Aargus

Environmental - Remediation - Engineering - Laboratories - Drilling

ACID SULPHATE SOILS ASSESSMENT

Malco Site
Rich Street,
Marrickville NSW

Prepared for

E & D Danias Pty Ltd

14th October 2013

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- Acid Sulphate Soils Management Advisory Committee (ASSMAC) (1998) – *Acid Sulphate Soils Assessment Guidelines*.

ABBREVIATIONS

AASS	Actual Acid Sulphate Soils
AHD	Above Height Datum
ANC	Acid Neutralising Capacity
ASS	Acid Sulphate Soils
ASSMAC	Acid Sulphate Soils Management Advisory Committee
ASSMP	Acid Sulphate Soils Management Plan
BGL	Below Ground Level
DNR&M	Department of Natural resources and Mines
DO	Dissolved Oxygen
EC	Electric Conductivity
EIL	Ecological Investigation Level
EPA	Environmental Protection Authority
HIL	Health-based Investigation Level
LOR	Limit of reporting
NV	Neutralising Value
PASS	Potential Acid Sulphate Soils
POCAS	Peroxide Oxidation Combined Acidity and Sulphate
PSI	Preliminary Site Investigation
QA/QC	Quality Assurance/Quality Control
QASSIT	Queensland Acid Sulphate Soils Investigation Team
SPOCAS	Suspended Peroxide Oxidation Combined Acidity and Sulphate
Spos	Peroxide Oxidisable
TAA	Total Actual Acidity
TCLP	Toxicity Characteristic Leaching Procedure
TPA	Total Potential Acidity
TSA	Total Sulfidic Acidity
TSS	Total Suspended Solids
VENM	Virgin Excavated Natural Material

1.0 INTRODUCTION

Aargus Pty Ltd was commissioned by E & D Danias Pty Ltd to conduct an Acid Sulphate Soils Management Plan (ASSMP) within the “Malco” property located at Rich Street, Marrickville NSW (“the site”). The site is located in the Marrickville Council local government area.

The ASS is required as disturbances to Potential Acid Sulphate Soil (PASS) or Actual Acid Sulphate Soils, which may occur during construction and excavation works, can result in the formation of acid. The acid, once formed, could then damage infrastructure or harm ecological systems.

The results of the field parameters from this assessment should only be used as a preliminary study to determine if further investigations are required. If results meet the criteria no further work, including an ASS Management Plan, will be required.

2.0 OBJECTIVES

The purpose of the ASS Assessment is to determine the presence or absence of ASS at the site. In the absence of ASS it is essential to assess for the presence of Potential Acid Sulphate Soils (PASS). If the results do not meet criteria an Acid Sulphate Soil Management Plan will be required.

This Preliminary Assessment reviewed the presence of ASS / PASS in the portion of the site that may require excavation.

3.0 SCOPE OF WORKS

The scope of works of the Preliminary ASS Assessment included:

- Review of previous environmental assessments;
- Site walkover;
- Targeted soil boring, sampling and testing for potential ASS at the site;
- Interpretation of field test and laboratory analysis and findings; and
- Reporting in accordance with relevant assessment guidelines / regulations.

4.0 ASSESSMENT CRITERIA

When assessing ASS at sites in NSW Acid Sulphate Soils Management Advisory Committee (ASSMAC) (1998) Acid Sulphate Soils Assessment Guidelines apply.

The purpose of this report is to determine whether there is a probable risk associated with ASS or PASS and to determine whether these types of soils actually exist on the site.

These maps do not detail the severity of the ASS, but only provide an indication that they may be present. The decision to classify certain areas as ASS is based on a number of geomorphic conditions and site criteria. The following points are used to determine if ASS are likely to exist (extracted from ASSMAC (1998) Acid Sulphate Soils Assessment Guidelines):

- ➢ Sediments of recent geological age (Holocene) ~ 10 000 y.o.
- ➢ Soil horizons less than 5m AHD (Australian Height Datum).
- ➢ Marine or estuarine sediments and tidal lakes.

- In coastal wetlands or back swamp areas; waterlogged or scalded areas; interdune swales or coastal sand dunes.
- In areas where the dominant vegetation is mangroves, reeds, rushes and other swamp tolerant and marine vegetation.
- In areas identified in geological descriptions or in maps bearing sulphide minerals, coal deposits or former marine shales/sediments.
- Deeper older estuarine sediments >10m below the ground surface, Holocene or Pleistocene age.

The following soil indicators are used to determine if ASS are actually present on a site:

- field pH ≤4 in soils
- presence of shell
- any jarosite horizons or substantial iron oxide mottling in auger holes, in surface encrustations or in any material dredged or excavated and left exposed. Jarosite is not always found, however, in actual acid sulphate soils.

The following soil indicators are used to determine if PASS are actually present on a site:

- waterlogged soils, unripe muds (soft, buttery, blue grey or dark greenish grey) or estuarine silty sands or sands (mid to dark grey) or bottom sediments of estuaries or tidal lakes (dark grey to black)
- presence of shell
- soil pH usually neutral but may be acid -positive Peroxide Test (see section 7.2 Field pH results).

5.0 SITE INFORMATION

5.1 Site Identification

The site is located within the “Malco” property on Rich Street, Marrickville NSW (refer to Figure 1 – Locality Map in Appendix A). The site is located in the Marrickville Council local government area.

The site was bordered by commercial and industrial properties to the south-east, north-east and north-west, and Rich Street then commercial and industrial properties to the south-west.

5.2 Site Description

A site visit was carried out on 23rd July 2013 by an Aargus field scientist. At the time of the site inspection, the following observations were made:

- The site was irregular in shape;
- The main access to the site was located along Rich Street in the south western boundary and Brompton Street in northern eastern boundary;
- The site comprised of a commercial / industrial area, including one two storey brick office building, three brick factory style buildings, one pre cast panel warehouse style building and car park areas;
- The north eastern half of the northern brick factory building was occupied by a paint workshop;
- There was evidence of a previous building located in the central portion of the site that appears to have been burnt down recently as ash was located on the sealed surfaces;
- An above ground oil tank was located in the northern brick factory style building. This building was occupied by Road Runner Coaches and was used to service the coaches;

- The sealed car park areas contained a number of cracks located across the site;
- A man-made canal intersected the site. The depth of the canal base was approximately 2-3m BGL;
- There was a bunded plant area located in the north eastern portion of the site;
- A generator was located in the car park area which appeared to be leaking diesel onto the sealed concrete surface;
- There was an unsealed gravel and grass area located to the north of the site. There were cars, rubbish & machinery standing on the unsealed surfaces. Also Road Runners coaches parked part of their buses on this area;
- No surface standing water was noticed at the site.
- There was evidence of chemical storage located on the site. Chemicals included paint, oil & lacquer;
- There are no visual indicators of underground storage tanks within the site. A previous site plan does indicate fill points and these could not be located at the time of the site visit due to possibly being covered by building materials and skip bin. Anecdotally, it has been recorded that the previous tanks were decommissioned.

5.3 Topography

The regional topography is undulating, with an approximate slope of 5° towards the south-east. The general slope of the subject site is towards the south east, but the western part of the site appears to have been filled.

Stormwater runoff from the site is expected to flow towards the south and south east.

5.4 Local geology, hydrogeology, surface waters

The Geological Map of Sydney (Geological Series Sheet 9130, Scale 1:100,000, 1983), published by the Department of Mineral Resources indicates the residual soils within the site to be underlain by Triassic Age Shale of the Wianamatta Group, comprising black to dark grey shale and laminite.

Based on a search of the NSW Groundwater Works website database, the three closest bores were located within a 2.0 kilometre radius, with final drilling depths of 1.30m to 4.25m BGL, and used for domestic and farming stock purposes.

The nearest surface water body from the site is Alexandra Canal located approximately 1.8 km south-east of the site, which runs south westerly towards Wolli Creek. Water from the local and surrounding areas is likely to flow towards Wolli Creek and thence into Botany Bay.

5.5 Proposed development

The report has been prepared as part of a due diligence process for investigation purposes as a part of a rezoning/new medium density residential land use application.

6.0 SOIL BORING AND SAMPLING

A soil sampling and analysis program was used to consolidate the nature and degree of Acid Sulphate Soils present in the surface and subsurface geology. Samples were collected from three (3) boreholes (BH101 to BH103) drilled within the site. The boreholes were drilled to a maximum depth of 10.7m below ground level (BGL), that being in bedrock, with samples collected at varying depths depending on the soil profile (the borehole locations are presented in Figure 2 – Site Plan in Appendix A).

Field analysis was performed on the collected samples for pH_f and pH_{fox} in accordance with the required sampling techniques of the *ASSMAC (1998) Assessment Guidelines* (see Appendix D – ASSMAC (1998) Field pH and peroxide test protocol).

