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PRELIMINARY CONTAMINATION GEOTECHNICAL AND MINE SUBSIDENCE ASSESSMENT

PROPOSED RESIDENTIAL SUBDIVISION GWANDALAN

Prepared for

COAL & ALLIED INDUSTRIES LTD

Project 39662.06-03

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12 October 2010

PRELIMINARY CONTAMINATION, GEOTECHNICAL AND MINE SUBSIDENCE ASSESSMENT PROPOSED RESIDENTIAL SUBDIVISION GWANDALAN

1. INTRODUCTION

This report presents the results of a preliminary contamination, geotechnical and mine subsidence assessment for a proposed residential subdivision. The assessment was carried out at the request of Coal & Allied Industries Ltd, (Coal & Allied) in consultation with Catylis Pty Ltd.

The assessment comprised the following components:

- Desktop review of regional geology, hydrogeology, soil landscape and acid sulphate soils;
- Review of previous mining operations beneath the subject site;
- Site history;
- Site walkover survey to describe the current site condition and surface features;
- Subsurface investigation by test pits;
- Soil sampling and chemical testing;
- Comments on actual and anticipated development constraints and opportunities including the following:
  - Potential contamination;
  - Depth, extent and nature of filling;

  - Presence of soft alluvial soils and acid sulphate soils;
  - Slope stability;
  - Likely founding conditions;
  - Presence of aggressive soil conditions with respect to buried structures;
  - Presence of shallow rock.
- General recommendations for further investigation.

The contamination assessment was being carried out in general accordance with the NSW EPA "Guidelines for Consultants Reporting on Contaminated Sites" (Ref 2) and SEPP 55 "Remediation of Land" (Ref 3).

In addition to the above, a Hazard Materials Survey was undertaken at the site by ESP Environmental (Ref 16). The purpose of the hazard materials survey was to identify potentially hazardous materials at the site (asbestos, synthetic mineral fibres, polychlorinated biphenyls and lead in paint) which may require remediation.

2. PROPOSED DEVELOPMENT

It is proposed that the entire Coal & Allied Industries Limited owned Gwandalan site be rezoned/listed as a 'State Significant Site' in Schedule 3 of State Environmental Planning Policy (SEPP) (Major Development). A draft Schedule 3 listing will be prepared with the Concept Plan Application.

The Concept Plan for a residential subdivision and conservation land transfer of the Gwandalan site will apply to the entire 268 ha Gwandalan site. The key parameters for the proposed development of the site are as follows:

- Dedication of 205.75 ha of conservation land to the New South Wales Government (NSWG) that is identified in the Lower Hunter Regional Strategy and Lower Hunter Regional Conservation Plan, comprising approximately 77% of the Gwandalan site;
- Maximum dwelling yield of 623 dwellings over 62.24 ha;

- Indicative development staging. The number of lots and extent of staging for release areas will be largely dictated by the service infrastructure requirements as well as responding to market forces;
- The provision of associated infrastructure;
- Torrens title subdivision of the Gwandalan site. The Torrens title subdivision and boundary realignment of Coal & Allied land will enable land 205.75 ha in area that is owned by Coal & Allied to be excised and dedicated to NSWG for conservation land.

Approval will not be sought under the Concept Plan for a specific lot or road layout. An indicative lot layout will indicate how the maximum dwelling yield of 623 dwellings could be achieved on the site.

Similarly, approval will not be sought under the Concept Plan for subdivision or construction of individual houses. However, the desired future character of the proposed concept plan will be included in Urban Design Guidelines. Urban Design Guidelines will be prepared to inform the Concept Plan in respect of urban form, built form, open space and landscape, access and movement and visual impact for the site.

It is proposed to dedicate land for conservation purposes as part of the Major Project Application via a Voluntary Planning Agreement between Coal & Allied and the NSWG in accordance with S.93F of the Environmental Planning & Assessment Act, 1979 (EP&A Act).

The proposed Concept Plan and a Plan showing the proposed development areas and conservation areas is included in the Preliminary Environmental Assessment prepared by Urbis.

3. SITE IDENTIFICATION

This report comprises an assessment of the proposed development, identified as Part Lot 2 DP 1043151, within the Wyong Shire Council area. The Gwandalan development site is located south of the existing township of Gwandalan, and east of Kanangra Drive.

The Gwandalan development site comprises an approximate rectangular shaped portion of land, as shown in blue on Drawing 7, attached.

Adjacent land use comprises the following:

- North – proposed and existing light industrial and residential development, bushland;
- South – bushland;
- East – Crangan Bay, Lake Macquarie;
- West – Kanangra Drive and bushland.

4. DESKTOP REVIEW

4.1 Regional Geology and Hydrogeology

The 1:100,000 scale Newcastle Coalfield Regional Geology map indicates the site is primarily underlain by the Triassic Age Narrabeen Group geological formation which typically comprise conglomerate, sandstone, siltstone and claystone. A weathered residual soil zone would be expected near the surface, with rock depths generally shallow.

Alluvial soils are expected to be present along the foreshore, extending further onto the site in the north east corner, as well as a tongue of alluvial soil on the southern portions of the site in the low lying area below about 5 to 15 m AHD surface level.

Reference to the soil landscape map for Gosford-Lake Macquarie indicates the soils at the site fall into two typical landscapes as follows:

Doyalson: The majority of the site soils are mapped as the Doyalson Landscape and typical limitations include the following:

- High erosion hazard;
- Localised foundation hazard;
- Strongly acidic.

Wyong: Alluvial soils as described above are mapped as the Wyong Landscape and typical limitations include the following:

- Seasonal/permanent water logging;
- Foundation hazard;
- Stream bank erosion;
- Acid sulphate potential;
- Strongly acidic;
- Saline subsoils.

Reference to the Catherine Hill Bay Acid Sulphate Soil Risk Map prepared by the Department of Land & Water Conservation indicates that there is an area of high probability acid sulphate soil across the eastern portion of the site. The acid sulphate soils mapped are within estuarine soils within 1 metre of the ground surface (indicated in purple on Drawing 7). The ASS Risk Map indicates that there is no known occurrence of acid sulphate soil materials across the remainder of the site.

The regional groundwater flow regime is believed to be to the east of the site, towards Crangan Bay, Lake Macquarie, which is adjacent to the eastern boundary of the site and is considered to be the nearest sensitive receptor. It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

There is no specific data available regarding groundwater quality, however surface water quality testing has previously been undertaken by DP for the site (Ref 17) which indicated the following:

- Total Phosphorus was greater than ANZECC trigger levels for slightly to moderately disturbed systems;
- E coli was detected and exceeded the ANZECC trigger levels for recreational use;
- When compared to ANZECC trigger levels for lowland rivers, the turbidity was significantly greater than expected for slightly disturbed catchments;
- Concentrations of Copper and Zinc were above ANZECC trigger levels, however elevations of such parameters are not unusual in the natural environment and could be typical of background levels.

There are no registered groundwater wells in the vicinity of the site. The nearest registered wells are on the northern peninsula of Gwandalan (GW034600, GW024575), about 1.5 km north and up gradient of the site.

4.2 Mine Subsidence

General

Review of record traces (RTs) obtained from the Department of Primary Industries – Minerals indicate that the site is underlain by abandoned workings in two seams, the Wallarah and the Great Northern.
The RTs have been overlayed on the proposed development outline and are presented on Drawings 8 (Wallarah Seam) and 8A (Great Northern Seam). The workings are described as follows:

Wallarah Seam

The Wallarah Seam was worked by Wallarah Colliery on the southern parts of the site and Chain Valley Bay Colliery on the northern parts of the site. The workings are bord and pillar style with selected panels subject to pillar extraction. The depth of cover ranges from about 120 m at the southern end of the site to 150 m at the northern end of the site.

Great Northern Seam

The Great Northern Seam was worked by Wallarah Colliery on the southern parts of the site and Chain Valley Bay Colliery on the northern parts of the site. The workings are bord and pillar style. On the northern parts of the site the Chain Valley Bay Colliery has recently undertaken second workings comprising split (partial) pillar removal, with selected panels subject to pillar extraction. The depth of cover ranges from about 150 m at the southern end of the site to 185 m at the northern end of the site.

A subsidence management plan (Ref 11) was developed for the pillar splitting being undertaken by the Chain Valley Bay Colliery and indicated the following:

- Pillar extraction and subsidence (up to 1 m) has been experienced in this area from mining in the Wallarah seam;
- The area is within a mines subsidence district and infrastructure has been designed to stand subsidence, compression , tensions and tilts for total extraction;
- The partial extraction layout proposed was a conservative non-caving design that results in low range subsidence of up to 100 mm and tensions of up to 1 mm/m (Shepherd Mining Geotechnical SMG 798/4);
- If the inter-panel pillars are loaded up and if the actual floor conditions are inferior as in the case in other collieries, subsidence may increase to 200 mm to 500 mm (Shepherd Mining Geotechnics SMG 798/4).

Discussions with Mr Keith Harris, the mine surveyor for Lake Coal, operators of the Chain Valley Colliery, indicated that the floor of the Great Northern Seam is generally in good condition with some localised poor areas and that it was generally in better condition than at Newvale Colliery.

Consultations

Consultations have been undertaken with Mr Greg Cole-Clark of the Mine Subsidence Board. Mr Cole-Clark indicated that where there is more than 50 m cover to mine workings, the traditional development guidelines have allowed two storey brick veneer style development, however, a detailed risk assessment would be required for this development.

If the assessment indicated that subsidence was likely, then it would be necessary to predict worst case subsidence parameters. For predicted subsidence parameters, exceeding the following, development would be restricted to single storey brick veneer or similar.

- Maximum Subsidence = 400 mm;
- Strains = ± 3mm/m;
- Tilts = 4 mm/m.

Lake Coal indicate they propose mining under the site in the Fassifern Seam, which is expected to be at about 200 m depth however no details of the proposed mining are available at this time.

5. SITE HISTORY

The brief review of site history comprised the following:

- Interview with Mr Keith Harris of Lake Coal;
- Review of historical aerial photos;
- Searches with NSW Department of Environment, Climate Change and Water (DECCW).

Interviews with Personnel Familiar with the Site

A telephone interview with Mr Keith Harris, employee of Lake Coal since 1996, revealed the following information:

- The site was leased by Wallarah Colliery until 1996;
- Chain Valley Colliery have leased the land from 1996 to present;
- Keith was unsure of the reason for land clearing, observed in the centre of the site during the late 1980s/early 1990's, as this was prior to his employment in 1996. However it may possibly be a Ballast Borehole (300 mm diameter) and access track;
- Lake Coal are currently undertaking pillar extraction of the Great Northern Seam beneath Kanangra Drive, this will affect part of the subject site;
- Lake Coal propose to undertake pillar extraction of the Fassifern Seam in the future. This work would not commence for at least 5 years.

Review of Historical Aerial Photos

The following historical aerial photos were reviewed:

Table 1 – Aerial Photo Review

Year	Approximate Scale	Black and White/Colour
1954	1:40000	Black and White
1966	1:38000	Black and White
1975	1:40000	Black and White
1984	1:40000	Black and White
1996	1:50000	Colour
2006	1:25000	Colour

1954 Aerial Photograph

- Kanangra Drive road alignment present, runs north to Point Wolstoncroft;
- track visible, connecting to Kanangra Drive and running north-east to centre of site, then north across centre of site, grassed area (possibly with dam) at corner of track;
- site generally comprises undeveloped bushland;
- Gwandalan township not yet developed.

1966 Aerial Photograph

- Cleared area, approx 500 m^2, adjacent to Kanangra Drive in north-west corner of site;
- Gwandalan township developing.

1975 Aerial Photograph

- Cleared area in north-west corner now overgrown/grassed;
- Road along northern boundary, running east-west from Kanangra Drive to Lake Macquarie.

1984 Aerial Photograph

- Minor tracks visible adjacent (and approximately parallel) to Kanangra Drive.

1996 Aerial Photograph

- Major track visible, from Kanangra Drive east to the centre of the site, with several off-shoots to cleared areas;
- Three small buildings (sheds?) visible in centre of site, in a cleared area on the eastern extent of the major track.

2006 Aerial Photograph

- No additional clearing or development noted since 1996;
- Cleared area in centre of site appears overgrown;
- The three small buildings (sheds?) no longer visible.

Information obtained from aerial photos was limited by the relatively small scale and poor resolutions.

NSW Department of Environment and Climate Change

A property information inquiry with the NSW DECCW indicated that the site has no statutory notices issued under the provision of the Contaminated Land and Management Act.

6. SITE CONDITION

A site walk-over survey was undertaken by a senior engineer in January 2007. The eastern strip of the site, adjacent to the lake foreshore is low lying with surface levels of less than 1 m AHD. There is a bank feature running parallel with the foreshore on the northern portions of the site with localised slopes of up to about 35$^{o.}$ (Photo 1). To the west of the bank surface levels rise gradually to the west, with average slopes of about 4^{o} to 5^{o} and surface levels in the order of 30 m AHD along the western boundary. The southern portion of the site is more low lying with surface levels of less than 4 m AHD extending up to 90 m in from the foreshore and a slight valley feature with surface levels less than 10 m AHD extending up to 500 m inland. This area is vegetated with reeds and grasses (Photo 4).

The majority of the site is bushland. Disturbed ground was encountered across the site and is shaded red on Drawing 7. Disturbed ground was mainly limited to a network of access tracks, at times constructed from imported gravel including coal and chitter. Numerous incidences of opportunistic tipping and some car wrecks were observed, including fibro sheets in places, which may contain asbestos (Photo 3).

An area of cleared and disturbed ground was noted on the central parts of the site. This comprised bare ground and imported gravel. A partially exposed buried electricity cable was noted passing across the area and continuing down a track to the south east (Photo 6). Review of aerial photos suggests some limited activity in this part of the site in 1996, possibly associated with exploration drilling. It is also possible that mine vent shafts were located in this area, however there is no record of these on the available record traces and no obvious site evidence. Further investigation would be required to confirm this.

Photo 1 – Bank feature near foreshore

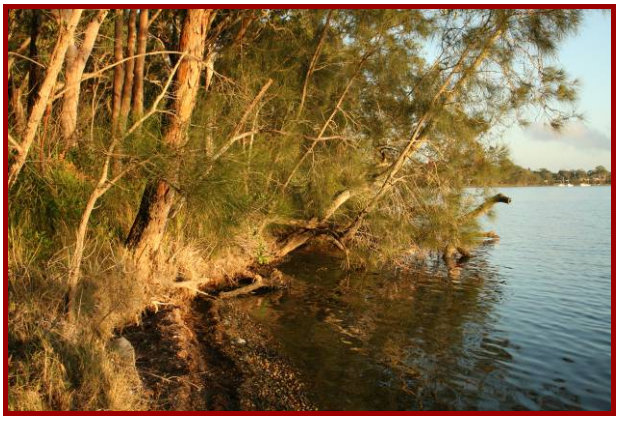


Photo 2 – Foreshore at northern end of site

Photo 3 – Fly tipping off track through bushland

Photo 4 – Lower lying valley on south part of site

Photo 5 – Cleared and disturbed are near centre of site

Photo 6 – Remnant buried electricity cable

The walk over and desk top assessments identified potential sources of contamination from the former site uses, including the following:

- Fill materials (source unknown), may contain a range of contaminants including asbestos, hydrocarbons, heavy metals etc;
- Asbestos from opportunistic dumping.

