Annexure E
Detailed Site Investigations

This Annexure is submitted as a separate report

Detailed site investigation of 19 River Road, Palmers Island, New South Wales.

Report No 50212

Report to Mr Paul Reid

February 2003

Environmental & Earth Sciences Pty Ltd

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5 February 2003

Mr Paul Reid
19 River Road
Palmers Island NSW 2463

Attention: Mr Paul Reid

Dear Paul

Re: Detailed site investigation of 19 River Road, Palmers Island, NSW

Environmental & Earth Sciences Pty Ltd are pleased to present two copies of our report *Detailed site investigation of 19 River Road, Palmers Island, NSW.*

Since at least 1966 the site has been used for the cultivation of sugar cane. Soil samples analysed for organic compounds found trace concentrations of dieldrin, well below guideline levels, in several surface samples. All other samples analysed for organochlorine pesticides and total petroleum hydrocarbons contained non detectable concentration. All samples analysed for heavy metals are considered to be representative of background concentrations and did not exceed relevant guideline levels.

Based upon the findings of this investigation, with regard to soil and groundwater contamination from organochlorine pesticides (OCP), total petroleum hydrocarbons (TPH) and heavy metals, the site can be considered as suitable for the proposed residential subdivision.

Thank you for the opportunity to undertake this study. Should you have any further questions regarding the report please do not hesitate to call the undersigned on (02) 6687 4650.

Yours sincerely
Environmental & Earth Sciences Pty Ltd

pp. Hugh McCaffery
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1.0 INTRODUCTION

Environmental & Earth Sciences Pty Ltd were commissioned by Mr Paul Reid to undertake a detailed site investigation (DSI) of 19 River Road, Palmers Island, New South Wales. The study area is the river frontage of a 33.6 hectare sugar cane farm. This area, approximately 9.9 hectares, comprised sugar cane fields, a house and shed where residential allotments are proposed.

As the site consists of land used for sugar cane farming, there is a potential for contamination from herbicides and pesticides associated with agricultural cultivation. An investigation was undertaken of the soil, at and below the site surface, to determine the potential for offsite migration of contaminants and to identify areas of gross contamination.

A historical investigation, soil sampling and laboratory analyses were performed as part of this study. Professional judgement was used to extrapolate between inspected areas and sampling locations, however even under ideal circumstances actual conditions may vary from those inferred to exist. The actual interface between materials and variation of soil quality may be more abrupt or gradual than the report indicates.

Environmental & Earth Sciences Pty Ltd is not responsible for variations due to alterations of site conditions or chemistry since the time of inspection, for example through illegal dumping.

The inspection was undertaken in accordance with a Stage 2 environmental site investigation, which is stated in the NSW EPA (1997) *Contaminated sites: guidelines for consultants reporting on contaminated sites* (Reference 8).

This report has been produced in accordance with an agreed scope of work (Environmental & Earth Sciences' proposal PO50227 dated 14 November 2002) for, and is the property of, Mr Paul Reid. The investigation was conducted as per written confirmation to conduct the work from Mr Paul Reid received 26 November 2002.

2.0 OBJECTIVES

It is understood that the 9.9 hectare study area, where residential allotments are proposed, requires an environmental assessment as a guide to the risk of liability for any potential contaminated site remediation. The objective of this report was to assess the potential for previous and/or current site activities to have impacted the site soils and/or groundwater.

The aim was achieved through undertaking an historical investigation, site inspection, field sampling and laboratory soil analysis in order to estimate the area and extent of possible contamination caused by site activities past or present. The work undertaken to achieve the above objective is presented in the following sections.

3.0 SITE CHARACTERISTICS

3.1 Location and property description

The site is located along River Road, Palmers Island, local government area of Maclean Shire Council, New South Wales. The study area, covering approximately 9.9 hectares, is located on the banks of the Clarence River, the western portion of the 33.6 hectare property. The study area is nearly level, has a westerly aspect and is bisected by a shallow drain and access track that runs east west. For the purposes of legal identification the property is known as Lot 2 DP 186236, Lot 22 DP 632 068, Lot 35 DP 661175, in the County of Clarence, Parish of Taloumbi, New South Wales.

The regional location of the site is shown in Figure 1.

3.2 Geology, hydrogeology, topography and soil

The local geology of the property has been described in the Woodburn 1:100 000 *Geological series sheet 9539* (Reference 3) as Quarternary aged undifferentiated alluvial plain consisting of sand, silt, clay and gravel deposits that includes beach, levee and back swamp deposits, point bars, overbank and some residual and colluvial deposits.

These Quarternary deposits are underlain by Triassic-Jurassic Ripley Road sandstone, Triassic Evans Head coal measures and the Silurian Neranliegh-Fernvale Group which comprises greywacke, slate, phyllite and quartzite (Reference 3).

The topography of the region in the vicinity of the site comprises an extensive (10 000 to 15 000 metre wide) level to very gently inclined deltaic plain. Elevation ranges from one to three metres above mean sea level. Slopes are generally 0 to 3 percent. The landscape is distinguished by numerous channels, creating an island network within the estuary. On Palmers Island, the migrating Micalo Channel/Oyster Channel drainage system has exploited the alluvium-sand mass boundary and consequent erosion has brought marine sediments close to the surface (Reference 6).

The soils observed on this site are topographically related to and incorporate soils classified in the *Soil Landscapes of the Woodburn 1:100 000 series sheet* report (Reference 6) as belonging to the Palmers Island soil landscape. A soil landscape is an area of land that has recognisable and specifiable topographies and soils.

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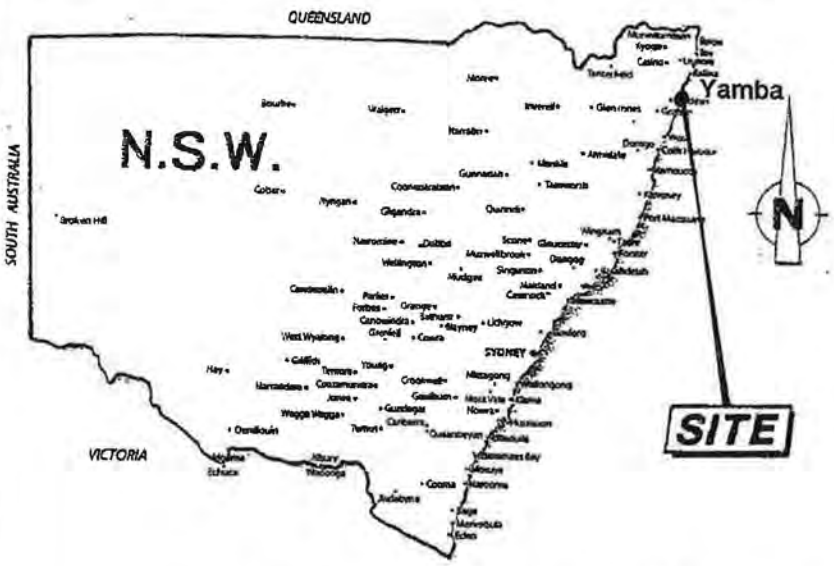
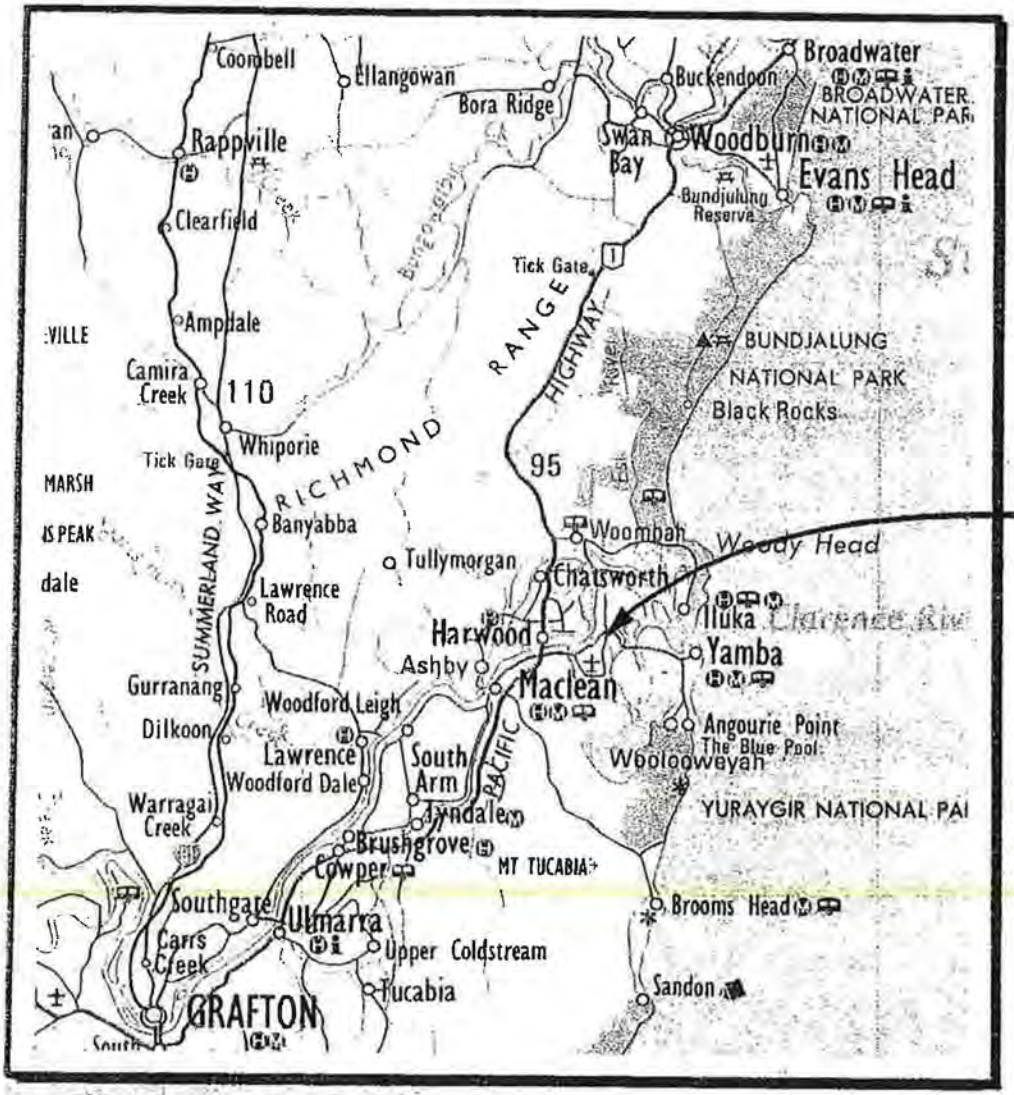


Site Location: YAMBA, NSW



Client:	Mr. P Reid		
Title:	Locality Plan	Drawn: TJ	Fig. 1
		Project Manager: HMc	
Location:	19 River Road, Palmers Island, NSW	Approved:	Date: Jan.03

Job No. 50212 Date drawn: 13/01/03

The Palmers Island soil landscape is a combination of alluvium overlying marine sediments, a pattern that varies little across the landscape, although the thickness of alluvium does. The soils generally consist of 10 to 50 millimetres deep, brown structured alluvial clays overlying brown massive clays 20 to 50 millimetres in depth. These alluvial clays of the A and B horizon are underlain by grey clayey sands with distinct orange mottling and saturated grey clayey sands containing potential acid sulfate soil. Generally, these soils are poorly drained, presenting a localised flood hazard, are strongly acid, sodic/dispersive and erodable with low wet bearing strength at field capacity. Subsoils are are hardsetting with high acid sulfate potential and low permiability (Reference 6).

3.3 Vegetation and drainage

Most of the original vegetation in this region has been extensively cleared, and replaced by sugar cane cultivation. *Setaria* sp. dominate grazing areas not used for sugar cane. *Casuarina glauca* (swamp oak) forms isolated stands throughout the landscape (Reference 6).

Drainage in the region is alluvial, slowly migrating, reticulated and integrated and has been modified by a network of artificial drains (Reference 6). The Yamba 1:25 000 topographic map shows that run-off from the site migrates topographically in a southerly and northerly direction to a shallow east /west oriented surface drain that bisects the site. Runoff and drainage from this drain migrates in an easterly direction to another drain that flows in a north easterly direction into Romiaka Channel which discharges into the Clarence River Estuary opposite the Iluka township (Reference 12).

3.4 Site history

The site history was gained by reviewing the following information:

— past aerial photographs;
— the section 149 zoning certificate provided by Maclean Shire Council;
— NSW DLWC acid sulfate soil risk map;
— groundwater bore data search; and
— a NSW EPA search from Land and Property Information NSW.

3.4.1 Aerial photograph investigation

As part of the historical survey, four aerial photographs of the area were studied from the period 1966 to 1998. A list of the photographs used in this study is presented in Table 1.

TABLE 1

AERIAL PHOTOGRAPHS

Year	Run	Map No	Series
1966	4M	1442	Woodburn
1971	7	1956	Woodburn
1989	7	3654	Woodburn
1998	12	4450	Woodburn

The 1966 aerial photograph showed the Clarence River flowed in a south north direction adjacent to the western boundary of the site. The site was extensively cleared of native vegetation, having been replaced by sugar cane cultivation. A shallow drain with an east west orientation bisected the site, connected to a larger drainage network to the east.

A house and shed was located on the western boundary, on the northern side of the shallow drain. A house and several sheds were located on the southwestern boundary. The site was surrounded by sugar cane cultivation on Palmers Island and across the Clarence River.

Two buildings were located across River Road, adjacent to the northwestern boundary of the site, on the Clarence River frontage. Four houses were located on the northern side of a paddock, north of Yamba Road. Numerous houses and sheds were observed north and south of the site along the river frontage.

The 1971 aerial photograph showed no change on the site and only minor changes regionally from the 1966 photograph. Several cabins had been erected on the land adjacent to the northwestern boundary of the site, on the Clarence River frontage. Six houses were now located on the northern side of the paddock, north of Yamba Road. A large, cleared area of bare soil could be observed on the opposite bank of the Clarence River, south west of the site.

The 1989 photograph indicated that the house and shed located on the western boundary, on the northern side of the shallow drain remained. A house and shed had been erected on the

northwestern boundary of the site. Two sheds north of the house located on the southwestern boundary had been removed.

The site's landuse was still dominated by sugar cane cultivation. Onsite drains were similar in orientation and shape to previous aerial photographs, although they had been straightened and made regular in shape.

More cabins had been erected on the land adjacent to the north western boundary of the site, on the Clarence River frontage. Several large additional trees could also be observed on this land. Numerous houses were now located around the paddock, north of Yamba Road. Several large sheds had been constructed on the large, cleared area on the opposite bank of the Clarence River, south west of the site, observed in the 1971 photograph.

Areas to the east, southeast and west of the investigation area appeared to have been converted to pasture consistent with cattle grazing.

No changes had occurred to the investigation site between 1989 and 1998, excepting that the house and shed located on the western boundary, on the northern side of the shallow drain had been removed. More large trees could also be observed on the land adjacent to the north western boundary of the site, on the Clarence River frontage. Numerous houses were located around the paddock, north of Yamba Road.

In summary, the site was used for sugar cane cultivation from between 1966 and 1998. A house and shed had been erected on the northwestern boundary of the site between 1971 and 1989. A house and shed located on the western boundary, on the northern side of the shallow drain had been removed between 1989 and 1998.

3.4.2 Review of environmental planning certificate

An application was made to Maclean Shire Council for the provisions of a Section 149 certificate to the Environmental Planning & Assessment Act 1979. Part (F)of the Certificate identifies the site as being flood liable and as being identified bushfire prone land. The site is also identified as potentially containing acid sulfate soils

Part (G) of the Certificate identified the site as not being subject to a current voluntary agreement, site audit statement, declaration, or order for investigation or remediation issue under the *Contaminated Land Management ACT 1997* as notified by the EPA.

3.4.3 Review of acid sulfate soil risk map

The Department of Land and Water Conservation (1997) Acid Sulfate Soil Risk Map of Yamba Sheet identifies the site as being within a high risk acid sulfate soil (ASS) Class where potential acid sufate soils can occur at a depth of between one and three metres (Reference 5).

3.4.4 Review of land and property information certificates

An Environment Protection Authority (NSW EPA) Unhealthy Building Land Act 1990 certificate for the site, was supplied by the client. No statutory notices have been issued under the provisions of either the Environmentally Hazardous Chemicals Act 1985 or the Unhealthy Building Land Act 1990 for the subject land.

3.4.5 Review of groundwater bore search

A groundwater bore search conducted by the Department of Land & Water Conservation found that six registered groundwater bores are located within a six kilometre radius of the site. These groundwater bores are privately owned and are used for domestic and stock purposes.

Two of the groundwater bores are located east of the project site, across Romiaka and Oyster Channels, in Yamba. No drillers logs, water bearing zone, standing water level or salinity data was supplied in the work summaries of these bores.

The other four groundwater bores were located south west of the project site. Groundwater bore GW301178 was approximately four kilometres southwest of the project site. The bore was drilled to a depth of 42 metres, had a standing water level of seven metres, a yield of 0.38 Litres per second (L/s) and its salinity was described as good. The geology of the borehole was described as topsoil to 0.3 metres, underlain by 5.7 metres of yellow clay to six metres, underlain by 36 metres of yellow to grey sandstone to 42 metres in depth. GW063628 and GW065734 were a further kilometre south west and south of GW301178 respectively. GW063628 was drilled to a depth of 37 metres through two metres of clay, underlain by 35 metres of sandstone and 19 metres of coal with salinity at 0-500ppm. GW301178 was 24 metres in depth, consisting of one metre topsoil underlain by 23 metres of sandstone with a standing water level of eleven metres and a yield of 1.14 L/s.

GW301181 was located approximately 5.8 kilometres south west of the site, was drilled to a depth of 33 metres, had a standing water level of 21 metres, a yield of 0.76 L/s, the water bearing zone was four metres thick and occurred at a depth of between 27 and 31 metres in cracky black shale. The geology of the borehole was described as topsoil to 0.3 metres, underlain by 2.7 metres of grey clay to six metres, underlain by 23 metres of grey mudstone, one metre of shale, four metres of cracky black shale and two metres of black shale to 33 metres in depth. The salinity of water yielded was described as good.

3.5 Potential for contamination

Following the study of historical information it was concluded that the potential for residual contamination of the site is restricted to sugar cane cultivation activities. The client indicated that dieldrin had not been used on the plantation for at least 20 years. As a consequence these soils have the potential to contain concentrations of organochlorine pesticides at the surface which may persist in the soil for a considerable amount of time.

Previous Environmental & Earth Sciences experience with former market garden and orchard sites has indicated consistently that while chlorinated hydrocarbons are present in the surface soil of such areas, concentrations are not a concern to site users and sediment migration is minimal to non-existent on minor slopes and/or stable soils such as those observed in this region.

It is unlikely that potential contamination from more recently used organophosphates and carbamates would be a problem, as they degrade quickly in the soil and residues are often undetectable within a year.

Contamination on agricultural land can be associated with intensive agriculture or animal treatment enclosures such as yards, dips and dairies. No evidence of infrastructure that would be associated with any dip site location was observed on aerial photographs of the site.

Where buildings, hard stands or dumps for surface and buried rubbish have been existent in the past, a minor potential exists for hydrocarbon and heavy metal contamination. The construction materials indicate a minor potential for localised heavy metals impact on site soils, usually as a result of runoff from galvanised iron roofing. No potential for hydrocarbon contamination could be detected from past activities as revealed in the aerial photographs. It is unlikely that residual organochlorine pesticides used as termiticides under any concrete slabs would be a problem, as concentrations in the soil are often minimal to non-detectable.

Minor soil redistribution has been undertaken on the property and at the time of the investigation there were small areas of mixed natural soil material around the shed, constructed in the north west of the site. As this material appeared to be natural soil material sourced from the site. Potential for contaminated material brought from offsite sources is low.

There was no evidence of imported fill material being used on the site, apart from the track that ran adjacent to the shallow drain that bisected the site. This track appeared to be derived from local soil material. Therefore the presence of chemicals, such as heavy metals, total petroleum hydrocarbons (TPH), organochlorine pesticides (OCPs), phenols and/or polycyclic aromatic hydrocarbons (PAHs), in such material is minimal.

In summary, potential contamination sources on Site were considered to be limited to organochlorine pesticides (OCPs) associated with sugar cane cultivation and localised metals around buildings. The site inspection will aim to further elucidate these potential sources of contamination.

4.0 FIELD INVESTIGATION

The field investigation was undertaken on 17 December 2002 and consisted of a site inspection utilising information gained in the historical survey and discussions with the owner Mr Paul Reid. Site features at the time of the investigation are presented in Figure 2.

4.1 Site inspection

At the time of the investigation, the study area comprised a cultivated field divided by a shallow drain oriented east west covered by a juvenile crop of soy beans and a house and shed in the north western corner. The site was approximately 9.9 hectares, part of a 33.6 hectare sugar cane farm and had a north south orientation.

A house with an attached garage and large galvanised iron machinery shed were located on the north western corner of the site. The house was constructed of brick and tile and was in good condition. The shed, used to store farm machinery and equipment, was constructed of galvanised iron and was in good condition. An above ground storage tank (AST), 4 000 litres in volume and used to store diesel fuel, was located outside the southern side of the shed. Minor oil staining was observed around the front of the AST. The shed was raised above ground level by what appeared to be locally derived fill material.

The investigation area was surrounded to the north, south and east by sugar cane plantations, while the western boundary consisted of River Road and the Clarence River. A house and shed were located adjacent to the south western corner of the site.

Vegetation throughout the site was noted to be healthy with no visible signs of stress. Trees and shrubs were scattered across the site, with remnant pockets of shrubs, trees and herbs occupying the north and north eastern sides of the house. Both native (such as eucalyptus and casuarina) and introduced species (such as camphor laurel and privet) were present.

No drums, wastes, imported fill materials or unusual odours were observed or smelt within the investigation area. The site is adjacent to the Clarence River, no other locally sensitive environments such wetlands or faunal habitat was observed within or close to the investigation area. No surficial rubbish was observed on site.

Drainage across the site would migrate topographically in a southerly and northerly direction towards the shallow drain that bisected the site.

Although there was evidence of fill material on site, this appeared to be locally derived natural soil material that had been used to level the area on which the plantations' machinery shed was located. A small access track next to the shallow drain that bisected the site was consolidated by what appeared to be locally derived natural soil material.

4.2 Sampling locations

A total of 107 surface soil sampling (SS2 to SS107) and three borehole locations (BH1, BH53 and BH106) were sampled across the site (Figure 2). Sampling design was based on NSW EPA's *Contaminated sites: sampling design guidelines* (1995) and was conducted using a grid basis. In addition, judgemental sample selection, based upon the location of potential contamination sources (e.g. above ground storage tanks and drains), was also undertaken.

Samples were collected using surface soil sampling techniques. During the inspection, soil description, texture and pH were recorded at each sampling location and are presented in Appendix A of this report. Sampling techniques conform with Environmental & Earth Sciences' *Soil, gas and groundwater sampling manual* and the quality assurance and quality control (QA/QC) procedures outlined in Appendix C of this report.

Due to the large number of samples collected, soil samples were composited to allow economical laboratory analysis. Four individual soil samples were used to form each composite. Soils used to make each composite set all contained similar textural characteristics and were taken from the same soil horizon. Composited samples are listed in Table 2. The sampling procedure conformed to the NSW EPA's *Contaminated sites: sampling design guidelines* (1995).

