



**Douglas Partners**

*Geotechnics • Environment • Groundwater*

*Integrated Practical Solutions*

**REPORT  
on  
GEOTECHNICAL AND CONTAMINATION  
ASSESSMENT**

**MINTO RENEWAL PROJECT  
MINTO**

**Prepared for  
HUGHES TRUEMAN**

**Project 43104  
May 2005**



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**REPORT ON**  
**GEOTECHNICAL AND CONTAMINATION ASSESSMENT**  
**MINTO RENEWAL PROJECT, MINTO**

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## **1. INTRODUCTION**

This report presents the results of a preliminary geotechnical and contamination assessment of the Minto Renewal Project at Minto. The report was prepared at the request of Hughes Trueman, on behalf of Landcom.

It is understood that a master plan is being developed for renewal of the Department of Housing's Minto estate, and that information on geotechnical and contamination issues is required for input into the concept designs.

The investigation was carried out in 2003 and comprised the review of available information, drilling of test bores and laboratory tests on selected soil samples. Details are given in the report, together with comments on the findings of the investigation and recommendations for development of the site.

## **2. SITE DESCRIPTION**

The Minto Renewal Project is located approximately 5 km north of Campbelltown in an area to the east of the Minto railway station. The site comprises an irregular shaped area of about 140 hectares, bounded approximately by Benham Road to the north, Eagleview Road to the east, Pendergast Avenue to the south, and Townson and Guernsey Avenues to the west.

An extract of the 1:100,000 topographic map for the area is given on Drawing 2 and shows that the eastern boundary of the site runs along the crest of a north-easterly trending ridge, with most of the site being located on the west facing slopes of the ridge. The site generally

slopes towards the north-west and includes some local drainage depressions, also trending in a north-westerly direction towards Bow Bowing Creek.

The site includes gently undulating small hills and valleys with slopes are mostly in the range of 2% to 10%, but some local slopes near the crests of the ridges are up to 20%.

At the time of the investigation the site had been substantially cleared of the original vegetation, and most of the site was occupied by housing areas with some parks and reserves. The eastern, steeper part of the site, adjacent to Eagleview Road, was typically not developed, being mostly open grassland. A water reservoir is located on a high point of the ridge adjacent to a bend in Eagleview Road

### **3. REGIONAL GEOLOGY**

The site is mapped on the Wollongong 1:100 000 Geological Series Sheet as being underlain by Ashfield Shale of Triassic Age. An extract of the regional geological map is given on Drawing 3.

Ashfield Shale (Rwa) is the lowest member of the Wianamatta Group of rocks and typically comprises dark grey to black claystone and siltstone with some finely interbedded sandstone and siltstone (known as laminite) and some beds of fine grained sandstone. The Ashfield Shale usually weathers to form moderately to highly reactive clay soils.

Hawkesbury Sandstone (Rh) is shown on the geological map as occurring in some of the lower areas to the east, south and north of the site, particularly along the deeper incised creek valleys. Hawkesbury Sandstone typically comprises medium to coarse grained quartz sandstone with minor lenses of mudstone or siltstone. This rock formation underlies the Ashfield Shale, and the sandstone exposures in nearby creeks indicate that the site is probably mostly located on the lower beds of the Ashfield Shale

To the west of the site the geological map indicates that there is Quaternary Alluvium (Qal) deposited along the valley of Bow Bowing Creek. The alluvium has been deposited by the creek and includes sand, silt and clay. It is possible that the alluvium extends further up the smaller tributary creeks than is shown on the geological map.

The geological map indicates that the site is located just to the west of the “South Coast Warp” and the “Coastal Lineament”, both of which trend in a north-easterly direction along the line of the local ridge. In addition the map shows a fault trending in a north-westerly direction from the northern end of the site. None of these regional structural features are likely to have any significant geotechnical impact on the proposed development of the site.

#### **4. SOIL LANDSCAPES**

Reference to the “Soils Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet”, published by the Soil Conservation Service of NSW in 1990, indicates that the site is located entirely on soils of the Blacktown Soil Landscape Group (bt). An extract from the Soil Landscapes map is given on Drawing 4.

The Blacktown Group is a residual landscape derived from the weathering of the underlying shales and sandstones of the Wianamatta Group. These soils typically occur on gently undulating rises with local relief to 30 m but slopes usually less than 5%. The landscape is typified by broad rounded crests and ridges with gently inclined slopes. The original vegetation on these soils would have been predominantly eucalypt woodland, open-forest and tall open-forest (wet sclerophyll forest).

The soils on the crests, upper slopes and in well drained areas are red podzolic and brown podzolic soils typically less than 1.5 m deep. On the lower slopes and in localised areas of poor drainage the soils may be up to 3 m deep and typically comprise yellow podzolic soils and soloths.

The main limitations of this soil landscape group to development have been assessed by the Soil Conservation Service as being low fertility, high tendency to shrink/swell movements, often strongly acid and moderate erosion hazard.

## 5. HYDROGEOLOGY

The regional hydrogeology in this area of the Sydney Basin is governed by a number of creeks and rivers flowing mostly in a northerly direction. The regional groundwater flows towards these main drainage channels and is likely to be a subdued reflection of the surface topography.

The ridge along the eastern boundary of the site forms a water shed and it is likely that the groundwater beneath the site flows in a similar direction to the surface water, that is, to the north-west towards Bow Bowling Creek. It is expected that the main groundwater table is many metres below the more elevated eastern parts of the site although there may be local areas of seepage in some areas. The groundwater table may be closer to the surface along the drainage depressions or on lower lying parts of the site, but very few of the bores and test pits undertaken in the Minto area, which were mostly less than 2 m deep, encountered groundwater.

The groundwater occurring within the Ashfield Shale formation has not been used in the Sydney region for water supply purposes because of the relatively high levels of naturally occurring total dissolved salts.

## 6. SITE HISTORY

During the review of available information a series of aerial photographs taken over the years between 1947 and the present were examined. The photographs show that the area was used for farming in the period between 1947 and the mid 1970s, with most of the original vegetation having been cleared prior to 1947.

In the 1970s and 1980s much of the site was subdivided into housing estates. The construction drawings for the roads on these subdivisions show that there was some regrading of areas of the site. In general terms, however, the regrading involved alterations in the levels of less than 1 m.

Since the 1980s there have only been a few small subdivisions created in the area, with most of the site remaining unchanged. Based on inspection of the aerial photographs, possible areas of filling were identified and are shown on Drawing 5. Extracts of the aerial photographs used in the assessment are given on Drawings 6 to 10.

## **7. FIELDWORK METHODS**

### **7.1. Drilling**

A truck mounted drilling rig was used to drill 19 bores (Bores 1, 2 and 4 to 20) to depths ranging from 1 m to 4.5 m. The bores were drilled using spiral flight augers and were terminated in weathered bedrock. Disturbed samples were collected from the augers at 0.5 m depth intervals for identification purposes and for testing for possible contaminants. The drilling was supervised and logged by an experienced geotechnical engineer. Immediately following completion of the drilling the bores were backfilled and the ground surface repaired.

The locations of the bores were chosen to target the areas in which aerial photographs showed that filling might have occurred. The locations are shown on Drawing 1 in Appendix A and were measured from existing site features such as roads and fences.

### **7.2. Sampling Methodology for Contamination testing**

Environmental sampling was performed according to standard operating procedures outlined in the Douglas Partners' Field Procedure Manual, which conform to EPA requirements. All sampling data was recorded on Douglas Partners' Chain of Custody Sheets which are countersigned by the laboratory and returned to Douglas Partners to ensure integrity and security of sample handling, transport and delivery. The general sampling procedure comprised: -

- obtaining samples direct from auger blade using pre-cleaned hand-tools;
- transferring samples into laboratory prepared glass jars, and capping immediately;

- labelling sample containers with individual and unique identification, including project number, bore number and sample depth;
- collection of additional sets of duplicate samples at the appropriate frequency;
- provision of daily equipment rinsate samples, field blanks and trip spikes as required by the QA/QC plan;
- placement of the glass jars into a cooled, insulated and sealed container for transport to the laboratory;
- completing chain of custody information to ensure sample security and integrity during transport and handling.

SGS Environmental Services (SGS), a laboratory certified by the National Association of Testing Authorities (NATA), was employed to conduct the sample analysis. The laboratory is required to carry out routine in-house quality control procedures. SGS carries out sample analysis in compliance with schedule B(3) of the National Environmental Protection Measure, 1999.

### **7.3. Selection of Site Investigation Levels**

It is understood that the area is to be redeveloped for mainly residential uses. It is therefore considered that the appropriate Site Investigation Levels (SILs) for the site are:-

- Health based investigation levels (HIL) for residential sites, from NSW EPA's *Contaminated Sites: Guidelines for the NSW Site Auditors Scheme, 1998* - (Column 1 and Column 5); and
- Threshold concentrations for sensitive land use from NSW EPA's *Contaminated Sites: Guidelines for Assessing Service Station Sites, 1994* - these criteria are used for assessing total recoverable hydrocarbons (TRH) and selected monocyclic hydrocarbons (BTEX), as investigation levels for TRH and BTEX have not been defined in the Guidelines for the NSW Site Auditor Scheme.

## 8. RESULTS OF INVESTIGATION

### 8.1. Field Observations

Details of the sub-surface conditions encountered during the course of the investigation are shown on the Test Bore Report Sheets given in Appendix B, together with notes defining the terms used to classify the strata.

The bores intersected relatively similar conditions across the site comprising:

**FILLING** - encountered in most test bores. Mostly silty clays and clays derived from local materials, with some sand and gravel. Thickness ranged from 0.1 m to a maximum of 3.3 m in Bore 10.

**SILTY CLAYS** - encountered in most test bores, except Bores 8 and 12 where no clay layer was present (probably due to excavation). Typically stiff to hard, red brown and grey residual silty clays and shaly clays derived from weathering of the underlying Bringelly Shale. The thickness of the clay ranged from 0.3 m to 2.15 m in Bore 4.

Sandy clays were noted in Bores 7, 16 and 17 and may represent weathering of sandstone bands within the shale. In Bore 2 the clays were located beneath 2.7 m of filling and were soft and very soft. It is possible that these clays are alluvial deposits along an old creek valley.

**WEATHERED BEDROCK** - most of the bores intersected weathered shale bedrock. The exceptions were Bores 1, 2 and 19 which were terminated in very low strength sandstone. The shale bedrock was typically highly weathered and extremely low to low strength, with increasing strength with depth. The depth to bedrock in the bores ranged from 0.2 m to 3.7 m with an average of 1.6 m.

No groundwater was observed in any of the test bores during drilling.

Observations of the site during the investigations indicated that most of the area was at or near the natural ground surface levels. In constructing the roads and existing housing developments there appears to have been minor excavation and filling to form level construction platforms but there are no areas of major excavation apparent.

Significant filling has occurred in some parks, such as Townson Oval where there appears to be up to 3 m of fill placed over the western side of the oval. There is also evidence of some indiscriminant dumping of mounds of filling within many of the open areas and reserves. In addition some building rubble remains on the ground surface in areas where buildings have been demolished.

## **8.2. Analytical Results for Soils**

All soil samples were screened with a Photoionisation Detector (PID) for Total Photoionisable Compounds (TOPIC). Results of the sample screening are shown on the Test Bore Reports in Appendix B. TOPIC results were generally found to be low and indicative of background levels in Australian soils.