7. FIELD WORK

7.1 Sampling Rationale

A systematic and judgemental sampling procedure was conducted for the current assessment to address the potential sources of contamination identified from the walk over and desktop assessment. In addition, potential geotechnical constraints were also assessed at the sampling locations.

A total of 13 test pit locations (Pits G1 to G7, Pits G9 to G14) were sampled and analysed as part of the current assessment. Pit G8 was not excavated due to the considerations of aboriginal heritage.

Samples were selected for analysis on the basis of the likely presence of contamination, based on material type, visual or olfactory evidence of possible contamination (i.e. odour or staining), proximity to a known source of contamination, and whether generally representative of soil/fill conditions.

7.2 Methods

The field work was undertaken on 7 and 8 August 2007 and comprised the following:

- Excavation of 13 test pits to depths of 0.65 m to 3.0 m by backhoe;
- Collection of soil samples for environmental testing, acid sulphate soil testing and identification.

The test locations were set out by an environmental engineer from DP who also logged the subsurface profile in the pits and collected samples for identification and testing purposes. The approximate locations of the pits are shown on Drawing 2, Appendix D. A hand held GPS was used to obtain approximate borehole and test pit co-ordinates, which are shown in Table 3, Section 7.5.

Test locations were selected to further assess identified areas of potential contamination and geotechnical constraints, as summarised below:

- Pits G1, G2, G6 – stockpiled fill materials;
- Pits G5, G6, G7 – disturbed/cleared area;
- Pits G3, G9, G10, G11, G12, G14 – potential acid sulphate/alluvial soils;
- Pit G5 – surface deleterious materials.

Samples for environmental purposes were generally collected from the near surface filling within each pit. Soil samples were collected directly from the side walls of the test pits or from the backhoe bucket using disposable gloves. Care was taken to remove any extraneous material deposited on the sample.

All sampling data was recorded on DP chain of custody sheets, and the general sampling procedure comprised:

- Decontamination of all sampling equipment using a 3% solution of phosphate free detergent (Decon 90) and tap water prior to collecting each sample;
- The use of disposable gloves for each sampling event;
- Transfer of samples into laboratory-prepared glass jars, and capping immediately;
- Collection of 10% replicate samples for QA/QC purposes;
- Collection of replicate soil samples in zip-lock plastic bags at each depth for PID screening;
- Labelling of sample containers with individual and unique identification, including project number, sample location and sample depth;
- Placement of the sample jars and replicate sample bags into a cooled, insulated and sealed container for transport to the laboratory;

- Use of chain of custody (C-O-C) documentation ensuring that sample tracking and custody could be cross-checked at any point in the transfer of samples from the field to the laboratory.

The process of obtaining samples and their transportation, storage and delivery to laboratories for analysis was documented on a DP standard chain-of-custody form. Copies of completed forms are contained in Appendix C.

Replicate samples for each sample were screened for the presence of volatile organic compounds (VOCs), using a Photovac 2020 photo-ionisation detector (PID) with a 10.6 eV lamp, calibrated to 100 ppm Isobutylene. The PID is capable of detecting over 300 VOCs.

Samples collected for the assessment of acid sulphate soil conditions were wrapped in plastic wrap and plastic bags to exclude air, and stored and transported on ice. Samples were then refrigerated in the DP laboratory.

The work was undertaken in accordance with the DP quality system and procedures for contamination assessments as presented in the company's field procedures manual. A list of the procedures used and other information on quality assurance and quality control, including analysis of replicate samples, is found in Appendix D.

7.3 Data Quality Objectives (DQOs)

Table 2 summarises data quality objectives (DQOs) and the procedures designed to enable achievement of the DQOs.

Table 2 – Data Quality Objectives

DQO	Achievement Evaluation Procedure
Documentation completeness	Completion of field and laboratory chain of custody documentation, completion of test pit logs.
Data completeness	Analysis of appropriate determinants based on site history and on-site observation.
Data comparability	Use of NATA certified laboratory, use of consistent sampling technique.
Precision and accuracy for sampling and analysis	Achievement of 50% RPD for replicate analysis, acceptable levels for laboratory QC criteria.

7.4 Results

The subsurface conditions are presented in detail in the test pit logs, Appendix A. These should be read in conjunction with the general notes preceding them, which explain definitions of the classification methods and descriptive terms.

The following is a summary of the subsurface conditions encountered:

FILLING - encountered to depths of 0.3 m to 0.5 m depth in Pits G1, G2 and G6 sandy clay/clayey sand filling and sand and gravel filling.

CLAY – encountered from depths of 0.3/2.7 m to depths of 1.2/3.0 m in Pits G2, G4, G6, G7 and G9 comprising very stiff to hard clay.

SANDY CLAY –encountered in Pits G3 to G5, G7, G9 to G12 and G14 from depths of 0.2/2.8 m to depths of 0.5/3.0 m generally comprising stiff to hard sandy clay. Firm to stiff sandy clay was encountered in Pit G9 between 1.8 m and 2.7 m depth, and very soft sandy clay was encountered in Pit G11 between 0.5 m and 1.5 m depth.

SANDSTONE - encountered in Pits G1, G2, G4 to G7 and G13 from depths of 0.6/2.3 m to termination depths of 0.65/3.0 m, generally comprising extremely low strength to medium strength sandstone.

Groundwater seepage was encountered in Pit G9 at a depth of between 1.5 m and 1.8 m, and in G14 from a depth of 2.5 m. Groundwater seepage was not observed in the remaining pits. It is noted that groundwater levels are transient and may vary with climatic conditions.

7.5 Summary

A summary of the depth of filling, depth to rock and depth of groundwater is presented in Table 3 below. Depths of filling and depth to rock are also presented on Drawing 7.

Table 3 – Summary of Depth of Filling, Rock, Backhoe Refusal and Groundwater

Pit	Easting	Northing	Surface Level (AHD)	Depth of Fill (m)	Depth to Rock (m)	Refusal/Slow Progress Depth (m)	Groundwater Depth (m)
G1	367497	6331194	31.2	0.4	0.6	0.65	
G2	367894	6331285	12.70	0.5	1.2	2.1	
G3	368264	6331225	0.51	-	>3.0	-	
G4	367872	6330953	27.90	-	1.7	-	
G5	368320	6330700	19.10	-	0.6	1.8	
G6	368355	6330712	18.40	0.3	2.0	2.6	
G7	368298	6330711	19.40	-	2.0	-	
G8	-	-		-	-	-	
G9	368657	6330683	3.20	-	>3.0	-	1.5-1.8 (seepage)
G10	368870	6330463	1.30	-	>3.0	-	
G11	368427	6330418	7.60	-	>3.0	-	
G12	368869	6330423	3.40	-	>3.0	-	
G13	368258	6330186	24.2	-	2.3	-	
G14	368496	6330224	11.40	-	>3.0	-	2.5 (seepage)

Note to Table 3:

Depths in metres
See Drawing 7 for pit locations

7.6 Contaminant Observations

Observations of potential contamination within the test pits were limited to asphalt at the surface of the stockpiled fill materials in Pit G1, and some asphalt inclusions in stockpiled filling in Pit G2.

The results of PID screening on soil samples are shown on the test pit logs in Appendix A, and suggest the absence of gross volatile hydrocarbon impact.

There was no visual or olfactory evidence (i.e. staining or odours) to suggest the presence of gross contamination within the soils investigated.

Seepage water was observed in two test pits. There was no visual or olfactory evidence (i.e. staining or odours) to suggest the presence of gross contamination within seepage water.

It is noted, however, that groundwater was not sampled or analysed to confirm groundwater constituents.

8. LABORATORY TESTING

8.1 Analytical Programme

Laboratory testing was undertaken by SGS Environmental, a National Association of Testing Authorities, Australia (NATA) registered laboratory.

A total of four soil samples from the pits were selected to provide an assessment of soil/fill conditions. The samples were selected to target the identified potential sources of contamination (Ref 1), namely uncontrolled filling.

The selected samples were analysed for the following potential contaminants:

- Total Recoverable Hydrocarbons (TRH);

- Polycyclic Aromatic Hydrocarbons (PAH);
- Organochlorine Pesticides (OCP);
- Organophosphorus Pesticides (OPP);
- Polychlorinated Biphenyls (PCB);
- Benzene, Toluene, Ethyl Benzene, Xylene (BTEX);
- Metals: Arsenic (As); Cadmium (Cd); Chromium (Cr); Copper (Cu); Lead (Pb); Mercury (Hg); Nickel (Ni); Zinc (Zn).

Three soil samples were analysed for full chromium suite as part of the acid sulphate soil assessment. The results of acid sulphate soil investigation is presented in Section 7.3.

Three soil samples were also analysed for sulphate, chloride and pH as part of aggressivity analysis of soil samples. The results of aggressivity testing is presented in Section 7.4.

8.2 Analytical Results

The results of chemical analysis of soil samples are presented in the laboratory report sheets (Appendix B), and are summarised in Tables 4 to 6 below.

Table 4 - Laboratory Results for Metals in Soil

Pit / Depth (m)	PID (ppm)	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Pit G1/0.2	<1	5	0.3	12	1.7	7	<PQL	0.8	8.8
Pit G2/0.2	<1	<PQL	0.3	41	2.1	8	<PQL	2	11
Pit G5/0.05	<1	4	0.6	12	7.3	68	<PQL	3.4	58
Pit G6/0.1	<1	3	0.2	7.9	15	19	<PQL	4.8	42
PQL		3	0.1	0.3	0.5	1	0.05	0.5	0.3
NEHF A (Ref 4)		100	20	100	1000	300	15	600	7000
General Solid Waste (Ref 6)		100	20	100	NC	100	4	40	NC
Restricted Solid Waste (Ref 6)		400	80	400	NC	400	16	160	NC

Notes to Table 4:

All results expressed in mg/kg on a dry weight basis
NC – No Criteria
PQL – Laboratory Practical Quantitation Limit

Table 5 - Laboratory Results for TRH and BTEX in Soil

Pit / Depth (m)	PID (ppm)	TRH				Benzene	Toluene	Ethyl Benzene	Total Xylene
		C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}				
Pit G1/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit G2/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit G5/0.05	<1	<PQL	37	340	180	<PQL	<PQL	<PQL	<PQL
Pit G6/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
PQL		20	50	50	50/100*	0.5	0.5	0.5	1.5
Service Station (Ref 6)		65	1000 total			1	1.4	3.1	14
General Solid Waste (Ref 6)		650	10000 total			10	288	600	1000
Restricted Solid Waste (Ref 6)		2600	40000 total			40	1152	2400	4000

Notes to Table 5:

All results expressed in mg/kg on a dry weight basis
PQL – Laboratory Practical Quantitation Limit

Table 6 - Laboratory Results for OCP, OPP, PCB and PAH in Soil

Pit / Depth (m)	PID (ppm)	PCB	OPP	OCP				Total PAH	Benzo (a) pyrene
				Aldrin/Dieldrin	Chlordane	DDT	Heptachlor		
Pit G1/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit G2/0.2	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Pit G5/0.05	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL*	<PQL
Pit G6/0.1	<1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
PQL		0.9	0.1	0.1	0.1	0.1	0.1	0.05	0.05
NEHF A (Ref 4)		10	NC	10	50	200	10	20	1
General Solid Waste (Ref 6)		50	NC	NC	NC	NC	NC	200	0.8
Restricted Solid Waste (Ref 6)		50	NC	NC	NC	NC	NC	800	3.2

Notes to Table 6:

All results expressed in mg/kg on a dry weight basis
PQL – Laboratory Practical Quantitation Limit
*Elevated PQL for PAH in sample G5/0.05 due to matrix interference

8.3 Acid Sulphate Soils

Laboratory testing comprised 39 acid sulphate screening tests. The results of the screening tests are presented in Table 7 below.

Table 7 – Results of Acid Sulphate Soil Screening Tests

Sample ID	Sample Depth [a] (m)	Sample Description	Screening Test Results			
			pH			Strength of Reaction [b]
			pH_F	pH_{FOX}	pH_F - pH_{FOX}	
Pit G3	0.1	Dark grey/black silty sand	5.5	4.8	0.7	2
	0.4	Light grey sand	6	5.3	0.7	1
	0.9	Grey clayey sand	5.7	5.2	0.5	1
	1.4	Light grey sandy clay	5.3	4.9	0.4	1
	2	Light grey sandy clay	5	4.7	0.3	1
	2.5	Light grey sand and gravel	4.9	4.6	0.3	1
	2.9	Light grey sandy clay	5	4.7	0.3	1
Pit G9	0.1	Grey silty sand	5.2	4.2	1	1-2
	0.3	Light grey gravelly sand	5.3	4.3	1	1-2
	0.6	Light grey and yellow/orange clayey gravelly sand	5.5	5.3	0.2	1
	1	Light grey and yellow clayey sand	5.9	5.7	0.2	1
	1.4	Light grey and yellow clayey sand	5.6	5.4	0.2	1
	1.9	Light grey mottled orange clayey sand	5.1	5.1	0	1
	2.5	Light grey mottled orange clayey sand	5	4.8	0.2	1
	2.8	Light grey mottled orange sand	5.1	5	0.1	1
Pit G10	0.1	Grey brown clayey silty sand	5.8	2.9	2.9	2-3
	0.6	Light grey mottled orange sandy clay and gravel	5.7	5.3	0.4	1
	1	Light grey mottled orange sandy clay	5	4.6	0.4	1
	1.5	Light grey mottled orange sandy clay	4.8	4.8	0	1
	2	Light grey mottled orange sandy clay	5.2	5.1	0.1	1
	2.5	Light grey mottled orange sandy clay	6	5.9	0.1	1
Pit G11	0.3	Grey brown clayey silty sand	5.7	4.8	0.9	1
	0.8	Light grey mottled orange sandy clay	5.9	5.6	0.3	1
	1.5	Light grey mottled orange sandy clay	6	5.8	0.2	1
	2	Light grey mottled orange sandy clay	6.1	5.9	0.2	1
	2.5	Light grey mottled orange sandy clay	6.4	6	0.4	1
	2.9	Light grey mottled orange sandy clay	6.5	6.3	0.2	1

Table 7 – Results of Acid Sulphate Soil Screening Tests (continued)

Sample ID	Sample Depth [a] (m)	Sample Description	Screening Test Results			
			pH			Strength of Reaction [b]
			pH_F	pH_{FOX}	pH_F - pH_{FOX}	
Pit G12	0.1	Dark grey brown silty sand	6.3	5.2	1.1	2
	0.6	Dark grey brown gravelly sand	6.4	5.8	0.6	1
	1	Light grey and yellow sandy gravelly clay	5.9	5.5	0.4	1
	1.5	Light grey and yellow sandy gravelly clay	5.7	5.3	0.4	1
	2	Light grey mottled red sandy clay	4.9	4.7	0.2	1
	2.5	Light grey mottled red sandy clay	4.9	4.8	0.1	1
	2.9	Light grey mottled red sandy clay	4.8	4.8	0	1
Pit G14	0.1	Dark grey silty sand	5.5	3.7	1.8	2
	0.5	Light grey clayey sand	6.1	5.8	0.3	1
	1	Light grey mottled orange sandy clay	5.7	5.2	0.5	1
	1.5	Light grey mottled orange sandy clay	5.6	5.3	0.3	1
	2	Light grey mottled orange sandy clay	5.3	5	0.3	1
Guidelines		Sands to loamy sands	<4[d]	<3.5[e]	≥1[e]	-
		Sandy loams to light clays				
		Medium to heavy clays & silty clays				

Notes to Table 7:

a Depth below ground surface
b Strength of Reaction
- 1 denotes no or slight reaction
- 2 denotes moderate reaction
- 3 denotes high reaction
- 4 denotes very vigorous reaction
- F denotes bubbling/frothy reaction indicative of organics
- H denotes heat generated

d For actual acid sulphate soils (ASS)
e Indicative value only for Potential Acid Sulphate Soils (PASS)
Shaded results indicate an exceedence of QASSMAC criteria (Ref 8)

The QASSIT guidelines suggest that a soil pH<4 in water is an indicator of actual acid sulphate soils. The results of screening tests therefore suggest the absence of actual acid sulphate soils at the locations and depths tested.

