Hale Capital Development Management

Acid Sulfate Soil Management Plan

45-57 Moxon Rd,
Punchbowl, NSW

22 March 2023

63791/147784 (Rev C)

JBS&G Australia Pty Ltd

www.jbsg.com.au

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Abbreviations

Term	Definition
ACM	Asbestos Containing Material
AHD	Australian Height Datum
ASS	Acid Sulfate Soil
B(a)P	Benzo(a)pyrene
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DP	Deposited Plan
DQI	Data quality indicator
DQOs	Data Quality Objectives
DSI	Detailed Site Investigation
EIL	Ecological Investigation Level
EPA	NSW Environment Protection Authority
ESL	Ecological Screening Level
ha	Hectare
HIL	Health Investigation Level
HSL	Health Screening Level
JBS&G	JBS&G Australia Pty Ltd
LOR	Limit of Reporting
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
OCP	Organochlorine Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PASS	Potential Acid Sulfate Soil
PCB	Polychlorinated Biphenyls
PID	Photo-ionisation Detector
ppm	Parts Per Million
PSI	Preliminary Site Investigation
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
RPD	Relative Percentage Difference
TCLP	Toxicity Characteristic Leaching Procedure
TRH	Total Recoverable Hydrocarbon
TPH	Total Petroleum Hydrocarbons
UF	Unexpected Find
UST	Underground Storage Tank
VENM	Virgin Excavation Natural Material
VOC	Volatile Organic Compound
WHS	Work Health & Safety

1. Introduction

1.1 Introduction and Development Details

JBS&G Australia Pty Ltd (JBS&G) was engaged by Hale Capital Development Management (Hale) (the client) to prepare an Acid Sulfate Soil Management Plan (ASSMP) for the property located at 45-57 Moxon Road, Punchbowl NSW (the site). The site is legally identified as 1 in DP618465, Lot B in DP390488, Lots 221 and 222 in DP840328, and Lot 23 in DP552521 and covers an area of 3.5 hectares (ha). The site location and layout are shown in **Figures 1** and **2**.

It is understood that the client proposes to redevelop the site with for a commercial/industrial use for warehouses likely to be used as distribution centres. Indicative development plans are provided in **Appendix A.** The disturbance of in-situ materials during future construction works is expected to mainly occur during redevelopment excavations. Excavation works will be required for piling works, removal, relocation and modification of existing underground services and service connections and removal of vegetation, rather than any largescale excavation activities.

Review of the Acid Sulfate Soil Risk Map[1] indicates that the site exists on disturbed terrain. JBS&G (2022[2]) reported acid sulfate soils (ASS)/ potential acid sulfate soils (PASS) in natural soils across the site.

As such an ASSMP is required to document procedures to be implemented to manage the potential environmental risk associated with disturbance of these materials should they be encountered during construction works. This ASSMP has been prepared in accordance with the general requirements of the Acid Sulfate Soil Manual (ASSMAC 1998[3]) and with consideration to the National Acid Sulfate Soils Guidance (DAWR 2018[4]).

1.2 Aims and Objectives

The ASSMP has been developed to address Condition 12 of the the Secretary's Environmental Assessment Requirements (SEARs) issued by the NSW Department of Planning and Environment for warehouse and distribution centre applications. 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 Acid Sulfate Soils (ASS)/Potential Acid Sulfate Soils (PASS) during the proposed site construction works. Specifically, the objectives of this ASSMP are to document:

- The known and anticipated site sub-surface characteristics expected to be encountered during future excavation works and 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

1 Botany Bay Acid Sulfate Risk Map – Edition Two (9130S3), Department of Land and Conservation of Water. Printed December 1997
2 *Detailed Site Investigation*, 45-57 Moxon Road Punchbowl, NSW JBS&G Australia Pty Ltd, 23 December 2022, 62978/145,165 (Rev B) (JBS&G 2022)
3 *Acid Sulfate Soil Manual*, NSW Acid Sulfate Soil Management Advisory Committee, August 1998 (ASSMAC 1998)
4 *National Acid Sulfate Soil Guidance*. Australian Government Department of Agriculture and Water Resources (DAWR), June 2018 (AGDAW, 2018)

- Procedures for the management and validation of ASS during future site excavation works to minimise the potential for adverse environmental impacts resulting from the ASS/PASS disturbance activities.

