of 35 discrete grab samples were taken from the six paddocks (7, 13, 14, 15, 16, 17 & 18). A total of five discrete samples were collected from each paddock. As per the methodology employed in Golder's initial investigation, and in accordance with Ministry for Environment (MfE) guidelines for investigating former orchard sites, the surface samples were taken using a plastic trowel, to a typical depth of 0.0-0.3m below ground level (bgl). It is recognised that the nominal depth for residential soil pathways is between 0.0-0.15 however, the depth of the sample collection zone was modified to accommodate soil disturbance associated with the fruit tree removal and ripping of the ground. In this instance the 0.0-0.3m bgl sample range is considered more appropriate. The samples were placed in laboratory grade containers (approximately 0.25 litre capacity) and transferred to Hill Laboratories in Hamilton under chain of custody conditions.

The location of the sampling points is illustrated on the enclosed plan, Figure 1.

Soil Laboratory Test Results and Data Assessment

The laboratory results are enclosed and a summary of each category is presented in Table 1 to Table 3 below. Each result is compared to the relevant residential land use guideline value cited in Golders initial report.

Table 1: Laboratory analysis of Copper in soils

Sample	Value (mg/kg)	Residential Soil Criteria[1] (mg/kg)	Passed
PAD007/01	42	130	Y
PAD007/02	45	130	Y
PAD007/03	53	130	Y
PAD007/04	13	130	Y
PAD007/05	18	130	Y
PAD013/01	46	130	Y
PAD013/02	42	130	Y
PAD013/03	35	130	Y
PAD013/04	29	130	Y
PAD013/05	39	130	Y
PAD015/01	51	130	Y
PAD015/02	44	130	Y
PAD015/03	57	130	Y
PAD015/04	38	130	Y
PAD015/05	35	130	Y
PAD016/01	73	130	Y
PAD016/02	10	130	Y
PAD016/03	47	130	Y
PAD016/04	45	130	Y
PAD016/05	73	130	Y
PAD017/01	6	130	Y
PAD017/02	6	130	Y
PAD017/03	7	130	Y
PAD017/04	6	130	Y
PAD017/05	6	130	Y
PAD018/01	78	130	Y
PAD018/02	68	130	Y
PAD018/03	44	130	Y
PAD018/04	74	130	Y

Sample	Value (mg/kg)	Residential Soil Criteria[1] (mg/kg)	Passed
PAD018/05	41	130	Y

[1] New Zealand Timber Treatment Guidelines MfE 1997

The discrete sample laboratory results presented above for additional sampling across the site indicate that copper concentrations are below the relevant land use guideline value of 130mg/kg. This indicates that copper concentrations in the composite adjusted samples are more indicative of average concentrations across the site.

Table 2: Laboratory analysis of Arsenic in soils

Sample	Value (mg/kg)	Guideline value[1] (mg/kg)	Passed
PAD014/01	5	30	Y
PAD014/02	5	30	Y
PAD014/03	4	30	Y
PAD014/04	4	30	Y
PAD014/05	4	30	Y

[1] New Zealand Timber Treatment Guidelines MfE 1997

The discrete sample laboratory results above indicate that all samples collected from Paddock 14 were below the relevant land use guideline value of 30mg/kg. This indicates that arsenic concentrations in the composite adjusted samples are more indicative of average concentrations across the paddock.

Table 3: Laboratory analysis of Lead in soils

Sample	Value (mg/kg)	Original Guideline value[1] (mg/kg)	Appropriate Guideline Value[1] (mg/kg)	Passed
PAD018/01	51	300	600	Y
PAD018/02	149	300	600	Y
PAD018/03	179	300	600	Y
PAD018/04	103	300	600	Y
PAD018/05	**644**	**300**	**600**	**N**

[1] Australian National Environment Protection Measure

It is apparent from the above information that a single sample taken from Paddock 18 (PAD018/05), exceeded the guideline value of 300mg/kg, as used in Golder's initial report. Paddock 18 is located in the north-east of the site and the sample was taken in the south-west of the paddock, adjacent to the access road and surface water pond, as illustrated in Figure 1. The contamination encountered is thought to relate to an isolated hot-spot of contamination rather than being indicative of the entire paddock. In this regard, it should be noted that the average of the five samples taken (data representing the whole paddock) is 225.2mg/kg, which falls below the 300mg/kg threshold.