The QASSIT guidelines also suggest that indicators of potential acid sulphate soils (PASS) include the following:

- Soil pH <3.5 in H_2O_2 (i.e. pH_{FOX});
- Drop of 1 pH unit or more between pH_F and pH_{FOX}.

Five samples tested exhibited a pH drop of greater than one unit, with one of these samples also showing a pH in peroxide of less than 3.5, suggesting that potential acid sulphate soils may be present within upper soils at the site.

It is noted that the above test method is a qualitative method only and gives an indication of the intensity of total acidification (pH). The ASSMAC guidelines indicate that peroxide may also oxidise organic matter (in addition to pyrite) to produce acids which are unlikely to form under natural conditions, thus giving falsely high indication of acid sulphate potential.

Based on the results of the screening tests, three soil samples were selected for detailed laboratory testing, comprising the Full Chromium Suite in accordance with QASSIT guidelines (Ref 7 and 8).

Detailed test results are contained in the attached laboratory report sheets, and are summarised in Table 8 below.

Table 8 – Results of Detailed Acid Sulphate Soil Laboratory Testing

Sample ID	Sample Depth [a] (m)	Sample Description	Laboratory Results				
			pH_{KCL}	Scr %S	s-TAA %S	S_{NAS} %S	Net Acidity[c] %S
Pit G9	0.3	Light grey gravelly sand	5.4	<PQL	<PQL	NA	<PQL
Pit G10	0.1	Grey brown clayey silty sand	4.3	<PQL	0.22	<PQL	0.22
Pit G10	0.6	Light grey mottled orange sandy clay and gravel	4.9	0.02	0.02	NA	0.04
Guidelines		Sands to loamy sands	-	-	-	-	0.03
		Sandy loams to light clays					0.06[f]/0.03[g]
		Medium to heavy clays & silty clays					0.1[f]/0.03[g]

Notes to Table 8:

a Depth below ground surface
c Calculated from ABA equation in ASS Laboratory Methods Guidelines (Ref 9)
f QASSMAC Action Criteria for disturbance of 1-1000 tonnes of material
g QASSMAC Action Criteria for disturbance of more than 1000 tonnes of material
Shaded results indicate an exceedence of QASSMAC criteria (Ref 8)
Scr – Chromium reducible sulphur
TAA – Titratable actual acidity
S_{NAS} – Net Acid Soluble Sulphur

The results of detailed laboratory testing indicate marginally acid sulphate soils in the sample Pit G10/0.6 m, and the presence of actual acid sulphate soils in the sample G10/0.1 m.

8.4 Soil Aggressivity

Laboratory testing was also undertaken by SGS Environmental for assessment of soil aggressivity. Five samples were submitted for analysis to assess the aggressiveness of the soil toward buried steel/concrete structures. The testing comprised the following analytes:

- Sulphate;
- Chloride;
- pH.

Detailed laboratory report sheets are attached and the results are summarised in Table 9, below:

Table 9 – Summary of Soil Aggressiveness

Pit/Depth (m)	Description	Laboratory Results			
		pH	FMC (%)	Sulphate SO_4 (mg/kg)	Chloride Cl (mg/kg)
Pit G2/0.8	Light brown mottled orange slightly sandy clay	5.1	20	73	43
Pit G6/0.5	Orange brown clay	5	22	28	61
Pit G9/0.6	Light grey and yellow-orange clayey gravelly sand	4.9	11	11	7.8
Pit G12/1.0	Light grey and yellow sandy gravelly clay	5	13	46	45
Pit G13/0.7	Light brown clayey sand and gravel	5.6	17	14	11
PQL		0.1	1	20	0.5

Notes to Table 9:

FMC – Field moisture content

The results are discussed in Section 10.6.

9. CONTAMINATION

9.1 Assessment Criteria

Results of the chemical analyses were compared to the following NSW EPA recommended guidelines.

- NSW EPA (1998). Contaminated Sites - Guidelines for the Site Auditor Scheme 2nd Edition, April 2006 (Ref 4);
- NSW EPA (1994). Contaminated Sites - Guidelines for Assessing Service Station Sites, December 1994, (Ref 6);
- NSW DECCW (2009). Waste Classification Guidelines – Part 1: Classifying Waste (Ref 5).

The NSW EPA Guidelines for the NSW Site Auditor Scheme (Ref 4) contain National Environmental Health Forum (NEHF) levels for various beneficial use scenarios including: low density residential (A), high density residential (D), recreational (E) and commercial/industrial (F). These criteria are applicable where aesthetic and ecological concerns are not an issue.

Health based criteria for standard residential uses with access to soil (NEHF A), are considered to be appropriate for the proposed residential development.

The NSW EPA Guidelines for Assessing Service Station Sites (Ref 6) were used to assess total TRH and BTEX contamination across the site. The criteria used are threshold concentrations for sensitive land use.

The NSW DECCW Waste Classification Guidelines (Ref 5) were used to assess soil conditions for possible off-site disposal to a licensed landfill.

9.2 Assessment of Contamination

Soil chemical analysis results were within the health based criteria for low density residential land use (i.e. NEHF A), and NSW EPA sensitive land use criteria for TRH and BTEX.

Slightly elevated levels of C_{10}-C_{36} hydrocarbons were found in the sample G5/0.05, sampled beneath dumped rubble (metal sheeting, rubbish), but levels were within the adopted criteria.

9.3 Conclusions

The results of the assessment generally indicate the absence of gross contamination within the site.

It is noted that unauthorised dumping has occurred at the site, including fibro materials as noted in the walk over.

Testing of dumped fibro materials at the site as presented in the ESP report (Ref 16) indicate the presence of asbestos materials at the site (i.e. in dumped stockpiles).

With respect to chemical contaminants, soil/fill materials tested at the site are classified as 'General Solid Waste' for off-site disposal with reference to NSW DECCW guidelines.

Fibro Sheet fragments containing asbestos (as identified in the Hazardous Materials Survey – Ref 16) and any possible affected soils are classified as 'Asbestos Waste' with reference to NSW DECCW guidelines.

The results of the PCA indicate that site remediation will be required. Remediation, where required, would include the preparation of a remediation action plan (RAP), appropriate excavation and removal/disposal/capping of contaminated soil, followed by validation sampling and analysis to the requirements of SEPP 55 and NSW DECCW.

Based on the known and potential contaminants in parts of the site and the ability to remediate the above listed contaminants, Douglas Partners is satisfied that the land will be suitable, after remediation, for residential purposes. The land is required to be remediated before the land is used for such a purpose and the following must be undertaken:

- Development of a Remediation Action Plan;

- Appropriate remediation conducted to remove identified contaminants exceeding the DECCW land use criteria;
- Deleterious materials and possible associated surface impact removed;
- Validation testing and verification;
- Validation of asbestos contamination should be conducted by a qualified asbestos consultant;
- Waste classification to DECCW guidelines of any materials destined for off-site disposal at a licensed landfill.

It is likely that the above localised remedial measures could be readily managed during the initial stages of earthworks and construction.

10. GEOTECHNICAL CONSTRAINTS

10.1 Founding Conditions

Ground conditions across most of the proposed development site are expected to comprise generally thin topsoil and surface filling overlying residual clay soils with weathered rock at depth.

Therefore conventional shallow footings, as per AS 2870-1996 (Ref 9), are expected to be suitable across much of the site. Footings should be founded in natural clay or rock and therefore in areas with filling deeper than about 0.4 m, deepening of the footings may be required. If the filling near Pits N6 to N9 is left of site, then piled footings may be required in this location.

The clay soils on site are expected to be reactive. Reactive soils shrink and swell with changing moisture conditions, leading to ground surface movements. Soil reactivity can be readily accommodated in design, and should be confirmed during future detailed investigations prior to development by classifying building sites in accordance with AS 2870-1996.

Soft/weak alluvial soils, were encountered on the southern portion of the site (Pits 9, 11 and 14). The approximate extent of the alluvial soil, based on the results of tests pits and geological mapping, is shown in yellow on Drawing 7. The proposed development encroaches onto this area and conditions encountered at the test pits included soft clay and loose sand to depths in the range 1.0 to 2.0 m, underlain by stiff or stiffer clay. In these areas it is likely that conventional shallow footings would be unsuitable, possibly requiring the use of piles.

10.2 Acid Sulphate Soils

A preliminary acid sulphate soil assessment was undertaken with reference to the ASSMAC "Acid Sulphate Soils Manual" (Ref 7) and QASSIT "Soil Management Guidelines" (Ref 8), and comprised the following:

- Review of available acid sulphate risk maps;
- 39 screening tests on selected soil samples for pH in water (pH_F) and pH in hydrocarbon peroxide (pH_{FOX});
- Three samples tested for the full chromium suite to assess acid sulphate potential.

The results of the assessment indicate that acid sulphate soils are not present across most of the proposed development site, with the possible exception of where development is proposed to fringe around the area of alluvial soils on the southern part of the site (shown as yellow on Drawing 7). In this area there is a low risk of acid sulphate soils being present.

Further acid sulphate soil investigation is recommended prior to construction at the site in order to further delineate possible affected areas, and to confirm treatment requirements.

If potential acid sulphate soils are to be disturbed an acid sulphate soil management plan for construction should be prepared following additional assessment. This plan would outline the acid sulphate soil management strategies, monitoring programs and contingency procedures for soil, surface water and groundwater. General procedures for the management of acid sulphate soils and groundwater are presented below.

Soil

- Any soils identified with acid sulphate soil potential which are excavated should be stockpiled separately prior to lime treatment in a bunded area to collect any leachate that may form;
- Lime treatment would involve mixing Agricultural Grade Lime into the stockpiled soil to neutralise any acid generated by the oxidation of the potential acid sulphate soils and actual acid sulphate soils. Based on the laboratory test results the rate of lime application is estimated to be approximately 4 to 16 kg/m^3 soil;
- Further on-site screening tests by DP would then be required to verify that adequate neutralisation has occurred, and if necessary adjust the liming rate;
- The base of any excavation in the affected soils should be limed at a rate of approximately 1 kg/m^2.

Groundwater

- Groundwater extracted during dewatering (if required for basement excavation and construction) should be tested for pH prior to discharge;
- Dewatering monitoring would involve regular visits by DP personnel to measure dewatering pH. The frequency of which would depend on the construction programme and monitoring results, however it is likely to initially be daily, possibly reducing to weekly once excavations are complete and consistent results are being achieved;
- If the pH of discharge water is below natural levels, a lime slurry should be added to raise the pH to within natural groundwater levels.

10.3 Slope Stability

There was generally no evidence of previous or incipient deep seated slope instability observed over the site. The site is generally considered to have a low to moderate risk of slope instability with respect to the natural topography.

There may be a localised medium to high risk of instability near the bank feature close the foreshore and if development is proposed in this area additional investigation should be undertaken.

In the event that significant cuts or fills are proposed for the site, further geotechnical investigation to specifically assess the risk of slope instability due to cut and fills should be undertaken. Such issues are generally managed by limiting batter slopes, drainage measures or suitably designed support.

10.4 Erosion

There was no obvious soil erosion evident on the site during the site walkover, however based on the Soil Landscape Sheet for Gosford – Lake Macquarie the soils on the slopes typically have high erosion potential.

Water quality may be impacted due to sediment laden run-off from the topsoil material occurring during construction. Such potential erosion and sedimentation are readily amenable to mitigation measures such as silt fences, revegetation/reshaping batters, drainage structures (catch drains), sediment traps and sedimentation basins.

10.5 Excavatability

The results of subsurface investigations indicated the depth to rock across the site was generally 2 m or deeper, increasing on the eastern and southern parts of the site. Backhoe refusal occurred at depths in the range 0.65 m to 2.0 m on the northern and central parts of the site.

Soil and weak rock encountered to the depth of backhoe/auger refusal as shown on Table 2 would be readily excavatable using hydraulic excavators or small bulldozers. Beyond the depth of backhoe / auger refusal large earthmoving equipment may be required for excavation, such as excavators with rock teeth or bulldozers with rippers. There is some risk that heavy ripping or pneumatic/hydraulic hammering may be required if medium or high strength rock occurs within the depth of excavation and for detailed excavation such as footings, service trenches and batter trimming.

10.6 Aggressive Soils

The soil landscape mapping suggest the possible presence of naturally acidic or saline soils which may be aggressive to buried structures or services.

The results of testing listed in Table 8 above indicate a non-aggressive exposure classification when compared to the requirements for steel/concrete piles presented in AS 2159-1995 (Ref 14).

It is recommended, however, to provide sufficient concrete cover and appropriate strength to accommodate for the environment and any changes in conditions.

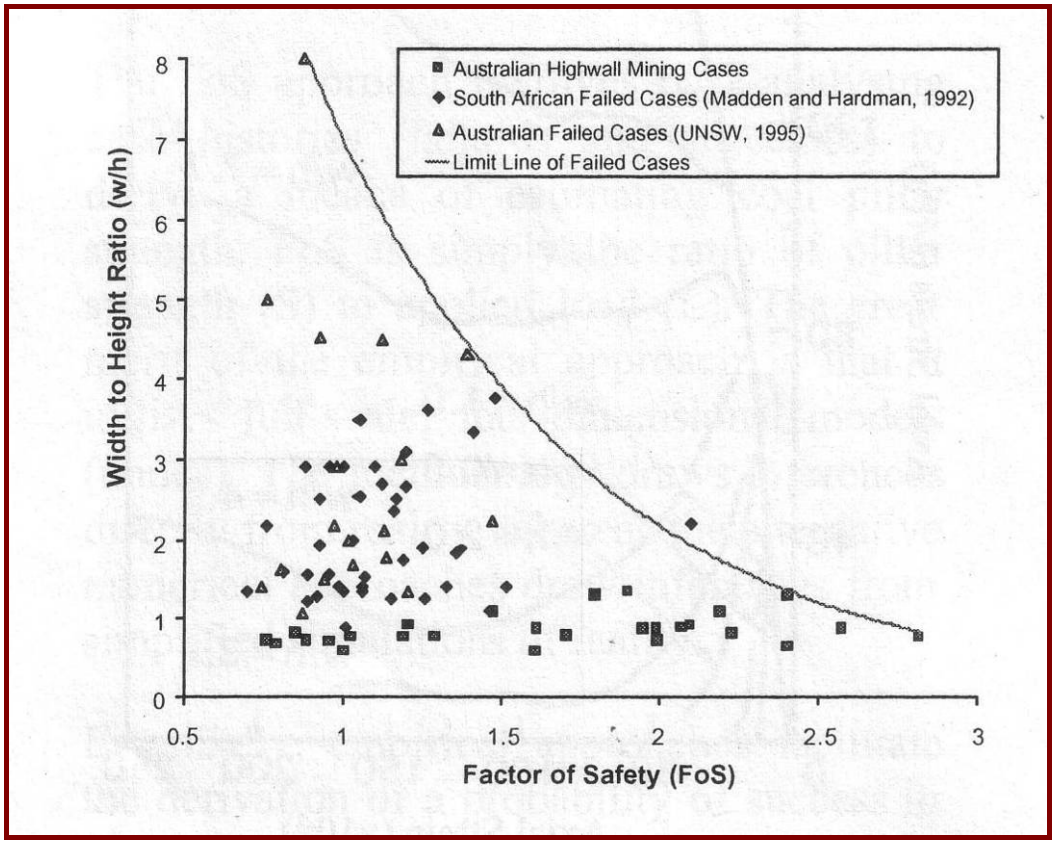
11. MINE SUBSIDENCE

11.1 Pillar Stability Assessment

11.1.1 General

Pillar stability analysis has been undertaken using the UNSW pillar stability formula (Ref 13). Due to the extensive and complex nature of the workings below the site, the pillars have been split into separate representative panels for the analyses. The panels and individual pillar numbers are shown on Drawings 8, 8A and 9 in Appendix D.

