Aliro Trusco 1 Pty Ltd
C/- Aliro Management Pty Ltd

Acid Sulfate Soil Management Plan

13 Endeavour Road, Caringbah, NSW

22 July 2020

58037 - 130619

JBS&G Australia Pty Ltd

www.jbsg.com.au

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Abbreviations

Term	Definition
AHD	Australian Height Datum
ASS	Acid Sulfate Soil
ASSMP	Acid Sulfate Soil Management Plan
ASSMAC	Acid Sulfate Soil Management Advisory Committee
bgs	Below Ground Surface
COC	Chain of Custody
DAWR	Australian Department of Agriculture and Water Resources
EPA	NSW Environment Protection Authority
ha	Hectare
LEP	Local Environment Plan
LOR	Limit of Reporting
PASS	Potential Acid Sulfate Soil
SAC	Site Action Criteria
S_{Cr}%	Chromium Reducible Sulfur (%)
sPOCAS	Suspended Potential Oxidation Combined Acidity and Sulfur (test method)
S_{pos}%	Potential Oxidisable Sulfur
SWL	Standing Water Level
TAA	Total Actual Acidity
TPA	Total Potential Acidity
TSA	Total Sulfidic Acidity

1. Introduction

1.1 Background

JBS&G Australia Pty Ltd (JBS&G) was engaged by Aliro Trusco 1 Pty Ltd (Aliro Trusco, the client), care of Aliro Management Pty Australia (Aliro) to prepare an Acid Sulfate Soil Management Plan (ASSMP) for a parcel of land located at 13 Endeavour Road, Caringbah, NSW (the site). The site is legally identified as Lot 2 Deposited Plan (DP) 714965 and occupies and area of 12.5 hectares (ha). The site location and layout are shown in **Figures 1** and **2,** respectively.

It is understood that the client proposes adaptive reuse of existing buildings with some alterations and additions, construction of a childcare centre, and construction of several new warehouse style buildings for commercial/industrial use. Minor augmentation is proposed to existing driveways, hardstand pavements and landscaped areas. It is understood that the overall design plans may require the excavation of soils to depths greater than 2 m below the current ground surface.

Review of the *Acid Sulfate Soil Risk Map for* Port Hacking[1] indicates that the site is located within an area classed as 'disturbed terrain'. Areas having this classification may include filled areas which often occur following reclamation of low-lying swamps for urban development. Other areas with this classification may include areas which have been mined, dredged, or have undergone heavy ground disturbance through general urban development.

Previous environmental investigations conducted by JBS&G (JBS&G 2020[2]) identified potential and/or actual acid sulfate soils (P/ASS) across the site, characterised as a dark grey organic rich estuarine silty clays and alluvial grey silty sands which were identified underlying site fill materials, and potentially in fill materials where estuarine sediments may be mixed. P/ASS are anticipated to be encountered at depths from approximately 2-3 m bgs and extent to at least 7 m bgs (JBS&G (2020).

Review of the Sutherland Local Environmental Plan (LEP) 2015 online portal[3] indicates that the site falls within a category classified as Class 3 ASS. According to the LEP, development consent is required for any works in a Class 3 ASS area that extend beyond 1 metre below the natural ground surface and which are likely to lower the water table more than 1 m below ground surface (bgs).Such works would trigger the requirement for assessment and may require ASS management unless preliminary assessment indicates management is not required. It is noted that land within a category classified as Class 1 and 2 are located directly adjacent the site (mangroves associated with Woolooware Bay).

As such an ASSMP is required to document procedures to be implemented to manage the potential environmental risk associated with disturbance of these materials. This ASSMP has been prepared in accordance with the general requirements of the *Acid Sulfate Soil Manual* (ASSMAC 1998[4]) and with consideration to the National Acid Sulfate Soils Guidance (DAWR 2018[5]).

1.2 Aims and Objectives

The aim of this ASSMP is to outline management techniques that may be employed to mitigate the potential environmental impacts associated with the risk of disturbance of ASS/PASS during the proposed site construction works. Specifically, the objectives of this ASSMP are to document:

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1 *Port Hacking Acid Sulfate Soil Risk Map* (Edition 2), Department of Land and Water Conservation, December 1997 (DLWC 1997)
2 *Toyota Caringbah Due Diligence Assessment - 13 Endeavour Road, Caringbah NSW*, JBS&G, 25 February 2020 *(JBS&G 2020)*
3 *https://maps.ssc.nsw.gov.au/LEP/*. Sutherland Shire Council LEP 2015 Online Portal. Accessed on 11 December 2019
4 *Acid Sulfate Soil Manual*, NSW Acid Sulfate Soil Management Advisory Committee, August 1998 (ASSMAC 1998)
5 *National Acid Sulfate Soil Guidance*. Australian Government Department of Agriculture and Water Resources (DAWR), June 2018 (AGDAW, 2018)

- The known and anticipated site sub-surface characteristics expected to be encountered during future excavation works for consideration in development of future investigative and management activities;
- A monitoring and sampling strategy to be implemented prior to and during the proposed ground disturbance activities such that ASS/PASS may be appropriately identified and managed during the excavation works;
- Evaluation of potential ASS/PASS management opportunities and constraints resulting in the identification of a preferred management strategy(ies); and

Procedures for the management and validation of ASS during the future site excavation works so as to minimise the potential for adverse environmental impacts as a result of the ASS/PASS disturbance activities.

1.3 Proposed Development Details

Following review of design plans provided by the client, it is understood that the client proposes adaptive reuse of existing buildings with some alterations and additions, construction of a childcare centre, and construction of several new warehouse style buildings for commercial/industrial use. Minor augmentation is proposed to existing driveways, hardstand pavements and landscaped areas.

Proposed site development details are shown in **Figure 3**.

1.4 Summary of Key ASSMP Aspects

JBS&G has included the following brief ASSMP summary guide to aid the ongoing management of ASS/PASS at the site (as summarised from the document presented herein):

- Based on previous investigations, P/ASS materials are typically associated with natural/reworked natural estuarine silty clays and alluvial sands (refer **Section 3.4**);
- Construction activities which have the potential to generate P/ASS include (but not limited to); building foundations, service installations, piling, dewatering, and/or general site excavations (refer **Section 4.1**);
- The collection of additional environmental data (in accordance with **Section 4.2**) prior to proposed excavations would facilitate the efficient and effective management of P/ASS at the site;
- JBS&G recommends the addition of neutralising chemicals as the preferred P/ASS treatment approach (refer **Section 4.4.2**); and
- Existing data presents liming rates varying between 9 kg and 25 kg lime/tonne of PASS for appropriate treatment. Notwithstanding, the revising of liming rates will be required based on the placement (i.e. stockpiled) or extents (i.e. batters/exposed faces) of P/ASS materials (in accordance with **Sections 4.4.5** and **4.4.6**).

2. Acid Sulfate Soil General Information

2.1 Acid Sulfate Soils Background

ASSMAC (1998)[6] and DAWR (2018) provide useful information on acid sulfate soils. ASS is a common name given to naturally occurring sediments and soils containing iron sulfides (generally as iron sulfide or iron disulfide). These soil profiles are typically located in coastal, low-lying alluvial or estuarine areas such as mangroves, salt marshes, coastal rivers and creeks, estuaries, tidal lakes and coastal floodplains where historical iron rich sediment deposition in the presence of a sulfate source (commonly salt water), organic matter and microbial action over time has resulted in the formation of particular environmental conditions. ASS are predominantly encountered in areas where the soil profile has an elevation of less than 5 m Australian Height Datum (AHD), and may be found close to the ground level or at depth in the soil profile where continued deposition actions have resulted in raising of the ground levels.

Changes in environmental conditions which result in the exposure of these materials to air, via excavation or drainage of subsurface soils, can lead to the reaction of the iron sulfides with oxygen, causing the generation of sulfuric acid. This may result in significant environmental and infrastructure damage if the produced acid is spread by groundwater or surface water.

ASS consist of two major categories:

- Acid Sulfate Soils (ASS) are soils that have been exposed to air which has caused the oxidation of iron sulfides to form sulfuric acid. Some of this acid is commonly neutralised by other soil particles in a process known as buffering, however the excess acid is spread by water movement through the soil; and
- Potential Acid Sulfate Soils (PASS) are soils which contain iron sulfides, but which have not been exposed to air and oxidised. These soils are generally kept from contact with air by permanent waterlogging or the density of the soil profile and so are relatively stable, or in equilibrium. In this state the soils are generally non-acidic and are considered harmless to the environment. However, oxidation of such soils through disturbance has the potential to generate acidic conditions.

Commonly, an ASS profile will consist of a combination of both ASS and PASS material as a result of ongoing chemical reactions in response to environmental changes including groundwater fluctuations and seasonal soil moisture changes.

The following types of site activities are likely to result in disturbance of ASS (both ASS and PASS) during urban development activities:

- Bulk excavation works which encounter subsurface soil which may be completed to achieve basement levels, installation of drainage infrastructure, alteration of existing site levels to achieve modified ground levels, dredging or otherwise mobilisation such that the sediment may become oxidised, etc.;
- Dewatering activities associated with construction works proposed at elevations below the standing water table, for example installation of drainage infrastructure, etc. which may result in ASS beyond the excavation extent becoming exposed to oxygen due to a lowering of groundwater levels, thereby generating acidic conditions; and
- Generation of spoil which may return ASS to the ground surface associated with foundation construction works, including piling spoil during continuous flight auger piles (CFA) or bored

[6] *Acid Sulfate Soils Assessment Guidelines* – NSW Acid Sulfate Soils Management Advisory Committee August 1998. Accessed 10 July 2020

pile installation activities, directional drilling works for infrastructure services installation, etc.

2.2 Laboratory Assessment Criteria

The assessment of site soil conditions with respect to ASS occurrence is completed in accordance with the guidance provided in ASSMAC (1998). The requirement to manage soils for ASS is evaluated by comparison of laboratory analysis results with Site Action Criteria (SAC) developed based on three broad soil texture categories. The SAC are based on the percentage of oxidisable sulfur or equivalent acid trail (i.e. titratable actual acidity-TAA or titratable potential acidity-TPA) results. There are two categories based on the scale of the proposed disturbance, with the SAC for small scale (i.e. less than 1000 tonnes) works based upon the texture of the soil material and the SAC for large scale works adopting the most sensitive SAC being the SAC for coarse textured soils in small scale works.

Table 2.1: ASSMAC Site Action Criteria based on General Soil Texture Categories

Type of material		Action Criteria 1-1000 tonnes disturbed		Action Criteria if more than 1000 tonnes disturbed	
Texture Range. McDonald at al. (1990)	Approx. clay content (%<0.002 mm)	Sulfur trail % S oxidisable (oven-dry basis) e.g. S_{Cr} or S_{pos}	Acid trail Mol H^+/tonne (oven-dry basis) e.g., TPA or TSA	Sulfur Trail % S oxidisable (oven-dry basis) e.g. S_{Cr} or S_{pos}	Acid trail Mol H^+/tonne (oven-dry basis) e.g., TPA or TSA
Coarse Texture Sands to loamy sands	≤5	0.03	18	0.03	18
Medium texture Sandy loams to light clay	5-40	0.06	36	0.03	18
Fine texture Medium to Heavy clays and silty clays	≥40	0.1	62	0.03	18

Exceedance of the SAC attributable to ASS material generally triggers the need to prepare a management plan and is based on the percentage of oxidisable sulfur (or equivalent TPA, TAA) for broad categories of soil. However, it is noted that other soil properties and constituents may cause acidic conditions in soils that are not related to acid sulfate soil conditions. This may include sources of organic acidity where the soils have a pH of less than 5 and positive titratable actual acidity (TAA) or titratable potential acidity (TPA) but have no detectable sulfur source (i.e. no S%). In this case, exceedance of the Acid Trail SAC does not trigger treatment of these soils (DWAR 2018e[7]).

Given the nature of the works to be undertaken at the site (expected to result in >1000 tonnes of materials disturbed) and with consideration to the variability of the soils types noted in previous investigations, the SAC adopted for assessment and management of ASS at this site are:

- Sulfur Trail Criteria (S_{pos} or S_{Cr} %) > 0.03 %;
- Acid Trail Criteria (TSA, TPA) > 18 mol H^+ / tonne soil.