6.1 Health & Safety

Standard Health and Safety procedures were observed. Rubber gloves were worn to minimise exposure to any potential contaminants. Breathing apparatus and PPE suits were supplied but not worn.

6.2 Quality Assurance/Quality Control (QA/QC)

Standard QA/QC procedures were followed. The decontamination of sampling equipment and the hand auger was achieved by washing with phosphate-free detergent and tap water, followed by final rinsing with distilled water. This was conducted after the collection of samples.

Standard sampling and analysing procedures are in accordance with and set out in the *NSW ASSMAC (1998) “Acid Sulphate Soils Assessment Guidelines”*.

7.0 FIELD RESULTS

7.1 Soil observations

Based on information from all boreholes, the surface and sub-surface profile across the site is generalised as follows:

- FILL – Silty Gravel, medium grained, angular, brown with bricks, ash & bitumen;
- FILL – Silty Clayey Gravel, medium grained, angular, brown and orange;
- FILL – Silty Clay, low-medium plasticity, brown, orange, black, grey, traces of ironstone, sandstone, shale and gravel;
- FILL – Silty Gravelly Sand, coarse to medium grained, white, brown & black with traces of gravel and brick;
- FILL – Sand, coarse grained, white, brown & black with traces of gravel and brick;
- NATURAL – Silty Clay, low plasticity, grey & brown, traces of ironstone & gravel;
- NATURAL – Clay, low to medium plasticity, grey with ironstone and shale gravel;
- NATURAL – Clay, low to medium plasticity, red, grey & brown, traces of gravel;
- NATURAL – Clay, medium plasticity, orange, grey, green & brown, traces of shale;
- NATURAL – Silty Clay, low to medium plasticity, brown, orange & grey with shale mottling; and
- NATURAL – Clay, medium to high plasticity, orange & brown, traces of shale.

No unusual colouring was detected in the soil suggesting the presence of pyrite (iron sulphide) or Jarosite was unlikely. Unripe muds or mid to dark-grey estuarine sands were not detected. Sulphurous odours were not detected in any of the recovered samples.

For full details of the soil profile refer to the borehole logs in Appendix C.

7.2 Field pH results

The results of field pH tests are presented in Table 1 below.

Table 1: Summary of field analysis results

Sample	Depth (m)	Soil Type	pH		pH	
			H_2O	Soil pH_f	H_2O_2	Soil pH_{fox}
BH101	0.5-1.0	Fill	7.02	9.0	5.00	7.2
BH101	1.0-1.45	Silty Clay	7.02	6.7	5.00	**4.8**
BH101	1.5-2.0	Silty Clay	7.02	7.1	5.00	**3.9**
BH101	2.5-2.95	Clayey Sand	7.02	7.2	5.00	5.3
BH101	3.0-3.5	Clayey Sand	7.02	6.2	5.00	**4.3**
BH101	4.0-4.45	Clayey Sand	7.02	6.5	5.00	5.3
BH102	0.5-1.0	Fill	7.02	6.3	5.00	5.9
BH102	2.0-2.5	Silty Clay	7.02	6.7	5.00	**3.9**
BH102	2.5-2.95	Silty Clay	7.02	6.7	5.00	**4.2**
BH102	5.0-5.5	Silty Clay	7.02	7.1	5.00	5.2
BH102	5.5-5.95	Silty Clay	7.02	7.0	5.00	5.4
BH102	9.5-10	Silty Clay	7.02	7.0	5.00	5.1
BH103	0.5-1.0	Fill	7.02	6.0	5.00	6.0
BH103	1.0-1.45	Fill	7.02	7.0	5.00	5.7
BH103	2.0-2.5	Silty Clay	7.02	6.2	5.00	5.4
BH103	2.5-2.95	Silty Clay	7.02	6.9	5.00	5.3
BH103	3.5-4.0	Silty Clay	7.02	6.0	5.00	5.2
BH103	4.0-4.45	Silty Clay	7.02	7.0	5.00	5.4
BH103	5.0-5.5	Clay	7.02	6.0	5.00	5.3

BH103	5.5-6.0	Clay / Silty Clay	7.02	7.2	5.00	5.5
BH103	6.5-7.0	Silty Clay	7.02	7.1	5.00	5.4
BH103	7.0-7.45	Silty Clay	7.02	7.1	5.00	5.5
BH103	8.0-8.5	Silty Clay	7.02	7.1	5.00	5.4
BH103	8.5-8.95	Silty Clay	7.02	7.0	5.00	5.3
BH103	10.0-10.5	Silty Clay	7.02	7.0	5.00	5.2

Notes:

- pH_f refers to pH field (soil and distilled H_2O).
- pH_{fox} refers to pH field oxidised (soil and peroxide).

To investigate the presence of Actual ASS (acid sulfate soils) of the soils water was added to the soil samples. The pH_f of the investigated samples was well above 4. This indicates the soils from which the samples were collected did not contain Actual Acid Sulfate Soil (ASS).

To investigate the presence of PASS (potential acid sulfate soils), 30% peroxide (H_2O_2) was added to soil samples and the resulting pH of the mixture was measured. The pH of the soil peroxide solution (pH_{fox}) did not decrease below 3 pH units in any of the samples, which would indicate if PASS was present. The values for pH_{fox} of greater than 5 indicate no net acid generating ability, however those below 5 may be considered to contain Potential Acid Sulfate Soils, these include samples BH101 (1.0-1.45m), BH101 (1.5-2.0m), BH101 (3.0-3.5m), BH102 (2.0-2.5m) and BH102 (2.5-2.95m). Therefore these samples can be considered to contain Potential Acid Sulfate Soil.

The addition of peroxide to the soil did not change colour or release sulfurous odours.

Further assessment was undertaken to determine the presence or otherwise of potential acid sulfate soils within the site. All samples were sent to a NATA certified laboratory to undertake SPOCAS testing.

7.3 SPOCAS Testing (Suspended Peroxide Oxidation Combined Acidity and Sulphate)

The soils were assessed against the guidelines set out in Acid Sulphate Soils Management Advisory Committee (ASSMAC) (1998) *Acid Sulphate Soils Assessment Guidelines*. The action criteria selected was based on if there will be between greater than 1,000 tonnes of soils disturbed within the site. The results are assessed against two available criteria regardless of the soil texture due to greater than 1,000 tonnes being disturbed, those being:

- Sulphur Trail (S_{pos}) = 0.03%
- Acid Trail (TPA) = 18 mol H^+/tonne

The laboratory analysis results are presented in the following Table 2.

Table 2: Laboratory SPOCAS Test Results

Sample	S-POS (%) (sulfur trail)	TAA (mol H^+/ tonne)	TPA (mol H^+/ tonne) (acid trail)	TSA (mol H^+/tonne) (acid trail)	Lime Calculation (kg $CaCO_3/m^3$) (includes 1.5 safety factor
BH101 – 1.0-1.45m	0.03	24	**30**	6.0	3.1
BH101 – 1.5-2.0m	0.03	14	**23**	9.0	2.3
BH101 – 2.5-2.95m	< 0.02	< 2	< 2	< 2	< 1
BH101 – 3.0-3.5m	< 0.02	< 2	5.0	5.0	< 1
BH101 – 4.0-4.45m	< 0.02	< 2	< 2	< 2	< 1
BH102 – 2.0-2.5m	< 0.02	49	**58**	5	4.2
BH102 – 2.5-2.95m	< 0.02	80	**86**	6.3	6.6
BH102 – 5.0-5.5m	< 0.02	7.5	**19**	11	< 1
BH103 – 3.5-4.0m	< 0.02	5.0	14	9.0	< 1
BH103 – 4.0-4.5m	< 0.02	2.5	6.3	3.8	< 1
ASSMAC Guidelines	***0.03***		***18***	***18***	

Notes for Table 2:

- Guidelines follow the ASSMAC “Acid Sulfate Soils Assessment Guidelines 1998”.
- Criteria based upon clay content of >40%
- Criteria based upon more than 1000 tonnes disturbed
- **Bold** values exceed ASSMAC guidelines

The results shown above suggest that based on the soils described above it is considered that they most closely resemble the *“Fine Texture”* soils described in Table 4.4, Assessment Guidelines of the NSW Acid Sulphate Soil Management Advisory Committee (ASSMAC) *“Acid Sulphate Soil Manual”* (August 1998).

When comparing the results summarised above in Table 2 to Table 4.4 (ASSMAC) for Fine Texture soils it can be determined that the percentage of oxidisable Sulfur (SPOS or equivalent TPA/TSA) in the samples analysed were below the action criteria, indicating that there is no acid sulphate generating potential. Based on the highlighted TAA, TPA & TSA results it is indicated that the soil material has generated acid within the soil matrix.