In assessment of the likelihood of pillar failure, consideration of the width to height ratio of the pillar is critical, as outlined by Hill and Buddery (Ref 11) who have compiled a data base of failed South African and Australian pillars and compared the FOS and pillar width to height ratio. The results are presented in Figure 1 below.



The results of the Gwandalan assessment have been compared to Figure 1, in the assessment of likelihood of pillar failure.

Hill and Buddery also note that the Great Northern Seam floor in the Lake Macquarie area often has a high smectite content and tends to swell and degrade in the presence of moisture and that specific consideration should be given to the presence of such extremely weak floor conditions.

11.1.2 Great Northern Seam

Wallarah Colliery Workings (Panel A)

Workings in Panel A comprised bord and pillar first workings with no pillar extraction. A working section of 3.5 m was adopted, the typical seam thickness shown on the RT. The results indicated individual pillar factors of safety in the range 1.89 to 2.06 with an overall panel factor of safety of 2.1.

Chain Valley Bay Workings (Panels B, C and D)

Workings in Panels B, C and D comprised bord and pillar workings with split pillar extraction. A seam and working section thickness of 2.7 m was adopted, as indicated on the relevant RT sheet.

The results are summarised in Table 10 below.

Table 10 – Pillar Factors of Safety for Great Northern Seam

Panel	Minimum Pillar FOS	Maximum Pillar FOS	Panel FOS	Typical Pillar Widths (m)
A	1.89	2.06	2.1	17-19 m
B	1.41	2.01	2.03	18-24
C	1.25	4.62	2.25	17-28
D	1.67	4.3	3.38	19-25

Based on the results of the assessment, it is considered that pillar instability in the Great Northern Seam workings is very unlikely, provided that weak floor conditions are not present, with panel factors of safety in the range 2.03 to 3.38. When the results are plotted against Figure 1, all individual pillars plot above the limit of failed cases, with the panels plotting well above the line. With a depth of cover of over 150 m, significant load spreading will occur and therefore panel factors of safety are considered much more representative of actual conditions.

There is historical evidence of weak claystone in the floor of the Great Northern Seam in the Gwandalan area, which can soften, leading to punching failure of the pillars. The width of the pillars is generally 17 m or wider, which will protect the floor below the centre of the pillars from softening to a large degree, however there is some risk of such a punching failure.

Estimates of maximum likely subsidence due to a pillar run in the Great Northern Seam have been undertaken using the methods outlines in Holla (Ref 13) and indicated the following:

- Maximum subsidence = 0.5 m to 0.75 m;
- Maximum Tensile Strain = 1.5 to 1.7 mm/m;
- Maximum Compressive Strain = 2.5 mm/m;
- Maximum Tilt = 7.5 mm/m;
- Goaf side subsidence = 0.1 m;
- Goaf side tilt = 2 to 3 mm/m.

Therefore, if a pillar failure were to occur in the Great Northern Seam, which would only be expected to occur if a weak floor was present, then the subsidence parameters within the area of goaf would exceed those allowable for two storey development.

11.1.3 Wallarah Seam

Chain Valley Colliery Workings (Panel A)

Panel A is a narrow panel beside an area of supercritical panel extraction. The area of panel extraction is expected to have goafed. The pillar stability assessment indicated that the row of pillars adjacent to the goaf have factors of safety of less than 1 and therefore will have crushed. When the abutment loads are transferred to the remaining pillars the panel factor of safety is 1.96. Therefore it is considered that this area is long term stable.

Chain Valley Colliery Workings (Panel B)

Panel B is located between two areas of supercritical goaf to the north west and south and a subcritical goaf to the east. For purposes of the calculations abnormally large and small pillars (131-133) were ignored. The panel factor of safety was 2.04, however some pillars around the edge of the panel had factors of safety of 1.8 or less and therefore crush of these edge pillars is possible, however pillars in the centre of the panel are considered long term stable.

Therefore the likely subsidence due to crush of the perimeter pillars was estimated as follows:

- Maximum Subsidence = 0.73 m;
- Maximum Tensile Strain = 2.0 mm/m;
- Maximum Compressive Strain = 3.0 mm/m;
- Maximum Tilt = 9 mm/m;
- Goaf Side Subsidence = 0.22 m;
- Goaf Side Tilt = 4 mm/m;
- Tilt 25 mm Outside Goaf= 2 mm/m.

Therefore, the subsidence parameters for two storey development are likely to be exceeded in an area 25 m past the line of the unstable perimeter pillars.

Chain Valley Colliery Workings (Panel C)

Panel C is located between two areas of supercritical goaf to the north and south and a subcritical goaf to the east. The panel factor of safety was 1.71 and when abnormal pillars were removed the factor of safety reduced to 1.46. The stability of the panel is marginal. The expected subsidence parameters for this area are similar to Panel B.

Wallarah Colliery Workings (Panels A to H)

A similar process was undertaken for the Wallarah Colliery workings to the Chain Valley workings, as described above. In general the panels were found to have crushed, or the pillars along the edge of areas of goaf had crushed or were potentially unstable. The results are summarised in Table 11 below.

Table 11 – Pillar Factors of Safety for Wallarah Colliery, Wallarah Seam

Panel	FOS Edge Pillars	FOS Central Pillars	Panel FOS	Comments
A	NA	NA	0.8	Panel has crushed, long term stable
B	1.05-1.54	1.88-3.74	1.86	Perimeter two rows of pillars potentially unstable Centre Long term stable
C	<0.8 for western half	1.3-2.12 on eastern half	0.88	Western side has crushed and is long term stable Eastern side is potentially unstable
D	0.96-1.74	1.89-2.55	1.85	Perimeter two rows of pillars potentially unstable Centre Long term stable
E	0.93-1.39	NA	1.13	Panel has crushed, long term stable
F	<1			Panel has crushed, long term stable
G	0.2-2.6		1.39	Likely to have crushed, however design for subsidence
H	0.68-1.29	2.03-2.53	1.46	Edge three rows of pillars potentially unstable Centre Long term stable

The areas of full pillar extraction all have width to depth ratios of more than 1.0 and are expected to have fully collapsed, leading to no additional potential subsidence from these areas.

Subsidence predictions indicate that where crush of pillars is occurring along the edge of an otherwise stable panel, tilts of greater than about 4 mm/m would continue for a distance of about 25 m into the area of stable pillars and 75 m to 125 m into the goaf.

In instances where full crush of a narrow panel is possible between two areas of pillar extraction, then tilts of greater than about 4 mm/m would continue for a distance of about 75 m to 125 m either direction into the goaf.

11.2 Mining Subsidence Constraints to Development

Based on the results of the assessment described above, the expected development restrictions have been plotted on Drawings 8, 8A and 9. In the absence of data suggesting otherwise it has been assumed that a weak floor could be present in the Great Northern Seam and therefore pillar instability is possible.

In areas where pillar crush is likely and the subsidence predictions indicate tilts of greater than about 4 mm/m, the areas are shown as yellow and are likely to be restricted to single storey brick veneer, or similar. The remaining (blue) areas would be suitable for two storey development.

It is noted that much of the areas in the north of the site where aged care facilities are proposed will be restricted to single storey development. The guidelines are intended for residential type structures, and if a building with a large footprint is proposed, it is likely the building will need to be heavily articulated or split into several separate structures.

The mine workings below the site are complex and the estimates of subsidence are based on empirical methods which may not fully account for three dimensional effects and load spreading. It is likely that three dimensional numerical analyses would lead to predictions of lesser subsidence and a likely increase in the area suitable for two storey development.

It is noted that Lake Coal Pty Ltd (currently owned by LDO Coal Pty Ltd) has recently lodged a Preliminary Environmental Assessment (PEA) with the Department of Planning seeking Project Approval from the Minster for Planning under Part 3A of the EP&A Act 1979 for underground mining operations at the Chain Valley Colliery in the underlying Fassifern Seam. The proposed underground mining area extends beneath the Coal & Allied owned Gwandalan site. Mining is also proposed under existing residential development at Summerland Point and Gwandalan. Provided that the mine workings comprise long term stable bord and pillar workings they are unlikely to affect the standard guidelines outlined above. Restrictions on future mining taking into account surface development are provided by the DARZL committee and a formal application to the MSB is required for consideration by DARZL.

The general area is subject to petroleum exploration licence 5 held by AGL Operations Pty Limited, and expires in November 2011. Petroleum extraction, if proposed in the future, can generally be designed to be compatible with existing development.

12. GROUNDWATER DEPENDANT ECOSYSTEMS

12.1 Distribution

It is understood that Groundwater Dependant Ecosystem (GDE) communities have been identified in the vicinity of the proposed development by Harper Somers O'Sullivan in locations shown on Drawing 107 attached. The GDE communities in proximity to the site, as labelled on Drawing 107, are described as follows:

GDE 1 -Strip of Swamp Oak along lake edge.

GDE 2 - Redgum Roughbarked Apple Swamp Forest and Swamp Mahogany in lower reaches of shallow gully, between the site and the lake.

GDE 3- Riparian Melaleuca Swamp Woodland and coastal Wet Sand Cyperoid Heath located in shallow gully along southern boundary of proposed development area, with the development area encroaching slightly on the Riparian Melaleuca Swamp Woodland. A detention basin is proposed at the upstream eastern end of the area and at the north-east corner of the area.

GDE 4 - Narrow strip of Riparian Melaleuca Swamp Woodland located in very slight gully within northern area of development. The proposed development generally skirts around the area with some encroachment on the south-western side. A stormwater detention basin is proposed at the western upstream and eastern downstream end of the area.

GDE 5 - Localised area of Riparian Melaleuca Swamp Woodland located adjacent to the northern boundary in a slight gully feature.

Alluvial Soils

Alluvial soils are mapped at the following locations as shown on Drawing 107:

- A strip of alluvial soils along the immediate lake edge coinciding with GDE 1. The soils are expected to be shallow and underlain by clay and weathered rock;
- A shallow gully feature along the southern boundary of the development area. Pits G9, G11 and G14 were excavated in this area and indicated alluvial soils comprising clayey sand and gravelly sand underlain by residual clays at depths in the range 0.9 m to 1.8m. Groundwater was encountered at depths in the range 1.5 m to greater than 3.0 m.

Residual Soils

The remainder of the site comprised residual clay soil overlying weathered rock. There was no free groundwater encountered within the 3 m depth of investigation in these areas.

Mine Workings

The site has been subject to bord and pillar workings and subsequent pillar extraction and many parts of the site have been subject to subsidence of up to about 1 m.

12.2 Conceptual Groundwater Model

Based on the results of the desktop assessment, the subsurface investigation and the site topography a conceptual groundwater model has been developed for the site as follows:

- Groundwater recharge on the parts of the site proposed for development is generally very limited due to the low permeability clay soil and weathered rock. The vast majority of rainfall is expected either run off or be lost by evapo-transpiration;
- Some recharge may occur in these areas due to infiltration through mine subsidence induced cracks in the rock. This would be expected to infiltrate near vertically to a regional water table at depth;
- The alluvial soils along the lake edge are shallow and the water level will be controlled by water levels in the lake;
- The alluvial soils along the southern boundary of the site are expected to comprise unconfined aquifers perched above the less permeable underling residual soils and rock;
- The alluvial area along the southern boundary is in a locally low lying area and recharge to the aquifers occurs within these low lying areas. The source of the recharge water is from surface runoff from surrounding areas as well as direct rainfall within the areas. Groundwater recharge from the adjacent areas of residual soils will be very minor;
- Groundwater will flow within the alluvial areas, generally following the fall of the gully as well as interact with the surface water ponding. In times of high rainfall the aquifer will be recharged by flow and ponding along the gully invert and in times of low rainfall the groundwater may provide base-flow back to the creek and prolong surface water ponding;

- There may be minor salt water intrusion into the underlying fractured rock aquifer along the lake foreshore, however no saltwater intrusion effects would be expected to occur in the alluvial areas as they are inland of any possible salt water intrusion. This situation isn't expected to change post development.

12.3 Effect Of Development on Groundwater Levels

The footprint of the development is generally on residual soils or filling over residual soils with some encroachments onto alluvial soils as shown on Drawing 107. Only the alluvial soils are expected to provide conditions where perched aquifers can form, with shallow higher permeability soils over low permeability residual soils and rock.

Groundwater recharge to the aquifers is considered to be partly due to direct rainfall in the alluvial areas, however primarily from runoff from the surrounding residual areas and not due to groundwater recharge from the residual areas.

Potential interactions between the proposed development and the GDEs identified in Section 13.1 and shown on Drawing 107 are expected to be as follows:

GDE 1 - This area is directly associated with the lake and the development will have no effect on groundwater levels.

GDEs 2 AND 3 - These areas are generally within a shallow gully along the southern end of the site. The development area does directly encroach on some of the Riparian Melaleuca Swamp Woodland. For the remaining areas the groundwater will generally be controlled by recharge from the upslope areas, which will include the developed areas. Groundwater levels could also be affected by changes in the creek bed levels or other controls such as weirs or culverts which would influence surface water flows and levels.

GDEs 4 AND 5 – These are within localised shallow gullies over residual soils and the presence of GDEs is likely to be associated with shallow periodic saturation of the surface soils due to surface runoff rather than a water table aquifer.

Provided that the existing surface water flow rates / levels and fluctuations thereof within the gullies are maintained there will be minimal impact on the groundwater levels and therefore GDEs. This can be achieved by appropriate water-sensitive urban design, which would include the provision of surface water storage devices such as ponds or swales to limit peak flows. The use of stormwater infiltrations systems within the development along the southern boundary, where the development encroaches slightly on the alluvial area, would provide additional protection, however this would be expected to have minor influence on the groundwater in the adjacent areas.

The potential for adverse impacts on groundwater quality from the proposed development would most likely come from surface runoff. As with groundwater/surface water levels, the surface water quality and therefore groundwater quality can be managed by appropriate water sensitive urban design. It is proposed that the development of the site will incorporate water sensitive urban design measures including a detailed surface water management plan which will be prepared prior to any construction on site.

13. ADDITIONAL INVESTIGATIONS

13.1 Contamination

It is recommended that an assessment of surface fibro to confirm the presence of asbestos associated with existing structures, surface fibro fragments and possibly near surface soils, should be undertaken by a qualified asbestos consultant.