2.3 Other Regulatory Guidance

Section 105 of the *Contaminated Land Management Act 1997* (CLM Act) allows the Environment Protection Authority (EPA) to "make or approve" guidelines for any purpose related to the objects of the Act. In addition to ASSMAC (1998), this management plan has been prepared with reference to the following:

- *Waste Classification Guidelines Part 1: Classifying Waste* (EPA 2014a);

[7] *Guideline for the Dredging of Acid Sulfate Soil Sediments and Associated Dredge Spoil Management, Australian Government Department of Agriculture and Water Resources, June 2018 (DAWR 2018e)*

- *Waste Classification Guidelines Part 4: Acid Sulfate Soils* (EPA 2014b);
- *Contaminated Land Management: Guidelines for NSW Site Auditor Scheme*, 3rd Edition, EPA (2017); and
- *Protection of the Environment Operations Act* 1997 (POEO Act) and associated regulations.

Note is also made of the National Acid Sulfate Soil Guidance issued in June 2018 by the Australian Government Department of Agriculture and Water Resources (DAWR), including:

- *National Acid Sulfate Soil Guidance: A Synthesis* (DAWR 2018a);
- *National Strategy for the Management of Coastal Acid Sulfate Soils* (DAWR 2018b);
- *National Acid Sulfate Soils Sampling and Identification Methods Manual* (DAWR 2018c)*;*
- *National Acid Sulfate Soils Sampling and Laboratory Methods Manual* (DAWR 2018c)*;*
- *Guidance for the Dewatering of Acid Sulfate Soils in Shallow Groundwater Environments* (DAWR 2018d); and
- *Guideline for the Dredging of Acid Sulfate Soil Sediments and Associated Dredge Spoil Management* (DAWR 2018e).

3. Site Condition

3.1 Site Identification

The site details are summarised in **Table 2.1** and shown on **Figures 1** and **2**.

Table 2.1: Site Details

Lot/DP	Lot 2 DP 714965
Site Address	13 Endeavour Road, Caringbah, NSW
Local Government Authority	Sutherland Shire Council
Approximated Geographical Coordinates (MGA 56)	**Easting**: 327727.77 **Northing:** 6232248.46 (centre of site)
Site Area	Approximately 12.5 ha
Site Zoning	B7 Business Park – Sutherland LEP 2015
Previous Use	Vacant Land then Commercial / Industrial Land Use
Current Use	Commercial / Industrial Land Use
Proposed Land Use	Commercial / Industrial Land Use

3.2 Geology and Soils

A review of the 1:100 000 scale Wollongong – Port Hacking Geological Map (DMR 1985)[8] identifies the site is underlain by man-made fill and organic-rich muddy, mostly "marine" sand. Man-made fill typically comprises dredged estuarine sand and mud, coal washing, industrial and household waste whereas the organic-rich muddy "marine" typically overlaid clean to muddy, shelly "marine" sand, sometimes with low dunes, then medium to fine-grained "marine" sand with podzols and shelly layers.

Review of the *Acid Sulfate Soil Risk Map for* Port Hacking (DLWC 1997) indicates that the site is located within an area classed as 'disturbed terrain'. Areas having this classification may include filled areas which often occur following reclamation of low-lying swamps for urban development. Other areas with this classification may include areas which have been mined, dredged, or have undergone heavy ground disturbance through general urban development.

JBS&G 2020 reported the presence of strong organic odours associated with silty clays and underlying silty sand, which were reported to be indicative of potential acid sulfate soils (PASS). Furthermore, JBS&G 2020 noted the presence of a strong sulfuric/organic odour in groundwater that was observed to be grey/brown in colour, which is further evidence for the presence of PASS conditions.

3.3 Sutherland Council LEP (2015) Requirements

Review of the Sutherland LEP 2015 online portal indicates that the site falls within a category classified as Class 3 ASS. According to the LEP, development consent is required for any works in a Class 3 ASS area that extend beyond 1 metre below the natural ground surface and which are likely to lower the water table more than 1 m below ground surface (bgs). Such works would trigger the requirement for assessment and may require ASS management unless preliminary assessment indicates management is not required. It is noted that land within a category classified as Class 1 and 2 are located directly adjacent the site (mangroves associated with Woolooware Bay).

[8] *Wollongong – Port Hacking Geological Series Sheet 9029-9129 (Edition 1) 1983*. Department of Mineral Resource, Geological Survey of NSW (DMR 1983)

3.4 Previous Investigations

3.4.1 JBS&G (2020) – Due Diligence Assessment

The subsurface conditions encountered at the site were typically identified to comprise the following, with P/ASS material highlighted (**bold**):

- Fill – road base underlying hardstand pavement to a maximum depth of 0.5 m bgs (BH25) noted to comprise a silty sandy gravel with inclusions of igneous gravel and crushed concrete inclusions;
- Fill – heterogeneous silty sand with varied inclusions of small angular igneous gravel, crushed concrete/brick and sandstone fragments noted to depths of between 0 m bgs (BH30) and 3.7 m bgs (MW07);
- Fill – **Reworked estuarine silty clays** noted to contain organic matter/vegetation at sample locations BH26 to BH30 and MW06, to a depth between 0.1 m bgs and 4 m bgs.
- **Alluvial Sands** – silty sand observed underlying fill and/or estuarine silty clays, grey to brown well sorted medium to fine grained.
- Sandstone – off-white to grey fine-grained sandstone observed at depths between 3.5 m (MW06) and 6.8 m bgs (BH26) near the boundary with Captain Cook Drive.

Based on the field observations made by JBS&G 2020, fill material was generally encountered to a depth of 3.35 m bgs. Sandstone bedrock was encountered along the western portion of the site, with the anticipated depth to bedrock increasing toward the east (Woolooware Bay). Lithological logs from JBS&G (2020) are provided in **Appendix A**.

Estuarine silty clays are inferred to be disturbed/reworked materials based on the known site history (land reclamation activities) and observations made during the JBS&G (2020) investigation, noting some areas of the site may encounter undisturbed natural original sediments (consistent with the mapped geology and soils).

Moderate to strong organic/sulphuric odours was noted in estuarine clays and wet natural silty sands at depths of between 2.0 m and 7.0 m bgs.

JBS&G (2020) conducted field tests and laboratory analyses (sPOCAS) on representative soil samples. Sample locations are shown on **Figure 3**, and summarised laboratory results are provided in **Table 2.2** below. Laboratory reports and chain of custody (COC) documents are provided in **Appendix B**.

Table 2.2: Results of sPOCAS Analysis

Sample	Sample description	Texture	Action Criteria (1-1000 tonnes disturbed)		Action Criteria (>1000 tonnes disturbed)		P/ASS
			Sulfur Trail (S_{pos}%) - S %	Acid Trail (TPA/TSA) mol H^+/tonne	Sulfur Trail (S_{pos}%) - S %	Acid Trail (TPA/TSA) mol H^+/tonne	
		Coarse	0.03	18	0.03	18	
		Medium	0.06	36	0.03	18	
		Fine	0.1	62	0.03	18	
MW06 0.5-0.6	Fill, Silty sand, brown, fine grained with gravel, dry, no odour	Medium	<0.005	<5 /<5	<0.005	<5 /<5	No PASS
MW07 4-4.1	Sandy clay, brown/black, medium plasticity, moist, strong organic odour	Medium	**0.71**	**280 / 280**	**0.71**	**280 / 280**	**PASS/ASS**
BH26 4-4.1	Silty sand, brown, wet, homogenous well sorted, slight organic odour	Medium	**0.46**	**98 / 98**	**0.46**	**98 / 98**	**PASS/ASS**
BH26 6.7-6.8	Weathered sandstone, off-white, fine grained, no odour, top of unit immediately below saturated organic sediments	Medium	**0.12**	<5 /<5	**0.12**	<5 /<5	**PASS**
BH28 5-5.1	Silty sand, brown/grey, homogenous well sorted, saturated, strong organic odour	Medium	**0.22**	<5 /<5	**0.22**	<5 /<5	**PASS**
BH30 1-1.1	Fill, Sandy clay, light brown, soft medium plasticity, no odour	Fine	0.01	<5 /<5	0.01	<5 /<5	No PASS
BH30 3-3.1	Fill/reworked Silty clay, black/grey, medium plasticity, saturated, strong organic odour	Fine	**0.20**	<5 /<5	**0.20**	<5 /<5	**PASS**

Review of analytical results against adopted criteria (**Table 2.2**) indicates five of seven soil samples exceeded the action criterion for both 1-1000 tonnes of disturbed soils and the action criteria for >1000 tonnes of disturbed soils.

JBS&G 2020 indicated that PASS is generally likely to occur in the soils underlying site fill materials, including disturbed organic rich estuarine clays and alluvial silty sands.

Based on the preliminary data, the anticipated extent of P/ASS is across the majority of the site from a depth of approximately 3-7 m bgs. There is the potential that some fill materials containing reworked organic-rich sediments may also include P/ASS.

Soils for which analytical data are reported to be below the applicable ASSMAC (1998) action criteria are classified as non-ASS and do not require management.

4. Management Procedures

The aim of the following management procedures is to identify ASS/PASS material and implement appropriate mitigation measures such that the potential environmental impacts associated with disturbance of ASS/PASS during the proposed site remediation and construction works may be appropriately managed. Specifically, the objectives are to provide:

- A methodology for the identification of materials requiring management;
- Protocols for the on-site treatment and management of ASS/PASS materials and associated leachate water (as required) during the proposed works;
- Excavation inspection and validation assessment protocols to be implemented during the proposed works such that the extent of ASS/PASS material may be delineated from non-ASS material (overlying non-ASS material, residual soils, etc) to provide for off-site disposal of the balance of excavated material without the need for lime stabilisation);
- Soil and water quality targets for the excavation, treatment and removal of material encountered during the proposed works; and
- A contingency framework in the event that additional ASS conditions are encountered during the site works; monitoring indicates disturbance of off-site ASS materials; or the proposed treatment strategy fails.

4.1 Scope of Soil Disturbance Activities

As outlined in **Section 1.3**, the proposed development works will include potential excavation works across the site to depths beyond 2 m bgs to facilitate the construction of design plans including (but not limited to) building foundations (piling), service installations, and potential basement envelopes. On this basis, it is anticipated that the following works will have the potential to result in disturbance of acid sulfate soils, where present:

- Installation of piled retention structures where methods that result in the generation of spoil at ground surface are employed (excluding driven or similar piling methods that don't result in spoil return to the surface);
- Dewatering of saturated alluvial soil within the potential excavation envelope that may occur prior to, or during proposed excavation works;
- Excavation of alluvial soil, where required to facilitate the construction of features that would require the excavation of soil to depths of ≥2-3 m bgs, and/or that may result in a reduction in standing groundwater levels within the PASS profile (e.g. lift pits, on-site stormwater detention (OSD) tanks, etc.).

4.2 Investigation of Occurrence of ASS and/or PASS Material

As limited field and laboratory assessment of PASS conditions has been completed within alluvial soils at the site, further investigation of the location and extent of PASS material within areas of the site where these soils may be disturbed, should be undertaken either prior to the commencement of bulk excavation works and/or sequentially as excavation materials extend vertically such that material requiring management may be identified and treatment requirements established as separate to non-ASS material.