Based on the observed soil profile, the results of the field tests and the laboratory analysis, it is unlikely that actual acid sulphate materials will be intercepted during the proposed excavations across the site, however, potential acid sulphate soils will be intercepted. The extent of the PASS to be intercepted is governed predominantly by one soil profile, that being a natural Silty CLAY, medium to high plasticity, grey with red mottling.

The Silty CLAY profile can be found as follows:

- BH101 – in a thin lense (1.1m-2.3m BGL) across the western portion.
- BH102 – greater extent (1.5m-6.5m BGL) in the northern central portion

8.0 CONCLUSIONS AND RECOMMENDATIONS

This report has been prepared as part of a due diligence process for investigation purposes as a part of a rezoning/new medium density residential land use application.

To investigate the presence of PASS, 30% peroxide was added to soil samples and the resulting pH of the mixture was measured. The pH of the soil peroxide solution (pHfox) did not decrease below 3 pH units in any of the samples, which would indicate if PASS was present. The values for pHfox of greater than 5 indicate no net acid generating ability, however those below 5 may be considered to contain Potential Acid Sulphate Soils, as was the case in a number of samples recovered across the site.

Due to the indicators above, the site has been designated as possibly containing PASS, therefore further assessment was undertaken to determine the extent of acid sulphate soils on the site. A number of selected samples were sent to a NATA certified laboratory to undertake SPOCAS testing. The results of the laboratory analysis indicated that there is a low acid sulphate generating potential within the site.

Based on the observed soil profile, the results of the field tests and the laboratory analysis, it is unlikely that actual acid sulphate materials will be intercepted during the proposed excavations across the site, however, potential acid sulphate soils will be intercepted. The extent of the PASS to be intercepted is governed predominantly by one soil profile, that being a natural Silty CLAY, medium to high plasticity, grey with red mottling.

The Silty CLAY profile can be found as follows:

- BH101 – in a thin lense (1.1m-2.3m BGL) across the western portion.
- BH102 – greater extent (1.5m-6.5m BGL) in the northern central portion

The soils at these locations would be considered to have a very low net acid generating potential based on the results and the liming rates applied. It should also be considered that it will be difficult to apply such small volumes of lime to the soil profile (a medium to high plasticity clay) and ensure that it is mixed thoroughly and distributed evenly throughout any treated soil. This may lead to lime overdosing of the soil which is considered neither environmentally or commercially necessary nor responsible.

Based on the variable vertical and horizontal extent of the soils considered to contain PASS and the fact that all other soils immediately above and below these areas have no net acid generating potential, the treatment of the soils in these areas should occur during the excavation phase.

Therefore, it is recommended that during the excavation phase of the natural soils that Aargus are present to undertake field pH testing of the natural soils that are being excavated prior to loading onto the trucks for off-site disposal. Any natural soils with a field pH of less than 5.5 and/or soils that appear to contain characteristics of PASS, will be stockpiled, treated with appropriate lime content and disposed of accordingly.

Due to the presence of PASS it is recommended an Acid Sulphate Soils Management be prepared.

We would be pleased to provide further information or discuss any aspect of our report. Please do not hesitate to contact the undersigned should you have any queries.

For and on behalf of

Aargus Pty Ltd

Joseph McDermott
Environmental Scientist

Reviewed By

Mark Kelly

Mark Kelly
Environmental Manager

9.0 LIMITATIONS

Whilst to the best of our knowledge, information contained in this report is accurate at the date of issue, although subsurface conditions, including groundwater levels and contaminant concentrations, can change in a limited time. This should be borne in mind if the report is used after a protracted delay.

There is always some disparity in subsurface conditions across a site that cannot be fully defined by investigation. Hence it is unlikely that measurements and values obtained from sampling and testing during environmental works carried out at a site will characterise the extremes of conditions that exist within the site.

There is no investigation that is thorough enough to preclude the presence of material that presently or in the future, may be considered hazardous at the site. Since regulatory criteria are constantly changing, concentrations of contaminants presently considered low may, in the future, fall under different regulatory standards that require remediation.

Opinions are judgements that are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions.

Although the information provided by an Acid Sulphate Soils Assessment and Management Plan can reduce exposure to risks, no assessment, however diligently carried out, can eliminate them. It must be noted that these findings are professional findings and have limitations. Even a rigorous professional assessment may fail to detect all ASS and/or PASS on a site. Sulphates may be present in areas that were not surveyed or sampled.

Appendix B – Important information about your environmental report should also be read in conjunction with this report.

APPENDIX A

LOCALITY MAP & SITE PLAN

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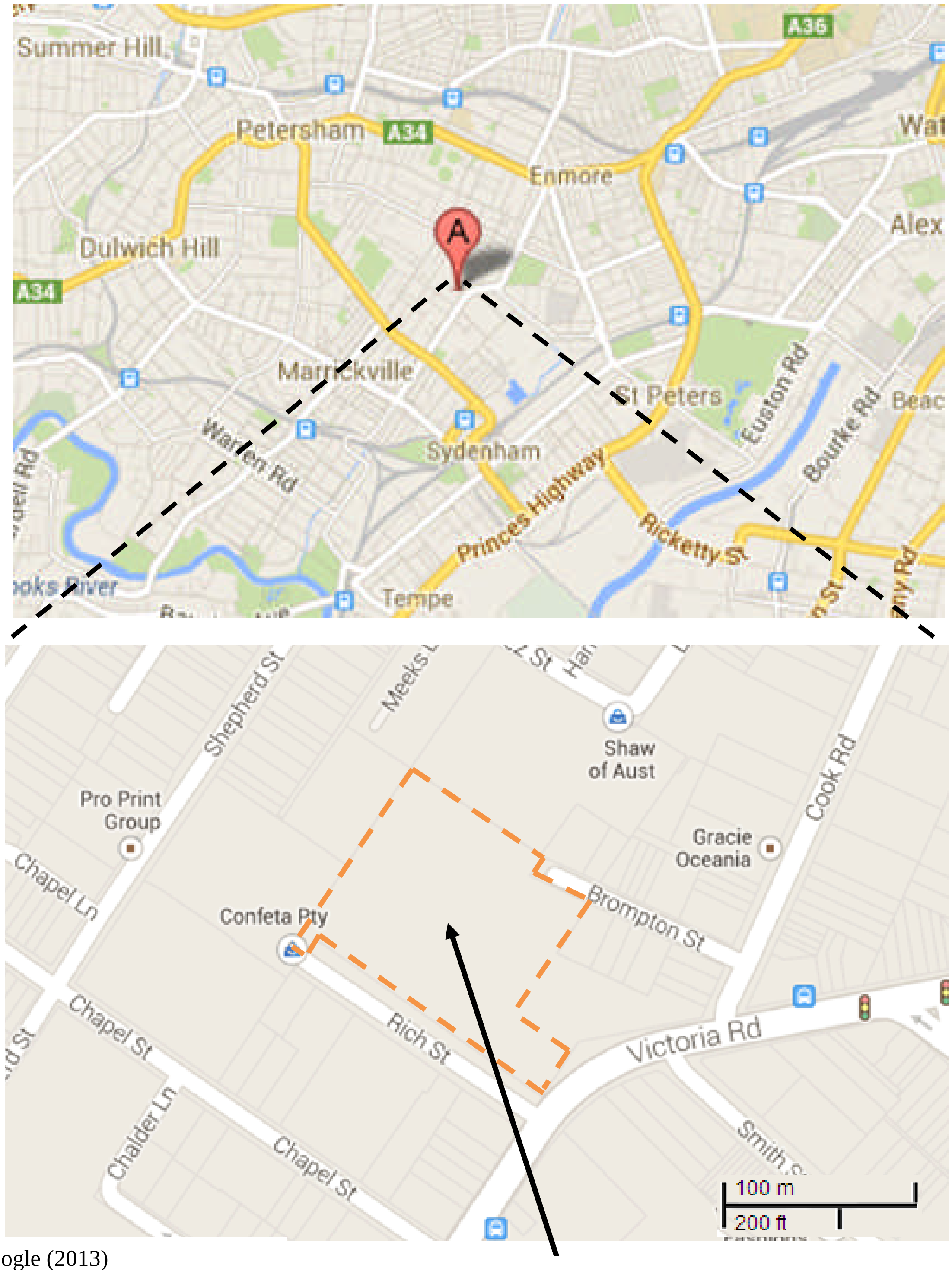
LOCALITY MAP



Reference: Google (2013)

Site Location

ABN 75 050 212 710 Aargus Pty Limited Environment – Chemicals – Business Development