Remediation and validation of identified contamination should be undertaken as described in Section 9.3.

13.2 Geotechnical

Additional geotechnical investigation is expected to be required prior to development which may include the following:

- Specific investigation for proposed footings, buildings or excavations including maximum depths of cut and safe batter slopes;
- Site classifications to AS 2870;
- Slope stability assessment for bank near foreshore, if development proposed here;
- Earthworks procedures and specifications;
- Pavement thickness design for roads.

14. LIMITATIONS

Douglas Partners (DP) has prepared this report for this project at Gwandalan in accordance with DP's proposals dated 22 June 2007 and 20 January 2010. The work was carried out under Rio Tinto Short Form General Conditions for Consultancy Services, August 2004 as amended by DP letter of 6 September 2007. This report is provided for the exclusive use of the Coal & Allied Industries Ltd and Catylis for the specific project and purpose as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party.

The results provided in the report are considered to be indicative of the sub-surface conditions on the site only to the depths investigated at the specific sampling and/or testing locations, and only at the time the work was carried out. DP's advice may be based on observations, measurements, tests or derived interpretations. The accuracy of the advice provided by DP in this report is limited by unobserved features and variations in ground conditions across the site in areas between test locations and beyond the site boundaries or by variations with time. The advice may be limited by restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints. Actual ground conditions and materials behaviour observed or inferred at the test locations may differ from those which may be encountered elsewhere on the site. Should variations in subsurface conditions be encountered, then additional advice should be sought from DP and, if required, amendments made.

It is noted that the site is within a proclaimed mine subsidence district. This report outlines the potential risks associated with mine subsidence and presents guidelines for managing the risk and obtaining Mine Subsidence Board consideration for the proposed development. It is noted that the guidelines presented are not intended to fully prevent damage to property or person, rather reduce the risks and Douglas Partners accept no liability with respect to such damage. The Mine Subsidence Board should be consulted with respect to the proposed development to obtain their consent of the proposal.

This report must be read in conjunction with the attached "Notes Relating to This Report" and any other attached explanatory notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions from review by others of this report or test data, which are not otherwise supported by an expressed statement, interpretation, outcome or conclusion stated in this report. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

DOUGLAS PARTNERS PTY LTD

Reviewed by:

Patrick Heads
Environmental Engineer

Stephen Jones
Principal

Will Wright
Principal

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APPENDIX A

NOTES RELATING TO THIS REPORT
TEST PIT LOGS (PITS G1 to G13)

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_c — 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 (MPa) = (0.4 to 0.6) N (blows per 300 mm)

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

q_c = (12 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.

AN ENGINEERING CLASSIFICATION OF SEDIMENTARY ROCKS IN THE SYDNEY AREA

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

Under this system rocks are classified by Rock Type, Degree of Weathering, Strength, Stratification Spacing, and Degree of Fracturing. These terms do not cover the full range of engineering properties. Descriptions of rock may also need to refer to other properties (e.g. durability, abrasiveness, etc.) where these are relevant.

ROCK TYPE DEFINITIONS

Rock Type	Definition
Conglomerate:	More than 50% of the rock consists of gravel sized (greater than 2mm) fragments
Sandstone:	More than 50% of the rock consists of sand sized (.06 to 2mm) fragments
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06mm) 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, e.g. clayey sandstone, sandy shale.

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 and texture 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	Fs	Rock substance unaffected by weathering, limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

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

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics (Reference).

Strength Term	Is(50) MPa	Field Guide	Approx. qu MPa*
Extremely Low:	0.03	Easily remoulded by hand to a material with soil properties	0.7
Very Low:	0.1	May be crumbled in the hand. Sandstone is “sugary” and friable.	2.4
Low:	0.3	A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.	7
Medium:	1	A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.	24
High:	3	A piece of core 150 mm long x 50 mm dia. cannot be broken by unaided hands, can be slightly scratched or scored with knife.	70
Very High:	10	A piece of core 150 mm long x 50 mm dia. may be broken readily with hand held hammer. Cannot be scratched with pen knife.	240
Extremely High:		A piece of core 150 mm long x 50 mm dia. is difficult to break with hand held hammer. Rings when struck with a hammer.	

* The approximate unconfined compressive strength (qu) shownin the table is based on an assumed ratio to the point load index of 24:1. This ratio may vary widely.

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

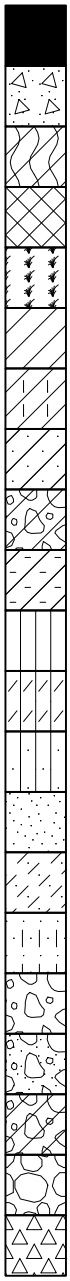
Term	Description
Fragmented:	The core is comprised primarily of fragments of length less than 20 mm, and mostly of width less than the core diameter.
Highly Fractured:	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured:	Core lengths are mainly 30 mm - 100 mm with occasional shorter and longer sections.
Slightly Fractured:	Core lengths are generally 300 mm - 1000 mm with occasional longer sections and occasional sections of 100 mm - 300 mm.
Unbroken:	The core does not contain any fracture.

REFERENCE

International Society of Rock Mechanics, Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1 Final Draft October 1972

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

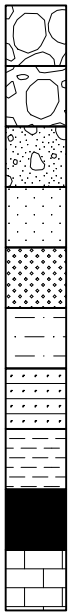
SANDY GRAVEL

CLAYEY GRAVEL

COBBLES/BOULDERS

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

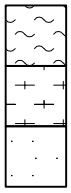
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

COAL

LIMESTONE

METAMORPHIC ROCK

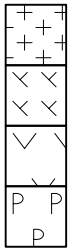


SLATE, PHYLITTE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

Douglas Partners
Geotechnics · Environment · Groundwater

TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 367497
NORTHING: 6331194
DIP/AZIMUTH: 90°/--

PIT No: G1
PROJECT No: 39662C
DATE: 7/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
	0.05	FILLING: Asphalt							
		FILLING: Light yellow brown sandy clay/clayey sand filling, M<Wp		PID	0.2		<1ppm		
	0.4	SILTY SAND: Grey-brown fine to medium grained silty sand, damp							
	0.6								
	0.65	SANDSTONE: Medium strength, light grey and orange sandstone							
		Pit discontinued at 0.65m, refusal on sandstone							
	1								1
	2								2
	3								3

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Excavated through side of stockpile (top of stockpile 1.0m above surrounding levels)

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

Douglas Partners
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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 367894
NORTHING: 6331285
DIP/AZIMUTH: 90°/--

PIT No: G2
PROJECT No: 39662C
DATE: 7/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Orange-brown sandy clay and gravel filling, some asphalt inclusions, M<Wp		D,PID	0.2		<1ppm		
	0.5	SILTY SAND: Dark grey-brown fine to medium grained silty sand, some rootlets, damp							
	0.6	CLAY: Very stiff, light brown mottled orange slightly sandy clay		D,pp	0.8		250-300 kPa		
	1	from 1m, gravelly							1
	1.2	PEBBLY SANDSTONE: Extremely low to very low strength, moderately weathered light grey-orange pebbly sandstone							
	2	from 1.7m, sandstone (no pebbles), strength varying (low strength bands)							2
	2.1	Pit discontinued at 2.1m, slow progress on sandstone							
	3								3

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Excavated 0.5m through side of stockpile (top of stockpile 2.0m above surrounding levels)

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 368264
NORTHING: 6331225
DIP/AZIMUTH: 90°/--

PIT No: G3
PROJECT No: 39662C
DATE: 7/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		SILTY SAND: Dark grey-black fine to medium grained silty sand with roots and rootlets, damp		D	0.1				
	0.3	SAND: Light grey fine to medium grained sand, moist		D	0.4				
	0.7	CLAYEY SAND: Grey fine to medium grained clayey sand, wet		D	0.9				
	1								1
	1.1	SANDY CLAY: Stiff, light grey sandy clay, M>Wp		D,pp	1.4		120-150 kPa		
		from 1.8m, some fine gravel							
	2			D,pp	2.0		150-200 kPa		2
	2.3	SAND AND GRAVEL: Light grey fine to coarse grained sand and fine to coarse gravel, moist		D	2.5				
	2.8	SANDY CLAY: Stiff, light grey sandy clay, M>Wp		D,pp	2.9		150-220 kPa		
	3 3.0	Pit discontinued at 3.0m							3

Dynamic Penetrometer Test (blows per mm): 5 10 15 20

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 367872
NORTHING: 6330953
DIP/AZIMUTH: 90°/--

PIT No: G4
PROJECT No: 39662C
DATE: 7/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		GRAVELLY SAND: Light grey-brown fine to coarse grained gravelly sand, damp, some roots and rootlets							
	0.3	SANDY CLAY: Hard, yellow-brown sandy clay, trace gravel, M<Wp		D,pp	0.4		>400 kPa		
	0.5	CLAY: Very stiff, light grey mottled red clay, M<Wp		D,pp	0.7		300-350 kPa		
	1.2	SANDY CLAY: Very stiff, light grey mottled red sandy clay, M<Wp		D,pp	1.4		300-350 kPa		
	1.7	SANDSTONE / CLAYEY SAND: Extremely low strength, moderately weathered, light grey mottled orange sandstone / clayey sand							
	3.0	Pit discontinued at 3.0m							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20; 1, 2, 3

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 368320
NORTHING: 6330700
DIP/AZIMUTH: 90°/--

PIT No: G5
PROJECT No: 39662C
DATE: 7/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		SAND: Light grey-brown slightly clayey fine to medium grained sand, damp		D,PID	0.05		<1ppm		
	0.2	SANDY CLAY: Very stiff, light brown mottled orange sandy clay, M<Wp		D,pp	0.4				
	0.6	SANDSTONE: Extremely low strength, extremely weathered, light grey and orange sandstone (clayey sand)							
	1	from 1m, very low to low strength bands							1
	1.8	Pit discontinued at 1.8m, slow progress on low strength sandstone							
	2								2
	3								3

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Rubbish stockpile on surface

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⫧ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 368355
NORTHING: 6330712
DIP/AZIMUTH: 90°/--

PIT No: G6
PROJECT No: 39662C
DATE: 7/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING: Grey-brown fine to medium grained sand and fine to medium gravel, boulders at surface		D,PID	0.1		<1ppm		
	0.3	CLAY: Very stiff to hard, orange-brown clay, M>Wp		D,pp	0.5		350-450 kPa		
		from 0.7m, light grey mottled red, M<Wp							
	1			pp	1.0		350 kPa		
				pp	1.8		350 kPa		
	2 2.0	SANDSTONE: Extremely low strength, extremely weathered, light grey and orange fine to medium grained sandstone, strength varying (low strength bands)							
	2.6	Pit discontinued at 2.6m, slow progress							
	3								

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS: Boulder stockpile on surface

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 368298
NORTHING: 6330711
DIP/AZIMUTH: 90°/--

PIT No: G7
PROJECT No: 39662C
DATE: 7/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		CLAYEY SAND / SANDY CLAY: Hard, grey-brown clayey sand, dry/M<<Wp		D	0.1				
	0.3	SANDY CLAY: Hard, light brown mottled orange sandy clay, M<Wp		D,pp	0.4		>400 kPa		
	0.6	CLAY: Hard, light grey mottled red clay		D,pp	0.7		>400 kPa		
	1	from 1m, very stiff		pp	1.0		250-300 kPa		
				pp	1.6		350-400 kPa		
		From approximately 1.8m depth, rock-like structure							
	2.0	CLAYSTONE / CLAY: Extremely low strength, moderately weathered, light grey and red claystone		D	2.2				
	3.0	Pit discontinued at 3.0m							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 368657
NORTHING: 6330683
DIP/AZIMUTH: 90°/--

PIT No: G9
PROJECT No: 39662C
DATE: 8/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		SILTY SAND: Grey, fine to medium grained silty sand with roots and rootlets, damp		D	0.1				
	0.2	GRAVELLY SAND: Light grey fine to coarse grained gravelly sand (fine gravel), moist		D	0.3				
	0.4	CLAYEY GRAVELLY SAND: Light grey, yellow-orange fine to coarse grained clayey gravelly sand, moist		D	0.6				
	0.9	CLAYEY SAND: (Loose), light grey and yellow fine to medium grained sand, wet		D	1.0			▽	
1				D	1.4				1
	1.8	SANDY CLAY: Firm to stiff, light grey mottled orange sandy clay, M>Wp		D	1.9				
2		from 2.5m, very stiff		D,pp	2.5		250-300 kPa		2
	2.7	CLAY: Hard, light grey mottled orange clay, M>Wp		D,pp	2.8		>400 kPa		
3	3.0	Pit discontinued at 3.0m							3

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: Seepage from 1.5m to 1.8m

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 368870
NORTHING: 6330463
DIP/AZIMUTH: 90°/--

PIT No: G10
PROJECT No: 39662C
DATE: 8/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		CLAYEY SILTY SAND: Grey-brown fine to medium grained clayey silty sand, damp to moist		D	0.1				
		from 0.4m, gravelly							
	0.5	SANDY CLAY AND GRAVEL: Light grey mottled orange sandy clay and gravel, moist		D	0.6				
	0.7	SANDY CLAY: Hard, light grey mottled orange sandy clay, M<Wp							
	1			D,pp	1.0		>400 kPa		1
				D	1.5				
		from 1.6m, stiff, increasing sand content, some gravel		pp	1.6		200kPa		
	2			D,pp	2.0		200-250 kPa		2
				D,pp	2.5		200-250 kPa		
		from 2.8m, sandy clay (no gravel)							
	3 3.0	Pit discontinued at 3.0m							3

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 368427
NORTHING: 6330418
DIP/AZIMUTH: 90°/--

PIT No: G11
PROJECT No: 39662C
DATE: 7/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		CLAYEY SILTY SAND: (Very loose), grey-brown clayey silty fine to medium grained sand, wet		D	0.3				
	0.5	SANDY CLAY: (Very soft), light grey mottled orange sandy clay, M>>Wp		D,pp	0.8		<20kPa		
	1			pp	1.1		40 kPa		
		from 1.5m, stiff		D,pp	1.5		120-150 kPa		
	2			D,pp	2.0		200 kPa		
		from 2.6m, some red mottling and cementing		D,pp	2.5		150-220 kPa		
				D,pp	2.9		150-230 kPa		
	3 3.0	Pit discontinued at 3.0m							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 368869
NORTHING: 6330423
DIP/AZIMUTH: 90°/--

PIT No: G12
PROJECT No: 39662C
DATE: 7/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		SILTY SAND: Dark grey-brown fine to medium grained silty sand, some rootlets		D	0.1				
		from 0.5m, gravelly		D	0.6				
	0.7	SANDY GRAVELLY CLAY: Hard, light grey and yellow sandy gravelly clay (fine to medium grained sand and gravel), M<Wp		D,pp	1.0		>400 kPa		
				D,pp	1.5		>400kPa		
	1.8	SANDY CLAY: Stiff to very stiff, light grey mottled red sandy clay, some cementing, M<Wp		D,pp	2.0		200-250 kPa		
				D,pp	2.5		200-250 kPa		
		From 2.7m, stiff		D,pp	2.9		150 kPa		
	3.0	Pit discontinued at 3.0m							

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth
LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⧗ Water level

CHECKED
Initials:
Date:

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TEST PIT LOG

CLIENT: Coal & Allied Pty Ltd
PROJECT: Lower Hunter Lands Development
LOCATION: Kanangra Drive, Gwandalan