To evaluate the potential presence and extent of ASS/PASS material, the following assessment activities should be undertaken by an appropriately qualified environmental consultant in accordance with the general philosophies outlined in ASSMAC (1998) / DAWR (2018) regarding the identification of ASS/PASS material:

- Sampling locations should be completed at an even grid spacing of no greater than 20 m in areas of anticipated ground disturbance to provide for assessment of the variability of ASS/PASS conditions. In transitional zones between areas of likely disturbance and those of no disturbance, sufficient sampling should be completed to ensure management requirements may be suitably understood prior to commencement of works. Each sampling location should be extended to confirm the presence of bedrock, or to a maximum of 1 m below the proposed level of disturbance (whichever is less);
- Visual inspection and sampling of representative soil profiles of damp to saturated soil/sediment at a frequency of no less than one sample per 1 m per metre depth interval, or discrete strata, at each sampling location. Each sample should be the subject of field pH_f and pH_{fox} tests;
- Based on the inspection and field testing results, one representative sample per material type per area should subsequently be selected for sPOCAS or chromium reducible sulfur (S_{Cr}) laboratory analysis to confirm the presence/absence of ASS/PASS material requiring management;
- Based upon the results of the field and laboratory analysis program, an updated inferred plan of the lateral and vertical extent of ASS/PASS requiring management will be provided to the Principal Contractor. In addition, the laboratory data will be used to identify anticipated liming requirements for ASS/PASS material types at the site (where appropriate); and
- The results of the assessment will provide a line of evidence for the validation of material beyond the ASS/PASS zone (if identified) for characterisation of the balance of surrounding/overlying soils as non-ASS material.

4.3 Evaluation of Potential Management Strategies

Where the presence of ASS has been identified, evaluation of options to minimise the level of disturbance and to mitigate the potential impact of disturbance (if necessary) of the materials is required. As per ASSMAC (1998), potential mitigation approaches have been identified:

- Avoid ASS materials being encountered during works by not undertaking the proposed development works or by altering the proposed development plans, i.e. removing excavation and/or dewatering requirements;
- Where encountering ASS during works cannot be avoided, manage the potential for acid generation by neutralising disturbed materials, preventing movement of acid impacted water, and the use of suitable construction materials;
- If ASS materials have previously been disturbed, undertake works to mitigate the existing conditions, minimise the production of further acid during the proposed works and rehabilitate impacted areas;
- Treat soil by allowing full oxidation of the sulfide component under controlled conditions followed by flushing the acid from the soil with water and neutralisation of the subsequent leachate;
- Avoid using untreated ASS materials as fill material in non-ASS areas by either leaving material on-site, or managing the potential for acid generation prior to material being transported from the site of origin; and/or
- Reburial of ASS materials beneath the permanent water table or beneath a dense soil profile which excludes oxygen exposure such as an engineered clay cap. This may be undertaken on-site if there are low lying areas where reburial and consequential flooding of the soil profile or construction of a suitable capping layer can be undertaken as part of

development works, or at an alternative off-site location provided that sufficient stabilisation of material is undertaken to minimise acid generation during transportation and handling.

The potential suitability of the various options is further discussed in the following sections.

4.3.1 Avoidance Strategies

Avoidance of ASS disturbance is generally considered to be the preferred means of ASS risk management where such actions can be achieved. Implementation of appropriate basement retention methods to minimise impacts to groundwater levels and associated saturated PASS material beyond the basement extent will result in avoidance of disturbance of PASS material beyond the lateral extent of any proposed basement envelopes.

In general, for works extending beneath the water table and/or to approximate depths of 2-3 m bgs which may generate excess materials, the alternative management strategies detailed below will need to be considered.

4.3.2 Management by Neutralisation

Neutralisation techniques can be used to treat ASS by the addition of chemicals that react with the produced acid to ensure that acid is not released from the treated material. The neutralisation activities should result in the pH of the disturbed materials (water and/or soil) being between 5.5 to 7.5 and requires that ASS material disturbed during site activities be treated with the preferred neutralising agent.

Laboratory analysis is used to assess the levels of existing and/or actual acidity and indicates the level of neutralising capacity required to react with all potential acidity that may be generated during/following disturbance of the ASS material.

The potential uncertainty associated with the quantity of neutralising capacity to be added is commonly managed by the use of a factor of safety of 1.5 (at minimum) (DER 2015)[9].

Sufficient capacity in terms of a suitable treatment area, machinery, budget to purchase the neutralising agent and time is necessary to successfully implement ASS neutralisation. Implementation of environmental controls is also necessary to ensure that all potentially acidic leachate produced during the treatment process is captured and adequately treated and that heavy metals which may be released during oxidation of ASS material are also appropriately managed.

An evaluation of potential neutralisation chemicals should be undertaken during the planning process and appropriate quantities of the preferred chemicals sourced for the duration of the site activities.

In this ASSMP it is assumed the neutralising chemical is high quality agricultural lime (aglime) Further discussion regarding neutralising chemicals is provided in **Section 4.4.2.**

It is recommended that small scale treatment trials be implemented prior to broad scale implementation of alternative neutralising compounds. The small-scale trials should document the effectiveness of the revised approach in terms of the time, cost, availability, suitability, etc.

During works, a sufficient supply of aglime will be required to be kept on site at all times. The quantity is based on requirements for the treatment of acid sulfate soils to be neutralised within the treatment area; for application on exposed excavation faces where ASS is expected or suspected; and for wet weather events where existing applications will require replacement and/or treatment

[9] *Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes (June 2015)* – Government of Western Australia Department of Regulation. Accessed 9 July 2020.

of acidic water is necessary. Receipts, dockets and other field records showing the storage locations of all chemicals and location of all applications of neutralising agents must be kept.

ASS management by neutralisation is considered to be a suitable option for the proposed works as:

- Excavation of volumes of alluvial material which may occur as part of the development works;
- The proposed works are able to be staged in a manner which will allow treatment of ASS material in a timely manner;
- Via staging of the excavation works, a contractor will be able to ensure sufficient space can be made available within the site to set aside a treatment area(s) close to the identified ASS disturbance which can be hydraulically isolated from the remainder of the site;
- Appropriate machinery to mix the soil and neutralisation chemicals can be supplied by the civil works/earthworks contractors completing works on site; and
- Following successful completion of the neutralisation process, the treated soils are no longer considered to be ASS materials and so may either be reused on site beyond the basement footprint as engineered fill material, or alternatively, may be removed off-site as waste.

4.3.3 Full Oxidation and Leachate Collection

In the event that the acid production potential is relatively low, or there is a relatively low quantity of material to be treated, consideration may be given to the excavation and exposure of the soils to promote full oxidation. This option requires the implementation of environmental controls to ensure that all acid produced is flushed from the soil as leachate. Similar to management by neutralisation, a suitable treatment area is necessary where material can be spread and reworked to allow oxygen to react with the sulfides in the soil and where all leachate produced can be captured and treated by neutralisation.

This method is considered not to be a viable option for larger material volumes (e.g. excavated basement spoil) as the process of soil oxidation may take extended periods (weeks to months) to reach completion. There is also a significant level of uncertainty in the volumes of leachate that would require neutralisation and disposal due to climatic variation, including rainfall events. Given the currently unknown anticipated volume of material requiring treatment, the requirement to maintain environmental controls for this period and the potential for such works to delay the construction program, this option is considered undesirable when compared to the relatively low cost of neutralisation chemicals as discussed in **Section 4.3.2** above.

4.3.4 Reburial of ASS Material

Strategic reburial or interment techniques can be used to manage PASS material by prevention of oxidation through permanent storage in an anoxic environment. These techniques are often adopted where areas are available for reburial and cost savings can be achieved by avoiding soil handling labour and neutralisation chemical costs. An alternative method of achieving reburial is over excavation of non-acid sulfate soil materials followed by reinstatement of the excavation with potential ASS material. Potential reburial sites must have a permanent groundwater table level above the proposed top of the reburial cell or alternatively measures to minimise oxygen exposure to ensure that the material is returned to an anoxic environment.

Reburial may occur within the site or alternatively, where appropriate licences are obtained, at a site lawfully able to accept this material in accordance with the requirements of EPA (2014). Notwithstanding, it should be noted that, at the time of reporting (as presented herein), no known public accessible waste disposal facilities licensed to accept untreated ASS for burial.

Excavation of ASS and creation of re-interment voids must be staged to ensure that adequate space is available for all ASS materials to be adequately reburied below a permanent water table and that the ASS will not be buried in conditions that may cause the formation of acidic conditions. A maximum period of time between the commencement of disturbance and completion of interment works of approximately 48 hours should be adopted in all instances. If the material is to remain exposed for longer the 24 hours the pH levels should be monitored every 12 hours to ensure acid conditions are not developing.

On this site, given the required depth of excavation to expose the PASS material, the potential excavation requirements and the standing water table (≥2 m bgs), strategic reburial of PASS without neutralisation is considered unlikely to be a practicable management option.

4.3.5 Separation Techniques

Separation techniques are increasingly being implemented to reduce the quantity of PASS material requiring treatment in areas where works include the disturbance of large quantities of PASS. These activities include the removal of fine ASS particles including pyrite and monosulfides from coarser grained soil particles. This results in two material streams, concentrated 'ASS fines' and non-ASS material which can be removed from the management process. Management of ASS fines would then involve implementation of other ASS management techniques such as reburial, neutralisation, etc.

Separation is typically implemented by creating a soil slurry where fine particles can be suspended in solution away from heavier soil particles using methods such as sluicing or cycloning. Typically, such methods require suitably grained soils such as sand or non-consolidated sediments and a significant water source to implement the separation.

Environmental controls are required during the separation processes to ensure that the PASS fines do not undergo oxidation prior to the implementation of other management measures and validation of the non-ASS stream would then be necessary to confirm that the ASS fines have been adequately removed.

On this site, separation techniques are considered not to be a viable management option as these techniques cannot be used as a standalone management option and as such the ASS fines once separated would still require further treatment. The use of separation techniques would require the construction of sluicing channels or installation of cyclone treatment equipment to manage the quantities of slurry produced during the treatment process and provide sufficient areas for drying of the separated non-ASS portions following separation of the ASS fines.

4.3.6 Selection of Preferred Management Strategies

Evaluation of potential management strategies has identified the use of neutralisation techniques where disturbance cannot be avoided as the most appropriate technique for this site.

Management measures for identified PASS material will include the application of neutralisation chemicals to excavated PASS material, neutralisation of exposed excavation faces during staged treatment works and neutralisation of groundwater seepage and drainage leachate produced during the excavation and treatment works. Following validation to confirm the acid generation potential of the material has been appropriately neutralised, the material will either be set aside for potential use as engineered fill material within the development site, or alternatively, will require off-site disposal as per the requirements of EPA (2014).

4.4 General Site Management Strategy

The site management strategy to be implemented during works which may disturb PASS materials will ensure the following:

- Adequate treatment of PASS material such that there is sufficient acid neutralising capacity and no net acidity following stabilisation (as measured through appropriate field testing and laboratory validation);
- Water discharged from any excavations and treatment areas (including run-off, water from dewatering and leachate) is neutral and discharged to stormwater once it has been shown to meet with the criteria specified in this plan or alternatively, shall be reused on site for dust suppression;
- Groundwater quality indicators and levels are not significantly changed beyond the basement footprint from the existing levels/quality during excavation activities and are re-established after the completion of construction works; and
- Implementation of additional assessment procedures during earthworks operations for the effective treatment and management of any drained, disturbed or excavated acid sulfate soils.

4.4.1 Pre-disturbance Works

Subsequent to the additional investigation activities as identified in **Section 4.2**, and prior to the commencement of excavation works which may disturb PASS materials at the site, including piling activities with the potential to generate spoil, the following preparations should be considered:

- The sequencing of proposed piling, excavation, services installation and other activities should be planned in detail taking into account the time and space necessary to complete the PASS management activities outlined in this document. The planning should provide a contingency for treatment of additional quantities of materials in the event that the quantity of PASS material greater than anticipated is identified during implementation of the site works, or heavy rainfall events result in significant additional quantities of collected impacted water;
- The actual areas of PASS occurrence where disturbance/excavation will occur during each stage of works (piling, remediation, bulk excavation, services installation, etc) as part of the site activities should be identified and suitable location(s) for treatment areas close to the areas of disturbance identified. Based on the proposed works, the available space for treatment and the approximate volume anticipated to be disturbed, staging of the disturbance activities should then be planned such that sufficient drying and mixing time can be achieved for all disturbed materials. The staging should also allow for adequate time to obtain the results of verification testing before the material is placed at the final location or removed from the site.