TABLE 2

COMPOSITED SAMPLES

CS1	CS2	CS3	CS4	CS5
BH1 (0-0.1m)	SS2	SS3	SS4	SS5
SS10	SS9	SS8	SS7	SS6
SS11	SS12	SS13	SS14	SS15
SS20	SS19	SS18	SS17	SS16
CS6	**CS7**	**CS8**	**CS9**	**CS10**
SS21	SS23	SS25	SS31	SS32
SS22	SS24	SS26	SS40	SS39
SS29	SS27	SS35	SS41	SS42
SS30	SS28	SS36	SS50	SS49
CS11	**CS12**	**CS13**	**CS14**	**CS15**
SS33	SS34	SS46	SS60	SS59
SS38	SS37	SS55	SS61	SS62
SS43	SS44	SS56	SS70	SS69
SS48	SS47	SS65	SS71	SS72
CS16	**CS17**	**CS18**	**CS19**	**CS20**
SS58	SS57	SS79	SS74	SS75
SS63	SS64	SS80	SS77	SS76
SS68	SS67	SS81	SS84	SS85
SS73	SS74	SS82	SS87	SS86
CS21	**CS22**	**CS23**	**CS24**	**CS25**
SS91	SS92	SS83	SS94	SS95
SS100	SS99	SS88	SS97	SS96
SS101	SS102	SS93	SS104	SS105
SS110	SS109	SS98	SS107	BH 106 (0-0.1m)

Notes:

m	depth in metres
CS	composite samples
SS	individual samples used to form composite samples

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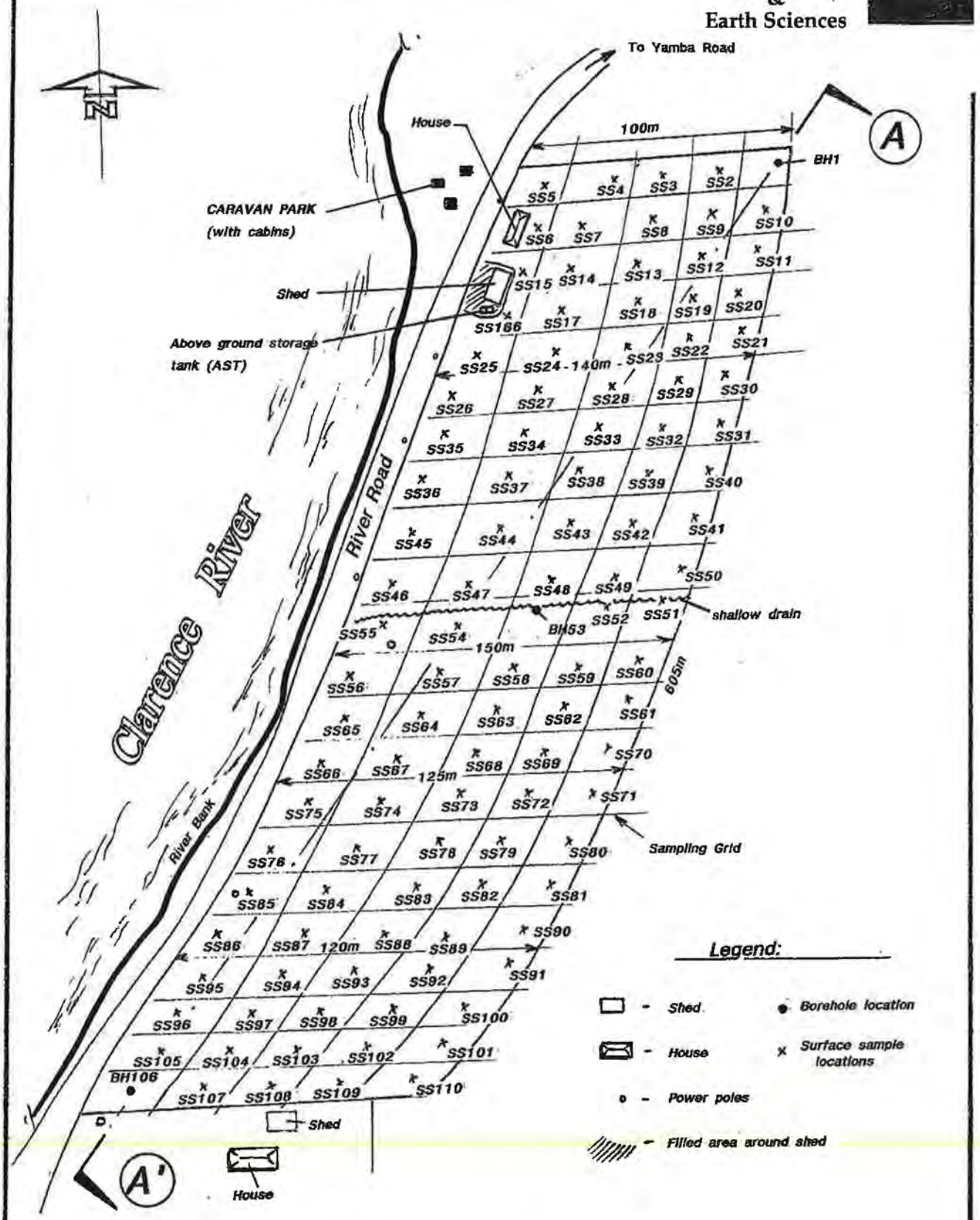


Site Features & Sampling Locations

(Schematic)

Investigation Area = 10ha

Sugar cane plantation

Client:	Mr. P Reid		
Title:	Site Features & Sampling Locations	Drawn: TJ Project Manager: HMc	Fig. 2
Location:	19 River Road, Palmers Island, NSW	Approved:	Date: Jan.03

Job No. 50212 Date 15/07/03 Fig Revised. 16/1/03 Rev. 5/2/03

5.0 STRATIGRAPHY

The natural soils across the site consisted of a layer of brown silty clay, 0.3 metres in depth at boreholes BH1 and BH53 and 0.9 metres in depth at BH106. This brown silty clay was underlain by dark brown medium clay with brown/orange mottles, 0.7 metres in depth at borehole BH1, 0.6 metres in depth at borehole BH53 and 1.2 metres in depth at borehole BH106.

The dark brown medium clay with brown/orange mottles, was underlain by grey sandy clay with brown/orange mottles at a depth of 0.7 metres at borehole BH1, 1.0 metres in depth at borehole BH53 and 1.5 metres at borehole BH106. The grey sandy clay with brown/orange mottles was underlain by grey medium sand with brown/orange mottles at a depth of 1.2 metres at borehole BH1, 1.4 metres in depth at borehole BH53 and 1.7 metres at borehole BH106.

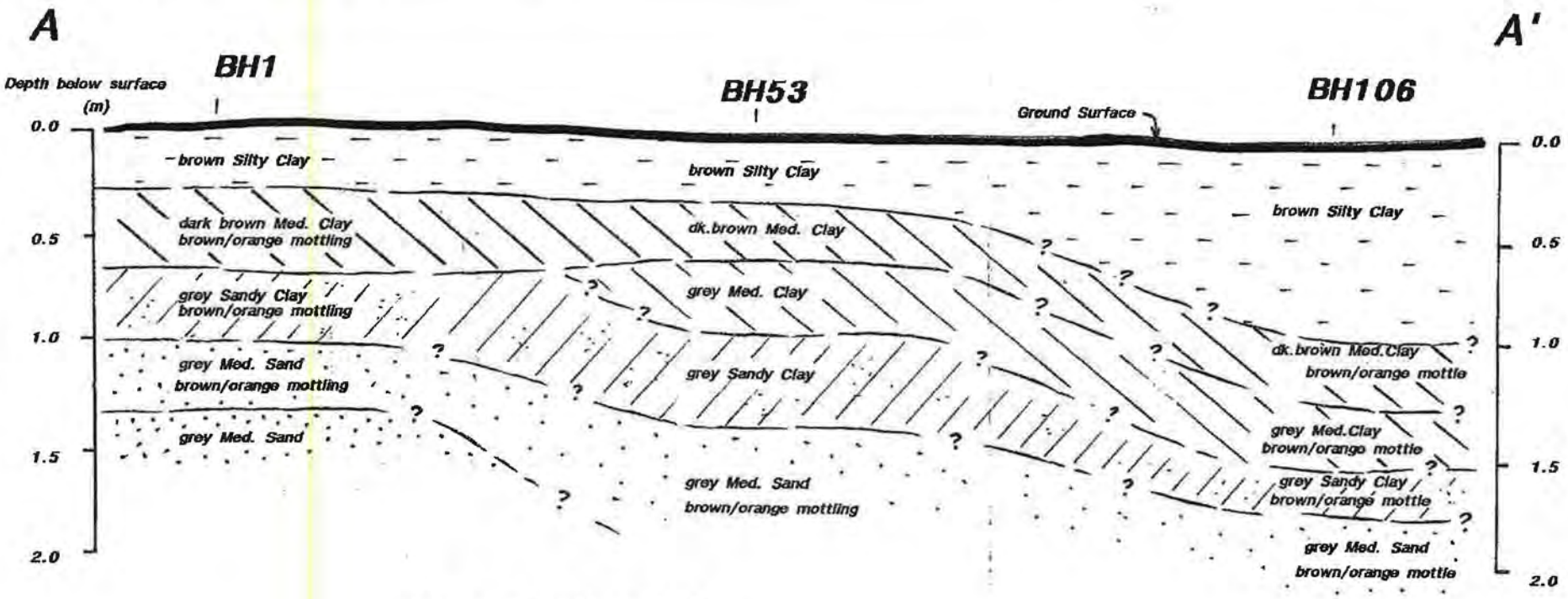
Borehole BH1 was drilled to a depth of 1.4 metres in wet medium grey sand, borehole BH53 was drilled to a depth of 1.8 metres in wet grey medium sand with brown/orange mottles and borehole BH106 to a depth of 2.0 metres in wet grey medium sand with brown/orange mottles. No groundwater was encountered in these boreholes.

This soil profile over the site was similar to the soil stratigraphies described in the Soil Landscapes of the Woodburn 1:100 000 series sheet report as belonging to the Palmers Island soil landscape. This report identifies the grey sandy clay with brown/orange mottles as containing potential acid sulfate soils (PASS).

The pH of the brown silty clay across the site ranged from pH 4 to pH 4.5. The dark brown medium clay had a pH of pH 4.5. The grey sandy clay with brown/orange mottles had a pH ranging between pH 6 and pH 6.5 and without brown/orange mottles had a pH of pH 4.5. The pH of the grey medium sand with brown/orange mottles was pH 4.5 to pH 5.5 and without brown/orange mottles had a pH of pH 4.5.

A stratigraphic cross-section of the site is presented in Figure 3, the transect of the cross-sections can be seen in Figure 2. Borehole logs showing site stratigraphy and soil characteristics are presented as Appendix A.

Job No. 5012 Date 5/2/03 TMJ



Cross-Section A-A'

Inferred Stratigraphy

See Figure 2 for location of section.

Note: Vertically Exaggerated.

Client:	Mr.P Reid		
Title: Cross-Section A-A'		Drawn: TJ	Fig. 3
Location: 19 River Road, Palmers Island,NSW		Project Manager: HMc	
		Approved:	Date: Jan.03

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6.0 APPLICATION OF RELEVANT GUIDELINES

Environmental & Earth Sciences Pty Ltd refer to the NSW EPA (1998) *Contaminated sites: guidelines for the NSW site auditor scheme* (Reference 9) as the recommended guidelines for contaminant level thresholds, sample selection and site coverage.

The health-based soil investigation levels presented in the NSW EPA (1998) *Contaminated sites: guidelines for the NSW site auditor scheme* are based on the National Environmental Health Forum (NEHF) (1998) *Health-based soil investigation levels* (Reference 3). These investigation levels are derived from toxicity of substances and estimated exposure of humans to the soil. As the site is to be subdivided into rural residential allotments, concentrations listed in Column A of Table 1 in that publication are most applicable. These are reproduced in Table 3 in this document.

In accordance with the NEPC (Reference 7) the data collected in an environmental site assessment are statistically assessed as follows:

— comparison of the arithmetic mean of sampled soil populations to the adopted site criteria;
— comparison of the standard deviation of the sampled populations to 50% of the site criteria; and
— evaluating whether any sample results exceed the site criteria by 250%.

If all these conditions are met, for all chemicals tested, the site is considered suitable for its current or proposed land-use.

The provisional phytotoxicity based investigation levels presented in the NSW EPA (1998) *Contaminated sites: guidelines for the NSW site auditor scheme* are derived from the values supplied in ANZECC (1992) *Australian and New Zealand guidelines for the assessment and management of contaminated sites* (Reference 1).

Table 2 of the ANZECC (1992) guidelines presents criteria for heavy metals and is considered inappropriate for the final determination of ecological risk (and groundwater protection). These criteria, although widely adopted, are based on total metal concentrations in the soil, which bears little relevance to the protection of groundwater, vegetation and soil fauna. Several recent studies (references 2 and 11) have recognised that the contaminants present in the soil solution, a measure of the portion available to biota, is a more reliable indicator of the threat to the environment than total metal concentrations. Thus, the provisional phytotoxicity

guideline values presented in the NSW EPA (1998) guidelines and derived from the ANZECC (1992) guidelines are not directly applicable to this site. Phytotoxicity is considered better assessed visually and chemically on a site-specific basis.

As groundwater was not encountered during this investigation, application of groundwater guidelines are not presented.

TABLE 3

NATIONAL ENVIRONMENTAL HEALTH FORUM HEALTH-BASED SOIL INVESTIGATION LEVELS (1998)

SUBSTANCE	Health-based Soil Investigation Levels (mg/kg)					
Exposure Settings	**A**	**B[a]**	**C[a]**	**D**	**E**	**F**
Aldrin + Dieldrin	10			40	20	50
Arsenic (total)	100			400	200	500
Benzo (a) pyrene	1			4	2	5
Beryllium	20			80	40	100
Boron	3 000			12 000	6 000	15 000
Cadmium	20			80	40	100
Chlordane	50			200	100	250
Chromium (III)	12%			48%	24%	60%
Chromium (VI)	100			400	200	500
Cobalt	100			700	200	500
Copper	1 000			4 000	2 000	5 000
Cyanides (complexed)	500			2 000	1 000	2 500
DDT+DDD+DDE	200			800	400	1 000
Heptachlor	10			40	20	50
Lead	300			1 200	600	1 500
Manganese	1 500			6 000	3 000	7 500
Methyl mercury	10			40	20	50
Mercury (inorganic)	15			60	30	75
Nickel	600			2 400	600	3 000
Total PAH	20			80	40	100
PCBs (total)	10			40	20	50
Phenol	8 500			34 000	17 000	42 500
TPH >C_{16}-C_{35} aromatics	90			360	180	450
TPH >C_{16}-C_{35} aliphatics	5 600			22 400	11 200	28 000
TPH >C_{35}	56 000			224 000	112 000	280 000
Zinc	7 000			28 000	14 000	35 000

Exposure Settings:

A. 'Standard' residential with garden/accessible soil (less than 10% intake of home grown produce; no poultry): this category includes children's day-care, pre-schools etc.

B. Residential with substantial vegetable garden (contributing up to 50% of vegetable and fruit intake) and poultry providing all dietary egg intake and 25% poultry meat intake.

C. Residential with substantial vegetable garden (contributing up to 50% of vegetable and fruit intake); poultry excluded.

D. Residential with minimal opportunities for soil access includes high-rise apartments and flats.

E. Parks, recreational open space and playing fields: includes secondary schools.

F. Commercial/Industrial: includes premises such as shops and offices as well as factories and industrial sites. (If, however, a commercial site is also used for residential purposes or regular soil access by children if possible then the appropriate 'residential' setting should be used.) It is assumed that thirty years is the duration of exposure.

[a] Site and contaminant specific

7.0 LABORATORY ANALYSIS

A total of 107 surface samples and 15 soil samples from three boreholes were collected during the field investigation. Twenty two selected composited samples and six discrete samples were analysed for either organic or inorganic compounds. The organic analysis was carried out at Australian Government Analytical Laboratories (AGAL), whilst the inorganic analysis was undertaken at Sydney Analytical Laboratories (SAL). The results and laboratory transcripts are presented in Appendix C.

A discussion on quality assurance and quality control is given in Appendix D of this report. Laboratory duplicates and surrogate recoveries were conducted as part of the analysis, these results are presented in Appendix C.

7.1 Tests undertaken

Organic analysis was undertaken on selected soil samples for organochlorine pesticides (OCPs) and total petroleum hydrocarbons (TPH). The selection of the samples for OCP analysis was to allow adequate coverage across the site including areas (ie. drainage lines) where sediment runoff could accumulate. Analysis for OCPs was undertaken on discrete samples, selected from areas near drainage lines, and composite samples selected from across the site. The selection of samples for TPH analysis was to target the AST.

Inorganic analysis undertaken on the soil samples included the following metals: copper, lead, zinc, cadmium, chromium, nickel, arsenic and mercury. The basis for selection of samples for inorganic analysis was to allow adequate coverage across the site and to target areas of concern.

7.2 Laboratory results

The laboratory results are presented in Tables 4, 5 and 6 and in Appendix C.

TABLE 4

SOIL ORGANIC RESULTS – ORGANOCHLORINE PESTICIDES

Sample I D	EQL[a]	CS1	CS3	CS8	CS9	CS11	CS13	CS14	CS16	Guidelines
Depth (m)		**0-0.1**	**0-0.1**	**0-0.1**	**0-0.1**	**0-0.1**	**0-0.1**	**0-0.1**	**0-0.1**	
BHC (total)	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Lindane	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Aldrin	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Dieldrin	0.005	<0.01	<0.01	<0.01	<0.01	0.011	<0.01	0.012	<0.01	-
Heptachlor	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.5[a]/10[b]
Heptachlor Epoxide	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
DDD	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
DDE	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
DDT	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Total Endosulfan	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Endrin	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Chlordane	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	12.5[a]/50[b]
Methoxychlor	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
HCB	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Aldrin+Dieldrin	-	ND	ND	ND	ND	0.011	ND	0.012	ND	2.5[a]/10[b]
DDD+DDE+DDT	-	ND	ND	ND	ND	ND	ND	ND	ND	50[a]/200[b]

Notes:

1. all results expressed in mg/kg (ppm) on a dry weight basis
2. EQL Estimated Quantitation Limit
3. ND not detected above EQL
4. CS composite sample
5. SS individual surface sample
6. guideline levels taken from NEHF (1998) Column A for 'Standard' residential landuse. Human health investigation threshold criteria only. Does not consider environmental, aesthetic or leachability issues
7. [a] guideline levels are divided by the number of individual samples used to form the composite sample, in this case four (4).
8. [b] guideline level for an individual sample

TABLE 4 (CONT)

SOIL ORGANIC RESULTS — ORGANOCHLORINE PESTICIDES

Sample ID	EQL[a]	CS21	CS23	CS25	SS51	SS52	BH53	SS54	Guidelines
Depth (m)		0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	
BHC (total)	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Lindane	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Aldrin	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Dieldrin	0.005	<0.01	<0.01	<0.01	0.011	0.013	<0.01	<0.01	-
Heptachlor	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.5[a]/10[b]
Heptachlor Epoxide	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
DDD	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
DDE	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
DDT	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Total Endosulfan	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Endrin	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Chlordane	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	12.5[a]/50[b]
Methoxychlor	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
HCB	0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Aldrin+Dieldrin	-	ND	ND	ND	0.011	0.013	ND	0.012	2.5[a]/10[b]
DDD+DDE+DDT	-	ND	ND	ND	ND	ND	ND	ND	50[a]/200[b]

Notes:

1. all results expressed in mg/kg (ppm) on a dry weight basis
2. EQL Estimated Quantitation Limit
3. ND not detected above EQL
4. CS composite sample
5. SS individual surface sample
6. guideline levels taken from NEHF (1998) Column A for 'Standard' residential landuse. Human health investigation threshold criteria only. Does not consider environmental, aesthetic or leachability issues
7. [a] guideline levels are divided by the number of individual samples used to form the composite sample, in this case four (4).
8. [b] guideline level for an individual sample

TABLE 5

ORGANIC LABORATORY RESULTS – TPH

Borehole	EQL	SS16	NEHF Guidelines
Depth (m)		**0.1-0.2**	
TPH			
C_6-C_9	25	<25	65[a]
C_{10}-C_{14}	50	<50	
C_{15}-C_{28}	100	<100	TPH C_{10}-C_{40}[a]
C_{29}-C_{36}	100	<100	
Total TPH (C_{10}-C_{36})		ND	1000[a]

Notes:

1. all results expressed in mg/kg (ppm) on a dry weight basis
2. - no individual value
3. EQL Estimated Quantitation Limit
4. Guideline levels taken from NEHF column A for 'Standard' residential – these are based on human health investigation threshold criteria only and do not consider environmental, aesthetic or leachability issues
5. [a] Guideline levels for sensitive land use taken from NSW EPA *Guidelines for assessing service station sites* (1994)
6. ND not detected above EQL

TABLE 6

INORGANIC LABORATORY RESULTS - HEAVY METALS

Borehole	EQL	CS2	CS4	CS5	CS6	CS10	CS12	Guidelines
Depth (m)		0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	
Copper	0.5	17	15	20	15	15	16	1 000
Lead	0.5	17	18	27	19	20	18	300
Zinc	0.5	57	56	67	54	56	53	7 000
Cadmium	0.5	-	-	<0.5	-	-	-	20
Chromium	0.5	-	-	15	-	-	-	100
Nickel	0.5	-	-	6.0	-	-	-	600
Arsenic	0.5	-	-	5.0	-	-	-	100
Mercury	0.005	-	-	0.090	-	-	-	15

Borehole	EQL	CS15	CS18	CS19	CS20	CS24	SS67	Guidelines
Depth (m)		0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	0-0.1	
Copper	0.5	15	15	15	23	17	10	1 000
Lead	0.5	20	20	21	10	22	19	300
Zinc	0.5	59	59	58	50	74	51	7 000
Cadmium	0.5	<0.5	-	-	<0.5	-	-	20
Chromium	0.5	16	-	-	15	-	-	100
Nickel	0.5	10	-	-	8.0	-	-	600
Arsenic	0.5	5.5	-	-	5.0	-	-	100
Mercury	0.005	0.12	-	-	0.12	-	-	15

Notes:

1. results are expressed in mg/kg (ppm) dry weight
2. – denotes not analysed
3. EQL = Estimated Quantitation Limit
4. guideline values taken from NEHF (1998) *Health-based soil investigation levels*, column A for residential landuse
5. shading indicates exceedence of guideline levels
6. for composite samples, guideline value must be divided by the number of component samples (see Table 3)

8.0 DISCUSSION

Historical information gathered indicated that the western edge of the property had been utilised for the cultivation of sugar cane since at least 1966. No evidence of major development or imported fill material was observed on site.

All site vegetation appeared healthy and vigorous which suggests that site activities, past or present, have not caused contamination to any soil on site that could cause phyto-toxic effects on plants.

8.1 Organic analysis results

The majority of recorded organochlorine pesticides (OCPs) concentrations were below detection limits. However trace concentrations of dieldrin were detected in surface samples SS51 (0.011 mg/kg) and 52 (0.013 mg/kg) and composite samples CS11 (0.011 mg/kg) and 14 (0.012 mg/kg). These concentrations did not exceed the adjusted site criterion (2.5 mg/kg).

The organic laboratory tests for total petroleum hydrocarbons (TPH) showed that surface sample SS16 did not contain detectable levels of TPH. Even though surface sample SS16 was not stored in a suitable container as specified by the industry standard, the result is still pertinent to this study. It would be expected that if TPH were present in these soils, they would be bound by clay particles within the soils of the sample and that an elevated concentration of TPH would have been detected within the soil sample. Therefore, as TPH was non-detectable in surface sample SS16, it can be deduced that the natural fill material east of the AST has not been impacted by diesel stored in the AST located south of the shed on site.

8.2 Inorganic analysis results

The consistency of results for concentrations of heavy metals in all samples analysed would indicate that these levels are likely to represent background concentrations for these soil types and are well below human health soil investigation levels. Therefore, these results indicate that there is minimal potential for heavy metal contamination at this site.

Based on the organic and inorganic results obtained, there is no human health or environmental concerns associated with OCPs or heavy metals in the soil on this site under 'Standard' residential or any other land use zoning. As the site is classified by the Department

of Land and Water Conservation as being within a high risk acid sulfate soil (ASS) class, there may be the occurrence of potential acid sulfate soils (PASS) at depths of between one and three metres across the site.

9.0 CONCLUSION

The historical review by Environmental & Earth Sciences as part of a DSI of 19 River Road, Palmers Island, NSW indicated that the previous use of the site was principally for sugar cane cultivation. A subsequent field investigation assessed the presence of identified chemicals of concern, namely organochlorine pesticides (OCPs), total petroleum hydrocarbons (TPH) and heavy metals.

The results of the field investigation indicated the following:

- trace concentrations of dieldrin were detected in several surface samples, these elevated concentrations were well below site criterion;
- all other samples analysed for a range of organic compounds contained non-detectable concentrations of organochlorine pesticides (OCP) and total petroleum hydrocarbons (TPH); and
- samples analysed for heavy metals indicate that concentrations are likely to represent background concentrations and do not exceed relevant guideline values. Based on these findings, there is no apparent potential for groundwater to have been impacted by site activities, past or present.

As a result of the historical survey and detailed site study, the property can be considered, with regard to soil and groundwater contamination from organochlorine pesticides (OCP), total petroleum hydrocarbons (TPH) and heavy metals, suitable for the proposed residential subdivision.

10.0 GLOSSARY OF TERMS

The following descriptions are of terms used in reports of this kind. A list of the references used in providing this glossary are presented in Section 8 of this report.

Colluvial — unconsolidated soil and rock material moved downslope by gravity.

Dispersion — The process by which species in solution mix with a second solution, thus reducing in concentration. In particular, relates to the reduction in concentration resulting from the movement of flowing groundwater.

Gradational — the lower boundary between soil layers (horizons) has a gradual transition to the next layer. The solum (soil horizon) becomes gradually more clayey with depth.

Laminite — thinly bedded fine-grained sedimentary rock.

Lithic — Containing large amounts of fragments derived from previously formed rocks.

Mottled — masses, blobs or blotches of sub-dominant colours with varying value/chroma (colour grades) in the soil matrix.

Profile — the solum. This includes the soil A and B horizons and is basically the depth of soil to weathered rock.

Sheet erosion — the removal of surface material from a wide area of gently sloping or graded land by broad continuous sheets of running water rather than by streams.

Swale — A linear level-floored open depression excavated by the wind or formed by the build-up of two adjacent ridges. Typically associated with the depression between two sand dunes.

Texture — is the size of particles in the soil. Texture is divided into six groups, depending on the amount of coarse sand, fine sand, silt and clay in the soil.