SURFACE LEVEL: --
EASTING: 368258
NORTHING: 6330186
DIP/AZIMUTH: 90°/--

PIT No: G13
PROJECT No: 39662C
DATE: 8/8/2007
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		SAND: Light grey-brown fine to medium grained sand, some clay and gravel, damp							
	0.2	CLAYEY SAND / SANDY CLAY AND GRAVEL: (Very stiff), light brown fine to coarse grained clayey sand and fine gravel, moist		D	0.3				
				D,pp	0.7		200-250 kPa		
	0.9	CLAYEY SAND: Light grey and orange clayey sand, some fine gravel, moist							1
	1			D	1.5				
	2	grading to extremely low strength sandstone							2
	2.3	SANDSTONE: Extremely low strength, extremely weathered, light grey and orange sandstone		D	2.5				
	2.9	Pit discontinued at 2.9m							3
	3								

RIG: Case 580 Super LE backhoe, 480mm bucket with teeth

LOGGED: Heads

WATER OBSERVATIONS: No Free Groundwater Observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials:
Date:

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APPENDIX B

LABORATORY TEST RESULTS

17 August 2007 **TEST REPORT**

Douglas Partners Pty Ltd
Box 324
Hunter Region Mail Centre
NSW 2310

Your Reference: 39622C, Gwandalan
Report Number: 54408

Attention: Patrick Heads

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

Samples: Qty.	4 Soils
Date of Receipt of Samples:	10/08/07
Date of Receipt of Instructions:	10/08/07
Date Preliminary Report Emailed:	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

Ly Kim Ha
Senior Organic Chemist

Edward Ibrahim
Laboratory Services Manager

Alexandra Stenta
Key Account Representative

SGS Australia Pty Ltd
ABN 44 000 964 278
Environmental Services Unit 16, 33 Maddox Street, Alexandria Australia
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www.au.sgs.com
Member of the SGS Group

TRH/BTEX in Soil Our Reference: Your Reference Sample Type Date Sampled	UNITS ---------- ----------	54408-1 PIT G1/0.2 soil 7/08/2007	54408-2 PIT G2/0.2 soil 7/08/2007	54408-3 PIT G5/0.05 soil 7/08/2007	54408-4 PIT G6/0.1 soil 7/08/2007
TRH C_6 - C_9 P&T	mg/kg	<20	<20	<20	<20
TRH C_{10} - C_{14}	mg/kg	<20	<20	37	<20
TRH C_{15} - C_{28}	mg/kg	<50	<50	340	<50
TRH C_{29} - C_{36}	mg/kg	<50	<50	180	<50
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<0.5	<0.5	<0.5	<0.5
Total Xylenes	mg/kg	<1.5	<1.5	<1.5	<1.5
BTEX Surrogate (%)	%	93	104	99	103

PAHs in Soil Our Reference: Your Reference Sample Type Date Sampled	UNITS ---------- ----------	54408-1 PIT G1/0.2 soil 7/08/2007	54408-2 PIT G2/0.2 soil 7/08/2007	54408-3 PIT G5/0.05 soil 7/08/2007	54408-4 PIT G6/0.1 soil 7/08/2007
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<1.2	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo[*a*]anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo[*b,k*]fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2
Benzo[*a*]pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05
Indeno[*123-cd*]pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Dibenzo[*ah*]anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo[*ghi*]perylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Total PAH's	mg/kg	<1.55	<1.55	<2.65	<1.55
Nitrobenzene-d5	%	95	94	86	94
2-Fluorobiphenyl	%	94	94	90	97
p -Terphenyl-*d14*	%	103	108	101	104

OC Pesticides in Soil Our Reference: Your Reference Sample Type Date Sampled	UNITS ---------- ----------	54408-1 PIT G1/0.2 soil 7/08/2007	54408-2 PIT G2/0.2 soil 7/08/2007	54408-3 PIT G5/0.05 soil 7/08/2007	54408-4 PIT G6/0.1 soil 7/08/2007
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-BHC (Lindane)	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1
o,p'-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-Endosulfan	mg/kg	<0.1	<0.1	<0.1	<0.1
trans-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
cis-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
trans-Nonachlor	mg/kg	<0.1	<0.1	<0.1	<0.1
p,p'-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1
o,p'-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1
o,p'-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1
beta-Endosulfan	mg/kg	<0.1	<0.1	<0.1	<0.1
p,p'-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1
p,p'-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin Ketone	mg/kg	<0.1	<0.1	<0.1	<0.1
2,4,5,6-Tetrachloro-m-xylene *(Surrogate*	%	107	111	101	109

OP Pesticides in Soil Our Reference: Your Reference Sample Type Date Sampled	UNITS ---------- ----------	54408-1 PIT G1/0.2 soil 7/08/2007	54408-2 PIT G2/0.2 soil 7/08/2007	54408-3 PIT G5/0.05 soil 7/08/2007	54408-4 PIT G6/0.1 soil 7/08/2007
Chlorpyrifos	mg/kg	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1
Bromofos Ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1
OP_Surrogate 1	%	107	111	101	109

PCBs in Soil Our Reference: Your Reference Sample Type Date Sampled	UNITS ---------- ----------	54408-1 PIT G1/0.2 soil 7/08/2007	54408-2 PIT G2/0.2 soil 7/08/2007	54408-3 PIT G5/0.05 soil 7/08/2007	54408-4 PIT G6/0.1 soil 7/08/2007
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1262	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1268	mg/kg	<0.1	<0.1	<0.1	<0.1
Total Positive PCB	mg/kg	<0.90	<0.90	<0.90	<0.90
PCB_Surrogate 1	%	107	111	101	109

Acid Extractable Metals in Soil Our Reference: Your Reference Sample Type Date Sampled	UNITS ---------- ----------	54408-1 PIT G1/0.2 soil 7/08/2007	54408-2 PIT G2/0.2 soil 7/08/2007	54408-3 PIT G5/0.05 soil 7/08/2007	54408-4 PIT G6/0.1 soil 7/08/2007
Arsenic	mg/kg	5	<3	4	3
Cadmium	mg/kg	0.3	0.3	0.6	0.2
Chromium	mg/kg	12	41	12	7.9
Copper	mg/kg	1.7	2.1	7.3	15
Lead	mg/kg	7	8	68	19
Mercury	mg/kg	<0.05	<0.05	<0.05	<0.05
Nickel	mg/kg	0.8	2.0	3.4	4.8
Zinc	mg/kg	8.8	11	58	42

Moisture Our Reference: Your Reference Sample Type Date Sampled	UNITS ---------- ----------	54408-1 PIT G1/0.2 soil 7/08/2007	54408-2 PIT G2/0.2 soil 7/08/2007	54408-3 PIT G5/0.05 soil 7/08/2007	54408-4 PIT G6/0.1 soil 7/08/2007
Moisture	%	13	13	12	5

Method ID	Methodology Summary
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 aaa-trifluorotoluene.
SEO-020	TRH - Determination of Total Recoverable Hydrocarbons by gas chromatography following extraction with DCM/Acetone for solids and DCM for liquids.
SEO-018	BTEX - Determination by purge and trap/ Gas Chromatography with MS Detection.
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.
SEO-005	OC/OP/PCB - Determination of a suite of Organchlorine 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.
SEM-010	Metals - Determination of various metals by ICP-AES following aqua regia digest.
SEM-005	Mercury - Determination of Mercury by Cold Vapour Generation Atomic Absorption Spectroscopy.
AN002	Preparation of soils, sediments and sludges undergo analysis by either air drying, compositing, subsampling and 1:5 soil water extraction where required. Moisture content is determined by drying the sample at 105 ± 5°C.

QUALITY CONTROL TRH/BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Matrix Spike % Recovery Duplicate + %RPD
TRH C_6 - C_9 P&T	mg/kg	20	SEO-017	<20	54408-1	<20 || <20	LCS	115 || [N/T]
TRH C_{10} - C_{14}	mg/kg	20	SEO-020	<20	54408-1	<20 || <20	LCS	108 || [N/T]
TRH C_{15} - C_{28}	mg/kg	50	SEO-020	<50	54408-1	<50 || <50	LCS	113 || [N/T]
TRH C_{29} - C_{36}	mg/kg	50	SEO-020	<50	54408-1	<50 || <50	LCS	107 || [N/T]
Benzene	mg/kg	0.5	SEO-018	<0.5	54408-1	<0.5 || <0.5	LCS	91 || [N/T]
Toluene	mg/kg	0.5	SEO-018	<0.5	54408-1	<0.5 || <0.5	LCS	93 || [N/T]
Ethylbenzene	mg/kg	0.5	SEO-018	<0.5	54408-1	<0.5 || <0.5	LCS	94 || [N/T]
Total Xylenes	mg/kg	1.5	SEO-018	<1.5	54408-1	<1.5 || <1.5	LCS	99 || [N/T]
BTEX Surrogate (%)	%	0	SEO-018	101	54408-1	93 || 115 || RPD: 21	LCS	110 || [N/T]
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	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	LCS	90 || [N/T]
Acenaphthylene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	LCS	68 || [N/T]
Acenaphthene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	LCS	104 || [N/T]
Fluorene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Phenanthrene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	LCS	96 || [N/T]
Anthracene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	LCS	98 || [N/T]
Fluoranthene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	LCS	96 || [N/T]
Pyrene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	LCS	92 || [N/T]
Benzo[*a*]anthracene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Benzo[*b,k*]fluoranthene	mg/kg	0.2	SEO-030	<0.2	54408-1	<0.2 || <0.2	[NR]	[NR]
Benzo[*a*]pyrene	mg/kg	0.05	SEO-030	<0.05	54408-1	<0.05 || <0.05	LCS	101 || [N/T]
Indeno[*123-cd*]pyrene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Dibenzo[*ah*]anthracene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Benzo[*ghi*]perylene	mg/kg	0.1	SEO-030	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Total PAH's	mg/kg	1.55	SEO-030	1.55	54408-1	<1.55 || <1.55	[NR]	[NR]
Nitrobenzene-d5	%	0	SEO-030	92	54408-1	95 || 89 || RPD: 7	LCS	90 || [N/T]
2-Fluorobiphenyl	%	0	SEO-030	95	54408-1	94 || 93 || RPD: 1	LCS	91 || [N/T]
p -Terphenyl-*d* 14	%	0	SEO-030	110	54408-1	103 || 102 || RPD: 1	LCS	103 || [N/T]

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	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
gamma-BHC (Lindane)	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Heptachlor	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	LCS	91 || [N/T]
Aldrin	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	LCS	88 || [N/T]
beta-BHC	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
delta-BHC	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	LCS	88 || [N/T]
Heptachlor Epoxide	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
o,p'-DDE	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
alpha-Endosulfan	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
trans-Chlordane	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
cis-Chlordane	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
trans-Nonachlor	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
p,p'-DDE	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Dieldrin	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	LCS	90 || [N/T]
Endrin	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	LCS	93 || [N/T]
o,p'-DDD	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
o,p'-DDT	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
beta-Endosulfan	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
p,p'-DDD	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
p,p'-DDT	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	LCS	92 || [N/T]
Endosulfan Sulphate	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Methoxychlor	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Endrin Ketone	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
2,4,5,6-Tetrachloro-m-xylene *(Surrogate*	%	0	SEO-005	103	54408-1	107 || 110 || RPD: 3	LCS	104 || [N/T]

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	<0.1	54408-1	<0.1 || <0.1	LCS	100 || [N/T]
Fenitrothion	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Bromofos Ethyl	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
OP_Surrogate 1	%	0	SEO-005	103	54408-1	107 || 110 || RPD: 3	LCS	104 || [N/T]
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	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1260	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	LCS	119 || [N/T]
Arochlor 1262	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1268	mg/kg	0.1	SEO-005	<0.1	54408-1	<0.1 || <0.1	[NR]	[NR]
Total Positive PCB	mg/kg	0.9	SEO-005	0.90	54408-1	<0.90 || <0.90	[NR]	[NR]
PCB_Surrogate 1	%	0	SEO-005	103	54408-1	107 || 110 || RPD: 3	LCS	109 || [N/T]
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	[NT]	[NT]	LCS	98 || [N/T]
Cadmium	mg/kg	0.1	SEM-010	<0.1	[NT]	[NT]	LCS	100 || [N/T]
Chromium	mg/kg	0.3	SEM-010	<0.3	[NT]	[NT]	LCS	97 || [N/T]
Copper	mg/kg	0.5	SEM-010	<0.5	[NT]	[NT]	LCS	102 || [N/T]
Lead	mg/kg	1	SEM-010	<1	[NT]	[NT]	LCS	100 || [N/T]
Mercury	mg/kg	0.05	SEM-005	<0.05	[NT]	[NT]	LCS	102 || [N/T]
Nickel	mg/kg	0.5	SEM-010	<0.5	[NT]	[NT]	LCS	100 || [N/T]
Zinc	mg/kg	0.3	SEM-010	<0.3	[NT]	[NT]	LCS	97 || [N/T]

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Moisture	%	1	AN002	<1

Result Codes

[INS]	:	Insufficient Sample for this test	[HBG]	:	Results not Reported due to High Background Interference
[NR]	:	Not Requested	*	:	Not part of NATA Accreditation
[NT]	:	Not tested	[N/A]	:	Not Applicable

Result Comments

PAHs level of reporting has been raised due to the sample matrix interference.
Date Organics extraction commenced: 10/08/07
NATA Corporate Accreditation No. 2562, Site No 4354
Note: Test results are not corrected for recovery (excluding Dioxins/Furans* and PAH in XAD and PUF).

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 10 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.

3 September 2007 **TEST REPORT**

Douglas Partners Pty Ltd
Box 324
Hunter Region Mail Centre
NSW 2310

Your Reference: 39662C, Gwandalan
Report Number: 54680-R

Attention: Patrick Heads

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

Samples:	Qty.	5 Soils
Date of Receipt of Samples:		23/08/07
Date of Receipt of Instructions:		23/08/07
Date Preliminary Report Emailed:		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.

This report cancels and supersedes report No. 54680 issued on 29/08/2007 by SGS Environmental Services due to correction in sample ID.

Yours faithfully
SGS ENVIRONMENTAL SERVICES

Ly Kim Ha
Senior Organic Chemist

Edward Ibrahim
Laboratory Services Manager

SGS Australia Pty Ltd | Environmental Services Unit 16, 33 Maddox Street, Alexandria Australia

Inorganics Our Reference: Your Reference Sample Type Date Sampled	UNITS ---------- ----------	54680-R-1 PITG2/0.8 soil 7/08/2007	54680-R-2 PITG6/0.5 soil 7/08/2007	54680-R-3 PITG9/0.6 soil 8/08/2007	54680-R-4 PITG12/1.0 soil 7/08/2007	54680-R-5 PITG13/0.7 soil 8/08/2007
Sulphate, SO4 1:5 soil:water	mg/kg	73	28	11	46	14
Chloride, Cl 1:5 soil:water	mg/kg	43	61	7.8	45	11
pH 1:5 soil:water	pH Units	5.1	5.0	4.9	5.0	5.6

Moisture Our Reference: Your Reference Sample Type Date Sampled	UNITS ---------- ----------	54680-R-1 PITG2/0.8 soil 7/08/2007	54680-R-2 PITG6/0.5 soil 7/08/2007	54680-R-3 PITG9/0.6 soil 8/08/2007	54680-R-4 PITG12/1.0 soil 7/08/2007	54680-R-5 PITG13/0.7 soil 8/08/2007
Moisture	%	20	22	11	13	17

Method ID	Methodology Summary
SEI-038	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 20th ED, 4110-B.
AN101	pH - Measured using pH meter and electrode in accordance with APHA 20th ED, 4500-H+.
AN002	Preparation of soils, sediments and sludges undergo analysis by either air drying, compositing, subsampling and 1:5 soil water extraction where required. Moisture content is determined by drying the sample at 105 ± 5°C.