Following the PID testing ten samples, plus one duplicate sample, were selected for detailed laboratory testing for a range of possible contaminants. The samples selected for testing are given in Table 1 below. The duplicate sample (Z1) submitted for testing was a field replicate of the sample from Bore 16 at a depth of 0.0-0.3 m.

With the exception of the sample from Bore 12, all the tested samples were from within the filling layers.

**Table 1 – Soil Samples Tested**

Bore No.	Depth of Bottom of Filling (m)	Sample Depth (m)	Total Depth Drilled (m)
2	2.70	0.5	4.5
5	0.6	0.5	2.0
6	0.6	0.5	2.3
8	0.70	0.5	1.50
10	3.3	0.5	4.5
12	0.2	0.5	1.0
14	0.3	0-0.3	2.0
15	0.3	0-0.3	2.5
16	0.3	0-0.3	1.5
19	0.5	0.5	2.0

It was considered that the potential contaminants on the site might include:

- Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn)
- Monocyclic Aromatic Hydrocarbons (Benzene, Toluene, Ethylbenzene and Xylene - BTEX)
- Total Recoverable Hydrocarbons (TRH)
- Polycyclic Aromatic Hydrocarbons (PAH)
- Polychlorinated Biphenyls (PCB)
- Organochlorine Pesticides (OCP)
- Organophosphate Pesticides (OPP)

The results of laboratory analysis for the potential contaminants in the soil samples are summarised in the following tables:-

- Table 2 - Results of Heavy Metals Analysis
- Table 3 - Results of TRH/BTEX Analysis
- Table 4 - Results of OCP/OPP and PCB Analysis
- Table 5 - Results of PAH Analysis

**Table 2 - Results of Laboratory Analysis for Heavy Metals**

Sample ID	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
2/0.5	12	<0.5	11	36	25	<0.05	17	110
5/0.5	19	<0.5	15	30	26	<0.05	9	49
6/0.5	9	<0.5	14	30	27	<0.05	14	91
8/0.5	9	<0.5	14	30	24	<0.05	12	56
10/0.5	9	<0.5	13	32	61	0.07	13	66
12/0.5	10	<0.5	10	40	25	<0.05	11	120
14/0-0.3	12	<0.5	22	28	29	0.05	22	64
15/0-0.3	9	<0.5	11	24	58	0.11	7	98
16/0-0.3	4	<0.5	15	26	25	<0.05	10	46
19/0.5	8	<0.5	16	23	25	0.05	12	56
Z1 *	4	<0.5	15	24	24	<0.05	10	39
Guideline 1	100	20	48%	1000	300	15	600	7000
Guideline 5	20	3	400	100	600	1	60	200

**Notes:**

Guideline 1 - NSW EPA Contaminated Sites (1998) - *Guidelines for the NSW SITE Auditor Scheme*, Health Based Investigation Levels, Column 1, Residential

Guideline 5 - NSW EPA Contaminated Sites (1998) - *Guidelines for the NSW SITE Auditor Scheme*, Health Based Investigation Levels, Column 5, Phytotoxicity levels

**Bold** - Indicates exceedance of Guideline 5

\* - Sample Z1 is a field replicate sample of 16/0-0.3 m analysed for QA/QC requirements

**Table 3 - Results of TRH/BTEX Analysis**

Sample ID	Total Recoverable Hydrocarbons (TRH)				Monocyclic Aromatic Hydrocarbons (BTEX)			
	C6-C9	C10-C14	C15-C28	C29-C40	Benzene	Toluene	Ethyl benzene	Xylene
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
2/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
5/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
6/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
8/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
10/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
12/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
14/0-0.3	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
15/0-0.3	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
16/0-0.3	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
19/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
Z1 *	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5
Guideline 2	65	1000			1	1.4	3.1	14

**Notes:**

Guideline 2 - NSW EPA Contaminated Sites Guidelines for assessing Service Stations (1994)

**Bold** - Indicates exceedance of Guideline 2

\* - Sample Z1 is a field replicate sample of 16/0-0.3 m analysed for QA/QC requirements

**Table 4 - Results of OCP/OPP and PCB Analysis**

Sample ID	OC Pesticides					OP Pesticides			PCB Total
	Aldrin	Dieldrin	Heptachlor	Chlordane	DDT	Chlorpyrifos	Fenitrothion	Ethion	
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
2/0.5	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
5/0.5	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
6/0.5	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
8/0.5	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
10/0.5	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
12/0.5	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
14/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
15/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
16/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
19/0.5	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
Z1 *	<0.10	<0.10	<0.10	<0.10	<0.01	<0.01	<0.01	<0.01	<0.9
Guideline 1						NS	NS	NS	

**Notes:**

 Guideline 1 - NSW EPA Contaminated Sites (1998) - *Guidelines for the NSW SITE Auditor Scheme*, Health Based Investigation Levels, Column 1 Residential

**Bold** - Indicates exceedance of Guideline 1

\* - Sample Z1 is a field replicate sample of 16/0-0.3 m analysed for QA/QC requirements

NS - Not specified in the EPA guidelines

**Table 5 - Results of PAH Analysis**

Sample ID	Total PAH	Benzo(a)pyrene
	mg/kg	mg/kg
2/0.5	0.00	<0.05
5/0.5	0.00	<0.05
6/0.5	0.00	<0.05
8/0.5	0.00	<0.05
10/0.5	0.00	<0.05
12/0.5	0.00	<0.05
14/0-0.3	0.00	<0.05
15/0-0.3	0.00	<0.05
16/0-0.3	0.00	<0.05
19/0.5	0.00	<0.05
Z1 *	0.00	<0.05
Guideline 1	20	1

**Notes:**

Guideline 1 - NSW EPA Contaminated Sites (1998) - *Guidelines for the NSW SITE Auditor Scheme*, Health Based Investigation Levels, Column 1 Residential

**Bold** - Indicates exceedance of Guideline 1

\* - Sample Z1 is a field replicate sample of 16/0-0.3 m analysed for QA/QC requirements

## 9. COMMENTS

### 9.1. Proposed Development

This preliminary geotechnical and contamination investigation has been undertaken in order to provide information for development of a masterplan for the area. The exact development is yet to be determined but it is understood that most of the area will be redeveloped for residential use.

It is expected that the development will include construction of additional roads and minor cutting and filling to provide level building platforms for construction of one and two storey residences and shops. The comments given in the following sections are directed at providing advice for development of this type. If deep excavations or multi-storey buildings are proposed then additional investigations will be required.

### 9.2. Geological Model

The information obtained from the test bores, observations on the site and a review of the available information from previous investigations indicates that undisturbed sections of the site are typically underlain by:

- topsoil typically less than 0.3 m thick,
- stiff to hard red-brown and grey clays and shaly clays, moderately to highly reactive, usually to average depths of 1.6 m.
- highly weathered, very low strength shales with some sandstone bands, increasing in strength with depth and typically becoming low to medium strength or stronger below depths of about 2-3 m.

In developing the site, however, there has been regrading of some areas, particularly along the roads. This is likely to have involved cutting and filling of the natural soils and rocks on the site. As a result there are likely to be some areas in which the shale bedrock is at the

ground surface and others where there is 1-2 m of clay and ripped shale filling placed over the original ground levels.

There are also some parks and playing fields which have been made into level platforms. It is not known where the filling for these areas originated, but it is likely to have come from excavations on other parts of the site. It is possible, however, that some filling could also have been imported from other sources. Test bores drilled in Townson Oval indicated that the level playing field had been formed by cutting on the eastern side and filling of up to 3 m on the western side of the oval. Deep filling was also found in Bore 10 at the eastern end of Longhurst Road.

### **9.3. Slope Stability**

There is no evidence of slope instability on the site. On the steeper, sections along the eastern boundary of the site it is possible that there may be some slow soil creep of the upper clay layers, resulting from a combination of gravity and water.

It is considered that most of the site has a low risk of slope instability, with a low to medium risk for the local parts of the site along the eastern boundary with slopes steeper than about 15%.

### **9.4. Site Classification and Foundations**

The results of numerous soil tests in the general area, together with previous experience of the soils derived from weathering of the Ashfield Shale, indicates that most of the clay soils on the site have a high plasticity and have a moderate to high tendency to shrink and swell when subjected to changes in moisture content.

It is expected that most of the sites located on the undisturbed natural soils would be classified as Class M, in accordance with the classification system used in the Australian Standard for Design and Construction of Residential Slabs and Footings (AS2870). Any sites located on filling would be classified as Class P, unless it can be established that the filling has been properly compacted.

Where residential structures are to be built on residual clays and weathered shales, which is expected to be the case over most of the site, ground slabs or shallow footings designed to the recommendations given in AS2870 may be used.

For filled areas it is recommended that either the structures be founded on the residual clays or weathered bedrock beneath the filling, or the filling should be removed and recompacted in layers before construction of footings.

For compaction of filling layers which are to provide support to residential structures it is recommended that:

- any existing filling be removed down to the natural ground surface and any vegetation or organic matter removed,
- the filling should be compacted in near horizontal layers with less than 300 mm loose thickness, and
- the filling should be compacted to a minimum of 95% dry density ratio at a moisture content which is within 2% of the optimum moisture content.

As the clay soils in the area are moderately to highly reactive any changes in moisture content within the soils can lead to significant shrink and swell movements. It is therefore critical that any filling be placed and maintained at the correct moisture content prior to building construction. Over compaction of the filling and/or compaction at low moisture contents should also be avoided as this may lead to excessive swelling pressures.

## **9.5. Earthworks**

It is considered that the soils and filling on the site should be readily excavatable using conventional earthmoving equipment. Excavation of the weathered shale bedrock below average depths of about 2 m is likely to be more difficult and may require the use of heavy machinery.

Given the types of materials present on the site it is expected that a maximum batter of 2(H):1(V) may be adopted for any permanent cut or fill slopes in clays which are less than 2 m high. For any higher slopes formal stability analysis will be required. For batter slopes of 2(H):1(V), however, there may be local erosion of the face and it is therefore

recommended that either the batters be flattened to 3(H):1(V) or the slope face protected against erosion.

For cuts in weathered shale a maximum batter slope of 1(H):1(V) is recommended. Again it is noted that for slopes exposed to long term weathering there is likely to be some erosion of the face and protection will be required for permanent excavation faces.

If steeper slopes are required then it would be necessary to use retaining walls for soils, or a combination of shotcrete and ground anchors to stabilise excavated slopes in weathered bedrock.

## **9.6. Pavements**

Due to the cutting and filling required for construction of the roads on the site, existing roads are founded on a range of materials ranging from clays to medium strength shales and sandstones. California Bearing Ratio (CBR) tests in the area typically give soaked CBR values of 2% - 4% for the clays, while the weathered shales have CBRs ranging from 7% to more than 15% depending on the strength of the shales.

A pavement assessment undertaken by Jeffery and Katauskas (J&K) in 1997 of some of the existing roads on the site, indicated that there had been some deterioration of the pavements. J&K gave recommendations for some repairs and maintenance in order to extend the life of the pavements. As the pavements would have been originally designed for a life of 20 - 25 years, it is probable that most of the pavements would now have reached their design life and would require replacement or at least major rehabilitation.