4.4.2 Neutralisation Chemicals

An evaluation of potential neutralisation chemicals should be undertaken during the planning process and appropriate quantities of the preferred chemicals sourced for the duration of the site activities. For the purposes of this plan, the neutralising chemical is assumed to be high quality aglime. The aglime should be fine ground (<1 mm) calcium carbonate ($CaCO_3$) or calcite (limestone or marble powder). In the event that neutralising products other than high quality aglime are selected for use in this project, there are several issues that should be considered:

- Is there any potential environmental risk associated with use of the compounds (i.e. other components that may contaminate water, result in a much higher pH value (i.e. hydrated lime), stain treatment areas, etc); and
- Will the neutralising agent be of comparable effectiveness or will properties including: neutralising value, effective neutralising capacity, solubility, pH, chemical components,

moisture content, impurities and particle size; require the quantity of agent addition to be varied by a consistent factor.

It is recommended that, if ASS or PASS materials are anticipated to be generated during works, a small-scale treatment trial be implemented at the commencement of site works prior to broad scale implementation of alternative neutralising compounds. The small-scale trials should document the effectiveness of the revised approach in terms of the time, cost, availability, suitability, etc.

4.4.3 Treatment Area Design

As noted above, the treatment area should be situated in an appropriate location(s) with respect to site disturbance activities. In addition, consideration should also be given to the ease with which environmental controls can be implemented and potential requirement for off-site disposal of the material once stabilised and validated. More than one treatment area may be needed depending on site layout and constraints during works.

Small Quantities

For small scale disturbance activities, it is anticipated that a large lined skip bin or suitable structure could be used as a 'treatment cell' to minimise the potential for release of acidic leachate or partially treated soil.

Bulk Excavation Works

Should quantities of material disturbed in a stage exceed that able to be managed in a large skip bin, one or more treatment areas should be established with consideration of the following:

- The treatment area should be established separate to the area of disturbance but able to be accessed from the area of disturbance by plant/vehicles transporting the material to be treated and material to be removed from the treatment area at the completion of stabilisation activities;
- The treatment area should be sufficiently large to facilitate a pre-treatment stockpile area, a treatment pad, water/sediment collection and treatment measures, post treatment stockpile storage area and lime storage area.
- The treatment area should be isolated from major external surface water catchments, including overland surface water flow and potential flood water, basement excavation flooding by rainfall events, by ground surface contouring, installation of perimeter drains or bunds covered with an impervious layer (concrete, geomembrane, compacted non-ASS clay, etc).
- Infiltration of surface water (rain or drainage) through the ASS to groundwater within the treatment area should also be prevented to the extent possible. Alternatively, a layer of lime stabilised soil should be prepared on the ground surface within the treatment area that will act to neutralise any acidic water that my infiltrate the ground surface during treatment activities. The application should be no less than5 kg lime/m^2 of treatment area. This application should not be taken into account when material to be treated is placed within the treatment area as the neutralisation capacity of these added chemicals will decrease with time as a result of insoluble iron coating generation and it is difficult to ensure that there has been adequate mixing of the neutralising agent within the soil added to the site.
- Pre-treatment and post-treatment stockpile areas should be separately bunded or drained to minimise the potential for re-acidification of treated material.
- The treatment pad should be of a size that would allow treatment of material by a single machine over a reasonable timeframe to minimise the oxidation of material during

spreading and treatment. Assuming the material the subject of treatment is spread to a depth of approximately 0.3 m, a single treatment area 10 m by 20 m could treat 60 m^3 of material per treatment cycle. Should capacity to treat more material be required, two or three treatment pads could be established, separated by a suitable width to allow for excavator movement between the bunds of each pad.

- The bund surrounding each treatment pad may be constructed of concrete, compacted non-ASS clay, sand and lime filled sandbags or other suitable materials that are relatively impervious and can be coated with a guard layer of lime to neutralise acidic leachate that may contact the bund.
- The base of the treatment pad should be surfaced with concrete, asphaltic concrete, or soil mixed with lime as discussed above. This base should be graded where possible at a minimum fall of 1° to facilitate drainage of leachate such that it can be collected and/or pumped to a treatment/holding tank.
- Once well mixed with a suitable quantity of neutralisation agent, the material should be transferred to the post treatment stockpile area. Here the validation testing will be completed, and the material will remain until receipt of the validation results. The material will then be cleared for beneficial reuse within the site, or alternatively for off-site disposal to landfill.
- Surface water flows will be diverted around the treatment area where possible. Water falling within the various portions of the treatment area will be collected at appropriate locations and transferred either to a holding tank or artificial detention basin. The water quality will be monitored to ensure only water of suitable quality is discharged from the treatment area of the site. Dilution of water collected within the treatment area is not an acceptable method of treatment at this site. Contaminants resulting from oxidation of ASS should be collected, treated and/or managed on-site. Water discharges from the site must not have a significant impact on pH, buffering capacity, colour or ionic composition of the receiving water body (stormwater, groundwater, sewer, etc).
- A sufficient supply of aglime should be kept on site at all times for the treatment of PASS to be neutralised within the treatment area, for application on exposed excavation faces where ASS is expected or suspected; and for wet weather events where existing applications will require replacement and/or treatment of acidic water is necessary. Receipts, dockets and other field records showing the storage locations of all chemicals and location of all applications of neutralising agents must be kept.
- The supply shall be stored in a covered and bunded area to prevent accidental exposure to water and deterioration of the inherent neutralising capacity. ASS treatment materials should be stored in a manner that minimise the exposure of the materials to wet or humid conditions. Such conditions may result in the clumping or surface crusting of particulate lime which can reduce the level of effectiveness in neutralising water or soil.

4.4.4 General Site Management

All natural soils (including reworked natural soils) within the PASS identified zones must be treated as PASS material until such a time as the material is demonstrated to be non-PASS material or treatment effectively reduces the risk associated with the material and validation results meet the relevant specifications.

PASS materials that have been disturbed or excavated should be immediately transferred to the treatment area or treated in-situ as soon as practicable to minimise the quantity of soil, sediment and/or groundwater requiring treatment and the risk of environmental harm to the site and/or down-gradient receptors.

Bunding, diversion drains, contaminated water treatment/containment etc may be used to contain surface water run-off from PASS storage and treatment areas. However, PASS materials must not be used in the construction of bunds and other diversion devices.

Equipment used in the treatment of PASS shall be washed with an alkaline solution at the completion of each work period to minimize corrosion of equipment.

4.4.5 Excavation Works

Excavation works to be undertaken in the identified PASS areas of the site should be undertaken in the following manner:

- Fill/reworked material comprising black/grey silty clay (refer **Section 3.4.1**) requiring excavation should be removed and placed in a designated treatment area for further assessment and/or treatment;
- Natural soils encountered ≥2-3 m bgs will require the immediate transfer to the treatment area upon excavation. The material will be required to be treated as PASS material;
- Works including disturbance of natural rock will be subject to field testing upon initial exposure of underlying strata, either in-situ or as stockpiled material within the treatment zone. Field testing will include pH_f and post peroxide pH_{fox}, with both required to meet the validation criteria of pH 6 to be considered non-PASS soil. Alternatively, dependent upon the scheduling of the excavation works, laboratory pre-testing of soils from this zone may be undertaken using sPOCAS of S_{Cr} methods. If either the field criteria or laboratory analysis results indicate the material is considered to be PASS, then the material will require treatment as discussed in the following section;
- Excavation works should be staged to limit the period of any required dewatering (and the consequential extent of groundwater drawdown in surrounding PASS areas). This may involve the excavation of smaller cells (than allowable within the treatment area);
- At the completion of the day's activities, where excavation works result in the exposure of known or suspected PASS, a guard layer of fine aglime will be applied to the base of the excavation at a rate of no less than 5 kg lime/m^2 of exposed soil. If the base of the excavation is to remain exposed for an extended period (i.e. more than three days) the lime coating should be checked and re-limed as necessary. Alternatively, the lime may be covered with a layer of compacted non-ASS material at least 0.3 m in thickness;
- All cut batters/exposed faces potentially including ASS, (i.e. faces at the edge of excavation faces, etc), shall be coated with fine aglime at a rate of no less than 5 kg/m^2 and the lime coating should be checked and re-limed as necessary on a daily basis during periods of dewatering, whilst the faces are temporarily exposed and/or following wet weather events.

4.4.6 Treatment of Excavated PASS Material (incl. Liming Rate)

Treatment of PASS soils will comprise the addition of sufficient quantities of finely ground neutralising agent to treat all oxidisable sulfur and actual acidity and provide a factor of safety to compensate for potential impurities in the neutralising agent, non-homogenous mixing and limitations to the solubility of the neutralising agent.

Existing laboratory data (see **Attachment B**) presents **liming rates varying between 9.4 kg and 25 kg lime/tonne of PASS** for treatment. As such, segregation of PASS material is considered appropriate prior to application of treatment lime to ensure that appropriate liming rates are applied to address the acid generation capacity of the different materials in an efficient manner.

The excavated PASS material will be immediately transferred to the treatment area and placed either in a stockpile within the pre-treatment stockpile area or immediately on the treatment pad. Treatment of excavated material should occur within one day of excavation of the material.

If stockpiled, the material should be formed into a conical stockpile to minimise the exposure of the material to air. In the event of significant wet weather periods, the stockpiles should be covered with builder's plastic or similar to limit the infiltration of rainfall into the stockpiles.

If site conditions require the stockpiling of material for longer than 24 hours, the stockpiles should be treated with a guard layer of aglime of no less than 5 kg lime/ m^2 per vertical metre of soil in the stockpile. This would result in a two metre high stockpile requiring an application of no less than 10 kg lime/m^2 surface area. The stockpile should then be covered with an impervious surface (i.e. builder's plastic) that covers the top and sides of the stockpile to minimise drying by wind and sun and to prevent rainfall entering the stockpile.

Following placement within the treatment pad the material should be spread to a depth that will allow the material to be properly treated by thoroughly mixing neutralising agent through the soil. The actual depth of spreading will be somewhat dependent upon the soil type, the machinery used to mix the material and the form of the neutralising agent. However, the nominal spread depth should initially be no more than 0.3 m. Mixing of the lime and soil mixture may be undertaken by harrowing, rotary hoeing, using an excavator shaker bucket to blend the material, the use of a pug mill or similar equipment.

Care shall be taken to ensure that mixing occurs throughout the depth of the layer. The soil must be managed to achieve a consistency that will allow for thorough mixing of the soil and neutralising agent to ensure that the effective neutralisation occurs. This may require drying of the disturbed material (with associated management of any acidic leachate and other resulting contaminants), mechanical turning and breaking up of soil. Drying should not be undertaken during foreseeable wet weather events due to the increased risk of runoff flushing acid from the material and into uncontrolled areas.

Following mixing, aglime shall be spread at a rate of no less than 5 kg lime/m^2 around the toe of the treated soil, around a 1 m perimeter between the toe of the material and across the exposed face of the bund to neutralise any leachate released from the soil. Once the soil has sufficiently dried that no more leachate is being released, the material should be turned to ensure that all leachate is released from the treatment area.

If there is a likelihood that neutralisation treatment of particular soils encountered during works (i.e. heavy clays) will not be effective for the soil type/s, a small-scale trial to demonstrate that the proposal is practical should be performed before larger scale disturbance of this soil type.

4.4.7 Water Management During Treatment

Surface drainage and groundwater that comes into contact with PASS materials has the potential to become acidic and contaminated with heavy metals leached from the acidified soil. Sources of water may include ground surface drainage associated with rainfall, dewatering product produced during the excavation works, leachate produced during treatment of excavated soils, and groundwater inflow into open excavations.

In general, soil and water at the site is required to be managed under an earthworks Soil and Water Management Plan to be prepared by the Principal Contractor prior to the commencement of site works. However, in addition to these requirements, water from within the treatment area will be required to be collected, assessed and if necessary, treated prior to discharge from the site. Once pH and contaminant concentrations are considered suitable for discharge from the site, the water may be used for dust suppression at the site and/or released to the site stormwater system.