1.3 Proposed Development

As noted in **Section 1.1**, it is proposed to redevelop the site for commercial / industrial land use. The proposed development consists of:

- Construction, fit out and operation of a two-storey warehouse and distribution centre comprising approximately 29,309 m^2 Gross Floor Area (GFA) including;
    - 25,565 m^2 of warehouse and distribution GFA;
    - 3,744 m^2 GFA ancillary office space;
- Provision of 20 bicycle parking spaces, 20 motorcycle parking spaces and 178 car parking spaces at ground floor level;
- Approximately 3,451 m^2 of soft landscaping at ground level;
- Replacement of the existing vehicular access from Moxon Road with three new access driveways;
- Earthworks and upgrades to existing onsite infrastructure;
- Provision of internal vehicle access road and loading docks; and
- Building identification signage.

The proposed development plans are provided in **Appendix A**.

2. Acid Sulfate Soil General Information

2.1 Acid Sulfate Soils Background

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. ASSs 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 iron sulfides with oxygen, resulting in 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:

- 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
- PASS are soils which contain iron sulfides that 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 ASS 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 or bored 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 criteria 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[5]).

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);
- *Waste Classification Guidelines Part 4: Acid Sulfate Soils* (EPA 2014b);
- *Contaminated Sites: 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);*

[5] *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)*

- *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 location and current layout of the site is shown in **Figures 1** and **2** respectively. The site details are summarised in **Table 3.1.**

Table 3.1: Summary of Site Details

Lot / DP	Lot 1 in DP618465, Lot B in DP390488, Lot 221 and 222 in DP840328, and Lot 23 in DP552521
Address	45-57 Moxon Road, Punchbowl, NSW
Local Government Authority	City of Canterbury-Bankstown Council
Approximate MGA Coordinates (MGA 56)	Easting: 319039 Northing: 6243062
Previous Use	Commercial / industrial and agricultural
Current Use	Commercial / industrial
Proposed Use	Commercial / industrial
Site Area	Approximately 3.5 ha

3.2 Site Description

Site inspections to evaluate site conditions and identify potentially contaminating conditions and/or activities were undertaken by experienced JBS&G personnel on 22 April 2022. The following key observations were documented:

Lot 1 DP618465 (northern portion)

- Majority of the northern portion of the site comprised of two adjoining rectangular warehouse buildings. One warehouse was a beauty product distributor (Frostbland) and the other was a clothing distributor (Williams Fashion Logistics).
- Each warehouse was concrete surfaced and mostly contained storage shelves / racks. There were no clear chemical storage areas or evident storage tanks. Various areas with steel roadplates were identified and likely corresponded to stormwater and/or electrical pits.
- There was an electrical substation near the entry driveway to the north portion. A bitumen carpark was also present in the northern portion of the site. There were several rainwater tanks.
- The west region contained an open grassed area with a stormwater collection pit, and pipework leading off-site towards the nearby creek.
- The north-east region operated as a small holding yard consisting of sand, gravel and mulch stockpiles and filled bulker bags.

Lot B DP390488 (north-eastern portion)

- A double story brick building containing asbestos building materials was present, with the front area used for storage of items sealed in cardboard boxes. At the time of inspection there was no access to inside the building.

Lot 222 DP840328 (central portion)

- A single building was present and operated as a vehicle mechanic. Various parts of the building contained asbestos materials. The internal part of the building had a solvent odour, and there was a possible collection / waste storage pit near the western extent of the building entry / exit.
- A small electrical substation was present along the east part / entry point from Moxon Rd. A stormwater retention pit was located near the substation.
- Multiple vehicles were being stored around the building on bitumen or unsealed surfaces.
- The western extent contained a large stormwater retention tank and nearby generator, with pipework leading along the south boundary towards the creek discharge point.

Lot 221 DP840328 and Lot 23 DP552521 (south part of site)

- Three warehouse buildings operated as storage for stone slabs, storage of charcoal bags and mostly for material storage / distribution. Most buildings contained asbestos materials such as downpipes, roof and wall sheeting.
- The west part contained bitumen and unsealed areas where stone offcuts were kept, along with shipping containers and various abandoned items / old machinery.

The location of key site features are shown on **Figure 2**.

3.3 Geology and Topography

The site is underlain by Wianamatta group shale (Sydney 1:100 000[6]) with a topographic slope ranging from approximately four to 10 m AHD (Google Earth, 2022[7]). The site slopes in a general westerly direction. Level to gently undulating alluvial floodplains with local relief <5m and slope gradient <3%.