Drawn	JM	**Acid Sulphate Soils Assessment E & D Danias Pty Ltd Malco Site Rich Street, Marrickville NSW**	Figure 1
Approved	MK		
Date	11/10/13		
Scale	As Shown		Job No: ES5544/3

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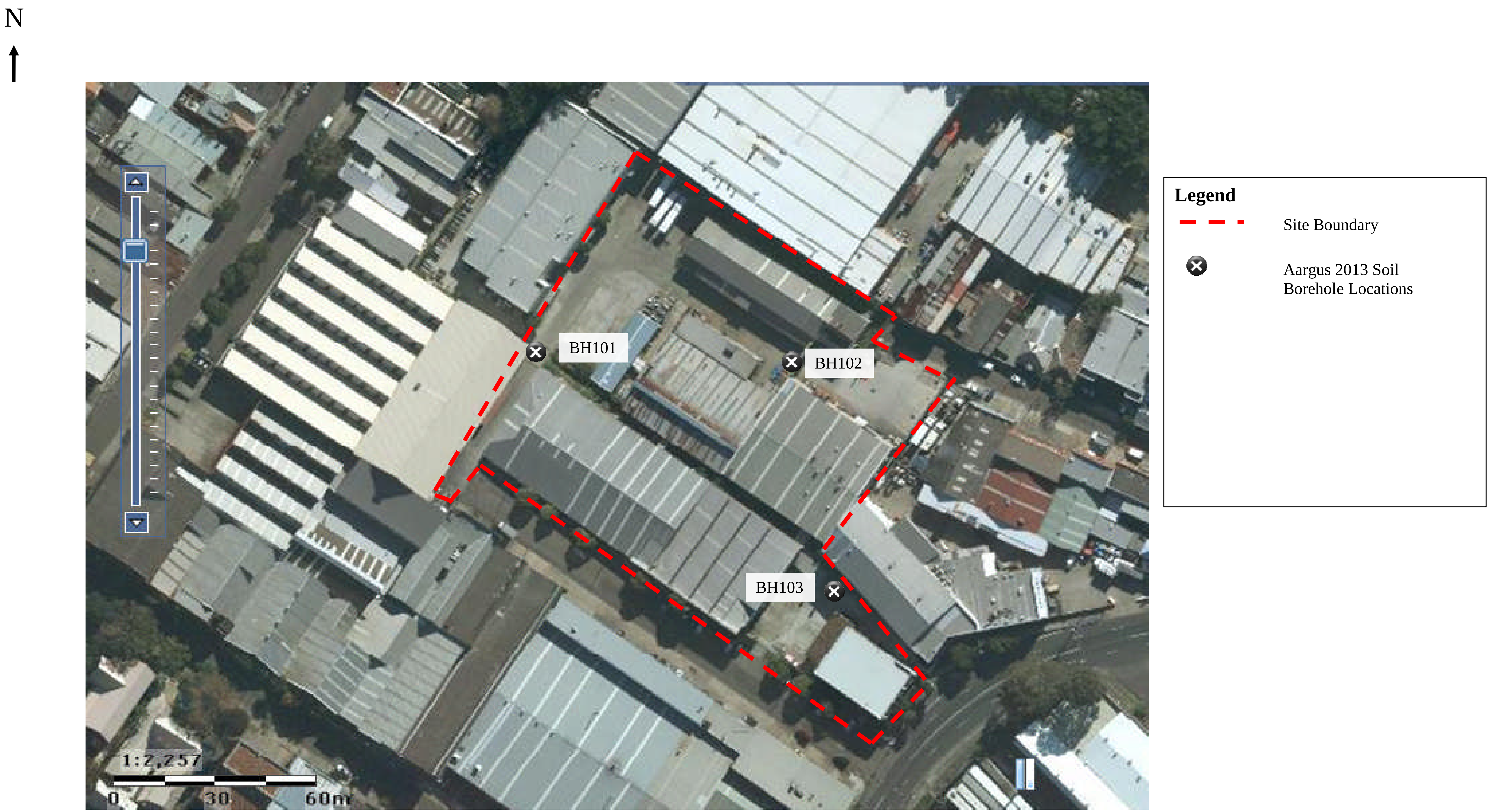
SITE PLAN



ABN 75 050 212 710 Aargus Pty Limited Environment – Remediation – Geotechnical Engineering

Source: Six Maps 2013

Drawn	JM
Approved	MK
Date	11.10.13
Approx Scale	As shown

Targeted Environmental Site Assessment
E & D Danias Pty Ltd
Malco Site
Rich Street, Marrickville NSW

Fig 2

ES5544/3

APPENDIX B

IMPORTANT INFORMATION ABOUT YOUR ENVIRONMENTAL REPORT

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IMPORTANT INFORMATION ABOUT YOUR ENVIRONMENTAL SITE ASSESSMENT

These notes have been prepared by Aargus (Australia) Pty Ltd and its associated companies using guidelines prepared by ASFE (The Association) of Engineering Firms Practising in the Geo-sciences. They are offered to help you in the interpretation of your Environmental Site Assessment (ESA) reports.

REASONS FOR CONDUCTING AN ESA

ESA's are typically, though not exclusively, carried out in the following circumstances:

- as pre-acquisition assessments, on behalf of either purchaser or vender, when a property is to be sold;
- as pre-development assessments, when a property or area of land is to be redeveloped or have its use changed for example, from a factory to a residential subdivision;
- as pre-development assessments of greenfield sites, to establish "baseline" conditions and assess environmental, geological and hydrological constraints to the development of, for example, a landfill; and
- as audits of the environmental effects of an ongoing operation.

Each of these circumstances requires a specific approach to the assessment of soil and groundwater contamination. In all cases however, the objective is to identify and if possible quantify the risks that unrecognised contamination poses to the proposed activity. Such risks may be both financial, for example, cleanup costs or limitations on site use, and physical, for example, health risks to site users or the public.

THE LIMITATIONS OF AN ESA

Although the information provided by an ESA could reduce exposure to such risks, no ESA, however, diligently carried out can eliminate them. Even a rigorous professional assessment may fail to detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled.

AN ESA REPORT IS BASED ON A UNIQUE SET OF PROJECT SPECIFIC FACTORS

Your environmental report should not be used:

- when the nature of the proposed development is changed, for example, if a residential development is proposed instead of a commercial one;
- when the size or configuration of the proposed development is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership
- or for application to an adjacent site.

To help avoid costly problems, refer to your consultant to determine how any factors, which have changed subsequent to the date of the report, may affect its recommendations.

ESA "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site assessment identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists who then render an opinion about overall subsurface conditions, the nature and extent of contamination, its likely impact on the proposed development and appropriate remediation measures. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to help minimise its impact. For this reason owners should retain the services of their consultants through the development stage, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Natural processes and the activity of man change subsurface conditions. As an ESA report is based on conditions, which existed at the time of subsurface exploration, decisions should not be based on an ESA report whose adequacy may have been affected by time. Speak with the consultant to learn if additional tests are advisable.

ESA SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Every study and ESA report is prepared in response to a specific brief to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Other persons should not use a report for any purpose, or by the client for a different purpose. No individual other than the client should apply a report even apparently for its intended purpose without first conferring with the consultant. No person should apply a report for any purpose other than that originally contemplated without first conferring with the consultant.

AN ESA REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when design professionals develop their plans based on misinterpretations of an ESA. To help avoid these problems, the environmental consultant should be retained to work with appropriate design professionals to explain relevant findings and to review the adequacy of their plans and specifications relative to contamination issues.

LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final borehole or test pit logs are developed by environmental scientists, engineers or geologists based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final logs customarily included in our reports. These logs should not under any circumstances be redrawn for inclusion in site remediation or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimise the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To reduce the likelihood of boring log misinterpretation, the complete report must be available to persons or organisations involved in the project, such as contractors, for their use. Those who o not provide such access may proceed under the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing all the available information to persons and organisations such as contractors helps prevent costly construction problems and the adversarial attitudes that may aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because an ESA is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in transmittals. These are not exculpatory clauses designed to foist liabilities onto some other party. Rather, they are definitive clauses that identify where your consultant’s responsibilities begin and end. Their use helps all parties involved recognise their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your ESA report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

APPENDIX C

BOREHOLE LOGS

Aargus Pty Ltd
446 Parramatta Road
PETERSHAM N.S.W.
Telephone: (61) 1300137038
Fax: (61) 1300136038

BOREHOLE NUMBER BH101

CLIENT E&D Danias Pty Ltd
PROJECT NAME Geotechnical Investigation
PROJECT NUMBER GS5544/2A
PROJECT LOCATION Victoria Road Corridor - Site 3, Marrickville, NSW

DATE STARTED 12/9/13 **COMPLETED** 12/9/13
R.L. SURFACE 6.8
DATUM m AHD
DRILLING CONTRACTOR Aargus Pty Ltd
SLOPE 90°
BEARING ---
EQUIPMENT Aargus Drilling Rig
HOLE LOCATION Refer to Site Plan Figure 1
HOLE SIZE 100mm diameter
LOGGED BY MM
CHECKED BY HN
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
ADV						Reinforced Concrete approximate 200mm thick.		Pavement
						FILL, gravely silty sand, fine to coarse, dark grey, fine to coarse gravel, with some silty clay, moist, loose.		Fill
							ES	
		6						
			1					
					CI	Silty CLAY, medium to high plasticity, grey with red mottling, with some fine to coarse sand, moist, soft to firm.	SPT 1, 2, 2 N=4	Residual soil
							DS, ES	
		5						
			2					
	▶ Seepage				SC	Clayey SAND, fine to coarse, grey, wet, medium dense to dense.		
							SPT 9, 13, 18 N=31	
		4						
			3					
							ES	
		3						
			4					
							SPT 12, 16, 18 N=34	
					CI	Silty Sandy CLAY, medium plasticity, reddish grey, fine to coarse sand, wet, hard.		
		2						
			5					
					CL	Sandy CLAY, medium to high plasticity, fine to coarse sand, grey, wet, hard.		
		1						
			6					

BOREHOLE NUMBER BH101

CLIENT E&D Danias Pty Ltd
PROJECT NAME Geotechnical Investigation
PROJECT NUMBER GS5544/2A
PROJECT LOCATION Victoria Road Corridor - Site 3, Marrickville, NSW

DATE STARTED 12/9/13
COMPLETED 12/9/13
R.L. SURFACE 6.8
DATUM m AHD
DRILLING CONTRACTOR Aargus Pty Ltd
SLOPE 90°
BEARING ---
EQUIPMENT Aargus Drilling Rig
HOLE LOCATION Refer to Site Plan Figure 1
HOLE SIZE 100mm diameter
LOGGED BY MM
CHECKED BY HN
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
ADV				▨	CL	Sandy CLAY, medium to high plasticity, fine to coarse sand, grey, wet, hard. *(continued)*		'V' bit refusal at 6.4m
ADT				∴		SANDSTONE, grey, very low strength, highly weathered.		Bedrock 'TC' bit refusal at 6.6m
NMLC		0	7	∴		SANDSTONE, grey, low strength, highly weathered.	DS (from coring)	Coring started at 6.6m, bedrock material was recovered as gravel
		-1 -2 -3 -4 -5	8 9 10 11 12			Borehole BH101 terminated at 7.2m		

Aargus
Aargus Pty Ltd
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BOREHOLE NUMBER BH102

CLIENT E&D Danias Pty Ltd
PROJECT NAME Geotechnical Investigation
PROJECT NUMBER GS5544/2A
PROJECT LOCATION Victoria Road Corridor - Site 3, Marrickville, NSW

DATE STARTED 13/9/13
COMPLETED 13/9/13
R.L. SURFACE 6.3
DATUM m AHD
DRILLING CONTRACTOR Aargus Pty Ltd
SLOPE 90°
BEARING ---
EQUIPMENT Aargus Drilling Rig
HOLE LOCATION Refer to Site Plan Figure 1
HOLE SIZE 100mm diameter
LOGGED BY MM
CHECKED BY HN
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
ADV				░		Reinforced Concrete approximate 200mm thick.		Pavement
		6		▩		FILL, gravely silty sand, fine to coarse, dark grey, fine to coarse gravel, with some silty clay, moist, loose.		Fill
				▩			ES	
			1	▩				
		5		▩				
				▧	CI	Silty CLAY, medium to high plasticity, grey with red mottling, moist, stiff.		Residual soil
			2	▧			DS, ES	
		4		▧				
	Seepage ▶			▧		becoming wet.	SPT 2, 4, 5 N=9	
			3	▧				
		3		▧				
			4	▧				
		2		▧				
				▧	CI	Silty CLAY, medium to high plasticity, grey with red mottling, with some silty gravel, fine to coarse gravel, wet, stiff to very stiff.		
			5	▧			DS	
		1		▧				
				▧			SPT 4, 7, 9 N=16	
			6					

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BOREHOLE NUMBER BH102

CLIENT E&D Danias Pty Ltd
PROJECT NAME Geotechnical Investigation
PROJECT NUMBER GS5544/2A
PROJECT LOCATION Victoria Road Corridor - Site 3, Marrickville, NSW

DATE STARTED 13/9/13
COMPLETED 13/9/13
R.L. SURFACE 6.3
DATUM m AHD
DRILLING CONTRACTOR Aargus Pty Ltd
SLOPE 90°
BEARING ---
EQUIPMENT Aargus Drilling Rig
HOLE LOCATION Refer to Site Plan Figure 1
HOLE SIZE 100mm diameter
LOGGED BY MM
CHECKED BY HN
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
ADV		0		▨	CI	Silty CLAY, medium to high plasticity, grey with red mottling, with some silty gravel, fine to coarse gravel, wet, stiff to very stiff. *(continued)*		
		-1 -2	7 8 9	▨	CI	Silty CLAY, medium to high plasticity, grey with yellow and red mottling, interbedded with siltstone layers, wet, very stiff.		'V' bit refusal at 9.2m
ADT		-3	10	▨	CL	Silty Sandy CLAY, medium plasticity, reddish grey and yellow mottling, fine to coarse sand, wet, hard.	DS	'TC' bit refusal at 10.1m
		-4 -5	11 12			Borehole BH102 terminated at 10.1m		

Aargus Pty Ltd
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BOREHOLE NUMBER BH103

PAGE 1 OF 2

CLIENT E&D Danias Pty Ltd
PROJECT NAME Geotechnical Investigation
PROJECT NUMBER GS5544/2A
PROJECT LOCATION Victoria Road Corridor - Site 3, Marrickville, NSW

DATE STARTED 13/9/13 **COMPLETED** 13/9/13
R.L. SURFACE 6.0 **DATUM** m AHD
DRILLING CONTRACTOR Aargus Pty Ltd
SLOPE 90° **BEARING** ---
EQUIPMENT Aargus Drilling Rig
HOLE LOCATION Refer to Site Plan Figure 1
HOLE SIZE 100mm diameter
LOGGED BY MM **CHECKED BY** HN
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
ADV						Reinforced Concrete approximate 200mm thick.		Pavement
						FILL, gravely silty sand, fine to coarse, dark grey with yellow mottling, fine to coarse gravel, with some silty clay, moist, very loose to loose.		Fill
							DS, ES	
		5	1				SPT 1, 2, 2 N=4	
					CI	Silty CLAY, medium to high plasticity, reddish brown, with some silty gravel, fine to coarse gravel, moist, firm to stiff.		Residual soil
		4	2				DS, ES	
	Seepage					becoming wet.	SPT 1, 3, 5 N=8	
		3	3					
							DS, ES	
		2	4				SPT 3, 6, 7 N=13	
					CH	CLAY, high plasticity, grey and yellow, wet, stiff.		
		1	5				DS, ES	
							SPT 3, 10, 12 N=22	
					CI	Silty CLAY, medium to high plasticity, grey and yellow with red mottling, with some silty gravel, fine to coarse gravel, wet, very stiff.		
		0	6					

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BOREHOLE NUMBER BH103

CLIENT E&D Danias Pty Ltd
PROJECT NAME Geotechnical Investigation
PROJECT NUMBER GS5544/2A
PROJECT LOCATION Victoria Road Corridor - Site 3, Marrickville, NSW

DATE STARTED 13/9/13 **COMPLETED** 13/9/13
R.L. SURFACE 6.0 **DATUM** m AHD
DRILLING CONTRACTOR Aargus Pty Ltd
SLOPE 90° **BEARING** ---
EQUIPMENT Aargus Drilling Rig
HOLE LOCATION Refer to Site Plan Figure 1
HOLE SIZE 100mm diameter
LOGGED BY MM **CHECKED BY** HN
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
ADV				▧	CI	Silty CLAY, medium to high plasticity, grey and yellow with red mottling, with some silty gravel, fine to coarse gravel, wet, very stiff. *(continued)*		
							DS	
		-1	7					
				▧	CI	Silty CLAY, medium to high plasticity, grey and yellow with red mottling, interbedded with siltstone layers, wet, very stiff.	SPT 3, 9, 13 N=22	
		-2	8					
							DS	
							SPT 4, 11, 14 N=25	
		-3	9					
				▨	CL	Silty Sandy CLAY, medium plasticity, reddish grey and yellow mottling, fine to coarse sand, wet, hard.		
		-4	10					'V' bit refusal at 10.1m
ADT							DS	
								'TC' bit refusal at 10.7m
						Borehole BH103 terminated at 10.7m		
		-5	11					
		-6	12					

APPENDIX D

ASSMAC (1998) FIELD pH AND PEROXIDE TEST PROTOCOL

APPENDIX 1. Field pH and the Peroxide Test

1. Field pH Test

The field pH (pH_F) of actual acid sulfate soils tends to be ≤ 4 while the field pH of potential acid sulfate soils tends to be neutral. Field pH provides a useful quick indication of the likely presence and severity of "actual" acid sulfate soils. The field pH is a qualitative method only that cannot be used as a substitute for laboratory analysis in the identification of acid sulfate soils for assessment purposes.