11.0 REFERENCES

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4. Imray, P and Langley, A (1998) — *Health-based soil investigation levels,* National Environmental Health Forum monograph series. Soil Series No.1, 2nd Ed.
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11. Sauve, S, Cook, N, Hendershot, W H, and McBride, M. (1996) — *Linking plant tissue concentrations and soil copper pools in urban contaminated soils* Environmental Pollution Vol 94. No 2, pp 153-157.
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APPENDIX A

RELEVANT CLEARANCE CERTIFICATES

Land and Property Information

LAND AND PROPERTY INFORMATION NSW

CENTRAL REGISTER OF RESTRICTIONS

2213U - ENVIRONMENTAL & EARTH SCIENCES

APPLN NO: 142210 ISSUED: 6/12/2002 9:48 AM

YOUR REFERENCE: 2/186236

Certificate

REFERENCE: 2/186236, 22/632068, 35/661178

LGA: MACLEAN

PARISH: TALOUMBI COUNTY: CLARENCE

NO. OF AUTHORITIES INQUIRED OF: 1

THE FOLLOWING AUTHORITIES HAVE A POSSIBLE OR ACTUAL INTEREST IN THIS PROPERTY. YOUR INQUIRY HAS BEEN REFERRED TO THEM FOR DIRECT RESPONSE:

ENVIRONMENT PROTECTION AUTHORITY

REGISTRAR GENERAL

***** END OF CERTIFICATE *****

Hugh McCaffery
Environmental & Earth Sciences
PO Box 380
NORTH SYDNEY

LAND & WATER CONSERVATION

Contact: Lynne Cairns
Phone: (02) 66 402092
Fax: (02) 66 402100
e-mail: lcairns@dlwc.nsw.gov.au

Our Ref: Letter.doc

16 January 2003

Dear Mr McCaffery

Subject: Groundwater Bore Summary Sheets –Palmers Island

A bore search was conducted in the Palmers Island area within a 6 km radius of the required site, grid reference E 527289 N 6745018. Six groundwater works were located as listed below. Please find in the attached the Work Summary Report for each of these groundwater works. A diagram showing the location of these groundwater works is also attached.

GW063628	GW065734	GW301178	GW301181	GW301400	GW301446

Please note that other licensed groundwater works may exist in the area that have not yet been entered into the Department's database. Unlicensed groundwater works may also exist in the area.

A fee of $99 is payable for this search. An invoice for same will be forwarded by post.

If you have any further enquiries please contact Richard Green on 66402120.

Yours sincerely

Lynne Cairns
Resource Information Officer Licensing
Hydrogeology Unit

Date/Time :16-Jan-2003 9:51 AM
User :LASMITH
Report :RMGW001D.QRP
Executable :S:\G5\PROD32\GROUND.EXE
Exe Date :29-Nov-2002
System :Groundwater
Database :Diwcp

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW063628 *Converted From HYDSYS*

License :

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Rotary Air
Owner Type : Private

Authorised Purpose(s)

Intended Purpose(s)
DOMESTIC
STOCK

Commenced Date :
Completion Date :01-Sep-1986

Final Depth : 37.00 m
Drilled Depth : 37.00 m

Contractor Name :
Driller :1504 JACKWITZ, William Douglas

Property :
GWMA :
GW Zone :

Standing Water Level :
Salinity : 0-500 ppm
Yield :

Site Details

Site Chosen By

County
Form A :CLARENCE
Licensed :

Parish
TALOUMBI

Portion/Lot DP
109

Region :30 - NORTH COAST
River Basin :204 - CLARENCE RIVER
Area / District :

CMA Map :9539-3S MACLEAN
Grid Zone :56/2 **Scale :**1:25,000

Elevation :
Elevation Source :(Unknown)

Northing :6740550 **Latitude (S) :**29° 27' 51"
Easting :523085 **Longitude (E) :**153° 14' 17"

GS Map :0006A2 **AMG Zone :**56 **Coordinate Source :**GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	>From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	P.V.C.	0.00	37.00	125			Seated on Bottom
1	1	Opening	Slots - Vertical	19.00	37.00	125		1	SL: 0mm; A: 3mm

Water Bearing Zones

>From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
17.00	18.00	1.00	Consolidated			0.13			0-500 ppm
34.00	35.00	1.00	Consolidated			0.26			0-500 ppm

Drillers Log

>From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments
0.00	2.00	2.00		Clay	
2.00	18.00	16.00	Sandstone Soft Water Supply	Sandstone	
18.00	37.00	19.00	Sandstone Water Supply	Sandstone	
18.00	37.00	19.00	Coal Shale	Coal	

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
Single-Rate Pumping Test	17-Sep-1986				0.39		Airlift			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Chemical Treatment

Treatment	Method	Duration	Success

(No Chemical Treatment Details Found)

Development

Method	Time Taken	Other Development Method

(No Development Details Found)

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW063628 *Converted From HYDSYS*

Remarks

TDS = 120 MG/L

***** End of GW063628 *****

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW065734 *Converted From HYDSYS*

License :30BL138589

Work Type :Bore
Work Status :(Unknown)
Construct. Method :Rotary
Owner Type :Private

Authorised Purpose(s)	Intended Purpose(s)
DOMESTIC	DOMESTIC

Commenced Date :
Completion Date :27-Nov-1988
Final Depth : 24.00 m
Drilled Depth : 24.00 m

Contractor Name :SLADE DRILLING
Driller :1160 SLADE, Phillip Henry

Property :
GWMA : -
GW Zone : -
Standing Water Level : 11.00 m
Salinity :
Yield : 1.14 L/s

Site Details

Site Chosen By

County	Parish	Portion/Lot DP
Form A :CLARENCE	TALOUMBI	LOT 4 DP1002238
Licensed :CLARENCE	TALOUMBI	LT4 DP58449

Region :30 - NORTH COAST
River Basin :204 - CLARENCE RIVER
Area / District :
CMA Map :9539-3S MACLEAN
Grid Zone :56/2
Scale :1:25,000

Elevation : 0.00
Elevation Source :
Northing :6740175
Easting :523875
Latitude (S) :29° 28' 3"
Longitude (E) :153° 14' 46"

GS Map :0006A3
AMG Zone :56
Coordinate Source :

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	>From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1	1	Casing	PVC Class 9	0.00	24.00	137			Seated on Bottom
1	1	Opening	Slots - Diagonal	18.00	24.00	137		1	PVC; SL: 6mm; A: 3mm

Water Bearing Zones

>From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
18.00	21.00	3.00	Consolidated	11.00		1.14	24.00		

Drillers Log

>From (m)	To (m)	Thickness(m)	Driller's	Geological Material	Comments
0.00	1.00	1.00	[illegible]OPSOIL		
1.00	10.00	9.00	SOFT SANDSTONE		
10.00	24.00	14.00	SANDSTONE		

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By
Single-Rate Pumping Test	27-Nov-1988		11.00		1.14		Airlift			

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Chemical Treatment

Treatment	Method	Duration	Success

(No Chemical Treatment Details Found)

Development

Method	Time Taken	Other Development Method

(No Development Details Found)

Remarks

***** End of GW065734 *****

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW301178

License :30BL176897

Work Type :Bore
Work Status :(Unknown)
Construct. Method :Rotary
Owner Type :

Authorised Purpose(s)	Intended Purpose(s)
DOMESTIC	DOMESTIC

Commenced Date :
Completion Date :16-Aug-1995
Final Depth : 42.00 m
Drilled Depth : 42.00 m

Contractor Name :TANNER DRILLING
Driller :1412 TANNER, Robert Leslie

Property : - SMITH'S
GWMA : -
GW Zone : -

Standing Water Level : 7.00 m
Salinity : Good
Yield : 0.38 L/s

Site Details

Site Chosen By		County	Parish	Portion/Lot DP
Diviner	Driller	Form A :CLARENCE	TALOUMBI	LOT 1 DP606338
		Licensed :CLARENCE	TALOUMBI	LT 1 DP 606338

Region :30 - NORTH COAST
River Basin :
Area / District :

CMA Map :
Grid Zone :
Scale :

Elevation :
Elevation Source :

Northing :6740863
Easting :524168

Latitude (S) :29° 27' 41"
Longitude (E) :153° 14' 57"

GS Map :
AMG Zone :56
Coordinate Source :

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	>From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Hole	Hole	0.00	18.00	140			Rotary Air
1		Hole	Hole	18.00	42.00	140			Down Hole Hammer
1	1	Casing	PVC Class 9	-0.30	42.00	125			Glued; Seated on Bottom; Cap
1	1	Opening	Slots - Vertical	24.00	29.00	125			PVC Class 9; Sawn; SL: 100mm; A: 2.6mm
1	1	Opening	Slots - Vertical	34.00	39.00				Sawn; SL: 100mm; A: 2.6mm

Water Bearing Zones

>From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
24.00	29.00	5.00		7.00		0.13			
34.00	39.00	5.00		7.00		0.25	42.00	1.00	Good

Drillers Log

>From (m)	To (m)	Thickness(m)	Drillers	Geological Material	Comments
0.00	0.30	0.30	[illegible]SOIL		
0.30	6.00	5.70	YELLOW CLAY		
6.00	12.00	6.00	YELLOW SANDSTONE		
12.00	18.00	6.00	GREY SANDSTONE		
18.00	24.00	6.00	GREY SANDSTONE		
24.00	29.00	5.00	CRACKY GREY SANDSTONE		
29.00	34.00	5.00	GREY SANDSTONE		
34.00	39.00	5.00	CRACKY GREY SANDSTONE		
39.00	42.00	3.00	GREY SANDSTONE		

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Summary Details Found)

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Chemical Treatment

Treatment	Method	Duration	Success

(No Chemical Treatment Details Found)

Development

Method	Time Taken	Other Development Method
Air	1.00	

Remarks

Form A Remarks:

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW301178

NOTE: Casing completed at top with 600 x 600 mm deep surface pad.

*** End of GW301178 ***

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW301181

License :30BL176899

Work Type : Bore
Work Status :(Unknown)
Construct. Method : Rotary
Owner Type :

Authorised Purpose(s)	Intended Purpose(s)
DOMESTIC	DOMESTIC

Commenced Date :
Completion Date :20-Aug-1995
Final Depth : 33.00 m
Drilled Depth : 33.00 m

Contractor Name :TANNER DRILLING
Driller :1412 TANNER, Robert Leslie

Property : - BLEACH'S
GWMA : -
GW Zone : -

Standing Water Level : 21.00 m
Salinity : Good
Yield : 0.76 L/s

Site Details

Site Chosen By		County	Parish	Portion/Lot DP
Diviner	Driller	Form A :CLARENCE	TALOUMBI	LOT 11 DP1000495
		Licensed :CLARENCE	TALOUMBI	LOT 1 DP819132

Region :30 - NORTH COAST
River Basin :
Area / District :

CMA Map :
Grid Zone :
Scale :

Elevation :
Elevation Source :

Northing :6740349
Easting :523244
Latitude (S) :29° 27' 58"
Longitude (E) :153° 14' 23"

GS Map : **AMG Zone :**56 **Coordinate Source :**

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	>From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Hole	Hole	0.00	3.00	140			Rotary Air
1		Hole	Hole	3.00	33.00	140			Down Hole Hammer
1	1	Casing	PVC Class 9	-0.30	33.00	125			Glued; Seated on Bottom; Cap
1	1	Opening	Slots - Vertical	27.00	31.00	125			PVC Class 9; Sawn; SL: 100mm; A: 2.6mm

Water Bearing Zones

>From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
27.00	31.00	4.00		21.00		0.76	33.00	1.00	Good

Drillers Log

>From (m)	To (m)	Thickness(m)	Drillers	Geological Material	Comments
0.00	0.30	0.30	[illegible]SOIL		
0.30	3.00	2.70	GREY CLAY		
3.00	26.00	23.00	GREY MUDSTONE		
26.00	27.00	1.00	BLACK SHALE		
27.00	31.00	4.00	CRACKY BLACK SHALE		
31.00	33.00	2.00	BLACK SHALE		

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Summary Details Found)

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Chemical Treatment

Treatment	Method	Duration	Success

(No Chemical Treatment Details Found)

Development

Method	Time Taken	Other Development Method
Air	1.00	

Remarks

Form A Remarks:
Bore to be fitted with submersable pump, to fill a 22 730 litre tank for domestic use. Top of bore casing finished with 600 x 600 mm deep cement surface pad.

***** End of GW301181 *****

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW301400

License :30BL177147

Work Type :Bore
Work Status :(Unknown)
Construct. Method :
Owner Type :

Authorised Purpose(s): DOMESTIC
Intended Purpose(s): DOMESTIC

Commenced Date :
Completion Date :13-Nov-1994
Final Depth : 6.00 m
Drilled Depth :

Contractor Name :
Driller :

Property : - CAPEL'S
GWMA : -
GW Zone : -

Standing Water Level :
Salinity :
Yield :

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	CLARENCE	YAMBA	LOT 199 DP260230
Licensed :	CLARENCE	YAMBA	LT 199 DP 260230

Region :30 - NORTH COAST
River Basin :
Area / District :

CMA Map :
Grid Zone :
Scale :

Elevation :
Elevation Source :

Northing :6744845
Easting :531582

Latitude (S) :29° 25' 31"
Longitude (E) :153° 19' 32"

GS Map :
AMG Zone :56
Coordinate Source :Map Interpretation

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	>From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Hole	Hole	0.00	6.00	76.2			Hand Dug
1		Hole	Hole	0.00	6.00	76200			Other
1	1	Casing	Lining	0.00	6.00				

Water Bearing Zones

>From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

>From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

(No Drillers Log Details Found)

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Summary Details Found)

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Chemical Treatment

Treatment	Method	Duration	Success

(No Chemical Treatment Details Found)

Development

Method	Time Taken	Other Development Method

(No Development Details Found)

Remarks

Form A Remarks:
SPEAR POINT

*** End of GW301400 ***

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW301446

License :30BL177309

Work Type :Bore
Work Status :(Unknown)
Construct. Method :
Owner Type :

Authorised Purpose(s): DOMESTIC
Intended Purpose(s):

Commenced Date :
Completion Date :08-May-1996
Final Depth : 7.00 m
Drilled Depth :

Contractor Name :
Driller : MC LEOD, JOHN

Property : - MEPPEM
GWMA : -
GW Zone : -

Standing Water Level :
Salinity :
Yield : 0.02 L/s

Site Details

Site Chosen By

	County	Parish	Portion/Lot DP
Form A :	CLARENCE	YAMBA	LOT 36 DP786682
Licensed :	CLARENCE	YAMBA	LT 36 DP 786682

Region :30 - NORTH COAST
River Basin :
Area / District :

CMA Map :
Grid Zone :
Scale :

Elevation :
Elevation Source :

Northing :6745179
Easting :530951

Latitude (S) :29° 25' 20"
Longitude (E) :153° 19' 9"

GS Map :
AMG Zone :56
Coordinate Source :

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

H	P	Component	Type	>From (m)	To (m)	OD (mm)	ID (mm)	Interval	Details
1		Hole	Hole	0.00	7.00	90			(Unknown)
1		Hole	Hole	0.00	7.00	90			Other
1	1	Casing	Lining	0.00	0.00				

Water Bearing Zones

>From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

(No Water Bearing Zone Details Found)

Drillers Log

>From (m)	To (m)	Thickness(m)	Drillers Description	Geological Material	Comments

(No Drillers Log Details Found)

Pumping Tests - Summaries

Pumping Test Type	Date	Duration (hr)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Summary Details Found)

Pumping Tests - Readings

Pumping Test Type	Date	Time (mins)	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Intake Depth (m)	Test Method	To Measure Water Level	To Measure Discharge	Tested By

(No Pumping Test Reading Details Found)

Chemical Treatment

Treatment	Method	Duration	Success

(No Chemical Treatment Details Found)

Development

Method	Time Taken	Other Development Method

(No Development Details Found)

Remarks

Form A Remarks:
SPEARPOINT; NOT MUCH DETAILS ON FORM 'A' ; METHOD OF DRILLING IS "VENTURI" (?)

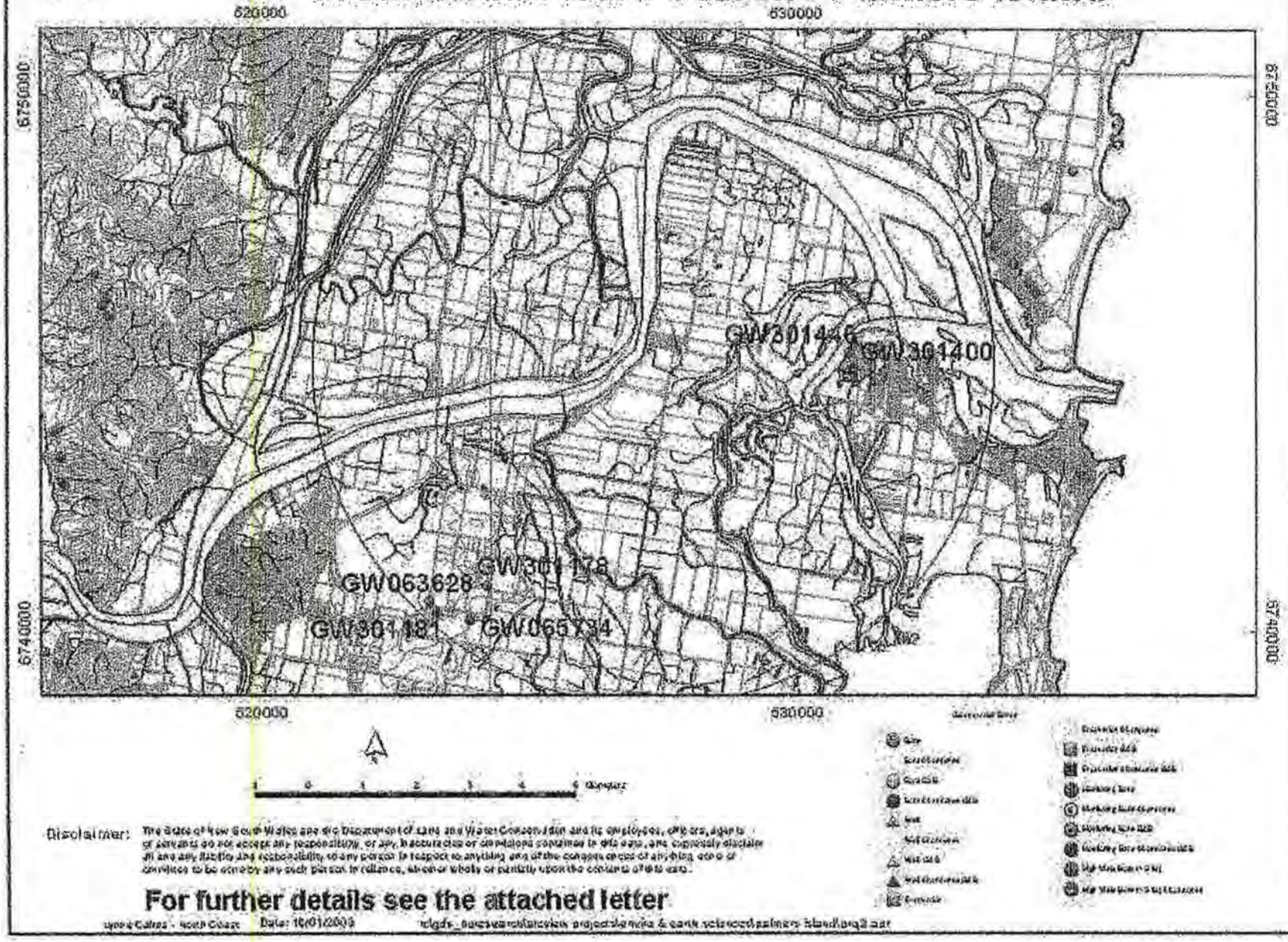
***** End of GW301446 *****

DEPARTMENT OF LAND & WATER CONSERVATION
Work Summary

GW301446

*** End of Report ***

Groundwater Bore Search - Palmers Island



Disclaimer: The State of New South Wales and the Department of Land and Water Conservation and its employees, officers, agents or servants do not accept any responsibility, or any, inaccuracies or completeness contained in this data, and expressly disclaim all and any liability and responsibility to any person in respect to anything and of the consequences of anything done or omitted to be done by any such person in reliance, whether wholly or partially, upon the contents of this data.

For further details see the attached letter

Date: 16/01/2004

Environmental & Earth Sciences Pty Ltd
Att: Ian Parkinson
PO Box 380
NORTH SYDNEY NSW 2059

NSW EPA
PO Box A290, Sydney South 1232
PHONE 9995 5495, FAX 9995 5962

Our Reference: 150740

Your Reference:

Verification of Notices under Unhealthy Building Land Act

Re : Street: RIVER RD PALMERS ISLAND
Folio Identifier: 2//DP 186236
22/632068,35/661175

The Environment Protection Authority currently has no statutory notices issued under the provisions of the Unhealthy Building Land Act 1990 for the subject land.

Following commencement of the Contaminated Land Management Act 1997 on 1 September 1998, the Environment Protection Authority no longer issues notices under S.35 or 36 of the Environmentally Hazardous Chemicals Act 1985.

Remaining current EHC Act notices, as well as current action taken under the CLM Act will now be noted on planning certificates issued by local councils under S.149(2) of the Environment Planning and Assessment Act.

Gretel Purser
Acting Manager Land & Waste Information Databases
Chemicals & Waste Branch

Date: 13/01/03
Paid by BULK-LPI

** On receipt, please check that the property details above are correct.

Maclean Shire Council

PLANNING CERTIFICATE UNDER SECTION 149
Environmental Planning and Assessment Act 1979 (as amended)

APPLICANT NAME:	**ENVIRONMENTAL & HEALTH SERVICES**	**CERTIFICATE NO:**	**1080/2002**
ADDRESS:	**PO BOX 195 LENNOX HEAD 2478**	**DATE**	**5/12/02**

Office Use Only	
Fee Paid:	**$40**
Receipt No:	**7329**

REFERENCE:

ADDRESS OF PROPERTY: **19 RIVER ROAD, PALMERS ISLAND**

LOT NO:	**2**	**SECTION NO.**	**D.P.**	**186236**
	22			**632068**
	35			**661175**

PART A
Local Environmental Plans, deemed Environmental Planning Instruments current at the date of this Certificate, restrict or purport to restrict the purposes for which development may be carried out on the land in the manner set out in Schedule 1 of Annexure A attached to this Certificate.
NOTE: This property does not contain a heritage item
However refer to Division 6 of Annexure A for further details concerning heritage items
Draft Local Environmental Plans placed on exhibition pursuant to Section 66(1)(b) of the Act are outlined in Schedule 3 of Annexure A attached to this Certificate.

PART B: NAME OF INSTRUMENT AND LAND ZONING DETAILS
Maclean Local Environmental Plan 2001 zones the land:
1(a) RURAL (AGRICULTURAL PROTECTION) ZONE

CLAUSE 15 APPLIES (SEE ATTACHMENT)

The purposes for which development may be carried out within the zone or zones without development consent and with development consent or the purpose for which the carrying out of development is prohibited within the zone or zones are listed in the extract of Maclean Local Environmental Plan 2001 attached as Annexure B.

PART C: STATE AND REGIONAL ENVIRONMENTAL PLANNING POLICIES
The following matters are specified:

1(a) State Environmental Planning Policies:4,9,20 & 36 are specified (as being generally notified by the Minister for Planning to be specified in the Certificate), as applying to land within the Shire of Maclean including the land to which this Certificate applies. The effect of the Policies (which the Minister has notified the Council should be specified in the Certificate) is outlined in Schedule 2 of Annexure A attached to this Certificate.
(b) Where any other State Environmental Planning Policy (as being specified by the Minister for Planning to be notified in the particular case for land to which a Certificate applies) applies to land to which this Certificate applies and is specified below, the effect of the policy is outlined in Schedule 2 of Annexure A attached to this Certificate.
The following Policy applies: SEPP 71

PART C: cont

2. Draft State Environmental Planning Policies are listed in Schedule 3 of Annexure A attached to this Certificate.
3. North Coast Regional Environmental Plan which specifies :
(I) that the Council is to consult, consider certain matters, and attach conditions before granting consent to particular development on rural and urban land in the North Coast Region.
(ii) That buildings over 14 metres in height require the concurrence of the Director of Planning.

PART D: DEVELOPMENT CONTROL PLANS:
(a) Affecting all properties in the Shire

MACLEAN SHIRE DEVELOPMENT CONTROL PLAN FOR OUTDOOR ADVERTISING
MACLEAN SHIRE DEVELOPMENT CONTROL PLAN (PARKING) ADOPTED
MACLEAN SHIRE DEVELOPMENT CONTROL PLAN FOR NOTIFIED DEVELOPMENT
MACLEAN SHIRE SUBDIVISION GUIDELINES
MACLEAN SHIRE DEVELOPMENT CONTROL PLAN FOR EXEMPT & COMPLYING DEVELOPMENT
MACLEAN SHIRE DEVELOPMENT CONTROL PLAN FOR KEEPING OF PIGS & POULTRY

(b) Affecting specific properties

PALMERS ISLAND RIVERBANK EROSION DCP
RURAL WORKERS DWELLINGS DCP

PART E: GENERAL INFORMATION PROVIDED IN ACCORDANCE WITH SECTION 149(2)

(1) Where land to which this Certificate relates is vacant and, is identified as being within a rural zone, the Council shall not consent to the erection of a dwelling-house (under Maclean Local Environmental Plan 2001) unless the allotment:
(a) has an area of not less than 40 hectares; or
(b) comprises an allotment created by a subdivision in accordance with Clause 32, 33 or 35 of Maclean LEP 2001; or
(c) comprises an allotment on which a dwelling-house could have been erected immediately prior to the appointed day and which could have been created in accordance with the provisions of Clause 32, 33 or 35 if those provisions were in force at the time that the allotment was created; or
(d) comprises an allotment of land that was consented to or approved by the Council prior to the appointed day and on which a dwelling-house could have been lawfully erected immediately prior to the appointed day.