The guideline value of 300mg/kg for residential land use, assumes 10% produce consumption for future site users. However, given that this particular area of the site (Paddock 18) is not proposed for residential redevelopment this exposure pathway (produce consumption) will not be present. Rather, it is understood that this area is to remain undeveloped, as open space, as per Figure 2 enclosed. As such, this guideline value is considered inappropriate. On the assumption that this area is not redeveloped for residential use, it is considered that a guideline reflective of the proposed land use in this area should be adopted. In consideration of the open space land use, the guideline developed by the USA Environment Protection Agency (EPA) for Parks and Recreational land of **600mg/kg** can be used to assess the suitability of the land.

Using this more appropriate guideline, it is apparent that although the aforementioned sample remains above the recommended guideline value, the exceedance is marginal (7% above the guideline).

Conclusion and Recommendations

In light of the additional sampling and laboratory analysis undertaken at 86 Edward Street, as part of the Broadfield Estate Ltd. redevelopment, it is the opinion of Golder that copper and arsenic concentrations initially identified at the site are below the residential land use criteria. In reflection, although required to comply with Ministry for the Environment contaminated land assessment guidelines, the comparison of composite adjusted land use criteria to the initial results was overly conservative and the composite values appear to have provided an accurate indication of the average concentration across a given paddock. It is therefore the opinion of Golder that no further work is required at the site in this regard and the area of proposed residential development can proceed without representing a risk to future site users.

Based on the laboratory analysis of discrete samples collected from paddock 18, an isolated hot-spot of lead contamination is located in the north-east of the site. This related to a single sample taken from the south-west corner of the paddock adjacent to the access road and a surface pond. This hot-spot is not identified to be within the proposed residential subdivision, rather within an area of development which is remaining as open space reserve.

The elevated lead contamination is not considered to be indicative of the entire paddock as four of the five discrete samples taken from Paddock 18 recorded lead concentrations below the adopted guideline of parkland recreational land use value of 600mg/kg. It should also be noted that this sample was taken from an area of known imported material and as such is not indicative of natural material at the site. It is therefore possible that the elevated lead represents an anomalous reading from within the imported material.

Based on the laboratory data available, in order to manage the identified elevated lead contamination, it is considered by Golder that there are two viable options as follows:

1. It may be possible to include a condition in the sub-division consent, distinguishing the portion of the site which has been identified as unsuitable for residential land use (10 % produce consumption) , in order to ensure that the land remains as open space. With this option a site management plan would be attached to the Land Information Memorandum which ensures that soil is managed appropriately when disturbed or removed.

2. Should Broadfield Estates Ltd. wish to remove all restrictions from the site it may be necessary to delineate the vertical and horizontal extent of the lead contamination identified. A sequence of additional sample locations separated at regular intervals from the known contamination hot-spot will indicate the extent of this contamination, and provide sufficient information for the consideration of remediation options.

It is recommended that Broadfield Estates Ltd. seek council approval of the preferred option prior to any further work.