A review of the ESPADE 2.1 tool (OEH 2021[8]) indicates that the site exists on Birrong fluvial. Relevant details of the soil landscapes are provided following:

- **Soils:** Deep (>250 cm) yellow podzolic soils and yellow solodic soils on older alluvial terraces. Deep (>250 cm) solodic soils and yellow solonetz on current floodplain.
- L**imitations:** localised flooding, high soil erosion hazard, saline subsoils, seasonal waterlogging, very low soil fertility.
- **Geology:** Dominated by silt and clay sized alluvial materials derived from the Wianamatta Group. The Wianamatta Group consists mostly of shale with some carbonaceous claystone, laminite, and occasional fine to medium grain lithic sandstones.

The site is mostly covered in concrete hardstand or bitumen, underlain by variable thicknesses of gravel roadbase, reworked clay or sandy clay fill materials to depths generally between 0.2-5 m below ground surface (bgs). Natural soil includes residual clay with inclusions of source rock up to the final investigation depth of 5 m.

[6] https://gmaps.geoscience.nsw.gov.au/100K/Sydney/, accessed 6 May 2022
[7] Google Earth Pro, accessed 6 May 2022
[8] OEH (2021) *ESPADE 2.1*. NSW Office of Environment and Heritage, accessed 9 May 2022 https://www.environment.nsw.gov.au/eSpade2Webapp

3.4 Acid Sulfate Soils

Review of the 1:25 000 Botany Bay Acid Sulfate Soil (ASS) Risk Map (DLWC 1997[9]) and the ESPADE Spatial Viewer ASS risk mapping indicates the site is within an area of 'disturbed terrain.' Soil investigations are required to assess the potential for acid sulfate soils in areas of disturbed terrain.

Review of ASS Class Zone 2 under maps provided in the Canterbury LEP 2012 (JBS&G 2022) indicated the site is within a Class 2 area where "*acid sulfate soils are likely to be found below the natural ground surface.*" Within Class 2 land, development consent is required for "*works below the natural ground surface*" and "*works by which the water table is likely to be lowered*." Where excavation occurs below the natural ground surface, an ASS management plan would be required.

3.5 Hydrology and Hydrogeology

The nearest surface water body is Salt Pan Creek, situated approximately 20 m west and 75 m southeast of the site. Salt Pan Creek is a tributary of the Georges River and discharges into the river 4.5 km south of the site. The Georges River empties into Botany Bay 11.5 km to the southeast, and then the Pacific Ocean. The site elevation ranges from 1.7 to 2.2 m AHD (JBS&G 2022), Salt Pan Creek to the west and southeast of the site is located at 2 m AHD. JBS&G (2022) reported groundwater flows to the southwest in the north western portion of the site and to the southeast in the south eastern portion of the site. Salt Pan Creek is characterised as being tidal in proximity of the site and is most appropriately described as a marine water receptor.

Excess rainwater would be directed through the stormwater network. Surface water movement across areas of hardstand is anticipated to flow to the west / southwest towards Salt Pan Creek.

[9] *Botany Bay Acid Sulfate Soil Risk Map (Edition 2),* Department of Land and Water Conservation 1997, (DLWC 1997)

4. Extent of Acid Sulfate Soils

JBS&G (2022) undertook a program of ASS assessment. JBS&G (2022) reported ASS/PASS is present within natural sandy clays / clay materials at the site. The upper profile of natural materials was encountered from between 0.1 m below ground surface (bgs) to 1.5 m bgs across the site.

Natural materials are generally present underlying the fill and comprise a mixture of non-PASS and PASS. Based on the current data the distribution of PASS appears to be randomly distributed within the natural soils at the site. As such, it should be assumed that any construction works that result in the disturbance of natural sandy clay /clay materials during site redevelopment will require management, until additional testing (**Section 5.2**) proves otherwise.

5. 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 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);
- Water and soil quality targets for the excavation, treatment and removal of ASS 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.

5.1 Scope of Soil Disturbance Activities

The proposed development works are anticipated to include the removal of existing site infrastructure, excavation/installation of footings, fixtures, foundations and underground services, all of which may require the excavation of fill material and natural soils that may comprise ASS or PASS. It is understood the site ground level is planned to be raised for the proposed development. The final scope of ASS/PASS disturbance activities will be evaluated upon finalisation of the construction requirements/methodologies to be implemented during the works.

5.2 Investigation of Occurrence of ASS and/or PASS Material

Fill materials encountered at depths ranging from 0.1-1.5 m bgs comprise non-PASS and do not require further assessment and/or management during construction works that result in their disturbance.