Field pH readings should be taken at regular intervals down the soil profile. It is recommended this test be done every 0.25 m down the profile but at least every 0.5 m interval or horizon whichever is the lesser.

- pH readings of pH ≤4, indicates that actual acid sulfate soil are present with the sulfides having been oxidised in the past, resulting in acid soil (and soil pore water) conditions.
- pH values >4 and <5.5 are extremely acid and may be the result of some previous or limited oxidation of sulfides, but is not confirmatory of actual ASS. Substantial exchangeable/soluble aluminium and hydrogen ions usually exist at these pH values. Other factors such as excessive fertiliser use, organic acids or strong leaching can cause pH >4 - <5.5. Field pH alone cannot indicate potential ASS as they may be neutral to slightly alkaline when unoxidised.

In order to test for potential acid sulfate soils that contain unoxidised sulfides, peroxide is used to rapidly oxidise the iron sulfides (usually pyrite), resulting in the production of acid with a corresponding drop in pH.

Notes on pH equipment

Preferably a battery powered, field pH meter with a robust, spear point, double reference pH electrode should be used. The probe can be inserted directly into soft wet soils or soil mixed up into a paste with deionised water. Care must be exercised not to scratch the electrode on sandy or gravely soils. The probe should be standardised prior to use and regularly during use against standard solutions according to the manufacturers instructions.

Alternatively, an approximate 1:5 soil:deionised water suspension can be made up in small tubes, hand shaken and pH of the solution measured. pH test strips can be used to give an approximate value (pH +/- 0.25). Raupach soil pH test kits should be used with caution as they can give erroneous results. Both these latter methods are based on mixed indicator solutions that give a pH dependant colour and are subject to interferences.

2. Field Peroxide pH Test

To test for the presence of unoxidised sulfides and therefore potential acid sulfate soils, the oxidation of the soil with 30% (100 volume) hydrogen peroxide can be performed in the field. The most common method is:

☐ a small sample of soil is placed in a small glass container (eg short clear centrifuge tubes or clear tissue culture clusters) and a small volume of peroxide is dropped onto the soil.

Note: Allow the digested solution to cool after the reaction.
A pH probe will only measure to 60°C.

The reaction should be observed and rated. In some cases, the reaction may be instantaneous; in others, it may take 10 minutes or more. Heating over hot water or in the sun may be necessary to start the reaction on cool days, particularly if the peroxide is cold.

Potentially positive reactions includes one or more of the following:

☐ change in colour of the soil from grey tones to brown tones
☐ effervescence
☐ the release of sulfurous odours
☐ a substantial depression in pH below pH_F
☐ $pH < 3$

The strength of the reaction is a useful indicator. The peroxide test is most useful and reliable with clays and loams containing low levels of organic matter. It is least useful on coffee rock, sands or gravels, particularly dredged sands with low levels of sulfidic material (eg <0.05 % S). With soils containing high organic matter (such as surface soils, peats, mangrove/estuarine muds and marine clays), care must be exercised when interpreting the reaction as high levels of organic matter and other soil constituents particularly manganese oxides can also cause a reaction.

Note of caution with the use of peroxide

30 % hydrogen peroxide is a strong oxidising agent and should be handled carefully with appropriate eye and skin protection. This test should be only undertaken by trained operators.

The pH of analytical grade peroxide may be as low as 3 as manufacturers stabilise technical grade peroxide with acid. The peroxide pH should be checked on every new container and regularly before taking to the field and adjusted to 4.5 - 5.5 with a few drops of 0.1M NaOH if necessary. False field pH_{FOX} readings could result if this step is not undertaken.

3. pH after oxidation

The measurement of the change in the pH $_{FOX}$ following oxidation can give a useful indication of the presence of sulfidic material and can give an early indication of the distribution of sulfide down a core/ profile or across the site. The pH after oxidation test is <u>not</u> a substitute for analytical test results.

If the pH $_{FOX}$ value is at least one unit below field pH $_{F}$, it may indicate potential acid sulfate soils. The greater the difference between the two measurements, the more indicative the value is of a potential acid sulfate soils. The lower the final pH $_{FOX}$ value is, the better the indication of a positive result.

- If the pH $_{FOX}$ < 3 and there was a strong reaction to the peroxide, there is a high level of certainty of a potential acid sulfate soils. The more the pH $_{FOX}$ drops below 3, the more positive the presence of sulfides.
- A pH $_{FOX}$ 3-4 is less positive and laboratory analyses are needed to confirm if sulfides are present. Sands particularly may give confusing field test results and must be confirmed by laboratory analysis.
- For pH $_{FOX}$ 4-5 the test is neither positive nor negative. Sulfides may be present either in small quantities and be poorly reactive under quick test field conditions. In some cases, the sample may contain shell/carbonate that neutralises some or all acid produced by oxidation. In other cases, the pH $_{FOX}$ value may be due to the production of organic acids and there may be no sulfides present. In these cases, analysis for sulfur using the POCAS method would be the best to check for the presence of oxidisable sulfides.
- For pH $_{FOX}$ >5 and little or no drop in pH from the field value, little net acid generating ability is indicated. Again, the sulfur trail of the POCAS method should be used to check some samples to confirm the absence of oxidisable sulfides.

Care is needed with interpretation of the result on highly reactive soils. Some soil minerals other than pyrite react vigorously with peroxide, particularly manganese but may only show small pH changes. When selecting soil for testing it is advisable to avoid material high in organic matter as the oxidation of organic matter can lead to the generation of acid. However, pH of soils containing organic matter and no pyrite do not generally stay below 4 on extended oxidation. In general, positive tests on 'apparently well drained' surface soils should always be treated with caution and followed up with laboratory confirmation.

The field peroxide tests can be made more consistent if a fixed volume of soil (using a small scoop) is used, a consistent volume of peroxide is added and left to react for an hour, and the sample is made up to a fixed volume with deionised water before reading. However, such procedures take time in the field and are more suited to a 'field shed' situation. When effervescence (sometimes violent) has ceased, a few additional mL of peroxide should be added until the reaction appears complete. If the reaction is violent, it is recommended that deionised water be added to cool and dilute the reaction. The test may have to be repeated with a small amount of water added to the soil prior to peroxide addition. The pH ^{FOX} of the resultant mixture is then measured.

4. Reporting the results

All pH $_{F}$ and pH$_{FOX}$ results along with the strength of reaction should be tabulated by site and depth and reported in the ASS report. An example of a recording sheet is attached.

APPENDIX E

LABORATORY CERITIFICATES

eurofins | mgt

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

WORLD RECOGNISED ACCREDITATION

Aargus P/L
446 Parramatta Road
Petersham
NSW 2049

Attention: **Lubos Melicharek**

Report **393401-S**
Client Reference SITE INVESTIGATION GS5544/3
Received Date Sep 19, 2013

Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**BH101 1.0-1.45** **Soil** **S13-Se13991** **Sep 12, 2013**	**BH101 1.5-2.0** **Soil** **S13-Se13992** **Sep 12, 2013**	**BH101 2.5-2.95** **Soil** **S13-Se13993** **Sep 12, 2013**	**BH101 3.0-3.5** **Soil** **S13-Se13994** **Sep 12, 2013**
Acidity Trail						
Acid trail - Titratable Actual Acidity	2	mol H+/t	24	14	< 2	< 2
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	30	23	< 2	5.0
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	6.0	9.0	< 2	5.0
sulfidic - Titratable Actual Acidity	0.02	% pyrite S	0.04	0.02	< 0.02	< 0.02
sulfidic - Titratable Peroxide Acidity	0.02	% pyrite S	0.05	0.04	< 0.02	< 0.02
sulfidic - Titratable Sulfidic Acidity	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Sulfur Trail						
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	17	17	< 10	11
Sulfur - KCl Extractable	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Sulfur - Peroxide	0.02	% S	0.04	0.03	< 0.02	0.02
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	0.03	0.03	< 0.02	0.02
pH Measurements						
pH-KCL	0.1	units	4.5	4.9	7.4	6.3
pH-OX	0.1	units	4.4	4.6	7.0	5.9
Calcium Values						
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10	< 10	< 10
Calcium - KCl Extractable	0.02	% Ca	0.11	0.03	0.07	0.03
Calcium - Peroxide	0.02	% Ca	0.12	0.04	0.07	0.04
sulfidic - Acid Reacted Calcium	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium Values						
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10	< 10	< 10
Magnesium - KCl Extractable	0.02	% Mg	0.02	0.03	0.03	0.03
Magnesium - Peroxide	0.02	% Mg	0.02	0.03	0.02	0.04
sulfidic - Acid Reacted Magnesium	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Base Accounting (SPOCAS)						
ANC Fineness Factor	0.5	units	1.5	1.5	1.5	1.5
Liming rate - SPOCAS	1	kg CaCO3/t	3.1	2.3	< 1	< 1
Net Acidity (acidity units) - SPOCAS	10	mol H+/t	41	31	< 10	11
Net Acidity (sulfur units) - SPOCAS	0.02	% S	0.07	0.05	< 0.02	< 0.02
% Moisture	0.1	%	20	15	13	21