(2) Where land to which this Certificate relates is vacant and, is identified as being within a environmental protection zone, the Council shall not consent to the erection of a dwelling-house (under Maclean Local Environmental Plan 2001) unless the allotment:
(a) has an area of not less than 40 hectares; or
(b) comprises an allotment created by a subdivision in accordance with Clause 58 or 59 of Maclean LEP 2001; or
(c) comprises an allotment on which a dwelling-house could have been erected immediately prior to the appointed day and which could have been created in accordance with the provisions of Clause 58 or 59 if those provisions were in force at the time that the allotment was created; or
(d) comprises an allotment of land that was consented to or approved by the Council prior to the appointed day and on which a dwelling-house could have been lawfully erected immediately prior to the appointed day.

(3) Development consent is required for the demolition of any buildings on the land.

(4) Certain Section 94 Plans apply to this property. Refer to attachment for Section 94 Contribution Plans applicable in the Shire.

(5) Development to which State Environmental Planning Policy No. 34 - Major Employment Generating Industrial Development and State Environmental Planning Policy No. 48 - Major Putrescible Landfill Sites apply is State significant development.

PART E: CONT

Under clause 17(1) of the Environmental Planning and Assessment (Savings and Transitional) Regulation 1998, all s.101 directions in existence before 1 July 1998 are taken to be State significant development. There is a Direction applying to all applications, other than applications by public authorities, in respect of the carrying out of development for the purposes of canals or other artificial waterways whereby all applications are to be referred to the Minister for Planning for determination.

(6) The land is not affected by the operation of Section 38 or 39 of the Coastal Protection Act 1979.

(7) The land has not been proclaimed to be in a mine subsidence district within the meaning of section 159 of the Mine Subsidence Compensation Act 1961.

(8) Affects of any road widening or road realignment under -
(i) Division 2 of Part 3 of the Roads Act 1993 not affected/~~affected~~
(ii) any environmental planning instrument; not affected/~~affected~~
(iii) any resolution of the Council. not affected/~~affected~~

PART (F): DEVELOPMENT RESTRICTIONS DUE TO THE LIKELIHOOD OF LANDSLIP, BUSHFIRE, FLOODING, TIDAL INUNDATION, SUBSIDENCE OR ANY OTHER RISK AS ADOPTED BY COUNCIL ARE LISTED HEREUNDER:

THE LAND IS FLOOD LIABLE
SUBJECT TO THE PALMERS ISLAND RIVERBANK PLAN

THE PROPERTY (OR A PART OF IT) IS IDENTIFIED ON THE ACID SULFATE SOILS PLANNING MAPS (REFER TO THE MACLEAN LEP 2001) AS POTENTIALLY CONTAINING ACID SULFATE SOILS.

THIS LAND IS IDENTIFIED AS BUSHFIRE PRONE LAND. THIS DESIGNATION IS AN INTERIM ASSESSMENT AND WILL BE REVIEWED ON COMPLETION OF COUNCIL'S "BUSHFIRE PRONE LAND MAPPING" BY 31 JULY 2003.

For all land zoned 1a, 1b, 3a, 4a & 5a the zonings may have permitted past land uses that could give rise to potential site contamination
For further information refer to schedule 1 of annexure A and Council's Contaminated Lands Policy.

PART (G): Section 59 (2) of the Contaminated Land Management Act provides that specific notations relating to contaminated land issues must be included on section 149(2) certificates.

The subject land **is not** subject to a current voluntary agreement, site audit statement, declaration, or order for investigation or remediation issue under the *Contaminated Land Management Act 1997* as notified by the EPA.

SECTION 149(5)

On application to Council and the payment of the prescribed fee, advice is provided in Annexure C pursuant to Section 149(5) on such other relevant matters, affecting the land, of which Council may be aware.

PLEASE NOTE:

The Environmental Planning and Assessment Amendment Act 1997 commenced operation on 1 July 1998. As a consequence of this Act the information contained in this certificate needs to be read in conjunction with the provisions of the Environmental Planning and Assessment (Amendment) Regulation 1998, Environmental Planning and Assessment (Further Amendment)Regulation 1998 and Environmental Planning and Assessment (Savings and Transitional) Regulation 1998.

MR. ROSS BRYANT
GENERAL MANAGER

per TOWN PLANNER

ANNEXURE "A"

For attachment to Certificate under Section 149 Environmental Planning & Assessment Act
(Extract from Maclean Local Environmental Plan 2001)

SCHEDULE 1

This Schedule refers to Controls within the relevant planning instrument which restrict or purport to restrict the purposes for which development may be carried out. These controls are not included within the land use table (if applicable) of the relevant instrument. Restrictions applicable pursuant to a zoning of the land (which relates to a land use table) are referred to in Clause (b) of Column 1 of the Certificate.

A. DIVISION 1 - SUBDIVISION OF LAND

A person shall not subdivide land without the consent of the Council excepting for opening or widening a public road, a boundary adjustment that does not involve the creation of an additional allotment, rectifying an encroachment, creating a public reserve, consolidating allotments and excising an allotment for public purposes.

Controls apply for subdivision in Maclean Local Environmental Plan 2001 which vary according to zoning. For rural zonings subdivision controls see Clauses 32, 33, 34, and 35; for residential, business and industrial zones see Clauses 47 and 48; for special use and open space zones see Clause 54 ; for environmental protection zones see Clauses 58 and 59.

B. DIVISION 2 - DWELLING HOUSES AND DUPLEXES

Controls apply for the construction of dwelling houses and duplexes in all rural and environmental protection zones and for the construction of rural workers dwellings in all rural zones.

C. DIVISION 3 - ENVIRONMENTAL PROTECTION

Controls apply for development within: all environmental protection zones generally; Zones No 7(e) Environmental Protection (Escarpment/Scenic) and on ridgelines specifically; Zone No 7(c) Environmental Protection (Coastal Foreshore) specifically; land within Mangrove Creek catchment area; and land in the vicinity of waterways and Special Emphasis Areas.

D. DIVISION 4 - GEOLOGICAL RESOURCES

Controls apply to certain areas for the protection of economic geological resources. A control also applies over the development of land for mineral sand mining within Zones Nos 1(a), 1(b), 1(f), 1(i), 1(r) and 1(s).

E. DIVISION 5 - LAND ACQUISITION

Controls apply pertaining to the acquisition of land, by relevant authorities: within Zones Nos 6(b), 6(c) or 8(b); and for certain land for road purposes indicated on the Local Environmental Plan map by medium grey shading or by horizontal and vertical cross hatching and extending as road widening or relocation between Oyster Channel and Coldstream Street, Yamba.

F. DIVISION 6 - HERITAGE ITEMS

Properties which contain a heritage item or **are in the vicinity of** a heritage item are affected by Part 2 of the Maclean LEP 2001 which places restrictions on the development of the property and you are urged to refer to the provisions of that Part. These restrictions apply to the specific items listed in Schedule 1 of Maclean Local Environmental Plan 2001 and Aboriginal Conservation Areas identified within the publication "Aboriginal Archaeological Sites in the Shire of Maclean: A Heritage Study" by Denis Byrne.

G. DIVISION 7 - GENERAL DEVELOPMENT CONTROLS

General Development controls apply and are contained in Part 1 of Maclean Local Environmental Plan 2001 and include the following:

(a) Development of land at boundaries of adjoining zones (Clause 9);

(b) Development along main or arterial roads. The roads are indicated on the Local Environmental Plan maps (Clause 19).

(c) Development in the vicinity of waterways (Clause 12);

(d) Development within the coastal zone (Clause 13);

(e) Foreshore building lines where fixed by Council (Clause 14);

(f) Suspension of certain covenants (any agreement, covenant or similar instrument which purports to impose restrictions on the carrying out of development) (Clause 8);

(g) Exempt development (Clause 16);

(h) Complying development (Clause 17);

(i) Development on land identified on the Acid Sulphate Soils Planning maps (Clause 18)

H. DIVISION 8 - HAZARD CONTROLS

(i) Bushfire hazard

Clause 10 of Maclean Local Environmental Plan 2001 states that consent must not be granted to development of land within Maclean Shire unless the Council is satisfied that adequate provision has been or will be made for the reduction of bushfire hazard.

(ii) Flood liable land

Controls relating to land which is flood liable and within a floodway, where development on the land (or land in the immediate vicinity) is likely to adversely impede flood waters, imperil the safety of persons in the event of inundation with flood waters, aggravate the consequence of lying floodwaters with regard to erosion, siltation or destruction of vegetation or adversely effect the water table,

Clause 11 of the Local Environmental Plan 2001 states:

The Council shall not grant consent to the erection of a dwelling on flood liable land unless the floor level of the living accommodation of the dwelling is located-

(a) in the case of land within Zone No. 2(a), 2(b), 2(t), 3(a) or 4(a) within the towns of Iluka or Yamba, at least 0.3 metres above the 1 in 100 year flood level adopted by the Council; and

(b) in the case of all other land, at least 0.5 metres above the 1 in 100 year flood level adopted by the Council.

Where any development on land affects flood mitigation works carried out by the Clarence River county Council, Council shall, before determining an application take into consideration the representations from that County Council.

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Where the land contains a contaminated dip site or the land is within 200 metres of a contaminated dip site Council will not approve any development on the land without a risk assessment being first carried out and will then only permit development which is compatible with the findings of that risk assessment.

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2. Which has been used for certain purposes;
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5. In other circumstances outlined in the policy

Where Council records indicate that the land in question is potentially or actually contaminated. Council's policy on Contaminated Land and the provisions of relevant State legislation are applicable. Interested persons should make their own enquiries regarding the extent of any actual contamination of the land.

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Where a site has been previously contaminated and remediated, Council may have details of the remediation works. Interested persons should make further enquiries in this regard.

Definitions - Potentially Contaminated Land – Land which may have been used for a land use referred to in Appendix 1 of Council's Contaminated Lands Policy.

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Where land is identified on the Acid Sulfate Soils Planning Maps forming part of the Maclean LEP 2001 as containing acid sulfate soils, clause 18 of the LEP applies. Prior to any development being undertaken on the land, Council may require that a preliminary assessment be undertaken, a management plan prepared and development consent obtained.

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Species to which this order applies:-

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This Policy provides flexibility in the application of planning controls operating by virtue of development standards in circumstances where strict compliance with those standards would, in any particular case, be unreasonable or unnecessary or tend to hinder the attainment of the objects specified in Section 5 (a) (i) and (ii) of the Act.

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Controls the development of group homes on all land where dwellings are allowed.

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No. 22 Shops and Commercial Premises

The aim of this policy is to permit within a business zone:

c) the change of use of a building lawfully used for a particular kind of commercial premises to another kind of commercial premises or to a shop: or

d) the change of use of a building lawfully used for a particular kind of shop to another kind of shop or to a commercial premises, even though that change of use is prohibited under another environmental planning instrument, if

e) the consent authority is satisfied the change of use will not have more than a minor environmental effect and is in keeping with the objectives (if any) of the zone; and

f) development consent is obtained for the change of use from that consent authority.

No. 26 Littoral Rainforests.

Imposes strict controls on any development or any activity carried out or undertaken of land which is affected by it, including the necessity to obtain the consent of the Council and the concurrence of the Director of Planning before any such development or activity may be carried out on that land.

No.30C Intensive Agriculture

This Policy requires development consent for cattle feedlots having a capacity to accommodate 50 or more head of cattle, and piggeries having a capacity to accommodate 200 or more pigs or 20 or more breeding sows This Policy also extends

the definition of the term 'rural industry' to include composting facilities and works, including facilities and works for the production of mushroom substrate.

No.33 Hazardous and Offensive Development

This Policy aims:

(a) to amend the definitions of hazardous and offensive industries where used in environmental planning instruments; and

(b) to render ineffective a provision of any environmental planning instrument that prohibits development for the purposes of a storage facility on the ground that the facility is hazardous or offensive if it is not a hazardous or offensive storage establishment as defined in this Policy; and

(c) to require development consent for hazardous or offensive development proposed to be carried out in the Western Division; and

(d) to ensure that in determining whether a development is a hazardous of offensive industry, any measures proposed to be employed to reduce the impact of the development are taken into account; and

(e) to ensure that in considering any application to carry out potentially hazardous or offensive development, the consent authority has sufficient information to assess whether the development is hazardous or offensive and to impose conditions to reduce or minimise any adverse impact; and

(f) to require the advertising of applications to carry out any such development

No.34 Major Employment Generating Industrial Development

The aims of this Policy are:

(a) to promote and co-ordinate the orderly and economic use and development of land and the economic welfare of the State: and

(b) to facilitate certain types of major employment-generating industrial development and labour intensive rural industrial development.

No.35 Maintenance Dredging of Tidal Waterways

The objective of this Policy is to enable the maintenance dredging of tidal waterways by public authorities to be carried out in a timely, cost effective and environmentally responsible manner.

No. 36 Manufactured Home Estates.

(a) Defines where Manufactured Home Estates (MHEs) may be permitted and establishes criteria for the granting of development consent to these estates.

(b) Enables, with development consent, the subdivision of MHEs, provided such subdivision complies with the provisions of the Local Government (Manufactured Home Estates) Regulation 1993.

No. 37 Continued Mines & Extractive Industries

The objectives of this Policy are:

(a) to promote and safeguard the orderly and economic use of land for the purpose of mines and extractive industries and:

(b) to enable certain existing mines and extractive industries to continue to operate subject to appropriate environmental assessment and to specify the circumstances in which development consent for them may be obtained.

No. 44c Koala Habitat Protection

This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:

(a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat; and

(b) by encouraging the identification of areas of core koala habitat; and

(c) by encouraging the inclusion of areas of core koala habitat in environment protection zones.

No. 45 Permissibility of Mining

This Policy removes the effect of certain provisions in environmental planning instruments that might, in the absence of this Policy, be relevant to:

(a) the determination of whether or not a proposed development for the purposes of mining is permissible with development consent (including provisions that might otherwise require a consent authority to be satisfied as to certain matters before determining that mining is permissible with development consent); and

(b) the determination of development applications for consent to carry out development for the purposes of mining.

No. 48 Major Putrescible Landfill Sites

The aims of this Policy are:

(a) to provide for the assessment and determination of proposals for major putrescible landfill sites:

(i) in a way that will ensure a consistency of approach: and

(ii) so as to ensure that the significance of the proposals to the State is taken into account; and

(b) to ensure that the use of landfill sites as a means of waste disposal is weighed against other waste management and waste disposal alternatives.

No. 50 Canal Estate Development

This Policy aims to prohibit canal estate development in order to ensure that the environment is not adversely affected by the creation of new developments of this kind.

No. 55 Remediation of Land

State Environmental Planning Policy No. 55 - Remediation of Land aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment. The policy applies to the whole state, to ensure that remediation is permissible development and is always carried out to a high standard. It specifies when consent is required for remediation and lists considerations that are relevant when rezoning land and determining development applications.

No. 71 Coastal Protection

This Policy applies to land within the coastal zone as defined in the Coastal Protection Act, generally being one kilometre from the coast, estuary, coastal lake or tidal river. The Policy makes the Minister the consent authority for major high-risk development proposals within the coastal zone, and defines a category and development assessment process for development in sensitive coastal locations.

SCHEDULE 3

Draft State Environmental Planning Policies.

Nil

Draft Local Environmental Plans.

Where a Draft State Environmental Planning Policy or a Draft Local Environmental Plan affects the property to which this Certificate applies, copies of the relevant documents are available at Council's office.

ANNEXURE B

For attachment to Certificate under Section 149 Environmental Planning & Assessment Act
(Extract from Maclean Local Environmental Plan 2001)

Zone No 1 (a) Rural (Agricultural Protection) Zone

1 Aim of zone

The primary aims of this zone are to protect, reserve and encourage the use of land is this zone for agriculture and uses compatible with agriculture.

2 Objectives of zone

The particular objectives of this zone are:
(a) to conserve the productive potential of prime crop or pasture land, and
(b) to provide for new forms of agricultural development, and changing patterns of existing agricultural development, and
(c) to ensure that commercial farming is not affected adversely by incompatible uses which impair its long term sustainability, and
(d) to avoid degradation and alienation of prime agricultural land, and
(e) to enable rural tourism, which does not adversely affect the productive potential of the land, and
(f) to exclude urban development on all prime crop or pasture land, and
(g) to restrict the subdivision of prime crop or pasture land, and
(h) to encourage conservation in farming practices, and
(i) to control the clearing of vegetation and encourage the retention of vegetation.

3 Without development consent

Development for the purpose of:

Agriculture (other than intensive animal husbandry); ancillary removal of native vegetation; bushfire control; clearing not included in item 4; dams with a capacity of 2 megalitres or less, or dams requiring licensing under Part 2 of the *Water Act 1912*; flood mitigation works; forestry; jetties with a maximum of 2 vessels used for private use; public utility undertakings.

Exempt development.

4 Only with development consent

Development for the purpose of:

Aquaculture; bus stations; clear felling; clearing allowed only with consent under clause 40; cluster farming; dams not included in item 3, duplexes; dwelling houses; general stores; home industries; intensive animal husbandry; liquid fuel depots; livestock keeping establishments; professional consulting rooms; roadside stalls; rural industries; rural tourist facilities; rural workers' dwellings.

Any other development not included in item 3 or 5.

Note. Consent for development included in this item will be refused if the proposed development is not consistent with the objectives of the zone.

5 Prohibited

Development for the purpose of:

Caravan parks; commercial premises; educational establishments; institutions; motor showrooms; places of assembly; recreation vehicle areas; residential flat buildings; shops (other than general stores); taverns; total destination resorts; tourist facilities; transport terminals; units for aged persons; warehouses.

Attachment to Certificate under Section 149(2) & (5)

SECTION 94 CONTRIBUTION PLANS

The following Section 94 Contribution Plans are operative throughout the Shire and apply to all new subdivisions or multiple occupancy development except as otherwise stated.

(1) OPEN SPACE/RECREATION FACILITIES:

Applies to all properties within the Shire.

(2) COMMUNITY AMENITIES AND SERVICES:

Applies to all properties within the Shire.

(3) RURAL ROADS:

Applies to all rural areas.

(4) STREET TREES:

Applies to all residential areas.

(5) CRISP DRIVE ASHBY:

Refers to the Crisp Drive Ashby area and applies to all new subdivisions.

Multiple occupancy developments will not be affected by this plan.

(6) PHOTOGRAMMETRIC MAPPING:

Refers to the Ashby, Gulmarrad and Woombah areas and applies to all new subdivisions.

(7) ASHBY PENINSULA RING ROAD:

Refers to the Ashby Peninsula area in the vicinity of Old Ferry Road and Pateman's Road. This plan will affect all new subdivisions, resubdivisions and multiple occupancy developments.

(8) CARPARKING IN THE MACLEAN, YAMBA AND ILUKA CBDs

Applies to all properties in the Central Business Districts

(9) YAMBA URBAN BYPASS & URBAN INTERSECTIONS

Applies to Yamba and surrounding areas including Micalo Island, Palmers Island, Angourie and Wooloweyah.

(10) QUARRY ROAD MAINTENANCE

Applies to roads within the Shire used by extractive industries.

(11) YAMBA DRAINAGE CATCHMENTS

Applies to properties in the vicinity of the Yamba CBD

LIVING WITH PRIMARY INDUSTRY

Maclean Shire is situated approximately 700 kilometres north of Sydney and 300 kilometres south of Brisbane. Maclean Shire is principally a rural shire of 1041 square kilometres, with Maclean as its administrative centre. The area has a population of 15,987. The major primary industries in the shire are sugar and fishing.

Sugar cane is grown on the floodplain areas of the Lower Clarence Valley. The harvested sugar cane is transported by road to the Harwood Sugar Mill and Refinery where it is processed into raw sugar, refined sugar and molasses. All the sugar cane harvested in New South Wales is transported to the Harwood Sugar Refinery for processing.

Commercial fishing is carried out both in the Clarence River and the open sea. The major fishing fleets being at Iluka, Yamba and Maclean. Individual trawlers are also moored at various locations in Clarence River waterways. The techniques used to catch fish range from mesh netting of fish, trapping of crabs to trawling for prawns in the river and at sea and hauling of the beaches.

The Shire population is concentrated in the main town centres of Iluka, Maclean and Yamba. Smaller villages and individual residences are located throughout the rural area. A growing number of people are being attracted to the scenic beauty and tranquillity around the smaller villages and in rural areas.

When we choose to live in rural areas or near areas where fishing trawlers operate we have to accept the activities of these industries. Viable primary industry activities cannot be limited because an increased number of people choose to live amongst them.

These primary industries may cause residents some inconvenience from time to time as an unavoidable consequence of their operation, dust noise, odours, etc, are all part of primary industry. Any inconvenience would not be continuous, and would normally occur on a seasonal basis.

It is essential when considering the purchase of property, that purchasers familiarise themselves with the possible seasonal primary industry activities which may impact on the property.
Some of the activities that may be encountered in rural areas within Maclean Shire area are listed below:-

Aerial spraying
Animal husbandry practices (castration, dehorning etc.)
Burning of cane fields
Bushfire hazard reduction burning
Clearing and cultivation of land
Commercial fishing
Construction of access roads and tracks

Construction of dams, drains and contour banks
Driving of live stock on roads
Fencing
Fishing trawler operation
Haulage of rural produce
Herbicide spraying
Intensive livestock waste disposal systems and ponds
Logging and milling of timber
Livestock feed lots
Machinery repairs
Pesticide spraying
Planting of woodlots
Pumping and irrigation
Silage production
Slashing and mowing vegetation
Use of agricultural machinery (tractors, chainsaws, motor bikes etc)

15 Development within river bank erosion localities

(1) This clause applies to all land adjacent to the Clarence River, as shown edged with heavy black broken and unbroken lines on the map marked "Maclean Local Environmental Plan 1992 (Amendment No 7)". That map is referred to in this clause as ***the river bank map***.

(2) The aims of this clause are:

(a) to identify land at Palmers Island fronting the Clarence River or its tributaries which is subject to a risk of major river bank erosion, and

(b) to restrict development on any such land, and

(c) to allow more detailed provisions to be made by means of a development control plan for the control of development of any such land.

(3) A person must not carry out any development on, or subdivide, land to which this clause applies, except with development consent.

(4) Consent must not be granted to the erection of a building on land to which this clause applies shown cross-hatched and edged with a broken black line on the river bank map.

(5) However, a person may, with development consent, repair or rebuild a building erected before this clause commenced on land to which subclause (4) applies, but only if the building has been partially destroyed by accident or by damage caused otherwise than by river bank erosion. If any such building is totally destroyed, its rebuilding is prohibited.

(6) Consent may be granted to such repairing or rebuilding only if:

(a) the total floor area of the building after it has been carried out will be no greater than its total floor area prior to the accident or damage, and

(b) where possible, the building will be relocated (when it is rebuilt or repaired) to a location on the land as far as is practicable from the river bank erosion escarpment, and

(c) the repairing or rebuilding will be carried out within 12 months after the date when the accident or damage occurred.

(7) Consent must not be granted to the carrying out of any development on, or subdivision of, land to which this clause applies shown stippled and edged with a broken black line on the river bank map unless the consent authority has taken into consideration the following:

(a) the likelihood of the proposed development adversely affecting, or being adversely affected by, river bank erosion and flooding,

(b) the need to relocate buildings in the long-term,

(c) the need for the proposed development to be limited to a specified period of time,

(d) the nature, bulk and intensity of the proposed development,

(e) the provisions of any development control plan relating to development of the land or other land in the locality,

(f) whether adequate safeguards and measures have been or will be in place to protect the environment and mitigate the risk of property damage or loss of life as a result of river bank erosion and flooding,

(g) whether satisfactory arrangements will be made for access, during a flood and after river bank erosion, to and from the site of any building or work resulting from the proposed development.

(8) A person may carry out development to protect land to which this clause applies from river bank erosion or flooding only with development consent.

(g) Exempt development (Clause 16);

(h) Complying development (Clause 17);

(i) Development on land identified on the Acid Sulphate Soils Planning maps (Clause 18)

H. DIVISION 8 - HAZARD CONTROLS

(i) Bushfire hazard

Clause 10 of Maclean Local Environmental Plan 2001 states that consent must not be granted to development of land within Maclean Shire unless the Council is satisfied that adequate provision has been or will be made for the reduction of bushfire hazard.

(ii) Flood liable land

Controls relating to land which is flood liable and within a floodway, where development on the land (or land in the immediate vicinity) is likely to adversely impede flood waters, imperil the safety of persons in the event of inundation with flood waters, aggravate the consequence of lying floodwaters with regard to erosion, siltation or destruction of vegetation or adversely effect the water table,

Clause 11 of the Local Environmental Plan 2001 states:

The Council shall not grant consent to the erection of a dwelling on flood liable land unless the floor level of the living accommodation of the dwelling is located-

(a) in the case of land within Zone No. 2(a), 2(b), 2(t), 3(a) or 4(a) within the towns of Iluka or Yamba, at least 0.3 metres above the 1 in 100 year flood level adopted by the Council; and

(b) in the case of all other land, at least 0.5 metres above the 1 in 100 year flood level adopted by the Council.