Should construction works result in the disturbance of underlying natural sandy clay / clay materials, then further investigation should be undertaken either prior to the commencement of ground disturbance activities and/or sequentially as areas of disturbance extend across the site so 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 within natural soils at the site, the following assessment activities should be undertaken by an appropriately qualified environmental consultant in accordance with the general philosophies outlined in ASSMP (1998)/ DAWR (2018) with regard to the identification of ASS/PASS material:

- 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 the depth of disturbance;
- Visual inspection and sampling of representative soil profiles of damp to saturated soil 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, no less than one sample per 1 metre per material type per area/material type should subsequently be selected for sPOCAS or chromium reducible sulfur (SCr) 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 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.

5.3 Evaluation of Potential Management Strategies

Where the presence of ASS/PASS 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 ASSMP (1998)/DAWR (2018), potential mitigation approaches have been identified:

- Where encountering ASS/PASS 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; and
- 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.

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

5.3.1 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, sediment 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 1.2 or 2 depending upon the level of uncertainty.

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.

For the purposes of this plan, the neutralising chemical is assumed to be high quality agricultural lime (aglime). The aglime should be fine ground (<1mm) calcium carbonate ($CaCO_3$) or calcite (limestone or marble powder).

During works, a sufficient supply of agricultural lime (aglime) will be required to be kept on site at all times. The quantity is based on requirements for the treatment of ASS 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.

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

- Via staging of the minor excavation/piling etc. 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;
- The proposed works are able to be staged in a manner which will allow treatment of ASS material in a timely manner;
- 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 be removed off-site as waste or alternatively re-used on site.

5.3.2 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 the proposed works 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 volume of material that may require treatment, the requirement to maintain environmental controls for this period and the potential for such works to extend the civil works program, this option is considered undesirable when compared to the relatively low cost of neutralisation chemicals as discussed in **Section 5.3.1** above.

5.3.3 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 it is anticipated that the majority of the material that may require management is fine-grained sands and clay, thereby limiting the efficacy of the technique.

5.3.4 Selection of Preferred Management Strategies

Evaluation of potential management strategies has identified the use of neutralisation techniques, where disturbance cannot be avoided (as discussed in **Section 5.4** following), as the most appropriate technique for management of disturbed soil across the majority of this site.

Management measures for excavated ASS/PASS material will include the application of neutralisation chemicals, 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 use as engineered fill material within the site, or alternatively, will require off-site disposal in accordance with the requirements of EPA (2014).

5.4 General Site Management Strategy

The site management strategy to be implemented during works which may disturb ASS/PASS materials as identified via works described in **Section 5.2** will ensure the following:

- Adequate treatment of ASS/PASS material such that there is sufficient acid neutralizing capacity and no net acidity following stabilization (as measured through appropriate field testing and laboratory validation);
- Water discharged from the excavation 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, shall be reused on site, or alternatively reused on site for dust suppression;
- Surface/groundwater quality indicators and levels are not significantly changed beyond the construction 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.

5.4.1 Pre-disturbance Works

Subsequent to the additional investigation activities as identified in **Section 5.2**, and prior to the commencement of any ground disturbance works which may disturb ASS/PASS materials at the site, including demolition and piling activities with the potential to disturb soils and/or generate spoil, the following preparations should be implemented:

- 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 ASS/PASS management activities outlined in this document. The planning should provide a contingency for treatment of additional quantities of materials in the event that requirements for the disturbance of additional ASS/PASS material is identified following the commencement of site works, or heavy rainfall/storm events result in significant additional quantities of collected impacted water; and
- The actual areas of ASS/PASS occurrence where disturbance/excavation will occur during each stage of works (piling, 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 materials needing treatment. 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.

5.4.2 Neutralisation Chemicals

As noted in **Section 5.3.1**, 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 agricultural lime (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 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. Consideration as to the feasibility of dewatering material and associated management of separated water and solids will also be required. Alternatively, consideration may be given to disposal of all material as liquid waste (as per EPA 2014 requirements).

5.4.3 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.

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. This may be appropriate for the treatment of piling spoil or minor trenching activities.