QUALITY CONTROL Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Matrix Spike % Recovery Duplicate + %RPD
Sulphate, SO4 1:5 soil:water	mg/kg	2	SEI-038	<2	54680-1	73 || 72 || RPD: 1	LCS	101 || [N/T]
Chloride, Cl 1:5 soil:water	mg/kg	0.5	SEI-038	<0.5	54680-1	43 || 39 || RPD: 10	LCS	101 || [N/T]
pH 1:5 soil:water	pH Units	0	AN101	[NT]	54680-1	5.1 || 5.0 || RPD: 2	[NR]	[NR]

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Moisture	%	1	AN002	<1

Result Codes

[INS]	:	Insufficient Sample for this test	[HBG]	:	Results not Reported due to High Background Interference
[NR]	:	Not Requested	*	:	Not part of NATA Accreditation
[NT]	:	Not tested	[N/A]	:	Not Applicable

Result Comments

Date Organics extraction commenced: N/A
NATA Corporate Accreditation No. 2562, Site No 4354
Note: Test results are not corrected for recovery (excluding Dioxins/Furans* and PAH in XAD and PUF).
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Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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 10 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.

ALS Environmental

CERTIFICATE OF ANALYSIS

Client	: **DOUGLAS PARTNERS PTY LTD**	*Laboratory*	: **Environmental Division Brisbane**	*Page*	: **1 of 4**
Contact	: **MR PATRICK HEADS**	*Contact*	: **Tim Kilmister**	*Work Order*	: **EB0709668**
Address	: **PO BOX 324 HUNTER REGION MAIL CENTRE AUSTRALIA 2310**	*Address*	: **32 Shand Street Stafford QLD Australia 4053**		
E-mail	: **headsp@douglaspartners.com.au**	*E-mail*	: **Services.Brisbane@alsenviro.com**		
Telephone	: **49609600**	*Telephone*	: **+61-7-3243 7222**		
Facsimile	: **49609601**	*Facsimile*	: **+61-7-3243 7218**		
Project	: **39662C GWANDALAN**	*Quote number*	: **EN/020/07**	*Date received*	: **28 Aug 2007**
Order number	: **37366**			*Date issued*	: **4 Sep 2007**
C-O-C number	: **- Not provided -**			*No. of samples*	- *Received* : **3**
Site	: **- Not provided -**				*Analysed* : **3**

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NATA Accredited Laboratory 825

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	*Position*	*Department*
Cass Sealby	**Senior Chemist - Acid Sulphate Soils**	**Inorganics - NATA 825 (818 - Brisbane)**

ALS Environmental

Comments

This report for the ALSE reference EB0709668 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- **Analytical Results for Samples Submitted**
- **Surrogate Recovery Data**

The analytical procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate Recoveries.

Specific comments for Work Order **EB0709668**

ANC not required because pH KCl less than 6.5

Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from ‘kg/t dry weight’ to ‘kg/m3 in-situ soil’, multiply ‘reported results’ x ‘wet bulk density of soil in t/m3’.

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Analytical Results

				Client Sample ID :	PIT G9/0.3	PIT G10/0.1	PIT G10/0.6		
				Sample Matrix Type / Description :	SOIL	SOIL	SOIL		
				Sample Date / Time :	8 Aug 2007 15:00	8 Aug 2007 15:00	8 Aug 2007 15:00		
				Laboratory Sample ID :	EB0709668-001	EB0709668-002	EB0709668-003		
Analyte	*CAS number*	*LOR*	*Units*						
EA033-A: Actual Acidity									
pH KCl (23A)		0.1	pH Unit		5.4	4.3	4.9		
Titratable Actual Acidity (23F)		2	mole H+ / t		8	141	13		
sulfidic - Titratable Actual Acidity (s-23F)		0.02	% pyrite S		<0.02	0.22	0.02		
EA033-B: Potential Acidity									
Chromium Reducible Sulfur (22B)		0.02	% S		<0.02	<0.02	0.02		
acidity - Chromium Reducible Sulfur (a-22B)		10	mole H+ / t		<10	<10	15		
EA033-D: Retained Acidity									
Net Acid Soluble Sulfur (20Je)		0.02	% S		----	<0.02	----		
acidity - Net Acid Soluble Sulfur (a-20J)		10	mole H+ / t		----	<10	----		
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02	% pyrite S		----	<0.02	----		
KCl Extractable Sulfur (23Ce)		0.02	% S		----	<0.02	----		
HCl Extractable Sulfur (20Be)		0.02	% S		----	<0.02	----		
EA033-E: Acid Base Accounting									
ANC Fineness Factor		0.5			1.5	1.5	1.5		
Net Acidity (sulfur units)		0.02	% S		<0.02	0.22	0.04		
Net Acidity (acidity units)		10	mole H+ / t		<10	141	28		
Liming Rate		1	kg CaCO3/t		<1	10	2		

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Surrogate Control Limits

- **No surrogates present on this report.**

ALS Environmental

QUALITY CONTROL REPORT

Client	:	**DOUGLAS PARTNERS PTY LTD**	**Laboratory**	: Environmental Division Brisbane	**Page**	:	**1 of 4**
Contact	:	MR PATRICK HEADS	**Contact**	: Tim Kilmister			
Address	:	PO BOX 324 HUNTER REGION MAIL CENTRE AUSTRALIA 2310	**Address**	: 32 Shand Street Stafford QLD Australia 4053	**Work order**	:	**EB0709668**
					Amendment No.	:	
Project	:	39662C GWANDALAN	**Quote number**	: EN/020/07	**Date received**	:	**28 Aug 2007**
Order number	:	37366			**Date issued**	:	**4 Sep 2007**
C-O-C number	:	- Not provided -					
Site	:	- Not provided -					
E-mail	:	headsp@douglaspartners.com.au	**E-mail**	: Services.Brisbane@alsenviro.com	**No. of samples**		
Telephone	:	49609600	**Telephone**	: +61-7-3243 7222	**Received**	:	3
Facsimile	:	49609601	**Facsimile**	: +61-7-3243 7218	**Analysed**	:	3

This final report for the ALSE work order reference EB0709668 supersedes any previous reports with this reference.

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- Laboratory Duplicates (DUP); Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Samples (LCS); Recovery and Acceptance Limits
- Matrix Spikes (MS); Recovery and Acceptance Limits

Work order specific comments

ANC not required because pH KCl less than 6.5

Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.

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NATA Accredited Laboratory - 825

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance with ISO/IED 17025

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	Department
Cass Sealby	Inorganics - NATA 825 (818 - Brisbane)

ALS Environmental

Quality Control Report - Laboratory Duplicates (DUP)

The quality control term **Laboratory Duplicate** refers to an intralaboratory split sample randomly selected from the sample batch. Laboratory duplicates provide information on method precision and sample heterogeneity.
- Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** = *Limit of Reporting,* ***RPD*** = *Relative Percent Difference.*
* Indicates failed QC. The permitted ranges for the RPD of Laboratory Duplicates (relative percent deviation) are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting:- Result < 10 times LOR, no limit - Result between 10 and 20 times LOR, 0% - 50% - Result > 20 times LOR, 0% - 20%

Matrix Type: SOIL ***Laboratory Duplicates (DUP) Report***

Laboratory Sample ID	*Client Sample ID*	*Analyte name*	*LOR*	*Original Result*	*Duplicate Result*	*RPD*
EA033-A: Actual Acidity						
EA033-A: Actual Acidity - (QC Lot: 483162)				**pH Unit**	**pH Unit**	**%**
EB0709667-001	Anonymous	pH KCl (23A)	0.1 pH Unit	5.5	5.5	0.0
		Titratable Actual Acidity (23F)	2 mole H+ / t	11	8	25.7
		sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	<0.02	<0.02	0.0
EB0709669-006	Anonymous	pH KCl (23A)	0.1 pH Unit	5.2	5.1	1.9
		Titratable Actual Acidity (23F)	2 mole H+ / t	16	13	16.1
		sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	0.02	0.02	0.0
EA033-B: Potential Acidity						
EA033-B: Potential Acidity - (QC Lot: 483162)				**% S**	**% S**	**%**
EB0709667-001	Anonymous	Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	<0.02	0.0
		Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	<10	0.0
EB0709669-006	Anonymous	Chromium Reducible Sulfur (22B)	0.02 % S	0.06	0.07	0.0
		Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	41	43	5.9

ALS Environmental

Quality Control Report - Method Blank (MB) and Laboratory Control Samples (LCS)

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC type is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a known, interference free matrix spiked with target analytes or certified reference material. The purpose of this QC type is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of actual laboratory data. Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. Abbreviations: LOR = Limit of reporting.

Matrix Type: SOIL

Method Blank (MB) and Laboratory Control Samples (LCS) Report

		Method blank result	*Actual Results*		*Recovery Limits*	
			Spike concentration	*Spike Recovery*	*Dynamic Recovery Limits*	
Analyte name	*LOR*			*LCS*	*Low*	*High*
EA033-A: Actual Acidity						
EA033-A: Actual Acidity - (QC Lot: 483162)		% pyrite S	% pyrite S	%	%	%
sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	<0.02	----	----	----	----
Titratable Actual Acidity (23F)	2 mole H+ / t	<2	----	----	----	----
EA033-B: Potential Acidity						
EA033-B: Potential Acidity - (QC Lot: 483162)		mole H+ / t	mole H+ / t	%	%	%
Acidity - Chromium Reducible Sulfur (a-22B)	10 mole H+ / t	<10	----	----	----	----
Chromium Reducible Sulfur (22B)	0.02 % S	<0.02	----	----	----	----
EA033-D: Retained Acidity						
EA033-D: Retained Acidity - (QC Lot: 483162)		mole H+ / t	mole H+ / t	%	%	%
Acidity - Net Acid Soluble Sulfur (a-20J)	10 mole H+ / t	<10	----	----	----	----
HCl Extractable Sulfur (20Be)	0.02 % S	<0.02	----	----	----	----
KCl Extractable Sulfur (23Ce)	0.02 % S	<0.02	----	----	----	----
Net Acid Soluble Sulfur (20Je)	0.02 % S	<0.02	----	----	----	----
sulfidic - Net Acid Soluble Sulfur (s-20J)	0.02 % pyrite S	<0.02	----	----	----	----

ALS Environmental

Quality Control Report - Matrix Spikes (MS)

The quality control term **Matrix Spike (MS)** refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC type is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQO's). 'Ideal' recovery ranges stated may be waived in the event of sample matrix interferences. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** *= Limit of Reporting,* ***RPD*** *= Relative Percent Difference.*

* Indicates failed QC

Matrix Spike (MS) Report

					Actual Results		*Recovery Limits*	
					Sample Result	*Spike Recovery*	*Static Limits*	
Analyte name	*Laboratory Sample ID*	*Client Sample ID*	*LOR*	*Spike Concentration*		*MS*	*Low*	*High*
- (QC Lot:)						%	%	%
					----			

l **No Matrix Spike (MS) carried out on this Work Order.**

ALS Environmental

INTERPRETIVE QUALITY CONTROL REPORT

Client	:	**DOUGLAS PARTNERS PTY LTD**	**Laboratory**	:	Environmental Division Brisbane	**Page**	: **1 of 5**
Contact	:	MR PATRICK HEADS	**Contact**	:	Tim Kilmister		
Address	:	PO BOX 324 HUNTER REGION MAIL CENTRE AUSTRALIA 2310	**Address**	:	32 Shand Street Stafford QLD Australia 4053	**Work order**	: **EB0709668**
						Amendment No.	:
Project	:	39662C GWANDALAN	**Quote number**	:	EN/020/07	**Date received**	: 28 Aug 2007
Order number	:	37366				**Date issued**	: 4 Sep 2007
C-O-C number	:	- Not provided -					
Site	:	- Not provided -					
E-mail	:	headsp@douglaspartners.com.au	**E-mail**	:	Services.Brisbane@alsenviro.com	**No. of samples**	
Telephone	:	49609600	**Telephone**	:	+61-7-3243 7222	**Received**	: 3
Facsimile	:	49609601	**Facsimile**	:	+61-7-3243 7218	**Analysed**	: 3

This Interpretive Quality Control Report was issued on 4 Sep 2007 for the ALS work order reference EB0709668 and supersedes any previous reports with this reference.
This report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Type Frequency Compliance
- Summary of all Quality Control Outliers
- Brief Method Summaries

ALS Environmental

Interpretive Quality Control Report - Analysis Holding Time

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the sample aliquot was taken. Elapsed time to analysis represents time from sampling where no extraction / digestion is involved or time from extraction / digestion where this is present. For composite samples, sampling date/time is taken as that of the oldest sample contributing to that composite. Sample date/time for laboratory produced leaches are taken from the completion date/time of the leaching process. Outliers for holding time are based on USEPA SW846, APHA, AS and NEPM (1999). Failed outliers, refer to the 'Summary of Outliers'.

Matrix Type: SOIL ***Analysis Holding Time and Preservation***

Method / **Container /** Client Sample ID(s)	**Date Sampled**	**Extraction / Preparation**			**Analysis**		
		Date extracted	Due for extraction	Pass?	Date analysed	Due for analysis	Pass?
EA033: Chromium Suite for Acid Sulphate Soils							
Snap Lock Bag - frozen PIT G9/0.3, PIT G10/0.1, PIT G10/0.6	**8 Aug 2007**	**28 Aug 2007**	7 Aug 2008	Pass	**3 Sep 2007**	2 Dec 2007	Pass

Interpretive Quality Control Report - Frequency of Quality Control Samples

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which this work order was processed. Actual rate should be greater than or equal to the expected rate.

Matrix Type: SOIL

Frequency of Quality Control Samples

Quality Control Sample Type / Method	Count		Rate (%)		Quality Control Specification
	QC	Regular	**Actual**	**Expected**	
Laboratory Duplicates (DUP)					
EA033: Chromium Suite for Acid Sulphate Soils	2	19	**10.5**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement
Method Blanks (MB)					
EA033: Chromium Suite for Acid Sulphate Soils	1	19	**5.3**	**5.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement

Interpretive Quality Control Report - Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged on the 'Quality Control Report'. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot.

Non-surrogates

- **For all matrices, no RPD recovery outliers occur for the duplicate analysis.**
- **For all matrices, no method blank result outliers occur.**
- **For all matrices, no laboratory spike recoveries breaches occur.**
- **For all matrices, no matrix spike recoveries breaches occur.**

Surrogates

- **For all matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time

The following report highlights outliers within this 'Interpretive Quality Control Report - Analysis Holding Time'.

- **No holding time outliers occur.**

Outliers : Frequency of Quality Control Samples

The following report highlights outliers within this 'Interpretive Quality Control Report - Frequency of Quality Control Samples'.

- **No frequency outliers occur.**

Method Reference Summary

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

Matrix Type: SOIL ***Method Reference Summary***

Preparation Methods

EN020PR : Drying at 85 degrees, bagging and labelling (ASS) - In house

Analytical Methods

EA033 : Chromium Suite for Acid Sulphate Soils - Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.