Closure

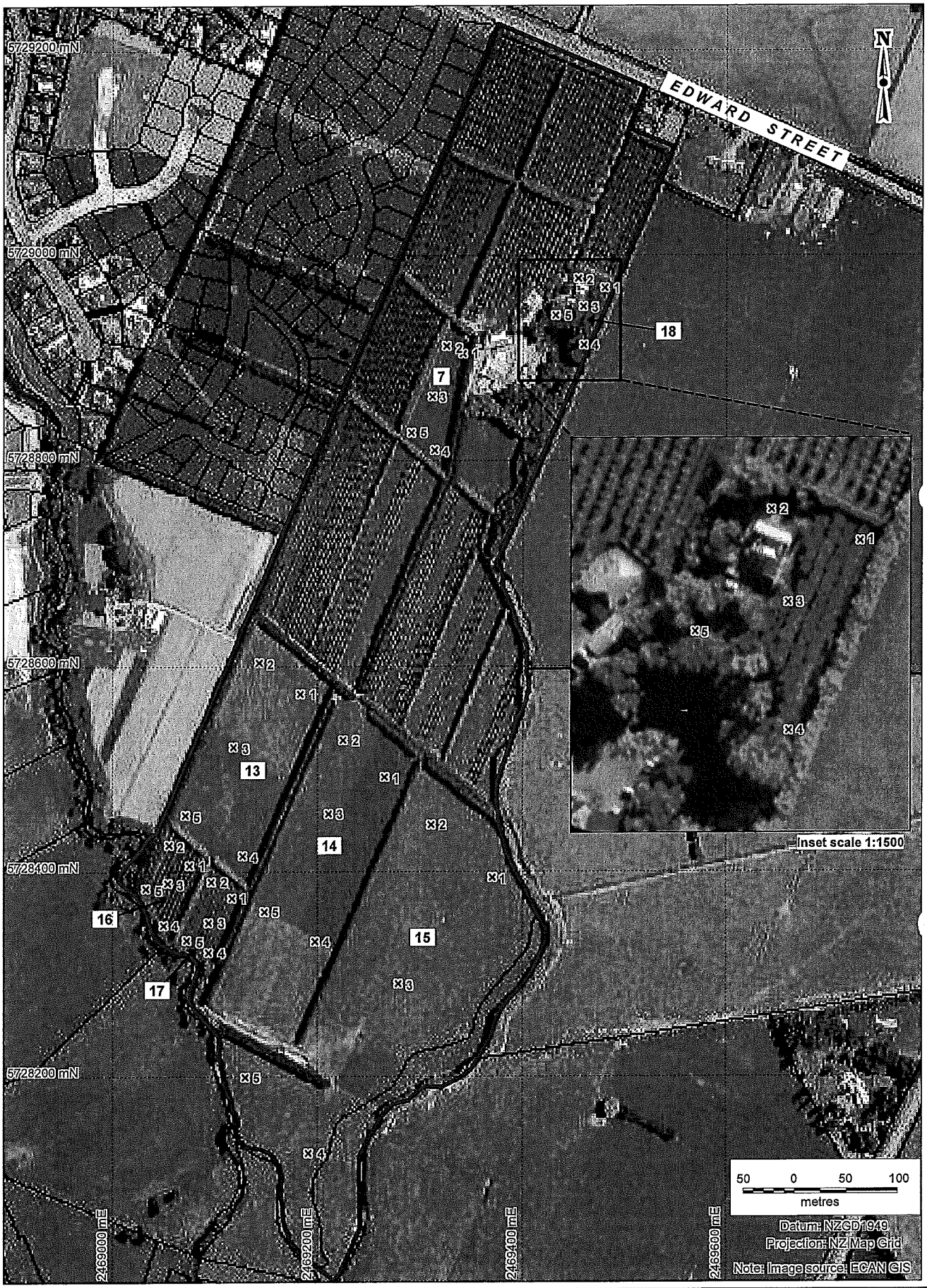
If you have any questions regarding the information discussed, please don not hesitate to contact us.

Yours sincerely,
GOLDER ASSOCIATES (NZ) LTD.