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The aim of this policy is to encourage the orderly and economic use and development of land used or intended to be used as a caravan park catering exclusively or predominantly for short-term residents (such as tourists) or for long-term residents, or catering for both.

No. 22 Shops and Commercial Premises

The aim of this policy is to permit within a business zone:

c) the change of use of a building lawfully used for a particular kind of commercial premises to another kind of commercial premises or to a shop: or

d) the change of use of a building lawfully used for a particular kind of shop to another kind of shop or to a commercial premises, even though that change of use is prohibited under another environmental planning instrument, if

e) the consent authority is satisfied the change of use will not have more than a minor environmental effect and is in keeping with the objectives (if any) of the zone; and

f) development consent is obtained for the change of use from that consent authority.

No. 26 Littoral Rainforests.

Imposes strict controls on any development or any activity carried out or undertaken of land which is affected by it, including the necessity to obtain the consent of the Council and the concurrence of the Director of Planning before any such development or activity may be carried out on that land.

No.30C Intensive Agriculture

This Policy requires development consent for cattle feedlots having a capacity to accommodate 50 or more head of cattle, and piggeries having a capacity to accommodate 200 or more pigs or 20 or more breeding sows This Policy also extends

the definition of the term 'rural industry' to include composting facilities and works, including facilities and works for the production of mushroom substrate.

No.33 Hazardous and Offensive Development

This Policy aims:

(a) to amend the definitions of hazardous and offensive industries where used in environmental planning instruments; and

(b) to render ineffective a provision of any environmental planning instrument that prohibits development for the purposes of a storage facility on the ground that the facility is hazardous or offensive if it is not a hazardous or offensive storage establishment as defined in this Policy; and

(c) to require development consent for hazardous or offensive development proposed to be carried out in the Western Division; and

(d) to ensure that in determining whether a development is a hazardous of offensive industry, any measures proposed to be employed to reduce the impact of the development are taken into account; and

(e) to ensure that in considering any application to carry out potentially hazardous or offensive development, the consent authority has sufficient information to assess whether the development is hazardous or offensive and to impose conditions to reduce or minimise any adverse impact; and

(f) to require the advertising of applications to carry out any such development

No.34 Major Employment Generating Industrial Development

The aims of this Policy are:

(a) to promote and co-ordinate the orderly and economic use and development of land and the economic welfare of the State: and

(b) to facilitate certain types of major employment-generating industrial development and labour intensive rural industrial development.

No.35 Maintenance Dredging of Tidal Waterways

The objective of this Policy is to enable the maintenance dredging of tidal waterways by public authorities to be carried out in a timely, cost effective and environmentally responsible manner.

No. 36 Manufactured Home Estates.

(a) Defines where Manufactured Home Estates (MHEs) may be permitted and establishes criteria for the granting of development consent to these estates.

(b) Enables, with development consent, the subdivision of MHEs, provided such subdivision complies with the provisions of the Local Government (Manufactured Home Estates) Regulation 1993.

No. 37 Continued Mines & Extractive Industries

The objectives of this Policy are:

(a) to promote and safeguard the orderly and economic use of land for the purpose of mines and extractive industries and:

(b) to enable certain existing mines and extractive industries to continue to operate subject to appropriate environmental assessment and to specify the circumstances in which development consent for them may be obtained.

No. 44c Koala Habitat Protection

This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:

(a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat; and

(b) by encouraging the identification of areas of core koala habitat; and

(c) by encouraging the inclusion of areas of core koala habitat in environment protection zones.

No. 45 Permissibility of Mining

This Policy removes the effect of certain provisions in environmental planning instruments that might, in the absence of this Policy, be relevant to:

(a) the determination of whether or not a proposed development for the purposes of mining is permissible with development consent (including provisions that might otherwise require a consent authority to be satisfied as to certain matters before determining that mining is permissible with development consent); and

(b) the determination of development applications for consent to carry out development for the purposes of mining.

No. 48 Major Putrescible Landfill Sites

The aims of this Policy are:

(a) to provide for the assessment and determination of proposals for major putrescible landfill sites:

(i) in a way that will ensure a consistency of approach: and

(ii) so as to ensure that the significance of the proposals to the State is taken into account; and

(b) to ensure that the use of landfill sites as a means of waste disposal is weighed against other waste management and waste disposal alternatives.

No. 50 Canal Estate Development

This Policy aims to prohibit canal estate development in order to ensure that the environment is not adversely affected by the creation of new developments of this kind.

No. 55 Remediation of Land

State Environmental Planning Policy No. 55 - Remediation of Land aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment. The policy applies to the whole state, to ensure that remediation is permissible development and is always carried out to a high standard. It specifies when consent is required for remediation and lists considerations that are relevant when rezoning land and determining development applications.

No. 71 Coastal Protection

This Policy applies to land within the coastal zone as defined in the Coastal Protection Act, generally being one kilometre from the coast, estuary, coastal lake or tidal river. The Policy makes the Minister the consent authority for major high-risk development proposals within the coastal zone, and defines a category and development assessment process for development in sensitive coastal locations.

SCHEDULE 3

Draft State Environmental Planning Policies.

Nil

Draft Local Environmental Plans.

Where a Draft State Environmental Planning Policy or a Draft Local Environmental Plan affects the property to which this Certificate applies, copies of the relevant documents are available at Council's office.

ANNEXURE B

For attachment to Certificate under Section 149 Environmental Planning & Assessment Act
(Extract from Maclean Local Environmental Plan 2001)

Zone No 1 (a) Rural (Agricultural Protection) Zone

1 Aim of zone

The primary aims of this zone are to protect, reserve and encourage the use of land is this zone for agriculture and uses compatible with agriculture.

2 Objectives of zone

The particular objectives of this zone are:
(a) to conserve the productive potential of prime crop or pasture land, and
(b) to provide for new forms of agricultural development, and changing patterns of existing agricultural development, and
(c) to ensure that commercial farming is not affected adversely by incompatible uses which impair its long term sustainability, and
(d) to avoid degradation and alienation of prime agricultural land, and
(e) to enable rural tourism, which does not adversely affect the productive potential of the land, and
(f) to exclude urban development on all prime crop or pasture land, and
(g) to restrict the subdivision of prime crop or pasture land, and
(h) to encourage conservation in farming practices, and
(i) to control the clearing of vegetation and encourage the retention of vegetation.

3 Without development consent

Development for the purpose of:

Agriculture (other than intensive animal husbandry); ancillary removal of native vegetation; bushfire control; clearing not included in item 4; dams with a capacity of 2 megalitres or less, or dams requiring licensing under Part 2 of the *Water Act 1912*; flood mitigation works; forestry; jetties with a maximum of 2 vessels used for private use; public utility undertakings.

Exempt development.

4 Only with development consent

Development for the purpose of:

Aquaculture; bus stations; clear felling; clearing allowed only with consent under clause 40; cluster farming; dams not included in item 3, duplexes; dwelling houses; general stores; home industries; intensive animal husbandry; liquid fuel depots; livestock keeping establishments; professional consulting rooms; roadside stalls; rural industries; rural tourist facilities; rural workers' dwellings.

Any other development not included in item 3 or 5.

Note. Consent for development included in this item will be refused if the proposed development is not consistent with the objectives of the zone.

5 Prohibited

Development for the purpose of:

Caravan parks; commercial premises; educational establishments; institutions; motor showrooms; places of assembly; recreation vehicle areas; residential flat buildings; shops (other than general stores); taverns; total destination resorts; tourist facilities; transport terminals; units for aged persons; warehouses.

Attachment to Certificate under Section 149(2) & (5)

SECTION 94 CONTRIBUTION PLANS

The following Section 94 Contribution Plans are operative throughout the Shire and apply to all new subdivisions or multiple occupancy development except as otherwise stated.

(1) OPEN SPACE/RECREATION FACILITIES:

Applies to all properties within the Shire.

(2) COMMUNITY AMENITIES AND SERVICES:

Applies to all properties within the Shire.

(3) RURAL ROADS:

Applies to all rural areas.

(4) STREET TREES:

Applies to all residential areas.

(5) CRISP DRIVE ASHBY:

Refers to the Crisp Drive Ashby area and applies to all new subdivisions.

Multiple occupancy developments will not be affected by this plan.

(6) PHOTOGRAMMETRIC MAPPING:

Refers to the Ashby, Gulmarrad and Woombah areas and applies to all new subdivisions.

(7) ASHBY PENINSULA RING ROAD:

Refers to the Ashby Peninsula area in the vicinity of Old Ferry Road and Pateman's Road. This plan will affect all new subdivisions, resubdivisions and multiple occupancy developments.

(8) CARPARKING IN THE MACLEAN, YAMBA AND ILUKA CBDs

Applies to all properties in the Central Business Districts

(9) YAMBA URBAN BYPASS & URBAN INTERSECTIONS

Applies to Yamba and surrounding areas including Micalo Island, Palmers Island, Angourie and Wooloweyah.

(10) QUARRY ROAD MAINTENANCE

Applies to roads within the Shire used by extractive industries.

(11) YAMBA DRAINAGE CATCHMENTS

Applies to properties in the vicinity of the Yamba CBD

LIVING WITH PRIMARY INDUSTRY

Maclean Shire is situated approximately 700 kilometres north of Sydney and 300 kilometres south of Brisbane. Maclean Shire is principally a rural shire of 1041 square kilometres, with Maclean as its administrative centre. The area has a population of 15,987. The major primary industries in the shire are sugar and fishing.

Sugar cane is grown on the floodplain areas of the Lower Clarence Valley. The harvested sugar cane is transported by road to the Harwood Sugar Mill and Refinery where it is processed into raw sugar, refined sugar and molasses. All the sugar cane harvested in New South Wales is transported to the Harwood Sugar Refinery for processing.

Commercial fishing is carried out both in the Clarence River and the open sea. The major fishing fleets being at Iluka, Yamba and Maclean. Individual trawlers are also moored at various locations in Clarence River waterways. The techniques used to catch fish range from mesh netting of fish, trapping of crabs to trawling for prawns in the river and at sea and hauling of the beaches.

The Shire population is concentrated in the main town centres of Iluka, Maclean and Yamba. Smaller villages and individual residences are located throughout the rural area. A growing number of people are being attracted to the scenic beauty and tranquillity around the smaller villages and in rural areas.

When we choose to live in rural areas or near areas where fishing trawlers operate we have to accept the activities of these industries. Viable primary industry activities cannot be limited because an increased number of people choose to live amongst them.

These primary industries may cause residents some inconvenience from time to time as an unavoidable consequence of their operation, dust noise, odours, etc, are all part of primary industry. Any inconvenience would not be continuous, and would normally occur on a seasonal basis.

It is essential when considering the purchase of property, that purchasers familiarise themselves with the possible seasonal primary industry activities which may impact on the property.
Some of the activities that may be encountered in rural areas within Maclean Shire area are listed below:-

Aerial spraying
Animal husbandry practices (castration, dehorning etc.)
Burning of cane fields
Bushfire hazard reduction burning
Clearing and cultivation of land
Commercial fishing
Construction of access roads and tracks

Construction of dams, drains and contour banks
Driving of live stock on roads
Fencing
Fishing trawler operation
Haulage of rural produce
Herbicide spraying
Intensive livestock waste disposal systems and ponds
Logging and milling of timber
Livestock feed lots
Machinery repairs
Pesticide spraying
Planting of woodlots
Pumping and irrigation
Silage production
Slashing and mowing vegetation
Use of agricultural machinery (tractors, chainsaws, motor bikes etc)

15 Development within river bank erosion localities

(1) This clause applies to all land adjacent to the Clarence River, as shown edged with heavy black broken and unbroken lines on the map marked "Maclean Local Environmental Plan 1992 (Amendment No 7)". That map is referred to in this clause as ***the river bank map***.

(2) The aims of this clause are:
   (a) to identify land at Palmers Island fronting the Clarence River or its tributaries which is subject to a risk of major river bank erosion, and
   (b) to restrict development on any such land, and
   (c) to allow more detailed provisions to be made by means of a development control plan for the control of development of any such land.

(3) A person must not carry out any development on, or subdivide, land to which this clause applies, except with development consent.

(4) Consent must not be granted to the erection of a building on land to which this clause applies shown cross-hatched and edged with a broken black line on the river bank map.

(5) However, a person may, with development consent, repair or rebuild a building erected before this clause commenced on land to which subclause (4) applies, but only if the building has been partially destroyed by accident or by damage caused otherwise than by river bank erosion. If any such building is totally destroyed, its rebuilding is prohibited.

(6) Consent may be granted to such repairing or rebuilding only if:
   (a) the total floor area of the building after it has been carried out will be no greater than its total floor area prior to the accident or damage, and
   (b) where possible, the building will be relocated (when it is rebuilt or repaired) to a location on the land as far as is practicable from the river bank erosion escarpment, and
   (c) the repairing or rebuilding will be carried out within 12 months after the date when the accident or damage occurred.

(7) Consent must not be granted to the carrying out of any development on, or subdivision of, land to which this clause applies shown stippled and edged with a broken black line on the river bank map unless the consent authority has taken into consideration the following:
   (a) the likelihood of the proposed development adversely affecting, or being adversely affected by, river bank erosion and flooding,
   (b) the need to relocate buildings in the long-term,
   (c) the need for the proposed development to be limited to a specified period of time,
   (d) the nature, bulk and intensity of the proposed development,
   (e) the provisions of any development control plan relating to development of the land or other land in the locality,

(f) whether adequate safeguards and measures have been or will be in place to protect the environment and mitigate the risk of property damage or loss of life as a result of river bank erosion and flooding,

(g) whether satisfactory arrangements will be made for access, during a flood and after river bank erosion, to and from the site of any building or work resulting from the proposed development.

(8) A person may carry out development to protect land to which this clause applies from river bank erosion or flooding only with development consent.

APPENDIX B

GEOLOGICAL BORELOGS

LOCATION See Figure 2		Borehole No. BH1	LOGGED BY HMc
SURFACE ELEVATION (RL)	JOB No. 50212		Project Manager HMc
GROUNDWATER As shown	DATUM	PROJECT Palmers Island 19 River Road NSW	Approved
DRILL TYPE/METHOD H/A	DATE 17/12/02		

#No.	STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES TYPE	SAMPLES undisturbed disturbed lost	Moisture content %	FID Background	FID Reading ppm	CHEMICAL DATA pH - soil	pH - H2O	pe - H2O	EC uS/cm	CONSTRUCTION DETAILS / COMMENTS
BH1	Natural – Silty Clay, loose, brown, with charcoal & roots (OL)		0	P		D			4				No odour throughout ↓
	Medium Clay – Dark brown, with brown/orange mottling & charcoal		0.4	P		D			4.5				
	Sandy Clay – Grey with brown mottling		0.8	P					6				NGWE
	Medium Sand – Grey		1.0	P		D-M			5.5				
	Medium Sand – Grey with large amount of brown/orange mottling		1.2	P		M			5.5				
	Medium Sand – Grey		1.4			W			5.5				
	E.O.H. @ 1.4m in Natural Medium grey Sand.		1.6 / 1.8 / 2.0										

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LOCATION See Figure 2		Borehole No. BH53 LOGGED BY HMc	Project Manager HMc
SURFACE ELEVATION (RL)	JOB No. 50212		
GROUNDWATER As shown	DATUM	PROJECT Palmers Island 19 River Road NSW	Approved
DRILL TYPE/METHOD H/A	DATE 17/12/02		

#No.	STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES TYPE	SAMPLES undisturbed disturbed lost	Moisture content %	FID Background	FID Reading ppm	CHEMICAL DATA pH - soil	CHEMICAL DATA pH - H2O	CHEMICAL DATA pe - H2O	CHEMICAL DATA EC uS/cm	CONSTRUCTION DETAILS COMMENTS
BH53	Natural – Silty Clay, loose, brown with roots & charcoal (OL)		0	P		D			4.5				No odour throughout
	Medium Clay – Dark brown with orange mottling & charcoal		0.2 / 0.4	P		D-M			4.5				
	Medium Clay – Grey with charcoal		0.6 / 0.8	P		M			4.5				
	Sandy Clay – Grey		1.0 / 1.2	P		M			4.5				NGWE
	Medium Sand – Grey with large amount of brown/orange mottling		1.4 / 1.6	P		W			4.5				
	E.O.H. @ 1.8m in Natural wet grey Medium Sand with brown/orange mottles		1.8 / 2.0										

LOCATION See Figure 2		Borehole No. BH106 LOGGED BY HMc	Project Manager HMc
SURFACE ELEVATION (RL)	JOB No. 50212		
GROUNDWATER As shown	DATUM	PROJECT Palmers Island 19 River Road NSW	Approved
DRILL TYPE/METHOD H/A	DATE 17/12/02		

#No.	STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES TYPE	SAMPLES undisturbed	SAMPLES disturbed	SAMPLES lost	Moisture content %	FID Background	FID Reading ppm	CHEMICAL DATA pH - soil	CHEMICAL DATA pH - H2O	CHEMICAL DATA pe - H2O	CHEMICAL DATA EC uS/cm	CONSTRUCTION DETAILS / COMMENTS
BH106	Natural – Silty Clay, loose, brown with roots & charcoal (OL)		0	P				D			5.5				No odour throughout
			0.2												
			0.4												
			0.6												
			0.8												
	Medium Clay – Dark brown with brown/orange mottling		1.0	P				D			4.5				NGWE
	Medium Clay – Grey with brown/ orange mottling		1.2	P				D-M			5				
			1.4												
	Sandy Clay – Grey with brown/ orange mottling		1.6	P				M			5.5				
	Medium Sand – Grey with large amount of brown/orange mottling		1.8	P				W			5.5				
	E.O.H. @ 2.0m in Natural grey Medium Sand with brown/orange mottles		2.0												

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LOCATION See Figure 2		Borehole No. SS2-SS110 ..... LOGGED BY HMc	Project Manager HMc
SURFACE ELEVATION (RL)	JOB No. 50212		
GROUNDWATER As shown	DATUM	PROJECT Palmers Island 19 River Road NSW	Approved .....
DRILL TYPE/METHOD H/A	DATE 17/12/02		

#No.	STRATIGRAPHY	GRAPHIC LOG	Depth metres	SAMPLES TYPE	SAMPLES undisturbed disturbed lost	Moisture content %	FID Background	FID Reading ppm	CHEMICAL DATA pH - soil	pH - H2O	pe - H2O	EC uS/cm	CONSTRUCTION DETAILS / COMMENTS
			0										
SS2	SILTY CLAY - loose, brown, roots, charcoal (OL)			P		Dry-Moist			5				No odours
SS3	As above								5.5				
SS4	As above								5.5				
SS5	As above								6.5				
SS6	As above								6				
SS7	As above								6.5				
SS8-SS10	As above								5.5				
SS11	As above								5				
SS12	As above								5.5				
SS13	As above								5				
SS14	As above								5.5				
SS15	As above								6				
SS16	As above								4				
SS17-SS26	As above								5.5				
SS27	As above								5				
SS28	As above								5.5				
SS29-SS35	As above								5.5				
SS36	As above								5				
SS37-SS40	As above								5.5				
SS41-SS43	As above								5				
SS44	As above								5.5				
SS45-SS63	As above								5				
SS64	As above shell fragments								7.5				
SS65	As above shell fragments								7				
SS66	As above minor shell fragments								6				
SS67-SS70	As above								5.5				
SS71-SS79	As above								5				
SS80-SS81	As above								5.5				
SS82-SS85	As above								5				
SS86	As above								5.5				
SS87 - SS105	As above								5				
SS107 - SS109	As above								6.5				
SS110	As above			V		V			6				

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APPENDIX C

LABORATORY TRANSCRIPTS

CHECKED

AGAL

REPORT OF ANALYSIS

Report No. RN334803

Client	: ENVIRONMENTAL & EARTH SCIENCES PO BOX 380 NORTH SYDNEY NSW 2059	**Job No.**	: ENVI10/021219
		Quote No.	: QT-00500
		Order No.	:
		Date Sampled	:
		Date Received	: 19-DEC-2002
Attention	: HUGH MCCAFFERY	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
N02/042034	CS1	SOIL PALMERS ISLAND JOB 50212 COMP BH1 (0-0.1M), SS10, SS11, SS20
N02/042035	CS3	SOIL PALMERS ISLAND JOB 50212 COMP SS3, SS8, SS13, SS18
N02/042036	CS8	SOIL PALMERS ISLAND JOB 50212 COMP SS25, SS26, SS35, SS36
N02/042037	CS9	SOIL PALMERS ISLAND JOB 50212 COMP SS31, SS40, SS41, SS50

Lab Reg No.		N02/042034	N02/042035	N02/042036	N02/042037	
Sample Reference	Units	CS1	CS3	CS8	CS9	Method
Trace Elements						
Total Solids	%	83.5	83.4	84.6	82.3	NT2_49

Signed:

Dr. Honway Loue, Trace Elements - NSW

Date: 13-JAN-2003

Lab Reg No.		N02/042034	N02/042035	N02/042036	N02/042037	
Sample Reference	Units	CS1	CS3	CS8	CS9	Method
Organochlorine (OC) Pesticides						
HCB	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
gamma BHC (Lindane)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Heptachlor	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Aldrin	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
BHC(other than g-BHC)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Heptachlor epoxide	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Chlordane (trans and cis)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDE	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Dieldrin	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Endrin	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDD	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDT	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Methoxychlor	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Total Endosulfan	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19

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REPORT OF ANALYSIS

Report No. RN334803

Lab Reg No.		N02/042034	N02/042035	N02/042036	N02/042037	
Sample Reference	Units	CS1	CS3	CS8	CS9	Method
Surrogate						
Surrogate OC Rec.	%	100	100	100	104	NR_19
Dates						
Date extracted		23-DEC-2002	23-DEC-2002	23-DEC-2002	23-DEC-2002	
Date analysed		23-DEC-2002	23-DEC-2002	23-DEC-2002	23-DEC-2002	

Signed:

Danny Slee, Environmental Residues - NSW

Date: 13-JAN-2003

REPORT OF ANALYSIS

Client	: ENVIRONMENTAL & EARTH SCIENCES PO BOX 380 NORTH SYDNEY NSW 2059	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: ENVI10/021219 : QT-00500 : : : 19-DEC-2002
Attention	: HUGH MCCAFFERY	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
N02/042038	CS11	SOIL PALMERS ISLAND JOB 50212 COMP SS33, SS38, SS43, SS48
N02/042039	CS13	SOIL PALMERS ISLAND JOB 50212 COMP SS46, SS55, SS56, SS65
N02/042040	CS14	SOIL PALMERS ISLAND JOB 50212 COMP SS60, SS61, SS70, SS71
N02/042041	CS16	SOIL PALMERS ISLAND JOB 50212 COMP SS58, SS63, SS68, SS73

Lab Reg No.		N02/042038	N02/042039	N02/042040	N02/042041	
Sample Reference	Units	CS11	CS13	CS14	CS16	Method
Trace Elements						
Total Solids	%	83.5	85	82.1	86.1	NT2_49

Signed:

Dr. Honway Louie, Trace Elements - NSW

Date: 13-JAN-2003

Lab Reg No.		N02/042038	N02/042039	N02/042040	N02/042041	
Sample Reference	Units	CS11	CS13	CS14	CS16	Method
Organochlorine (OC) Pesticides						
HCB	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
gamma BHC (Lindane)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Heptachlor	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Aldrin	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
BHC(other than g-BHC)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Heptachlor epoxide	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Chlordane (trans and cis)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDE	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Dieldrin	mg/kg	0.011	<0.010	0.012	<0.010	NR_19
Endrin	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDD	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDT	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Methoxychlor	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Total Endosulfan	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19

AGAL

REPORT OF ANALYSIS

Lab Reg No.	Units	N02/042038	N02/042039	N02/042040	N02/042041	Method
Sample Reference		CS11	CS13	CS14	CS16	
Surrogate						
Surrogate OC Rec.	%	109	106	101	103	NR_19
Dates						
Date extracted		23-DEC-2002	23-DEC-2002	23-DEC-2002	23-DEC-2002	
Date analysed		23-DEC-2002	23-DEC-2002	23-DEC-2002	23-DEC-2002	

Signed:

Danny Slee, Environmental Residues - NSW

Date: 13-JAN-2003

AGAL

REPORT OF ANALYSIS

Report No. RN334803

Client	: ENVIRONMENTAL & EARTH SCIENCES PO BOX 380 NORTH SYDNEY NSW 2059	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: ENVI10/021219 : QT-00500 : : : 19-DEC-2002
Attention	: HUGH MCCAFFERY	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
N02/042042	CS21	SOIL PALMERS ISLAND JOB 50212 COMP SS91, SS100, SS101, SS110
N02/042043	CS23	SOIL PALMERS ISLAND JOB 50212 COMP SS83, SS88, SS93, SS98
N02/042044	CS25	SOIL PALMERS ISLAND JOB 50212 COMP SS95, SS96, SS105, BH106 (0-0.1M)
N02/042045	SS51	SOIL PALMERS ISLAND JOB 50212