Additional water holding tanks may be necessary in the vicinity of the treatment works zones to store collected water prior to treatment. The water holding capacity directly related to the acid sulfate soil excavation and treatment areas should be maintained at a minimum quantity associated with a 1 in 10 year rainfall event to ensure that sufficient capacity is available to store all potentially acidic water that may be generated during site works.

Water will be neutralised, where required by the addition of lime within a dedicated treatment tank or lined detention basin. Lime shall be added incrementally and thoroughly mixed within the treatment vessel. Approximate lime application rates based on initial pH are provided in **Table 4.1** below.

Table 4.1 Treatment of Acidic Dewater

Water pH	Agricultural Lime / 1000L Water
0.5	11.7kg
1.0	3.7kg
1.5	1.2kg
2.0	0.37kg
2.5	0.12kg
3.0	37g
3.5	12g
4.0	4g
4.5	1.2g
5.0	0.37g
5.5	0.12g

Lime addition and mixing shall continue until the pH of the water is within the range of 6.5 – 8.5.

In the event water volumes greater than the capacity of the water treatment holding capacity are produced during the acid sulfate soil management activities, consideration should be given to off-site disposal of water via a licensed contractor or treatment of water using neutralisation chemical dosing within holding tanks prior to re-irrigation of open excavations once the pH of the water has been demonstrated to be suitable.

4.4.8 Validation of Treated PASS Material

Following the application and mixing of lime to the PASS at the treatment pad the material should be allowed to stand for a minimum of 48 hours prior to validation assessment. The spread soil should then be assessed to establish whether the following performance criteria have been achieved:

- The neutralising capacity of the treated soil must exceed the sum of the TAA and TPA of the soil, i.e. there is no net acidity in the soil as measured by sPOCAS / SCr < 0.03%S;
- Post neutralisation, the soil pH is greater than pH 5.5 (and preferably less than 9); and
- Excess neutralising potential should remain in the soil as all acid generation reactions may not be complete and so the soil may still have further capacity to generate acidity.

Validation testing using field tests to measure the soil/water pH shall be undertaken at a rate of ten samples per treatment batch (to a maximum quantity of 100 m^3, or a rate of 1 sample per 20 m^3). Field testing will include pH_f and post treatment peroxide pH_{fox}, with both required to meet the post neutralisation criteria noted above for all samples per treatment batch.

Confirmatory laboratory analysis (pH and sPOCAS / SCr) will be undertaken at a rate of two samples per treatment batch (to a maximum quantity of 100 m^3, or a rate of 1 sample per 100 m^3 for larger quantities). The samples obtained for laboratory analysis may be obtained by compositing three subsamples obtained from the treatment material to provide a broader indication of net acidity levels.

Samples should be obtained immediately following movement of the material from the treatment pad area to the post-treatment stockpile area of the treatment zone. Each stockpile should be identified with a unique identifier and its location logged with the laboratory validation sample identification so that laboratory results can then be matched to each stockpile within the post-treatment area. Following additional applications of neutralisation chemicals, a greater density of validation sampling is necessary to confirm the successful neutralisation.

In the presence of positive field validation tests, laboratory analysis of validation samples may be employed to determine the level of net acidity and confirm that the treatment has been successful or provide an indication of the quantity of further aglime application necessary to neutralise the soil.

If negative field tests occur but the confirmatory laboratory analysis results indicate that there is still net acidity, a further application of aglime will be mixed with material to ensure additional neutralisation capacity, prior to further confirmatory analysis.

Following receipt and logging of the successful laboratory validation results, the stockpile may then be released for beneficial reuse of material at the site, or alternatively, for off-site disposal. In the event that the laboratory results indicate that the stockpile requires further treatment, the material should be returned to the treatment pad as a unique treatment batch and treated as required prior to re-sampling.

4.4.9 Site Condition Monitoring

It is anticipated that monitoring of conditions will be undertaken by both the site contractors and an independent appropriately qualified consultant to ensure that the appropriate environmental controls are in place and the treatment strategy is minimising the environmental risk associated with the ASS materials.

The following inspection/monitoring regime will be implemented during the site works period and documented as appropriate to demonstrate compliance with this ASSMP:

- Stockpiles of material within the treatment area and of treated material will be inspected daily by the site contractors with pH measurements of any retained leachate taken and recorded. In the event that leachate is significantly acidic (pH < 5.0), the stockpiled material will be returned to the pre-treatment area until the laboratory results are available and the quantity of required additional lime application is known;
- In the event that an on-site sump/detention basin is used to manage water ingress, surface water monitoring points will be sampled and field tested and the pH recorded every day by site contractors during active site activities and weekly during periods where no active ground works are being undertaken within the PASS area; and
- All treated excavation faces to be retained for more than three days will be inspected on the third morning and lime reapplied as necessary each following morning.

Regular inspection of all excavation and treatment areas will be undertaken to identify potential indications of PASS oxidation. These inspections should note:

- Unexplained scalding, corrosion or degradation of onsite steel equipment and concrete paved surfaces;
- Formation of the mineral jarosite or other acidic salts in exposed or excavated soils;
- Areas of surface water blue-green, blue-white in colour or extremely clarified indicating high concentrations of aluminium; and
- Rust coloured deposits on excavation faces, in drainage paths, on bunds, channels, etc indicating iron precipitates.

- Such inspections should also identify the presence of unusual odours, including strong organic or sulfurous smells (i.e. rotten egg gas).

4.4.10 Removal of Neutralised PASS from the Site

Only material confirmed to be below the criteria listed in **Section 4.4.8** will be considered as stabilised ASS material for potential reuse within or removal from site. A final round of field pH testing should be undertaken prior to loading of the trucks to ensure that pH levels remain above 6. Material to be removed from the site will be classified in accordance with current EPA (2014) requirements and disposed of to a licensed facility permitted to accept the material.

5. Responsibilities

The selection of samples for environmental analysis as per **Section 4.2** shall be undertaken by a suitably qualified and experienced environmental or geotechnical consultant. Results of analysis shall be assessed and evaluated by a suitably qualified and experienced consultant.

Implementation of the physical treatment, material management and environmental controls portions of this ASSMP will be the responsibility of the site contractor engaged to complete remediation and/or construction earthworks within the site. The monitoring of conditions, unless otherwise specified in the monitoring sections will be the responsibility of a suitable qualified environmental consultant who will regularly inspect the site, the treatment area and treatment activities and implement the validation assessments to document compliance with this ASSMP.

The contractor should appoint a foreman or other responsible employee to undertake the appropriate monitoring activities as designated in this ASSMP. This person should be appropriately trained by the environmental consultant in all actions to be completed by the contractor. Where doubt arises concerning the results of the inspections or of field test validity, the environmental consultant should be contacted for verification of appropriate actions.

The contractor is not authorised to make any changes to this ASSMP or implement unapproved variations to the treatment and/or monitoring protocols outlined in this document unless explicit written approval is obtained from the environmental consultant prior to implementation of the changes.

Where ambiguity or conflicts in procedures arise, it is the contractor's responsibility to seek clarification on appropriate actions from the environmental consultant.

ASS mitigation measures should be documented as they apply to all individual works activities to be undertaken at the site. All persons responsible for the works activities should be made aware of their responsibilities in writing and suitable ASS management training should be provided to those persons to ensure that the responsibilities can be achieved.

Where contingency actions are necessary, or in the event that non-compliance with the ASSMP is identified by the contractor, the environmental consultant should be immediately informed in writing. The environmental consultant will then be obliged to provide a timely response documenting the necessary corrective actions.

6. Contingencies

In the event of unexpected events, including the identification of additional PASS zones at the site, or the failure of management measures as described in this ASSMP, the associated environmental risk will be managed by the evaluation and implementation of the contingency procedures and mitigation strategies.

6.1.1 Additional Acid Sulfate Soil Identification

In the event that site excavation works encounter the potential for additional acid sulfate soil areas at the site, identified by visual cues, field testing or laboratory analysis, the additional areas will be treated as per the PASS zone material treatment protocols. If the material is to be excavated as part of the development works, the excavation will be undertaken in stages with suitable volumes to allow the completion of the neutralisation treatment process prior to excavation of the next stage.

If the proposed works do not require excavation of the identified material, exposed surfaces will be treated with a guard layer of lime upon exposure. Groundwater seepage will be monitored, and neutralising agents added as necessary to manage the potentially acidic leachate produced.

6.1.2 Failure of Initial Acid Neutralisation Treatment

As described in **Section 4.4.8** following the treatment of materials within the treatment pad area, validation sampling will be completed to assess the success of the neutralisation process prior to removal of the material from the holding area. In the event that the validation testing indicates that neutralisation of the material is incomplete (i.e. pH<6 or S>0.03 %), a further application of lime and repeat of the treatment procedure will be undertaken prior to further validation assessment. If the proposed techniques fail, further consideration may be given to alternative management strategies as outlined in **Section 4.3**.

7. Conclusions

Based on investigation to date and associated limitations in **Section 8**, site characterisation data available for subsurface conditions across the site has identified the occurrence of PASS material at depth, primarily situated within natural alluvial soils at depths of ≥2-3 m bgs, and beneath the water table.

This ASSMP provides a methodology to manage the risks associated with the proposed activities which when successfully implemented will minimise the environmental risks associated with disturbance of the ASS materials.

8. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquiries.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

Figures

Legend

Approximate Site Boundary

JBS&G

Job No: 58037	
Client: Aliro	
Version: R01 Rev 0	Date 23/06/2020
Drawn By: AS	Checked By: MS

Scale 1:40,000
Relative to Street Map

0 500 1,000
metres

Coord. Sys. GDA 1994 MGA Zone 56

13 Endeavour Road, Caringbah NSW

SITE LOCATIONS

FIGURE 1

File Name: \\JBSG-NSW-FS01\Company Data\Projects\Aliro\58037 - Caringbah Due Diligence\GIS\Maps\R01 Rev 0\58037_01_SiteLocation.mxd
Reference: Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA: www.nearmap.com - 20191022

Legend

- Approximate Site Boundary
- Cadastre (NSW LPI, 2019)
- Site Features

JBS&G

Job No: 58037	
Client: Aliro	
Version: R01 Rev 0	Date 23/06/2020
Drawn By: AS	Checked By: MS
Scale 1:2,750	