## **9.7. Contamination Testing**

The testing of selected soil samples from test bores across the site gave results for a number of possible contaminants which were all within the EPA's health-based soil investigation levels for residential sites. The tests were mostly carried out on samples of filling from the bores and indicated that there is generally a low risk of contamination on the site.

It is noted, however, that there are many small mounds of filling which appear to have been illegally dumped on the open areas on the site and it is possible that these mounds may contain some contaminants.

The following table lists some of the potential contaminants which may be encountered in isolated pockets of filling, together with suggested disposal methods.

**Table 6 - Potential Contaminants in Dumped Filling**

Potential Contaminants	Disposal Method
Construction materials containing asbestos, eg. AC sheeting	Bag and take to licensed landfill
Drums or tins of paints (containing heavy metals), oils, solvents or pesticides	Take to licensed landfill
Foundry waste (ash or slag)	Take to licensed landfill
Treated timber (Copper, Chromium and Arsenic)	Take to licensed landfill
Putrescible waste	Take to landfill
Hydrocarbon impacted soils (petrol or diesel spills)	Excavate impacted soils and bioremediate on site

If any materials are to be transported off the site during the redevelopment then it will be necessary to have waste classifications carried out on these materials.

### 9.8. Salinity

Urban salinity has been recognized as a potential hazard in the western section of the Sydney Basin where geological conditions have resulted in the local soils having naturally high salt concentrations. Urban salinity typically occurs when salts stored in the soil profile are mobilised by the movement of water. Increased salt levels in the soils and water, due to evaporation and accumulation, may adversely affect vegetation and building materials.

Urban salinity can be triggered by changes to the storage and movement of salt and water in the environment, such as excavations which intersect the groundwater table or saline soils, the presence of impermeable fill which prevents good drainage and concentrates groundwater flow, and excessive watering of gardens.

The salinity potential in Western Sydney was mapped by the Department of Infrastructure, Planning and Natural Resources (DIPNR) in 2002. Reference to this map indicates that there are no known areas of salinity within the area of the Minto Renewal Project. The nearest mapped area of known salinity is along a creek line in St Andrews, to the west of Bow Bowing Creek, about 1.5 km to the west of the site. In addition along the low lying Bow Bowing Creek there are some areas which have been identified as having high salinity potential. The lower areas of the Minto Renewal Project are shown on the map as having a moderate salinity potential while the steeper areas have a very low salinity potential due to their better drainage.

No indications of salinity were observed on the site during the site inspection. Review of aerial photographs and inspection of the site indicates that there have been only minor changes to the natural ground levels during previous development of the site. Removal of the native vegetation is likely to have occurred many years previously when the site was turned into grazing land.

The results of the test bores, together with observations on the site, indicate that the groundwater table is likely to be many metres below the existing ground surface, with the only exceptions likely to be along creek valleys or on the lower western part of the site.

It is considered that the proposed redevelopment of the area is unlikely to have any significant impact on the amount of saline groundwater entering the creeks in the area. Reference to the cut and fill plan prepared by Hughes Trueman (Drawing No. 03S864-M07) shows that the cut and fill depths in the current proposed development are mostly less than 1 m. It is assessed that these cut and fill depths will not adversely affect the risk of salinity on the site.

In order to minimise the risk of salinity it is recommended that the proposed development incorporate the following:

- reduction in the amount of water entering the soil
  - by installing adequate stormwater drainage systems,
  - encouraging the use of native vegetation or deep rooted trees in gardens
  - providing surface and subsoil drainage beneath roads

- use of damp proof membranes in construction of buildings and where slabs on ground are to be used they should incorporate a 50 mm thick layer of sand beneath the damp proof membrane. Alternatively elevate the lower floor level of the buildings above the ground.

## 10. LIMITATIONS OF THIS REPORT

The scope of the site assessment activities and consulting services undertaken by DP were limited to those detailed in this report.

DP's assessment is necessarily based upon the results of the site investigation and a limited program of surface and subsurface sampling, screening and chemical testing. DP cannot provide unqualified warranties nor does DP assume any liability for site conditions not observed, or accessible during the time of the investigations.

Despite all reasonable care and diligence, the ground conditions encountered and concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. In addition, site characteristics may change at any time in response to variations in natural conditions, chemical reactions and other events, e.g. groundwater movement and or spillages of contaminating substances. These changes may occur subsequent to DP's investigations and assessment.

This report, its associated documentation and the information herein have been prepared solely for the use of Landcom. Any reliance assumed by third parties on this report shall be at such parties' own risk. Any ensuing liability resulting from use of the report by third parties cannot be transferred to DP.

**DOUGLAS PARTNERS PTY LTD**

Reviewed by:

**Fiona MacGregor**  
Principal

**Michael J Thom**  
Principal



# Douglas Partners

Geotechnics • Environment • Groundwater

## NOTES RELATING TO THIS REPORT

### Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

### Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q <sub>c</sub> — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25

Very dense greater than 50 greater than 25  
 Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

### Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

### Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

**Test Pits** — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

**Large Diameter Auger (eg. Pengo)** — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

**Continuous Sample Drilling** — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

**Continuous Spiral Flight Augers** — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow

sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

**Non-core Rotary Drilling** — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

**Rotary Mud Drilling** — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

**Continuous Core Drilling** — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

### Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

as     4, 6, 7  
       N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

as     15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain

samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

### Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

$$q_c \text{ (MPa)} = (0.4 \text{ to } 0.6) N \text{ (blows per 300 mm)}$$

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

$$q_c = (12 \text{ to } 18) c_u$$

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on

soil classification is required, direct drilling and sampling may be preferable.

### Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

### Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 “Methods of Testing Soil for Engineering Purposes”. Details of the test procedure used are given on the individual report forms.

### Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than ‘straight line’ variations between the boreholes.

### Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.

- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

### Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

### Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

### Reproduction of Information for Contractual Purposes

Attention is drawn to the document “Guidelines for the Provision of Geotechnical Information in Tender Documents”, published by the Institution of Engineers,

Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

### **Site Inspection**

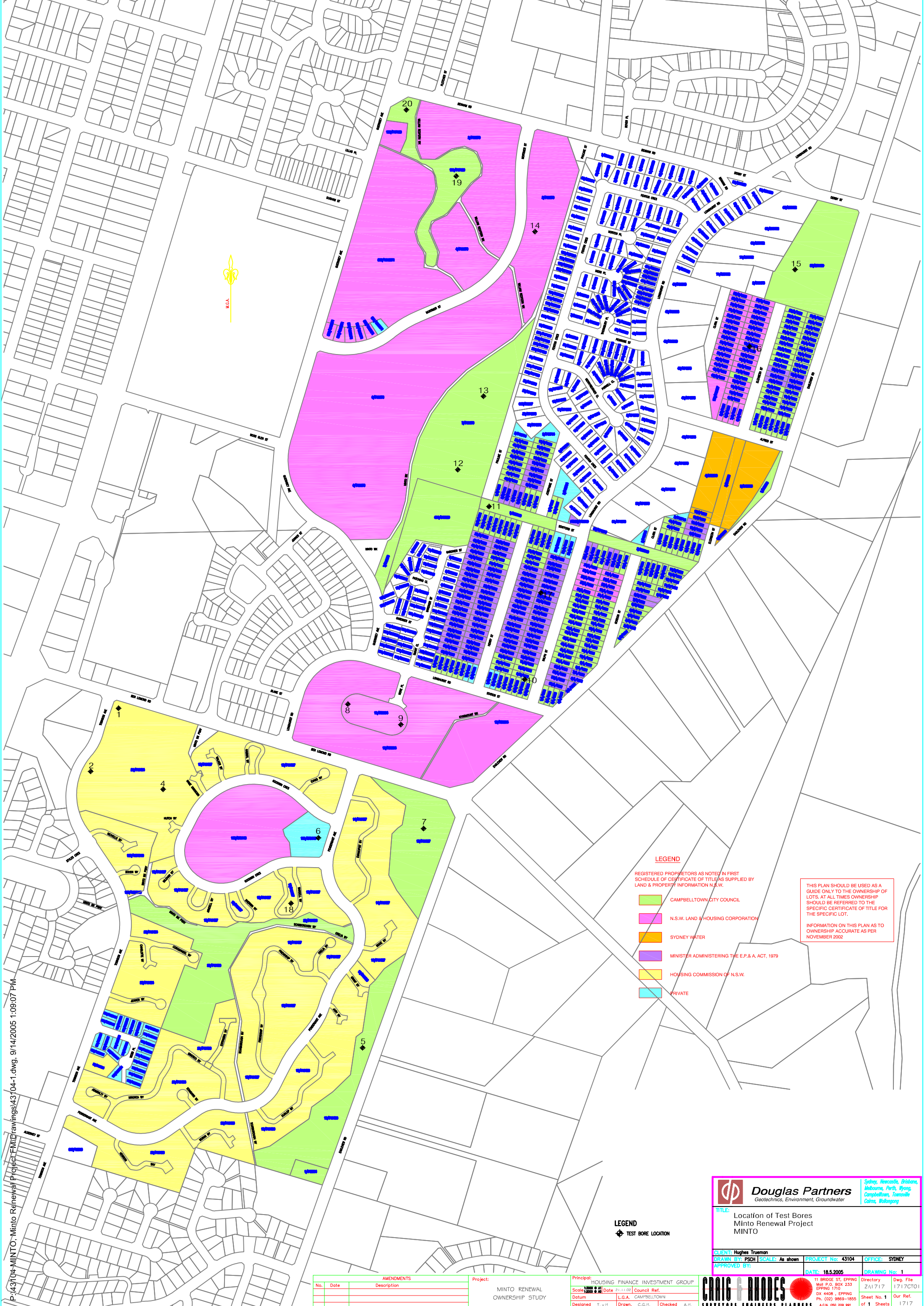
The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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**APPENDIX A**  
***Drawings***

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- LEGEND**
- REGISTERED PROPRIETORS AS NOTED IN FIRST SCHEDULE OF CERTIFICATE OF TITLE AS SUPPLIED BY LAND & PROPERTY INFORMATION N.S.W.
- CAMPBELLTOWN CITY COUNCIL
  - N.S.W. LAND & HOUSING CORPORATION
  - SYDNEY WATER
  - MINISTER ADMINISTERING THE E.P. & A. ACT, 1979
  - HOUSING COMMISSION OF N.S.W.
  - PRIVATE

THIS PLAN SHOULD BE USED AS A GUIDE ONLY TO THE OWNERSHIP OF LOTS. AT ALL TIMES OWNERSHIP SHOULD BE REFERRED TO THE SPECIFIC CERTIFICATE OF TITLE FOR THE SPECIFIC LOT.