Lab Reg No. Sample Reference	Units	N02/042042 CS21	N02/042043 CS23	N02/042044 CS25	N02/042045 SS51	Method
Trace Elements						
Total Solids	%	86.2	82.4	88.3	81.7	NT2_49

Signed:

Dr. Hon Kay Lolle, Trace Elements - NSW

Date: 13-JAN-2003

Lab Reg No. Sample Reference	Units	N02/042042 CS21	N02/042043 CS23	N02/042044 CS25	N02/042045 SS51	Method
Organochlorine (OC) Pesticides						
HCB	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
gamma BHC (Lindane)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Heptachlor	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Aldrin	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
BHC(other than g-BHC)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Heptachlor epoxide	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Chlordane (trans and cis)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDE	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Dieldrin	mg/kg	<0.010	<0.010	<0.010	0.011	NR_19
Endrin	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDD	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDT	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Methoxychlor	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Total Endosulfan	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Surrogate						
Surrogate OC Rec.	%	103	102	110	103	NR_19

AGAL

REPORT OF ANALYSIS

Report No. RN334803

Lab Reg No.	Units	N02/042042	N02/042043	N02/042044	N02/042045	Method
Sample Reference		CS21	CS23	CS25	SS51	
Dates						
Date extracted		23-DEC-2002	23-DEC-2002	23-DEC-2002	23-DEC-2002	
Date analysed		23-DEC-2002	23-DEC-2002	23-DEC-2002	23-DEC-2002	

Signed:

Danny Slee, Environmental Residues - NSW

Date: 13-JAN-2003

AGAL

REPORT OF ANALYSIS

Report No. RN334803

Client	: ENVIRONMENTAL & EARTH SCIENCES PO BOX 380 NORTH SYDNEY NSW 2059	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: ENVI10/021219 : QT-00500 : : : 19-DEC-2002
Attention	: HUGH MCCAFFERY	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
N02/042046	SS52	SOIL PALMERS ISLAND JOB 50212
N02/042047	BH53	SOIL PALMERS ISLAND JOB 50212 (0-0.1M)
N02/042048	SS54	SOIL PALMERS ISLAND JOB 50212
N02/042049	DUP1	SOIL PALMERS ISLAND JOB 50212

Lab Reg No.		N02/042046	N02/042047	N02/042048	N02/042049	
Sample Reference	Units	SS52	BH53	SS54	DUP1	Method
Trace Elements						
Total Solids	%	82.3	87.5	85.3	82.6	NT2_49

Signed:

Dr. Honway Louie, Trace Elements - NSW

Date: 13-JAN-2003

Lab Reg No.		N02/042046	N02/042047	N02/042048	N02/042049	
Sample Reference	Units	SS52	BH53	SS54	DUP1	Method
Organochlorine (OC) Pesticides						
HCB	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
gamma BHC (Lindane)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Heptachlor	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Aldrin	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
BHC(other than g-BHC)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Heptachlor epoxide	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Chlordane (trans and cis)	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDE	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Dieldrin	mg/kg	0.013	<0.010	<0.010	<0.010	NR_19
Endrin	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDD	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
DDT	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Methoxychlor	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Total Endosulfan	mg/kg	<0.010	<0.010	<0.010	<0.010	NR_19
Surrogate						
Surrogate OC Rec.	%	102	98	95	98	NR_19
Dates						
Date extracted		23-DEC-2002	23-DEC-2002	23-DEC-2002	23-DEC-2002	

AGAL

REPORT OF ANALYSIS

Report No. RN334803

Lab Reg No.	Units	N02/042046	N02/042047	N02/042048	N02/042049	Method
Sample Reference		SS52	BH53	SS54	DUP1	
Dates						
Date analysed		23-DEC-2002	23-DEC-2002	23-DEC-2002	23-DEC-2002	

Signed:

Danny Slee, Environmental Residues - NSW

Date: 13-JAN-2003

All results are expressed on a dry weight basis. TE Ref. SM377-02.8.

This Laboratory is accredited by the National Association of Testing Authorities, Australia. [Accreditation No 198].
The tests reported herein have been performed in accordance with its terms of accreditation.

Sample/s analysed as received.
This Report supersedes reports: *RN333158* *RN334547*

AUSTRALIAN GOVERNMENT ANALYTICAL LABORATORIES
ABN 51 835 430 479 002
1 Suakin Street, Pymble NSW 2073 PO Box 385 Pymble NSW 2073

AGAL

REPORT OF ANALYSIS

Report No. RN334804

Client	: ENVIRONMENTAL & EARTH SCIENCES PO BOX 380 NORTH SYDNEY NSW 2059	**Job No.** **Quote No.** **Order No.** **Date Sampled** **Date Received**	: ENVI10/021219 : QT-00500 : : : 19-DEC-2002
Attention	: HUGH MCCAFFERY	**Sampled By**	: CLIENT
Project Name	:		
Your Client Services Manager	: BRIAN WOODWARD	**Phone**	: (02) 94490151

Lab Reg No.	Sample Ref	Sample Description
N02/042050	SS16	SOIL PALMERS ISLAND JOB 50212

Lab Reg No.		N02/042050				
Sample Reference	Units	SS16				Method
Trace Elements						
Total Solids	%	90.9				NT2_49

Signed:

Dr. Honway Louie, Trace Elements - NSW

Date: 13-JAN-2003

Lab Reg No.		N02/042050				
Sample Reference	Units	SS16				Method
Total Petroleum Hydrocarbons						
TPH C6 - C9	mg/kg	<25				NGCMS_1121
TPH C10 - C14	mg/kg	<50				NGCMS_1112
TPH C15 - C28	mg/kg	<100				NGCMS_1112
TPH C29 - C36	mg/kg	<100				NGCMS_1112
Surrogate						
Surrogate 1 Rec.	%	98				
Surrogate 2 Rec.	%	98				
Dates						
Date extracted		20-DEC-2002				
Date analysed		20-DEC-2002				

Signed:

Danny Slee, Environmental Residues - NSW

Date: 13-JAN-2003

AGAL

REPORT OF ANALYSIS

All results are expressed on a dry weight basis. TE Ref. SM377-02.8.

This Laboratory is accredited by the National Association of Testing Authorities, Australia.
[Accreditation No 198].
The tests reported herein have been performed in accordance with its terms of accreditation.

Sample/s analysed as received.
This Report supersedes reports: *RN332535* *RN333158* *RN334553*

AUSTRALIAN GOVERNMENT ANALYTICAL LABORATORIES
ABN 51 835 430 479 002
1 Suakin Street, Pymble NSW 2073 PO Box 385 Pymble NSW 2073

AGAL

QUALITY ASSURANCE REPORT

Client: Environmental & Earth Sciences **AGAL Job No: ENVI10/021219**

Sample Matrix: Soil **Job No: 50212**

Analyte	LOR	Blank	Sample Duplicates			Sample Spikes		
			Sample	Duplicate	RPD	Spike 1	Spike 2	RPD
	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%
BTEX			**N02/042147**			**Blank Soil**		
Benzene	0.5	<0.5	<0.5	<0.5	-	103	98	4.9
Toluene	0.5	<0.5	<0.5	<0.5	-	103	101	2.3
Ethylbenzene	0.5	<0.5	<0.5	<0.5	-	98	95	2.6
Xylene	1.0	<1.0	2.9	3.0	3.4	99	97	2.5
TPH			**N02/042147**			**Blank Soil**		
TPH C6-C9	25	<25	<25	<25	-	101	98	3.1
			N02/042148			**Blank Soil**		
TPH C10-C14	50	<50	<50	<50	-	105	104	1.5
TPH C15-C28	100	<100	<100	<100	-	101	102	1.3
TPH C29-C36	100	<100	<100	<100	-	-	-	-
Surrogate 1 Recovery	-	-	101	103	2.0	101	104	2.9
Surrogate 2 Recovery	-	-	100	102	2.0	101	102	0.99

Results expressed in percentage (%) or mg/kg wherever appropriate on dry weight basis.
' - ' = Not Applicable.
Method used : AGAL Method NGC/MS 11.12 and 11.21
This report shall not be reproduced except in full.
Acceptable Spike recovery is 70-130% (For BTEX and TPH C6-C9)
Acceptable Spike recovery is 50-150% (For TPH C10-C36)
Acceptable RPDs on spikes and duplicates is 40%.
RPD= Relative Percentage Difference.

Signed:

Danny Slee, Senior Chemist
Environmental GCMS

Date: **9/01/03**

AUSTRALIAN GOVERNMENT ANALYTICAL LABORATORIES
ABN 51 835 430 479 002
1 Suakin Street, Pymble NSW 2073 PO Box 385 Pymble NSW 2073
Tel: +61 2 9449 0111 Fax: +61 2 9449 1653 www.agal.gov.au

ENVI10/021219
Due: 10/1/03

CHAIN OF CUSTODY - ORGANIC ANALYSIS REQUEST FORM

Sheet 1 of 2

Job No: 50212 Site Location: Palmers Island 1.4 Sampler: HUGH MCAFFERY

Date: 18.12.02 Lab: ACAL Report To: HUGH MCAFFERY

SAMPLE ID	ANTICIPATED RESULTS / EC RESULT	FID	pH	Sample Description: SOIL	WATER	SEDIMENT	Analysis Required - Barcodes: TPH	BTEX	PAH	OCP	EXTENDED 8270 SCAN	Barcode					Method: GC	GCMS	INFRARED
CS1				✓						✓		N02/042034							
CS3				✓						✓		N02/042035							
CS8				✓						✓		N02/042036							
CS9				✓						✓		N02/042037							
CS11				✓						✓		N02/042038							
CS13				✓						✓		N02/042039							
CS14				✓						✓		N02/042040							
CS16				✓						✓		N02/042041							
CS21				✓						✓		N02/042042							
CS23				✓						✓		N02/042043							
CS25				✓						✓		N02/042044							
SS51				✓						✓		N02/042045							
SS52				✓						✓		N02/042046			TE	✓			
BH53 0-0.1m				✓						✓		N02/042047			OE	1 of 16.			
SS54				✓						✓		N02/042048							
DUP1				✓						✓		N02/042049							
SS16				✓			✓					N02/042050			✓				
TS-TDT-SOL																			
TOTAL				17			1			16									

RECEIVED 10 DEC 11:30

TURN AROUND: (NORMAL) / 3 DAYS / 48 HRS / 24 HRS

COMMENTS: Could you please composite samples supplied in bags as per bag number and list attached to COC. These samples were taken from a sugar cane plantation. Could you please hold onto discrete samples after compositing.

	Time	Date
Left E&ES Site:	1.00pm	18.8.02
Transported By:	TNT	18.8.02
Received Lab:		
Fax Results Rec'd:		
Typed Results Rec'd:		

LAB SUPERVISOR:

Environmental & Earth Sciences
ph: (02) 9922 1777 fax: (02) 9922 1010

SYDNEY ANALYTICAL LABORATORIES

Office:
PO BOX 48
ERMINGTON NSW 2115

Laboratory:
1/4 ABBOTT ROAD
SEVEN HILLS NSW 2147
Telephone: (02) 9838 8903
Fax: (02) 9838 8919
A.C.N. 003 614 695
A.B.N. 81 829 182 852

CHECKED

ANALYTICAL REPORT for:

ENVIRONMENTAL & EARTH SCIENCES

PO BOX 380
NORTH SYDNEY 2059

ATTN: HUGH McCAFFERY

JOB NO:	SAL12814
CLIENT ORDER:	50212
DATE RECEIVED:	19/12/02
DATE COMPLETED:	08/01/03
TYPE OF SAMPLES:	SOILS
NO OF SAMPLES:	13

NATA Accredited Laboratory
Number: 1984

.....
Issued on 15/01/03
Lance Smith
(Chief Chemist)

ANALYTICAL REPORT

JOB NO: SAL12814
CLIENT ORDER: 50212

	SAMPLES	Cu mg/kg	Pb mg/kg	Zn mg/kg	Cd mg/kg	Cr mg/kg	Ni mg/kg
1	CS2	17	17	57			
2	CS4	15	18	56			
3	CS5	20	27	67	<0.5	15	6.0
4	CS6	15	19	54			
5	CS10	15	20	56			
6	CS12	16	18	53			
7	CS15	15	20	59	<0.5	16	10
8	CS18	15	20	59			
9	CS19	15	21	58			
10	CS24	17	22	74			
11	CS20	14	17	52	<0.5	15	8.0
12	SS67	10	19	51			
13	DUP/2	11	21	52			
	BCSS-1	18	21	115	<0.5	85	52
MDL		0.5	0.5	0.5	0.5	0.5	0.5
Method Code		M1	M1	M1	M1	M1	M1
Preparation		P3	P3	P3	P3	P3	P3

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL12814
CLIENT ORDER: 50212

	SAMPLES	As mg/kg	Hg mg/kg
3	CS5	5.0	0.090
7	CS15	5.5	0.12
11	CS20	5.0	0.12
	BCSS-1	11	0.14
MDL		0.5	0.005
Method Code		M7	M3
Preparation		P3	P1

RESULTS ON DRY BASIS

CERTIFIED REFERENCE MATERIAL

JOB NO: SAL12814
CLIENT ORDER: 50212

CRM Number	Analyte	Units	CRM Result	Certified Value	%Recovery	Acceptance Criteria %
BCSS-1	Copper	mg/kg	18	18.5	97	90-115
BCSS-1	Lead	mg/kg	21	22.7	93	90-110
BCSS-1	Zinc	mg/kg	115	119	97	90-110
BCSS-1	Cadmium	mg/kg	<0.5	0.25	-	-
BCSS-1	Chromium	mg/kg	85	123	69	60-80
BCSS-1	Nickel	mg/kg	52	55.3	94	90-110
BCSS-1	Arsenic	mg/kg	11	11.1	99	90-120
BCSS-1	Mercury	mg/kg	0.14	0.129	109	85-110

All results are within the acceptance criteria

Note: The hot acid digest does not always determine 'total' metals. Refractory elements such as Iron and Aluminium and some base metals (particularly Chromium) show lower recoveries depending on their form within the sample matrix. Silicates and oxides are normally less soluble than elements in metallic or salt forms. The acceptance criteria for this reference material is based on histories of analyte recoveries using the nitric acid based digestion procedures.

ANALYTICAL REPORT

JOB NO: SAL12814
CLIENT ORDER: 50212

METHODS OF PREPARATION AND ANALYSIS

The tests contained in this report have been carried out on the samples as received by the laboratory.

P3	Sample dried, jaw crushed and sieved at 2mm
P1	Analysis performed on sample as received
M1	Base Metal - Digestion Method 3050 (HNO_3/H_2O_2) Element determined by APHA 3111B (Flame AAS)
M7	Hydride Element - Digestion Method 7061 (HNO_3/H_2SO_4) Element determined by APHA 3114B (Hydride Generation AAS)
M3	Mercury - Digestion Method 7471 (HNO_3/HCl) Determined by APHA 3112B (Cold Vapour AAS)

A preliminary report was faxed on 08/01/03

CHAIN OF CUSTODY - INORGANIC ANALYSIS REQUEST FORM Sheet ___ of ___

Job No: 50212 Site Location: Palmers Island, NSW Sampler: HUGH MCAFFERY

Date: 17.12.02 Lab: SAL Report To: HUGH MCAFFERY

SAMPLE ID	pH	Sample Description: SOIL	WATER	SEDIMENT	Analysis Required: HEAVY METALS	IONIC BALANCE	PHENOLS	CEC AND EXCHANGEABLES	LEACH PROCEDURE	CYANIDE TOTAL/FREE	Cu, Pb, Zn					ANTICIPATED RESULTS/ TURNAROUND TIME
CS2		✓									✓					
CS4		✓									✓					
CS5		✓			✓											
CS6		✓									✓					
CS10		✓									✓					
CS12		✓									✓					
CS15		✓			✓											
CS18		✓									✓					
CS19		✓									✓					
CS24		✓									✓					
CS20		✓			✓											
SS67		✓									✓					
DUP 2		✓									✓					
TOTAL		13			3						10					

TURN AROUND: (NORMAL) / 3 DAYS / 48 HRS / 24 HRS

COMMENTS: Could you please composite samples supplied in bags as per number and list attached to COC. These samples were taken from a sugar cane plantation. Please hold discrete samples after compositing.

	Time	Date
Left E&ES Site:	1.00pm	18.8.02
Transported By:	TNT	18.8.02
Received Lab:	P. Magno (SAL)	19/12/02
Fax Results Rec'd		
Typed Results Rec'd		

LAB SUPERVISOR:

Environmental & Earth Sciences
ph: (02) 9922 1777 fax: (02) 9922 1010

APPENDIX D

PROCEDURES FOR QUALITY CONTROL AND QUALITY ASSURANCE

TABLE OF CONTENTS

1.0 INTRODUCTION

The terms "quality assurance" and "quality control" are often confused. With respect to laboratory analysis activities, these terms are defined in these guidelines as follows:

Quality Assurance (QA): "All the planned and systematic activities implemented within the quality system and demonstrated as needed to provide adequate confidence that an entity will fulfil requirements for quality". (ISO 8402-19941)

This encompasses all actions, procedures, checks and decisions undertaken to ensure the accuracy and reliability of analysis results. It includes routine procedures which ensure proper sample control, data transfer, instrument calibration, the decisions required to select and properly train staff, select equipment and analytical methods, and the day-to day judgements resulting from regular scrutiny and maintenance of the laboratory system.

Quality Control (QC): "The operational techniques and activities that are used to fulfil the requirements for quality". (ISO 8402-1994)

These are the components of QA which serve to monitor and measure the effectiveness of other QA procedures by comparison with previously decided objectives. They include measurement of the quality of reagents, cleanliness of apparatus, accuracy and precision of methods and instrumentation, and reliability of all of these factors as implemented in a given laboratory from day to day.

A complete discussion of either of these terms or the steps for implementing them is beyond the scope of this manual. It is widely recognised, however, that adoption of sound laboratory QA and QC procedures is essential and readers are referred to documentation available from the National Association of Testing Authorities (NATA), if further information is required.

The aim of a quality control and assurance program is to deliver data that is representative of what is sampled, precise, accurate and reproducible. In any program, quality control is required before assurance can be put in place. As investigations involve both field and laboratory analysis the QC/QA program is similarly divided. Field quality assurance is used not only to ensure precision, accuracy and reproducibility but that the sample is representative of the site conditions.

The objective of this document is to evaluate and identify quality data, which meets or exceeds Environmental & Earth Sciences Pty Ltd specifications and to ensure that sample

data is of the highest calibre. Data assessment for laboratories involved the comparison of laboratory QC/QA results to that of documented US EPA (1994) SW-846 methods (reference 1), US EPA CLP (1994) *National Functional Guidelines for Inorganic Data Review* (reference 8) and US EPA CLP *National Functional Guidelines for Organic Data Review* (reference 9), and other internationally recognised publications. Reference to Australian "in-house" laboratory methods, as well as specific company methods, may be applied. These are revisable through laboratory NATA assessments. All laboratory sample and QC/QA data for this project have been issued as final and have been checked by the following NATA Registered Laboratories, unless otherwise stated:

Project Laboratory (Inorganics): Sydney Analytical Laboratories, NATA Registration No. 1884 (Sydney); and

Project Laboratory (Organics): Australian Government Analytical Laboratories, NATA Registration No. 198 (Sydney).

This document provides a brief discussion on methods undertaken to collect and analyse samples, sample and document conveyance and quality assurance testing.

2.0 FIELD PROCEDURES FOR SAMPLING AND CONVEYANCE

2.1 Introduction

All soil, surface water, groundwater, and borewater sampling procedures to be followed are described in full in Environmental & Earth Sciences Pty Ltd *Soil, gas and groundwater sampling manual* (reference 6). The full copy is available for inspection if required. Some aspects, relevant to the investigations, are discussed below.

Other information is reported in Keith, 1991 (reference 3).

2.2 Sampling

2.2.1 General

The following standard procedures are employed during sampling of soil, soil gas and groundwater:

1. all sampling equipment is cleaned prior to the commencement of sampling;
2. sampling equipment is cleaned after each use or as required;
3. work in sites perceived to be 'cleaner' is undertaken first, where practical; and
4. only the minimum number of personnel necessary to achieve objectives are allowed within 10 metres of the sampling activity.

Gas chromatography and organic vapour analysis (OVA) can be employed to locate preferred sampling sites and will be employed to aid in selection of samples for laboratory analysis.

The procedures summarised below generally apply to most sites, however, variations may occur due to local conditions.

2.2.2 Soil sampling

Sample preservation and storage requirements depend on the parameters to be analysed.

Sample storage recommendations vary among authors, so the most commonly recommended containers for sampling for inorganic parameters and indicators are plastic, glass or teflon containers. Due to the possibility of leaching of metals from glass, Environmental & Earth Sciences Pty Ltd use plastic containers for metal analyses and glass containers for organic indicators such as TOC and oil and grease because of the increased adsorption of organics to plastics.

New sample bottles were used for every sample.

2.2.3 Groundwater sampling

Environmental & Earth Sciences Pty Ltd uses a submersible electric centrifugal pump for purging and groundwater sampling in > 40 mm diameter piezometers. This allows for a continuous water supply to the sample container. The pump is 38 mm in diameter and coated with an acetal co-polymer. It is driven by a 12 volt D.C. supply and is capable of pumping up to 10 L/min. A single pump is able to lift 8 m of water head and can be linked in series with other pumps for greater depths. Clear vinyl tubing (CVT) is connected between the pumps and is easily replaced to prevent cross contamination.

Amber glass bottles are used for samples being submitted for organic analysis while plastic bottles are used for samples being submitted for inorganic analysis. Samples to be submitted for cyanide analysis are preserved with sodium hydroxide to raise pH to between 10 and 11.

Bores are sampled using the following protocol:

1. The standing water level and the depth of each bore prior to purging is measured;
2. The submersible pump is then connected to the 12 volt supply and lowered beneath the water level;
3. Water is then pumped through the pumping arrangement before being placed into a container which houses the portable meters. During field sampling, pH, Eh (redox), electrolytic conductivity (EC), odour, clarity and recharge are measured and noted. A water sample is only taken after the pH, EC and pe of the water has stabilised or the water supply is running low.
4. The polyethylene container and cap are rinsed with groundwater taken from the bore. The vinyl hosing connected from the pump is then placed at the bottom of the sampling bottle;
5. If the water supply allows, the bottle is filled to overflowing one to two times the volume of the container. To minimise oxidation, all the trapped air is expelled completely from the sample bottle which is capped immediately after filling;
6. The bottles are then labelled with the appropriate information:

   project name and number;
   signature or initial of sample collector;
   date of sample collection;
   location.

Filtering is not carried out in the field because of the low volumes of water in the bores and slow yields. All samples are stored in an Esky with ice (below 4°C) and where possible taken to AGAL and SAL on the same day of sampling (which is usually less than 6 hours from taking the first sample). Preserving the samples without filtering is not undertaken as the addition of acid would result in stripping metals and ions from the suspended sediments which can cause erroneous results;

7. Between each sampling the pumps are cleaned either with water or rinsed with the proceeding bores groundwater; and
8. After the samples have been taken to AGAL and SAL they are filtered (<0.45μm) or centrifuged and prepared for analysis at the laboratory on the same day of sampling.

2.3 Sample labelling

In the field, each sample container will be clearly labelled with a waterproof marker. All or some of the following details will be recorded on each label:

1. project name and number;
2. hole number;
3. sample depth (for a soil sample);
4. date of sample collection;
5. signature or initial of sample collector; and
6. preservation treatment.

2.4 Equipment decontamination

All sampling equipment, and any items which come into contact with groundwater or soil samples, will be thoroughly washed with water, then rinsed with clean water and dried before the collection of each sample. This may be varied depending on the site conditions. Any items accidentally contaminated will be similarly washed before re-use. Should equipment become contaminated with oily wastes, acetone washing should be used if the decontamination detergents are unsuccessful in removing all organic residues.

Due care will be taken with the disposal of any wash water and residues from such cleaning operations. A sample of wash water will be kept and stored. If necessary, decontaminated wash water samples may be analysed to detect any cross contamination. Cleaning of equipment is addressed in the sampling manual.

2.5 Sample packing and transport

2.5.1 Chain of custody record

At the end of each days sampling the field manager in association with the project manager will select samples for laboratory testing based on the field observations and measurements, history and other data and specify the tests to be undertaken on each sample. Samples required for QC/QA will also be selected at this time.

Once selection has been made, the anticipated result range will be recorded (Organics: clear, trace, low, medium or high; Inorganics: trace, low, medium or high).

Before packing and dispatch of samples for analysis, a chain of custody form will be completed. This form will record details of the individual samples being dispatched and the details of analysis required for each individual sample, as well as relevant data for the laboratory.

A copy of the completed chain of custody record will be retained in the field job file and the original sent with the samples for analysis. A copy will be faxed or delivered to the offices of Environmental & Earth Sciences Pty Ltd together with the days geological logs and log of the days site activities including contractors work time. These will be placed in the job file in the office.

2.5.2 Packing

The refrigerated samples will be packed upright in an Esky with each jar or bottle, or plastic bag sealed in a larger bag containing all the samples from one hole. The original chain of custody form will be enclosed in each Esky that will be sealed, labelled and addressed to the analytical laboratory.