0 50 100
metres

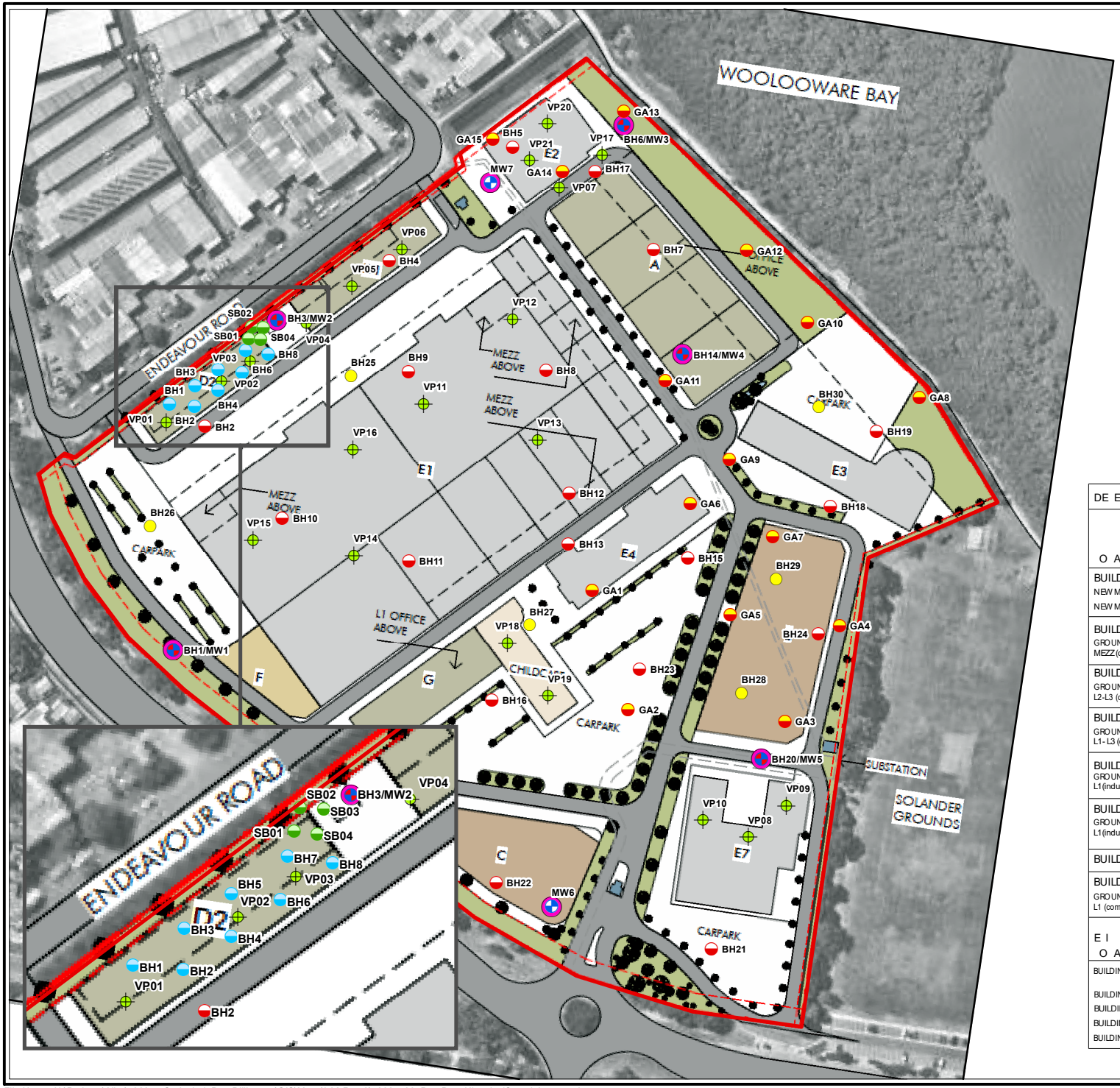
Coord. Sys. GDA 1994 MGA Zone 56

13 Endeavour Road, Caringbah NSW

SITE LAYOUT

FIGURE 2

File Name: \\JBSG-NSW-FS01\Company Data\Projects\Aliro\58037 - Caringbah Due Dilligence\GIS\Maps\R01 Rev 0\58037_02_SiteLayout.mxd
Reference: www.nearmap.com - Imagery 01-06-2020



DEVELOPMENT DATA	
TOTAL NEW AREA	46624m²
BUILDING E1 TOTAL	4114 m²
NEW MEZZ E1A (comm)	1505 m²
NEW MEZZ E1B (comm)	2609 m²
BUILDING A TOTAL	8335 m²
GROUND (industrial)	5575 m²
MEZZ (comm)	2760 m²
BUILDING B TOTAL	13020 m²
GROUND -L1 (show/comm)	1595 m²
L2-L3 (comm)	4915 m²
BUILDING TOTAL	12580 m²
GROUND (comm)	3145 m²
L1-L3 (comm)	3145m²
BUILDING D1	2920 m²
GROUND (industrial)	1460 m²
L1 (industrial)	1460 m²
BUILDING D2	2524 m²
GROUND (industrial)	1262 m²
L1 (industrial)	1262 m²
BUILDING	1035 m²
BUILDING G	3516 m²
GROUND (comm)	1758 m²
L1 (comm)	1758 m²
EXISTING BUILDING TOTAL	39059 m²
BUILDING E1 (industrial)	26080 m²
BUILDING E2 (industrial)	2174 m²
BUILDING E3 (industrial)	4872 m²
BUILDING E4 (industrial)	3228 m²
BUILDING E7 (brewery)	2705 m²

Legend

Approximate Site Boundary

Sample Locations - Historical

- Test Pit Location, Golder 1998
- Borehole Location, CES 2012
- Borehole Location, AECOM 2019
- Borehole/Groundwater Monitoring Well Location, AECOM 2019
- Sample Location, Noel Arnold & Ass. 2012

Sample Locations

- Groundwater Monitoring Location, JBS&G 2019
- Borehole Location, JBS&G 2019
- Sub Slab Vapour/Ground Gas Sample Location, JBS&G 2019
- Ground Gas Monitoring Well Location, JBS&G 2019

JBS&G

Job No: 58037

Client: Aliro

Version: R01 Rev 0 | Date 24/06/2020

Drawn By: JZ | Checked By: DD

Scale 1:2,750

0 25 50

metres

Coord. Sys. GDA 1994 MGA Zone 56

13 Endeavour Road, Caringbah NSW

PROPOSED DEVELOPMENT AND SAMPLE LOCATIONS

FIGURE 3

File Name: N:\Projects\Aliro\58037 - Caringbah Due Dilligence\GIS\Maps\L02 Rev 0\58037_03_PropDev_HistoricalSampleLocs.mxd
Reference:

Appendix A JBS&G 2020 Borehole Logs

BH25

Project Number: 58037
Client: Aliro Management Pty Ltd
Project Name: Caringbah Due Dilligence
Site Address: Captain Cook Drive, Caringbah

Date: 20-Jan-20
Logged By: MK
Contractor: Terratest
Total Hole Depth (mbgs): 4.1
Bore Diameter (mm): 150

Eastings (GDA 94): -
Northings (GDA 94): -
Zone/Area/Permit#: -
Reference Level: Ground Surface
Elevation (m): -

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Core				Fill	CONCRETE.		
Solid Flight Auger		0.20		Fill	ROAD BASE - black/grey, heterogeneous, loose with inclusions of roadbase/crushed concrete.	BH25 0.2-0.3 PID = 3.2 ppm	No odours, staining or ACM noted.
		0.50		Fill	Clayey Gravelly SAND - yellow/grey, heterogeneous, poorly sorted, dry with inclusions of rocks and styrofoam.	BH25 0.5-0.6 PID = 2.7 ppm	No odours, staining or ACM noted.
	1					BH25 1.0-1.1 PID = 3.8 ppm	No odours, staining or ACM noted.
	2	2.00		Fill	As above, grades to grey and damp.	BH25 2.0-2.1 PID = 7.7 ppm	Slight organic odour. No staining or ACM noted.
		2.30		Fill	Sandy Silty CLAY - grey/black, medium plasticity, wet with inclusions of roots.		Wet.
		2.80		SM	Silty SAND - grey, homogeneous, wet, medium grained, well sorted.		
	3					BH25 3.0-3.1 PID = 8.1 ppm	Organic odour. No staining or ACM noted.
	4					BH25 4.0-4.1 PID = 9.6 ppm	Strong organic odour. No staining or ACM noted.
		4.10			Borehole BH25 terminated at 4.1m		
	5						
	6						
	7						

BH26

Project Number: 58037
Client: Aliro Management Pty Ltd
Project Name: Caringbah Due Dilligence
Site Address: Captain Cook Drive, Caringbah

Date: 20-Jan-20
Logged By: MK
Contractor: Terratest
Total Hole Depth (mbgs): 7
Bore Diameter (mm): 150

Eastings (GDA 94): -
Northings (GDA 94): -
Zone/Area/Permit#: -
Reference Level: Ground Surface
Elevation (m): -

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger				Fill	ASPHALT.		
		0.10		Fill	Silty CLAY - grey, reworked, heterogeneous, dry, low plasticity.	BH26 0.2-0.3 PID = 8.1 ppm	No odours, staining or ACM noted.
		0.35		Fill	Clayey Gravelly SAND - yellow/cream, heterogenous, poorly sorted, dry with inclusions of igneous gravels.	BH26 0.5-0.6 PID = 6.2 ppm	No odours, staining or ACM noted.
	1					BH26 1.0-1.1 PID = 5.3 ppm	No odours, staining or ACM noted.
	2					BH26 2.0-2.1 PID = 4.7 ppm	No odours, staining or ACM noted.
		2.80		Fill	Sandy CLAY - grey, medium plasticity, moist with inclusions of organic matter.		
	3					BH26 3.0-3.1 PID = 10.1 ppm	Organic odour. No staining or ACM noted.
		3.40		SM	Silty SAND - brown, homogeneous, wet, medium grained, well sorted.		
	4					BH26 4.0-4.1 PID = 11.7 ppm	Slight organic odour. No staining or ACM noted.
	5					BH26 5.0-5.1 PID = 11.3 ppm	Saturated. Slight organic odour. No staining or ACM noted.
	6						Sample not taken as high saturation had yielded no soil return from auger.
		6.80		SANDSTONE	SANDSTONE - light grey, dry, hard.	BH26 6.7-6.8 PID = 11.7 ppm	No odours, staining or ACM noted.
	7						
		7.00			Borehole BH26 terminated at 7m		End of hole upon sandstone refusal.

BH27

Project Number: 58037
Client: Aliro Management Pty Ltd
Project Name: Caringbah Due Dilligence
Site Address: Captain Cook Drive, Caringbah

Date: 20-Jan-20
Logged By: MK
Contractor: Terratest
Total Hole Depth (mbgs): 4.1
Bore Diameter (mm): 150

Eastings (GDA 94): -
Northings (GDA 94): -
Zone/Area/Permit#: -
Reference Level: Ground Surface
Elevation (m): -

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger				Fill	ASPHALT.		
		0.10		Fill	Sandy GRAVEL - grey, heterogeneous, dry with inclusions of road base and crushed concrete.	BH27 0.2-0.3 PID = 2 ppm	No odours, staining or ACM noted.
		0.40		Fill	Clayey Silty SAND - grey, heterogeneous, dry with inclusions of igneous gravels. Increase in clay content at 2 m bgs.	BH27 0.5-0.6 PID = 3.1 ppm	No odours, staining or ACM noted.
	1					BH27 1.0-1.1 PID = 3.5 ppm	No odours, staining or ACM noted.
	2	2.00		Fill	Silty CLAY - black, reworked, heterogeneous, dry, low plasticity, with inclusions of organic matter (vegetation).	BH27 2.0-2.1 PID = 6.5 ppm	Strong organic odour. No staining or ACM noted.
	3					BH27 3.0-3.1 PID = 7.9 ppm	No odours, staining or ACM noted.
		3.50		SM	Silty SAND - Grey, homogeneous, wet, medium grained, well sorted.		Wet.
	4					BH27 4.0-4.1 PID = 8.6 ppm	Organic odour. No staining or ACM noted.
		4.10			Borehole BH27 terminated at 4.1m		
	5						
	6						
	7						

BH28

Project Number: 58037
Client: Aliro Management Pty Ltd
Project Name: Caringbah Due Dilligence
Site Address: Captain Cook Drive, Caringbah

Date: 21-Jan-20
Logged By: MK
Contractor: Terratest
Total Hole Depth (mbgs): 7.1
Bore Diameter (mm): 150

Eastings (GDA 94): -
Northings (GDA 94): -
Zone/Area/Permit#: -
Reference Level: Ground Surface
Elevation (m): -

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger				Fill	ASPHALT.		
		0.10		Fill	Clayey Gravelly SAND - yellow/cream, heterogeneous, poorly sorted, dry with inclusions of sandstone gravels.	BH28 0.2-0.3 PID = 5.3 ppm	No odours, staining or ACM noted.
						BH28 0.5-0.6 PID = 6.1 ppm	No odours, staining or ACM noted.
	1					BH28 1.0-1.1 PID = 6.3 ppm	No odours, staining or ACM noted.
	2	2.00		Fill	Sandy Silty CLAY - dark grey/black, reworked, heterogeneous, low plasticity, wet with inclusions of roots.	BH28 2.0-2.1 PID = 7.6 ppm	Organic odour. No staining or ACM noted.
				Fill	As above, no inclusions.		
	3					BH28 3.0-3.1 PID = 9.8 ppm	Organic odour. No staining or ACM noted.
	4	4.00		SM	Silty SAND - grey/black, heterogeneous, wet, medium grained, well sorted with inclusions of shells.	BH28 4.0-4.1 PID = 11.1 ppm	Strong organic odour. No staining or ACM noted.
	5	5.00		SM	As above, no inclusions.	BH28 5.0-5.1 PID = 10.9 ppm	Saturated. Strong organic odour. No staining or ACM noted.
	6					BH28 6.0-6.1 PID = 11.3 ppm	Strong organic odour. No staining or ACM noted.
	7					BH28 7.0-7.1 PID = 11.7 ppm	Strong organic odour. No staining or ACM noted.
		7.10			Borehole BH28 terminated at 7.1m		