INFORMATION ON THIS PLAN AS TO OWNERSHIP ACCURATE AS PER NOVEMBER 2002

**LEGEND**  
 ◆ TEST BORE LOCATION

**Douglas Partners**  
 Geotechnics, Environment, Groundwater

Sydney, Newcastle, Brisbane, Melbourne, Perth, Wyang, Campbelltown, Taree, Cairns, Wollongong

---

**TITLE:** Location of Test Bores  
 Minto Renewal Project  
 MINTO

---

**CLIENT:** Hughes Trueman  
**DRAWN BY:** PSCM **SCALE:** As shown **PROJECT No:** 43104 **OFFICE:** SYDNEY

---

**APPROVED BY:** \_\_\_\_\_ **DATE:** 18.5.2005 **DRAWING No:** 1

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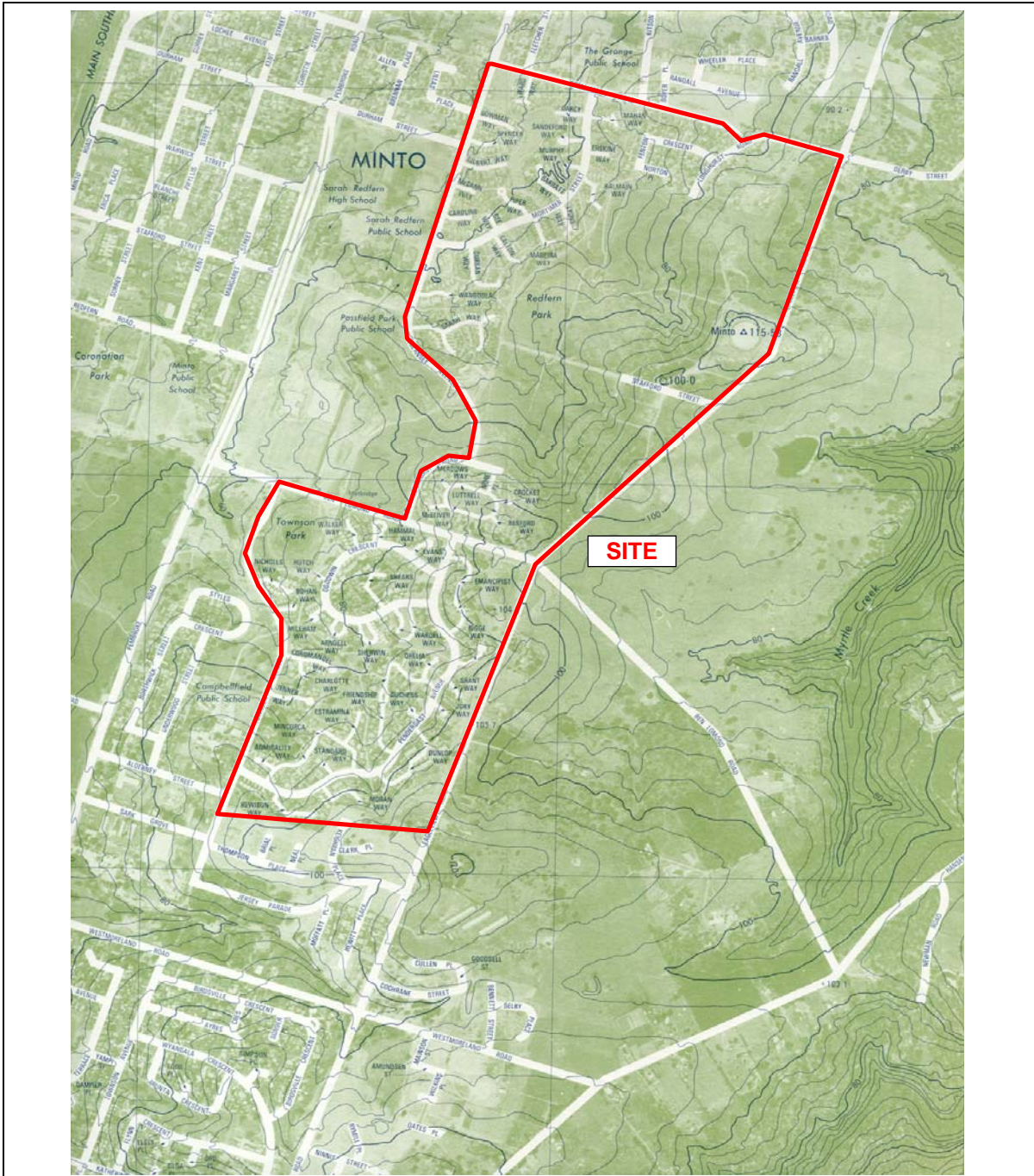
**11 BRIDGE ST, EPPING** **Directory** **Dwg. File**  
 Mail P.O. BOX 233 **2/1717** **1717CT01**  
 EPPING 1710 **DX 4408 - EPPING**  
 Ph. (02) 9859-1855 **Sheet No. 1** **Our Ref.**  
 A.C.K. 000 209 901 **of 1 Sheets** **1717**

AMENDMENTS		
No.	Date	Description

**Project:** MINTO RENEWAL OWNERSHIP STUDY

**Principal:** HOUSING FINANCE INVESTMENT GROUP  
**Scale:** 1:1000 **Date:** 21.11.02 **Council Ref.:** \_\_\_\_\_  
**Datum:** M.S.M. **L.G.A.:** CAMPBELLTOWN  
**Designed:** T.V.H. **Drawn:** C.G.H. **Checked:** A.H.

P:\43104-MINTO- Minto Renewal\Project\FMCDrawings\43104-1.dwg, 9/14/2005 1:09:07 PM



Sydney, Newcastle, Brisbane, Wollongong, Campbelltown  
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin

Title **Topographic Map**  
**Minto Renewal Project**  
**Minto**

Client: Hughes Trueman

Office: Sydney

Drawn by: FM

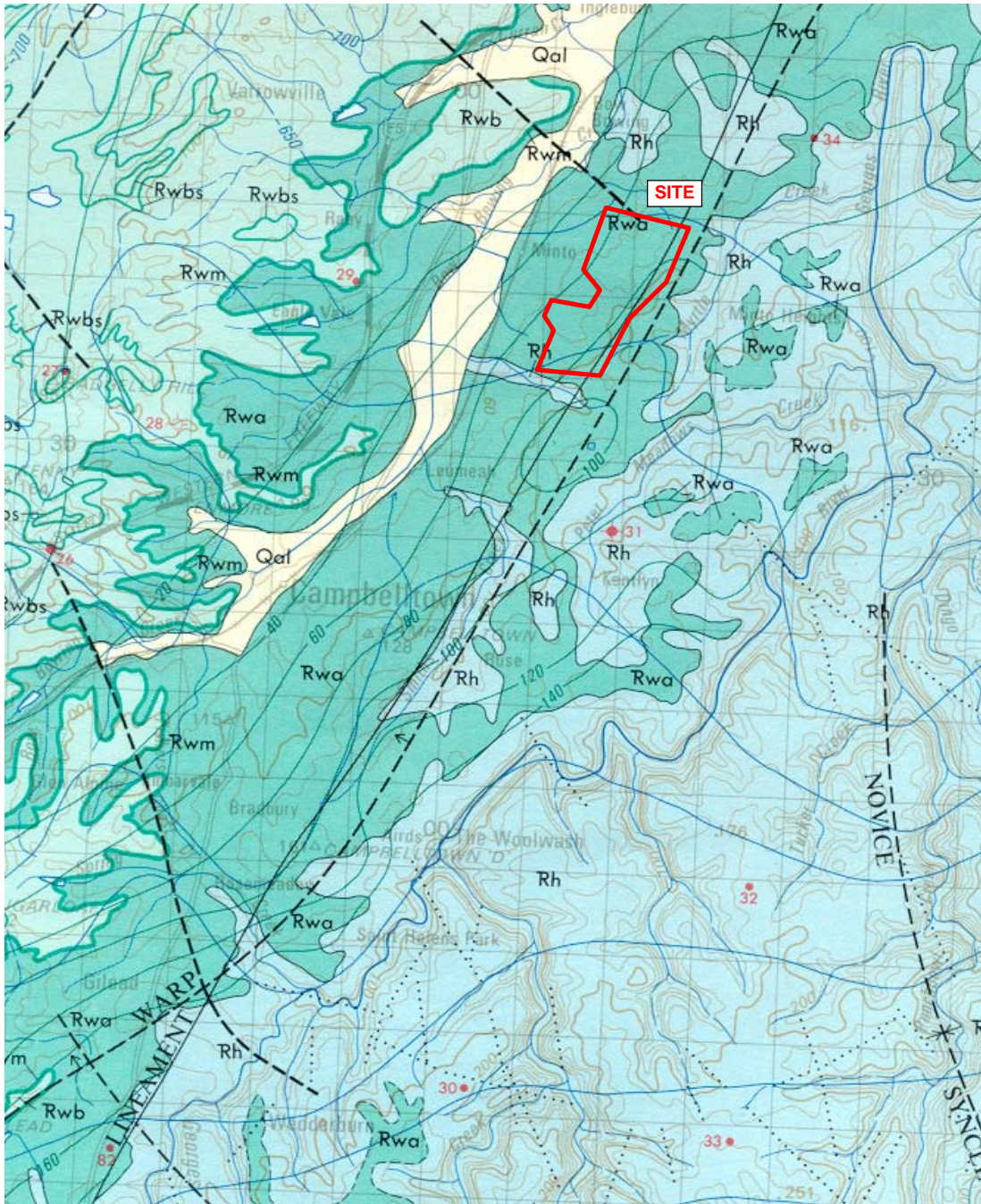
Scale: NTS

Project Number: 43104

Drawing No. 2

Approved by:

Date: May 2005



Sydney, Newcastle, Brisbane, Wollongong, Campbelltown  
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin

Title **Geological Map**  
**Minto Renewal Project**  
**Minto**

Client: Hughes Trueman

Office: Sydney

Drawn by: FM

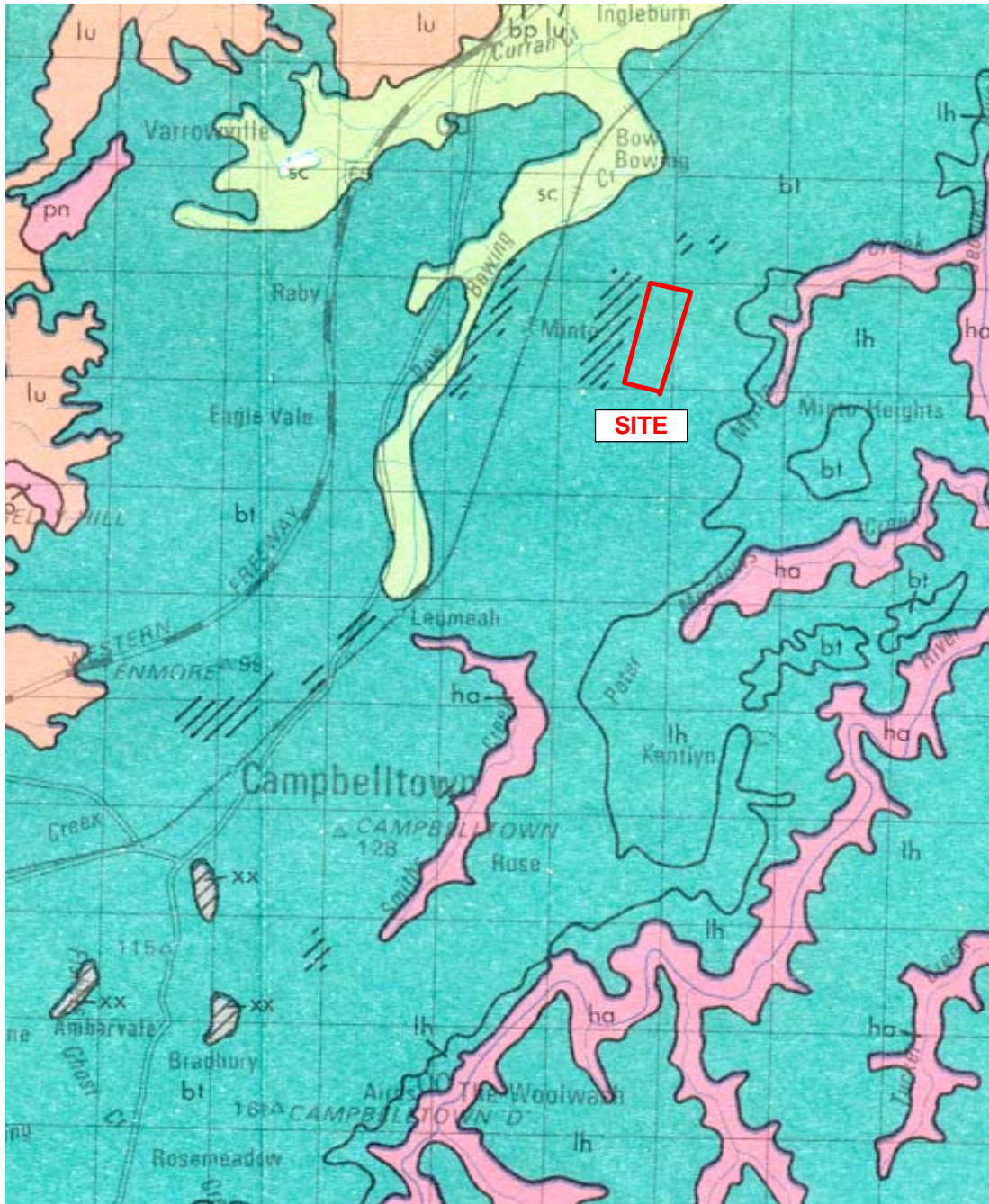
Scale: NTS

Project Number: 43104

Drawing No. 3

Approved by:

Date: May 2005



Sydney, Newcastle, Brisbane, Wollongong, Campbelltown  
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin

Title **Soils Landscapes**  
**Minto Renewal Project**  
**Minto**

Client: Hughes Trueman

Office: Sydney

Drawn by: FM

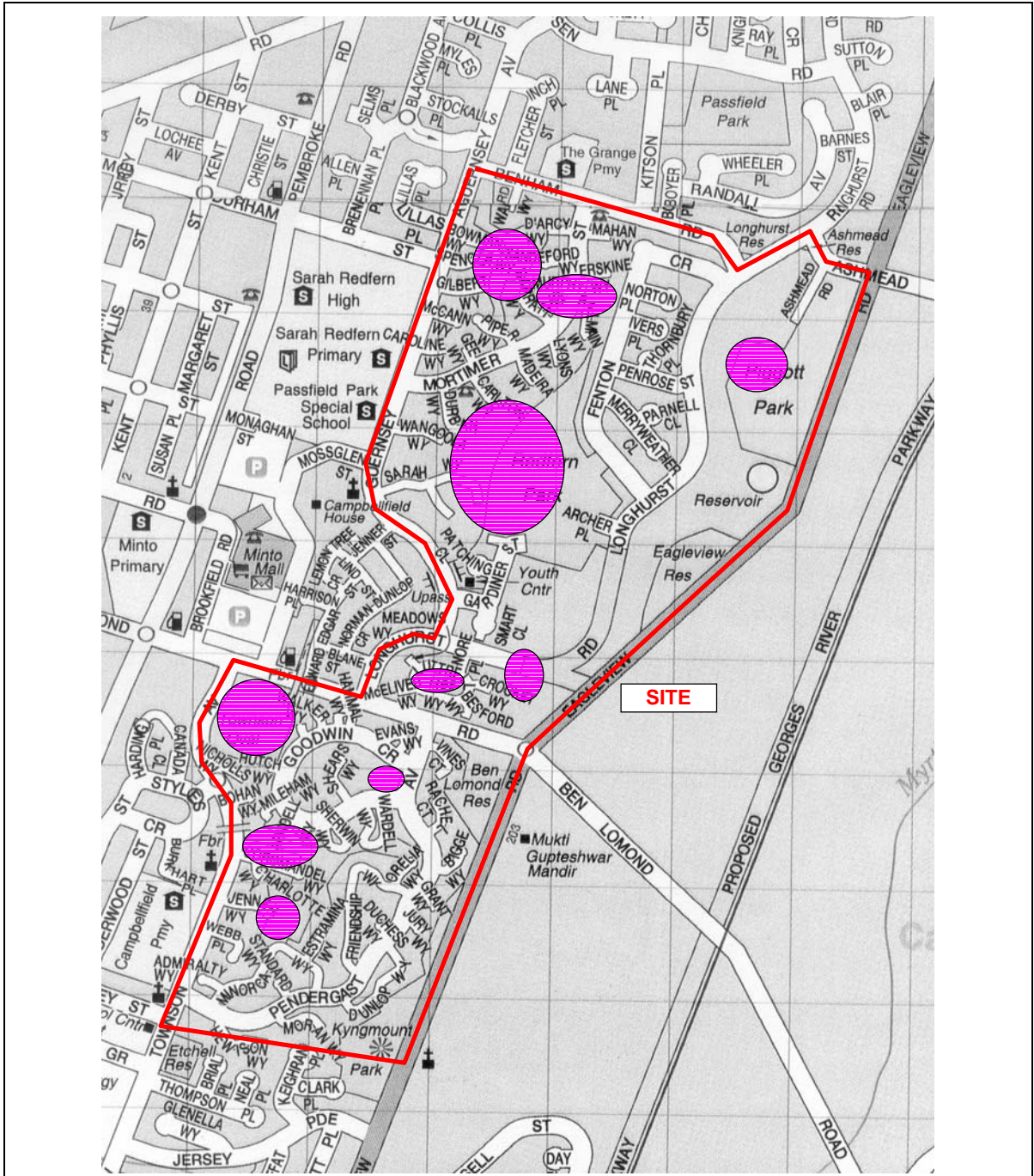
Scale: NTS

Project Number: 43104

Drawing No. 4

Approved by:

Date: May 2005



Sydney, Newcastle, Brisbane, Wollongong, Campbelltown  
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin

Title **Locations of Possible Filling  
Minto Renewal Project  
Minto**

Client: Hughes Trueman

Office: Sydney

Drawn by: FM

Scale: NTS

Project Number: 43104

Drawing No. 5

Approved by:

Date: May 2005



Sydney, Newcastle, Brisbane, Wollongong, Campbelltown  
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin

Title **Aerial Photograph 1947**  
**Minto Renewal Project**  
**Minto**

Client: Hughes Trueman

Office: Sydney

Drawn by: FM

Scale: NTS

Project Number: 43104

Drawing No. 6

Approved by:

Date: May 2005



Sydney, Newcastle, Brisbane, Wollongong, Campbelltown  
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin

Title **Aerial Photograph 1961**  
**Minto Renewal Project**  
**Minto**

Client: Hughes Trueman

Office: Sydney

Drawn by: FM

Scale: NTS

Project Number: 43104

Drawing No. 7

Approved by:

Date: May 2005



Sydney, Newcastle, Brisbane, Wollongong, Campbelltown  
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin

Title **Aerial Photograph 1972**  
**Minto Renewal Project**  
**Minto**

Client: Hughes Trueman

Office: Sydney

Drawn by: FM

Scale: NTS

Project Number: 43104

Drawing No. 8

Approved by:

Date: May 2005



Sydney, Newcastle, Brisbane, Wollongong, Campbelltown  
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin

Title **Aerial Photograph 1984**  
**Minto Renewal Project**  
**Minto**

Client: Hughes Trueman

Office: Sydney

Drawn by: FM

Scale: NTS

Project Number: 43104

Drawing No. 9

Approved by:

Date: May 2005



Sydney, Newcastle, Brisbane, Wollongong, Campbelltown  
Melbourne, Perth, Wyong, Townsville, Cairns, Darwin

Title **Aerial Photograph 2002**  
**Minto Renewal Project**  
**Minto**

Client: Hughes Trueman

Office: Sydney

Drawn by: FM

Scale: NTS

Project Number: 43104

Drawing No. 10

Approved by:

Date: May 2005

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***APPENDIX B***  
***Test Bore Reports***

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# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 30 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 1  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING – dark brown, clayey silt/silty clay filling, moist				
0.78	SILTY CLAY – stiff, red brown, silty clay, moist	A*	0.5		10
1	1.5m: with a trace of shale fragments	A	1.0		
2	– red brown mottled light grey, gravelly from 2.0m (mainly shale gravel)	A	1.5		
2.1	SANDSTONE – light brown, very low strength sandstone	A	2.0		
2.5	TEST BORE DISCONTINUED AT 2.5m	A	2.5		
3					
4					
5					

RIG: SCOUT                      DRILLER: G COOPER                      LOGGED: R HUI                      CASING: UNCASED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS: A\* INDICATES FIELD REPLICATE SAMPLE Z2 TAKEN

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>PH</i>
Date: 8/03



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# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 30 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 2  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, clayey silt filling				
0.25	FILLING - dark grey, gravelly silty clay filling, with shale gravel	A	0.5		12
1		A	1.0		13
1.1	FILLING - brown, silty clay filling with some gravel, stiff	A	1.5		14
2		A	2.0		10
2.15	FILLING - dark grey and brown, gravelly silty clay filling (with some sandstone gravel)	A	2.5		10
2.7	SILTY CLAY - soft, dark grey, silty clay, wet	A	3.0		
3		A	3.5		
3.1	SILTY CLAY - very soft, grey silty clay, with a trace of gravel, saturated	A	4.5		
4					
4.5	TEST BORE DISCONTINUED AT 4.5m - auger refusal on very low strength sandstone	A	4.5		
5					

RIG: SCOUT

DRILLER: G COOPER

LOGGED: R HUI

CASING: UNCASSED

TYPE OF BORING: SOLID FLIGHT AUGER

GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS:

### SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:

Initials: *RH*

Date: 8/03



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 Geotechnics • Environment • Groundwater



# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 30 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 5  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, clayey silt/silty clay filling, with some roots and gravel	A*	0.5		7
0.6	SILTY CLAY - light grey mottled brown, silty clay with some shale gravel, dry	A	1.0		
1		A	1.5		
1.6	SHALE - extremely low strength, dark grey shale	A	2.0		
2	TEST BORE DISCONTINUED AT 2.0m				
3					
4					
5					

RIG: SCOUT

DRILLER: G COOPER

LOGGED: R HUI

CASING: UNCASSED

TYPE OF BORING: SOLID FLIGHT AUGER

GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS: A/D\* INDICATES FIELD REPLICATE SAMPLE Z3 TAKEN

### SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength $I_p$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:

Initials: *RH*

Date: 8/03



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# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 30 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 6  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, silty clay/clayey silt filling, moist				
0.6	SILTY CLAY - stiff, red brown, silty clay, moist	A	0.5		6
1.1	SHALE - extremely low strength, light brown shale	A	1.0		
2.3	TEST BORE DISCONTINUED AT 2.3m	A	1.5		
		A	2.0		
		A	2.3		

RIG: SCOUT                      DRILLER: G COOPER      LOGGED: R HUI                      CASING: UNCASSED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>RH</i>
Date: 8/03



# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 30 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 7  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, silty gravelly clay filling	A*	0.5		9
0.7	FILLING - stiff, red brown, gravelly clay filling, moist	A	1.0		8
1.1	SANDY SILTY CLAY - stiff, light brown, sandy silty clay, dry	A	1.5		7
2		A	2.0		
2.35	SHALE - extremely low to very low strength, dark grey shale	A	2.35		
2.5	TEST BORE DISCONTINUED AT 2.5m				
3					
4					
5					

RIG: SCOUT                                      DRILLER: G COOPER                      LOGGED: R HUI                                      CASING: UNCASSED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS: A\* INDICATES FIELD REPLICATE SAMPLE Z4 TAKEN

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	U x mm dia, tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>PH</i>
Date: 8/03

# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 30 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 8  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results,	Headspace PID (ppm)
0	FILLING - dark brown, sandy clayey silt filling				
0.7	SHALE - brown and grey, extremely low strength shale	A	0.5		6
1.1	SHALE - very low to low strength, dark grey shale	A	1.0		
1.5	TEST BORE DISCONTINUED AT 1.5m	A	1.5		
2					
3					
4					
5					

RIG: SCOUT

DRILLER: G COOPER

LOGGED: R HUI

CASING: UNCASSED

TYPE OF BORING: SOLID FLIGHT AUGER

GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS:

**SAMPLING & IN SITU TESTING LEGEND**

A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:

Initials: *RH*

Date: 8/03



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# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 30 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 9  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0					
0.15	FILLING - dark brown, silty clay filling, with some roots	A	0.5		10
	FILLING - stiff, light brown, silty clay filling				
0.65	SILTY CLAY - stiff, red brown, silty clay	A	1.0		
1.3	SHALE - extremely low strength, grey shale	A	1.5		
1.8	SHALE - very low strength, grey and brown shale, with ironstone bands	A	2.0		
2.0	TEST BORE DISCONTINUED AT 2.0m				
3					
4					
5					

RIG: SCOUT                      DRILLER: G COOPER                      LOGGED: R HUI                      CASING: UNCASSED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_p$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>RH</i>
Date: 8/03

# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 31 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 10  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, sand filling				
0.2	FILLING - red brown, sandy clay filling	A	0.5		3
0.8	FILLING - dark brown mottled grey, silty clay filling, with a trace of shale gravel	A	1.0		7
1	- gravelly from 1.5m	A	1.5		9
2	- extremely low strength, dark grey shale bands from 1.8m	A	2.0		4
		A	2.5		6
3		A	3.0		
3.3	SILTY CLAY - stiff, light grey mottled brown, silty clay	A	3.5		
3.7	SHALE - very low to low strength, light grey mottled brown shale	A	4.0		
4		A	4.3		
4.3	SHALE - medium strength, dark grey shale	A	4.5		
4.5	TEST BORE DISCONTINUED AT 4.5m				
5					

RIG: SCOUT

DRILLER: G COOPER

LOGGED: R HUI

CASING: UNCASSED

TYPE OF BORING: SOLID FLIGHT AUGER

GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS:

### SAMPLING & IN SITU TESTING LEGEND

A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:

Initials: *TH*

Date: 8/03



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# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 31 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 11  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0					
0.1	SAND - fine grained, brown sand	A	0.1		
	SILTY CLAY - stiff, red brown mottled grey, silty clay	A	0.5		
0.7					
	SHALE - low to medium strength, dark grey shale, with ironstone bands				
1		A	1.0		
	TEST BORE DISCONTINUED AT 1.0m				
2					
3					
4					
5					

RIG: SCOUT                      DRILLER: G COOPER                      LOGGED: R HUI                      CASING: UNCASSED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>jh</i>
Date: 8/03



# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 31 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 12  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	SAND - brown, fine to medium grained sand	A	0.5		2
0.20	SHALE - very low strength, dark grey shale				
	0.7m: low to medium strength				
1	TEST BORE DISCONTINUED AT 1.0m	A	1.0		
2					
3					
4					
5					

RIG: SCOUT                                      DRILLER: G COOPER                      LOGGED: R HUI                                      CASING: UNCASSED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>RH</i>
Date: 8/03

# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 31 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 13  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, silty clay filling, with some roots				
0.3	SILTY CLAY - red brown mottled grey, silty clay	A	0.3		4
	- light grey mottled brown from 0.7m	A	0.5		6
1.1	SHALE - low to medium strength, dark grey shale	A	1.0		
1.5	TEST BORE DISCONTINUED AT 1.5m	A	1.5		

RIG: SCOUT                                      DRILLER: G COOPER                      LOGGED: R HUI                                      CASING: UNCASED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_p$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>TH</i>
Date: 8/03



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# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 31 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 14  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, silty clay filling	A			4
0.3	SILTY CLAY - stiff, red brown mottled light brown, silty clay	A	0.3		
		A	0.5		
1		A	1.0		
1.3	SHALE - extremely low strength, light brown and dark grey shale	A	1.5		
1.9 2.0	SHALE - low to medium strength, dark grey shale, with thin red ironstone laminite TEST BORE DISCONTINUED AT 2.0m	A	2.0		
3					
4					
5					

RIG: SCOUT                      DRILLER: G COOPER                      LOGGED: R HUI                      CASING: UNCASSED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_p$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	U x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>jh</i>
Date: 8/03

# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 31 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 15  
 SHEET 1 OF 1

Depth m.	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, silty clay filling	A			
0.3	SILTY CLAY - stiff, red brown mottled grey, silty clay, with a trace of ironstone gravel	A	0.3		6
		A	0.5		
1		A	1.0		
1.1	SILTY CLAY - stiff, light grey mottled red, silty clay, with some ironstone gravel	A			
		A	1.5		
2		A	2.0		
2.2	SHALE - very low to low strength, dark grey shale	A			
2.5	TEST BORE DISCONTINUED AT 2.5m	A	2.5		
3					
4					
5					

RIG: SCOUT                      DRILLER: G COOPER                      LOGGED: R HUI                      CASING: UNCASSED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>JH</i>
Date: 8/03

# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 31 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 16  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, clayey silt filling	A*			
0.3	SANDY CLAY - red brown mottled grey, sandy clay	A	0.3		
0.9	SHALE - extremely low to very low strength, red brown mottled grey shale	A	0.5		
1.3	SHALE - low strength, dark grey shale	A	1.0		
1.5	TEST BORE DISCONTINUED AT 1.5m	A	1.5		
2					
3					
4					
5					

RIG: SCOUT                      DRILLER: G COOPER                      LOGGED: R HUI                      CASING: UNCASED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS: A\* INDICATES FIELD REPLICATE SAMPLE Z1 TAKEN

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>RH</i>
Date: 8/03

# TEST BORE REPORT

**CLIENT:** HYDER CONSULTING  
**PROJECT:** MINTO RENEWAL PROJECT  
**LOCATION:** MINTO

**DATE:** JULY 03  
**PROJECT No.:** 35705  
**SURFACE LEVEL:**

**BORE No. 17**  
**SHEET 1 OF 1**

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	SAND - dark brown, fine grained sand				
0.3	SANDY CLAY - stiff, red brown, sandy clay with some gravel				
0.6	SHALE - low strength, dark grey mottled brown shale	A	0.5		
1	TEST BORE DISCONTINUED AT 1.0m	A	1.0		
2					
3					
4					
5					

**RIG:** SCOUT                      **DRILLER:** G COOPER      **LOGGED:** R HUI                      **CASING:** UNCASED  
**TYPE OF BORING:** SOLID FLIGHT AUGER  
**GROUND WATER OBSERVATIONS:** NO FREE GROUNDWATER OBSERVED  
**REMARKS:**

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>PH</i>
Date: 8/03

# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 30 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 18  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, sandy silty clay filling, with some roots				
0.3	SILTY CLAY - orange brown, silty clay	A	0.3		4
		A	0.5		3
0.65	GRAVELLY SANDY CLAY - stiff, light brown, gravelly sandy clay, with ironstone bands				
1	1.15m: shale band, very low to low strength	A	1.0		
		A	1.15		
1.3	SHALE - very low strength, dark grey and brown shale	A	1.5		
2	2.0	A	2.0		
	TEST BORE DISCONTINUED AT 2.0m				
3					
4					
5					

RIG: SCOUT      DRILLER: G COOPER      LOGGED: R HUI      CASING: UNCASED

TYPE OF BORING: SOLID FLIGHT AUGER

GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED

REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>RH</i>
Date: 8/03

# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 31 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BORE No. 19  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, silty sandy clay				
0.5	SILTY CLAY - stiff, red brown, silty clay	A	0.5		2
0.9	SILTY CLAY - stiff, brown silty clay	A	1.0		
1.8		A	1.5		
2.0	SANDSTONE - very low strength, fine grained, light brown sandstone	A	2.0		
TEST BORE DISCONTINUED AT 2.0m					
3					
4					
5					

RIG: SCOUT                                      DRILLER: G COOPER                      LOGGED: R HUI                                      CASING: UNCASED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>RH</i>
Date: 8/03



# TEST BORE REPORT

CLIENT: HYDER CONSULTING  
 PROJECT: MINTO RENEWAL PROJECT  
 LOCATION: MINTO

DATE: 30 JULY 03  
 PROJECT No.: 35705  
 SURFACE LEVEL:

BQRE No. 20  
 SHEET 1 OF 1

Depth m	Description of Strata	Sampling & In Situ Testing			
		Type	Depth (m)	Results	Headspace PID (ppm)
0	FILLING - dark brown, silty clay filling				
0.45	SILTY CLAY - red brown, silty clay	A	0.3		5
0.80	SLILTY CLAY - brown mottled light grey, silty clay	A	0.5		7
1.3	SHALE - extremely low strength, light grey mottled brown shale	A	1.0		
2.0	- very low strength from 1.8m	A	1.5		
2.0	TEST BORE DISCONTINUED AT 2.0m	A	2.0		
3					
4					
5					

RIG: SCOUT DRILLER: G COOPER LOGGED: R HUI CASING: UNCASSED  
 TYPE OF BORING: SOLID FLIGHT AUGER  
 GROUND WATER OBSERVATIONS: NO FREE GROUNDWATER OBSERVED  
 REMARKS:

SAMPLING & IN SITU TESTING LEGEND	
A auger sample	PL point load strength $I_s$ (50)MPa
B bulk sample	S standard penetration test
C core drilling	Ux x mm dia. tube
pp Pocket Penetration (kPa)	V shear vane (kPa)

CHECKED:
Initials: <i>RH</i>
Date: 8/03



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## DESCRIPTION AND CLASSIFICATION OF ROCKS FOR ENGINEERING PURPOSES

### DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh Stained	Fs	Rock substance unaffected by weathering, but showing limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

### ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index ( $I_{S(50)}$ ) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by Australian Standard 4133.4.1 - 1993.

Term	Symbol	Field Guide*	Point Load Index $I_{S(50)}$ MPa	Approx Unconfined Compressive Strength $q_u$ ** MPa
Extremely low	EL	Easily remoulded by hand to a material with soil properties	<0.03	< 0.6
Very low	VL	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. SPT will refuse. Pieces up to 3 cm thick can be broken by finger pressure.	0.03-0.1	0.6-2
Low	L	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long 40 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.1-0.3	2-6
Medium	M	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	0.3-1.0	6-20
High	H	Can be slightly scratched with a knife. A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow, rock rings under hammer.	1 - 3	20-60
Very high	VH	Cannot be scratched with a knife. Hand specimen breaks with pick after more than one blow, rock rings under hammer.	3 - 10	60-200
Extremely high	EH	Specimen requires many blows with geological pick to break through intact material, rock rings under hammer.	>10	> 200

Note that these terms refer to strength of rock material and not to the strength of the rock mass, which may be considerably weaker due to rock defects.