2.5.3 Transport

In general, the field scientists who collect the samples, whenever possible, packs the samples for delivery to the laboratory.

When the field scientist is unable to deliver the samples to the laboratory, arrangements will be made for a courier to dispatch samples to the analytical laboratories as soon as possible after packing, usually within 24 hours of the samples being taken.

Upon receipt of the samples the analytical laboratory will cross check the samples against the chain of custody form and report any discrepancies.

3.0 SAMPLE PREPARATION AND STORAGE

3.1 Selected laboratories

The laboratories selected to provide analytical services for this project were:

7. for inorganic analysis, Sydney Analytical Laboratories; and
8. for organic analysis, Australian Government Analytical Laboratories.

Both laboratories are located in Sydney.

Environmental & Earth Sciences Pty Ltd selected these laboratories on the following criteria:

1. inspection of the laboratories and a good working relationship with the chemists performing the tests resulting from at least 10 years association;
2. qualifications and experience of laboratory staff;
3. NATA registration for routine test methods and commonly encountered sample matrices,
4. satisfactory compliance to Environmental & Earth Sciences Pty Ltd quality objectives and response to out of specification or otherwise variable samples;
5. customer service assurances that all reports are to be issued within agreed time frames;
6. these laboratories certify that the results can be relied upon to be precise, accurate and reproducible; and
7. these laboratories carry all appropriate insurance.

Environmental & Earth Sciences Pty Ltd close association with the laboratories means that very rapid turnaround times can be achieved, if required.

Sydney Analytical Laboratories (SAL) and Australian Government Analytical Laboratory (AGAL) carry out extensive documented QA/QC procedures as set out in US EPA SW-846 "Test Methods for Evaluating Solid Waste" (June 1990) and APHA "Standard Methods for the Examination of Water and Waste-water" (19th Edition) Section 1020/1030. Both standards set out definitions of bias, lower limits of detection (LLD), precision, accuracy, completeness and comparability; along with correct procedures for standard / reagent preparations, instrument calibrations, data reduction validation and reporting, and corrective actions where required. The laboratory's QA/QC program have been fully approved by the National Association of Testing Authorities (NATA), and the list of analyses for which SAL and AGAL are accredited can be supplied on request.

The laboratories participate in frequent proficiency testing programs, which monitor inter-laboratory performance. Organisations running these round robins include NATA, FPA,

Water Board and ASPAC. Results of all programs are inspected during NATA laboratory audits, held every two years.

One facet of particular interest in the quality system is the nature and frequency of internal check standards and samples. These provide batch to batch monitoring of analytical data for precision and accuracy, enabling immediate corrective actions to be undertaken should any discrepancies come to light.

Any result that is considered by the chief chemist to be unusually high or above regulatory limits is automatically re-analysed. A significantly different result requires immediate remedial action on the whole sample batch (retesting or using an alternative analytical method).

3.2 Sample preparation

To obtain reproducible results it is essential that laboratories use standardised procedures for the preparation of samples. These procedures will not necessarily be the same for each sample but will comprise various combinations of the following treatments:

— separation and removal of extraneous components;
— homogenising;
— drying;
— grinding;
— sieving; and
— partitioning (to obtain representative portions).

The combination of treatments applied to any sample will depend primarily on the nature of the analytes of interest. These can be split into three broad categories:

— non-volatile compounds (including most metals, inorganics and some heavy organics);
— semi-volatiles compounds (many organics, some metals and other inorganics subject to evaporative losses); and
— volatile compounds (such as organic solvents and inorganic gases).

The laboratories address the problems associated with these steps in their own sampling manuals.

3.3 Sample storage

To maintain sample integrity, it is necessary that it is collected and kept in a container that will not add to or reduce the analyte concentration in the sample. It is also important to note that the less time the sample is stored, the more accurate the analytical result is likely to be. Table 1 lists the containers, maximum holding time and condition of the soil for the analytes included in these guidelines.

Storing of field moist samples has the disadvantage that it will allow faster degradation of analytes via microbial activity, particularly if samples are stored at ambient temperatures. Moist samples should therefore be stored at low temperature (4°C or below) and the analysis carried out within a reasonable time.

TABLE 1

CONTAINERS, HOLDING TIME AND CONDITION OF SOIL

Analyte	Method No.	Container[1]	Maximum holding time [4]	Sample condition
Leachable metals and semi-volatile organics	101	As for analyte of interest	As for analyte of interest	As for analyte of interest
Moisture content only	102	P or G	7 days	Field-moist
Moisture correction	102	As for analyte of interest	Same day as sample extraction for analyte	Field-moist
pH	103	P or G	7 days	Air-dry
Electrical conductivity	104	P or G	7 days	Air-dry
Organic carbon	105	G[2]	7 days	Air-dry
Metals (except mercury)	201, 202, 203	P (AW)	6 months	Field-moist or air-dry
Mercury	204	P (AW)[3]	28 days	Field-moist
Cation exchange capacity and exchangeable cations	301	P (AW)	6 months	Air-dry
Chloride (water soluble)	401	P or G	7 days	Field-moist or air-dry
Bromide (water-soluble)	402	P or G	7 days	Air-dry
Cyanide	403	P or G[2]	7 days	Field-moist
Fluoride	404	P	7 days	Field-moist or air-dry
Sulfur-total and Sulfate	405 and 406	P or G	7 days	Field-moist or air-dry
Sulfide	407	P or G[3]	7 days	Field-moist
Volatile organics: MAH, Halogenated HC and Miscellaneous	501.1, 501.2 and 501.3	G (SR)[2]	14 days	Field-moist
Semi-volatile organics		G (SR)[2]	14 days	Field-moist
PAH	502.1, 502.2		30/14 days	
Chlorinated hydrocarbons	503		30/14 days	
OC pesticides and PCB	504			
OP Pesticides	505		30/14 days	
Petroleum hydrocarbons	506.1, 506.2		30/14 days	
Phenols, Herbicides, Phthalate esters	507, 508, 509		30/14 days	

Notes:

1. Minimum volume of 250 mL; P = Plastic; G = Glass ; AW = Acid-washed; SR = Solvent rinsed
2. Store in the dark
3. Add sufficient 2M zinc acetate to fully cover surface of solid with minimal headspace; store at 4°C
4. 30/14: Soil holding time / other media holding time

Air-dried or oven-dried samples easily absorb moisture. Immediately after grinding, homogenising and partitioning, the prepared samples should be transferred into clearly

labelled and sealed containers to be stored under dry, relatively cool (<18°C) and low light conditions while awaiting analysis.

Exceedence of the storage time does not mean that the result is not useful, but only that the analyte decay or variation may have occurred.

All portions of the sample not analysed should be retained until agreed to or advised by the client that they may be discarded, or retained for a reasonable amount of time after the dispatch of the analytical report (eg two months).

4.0 LABORATORY DATA QUALITY OBJECTIVES

4.1 Introduction

Through the QC procedures adopted, the laboratory should be able to demonstrate:
— Method proficiency within the laboratory;
— Conformance to the performance characteristics expected of the method; and
— Confidence in the results produced.

Environmental & Earth Sciences Pty Ltd adopt the QC procedures described in Chapter 1: Quality Control in "Test Methods for Evaluating Solid Waste", USEPA Publication SW-846 4 (reference 1) in all analysis.

Many of the organic analysis methods recommended in this manual are derived from USEPA SW-846, and the QC procedures referred to above form a part of those methods. These procedures or variations of them can be incorporated into almost any analytical method. When using these USEPA methods, the analyst should consider the criteria for conformance to QC/QA requirements as discussed in "Criteria for Assessing Conformance to USEPA Testing Methods".

4.2 Recommended quality control procedures

The Australian and New Zealand Environmental and Conservation Council (1996) — *Guidelines for the laboratory analysis of contaminated soils* (reference 4) expect that laboratories would incorporate the following QC procedures:

4.2.1 Analysis blank

(at least one per process batch)

The component of the analytical signal which is not derived from the sample but from reagents, glassware, etc. can be determined by processing solvents and reagents in exactly the same manner as for samples. If below the maximum acceptable method blank (established during the method validation), this contribution is subtracted from the gross analytical signal for each analysis before calculating the sample analyte concentration. SAL reports that if the method blank value is greater than twice the detection limit, corrective action is taken to ascertain the source of contamination (frequency at SAL: 1 in 20 samples (5%)).

4.2.2 Laboratory replicate analysis

(at least one per process batch or one per ten samples, whichever is the smaller)

This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected for duplicate analysis should be one where the analyte concentration is easily measurable. The variation between duplicate analyses should be recorded for each process batch to provide an estimate of the precision of the method.

In the laboratory this occurs at a rate of 1 in every 10 to 20 samples for Environmental & Earth Sciences Pty Ltd samples. Sample batches of less than five samples may not include a sample duplicate unless specifically requested.

SAL reports that for soils, the sample is riffle divided into two equal portions at the preparation stage, and the duplicates analysed concurrently. For waters, the same sample is re-analysed at a different time, and occasionally by a different operator.

Replicate data for precision is expected to be <30% RPD (<40% for AGAL) at concentration levels greater than ten times the EQL, or <50% RPD at concentration levels less than ten times the EQL. Sample results identified with an RPD exceeding 100% shall require specific discussion. Certain methods may allow for threshold limits, which lie outside the above mentioned limits.

4.2.3 Field duplicate analysis

These samples provide a check on the analytical performance of the laboratory. On larger jobs, at least 5 percent of soil samples from a site are collected in duplicate. One of the duplicate samples from each split set is submitted to a secondary laboratory and the remaining samples to the primary laboratory. For comparability of data, it is important that there is little delay in the sample submission to allow minimum time difference between commencement of analysis by both laboratories. This is particularly important with the analysis of volatile compounds.

For split samples, because of error associated with field splitting, an RPD of between 80 and 150% (depending on the substance) is allowed. Soil heterogeneity due to the "nugget effect" could result in significantly greater difference, particularly for metals. Consequently, samples with the most observable field homogeneity are endeavoured to be selected.

Blind replicate samples provide a check of the repeatability of the laboratory's analysis. At least 5 percent of samples should be taken from a larger than normal quantity of soil collected from the same sampling point, removed from the ground in a single action if possible. This should be mixed as thoroughly as practicable and divided into two vessels. These samples should be submitted to the laboratory as two individual samples without any indication to the laboratory of their common source.

A similar test of analysis repeatability is provided by re-submission of previously analysed samples, provided the stability of analyte is adequate under the storage conditions used between the two submission dates.

4.2.4 Laboratory control sample

(at least one laboratory control sample per process batch)

This comprises either a standard reference material or a control matrix fortified with analytes representative of the analyte class. Recovery check portions should be fortified at concentrations which are easily quantified but within the range of concentrations expected for real samples.

Recovery data for any LCS is described by control limits specified by AGAL and SAL used and referenced to US EPA SW-846 guideline values (reference 1).

AGAL occasionally use their own SRMs prepared by their research department.

4.2.5 Matrix spikes

(one matrix spike for each soil type)

The purpose of the matrix spike is to monitor the performance of the analytical methods used, and to determine whether matrix interferences exist. When the recovery of the matrix spike is below the expected analytical method performance, it may be necessary to use other internal calibration methods, a modification of the analytical method or alternative analytical methods to accurately measure the analyte concentration in the extract.

In most cases, matrix spikes should be added at a concentration equivalent to the corresponding regulatory level. The spiking concentrations should be reported. If the analyte concentration is less than one half the regulatory level, the spike concentration may be as low as one half of the analyte concentration, but may be not less than five times the method detection limit. In order to avoid differences in matrix effects, the matrix spikes must be added to the same nominal volume of sample as that which was analysed for the un-spiked sample.

Matrix spikes are reported as a %R, one in every 20 samples for all Environmental & Earth Sciences Pty Ltd samples.

Recovery data for any matrix spikes is described by control limits specified by AGAL and SAL and referenced to US EPA SW-846 method guideline values.

SAL reports that to complement the use of certified referenced materials in soil work, water samples can be spiked with known concentrations of each analyte to assess analyte recovery and possible matrix interferences. This technique is most useful for metals testing, although it can also be applied to general chemistry parameters. The percent recovery should generally lie between 80-120% for most elements. This is usually undertaken only at our request.

For AGAL, the acceptable spike recovery range is as follows:

TABLE 2

AGAL – ACCEPTABLE SPIKE RECOVERY RANGE

Test	Acceptable spike recovery range
PAH / Phenols / 8270	50 – 150 %
TPH $C_{10} - C_{36}$	50 – 150 %
TPH $C_6 - C_9$ / BTEX	70 – 130 %

The list of the spiking mixes of AGAL is available upon request, but the concentration of the spikes should be stated in the report.

4.2.6 Surrogate spikes

(where appropriate)

For determinations where it is appropriate eg. chromatographic analysis of organics, surrogate spikes should be added to all analyses. Surrogate spikes are known additions to each sample, blank and matrix spike or reference sample analysis, of compounds which are similar to the analytes of interest in terms of:

1. extraction;
2. recovery through clean-up procedures; and
3. response to chromatography or other determination.

but which:

4. are not expected to be found in real samples;
5. will not interfere with quantification of any analyte of interest; and
6. may be separately and independently quantified by virtue of, for example, chromatographic separation or production of different mass ions in a GCIMS system.

Surrogate spikes are added to the analysis portion before extraction. The purpose of surrogates is to provide a means of checking, for one analysis, that no gross errors have occurred at any stage of the procedure leading to significant analyte losses.

In the case of organic analyses the surrogate spike compounds may be deuterated, alkylated or halogenated analogues, or structural isomers of analyte compounds.

Recovery data for accuracy is described by control limits specified by AGAL and SAL and referenced to US EPA SW-846 method guideline values. Surrogate compounds and their concentration should be specified. In the event that a surrogate recovery fails to comply with acceptable control limits, the following remedies shall proceed:

— the laboratory will be requested to review data;
— no further action necessary if all surrogate recoveries greater than the minimum specified %R and all sample concentration results reported are less than the EQL; and
— professional expertise is required where surrogate recoveries are reported below the acceptable control limits, which then may require additional analysis or retesting.

4.2.7 Internal standards

(where appropriate)

Use of internal standards is highly recommended for chromatographic analysis of organics. Internal standards are added, after all extraction, clean-up and concentration steps, to each final extract solution. The addition is a constant amount of one or more compounds with similar qualities as detailed in section 4.2.6 points 4, 5 and 6 above.

The purpose of internal standards is to check the consistency of the analytical step (eg. injection volumes, instrument sensitivity and retention times for chromatographic systems) and provide a reference against which results may be adjusted in case of variation (for organics analysis only).

Injection volume and instrument sensitivity variations are usually adjusted for by calibration using the ratio of peak height or area for analytes compared with that for the internal standards).

Note that the chromatograms for final extracts may then contain both internal and surrogate standards. The compounds used for these standards may be similar but the different stage of analysis at which they are added allows them to provide different information.

4.3 Method validation

4.3.1 Definition

This is the process of obtaining data on a method in order to determine its characteristic performance and to establish confidence in the use of the method to obtain reliable results. Method validation specific to each laboratory's operations needs to be performed before the method can be adopted and applied to the analysis of actual samples. The minimum validation data required are:

— accuracy;
— precision;
— percent recovery; and
— limits of detection and reporting.

4.3.2 Accuracy

Accuracy is a measure of the closeness of the analytical result obtained by a method to the "true" value. The following levels of accuracy should generally be achievable from a screening or reference method:

— screening method: within ± 40 % of:
  — the expected value of a certified reference material of similar matrix; or
  — the value obtained by a separately validated and recognised quantitative method for the sample matrix.
— reference method: within ± 15 % of:
  — the expected value of a certified reference material of similar matrix; or
  — the value obtained by a separately validated and recognised quantitative method for the sample matrix.

It is recognised, however, that coefficients of variation for a procedure can be expected to be higher for low concentrations of analytes, eg. those below ten times the minimum detectable concentration.

4.3.3 Precision

4.3.3.1 Definition

Precision is a measure of the variation in the method's results. It is a combination of two components, repeatability and reproducibility.

4.3.3.2 Repeatability

This is the precision that measures the variation in the method's results produced by the same analyst under conditions which are as close as possible using the same equipment in the one laboratory and within a short interval of time. Repeatability is expressed as a standard deviation. The smaller the standard deviation the better the repeatability. Determine the standard deviation as follows:
Perform at least 5 replicate analysis of each sample type expected to be analysed routinely. This should be repeated over at least three different analyte concentrations, across the range normally expected. From these results, calculate the standard deviation, s, for each concentration, c, as follows:

$$s_c = [\ \Sigma\ (X_i - X)^2 / (n - 1)]^{1/2}$$

where:
X_i = concentration of analyte of *i*th replicate
X = mean concentration of n replicate analytes
n = number of replicate analyses for that concentration

The acceptable repeatability of an analyte determination is, in general, two standard deviations of the mean value. This is not undertaken on each job, but undertaken quarterly for each analyte by the laboratory and reported to Environmental & earth Sciences Pty Ltd.

4.3.3.3 Confidence limit and confidence interval

When the results are assigned to the $\pm\ s_c$ multiples, they are the confidence limits eg. 10±4 mg/kg indicates the confidence limits are 6 and 14, while values from 6 to 14 represent the confidence interval. With the exception of research work, confidence limits are not reported.

4.3.3.4 Reproducibility

This is the precision that measures the variation in the method's results produced by different analysts in different laboratories under different conditions and using different equipment. It measures the 'ruggedness' of the method. Reproducibility data are best obtained through inter-laboratory comparisons and proficiency studies. Reproducibility is also expressed as a standard deviation.

4.3.4 Percent recovery

Percent recovery describes the capability of the method to recover a known amount of analyte added to a sample. This is the most realistic and useful term to be applied to the daily quality control of the analytical performance. The sample is spiked with a known quantity of the analyte such that the combined added and suspected natural concentration of the analyte is within the working range of the method. The longer the residence time of the spiked analyte before extraction or digestion, the closer is the simulation in recovering the analyte from the natural sample. The percent recovery is calculated as follows.

$$\% \text{ Recovery} = 100\ (c - a) / b$$

where:
a = natural concentration of analyte determined in the sample;
b = concentration of analyte added to the sample; and
c = concentration of analyte determined in the spiked sample.

Note that if a is known beforehand, c should be approximately twice a, or b should be approximately equal to a.

The data quality objectives for recovery are between 70 and 100%. Lower recoveries may be expected for low concentrations of analytes, or an unusual matrix.

4.3.5 Limits of detection and reporting

4.3.5.1 Limit of detection (LD)

This is the concentration of analyte which, when the sample is processed through the complete method, produces a response with a 95% probability that it is different from the blank.

4.3.5.2 Limit of reporting (LR)

The limit of reporting (LR), also known as the limit of quantitation, "is the lowest concentration of an analyte that can be determined with acceptable precision (repeatability) and accuracy under the stated conditions of the test". The limit of reporting is usually calculated as follows:

$LR = 10 \times LD$

5.0 ANALYTICAL PROCEDURES

5.1 Laboratory methods

All samples submitted for analysis for this project were analysed by one or more of the following listed laboratory methods. The laboratory test methods were NATA registered at the time of analysis.

Moisture: 5-10 g soil heated to 105°C for a minimum of 6 hours (SAL, reference US EPA 3550);

Extraction for organic compounds in soil: 10 g of sample (volatiles 8 g) extracted ultrasonically with methylene chloride for 30 minutes. Analysis undertaken using GC/MS for environmental samples (AGAL, reference based upon US EPA 625 and 625S);

Volatile TPH C_6-C_9: 5 mL extractant or water samples introduced by direct purging and analysed by capillary column Purge & Trap GC/FID (AGAL internal method NGCMS_1121, reference US EPA 5035 and 8015A);

Semi-volatile TPH C_{10}-C_{36}: extraction as above followed by analysis by GC/MS. The TPH and BTEX analysis is carried out in full scan mode. Any of the pollutants extracted and described in US EPA Method 625 can also be analysed, including PAHs, albeit at a lower sensitivity (typically 1 mg/mL for soil). This type of analysis can detect and identify many thousands of compounds with the capability for long term storage of the data for re-analysis should later questions arise as to the presence of a particular pollutant. (AGAL internal NGCMS_1112, reference US EPA 625);

BTEX: 5 mL of extractant or water samples introduced by direct purging and analysed. Analysis by capillary column purge and trap GC/FID, confirmation by secondary column technique (AGAL internal method NGCMS_1121, reference US EPA 5035 and 8015A);

PAHs: after extraction the sample is analysed by capillary column GC/MS. PAHs are normally analysed in selected ion monitoring (SIM) mode for enhanced sensitivity. The reporting level for soils is typically 0.1 µg/mL (AGAL internal method NGCMS_1111, reference US EPA 3510b, 8270);

SVOC Scan: Methods USA EPA SW846, 8270 is required by the EPA specifically for site validation. Environmental & Earth Sciences, together with AGAL, have adapted Method 8270 to serve as a suitable scanning test for investigations. The extraction is per 8270 and the GC/MS run is a modified 8270, however the data handling is not of the standard

8270 methodology. All data is saved to disk and anomalies above 1 to 5 ppm are interpreted as being present. An extended PAH scan is run as the standard and any detection above 5 ppm is analysed specifically and quantified. The modified 8270 scan Environmental & Earth Sciences wishes to utilise for this project is an acid leach. This will allow 95% of chlorinated phenols to be detected (method 8270 loses most chlorinated phenols under the standard procedure). The disadvantage of using the acid leach is that approximately a 10% loss of some pesticides will occur;

Total metals (As, Hg, Cd, Cr, Cu, Pb, Ni, Zn): 1 g soil digested with nitric perchloric acid for 10 minutes using microwave heating (crushed concrete ≤9 mm, and 1-2 mm fines used for digestion). Analysis by ICP/AES/MS, mercury analysis by Cold Vapour (SAL internal method M1 P3, M7 P3 and M3 P1, reference APHA 19th Edition 3111B, 3111C, 3112B, 3114B);

TSS: 100 mL water sample filtered through a wet 0.45 µm filter paper and dried for 1 hour at 104-105°C (SAL, APHA 19th Edition 2450D);

In addition to the above method descriptions, analysis was undertaken by AGAL for halogenated aliphatic compounds (AGAL internal method NGCMA_1120). Extraction and analysis by GC/MS is undertaken in a manner described for semi-volatile TPH fractions above. All other inorganic method procedures are as set out in the quality manual of SAL and AGAL laboratories and are available upon request.