BH29

Project Number: 58037
Client: Aliro Management Pty Ltd
Project Name: Caringbah Due Dilligence
Site Address: Captain Cook Drive, Caringbah

Date: 21-Jan-20
Logged By: MK
Contractor: Terratest
Total Hole Depth (mbgs): 6.1
Bore Diameter (mm): 150

Eastings (GDA 94): -
Northings (GDA 94): -
Zone/Area/Permit#: -
Reference Level: Ground Surface
Elevation (m): -

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger				Fill	ASPHALT - with inclusions of underlying igneous roadbase.		
		0.10		Fill	Silty SAND - black/grey, heterogeneous, dry, medium to course grained, loose with inclusions of minor crushed concrete gravels.	BH29 0.2-0.3 PID = 3.1 ppm	No odours, staining or ACM noted.
						BH29 0.5-0.6 PID = 2.5 ppm	No odours, staining or ACM noted.
	1					BH29 1.0-1.1 PID = 3.5 ppm	No odours, staining or ACM noted.
	2					BH29 2.0-2.1 PID = 7.6 ppm	No odours, staining or ACM noted.
		2.60		Fill	Sandy Silty CLAY - black, reworked, medium plasticity, wet with inclusions of organic material.		
	3					BH29 3.0-3.1 PID = 8.8 ppm	No odours, staining or ACM noted.
	4	3.90		SM	Silty SAND - grey/black, heterogeneous, wet, medium grained with inclusions of shells.	BH29 4.0-4.1 PID = 9.5 ppm	No odours, staining or ACM noted.
	5	5.00		SM	As above, no inclusions.	BH29 5.0-5.1 PID = 10.2 ppm	Saturated. No odours, staining or ACM noted.
	6					BH29 6.0-6.1 PID = 10.5 ppm	No odours, staining or ACM noted.
		6.10			Borehole BH29 terminated at 6.1m		
	7						

BH30

Project Number: 58037
Client: Aliro Management Pty Ltd
Project Name: Caringbah Due Dilligence
Site Address: Captain Cook Drive, Caringbah

Date: 21-Jan-20
Logged By: MK
Contractor: Terratest
Total Hole Depth (mbgs): 4.5
Bore Diameter (mm): 150

Eastings (GDA 94): -
Northings (GDA 94): -
Zone/Area/Permit#: -
Reference Level: Ground Surface
Elevation (m): -

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger				Fill	Silty Gravelly SAND - dark brown, heterogeneous, moist, medium coarse grained with sandstone inclusions.	BH30 0.2-0.3 PID = 5.1 ppm	Wet. No odours, staining or ACM noted.
						BH30 0.5-0.6 PID = 5.9 ppm	No odours, staining or ACM noted.
	1	0.80		Fill	Sandy CLAY - light brown, heterogeneous, soft, medium plasticity.	BH30 1.0-1.1 PID = 5.3 ppm	No odours, staining or ACM noted.
		1.20		Fill	Silty SAND - black/grey, heterogeneous, dry, medium to coarse grained, loose with inclusions of sandstone gravels.		
	2					BH30 2.0-2.1 PID = 5.1 ppm	Strong organic odour. No staining or ACM noted.
		2.50		Fill	Sandy Silty CLAY - black/grey, reworked, medium plasticity, wet with inclusions of roots.		
		2.80		Fill	As above, saturated, no inclusions.		
	3					BH30 3.0-3.1 PID = 8.9 ppm	Strong organic odour. No staining or ACM noted.
		3.50		SM	Silty SAND - grey/black, heterogeneous, wet, medium grained, poorly sorted.		
	4					BH30 4.0-4.1 PID = 9.8 ppm	Strong organic odour. No staining or ACM noted.
		4.50			Borehole BH30 terminated at 4.5m		Hole abandoned as high saturation yielded no soil return from auger.
	5						
	6						
	7						

MW06

Project Number: 58037
Client: Aliro Management Pty Ltd
Project Name: Caringbah Due Dilligence
Site Address: Captain Cook Drive, Caringbah

Date: 20-Jan-20
Logged By: CK
Contractor: Terratest
Total Hole Depth (mbgs): 3.5
Bore Diameter (mm): 150

Eastings (GDA 94): -
Northings (GDA 94): -
Zone/Area/Permit#: -
Reference Level: Ground Surface
Elevation (m): -

Water Level Initial (mbgs): 2
Surface Finish: Roadbox
Casing / Screen Type: Class 18 PVC - 50mm
Casing Bottom Depth (mbgs): 1.5
Screen Bottom Depth (mbgs): 3.5

Method	Water (mbgs)	Well Details	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger						Fill	Sandy SILT - brown/yellow, heterogeneous, dry, non plastic, firm with inclusions of crushed concrete, road base and shale gravels.	MW06 0.0-0.1 PID = 2 ppm	No odours, staining or ACM noted.
								MW06 0.2-0.3 PID = 3.5 ppm	No odours, staining or ACM noted.
				0.30		Fill	Silty SAND - brown, heterogeneous, dry, fine grained, poorly graded.	MW06 0.5-0.6 PID = 3.7 ppm	No odours, staining or ACM noted.
			1	0.80		Fill	Clayey SILT - brown, heterogeneous, dry, non plastic, firm with inclusions of crushed concrete and sandstone.	MW06 1.0-1.1 PID = 6.6 ppm	No odours, staining or ACM noted.
				1.50		Fill	Silty CLAY - grey, reworked, heterogeneous, dry, low plasticity.		
	▶		2	2.00		CL-ML-SM	Sandy Silty CLAY - dark brown/black, heterogeneous, medium to high plasticity, moist to wet with finer sands at 3 m bgs.	MW06 2.0-2.1 PID = 7.9 ppm	Wet. Organic odour. No staining or ACM noted.
			3					MW06 3.0-3.1 PID = 8.6 ppm	No odours, staining or ACM noted.
								MW06 3.4-3.5 PID = 9.2 ppm	No odours, staining or ACM noted.
				3.50			Borehole MW06 terminated at 3.5m		End of hole upon sandstone refusal.
			4						
			5						
			6						
			7						

MW07

Project Number: 58037
Client: Aliro Management Pty Ltd
Project Name: Caringbah Due Dilligence
Site Address: Captain Cook Drive, Caringbah

Date: 20-Jan-20
Logged By: CK
Contractor: Terratest
Total Hole Depth (mbgs): 4.1
Bore Diameter (mm): 150

Eastings (GDA 94): -
Northings (GDA 94): -
Zone/Area/Permit#: -
Reference Level: Ground Surface
Elevation (m): -

Water Level Initial (mbgs): 2.5
Surface Finish: Roadbox
Casing / Screen Type: Class 18 PVC - 50mm
Casing Bottom Depth (mbgs): 1
Screen Bottom Depth (mbgs): 4.1

Method	Water (mbgs)	Well Details	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Solid Flight Auger / Diamond Core						Fill	CONCRETE.		
				0.25		Fill	ROAD BASE - black/grey, heterogeneous, well sorted, angular with inclusions of silt, brick and igeneous gravels.	MW07 0.35-0.45 PID = 3 ppm	No odours, staining or ACM noted.
				0.40		Fill	Clayey Silty SAND - grey, heterogeneous, damp, poorly sorted with inclusions of roots, igneous road base, crushed concrete and brick.	MW07 0.5-0.6 PID = 2.5 ppm	Organic odour. No staining or ACM noted.
			1					MW07 1.0-1.1 PID = 3.4 ppm	No odours, staining or ACM noted.
				1.30		Fill	Silty SAND - grey, heterogeneous, wet at 2.5 m bgs, medium grained, well sorted with inclusions of organic matter and sandstone gravels.		
			2					MW07 2.0-2.1 PID = 7.9 ppm	No odours, staining or ACM noted.
	▼								Wet.
			3					MW07 3.0-3.1 PID = 8.3 ppm	Organic odour. No staining or ACM noted.
				3.70		CL-ML-SM	Sandy Silty CLAY - dark brown/black, heterogeneous, medium plasticity, moist.		
			4					MW07 4.0-4.1 PID = 9.6 ppm	Strong organic odour. No staining or ACM noted.
				4.10			Borehole MW07 terminated at 4.1m		
			5						
			6						
			7						

Appendix B sPOCAS Laboratory Analysis Results

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 235156

Client Details

Client	JBS & G (NSW & WA) Pty Ltd
Attention	C Kauffman
Address	Level 1, 50 Margaret St, Sydney, NSW, 2000

Sample Details

Your Reference	**58037, Caringbah**
Number of Samples	35 Soil
Date samples received	21/01/2020
Date completed instructions received	23/01/2020

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

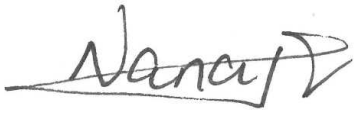
Date results requested by	29/01/2020
Date of Issue	29/01/2020

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By



Nancy Zhang, Laboratory Manager

sPOCAS + %S w/w						
Our Reference		235156-4	235156-6	235156-12	235156-21	235156-23
Your Reference	UNITS	BH26_4-4.1	BH26_6.7-6.8	BH28_5-5.1	BH30_1-1.1	BH30_3-3.1
Date Sampled		20/01/2020	20/01/2020	21/01/2020	21/01/2020	21/01/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	28/01/2020	28/01/2020	28/01/2020	28/01/2020	28/01/2020
Date analysed	-	28/01/2020	28/01/2020	28/01/2020	28/01/2020	28/01/2020
pH $_{kcl}$	pH units	8.7	9.4	9.5	9.4	9.4
TAA pH 6.5	moles H^+ /t	<5	<5	<5	<5	<5
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
pH $_{Ox}$	pH units	3.4	6.8	7.8	8.5	5.0
TPA pH 6.5	moles H^+ /t	98	<5	<5	<5	<5
s-TPA pH 6.5	%w/w S	0.16	<0.01	<0.01	<0.01	<0.01
TSA pH 6.5	moles H^+ /t	98	<5	<5	<5	<5
s-TSA pH 6.5	%w/w S	0.16	<0.01	<0.01	<0.01	<0.01
ANC_E	% $CaCO_3$	[NT]	0.19	0.44	0.81	[NT]
a-ANC_E	moles H^+ /t	[NT]	38	88	160	[NT]
s-ANC_E	%w/w S	[NT]	0.06	0.14	0.26	[NT]
S_{KCl}	%w/w S	0.03	0.04	0.04	0.009	0.03
S_P	%w/w	0.49	0.15	0.26	0.02	0.23
S_{POS}	%w/w	0.46	0.12	0.22	0.01	0.20
a-S_{POS}	moles H^+ /t	290	73	130	7	120
Ca_{KCl}	%w/w	0.17	0.12	0.11	0.15	0.14
Ca_P	%w/w	0.40	0.32	0.59	0.49	0.31
Ca_A	%w/w	0.23	0.20	0.48	0.34	0.17
Mg_{KCl}	%w/w	0.030	0.008	0.018	0.008	0.023
Mg_P	%w/w	0.046	0.027	0.053	0.036	0.048
Mg_A	%w/w	0.015	0.019	0.035	0.028	0.024
S_{HCl}	%w/w S	[NT]	[NT]	[NT]	[NT]	[NT]
S_{NAS}	%w/w S	[NT]	[NT]	[NT]	[NT]	[NT]
a-S_{NAS}	moles H^+ /t	[NT]	[NT]	[NT]	[NT]	[NT]
s-S_{NAS}	%w/w S	[NT]	[NT]	[NT]	[NT]	[NT]
Fineness Factor	-	1.5	1.5	1.5	1.5	1.5
a-Net Acidity	moles H^+ /t	160	<5	<5	<5	120
s-Net Acidity	%w/w S	0.26	<0.01	<0.01	<0.01	0.20
Liming rate	kg $CaCO_3$ /t	12	<0.75	<0.75	<0.75	9.4
s-Net Acidity without -ANCE	%w/w S	0.26	0.12	0.22	0.011	0.20
a-Net Acidity without ANCE	moles H^+ /t	160	73	130	6.6	120
Liming rate without ANCE	kg $CaCO_3$ /t	12	5.5	10	<0.75	9.4