Client Sample ID			**BH101 4.0-4.45**	**BH102 2.0-2.5**	**BH102 2.5-2.95**	**BH102 5.0-5.5**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S13-Se13995**	**S13-Se13996**	**S13-Se13997**	**S13-Se13998**
Date Sampled			**Sep 12, 2013**	**Sep 12, 2013**	**Sep 12, 2013**	**Sep 12, 2013**
Test/Reference	LOR	Unit				
Acidity Trail						
Acid trail - Titratable Actual Acidity	2	mol H+/t	< 2	49	80	7.5
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	< 2	58	86	19
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	< 2	5	6.3	11
sulfidic - Titratable Actual Acidity	0.02	% pyrite S	< 0.02	0.08	0.13	< 0.02
sulfidic - Titratable Peroxide Acidity	0.02	% pyrite S	< 0.02	0.09	0.14	0.03
sulfidic - Titratable Sulfidic Acidity	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Sulfur Trail						
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	< 10	< 10	< 10	< 10
Sulfur - KCl Extractable	0.02	% S	< 0.02	0.03	0.06	0.02
Sulfur - Peroxide	0.02	% S	0.02	0.04	0.08	< 0.02
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
pH Measurements						
pH-KCL	0.1	units	7.1	4.5	4.5	5.4
pH-OX	0.1	units	6.8	4.1	4.0	5.4
Calcium Values						
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02	< 0.02	< 10
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10	< 10	< 10
Calcium - KCl Extractable	0.02	% Ca	0.06	0.04	0.03	0.07
Calcium - Peroxide	0.02	% Ca	0.06	0.04	0.03	0.03
sulfidic - Acid Reacted Calcium	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Magnesium Values						
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10	< 10	< 10
Magnesium - KCl Extractable	0.02	% Mg	0.03	0.05	0.07	0.10
Magnesium - Peroxide	0.02	% Mg	0.03	0.05	0.07	0.05
sulfidic - Acid Reacted Magnesium	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Base Accounting (SPOCAS)						
ANC Fineness Factor	0.5	units	1.5	1.5	1.5	1.5
Liming rate - SPOCAS	1	kg CaCO3/t	< 1	4.2	6.6	< 1
Net Acidity (acidity units) - SPOCAS	10	mol H+/t	< 10	57	88	< 10
Net Acidity (sulfur units) - SPOCAS	0.02	% S	< 0.02	0.09	0.14	< 0.02
% Moisture	0.1	%	18	21	24	21

Client Sample ID			**BH103 3.5-4.0**	**BH103 4.0-4.5**
Sample Matrix			**Soil**	**Soil**
Eurofins | mgt Sample No.			**S13-Se13999**	**S13-Se14000**
Date Sampled			**Sep 12, 2013**	**Sep 12, 2013**
Test/Reference	LOR	Unit		
Acidity Trail				
Acid trail - Titratable Actual Acidity	2	mol H+/t	5.0	2.5
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	14	6.3
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	9.0	3.8
sulfidic - Titratable Actual Acidity	0.02	% pyrite S	< 0.02	< 0.02

Client Sample ID			**BH103 3.5-4.0**	**BH103 4.0-4.5**
Sample Matrix			**Soil**	**Soil**
Eurofins | mgt Sample No.			**S13-Se13999**	**S13-Se14000**
Date Sampled			**Sep 12, 2013**	**Sep 12, 2013**
Test/Reference	LOR	Unit		
Acidity Trail				
sulfidic - Titratable Peroxide Acidity	0.02	% pyrite S	0.02	< 0.02
sulfidic - Titratable Sulfidic Acidity	0.02	% pyrite S	< 0.02	< 0.02
Sulfur Trail				
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	< 10	< 10
Sulfur - KCl Extractable	0.02	% S	0.02	< 0.02
Sulfur - Peroxide	0.02	% S	< 0.02	< 0.02
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	< 0.02	< 0.02
pH Measurements				
pH-KCL	0.1	units	5.6	6.0
pH-OX	0.1	units	5.4	5.8
Calcium Values				
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10
Calcium - KCl Extractable	0.02	% Ca	0.04	0.04
Calcium - Peroxide	0.02	% Ca	0.08	0.09
sulfidic - Acid Reacted Calcium	0.02	% S	0.04	0.05
Magnesium Values				
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10
Magnesium - KCl Extractable	0.02	% Mg	0.11	0.11
Magnesium - Peroxide	0.02	% Mg	0.06	0.06
sulfidic - Acid Reacted Magnesium	0.02	% S	< 0.02	< 0.02
Acid Base Accounting (SPOCAS)				
ANC Fineness Factor	0.5	units	1.5	1.5
Liming rate - SPOCAS	1	kg CaCO3/t	< 1	< 1
Net Acidity (acidity units) - SPOCAS	10	mol H+/t	< 10	< 10
Net Acidity (sulfur units) - SPOCAS	0.02	% S	< 0.02	< 0.02
% Moisture	0.1	%	20	16

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

Description	Testing Site	Extracted	Holding Time
SPOCAS (Acid Sulphate Soils)			
Acidity Trail	Melbourne	Sep 23, 2013	7 Day
- Method: Acid Sulphate Soils Laboratory Methods Guidelines Version 2.1 - June 2004			
Sulfur Trail	Melbourne	Sep 23, 2013	
pH Measurements	Melbourne	Sep 23, 2013	
Calcium Values	Melbourne	Sep 23, 2013	
Magnesium Values	Melbourne	Sep 23, 2013	
- Method: Acid Sulphate Soils Laboratory Methods Guidelines Version 2.1 - June 2004			
Acid Base Accounting (SPOCAS)	Melbourne	Sep 23, 2013	
- Method: Acid Sulphate Soils Laboratory Methods Guidelines Version 2.1 - June 2004			
% Moisture	Melbourne	Sep 20, 2013	14 Day
- Method: Method 102 - ANZECC - % Moisture			

Company Name:	Aargus P/L	**Order No.:**		**Received:**	Sep 19, 2013 12:40 PM
Address:	446 Parramatta Road Petersham NSW 2049	**Report #:**	393401	**Due:**	Sep 26, 2013
		Phone:	1300 137 038	**Priority:**	5 Day
		Fax:	1300 136 038	**Contact Name:**	Lubos Melicharek
Client Job No.:	SITE INVESTIGATION GS5544/3				

Eurofins | mgt Client Manager: Ruth Callander

Sample Detail					% Moisture	SPOCAS (Acid Sulphate Soils)
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271					X	X
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794						
External Laboratory						
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
BH101 1.0-1.45	Sep 12, 2013		Soil	S13-Se13991	X	X
BH101 1.5-2.0	Sep 12, 2013		Soil	S13-Se13992	X	X
BH101 2.5-2.95	Sep 12, 2013		Soil	S13-Se13993	X	X
BH101 3.0-3.5	Sep 12, 2013		Soil	S13-Se13994	X	X
BH101 4.0-4.45	Sep 12, 2013		Soil	S13-Se13995	X	X
BH102 2.0-2.5	Sep 12, 2013		Soil	S13-Se13996	X	X
BH102 2.5-2.95	Sep 12, 2013		Soil	S13-Se13997	X	X

Company Name: Aargus P/L
Address: 446 Parramatta Road
Petersham
NSW 2049

Client Job No.: SITE INVESTIGATION GS5544/3

Order No.:
Report #: 393401
Phone: 1300 137 038
Fax: 1300 136 038

Received: Sep 19, 2013 12:40 PM
Due: Sep 26, 2013
Priority: 5 Day
Contact Name: Lubos Melicharek