Philip Johnson
Environmental Consultant

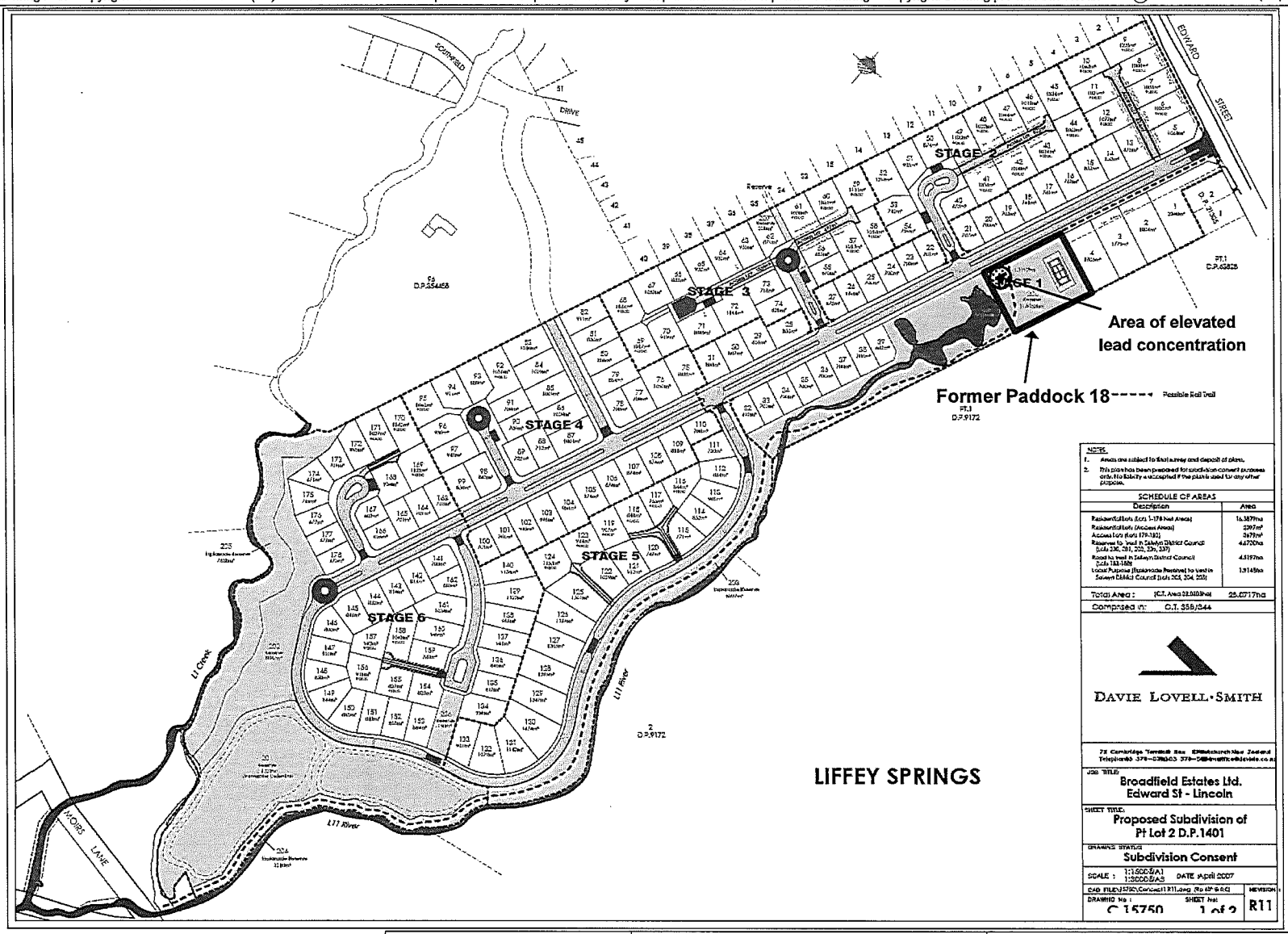
Brendon Love
Principal Environmental Consultant.

Encl. Hill Laboratories Test Certificate
Figure 1 – Additional Sample location points
Figure 2 – Proposed Development



Golder Associates	CLIENT: Broadfield Estates Ltd		PROJECT: Additional Contamination Assessment 86A Edward Street, Lincoln Canterbury			
	DRAWN: MCD	DATE: September 2007				
	CHECKED: pdj	DATE: 20/09/07	TITLE: ADDITIONAL SAMPLE LOCATION POINTS			
	SCALE: 1:5000 A4	FILE: AddSamples.wor	PROJECT No: 077813078	REPORT No: L077813078/09	VERSION No: 1	FIGURE No: 1

File location: S:\2007Jobs\077813078_Broadfield_Estates_ContamAss_Edward_St_Lin\2_Tech_Info\MapInfo\AddSamples.wor



NOTE:
Proposed Development plan from
Davie Lovell-Smith, Drawing No. C.15750
Concept R11.dwg R11, April 2007