\* The field guide assessment of rock strength may be used for preliminary assessment or when point load testing is not able to be done.

\*\* The approximate unconfined compressive strength ( $q_u$ ) shown in the table is based on an assumed ratio to the point load index of 20:1. This ratio may vary widely.

### STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2 m

### DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks. The orientation of rock defects is measured as an angle relative to a plane perpendicular to the core axis. Note that where possible, recordings of the actual defect spacing or range of spacings is preferred to the general terms given below.

Term	Description
Fragmented	The core consists mainly of fragments with dimensions less than 20 mm.
Highly Fractured	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured	Core lengths are mainly 40 mm - 200 mm with occasional shorter and longer sections.
Slightly Fractured	Core lengths are generally 200 mm - 1000 mm with occasional shorter and longer sections.
Unbroken	The core does not contain any fracture.

### ROCK QUALITY DESIGNATION (RQD)

This is defined as the ratio of sound (i.e. low strength or better) core in lengths of greater than 100 mm to the total length of the core, expressed in percent. If the core is broken by handling or by the drilling process (i.e. the fracture surfaces are fresh, irregular breaks rather than joint surfaces) the fresh broken pieces are fitted together and counted as one piece.

### SEDIMENTARY ROCK TYPES

This classification system provides a standardised terminology for the engineering description of sandstone and shales, particularly in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Rock Type	Definition
Conglomerate	More than 50% of the rock consists of gravel-sized (greater than 2 mm) fragments
Sandstone:	More than 50% of the rock consists of sand-sized (0.06 to 2 mm) grains
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06 mm) granular particles and the rock is not laminated.
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay-sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, eg. clayey sandstone, sandy shale.

# GRAPHIC SYMBOLS FOR SOIL & ROCK

## SOIL

	BITUMINOUS CONCRETE
	CONCRETE
	TOPSOIL
	FILLING
	PEAT
	CLAY
	SILTY CLAY
	SANDY CLAY
	GRAVELLY CLAY
	SHALY CLAY
	SILT
	CLAYEY SILT
	SANDY SILT
	SAND
	CLAYEY SAND
	SILTY SAND
	GRAVEL
	SANDY GRAVEL
	COBBLES/BOULDERS
	TALUS

## SEAMS

	SEAM >10mm		SEAM <10mm
--	---------------	--	---------------

## SEDIMENTARY ROCK

	BOULDER CONGLOMERATE
	CONGLOMERATE
	CONGLOMERATIC SANDSTONE
	SANDSTONE FINE GRAINED
	SANDSTONE COARSE GRAINED
	SILTSTONE
	LAMINITE
	MUDSTONE, CLAYSTONE, SHALE
	COAL
	LIMESTONE

## METAMORPHIC ROCK

	SLATE, PHYLLITE, SCHIST
	GNEISS
	QUARTZITE

## IGNEOUS ROCK

	GRANITE
	DOLERITE, BASALT
	TUFF
	PORPHYRY



**Douglas Partners**  
Geotechnics, Environment, Groundwater

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***APPENDIX C***  
***Laboratory Test Results***

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14 AUG 2003

11 August 2003

## TEST REPORT

**Douglas Partners Pty Ltd**  
96 Hermitage Road  
WEST RYDE  
NSW 2114

Your Reference: 35705, Minto Renewal Project  
Report Number: 24128

**Attention:** Raymond Hui

Dear Raymond

The following samples were received from you on the date indicated.

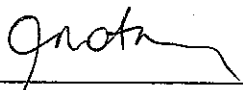
Samples: Qty. 11 Soils  
Date of Receipt of Samples: 01/08/03@5:30pm  
Date of Receipt of Instructions: 01/08/03  
Date Preliminary Report Faxed: Not Issued

These samples were analysed in accordance with your written instructions.  
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report.  
Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.

Yours faithfully  
SGS ENVIRONMENTAL SERVICES



Tania Notaras  
Manager Sydney



Jacinta Hurst  
Operations Manager

AEL Ref	Sample ID	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
---	---	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
24128-1	2/0.5	12	<0.5	11	36	25	<0.05	17	110
24128-2	5/0.5	19	<0.5	15	30	26	<0.05	9	49
24128-3	6/0.5	9	<0.5	14	30	27	<0.05	14	91
24128-4	8/0.5	9	<0.5	14	30	24	<0.05	12	56
24128-5	10/0.5	9	<0.5	13	32	61	0.07	13	66
24128-6	12/0.5	10	<0.5	10	40	25	<0.05	11	120
24128-7	14/0-0.3	12	<0.5	22	28	29	0.05	22	64
24128-8	15/0-0.3	9	<0.5	11	24	58	0.11	7	98
24128-9	16/0-0.3	4	<0.5	15	26	25	<0.05	10	46
24128-10	19/0.5	8	<0.5	16	23	25	0.05	12	56
24128-11	Z1	4	<0.5	15	24	24	<0.05	10	39

AEL Ref	Sample ID	TRH C6 - C9 P&T	TRH C10 - C14	TRH C15 - C28	TRH C29 - C36	Benzene	Toluene	Ethylbenzene	Total Xylenes	Surrogate
---	---	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%
24128-1	2/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	72
24128-2	5/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	108
24128-3	6/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	104
24128-4	8/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	68
24128-5	10/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	72
24128-6	12/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	83
24128-7	14/0-0.3	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	85
24128-8	15/0-0.3	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	74
24128-9	16/0-0.3	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	109
24128-10	19/0.5	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	73
24128-11	Z1	<20	<20	<50	<50	<0.50	<0.50	<0.50	<1.5	80

AEL Ref	Sample ID	HCB	alpha-BHC	gamma-BHC(Lindane)	Heptachlor	Aldrin	beta-BHC	delta-BHC	Heptachlor Epoxide	o,p'-DDE	alpha-Endosulfan	trans-Chlordane	cis-Chlordane	trans-Nonachlor	p,p'-DDE	Dieldrin
---	---	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
24128-1	2/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
24128-2	5/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
24128-3	6/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
24128-4	8/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
24128-5	10/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
24128-6	12/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
24128-7	14/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
24128-8	15/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
24128-9	16/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
24128-10	19/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
24128-11	Z1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

AEL Ref	Sample ID	Endrin	o,p'-DDD	o,p'-DDT	beta-Endosulfan	p,p'-DDD	p,p'-DDT	Endosulfan Sulphate	Endrin Aldehyde	Methoxychlor	Endrin Ketone	Surrogate
---	---	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%
24128-1	2/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	84
24128-2	5/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	81
24128-3	6/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	83
24128-4	8/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	99
24128-5	10/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	85
24128-6	12/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	96
24128-7	14/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	97
24128-8	15/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	96
24128-9	16/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	95
24128-10	19/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	96
24128-11	Z1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	96

5

AEL Ref	Sample ID	Chlorpyrifos	Fenitrothion	Bromofos Ethyl	Ethion	Surrogate
---	---	mg/kg	mg/kg	mg/kg	mg/kg	%
24128-1	2/0.5	<0.10	<0.10	<0.10	<0.10	84
24128-2	5/0.5	<0.10	<0.10	<0.10	<0.10	81
24128-3	6/0.5	<0.10	<0.10	<0.10	<0.10	83
24128-4	8/0.5	<0.10	<0.10	<0.10	<0.10	99
24128-5	10/0.5	<0.10	<0.10	<0.10	<0.10	85
24128-6	12/0.5	<0.10	<0.10	<0.10	<0.10	96
24128-7	14/0-0.3	<0.10	<0.10	<0.10	<0.10	97
24128-8	15/0-0.3	<0.10	<0.10	<0.10	<0.10	96
24128-9	16/0-0.3	<0.10	<0.10	<0.10	<0.10	95
24128-10	19/0.5	<0.10	<0.10	<0.10	<0.10	96
24128-11	Z1	<0.10	<0.10	<0.10	<0.10	96

4

AEL Ref	Sample ID	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	Arochlor 1262	Arochlor 1268	Total Positive PCB	Surrogate
---	---	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%
24128-1	2/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	84
24128-2	5/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	81
24128-3	6/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	83
24128-4	8/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	99
24128-5	10/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	85
24128-6	12/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	96
24128-7	14/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	97
24128-8	15/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	96
24128-9	16/0-0.3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	95
24128-10	19/0.5	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	96
24128-11	Z1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.90	96

AEL Ref	Sample ID	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b,k]fluoranthene	Benzo[a]pyrene	Indeno[1,2,3-cd]pyrene	Dibenzo[a,h]anthracene	Benzo[ghi]perylene
---	---	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
24128-1	2/0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
24128-2	5/0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
24128-3	6/0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
24128-4	8/0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
24128-5	10/0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
24128-6	12/0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
24128-7	14/0-0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
24128-8	15/0-0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
24128-9	16/0-0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
24128-10	19/0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
24128-11	Z1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1

AEL Ref	Sample ID	Total +ve PAH's	Surrogate
---	---	mg/kg	%
24128-1	2/0.5	0.00	116
24128-2	5/0.5	0.00	110
24128-3	6/0.5	0.00	107
24128-4	8/0.5	0.00	117
24128-5	10/0.5	0.00	110
24128-6	12/0.5	0.00	121
24128-7	14/0-0.3	0.00	114
24128-8	15/0-0.3	0.00	116
24128-9	16/0-0.3	0.00	119
24128-10	19/0.5	0.00	113
24128-11	Z1	0.00	110



AEL Ref	Sample ID	Moisture
---	---	%
24128-1	2/0.5	10
24128-2	5/0.5	19
24128-3	6/0.5	17
24128-4	8/0.5	19
24128-5	10/0.5	25
24128-6	12/0.5	12
24128-7	14/0-0.3	22
24128-8	15/0-0.3	21
24128-9	16/0-0.3	18
24128-10	19/0.5	20
24128-11	Z1	18

Method ID	Methodology Summary
SEM-010	Metals - Determination of various metals by ICP following aqua regia digest.
SEM-005	Mercury - Determination of Mercury by Cold Vapour Generation Atomic Absorption Spectroscopy.
SEO-017	BTEX/TRH C6-C9 - Determination by Purge and Trap Gas Chromatography with Flame Ionisation Detection (FID) and Photo Ionisation Detection (PID). The surrogate spike used is $\alpha,\alpha,\alpha$ -trifluorotoluene.
SEO-020	TRH - Determination of Total Recoverable Hydrocarbons by gas chromatography following extraction with DCM/Acetone for solids and DCM for liquids.
SEO-005	OC/OP/PCB - Determination of a suite of Organochlorine Pesticides, Chlorinated Organo-phosphorus Pesticides and Polychlorinated Biphenyls (PCB's) by sonication extraction using dichloromethane for waters or acetone / hexane for soils followed by Gas Chromatographic separation with Electron Capture Detection (GC/ECD). The surrogate spike used is 2,4,5,6-Tetrachloro-m-xylene.
SEO-030	PAHs by GC/MS - Determination of Polynuclear Aromatic Hydrocarbons (PAH's) by Gas Chromatography / Mass Spectrometry following extraction with dichloromethane or dichloromethane/acetone. The surrogate spike used is p-Terphenyl-d14.
SEP-001	Air Dry - Cover air drying at 40 C, moisture content at 103 C - 105 C, wet slurring, compositing and preparation of a 1:5 soil suspension.