Eurofins | mgt Client Manager: Ruth Callander

Sample Detail					% Moisture	SPOCAS (Acid Sulphate Soils)
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271					X	X
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794						
External Laboratory						
BH102 5.0-5.5	Sep 12, 2013		Soil	S13-Se13998	X	X
BH103 3.5-4.0	Sep 12, 2013		Soil	S13-Se13999	X	X
BH103 4.0-4.5	Sep 12, 2013		Soil	S13-Se14000	X	X

Eurofins | mgt Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Acknowledgment.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

UNITS

mg/kg: milligrams per Kilogram
ug/l: micrograms per litre
ppb: Parts per billion
org/100ml: Organisms per 100 millilitres
MPN/100mL: Most Probable Number of organisms per 100 millilitres
mg/l: milligrams per litre
ppm: Parts per million
%: Percentage
NTU: Units

TERMS

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery
CRM	Certified Reference Material - reported as percent recovery
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
Batch SPIKE	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
USEPA	United States Environment Protection Authority
APHA	American Public Health Association
ASLP	Australian Standard Leaching Procedure (AS4439.3)
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
Acidity Trail Acid Sulphate Soils Laboratory Methods Guidelines Version 2.1 - June 2004									
Acid trail - Titratable Actual Acidity			mol H+/t	< 2			2	Pass	
Acid trail - Titratable Peroxide Acidity			mol H+/t	< 2			2	Pass	
Acid trail - Titratable Sulfidic Acidity			mol H+/t	< 2			2	Pass	
sulfidic - Titratable Actual Acidity			% pyrite S	< 0.02			0.02	Pass	
sulfidic - Titratable Peroxide Acidity			% pyrite S	< 0.02			0.02	Pass	
sulfidic - Titratable Sulfidic Acidity			% pyrite S	< 0.02			0.02	Pass	
Method Blank									
Sulfur Trail Sulfur Trail									
acidity - Peroxide Oxidisable Sulfur			mol H+/t	< 10			10	Pass	
Sulfur - KCl Extractable			% S	< 0.02			0.02	Pass	
Sulfur - Peroxide			% S	< 0.02			0.02	Pass	
Sulfur - Peroxide Oxidisable Sulfur			% S	< 0.02			0.02	Pass	
Method Blank									
Calcium Values Calcium Values									
Acid Reacted Calcium			% Ca	< 0.02			0.02	Pass	
acidity - Acid Reacted Calcium			mol H+/t	< 10			10	Pass	
Calcium - KCl Extractable			% Ca	< 0.02			0.02	Pass	
Calcium - Peroxide			% Ca	< 0.02			0.02	Pass	
sulfidic - Acid Reacted Calcium			% S	< 0.02			0.02	Pass	
Method Blank									
Magnesium Values Acid Sulphate Soils Laboratory Methods Guidelines Version 2.1 - June 2004									
Acid Reacted Magnesium			% Mg	< 0.02			0.02	Pass	
acidity - Acid Reacted Magnesium			mol H+/t	< 10			10	Pass	
Magnesium - KCl Extractable			% Mg	< 0.02			0.02	Pass	
Magnesium - Peroxide			% Mg	< 0.02			0.02	Pass	
sulfidic - Acid Reacted Magnesium			% S	< 0.02			0.02	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Acidity Trail				Result 1	Result 2	RPD			
Acid trail - Titratable Actual Acidity	S13-Se13991	CP	mol H+/t	24	23	4.0	30%	Pass	
Acid trail - Titratable Peroxide Acidity	S13-Se13991	CP	mol H+/t	30	29	5.0	30%	Pass	
Acid trail - Titratable Sulfidic Acidity	S13-Se13991	CP	mol H+/t	6.0	6.0	<1	30%	Pass	
sulfidic - Titratable Actual Acidity	S13-Se13991	CP	% pyrite S	0.04	0.04	4.0	30%	Pass	
sulfidic - Titratable Peroxide Acidity	S13-Se13991	CP	% pyrite S	0.05	0.05	5.0	30%	Pass	
sulfidic - Titratable Sulfidic Acidity	S13-Se13991	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Duplicate									
Sulfur Trail				Result 1	Result 2	RPD			
acidity - Peroxide Oxidisable Sulfur	S13-Se13991	CP	mol H+/t	17	16	8.0	30%	Pass	
Sulfur - KCl Extractable	S13-Se13991	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Sulfur - Peroxide	S13-Se13991	CP	% S	0.04	0.03	4.0	30%	Pass	
Sulfur - Peroxide Oxidisable Sulfur	S13-Se13991	CP	% S	0.03	0.03	8.0	30%	Pass	
Duplicate									
Calcium Values				Result 1	Result 2	RPD			
Acid Reacted Calcium	S13-Se13991	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass	
acidity - Acid Reacted Calcium	S13-Se13991	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Calcium - KCl Extractable	S13-Se13991	CP	% Ca	0.11	0.11	1.0	30%	Pass	
Calcium - Peroxide	S13-Se13991	CP	% Ca	0.12	0.12	1.0	30%	Pass	
sulfidic - Acid Reacted Calcium	S13-Se13991	CP	% S	< 0.02	< 0.02	<1	30%	Pass	

Duplicate									
Magnesium Values				Result 1	Result 2	RPD			
Acid Reacted Magnesium	S13-Se13991	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass	
acidity - Acid Reacted Magnesium	S13-Se13991	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Magnesium - KCl Extractable	S13-Se13991	CP	% Mg	0.02	0.02	1.0	30%	Pass	
Magnesium - Peroxide	S13-Se13991	CP	% Mg	0.02	0.02	1.0	30%	Pass	
sulfidic - Acid Reacted Magnesium	S13-Se13991	CP	% S	< 0.02	< 0.02	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Organic samples had Teflon liners	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Ruth Callander	Client Services
Glenn Jackson	Senior Analyst-SPOCAS (VIC)

Dr. Bob Symons

Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh Vic 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Sample Receipt Advice

Company name:	**Aargus P/L**
Contact name:	Lubos Melicharek
Client job number:	SITE INVESTIGATION GS5544/3
COC number:	Not provided
Turn around time:	5 Day
Date/Time received:	Sep 19, 2013 12:40 PM
Eurofins | mgt reference:	**393401**

Sample information

☒ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Organic samples had Teflon liners.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Notes

Labelling discrepancy: all BH102 samples incorrectly labelled with project GS5544/2 instead of GS5544/3 as confirmed by client. | Samples received unfrozen.

Contact notes

If you have any questions with respect to these samples please contact:

Ruth Callander on Phone : (+61) (3) 8564 5000 or by e.mail: RuthCallander@eurofins.com.au

Results will be delivered electronically via e.mail to Lubos Melicharek - lubos@aargus.net.

Note: A copy of these results will also be delivered to the general Aargus P/L email address.

Eurofins | mgt Sample Receipt

AARGUS PTY LTD

Laboratory Test Request / Chain of Custody Record

446 Parramatta Road
PETERSHAM NSW 2049

P O Box 398
DRUMMOYNE NSW 1470

Tel: 1300 137 038
Fax: 1300 136 038
email: admin@aargus.net & MuraliMu@aargus.net

Page 1 of 1

TO:	EUROFIN MGT UNIT F3, BUILDING F 16 MARS ROAD LANE COVE WEST NSW 2066	Sampling Date:	12.09.2013 and 13.09.2013	Job No:	GS5544/3
		Sampled By:	MM	Project:	Site Investigation #393401
PH:	02 8215 6222 FAX: 02 9420 2977	Project Manager:	LM	Location:	Victoria Road Corridor - Site 3, Marrickville, NSW
ATTN:					

Sampling details		Sample type		Results required by: 5 DAYS TURN AROUND									
Location	Depth (m)	Soil	Wate										
				SPOCAS								SUITES	KEEP SAMPLE
BH101	1.0-1.45	DSP		✓									YES
	1.5-2.0	USG		✓									YES
	2.5-2.95	DSP		✓									YES
	3.0-3.5	USG		✓									YES
	4.0-4.45	DSP		✓									YES
BH102	2.0-2.5	USG		✓									YES
	2.5-2.95	USG		✓									YES
	5.0-5.5	USG		✓									YES
BH103	3.5-4.0	USG		✓									YES
	4.0-4.45	USG		✓									YES

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	Date
Murali Muralitharan	MM	18.09.2013	Priscilla		19/9 1240

Legend:

WG	Water sample, glass bottle	USG	Undisturbed soil sample (glass jar)	DSP	Disturbed soil sample (small plastic bag)
WP	Water sample, plastic bottle	DSG	Disturbed soil sample (glass jar)	✓	Test required

@ mole H^+/tonne

22.5 19/9/13 12.40pm