TABLE 3

INORGANIC SOIL/WATER ANALYSIS - METHOD CODES/LLD'S

Parameter	Extraction (soils)	*Analysis (soils/waters)	mg/kg LLD (soils)	mg/L LLD (waters)
Total Solids		2540B	N/A	1
Suspended Solids		2540D	N/A	1
Total Dissolved Solids		2540C	N/A	1
Biochemical Oxygen Demand		5210B	N/A	5
Chemical Oxygen Demand		5220B	N/A	5
Turbidity		2130	N/A	0.1 NTU
Total Organic Carbon		5310B	N/A	0.1
Oil & Grease		5520D	N/A	1
Carbonate/Bicarbonate		2320B	N/A	1
Nitrite		4500B	N/A	0.1
Sulphide		4500B	N/A	0.1
Bromide		4500C	N/A	0.1
Organic Matter	Dichromate Oxidation	Walkley Black	100	N/A
Cation Exchange Capacity	Silver Thiourea Extraction	Pleysier & Juo	0.1 MEQ%	N/A
Exchangeable Cations	Silver Thiourea Extraction	Pleysier & Juo	0.01 MEQ%	N/A
Cu, Pb, Zn, Cd, Cr, Ni, Co, Fe, Mn, Ag, Na, K, Mg	US EPA 3050	3111B	0.5	0.01
Ca, Al, Ba, Sn, Ti, V, Mo	US EPA 3050	3111D	1	0.1
As, Se, Sb, Bi	US EPA 3050	3114B	0.5	0.01
Hg US EPA 7471	3112B	0.001	0.0001	
pH	1:5 Soil/Water Extract		4500HB	
Conductivity	1:5 Soil/Water Extract	2510	1 µS/cm	0.1 µS/cm
Ammonia	1:5 Soil/Water Extract	4500F	1	0.1
Fluoride	1:5 Soil/Water Extract	4500C	1	0.1
Chloride	1:5 Soil/Water Extract	4500D	5	1
Nitrate	1:5 Soil/Water Extract	4500C	1	0.1
Sulphate	1:5 Soil/Water Extract	DMR-$BaCrO_4$	5	1
Formaldehyde	1:5 Soil/Water Extract	Walker 1964	1	0.1
Thiocyanate	1:5 Soil/Water Extract	4500M	1	0.1
Phosphate	Colwell Extract	4500E	1	0.1
Total Phosphorous	HF/H_2SO_4 Digestion	4500BE	1	0.1
Total Organic Nitrogen	Distillation	4500B	10	1
Total Cyanide	Harwell UKAEA Nov 1981	4500CE	0.1	0.01
Free Cyanide	Harwell UKAEA Nov 1981	4500E	0.1	0.01
Total Phenolics	Harwell UKAEA Nov 1981	5530	0.1	0.01
Sulphide	High Temperature Furnace	4500E	10	0.1
Boron	1:5 Hot Water Extract	4500BB	5	0.1
Hexavalent Chromium	1:10 Phosphate Extract	3500D	1	0.1

Note: for method numbers refer to APHA 19th Edition

TABLE 4

INORGANIC SOIL/WATER ANALYSIS–METHOD DESCRIPTIONS

Parameter	Extraction Method	Analytical Method
Total Solids	Gravimetric 103-105°C	
Suspended Solids	Gravimetric 103-105°C	
Total Dissolved Solids	Gravimetric 180°C	
Biochemical Oxygen Demand	Oxygen Electrode	
Chemical Oxygen Demand	Reflux $K_2Cr_2O_7$ (2 hrs)	FAS Titration
Turbidity	Nephelometric	
Total Organic Carbon	TOC Analyser (GC)	
Oil & Grease	Reflux Freon (2 hrs)	Gravimetric 100-105°C
Carbonate/Bicarbonate	pH Titration	
Nitrite	Colour – Sulphanilamide	
Sulphite	Iodometric Titration	
Bromide	Ion Chromatography	
Organic Matter	$K_2Cr_2O_7$ Oxidation	FAS Titration
Cation Exchange Capacity	Silver Thiourea Extract	AAS – Flame
Exchangeable Cations	Silver Thiourea Extract	AAS – Flame
Cu, Pb, Zn, Cd, Cr, Ni, Co, Fe, Mn, Ag, Na, K, Mg	HNO_3/H_2O_2 Digestion HCl Leach	AAS – Flame
Ca, Al, Ba, Sn, Ti, V, Mo	As above	AAS – Flame (N_2O)
As, Se, Sb, Bi	As above	AAS – Hydride
Hg	Reflux HCl/HNO_3 Oxidation	AAS – Cold Vapour
pH	1:5 Soil/Water Extract (0.5 hr)	pH electrode
Conductivity	1:5 Soil/Water Extract (0.5 hr)	Conductivity
Ammonia	1:5 Soil/Water Extract (0.5 hr)	NH_3 Electrode
Fluoride	1:5 Soil/Water Extract (0.5 hr)	F Electrode
Chloride	1:5 Soil/Water Extract (0.5 hr)	Potentiometric Titration
Nitrate	1:5 Soil/Water Extract (0.5 hr)	Ion Chromatography
Sulphate	1:5 Soil/Water Extract (0.5 hr)	Colour – $BaCrO_4$
Formaldehyde	1:5 Soil/Water Extract (0.5 hr)	Colour – NASH Reagent
Thiocyanate Complex	1:5 Soil/Water Extract (0.5 hr)	Colour – Ferric
Phosphate	$NaHCO_3$ Extract (16 hrs)	Colour –
Molybdate		Ascorbic Acid Reduction
Total Phosphorus	HF/H_2SO_4 Digestion	Colour –
Molybdate		Ascorbic Acid Reduction
Total Organic Nitrogen	H_2SO_4 Digestion/ Distillation	NH_3 Electrode
Total Cyanide	0.2 N NaOH Extract (12 hrs)	Colour – Barbituric Acid
H_2SO_4		Colour – Barbituric Acid
Free Cyanide	0.2 N NaOH Extract (12 hrs)	
pH7	Distillation	
Total Phenolics	0.2 N NaOH Extract (12 hrs)	Colour – Aminoantipyrine
H_3PO_4	Distillation	
Sulphide	Furnace – 1 400°C	Iodometric Titration
Boron	1:5 Hot Water Extract	Colour – Curcumin
Hexavalent Chromium	KH_2PO_4 Extract (12 hrs)	Colour – Diphenylcarbazide

5.2 Method limitations

The following method limitations must be understood:

TPH C_6-C_9:
Analysis of TPH C_6-C_9 (AGAL internal method NGCMS_1121) is reported as total petroleum hydrocarbons (TPH). This analysis includes all methylene chloride/dichloromethane extractables (eg. phenols, PAHs, pesticides, BTEX, etc.), and may contain other non-petroleum type compounds which include natural organic compounds such as humic and fulvic acids. This limitation is used to advantage in data set quality assurance.

Semi-volatile TPH C_{10}-C_{36} surrogate:
Surrogate recoveries for semi-volatile TPH are generally considered as being inappropriate due to the non-target specific nature of the analysis. In addition, there is a significant possibility that surrogate spiking analytes would not be resolved from the FID detector response chromatogram in a positive sample, where the sample result is greater than the surrogate PQL/surrogate spike concentration ratio.

Filtered metals (As, Hg, Cd, Cr, Cu, Pb, Ni, Zn) and phosphate:
Environmental & Earth Sciences do not filter in the field or acidify samples. Acidification is undertaken in the field to lower the pH so that when Fe(II) is converted to Fe(III) iron peroxide is not precipitated. Other soluble metals and phosphate are co-precipitated and absorbed onto the amorphous iron hydroxide. Filtering removes colloidal matter prior to acidifying to prevent the release of adsorbed metals from colloids with pH variable charge and displacement by protons. Environmental & Earth Sciences field methods are undertaken to ensure that the sample is taken with minimal disturbance and minimal introduction of oxygen. Groundwater is pumped until Eh is stabilised, at which point the hose is carefully removed from the bottle whilst pumping is continued. No void space is left at the top of the sample and the sample is chilled and taken to the laboratory within 8 hours of sampling. When sampling occurs such that the samples cannot be at the laboratory within 8 hours, the samples are filtered (limited only to when TSS is less than 100 ppm) and acidified for heavy metals.

Preservation treatments and careful handling is unnecessary when Fe(II) concentration is less than $1x10^{-8}$ mg/L. This can be calculated for water in poorly weathered soils by:

$$\text{Log Fe(II)} = 15.75 - pe - 3pH$$

And for water in highly weathered soils and many rocks where goethite exists by:

$$\text{Log Fe(II)} = 13.04 - pe - 3pH$$

5.3 Procedures for anomalous samples and confirmation checking

All results are checked for discrepancies by the project manager, against the anticipated result and all other results, within 8 hours of receipt of the result.

Any result that is considered by the supervising scientist to be unusually high or at variance with other results is automatically re-analysed. A significantly different result requires immediate remedial action on the whole sample batch (retesting or using an alternative analytical method) at the laboratory's expense.

After appropriate checking by laboratories, all sample analysis results work-sheets, including those of duplicates and replicate analyses, are provided at least weekly to Environmental & Earth Sciences for checking. Any results requiring confirmation will be re-analysed at the laboratory's cost.

Soil is defined as that passing through a 2 mm sieve when air dry. The gravel fraction (that retained) is assumed to be inert. Analysis is undertaken on the less than 2 mm fraction where possible. This procedure is not possible for organics, and original laboratory sheets are reported on 'an as received' basis unless a correction has been applied.

All results of chemical analysis are analysed on an air dry weight basis and reported on an oven (105°C) dry weight basis, unless specified otherwise.

Once confirmation checking is completed the final laboratory report is issued.

6.0 DATA POINT VALIDATION

Data assessment was undertaken on samples documented in the chain of custody forms presented in Appendix B.

6.1 Sample integrity and containers

Chain of custody documentation were sighted and dated by AGAL and stated that all samples were received in good order and were presented in adequate sample containers. No correspondence from SAL was received stating that samples were not received in good order.

6.2 Holding times

Holding times for all analysis undertaken are presented in Table 5 :

TABLE 5

MAXIMUM HOLDING TIMES

Analyte	Dates			Maximum holding time	Conclusion
	received	extracted	analysed		
Semi-volatile organics					
Petroleum hydrocarbons	19/12/02	20/12/02	20/12/02	30/14 days	correct
OCP	19/12/02	23/12/02	23/12/02	14 days	correct
Inorganics					
Heavy metals	19/12/02	-	08/01/03	6 months	correct

Holding times for all analysed samples were within the stipulated are correct.

6.3 Field duplicates

6.3.1 Number of field duplicates

The number of field duplicates for this project is reported in the Table 6:

TABLE 6

NUMBER OF FIELD DUPLICATES

Compound analysed	Number of analyses undertaken	Number of field duplicates
Organochlorine Pesticides	16	1
Copper, lead & zinc	10	1

The number of field duplicates complies with the requirements detailed in AS4482.1 and is therefore considered adequate for this project.

6.3.2 Relative percentage difference values

Blind duplicate samples were collected for both organic and inorganic compounds at this site and calculations of the relative percentage difference (RPD) values are presented below.

Table 7 contains the blind duplicate results for soil organic analysis for TPH and organochlorine pesticides, Table 8 contains the blind duplicate results for soil inorganic analysis. No exceedences of selected RPD values were noted in Tables 7 and 8, which therefore means that the duplicates are acceptable for this project.

TABLE 7

SOIL ORGANIC FIELD BLIND DUPLICATE QA/QC RESULTS

Sample	MDL	SS4	DUP1	RPD (%)	AcceptancCriteria
OCPs					
HCB	0.01	<0.01	<0.01	-	RPD <80-150%
Lindane	0.01	<0.01	<0.01	-	RPD <80-150%
Heptachlor	0.01	<0.01	<0.01	-	RPD <80-150%
Aldrin	0.01	<0.01	<0.01	-	RPD <80-150%
BHC	0.01	<0.01	<0.01	-	RPD <80-150%
Heptachlor epoxide	0.01	<0.01	<0.01	-	RPD <80-150%
Chlordane	0.01	<0.01	<0.01	-	RPD <80-150%
DDE	0.01	<0.01	<0.01	-	RPD <80-150%
Dieldrin	0.02	0.013	<0.01	26	RPD <80-150%
Endrin	0.01	<0.01	<0.01	-	RPD <80-150%
DDD	0.01	<0.01	<0.01	-	RPD <80-150%
DDT	0.01	<0.01	<0.01	-	RPD <80-150%
Methoxychlor	0.01	<0.01	<0.01	-	RPD <80-150%
Endosulfan	0.01	<0.01	<0.01	-	RPD <80-150%

Notes:
1. MDL method detection limit
2. AC acceptance criteria
3. BD field blind duplicate
4. RPD relative percentage difference
5. all units in mg/kg on a dry weight basis

TABLE 8

INORGANIC FIELD BLIND DUPLICATE QA/QC RESULTS

Sample	SS67	DUP2	RPD(%)	Acceptance criteria
Depth (m)	0-0.1			
Heavy Metals				
Copper	10	11	10	RPD <80-150%
Lead	19	21	10	RPD <80-150%
Zinc	51	52	2	RPD <80-150%
Cadmium	-	-	-	-
Chromium	-	-	-	RPD <80-150%
Nickel	-	-	-	RPD <80-150%
Arsenic	-	-	-	RPD <80-150%
Mercury	-	-	-	RPD <80-150%

Notes:
1. MDL method detection limit
2. FD field blind duplicate
3. RPD relative percentage difference
4. all units in mg/kg on a dry weight basis

6.4 Laboratory QA/QC

6.4.1 Surrogate recoveries

Surrogate recoveries and laboratory duplicates for all organic analyses undertaken were within acceptable laboratory error, and results are presented as part of the original laboratory transcript in Appendix B.

6.4.2 Blanks

For AGAL, the quality assurance reports presented with the laboratory certificates (report number ENVI10/021219) presented in Appendix B indicates that the laboratory method blanks were identified as being free of analyte concentrations above the reported EQLs, LORs or PQLs.

6.4.3 Laboratory sample duplicates

For AGAL, the quality assurance reports presented with the laboratory certificates in Appendix B indicates that the laboratory sample duplicate results meet the DQOs for the project.

For SAL, the quality assurance report presented indicates that a laboratory sample duplicate undertaken on sample SS67 met the DQOs for the project.

6.4.4 Matrix spikes and duplicate matrix spikes

For AGAL, the quality assurance report presented with the laboratory certificates in Appendix B indicates that sample spikes and duplicate matrix spikes for TPH and BTEX meet the DQOs for the project.

SAL undertakes analysis of certified reference material (BCSS-1), an international standard of known concentrations, as part of their internal QA/QC program. Results from SAL laboratory certificate (job number SAL12814) presented in APP B indicate that all results were within the DQOs for this project.

6.5 Data point QC/QA conclusions

The data can be accepted as being accurate, precise and reproducible.

7.0 DATA SET COMPARABILITY

7.1 Data compatibility

7.1.1 Definition

Data compatibility is authenticated by confirming that the laws of chemistry are upheld, that intra-laboratory analysis relationships are consistent, that observations and field measurements are in agreement with other field data and the laboratory data and that results are consistent with the geology, history and logic.

7.1.2 Chemical laws

BTEX did not exceed C_6-C_9 totals. Cations and anions have a balanced charge.

7.1.3 Comparison of field measurement, observation and laboratory data

Field observations and measurements correlated well with laboratory data in all instances.

7.1.4 Consistency of laboratory data with geology, history and logic

The organic and inorganic analyses are consistent with the geology, groundwater flow, known site history and previous investigations. No analysis is outside logical explanation.

7.1.5 Intra-laboratory analysis relationships

The following data relationships due to method procedure occurred:

— no data relationships due to method procedure occurred in organic compound analysis because non-detectable concentrations were found in all samples.

7.2 Data set conclusion

The laboratory data is consistent with the field observations, the geology of the site and the previous investigation results, and the laws of chemistry have been upheld. The data set is consistent, and the laboratory results can be seen as representative of the site condition.

The data can be accepted as being representative of samples taken from the site.

8.0 CONCLUSION

The following comments can be viewed as an overall summary of the quality of the analytical component for this project No 50212:

— sample integrity and container requirements were recorded on chain of custody documentation and laboratory sample receipt advice forms as being satisfactory; and

— sample extraction and analyses were performed within the required holding times for all analyses.

Analytical data reported by SAL and AGAL can be judged to have met the essential criteria for data quality commissioned by Environmental & Earth Sciences Pty Ltd for the project. In summary, data assessment involved the examination of laboratory results, COC documentation and field QC/QA data.

Laboratory surrogate recovery indicated that laboratory accuracy was acceptable. The matrix spike (duplicate) and laboratory batch recovery all meet the data quality objectives and are therefore acceptable. All laboratory QC/QA method blanks were found to be free of analyte concentrations above the reported LORs. Sample duplicate and laboratory batch RPD results indicated that sample precision was acceptable, given the nature of the contamination.

Field data was in agreement with laboratory data and both were internally coherent. Intra-laboratory relationships were found to be acceptable. Chemical laws were upheld. Therefore, data can be considered as representative.

In summary, the QC/QA data reported by SAL and AGAL for the documented soil samples were determined to be of sufficient quality to be considered acceptable to comply with the Environmental & Earth Sciences Pty Ltd quality protocols for the project, Report No 50212. This report has therefore concluded that the QC/QA data set and field duplicate results are free of systematic, method biases and field sampling errors, and the data is representative of the site conditions.

9.0 DEFINITIONS OF TERMS

The following terms are defined for use in this document:

ACCURACY	The closeness of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy will be a combination of a random component and of a common systematic error (or bias) component.
BATCH	A group of samples which behave similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.
BIAS	The deviation due to matrix effects of the measured value ($X_s - X_u$) from a known spiked amount. Bias can be assessed by comparing a measured value to an accepted reference value in a sample of known concentration or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike). Thus, the bias (B) due to matrix effects based on a matrix spike is calculated as: $B = (X_s - X_u) - K$ where: X_s = measured value for spiked sample; X_u = measured value for unspiked sample; and K = known value of the spike in the sample. Using the following equation yields the percent recovery $\%R = 100\ (X_s - X_u) / K$
BLANK	see Equipment Rinsate, Method Blank, Trip Blank.
CERTIFIED REFERENCE MATERIAL	Solid material or solution in which the concentration of analytes are known accurately within specified limits of confidence. Most commonly used for the analysis of metals in soils. Water CRM's are not stable over long periods and thus not recommended for routine analysis. These materials are very useful in monitoring digestion efficiencies, thus indicating whether or not "total" analyte concentration is being determined.
CONTROL SAMPLE	A QC sample introduced into a process to monitor the performance of the system.
DATA QUALITY OBJECTIVES (DQOs)	A statement of the overall level of uncertainty that a decision-maker is willing to accept in results derived from environmental data. This is qualitatively distinct from quality measurements such as precision, bias, and detection limit.
DATA VALIDATION	The process of evaluating the available data against the project DQOs to make sure that the objectives are met. Data validation may be very rigorous, or cursory, depending on project DQOs. The available data reviewed will include analytical results, field QC data and lab QC data, and may also include field records.

DUPLICATE	Laboratory duplicate samples measure precision, which is calculated as SD or RPD. Duplicates are collected in a single sample container in the field and are analysed as two separate extractions. %RPD is expressed as $\frac{(D1-D2)}{(D1+D2)/2}\times 100$ where: D1 = sample concentration; and D2 = duplicate sample concentration. Variation in duplicate results outside the RPD acceptance criteria (depending on analyte) may highlight problems with analyte stability, digestion / extraction procedures and cross contaminations. see also Matrix Duplicate, Field Duplicate, Matrix Spike Duplicate.
EQUIPMENT BLANK	see Equipment Rinsate.
EQUIPMENT RINSATE	A sample of analyte-free media which has been used to rinse the sampling equipment. It is collected after completion of decontamination and prior to sampling. This blank is useful in documenting adequate decontamination of sampling equipment.
ESTIMATED QUANTITATION LIMIT (EQL)	The lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The EQL is generally 5 to 10 times the MDL. However it may be nominally chosen within these guidelines to simplify data reporting. For many analytes, the EQL analyte concentration is selected as the lowest non-zero standard in the calibration curve. Sample EQLs are highly matrix-dependent. The EQLs in SW-846 (reference 1) are provided for guidance and may not always be achievable.
FIELD DUPLICATES	Independent samples which are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analysed independently. These duplicates are useful in documenting the precision of the sampling process.

LABORATORY CONTROL SAMPLE	A known matrix spiked with compounds representative of the target analytes. This is used to document laboratory performance. The laboratory control samples (LCS) or standard reference materials (SRMs) are an externally prepared and supplied reference material containing representative analytes under investigation. The LCS monitors long term accuracy and is reported as a %R. Matrix spike (MS) data may be substituted with LCS data where applicable. %R is expressed as $\frac{(SSR - SR)}{SA} \times 100$ where: SSR = spiked sample result; SR = sample result (blank); and SA = spike added.
MATRIX:	The component or substrate (eg, surface water. drinking water) which contains the analyte of interest.
MATRIX DUPLICATE	An intra-laboratory split sample which is used to document the precision of a method in a given sample matrix.
MATRIX SPIKE	An aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. Environmental samples are spiked with laboratory grade standards to determine the interactive effects between the sample matrix and the analytes being measured. Matrix compounds and their concentration should be specified. Matrix spikes are reported as a %R. Spiking concentration is greater than the sample concentration but not usually greater than ten times the EQL. %R is expressed as $\frac{(SSR - SR)}{SA} \times 100$ where: SSR = spiked sample result; SR = sample result (blank); and SA = spike added.
MATRIX SPIKE DUPLICATES	Intra-laboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.

METHOD BLANK

An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to assess inherent analyte contamination or interferences over the whole analytical procedure, either from reagent quality or testing environment. The method blank (or reagent blank as it is also known) consists simply of an aliquot of de-ionised water that is carried through the entire testing procedure with each sample batch.
For a method blank to be acceptable for use with the accompanying samples, the concentration in the blank of any analyte of concern should not be higher than the highest of either:

1. the method detection limit, or
2. five percent of the regulatory limit for that analyte, or
3. five percent of the measured concentration in the sample.

METHOD DETECTION LIMIT (MDL)

The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte.
For operational purposes, when it is necessary to determine the MDL in the matrix, the MDL should be determined by multiplying the appropriate one-sided 99% t-statistic by the standard deviation obtained from a minimum of three analyses of a matrix spike containing the analyte of interest at a concentration three to five times the estimated MDL, where the t-statistic is obtained from standard references or the table below.

No. of samples:	t-statistic
3	6.96
4	4.54
5	3.75
6	3.36
7	3.14
8	3.00
9	2.90
10	2.82

Estimate the MDL as follows:

1. Obtain the concentration value that corresponds to:
   a an instrument signal / noise ratio within the range of 2.5 to 5.0, or
   b the region of the standard curve where there is a significant change in sensitivity (ie a break in the slope of the standard curve).
2. Determine the variance (S^2) for each analyte
3. Determine the standard deviation (s) for each analyte (square root of S^2)
4. Determine the MDL for each analyte as follows:
   MDL = $t_{(n-1,\ \alpha = 0.99)}$ (s)
   where $t_{(n-1,\ \alpha = 0.99)}$ is the one-sided t-statistic appropriate for the number of samples used to determine (s), at the 99 percent level.

ORGANIC-FREE REAGENT WATER	For volatiles, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionised water. Organic-free reagent water may also be prepared by boiling water for 15 minutes and, subsequently, while maintaining the temperature at 90°C, bubbling a contaminant-free inert gas through the water for 1 hour. For semivolatiles and nonvolatiles, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionised water.
PRECISION	The agreement among a set of replicate measurements without assumption of knowledge of the true value. Precision is estimated by means of duplicate / replicate analyses. These samples should contain concentrations of analyte above the MDL, and may involve the use of matrix spikes. The most commonly used estimates of precision are the relative standard deviation (RSD) or the coefficient of variation (CV). RSD = CV = 100 S / E(X), where: E(X) = the arithmetic mean of the X_i measurements, and S = variance; and the relative percent difference (RPD) when only two samples are available. RPD = 100 $[(X_1 - X_2) / \{(X_1 + X_2) / 2\}]$.
PROJECT	Single or multiple data collection activities that are related through the same planning sequence.
QUALITY ASSURANCE PROJECT PLAN (QAPjP)	An orderly assemblage of detailed procedures designed to produce data of sufficient quality to meet the data quality objectives for a specific data collection activity.
REAGENT BLANK	See Method Blank.
REAGENT GRADE	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
REAGENT WATER	Water that has been generated by any method which would achieve the performance specifications for ASTM Type II water. For organic analyses, see the definition of organic-free reagent water.
REFERENCE MATERIAL	A material containing known quantities of target analytes in solution or in a homogeneous matrix. It is used to document the bias of the analytical process.
REPLICATES	See Split Samples

SPLIT SAMPLES	Aliquots of sample taken from the same container and analysed independently. In cases where aliquots of samples are impossible to obtain, field duplicate samples should be taken for the matrix duplicate analysis. These are usually taken after mixing or compositing and are used to document intra or inter-laboratory precision. They are used to assess analytical precision and sample matrix effects, especially for soil samples where homogeneity may be a problem.
STANDARD ADDITION	The practice of adding a known amount of an analyte to a sample immediately prior to analysis. It is typically used to evaluate interferences.
STANDARD CURVE	A plot of concentrations of known analyte standards versus the instrument response to the analyte. Calibration standards are prepared by successively diluting a standard solution to produce working standards which cover the working range of the instrument. Standards should be prepared at the frequency specified in the appropriate section. The calibration standards should be prepared using the same type of acid or solvent and at the same concentration as will result in the samples following sample preparation. This is applicable to organic and inorganic chemical analyses.
STANDARD REFERENCE MATERIAL	See Laboratory Control Samples
SURROGATE	An organic compound which is similar to the target analyte(s) in chemical composition and behaviour in the analytical process, but which is not normally found in environmental samples. Surrogates are QC monitoring spikes, which are added to all field and QC/QA samples at the beginning of the sample extraction process in the laboratory, where applicable. Surrogates are closely related to the sample analytes being measured and are not normally found in the natural environment. Surrogates are measured as %R. %R is expressed as $\frac{(SSR - SR)}{SA} \times 100$ where: SSR = spiked sample result; SR = sample result (blank); and SA = spike added.
TRIP BLANK:	A sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organics samples.

10.0 ABBREVIATIONS

%R	Percent recovery
Al	Aluminium
As	ARSENIC
Ba	Barium
BCSS	British Columbia standard sediment
Bi	Bismuth
BTEX	Benzene, toluene, ethyl benzene, xylene
Ca	Calcium
Cd	Cadmium
Co	Cobalt
COC	Chain of custody
Cr	Chromium
Cu	Copper
DQO	Data quality objectives
DSCF	Data set comparability figure
EQL	Estimated quantitation limit
Fe	Iron
FID	Flame ionisation detector
GC/FID	Gas chromatography/ flame ionisation detector
GC/MS	Gas chromatography/mass spectrometer
Hg	Mercury
ICPAES/MS	Inductively coupled plasma atomic emission spectrometer/mass spectrometer
K	Potassium
LCS	Laboratory control samples
LLD	Lower limit of detection
LOR	Limit of reporting
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
NATA	National accreditation testing authority
Ni	Nickel
OC	Organochlorine pesticides
OP	Organophosphate pesticides
OVA	ORGANIC VAPOUR ANALYSIS
PAHs	Polycyclic aromatic hydrocarbons
Pb	Lead
PCBs	Poly-chlorinated biphenyls
PQL	Practical quantitation limit
QA	Quality assurance
QC	Quality control
RPD	Relative percent difference
Sb	Antimony
SD	Standard deviation
Se	Selenium

Sn	Tin
SRMs	Standard reference materials
SVOC	Semi volatile organic compounds
TCLP	Toxicity characteristic leachate procedure
Ti	Titanium
TPH	Total petroleum hydrocarbons
TSS	Total soluble salts
V	Vanadium
Zn	Zinc

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