Golder Associates

CLIENT: Broadfield Estates Ltd		PROJECT: Additional Contamination Assessment 86A Edward Street, Lincoln Canterbury	
DRAWN: MCD	DATE: September 2007		
CHECKED: pdj	DATE: 20/09/07	TITLE: PROPOSED DEVELOPMENT	
SCALE: NTS A4	FILE: L09_PropDevt.wor	PROJECT No: 077813078	REPORT No: L077813078/09 VERSION No: 1 FIGURE No: 2

File location: S:\2007Jobs\077813078_Broadfield_Estates_ContamAss_Edward_St_Lin\2_Tech_Info\\...\L09_PropDevt.wor

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Contact: Philip Johnson

Laboratory No: 462777
Date Registered: 5/09/2007
Date Completed: 11/09/2007
Page Number: 1 of 3

Job No.
GOLDER ASSOCIATES (NZ) LTD.
17 SEP 2007
Level 1, 79 Cambridge Terrace
Christchurch
PM

Client's Reference: 077813078

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Soil

Sample Name	Lab No	Total Recoverable Arsenic (mg/kg dry wt)
PAD014/01 04/09/07	462777/31	5
PAD014/02 04/09/07	462777/32	5
PAD014/03 04/09/07	462777/33	4
PAD014/04 04/09/07	462777/34	4
PAD014/05 04/09/07	462777/35	4

Sample Type: Environmental Solids, Soil

Sample Name	Lab No	Total Recoverable Copper (mg/kg dry wt)
PAD007/01 04/09/07	462777/1	42
PAD007/02 04/09/07	462777/2	45
PAD007/03 04/09/07	462777/3	53
PAD007/04 04/09/07	462777/4	13
PAD007/05 04/09/07	462777/5	18
PAD013/01 04/09/07	462777/6	46
PAD013/02 04/09/07	462777/7	42
PAD013/03 04/09/07	462777/8	35
PAD013/04 04/09/07	462777/9	29
PAD013/05 04/09/07	462777/10	39
PAD017/01 04/09/07	462777/11	51
PAD017/02 04/09/07	462777/12	44
PAD017/03 04/09/07	462777/13	57
PAD017/04 04/09/07	462777/14	38
PAD017/05 04/09/07	462777/15	35
PAD018/01 04/09/07	462777/16	73
PAD018/02 04/09/07	462777/17	10
PAD018/03 04/09/07	462777/18	47

Sample Name	Lab No	Total Recoverable Copper (mg/kg dry wt)
PAD018/04 04/09/07	462777/19	45
PAD018/05 04/09/07	462777/20	73
PAD015/01 04/09/07	462777/21	6
PAD015/02 04/09/07	462777/22	6
PAD015/03 04/09/07	462777/23	7
PAD015/04 04/09/07	462777/24	6
PAD015/05 04/09/07	462777/25	6
PAD016/01 04/09/07	462777/26	78
PAD016/02 04/09/07	462777/27	68
PAD016/03 04/09/07	462777/28	44
PAD016/04 04/09/07	462777/29	74
PAD016/05 04/09/07	462777/30	41

Sample Type: Environmental Solids, Soil

Sample Name	Lab No	Total Recoverable Lead (mg/kg dry wt)
PAD018/01 04/09/07	462777/16	51.0
PAD018/02 04/09/07	462777/17	149
PAD018/03 04/09/07	462777/18	179
PAD018/04 04/09/07	462777/19	103
PAD018/05 04/09/07	462777/20	644

Sample Containers

The following table shows the sample containers that were associated with this job.

Container Description	Container Size (mL)	Number of Containers
Plastic Jar (Soils)	400	35

Details of sample bottle preparation procedures are available upon request.

Summary of Methods Used and Detection Limits

The following table(s) gives a brief description of the methods used to conduct the analyses for this job.
The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Substance Type: Environmental Solids

Parameter	Method Used	Detection Limit
Dry and sieve sample	Air dry (35 °C), sieved to pass 2mm.	N/A
Total Recoverable digest	Nitric / hydrochloric acid digestion. US EPA 200.2	N/A
Total Recoverable Arsenic	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Copper	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Lead	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.4 mg/kg dry wt

Analyst's Comments:

These samples were collected by yourselves and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the submitter.

Terry Cooney MSc (Hons), PhD, MNZIC
Technical Consultant

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental Division