sPOCAS + %S w/w			
Our Reference		235156-25	235156-33
Your Reference	UNITS	MW06_0.5-0.6	MW07_4-4.1
Date Sampled		20/01/2020	20/01/2020
Type of sample		Soil	Soil
Date prepared	-	28/01/2020	28/01/2020
Date analysed	-	28/01/2020	28/01/2020
pH $_{kcl}$	pH units	9.2	8.8
TAA pH 6.5	moles H^+ /t	<5	<5
s-TAA pH 6.5	%w/w S	<0.01	<0.01
pH $_{Ox}$	pH units	7.7	2.7
TPA pH 6.5	moles H^+ /t	<5	280
s-TPA pH 6.5	%w/w S	<0.01	0.44
TSA pH 6.5	moles H^+ /t	<5	280
s-TSA pH 6.5	%w/w S	<0.01	0.44
ANC_E	% $CaCO_3$	0.50	[NT]
a-ANC_E	moles H^+ /t	100	[NT]
s-ANC_E	%w/w S	0.16	[NT]
S_{KCl}	%w/w S	<0.005	0.06
S_P	%w/w	0.007	0.76
S_{POS}	%w/w	<0.005	0.71
a-S_{POS}	moles H^+ /t	<5	440
Ca_{KCl}	%w/w	0.13	0.14
Ca_P	%w/w	0.28	0.45
Ca_A	%w/w	0.16	0.31
Mg_{KCl}	%w/w	0.006	0.042
Mg_P	%w/w	0.019	0.063
Mg_A	%w/w	0.014	0.021
S_{HCl}	%w/w S	[NT]	[NT]
S_{NAS}	%w/w S	[NT]	[NT]
a-S_{NAS}	moles H^+ /t	[NT]	[NT]
s-S_{NAS}	%w/w S	[NT]	[NT]
Fineness Factor	-	1.5	1.5
a-Net Acidity	moles H^+ /t	<5	330
s-Net Acidity	%w/w S	<0.01	0.53
Liming rate	kg $CaCO_3$ /t	<0.75	25
s-Net Acidity without -ANCE	%w/w S	<0.01	0.53
a-Net Acidity without ANCE	moles H^+ /t	<5	330
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75	25

Method ID	Methodology Summary
Inorg-064	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL: sPOCAS + %S w/w						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			28/01/2020	4	28/01/2020	28/01/2020		28/01/2020	[NT]
Date analysed	-			28/01/2020	4	28/01/2020	28/01/2020		28/01/2020	[NT]
pH $_{kcl}$	pH units		Inorg-064	[NT]	4	8.7	8.6	1	92	[NT]
TAA pH 6.5	moles H^+ /t	5	Inorg-064	<5	4	<5	<5	0	85	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	4	<0.01	<0.01	0	[NT]	[NT]
pH $_{Ox}$	pH units		Inorg-064	[NT]	4	3.4	3.4	0	97	[NT]
TPA pH 6.5	moles H^+ /t	5	Inorg-064	<5	4	98	90	9	109	[NT]
s-TPA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	4	0.16	0.14	13	[NT]	[NT]
TSA pH 6.5	moles H^+ /t	5	Inorg-064	<5	4	98	90	9	[NT]	[NT]
s-TSA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	4	0.16	0.14	13	[NT]	[NT]
ANC_E	% $CaCO_3$	0.05	Inorg-064	<0.05	4	[NT]	[NT]		[NT]	[NT]
a-ANC_E	moles H^+ /t	5	Inorg-064	<5	4	[NT]	[NT]		[NT]	[NT]
s-ANC_E	%w/w S	0.05	Inorg-064	<0.05	4	[NT]	[NT]		[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-064	<0.005	4	0.03	0.03	0	[NT]	[NT]
S_P	%w/w	0.005	Inorg-064	<0.005	4	0.49	0.48	2	[NT]	[NT]
S_{POS}	%w/w	0.005	Inorg-064	<0.005	4	0.46	0.45	2	[NT]	[NT]
a-S_{POS}	moles H^+ /t	5	Inorg-064	<5	4	290	280	4	[NT]	[NT]
Ca_{KCl}	%w/w	0.005	Inorg-064	<0.005	4	0.17	0.17	0	[NT]	[NT]
Ca_P	%w/w	0.005	Inorg-064	<0.005	4	0.40	0.39	3	[NT]	[NT]
Ca_A	%w/w	0.005	Inorg-064	<0.005	4	0.23	0.22	4	[NT]	[NT]
Mg_{KCl}	%w/w	0.005	Inorg-064	<0.005	4	0.030	0.031	3	[NT]	[NT]
Mg_P	%w/w	0.005	Inorg-064	<0.005	4	0.046	0.049	6	[NT]	[NT]
Mg_A	%w/w	0.005	Inorg-064	<0.005	4	0.015	0.018	18	[NT]	[NT]
S_{HCl}	%w/w S	0.005	Inorg-064	<0.005	4	[NT]	[NT]		[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-064	<0.005	4	[NT]	[NT]		[NT]	[NT]
a-S_{NAS}	moles H^+ /t	5	Inorg-064	<5	4	[NT]	[NT]		[NT]	[NT]
s-S_{NAS}	%w/w S	0.01	Inorg-064	<0.01	4	[NT]	[NT]		[NT]	[NT]
Fineness Factor	-	1.5	Inorg-064	<1.5	4	1.5	1.5	0	[NT]	[NT]
a-Net Acidity	moles H^+ /t	5	Inorg-064	<5	4	160	150	6	[NT]	[NT]
s-Net Acidity	%w/w S	0.01	Inorg-064	<0.01	4	0.26	0.24	8	[NT]	[NT]
Liming rate	kg $CaCO_3$ /t	0.75	Inorg-064	<0.75	4	12	12	0	[NT]	[NT]
s-Net Acidity without -ANCE	%w/w S	0.01	Inorg-064	<0.01	4	0.26	0.24	8	[NT]	[NT]

QUALITY CONTROL: sPOCAS + %S w/w						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
a-Net Acidity without ANCE	moles H^+/t	5	Inorg-064	<5	4	160	150	6	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	4	12	12	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

COC 23/1, 3:18pm

20306

CHAIN OF CUSTODY

JBS&G

PROJECT NO.: 58037	LABORATORY BATCH NO.:
PROJECT NAME: Caringbah	SAMPLERS: CK + MR
DATE NEEDED BY: 3 day TAT	QC LEVEL: NEPM (2013)

PHONE: Sydney: 02 8245 0300 | Perth: 08 9488 0100 | Brisbane: 07 3112 2688

SEND REPORT & INVOICE TO: (1) adminnsw@jbsg.com.au; (2) ckaulfmann@jbsg.com.au; (3) .....@jbsg.com.au

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:

Samples frozen (ie within Holding time)

SAMPLE ID			MATRIX	DATE	TIME	TYPE & PRESERVATIVE	pH	SPOCAS	TYPE OF ASBESTOS ANALYSIS: IDENTIFICATION	TYPE OF ASBESTOS ANALYSIS: NEPM/WA	NOTES:
BH25	2-2.1	1	Soil	20.1.20		1x Bag					
↓	3-3.1	2									
↓	4-4.1	3									
BH26	3-3.1	NR									
↓	4-4.1	4						X			
↓	5-5.1	5		↓							
↓	6.7-6.8	6		↓				X			
BH27	3-3.1	7		21.1.20							
↓	4-4.1	8									
BH28	2-2.1	9									
↓	3-3.1	10									
↓	4-4.1	11									
↓	5-5.1	12						X			
↓	6-6.1	13									
↓	7-7.1	14									
BH29	1-1.1	15									
↓	2-2.1	16									
↓	3-3.1	17									
↓	4-4.1	18	↓	↓		↓					

ENVIROLAB GROUP

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 235150

Date Received: 21/01/20
Time Received: 1538
Received by: SP
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

SBal

RELINQUISHED BY:	METHOD OF SHIPMENT:	RECEIVED BY:	FOR RECEIVING LAB USE ONLY:
NAME: CK DATE: 23.1.20	CONSIGNMENT NOTE NO.	NAME: S. Bolton	COOLER SEAL – Yes... No ..... Intact ✓ Broken .....
OF: JBS&G	TRANSPORT CO.	DATE: 21/01/20	COOLER TEMP 3.3 deg C
		OF: ELS Syd.	
NAME: DATE:	CONSIGNMENT NOTE NO.	NAME: DATE:	COOLER SEAL – Yes..... No ..... Intact ..... Broken .....
OF:	TRANSPORT CO	OF:	COOLER TEMP ..... deg C

Container & Preservative Codes: P = Plastic; J = Soil Jar; B = Glass Bottle; N = Nitric Acid Prsvd.; C = Sodium Hydroxide Prsvd; VC = Hydrochloric Acid Prsvd Vial; VS = Sulfuric Acid Prsvd Vial; S = Sulfuric Acid Prsvd; Z = Zinc Prsvd; E = EDTA Prsvd; ST = Sterile Bottle; O = Other

IMSO Forms013 – Chain of Custody - Generic

20306

CHAIN OF CUSTODY

PROJECT NO.: S8037	LABORATORY BATCH NO.:
PROJECT NAME: Caringbah	SAMPLERS:
DATE NEEDED BY: 3 day	QC LEVEL: NEPM (2013)

PHONE: Sydney: 02 8245 0300 | Perth: 08 9488 0100 | Brisbane: 07 3112 2688

SEND REPORT & INVOICE TO: (1) adminnsw@jbsg.com.au; (2) cmaltinen@jbsg.com.au; (3) .....@jbsg.com.au

COMMENTS / SPECIAL HANDLING / STORAGE OR DISPOSAL:
Samples Frozen (ie within holding times)

SAMPLE ID	MATRIX	DATE	TIME	TYPE & PRESERVATIVE	pH	SPOCAS	TYPE OF ASBESTOS ANALYSIS: IDENTIFICATION	TYPE OF ASBESTOS ANALYSIS: NEPM/WA	NOTES:
BH29 5-5.1 19	Soil	21.1.20		1x Bag					
6-6.1 20									
BH30 0.5-0.6 NR									
1-1.1 21						X			
2-2.1 22									
3-3.1 23						X			
4-4.1 24									
MW06 0.5-0.6 25		20.1.20				X			
1-1.1 26									
2-2.1 27									
3-3.1. 28									
3.4-3.5 29									
MW07 2-2.1 30									
1-1.1 31									
3-3.1 32									
4-4.1 33						X			
BH28 1.0-1.1	34	extra samples							
Unlabelled bag.	35								

RELINQUISHED BY:	METHOD OF SHIPMENT:	RECEIVED BY:	FOR RECEIVING LAB USE ONLY:
NAME: CK DATE: 22.1.20 OF: JBS&G	CONSIGNMENT NOTE NO. TRANSPORT CO.	NAME: S. Bolton DATE: 21/01/20 OF: ELS Syd.	COOLER SEAL – Yes..... No ..... Intact ..... Broken ..... COOLER TEMP ..... deg C
NAME: DATE: OF:	CONSIGNMENT NOTE NO. TRANSPORT CO	NAME: DATE: OF:	COOLER SEAL – Yes..... No ..... Intact ..... Broken ..... COOLER TEMP ..... deg C

Container & Preservative Codes: P = Plastic; J = Soil Jar; B = Glass Bottle; N = Nitric Acid Prsvd.; C = Sodium Hydroxide Prsvd; VC = Hydrochloric Acid Prsvd Vial; VS = Sulfuric Acid Prsvd Vial; S = Sulfuric Acid Prsvd; Z = Zinc Prsvd; E = EDTA Prsvd; ST = Sterile Bottle; O = Other

IMSO FormsO13 – Chain of Custody - Generic

235156.

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