2

QUALITY CONTROL Acid Extractable Metals in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+%RPD	Spike Sm#	Matrix Spike % Recovery Duplicate+% RPD
Arsenic	mg/kg	3	SEM-010	<3	24128-1	12    12    RPD: 0	24128-2	95    99    RPD: 4
Cadmium	mg/kg	0.5	SEM-010	<0.5	24128-1	<0.5    <0.5	24128-2	94    96    RPD: 2
Chromium	mg/kg	0.5	SEM-010	<0.5	24128-1	11    11    RPD: 0	24128-2	93    96    RPD: 3
Copper	mg/kg	0.5	SEM-010	<0.5	24128-1	36    39    RPD: 8	24128-2	98    102    RPD: 4
Lead	mg/kg	2	SEM-010	<2	24128-1	25    26    RPD: 4	24128-2	91    96    RPD: 5
Mercury	mg/kg	0.05	SEM-005	<0.05	24128-1	<0.05    0.05	24128-2	81    81    RPD: 0
Nickel	mg/kg	0.2	SEM-010	<0.2	24128-1	17    18    RPD: 6	24128-2	90    93    RPD: 3
Zinc	mg/kg	0.5	SEM-010	<0.5	24128-1	110    110    RPD: 0	24128-2	100    105    RPD: 5
QUALITY CONTROL TRH/BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+%RPD	Spike Sm#	Matrix Spike % Recovery Duplicate+% RPD
TRH C6 - C9 P&T	mg/kg	20	SEO-017	<20	24128-2	<20    <20	24128-5	70    74    RPD: 6
TRH C10 - C14	mg/kg	20	SEO-020	<20	24128-2	<20    <20	24128-5	95    93    RPD: 2
TRH C15 - C28	mg/kg	50	SEO-020	<50	24128-2	<50    <50	24128-5	110    94    RPD: 16
TRH C29 - C36	mg/kg	50	SEO-020	<50	24128-2	<50    <50	24128-5	105    83    RPD: 23
Benzene	mg/kg	0.5	SEO-017	<0.50	24128-2	<0.50    <0.50	24128-5	69    72    RPD: 4
Toluene	mg/kg	0.5	SEO-017	<0.50	24128-2	<0.50    <0.50	24128-5	69    72    RPD: 4
Ethylbenzene	mg/kg	0.5	SEO-017	<0.50	24128-2	<0.50    <0.50	24128-5	67    74    RPD: 10
Total Xylenes	mg/kg	1.5	SEO-017	<1.5	24128-2	<1.5    <1.5	24128-5	63    68    RPD: 8
Surrogate	%		SEO-017	[NT]	24128-2	108    84    RPD: 25	24128-5	73    73    RPD: 0
QUALITY CONTROL OC Pesticides in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+%RPD	Spike Sm#	Matrix Spike % Recovery Duplicate+% RPD
HCB	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
alpha-BHC	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
gamma-BHC(Lindane)	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
Heptachlor	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	107    95    RPD: 12
Aldrin	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	100    92    RPD: 8
beta-BHC	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
delta-BHC	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	103    94    RPD: 9
Heptachlor Epoxide	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
o,p'-DDE	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
alpha-Endosulfan	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike

QUALITY CONTROL OC Pesticides in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+% RPD	Spike Sm#	Matrix Spike % Recovery Duplicate+% RPD
<i>trans</i> -Chlordane	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
<i>cis</i> -Chlordane	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
<i>trans</i> -Nonachlor	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
<i>p,p'</i> -DDE	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
Dieldrin	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	105    95    RPD: 10
Endrin	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
<i>o,p'</i> -DDD	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
<i>o,p'</i> -DDT	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
<i>beta</i> -Endosulfan	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
<i>p,p'</i> -DDD	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
<i>p,p'</i> -DDT	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	81    81    RPD: 0
Endosulfan Sulphate	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	114    94    RPD: 19
Endrin Aldehyde	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
Methoxychlor	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
Endrin Ketone	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
<i>Surrogate</i>	%		SEO-005	[NT]	24128-1	84    96    RPD: 13	24128-5	101    99    RPD: 2
QUALITY CONTROL OP Pesticides in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+% RPD	Spike Sm#	Matrix Spike % Recovery Duplicate+% RPD
Chlorpyrifos	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	116    103    RPD: 12
Fenitrothion	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
Bromofos Ethyl	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
Ethion	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-5	Nil Spike
<i>Surrogate</i>	%		SEO-005	[NT]	24128-1	84    96    RPD: 13	24128-5	101    99    RPD: 2
QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+% RPD	Spike Sm#	Matrix Spike % Recovery Duplicate+% RPD
Arochlor 1016	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-6	Nil Spike
Arochlor 1221	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-6	Nil Spike
Arochlor 1232	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-6	Nil Spike
Arochlor 1242	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-6	Nil Spike
Arochlor 1248	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-6	Nil Spike

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+% RPD	Spike Sm#	Matrix Spike % Recovery Duplicate+% RPD
Arochlor 1254	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-6	101    100    RPD: 1
Arochlor 1260	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-6	Nil Spike
Arochlor 1262	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-6	Nil Spike
Arochlor 1268	mg/kg	0.1	SEO-005	<0.10	24128-1	<0.10    <0.10	24128-6	Nil Spike
Total Positive PCB	mg/kg	0.9	SEO-005	0.90	24128-1	<0.90    <0.90	24128-6	Nil Spike
Surrogate	%		SEO-005	[NT]	24128-1	84    96    RPD: 13	24128-6	101    102    RPD: 1
QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+%RPD	Spike Sm#	Matrix Spike % Recovery Duplicate+% RPD
Naphthalene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	117    113    RPD: 3
Acenaphthylene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	110    107    RPD: 3
Acenaphthene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	121    118    RPD: 3
Fluorene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	Nil Spike
Phenanthrene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	120    115    RPD: 4
Anthracene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	123    103    RPD: 18
Fluoranthene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	134    129    RPD: 4
Pyrene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	117    113    RPD: 3
Benzo[a]anthracene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	Nil Spike
Chrysene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	Nil Spike
Benzo[b,k]fluoranthene	mg/kg	0.20	SEO-030	<0.2	24128-2	<0.2    <0.2	24128-4	Nil Spike
Benzo[a]pyrene	mg/kg	0.050	SEO-030	<0.05	24128-2	<0.05    <0.05	24128-4	93    93    RPD: 0
Indeno[123-cd]pyrene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	Nil Spike
Dibenzo[ah]anthracene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	Nil Spike
Benzo[ghi]perylene	mg/kg	0.10	SEO-030	<0.1	24128-2	<0.1    <0.1	24128-4	Nil Spike
Total +ve PAH's	mg/kg	0	SEO-030	0.00	24128-2	0.00    0.00	24128-4	Nil Spike
Surrogate	%		SEO-030	[NT]	24128-2	110    110    RPD: 0	24128-4	116    113    RPD: 3

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base+Duplicate+% RPD
Moisture	%		SEP-001	[NT]	24128-2	19    19    RPD: 0

**Result Codes**

[INS] : Insufficient Sample for this test  
[NR] : Not Requested  
[NT] : Not tested

[HBG] : Results not Reported due to High Background Interference  
\* : Not part of NATA Registration  
[N/A] : Not Applicable

**Result Comments**

The methods detailed in this report have been validated. Analysis and QA/QC is in accordance with Schedule B(3) NEPM Guideline on Laboratory Analysis of Potentially Contaminated Soils - 1999.

Date Organics extraction commenced: 07/08/03  
NATA Accreditation No. 4361

**Quality Control Protocol**

**Reagent Blank:** Sample free reagents carried through the preparation/extraction/digestion procedure and analysed at the beginning of every sample batch analysis. For larger projects, a reagent blank is prepared and analysed with every 20 samples.

**Duplicate:** A separate portion of a sample being analysed which is treated the same as the other samples in the batch. A duplicate is prepared at least every 20 samples.

**Matrix Spike Duplicates:** Sample replicates spiked with identical concentrations of target analyte(s). The spiking occurs during the sample preparation and prior to the extraction/digestion procedure. They are used to document the precision and bias of a method in a given sample matrix. Where there is not enough sample available to prepare a spiked sample, another known soil/sand or water (or Milli-Q water) may be used. A duplicate spiked sample is prepared at least every 20 samples.

**Surrogate Spike:** Added to all samples requiring analysis for organics (where relevant) prior to extraction. Used to determine the extraction efficiency. They are organic compounds which are similar to the target analyte(s) in chemical composition and behaviour in the analytical process, but which are not normally found in environmental samples.

**Internal Standard:** Added to all samples requiring analysis for organics (where relevant) after the extraction process; the compounds serve to give a standard of retention time and response, which is invariant from run-to-run with the instruments.

**Control Standards:** Prepared from a source independent of the calibration standards. At least one control standard is included in each run to confirm calibration validity.

**Additional QC Samples:** A calibration standard and blank are run after every 20 samples of an instrumental analysis run to assess analytical drift.

4

Project Name: Minto Renewal Project  
 Project No: 35705  
 DP Contact Person: Raymond Hui  
 Prior Storage: esky / fridge / shelved (circle)

To: **AUSTRALIAN ENVIRONMENTAL LABORATORIES**  
 Botany Technical Centre, Orica Industrial Park  
 Gate 3, Denison St, Matraville, NSW 2036  
 Ph: 9666 1426 Fax: 9666 1364  
 Attn: **TANIA NOTARAS**

Sample ID	Sample Type S-soil W-water	Lab ID	Inorganics								Organics				Other		Notes
			As	Cd	Cr	Cu	Pb	Hg	Zn	Ni	Total / GS/MS Phenol	BTEX/ TPH	OCs/ OPs/ PCBs	PAHs	TCLP		
210.5	S	1	X	X	X	X	X	X	X	X		X	X	X			
510.5		2															
610.5		3															
810.5		4															
1010.5		5															
1210.5		6															
1410-0.3		7															
1510-0.3		8															
1610-0.3		9															
1910.5		10															
21	✓	11	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			
PQL (S)	mg/kg		0.05	1	5	3	5	0.01	5		0.5/*	*	*	*			
PQL (W)	mg/L		0.001	0.01	0.05	0.03	0.05	0.0005	0.01		0.05/*	*	*	*			

**SGS**

Received: 1/8/03

By: Aileen

Time: 5:30

am/pm

Samples intact: yes/no

Ice/Cooler Pack: yes/no

Comments: 24128

PQL = practical quantitation limit, \*As per Laboratory Method Detection Limit  
 Date relinquished: 1/8/03  
 Total number of samples in container: 11  
 Results required by:  
 24 hours    48 hours    72 hours    Standard

**SAMPLES RECEIVED**  
 Please sign and date to acknowledge receipt of samples and return by fax  
 Signature: Aileen  
 Date: 1/8/03 Lab Ref: 24128

Send results to:  
**Douglas Partners Pty Ltd** Phone 02 9809 0666  
 96 Hermitage Road Fax 02 9809 4095  
 West Ryde NSW 2114  
 e-mail [dpenviro@douglaspartners.com.au](mailto:dpenviro@douglaspartners.com.au)