APPENDIX C

QA/QC

**QUALITY ASSURANCE/QUALITY CONTROL
FOR CONTAMINATION ASSESSMENT
KANANGRA DRIVE, GWANDALAN**

Quality Assurance (QA) was maintained by:

- compliance with a Project Quality Plan written for the objectives of the study;
- using qualified engineers to undertake the field supervision and sampling;
- following the Douglas Partners Pty Ltd (DP) operating procedures for sampling, field testing and decontamination as presented in Table 1;
- using NATA registered laboratories for sample testing that generally utilise standard laboratory methods of the US EPA, the APHA and NSW EPA.

Table 1 - Field Procedures

Abbreviation	Procedure Name
FPM LOG	Logging
FPM DECONT	Decontamination of Personnel and Equipment
FPM ENVID	Sample Identification, Handling, Transport and Storage of Contaminated Samples
FPM PIDETC	Operation of Field Analysers
FPM ENVSAMP	Sampling of Contaminated Soils

(from DP Field Procedures Manual)

Quality Control (QC) of the laboratory programme was achieved by the following means:

- method blanks - the laboratory ran reagent blanks to confirm the equipment and standards used were uncontaminated;
- laboratory duplicates - the laboratory split samples internally and conducted tests on separate extracts;
- laboratory spikes - samples were spiked by the laboratory with a known concentration of contaminants and subsequently tested for percent recovery;

DISCUSSION

A. Method Blanks

All method blanks returned results lower than the laboratory detection limit, therefore are acceptable.

B. Laboratory Replicates

The average RPD for individual contaminants ranged from 1% to 21%, which is considered to be within acceptable limits.

C. Laboratory Spikes

Recoveries in the order of 70% to 130% are generally considered to be acceptable. The average percent recovery for individual organic contaminants ranged from 68% to 119% which is generally within the quality control objectives. The results should however be qualified and may slightly under-estimate or over-estimate contaminant concentrations in certain samples (i.e. biased low or high respectively).

CONCLUSIONS

The accuracy and precision of the soil testing procedures, as inferred by the QA/QC data is generally considered to be of sufficient standard to allow the data reported to be used to interpret site contamination conditions.

S161

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: GWANDALAN
Project No: 39662C DP Order No:
DP Contact Person: PATRICK HEADS
Prior Storage: esky / fridge / shelved (circle)

To: SGS Australia PTY LTD
Unit 16/33 Maddox Street
ALEXANDRIA NSW 2015
Ph: (02) 8594 0400
Attn: Angela

Sample ID	Date Sampled	Sample Type S-soil W-water	Lab ID	Analytes: TRH	BTEX	PAH	PCB	OCP	OPP	Metals #								TCLP	Notes
PitG1/0.2	9/8/07	S	1	✓	✓	✓	✓	✓	✓	✓									
PitG2/0.2	↓	↓	2	✓	✓	✓	✓	✓	✓	✓									
PitG5/0.05			3	✓	✓	✓	✓	✓	✓	✓									
PitG6/0.1	↓	↓	4	✓	✓	✓	✓	✓	✓	✓									
PQL (S)		mg/kg																	
PQL (W)		mg/L																	

SGS
Received 10/8/07
By
Time 1730 am/pm
Samples intact yes/no
Ice/Cooler Pack yes/no
Comments: 54408

PQL = practical quantitation limit *As per Laboratory Method (Detection Limit)
# - Metals to Analyse (Please circle): As Cd Cr Cu Pb Zn Hg Ni Other
Date relinquished: 9/8/07
Total number of samples in container: 4
Results required by: 17/8/07
TAT (Circle): Standard 72 hr 48hr 24hr

SAMPLES RECEIVED
Please sign and date to acknowledge receipt of samples and return by fax
Signature:
Date: 10/8/7 Lab Ref: 54408

Send results to:
Douglas Partners Pty Ltd
Address:
BOX 324 Hunter Region Mail Centre
NSW 2310
Fax: (02) 4960 9601

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: CWANNAGAN
Project No: 39662C DP Order No: 67361
DP Contact Person: PATRICK HEARDS
Prior Storage: esky / fridge / shelved (circle)

To: SGS Australia PTY LTD
Unit 16/33 Maddox Street
ALEXANDRIA NSW 2015
Ph: (02) 8594 0400
Attn: Angela

Sample ID	Date Sampled	Sample Type S-soil W-water	Lab ID	Analytes: sulfate SO_4	chloride Cl^-	pH												TCLP	Notes
PitG2/0.8	7/8/07	S	1	✓	✓	✓													
PitG6/0.5	7/8/07		2	✓	✓	✓													
PitG9/0.6	8/8/07		3	✓	✓	✓													
PitG12/1.0	7/8/07		4	✓	✓	✓													
PitG13/0.7	8/8/07		5	✓	✓	✓													
PQL (S)		mg/kg																	
PQL (W)		mg/L																	

SGS
Received 23/8/07
By Sam
Time 9am. am/pm
Samples intact yes/no
Ice/Cooler Pack yes/no
54680

PQL = practical quantitation limit *As per Laboratory Method (Detection Limit)
# - Metals to Analyse (Please circle): As Cd Cr Cu Pb Zn Hg Ni Other
Date relinquished: 22/8/07
Total number of samples in container: 5
Results required by: 30/8/07
TAT (Circle): Standard 72 hr 48hr 24hr

SAMPLES RECEIVED
Please sign and date to acknowledge receipt of samples and return by fax
Signature: Sam.
Date: 23/8/07 Lab Ref: 54680.

Send results to:
Douglas Partners Pty Ltd
Address:
BOX 324 Hunter Region Mail Centre
NSW 2310
Fax: (02) 4960 9601

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: LWANNIKLAN
Project No: 39662C DP Order No:
DP Contact Person: PATRICIA HEADS
Prior Storage: esky / (fridge) / shelved (circle) Freezer

To: ALS PTY LTD
5 Rosegum Close
Warabrook NSW 2304
Ph: (02) 4968 9433
Attn: Ken Reid

	Sample ID	Date Sampled	Sample Type S-soil W-water	Lab ID	Analytes: Full Chromium Suite	TCLP	Notes
1	PitG9/0.3	8/8/07	S		✓		
2	PitG10/0.1	↓	↓		✓		
3	PitG10/0.6	↓	↓		✓		
	PQL (S)		mg/kg				
	PQL (W)		mg/L				

Environmental Division
Brisbane
Work Order
EB0709668

Telephone : +61-7-3243 7222

PQL = practical quantitation limit *As per Laboratory Method (Detection Limit)
# - Metals to Analyse (Please circle): As Cd Cr Cu Pb Zn Hg Ni Other
Date relinquished: 23/8/07
Total number of samples in container: 3
Results required by: 31/8/07
TAT (Circle): (Standard) 72 hr 48hr 24hr

SAMPLES RECEIVED
Please sign and date to acknowledge receipt of samples and return by fax
Signature: PETER DONAGHY AES NEWCASTLE
Date: 23/8/07 1610 Lab Ref:

Send results to:
Douglas Partners Pty Ltd
Address:
BOX 324 Hunter Region Mail Centre
NSW 2310
Fax: (02) 4960 9601

Received frozen 2°C
Relinquished frozen 0°C

Relinquished by: Hayley WS to AES Newcastle 27/8/07 4pm

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY FIELD SHEET

Client: COAL + ALLIED
Project: LOWER HUNTER LANDS DEVELOPMENT Project No: 39662C
Location: KANANGRA DR. GWANDALAN

Field								DP Office	Despatch	Notes
Sample ID	Depth (m)	Duplicate/ Replicate Sample	Sample Type S-soil W-water	Container Type G-glass P-plastic	Sampling			Received by: PH Date: 7/8/07	☑ 395 Date: 9/8/07	
					By	Date	Time	Storage Location*		
Pit G6	0.1		S	G/P	PH	7/8/07	am	fridge	✓	
Pit G5	0.05		↓	↓	↓	↓	am	↓	✓	
Pit G1	0.2		↓	↓	↓	↓	pm	↓	✓	
Pit G2	0.2		↓	↓	↓	↓	pm	↓	✓	

Default containers for soil: glass = clear 125/250 mL with teflon liner, plastic =press seal bag
*Default storage: Glass containers in fridge, plastic containers shelved, all water samples in fridge

SGS Environmental Services
Unit 16, 33 Maddox St. Alexandria NSW 2015
Telephone Number : (+61 2) 8594 0400
Fax Number : (+61 2) 8594 0499

SAMPLE RECEIPT CONFIRMATION

COMPANY	:	Douglas Partners Pty Ltd	FAX NO.	:	02 4960 9601
ATTENTION	:	Patrick Heads	PAGES	:	1
FROM	:	Sample Receipt	DATE	:	10/08/07

This is to confirm that samples for Project **39622C, Gwandalan** were received on **10/08/07** the results are expected to be ready on **17/08/2007** . Please quote SGS Reference: **54408** when making enquiries regarding this project. Please refer to below which details information about the integrity of the samples and other useful information.

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples, unless otherwise instructed.

Samples received in good order:	YES
Samples received in correct containers:	YES
Samples received without headspace:	YES
Sufficient quantity supplied:	YES
Upon receipt sample temperature:	Cool
Cooling Method:	Ice Pack
Sample containers provided by:	SGS
Samples Clearly Labelled:	YES
Turnaround time requested:	Standard
Completed documentation received:	YES

Comments:

Terms and conditions are available from www.au.sgs.com

The signed chain of custody will be returned to you with the original report.

SGS Environmental Services
Unit 16, 33 Maddox St. Alexandria NSW 2015
Telephone Number : **(+61 2) 8594 0400**
Fax Number : **(+61 2) 8594 0499**

SAMPLE RECEIPT CONFIRMATION

COMPANY	:	Douglas Partners Pty Ltd	FAX NO.	:	02 4960 9601
ATTENTION	:	Patrick Heads	PAGES	:	1
FROM	:	Sample Receipt	DATE	:	24/08/07

This is to confirm that samples for Project **39662C, Gwandalan** were received on **23/08/07** the results are expected to be ready on **30/08/2007** . Please quote SGS Reference: **54680** when making enquiries regarding this project. Please refer to below which details information about the integrity of the samples and other useful information.

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples, unless otherwise instructed.

Samples received in good order:	YES
Samples received in correct containers:	YES
Samples received without headspace:	N/A
Sufficient quantity supplied:	YES
Upon receipt sample temperature:	Cool
Cooling Method:	Ice
Sample containers provided by:	Customer
Samples Clearly Labelled:	YES
Turnaround time requested:	Standard
Completed documentation received:	YES

Comments:

Terms and conditions are available from www.au.sgs.com

The signed chain of custody will be returned to you with the original report.

AUSTRALIAN LABORATORY SERVICES PTY LTD ABN 84 009 936 029
32 Shand Street Stafford QLD 4053 Australia
Telephone: +61-7-3243 7222 Facsimile: +61-7-3243 7218 http://www.alsenviro.com/

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive report

Client Details

Client	:	**DOUGLAS PARTNERS PTY LTD**
Contact	:	**MR PATRICK HEADS**
Address	:	PO BOX 324 HUNTER REGION MAIL CENTRE AUSTRALIA 2310
Project	:	**39662C GWANDALAN**
Order number	:	**37366**
C-O-C Number	:	**- Not provided -**
Site	:	**- Not provided -**
Sampler	:	**- Not provided -**
E-mail	:	headsp@douglaspartners.com.au
Telephone	:	49609600
Facsimile	:	49609601

Laboratory Details

Laboratory	:	**Environmental Division Brisbane**
Manager	:	**Tim Kilmister**
Address	:	32 Shand Street Stafford QLD Australia 4053
Quote number	:	EP20070013
Work order	:	**EB0709668**
E-mail	:	Services.Brisbane@alsenviro.com
Telephone	:	+61-7-3243 7222
Facsimile	:	+61-7-3243 7218

Dates

Date Samples Received	:	28 Aug 2007	**SRA Issue Date**	:	29 Aug 2007
Scheduled Reporting Date	:	**4 Sep 2007**	**Client Requested Date**	:	31 Aug 2007

Delivery Details

Mode of Delivery	:	Carrier.	**Temperature**	:	1.4 C - Ice bricks present
No. of coolers/boxes	:	3 MEDIUM	**No. of samples** - **Received**		3
Security Seal	:	Intact.	- **Analysed**		3

Comments

- **Samples received in appropriately pretreated and preserved containers.**
- **Sample(s) have been received within recommended holding times.**

- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.
- Please direct any queries related to sample condition / numbering / breakages to Maggie Kahi.
- Analytical work for this work order will be conducted at ALSE Brisbane.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- When the sampling time is not supplied on the COC documentation, ALSE defaults the sampling time to that of the COC 'relinquishment' time (if supplied). If this also is not supplied, ALSE defaults the sampling time to the 'time of receipt at Laboratory'.

Client	: DOUGLAS PARTNERS PTY LTD	**Work Order**	: EB0709668
Project	: 39662C GWANDALAN	**ALS Quote Reference**	: EP20070013

Summary of Sample(s) / Container(s) and Requested Analysis

Some items described below may be part of a laboratory process neccessary for the execution of client requested tasks. Packages may contain additional analyses, such as moisture and preparation tasks, that form an implicit part of that package.

ALS Sample ID.	Client Sample ID - Sample Date	**Requested Analysis**									
		EA033 - SOIL Chromium Suite for Acid Sulphate Soils									
EB0709668-001	**PIT G9/0.3 - 8 Aug 2007**	]									
EB0709668-002	**PIT G10/0.1 - 8 Aug 2007**	]									
EB0709668-003	**PIT G10/0.6 - 8 Aug 2007**	]									
	Total(s) :	**3**									

Client	: DOUGLAS PARTNERS PTY LTD	**Work Order**	: EB0709668
Project	: 39662C GWANDALAN	**ALS Quote Reference**	: EP20070013

Requested Reports

l **MR PATRICK HEADS**

-	A4 - AU Certificate of Analysis - NEPM format	Email	headsp@douglaspartners.com.au
-	A4 - AU Quality Control Report - NEPM format	Email	headsp@douglaspartners.com.au
-	A4 - AU Interpretive Quality Control Report - NEPM format	Email	headsp@douglaspartners.com.au
-	EDI Format - ENMRG	Email	headsp@douglaspartners.com.au
-	EDI Format - XTab	Email	headsp@douglaspartners.com.au
-	Default - Chain of Custody	Email	headsp@douglaspartners.com.au
-	A4 - AU Sample Receipt Notification - Comprehensive format	Email	headsp@douglaspartners.com.au
-	A4 - AU Tax Invoice	Email	headsp@douglaspartners.com.au

Sample Container(s) / Preservation Non-Compliance Log

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

l **No sample container / preservation non-compliance exist.**

APPENDIX D

DRAWING 7 – TEST PIT LOCATIONS, SURFACE FEATURES AND GEOLOGY
DRAWING 8 – MINING CONSTRAINTS OVERLAIN ON WALLARAH COLLIERY – WARATAH SEAM WORKINGS
DRAWING 8A – MINING CONSTRAINTS OVERLAIN ON CHAIN VALLEY COLLIERY – WARATAH SEAM WORKINGS
DRAWING 9 – MINING CONSTRAINTS OVERLAIN ON GREAT NORTHERN SEAM WORKINGS
DRAWING 107 – GROUNDWATER DEPENDANT ECOSYSTEMS