Significant Excavation Quantities

Should quantities of material disturbed in a staged manner exceed that able to be managed in a large skip bin, a treatment area 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 areas 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, 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 or nearby surface waters from the treatment area should also be prevented to the extent possible. 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 minimum application should be no less than 5 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 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, where 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, turbidity, colour or ionic composition of the receiving water body (stormwater, groundwater, sewer, etc) as per the requirements of the POEO Act (1997);
- A sufficient supply of aglime should be kept on site at all times for the treatment of ASS 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; and
- The supply shall be stored in a covered and bunded area to prevent accidental exposure to water and deterioration of the inherent neutralizing 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.

5.4.4 General Site Management

All soils must be treated as ASS material until such a time as the material is demonstrated to be non-ASS material or treatment effectively reduces the risk associated with the material and validation results meet the relevant specifications.

ASS/PASS materials that have been excavated (or otherwise brought to the ground/water surface) 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 water 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 ASS storage and treatment areas. However, ASS materials must not be used in the construction of bunds and other diversion devices.

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

5.4.5 Excavation Works

Excavation works (other than the re-profiling activities) should be undertaken in the following manner:

- Any material identified as non-ASS (as determined through investigations as detailed in **Section 5.2**) is to be removed from within the ASS zone footprint and treatment area;
- Materials identified as ASS, or suspected to comprise physical properties indicative of ASS should be assumed to be ASS unless demonstrated otherwise;
- Works including disturbance of ASS materials will be subject to field testing upon initial exposure of each soil horizon. 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-ASS soil. Alternatively, dependent upon the scheduling of the excavation works, laboratory pre-testing of soils from this zone may be undertaken using sPOCAS or S_{Cr} methods. If either the field criteria or laboratory analysis results indicate the material is considered to be ASS, then the material will require treatment as discussed in the **Section 5.4.6**;
- At the completion of the day's activities, where excavation works result in the exposure of known or suspected ASS, a guard layer of fine aglime will be applied to the base of the excavation at a rate of 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; and
- 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 5 kg/m^2 and the lime coating should be checked and re-limed as necessary on a daily basis during periods of dewatering, if required, whilst the faces are temporarily exposed and/or following wet weather events.

5.4.6 Treatment of Excavated PASS Material

Treatment of ASS soils will comprise the addition of sufficient quantities of finely ground neutralising agent to treat all oxidisable S% 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. This will need to be determined on the basis of analysis data collected as per **Section 5.2**.

The excavated ASS 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 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 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 approximately 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.

5.4.7 Water Management During Treatment

Surface drainage and groundwater that comes into contact with ASS 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 a Construction Environmental Management Plan (CEMP) or similar document, that will be prepared for the site 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, suspended sediment 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 (or equivalent alkaline product) 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 5.1** below.

Table 5.1: 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.

5.4.8 Validation of Treated PASS Material

Following the application and mixing of lime to the ASS 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 one sample 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. All samples will be obtained from no less than 0.1 m below the stockpile surface at the time of sampling to ensure representative samples are obtained for field testing/laboratory analysis.

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 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.

5.4.9 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 ASS 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;
- Rust coloured deposits on excavation faces, in drainage paths, on bunds, channels, etc indicating iron precipitates; and
- Such inspections should also identify the presence of unusual odours, including strong organic or sulfurous smells (i.e. rotten egg gas).

5.4.10 Removal of Neutralised ASS Material from the Site

Only material confirmed to be below the criteria listed in **Section 5.4.8** will be considered as stabilised ASS material for potential reuse within or removal from the site. Once stabilised, the material will be provided a final waste classification as per the requirements of EPA (2014) for off-site disposal to a lawful facility. A final round of field pH testing should be undertaken prior to loading of the trucks to ensure that pH levels remain above 6. Should material continue to have a high moisture content, consideration may be given to off-site removal as liquid waste as per EPA (2014).

6. Responsibilities

The selection of samples for environmental analysis as per **Section 5.2** shall be undertaken by a suitably qualified and experienced environmental 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 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.

7. Contingencies

In the occurrence of unexpected events, including 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.

7.1 General Site Management Activities

7.1.1 Failure of Initial Acid Neutralisation Treatment

As described in **Section 5.4.8** 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 5.3**.

7.1.2 Significant Acidification of Surface Water

Monitoring of contained water conditions within the site will be undertaken prior to the commencement of site disturbance activities and during the period of disturbance as ASS conditions are identified as outlined in **Section 5.4.9**. Should the works identify the acidification of contained water not directly related to the treatment area, all works associated with the potential disturbance of ASS at the site shall cease.

Active exposure areas will require to be limed with a guard layer of at least 5 kg lime/m^2 exposed soil and all treatment areas will be checked to ensure that leachate and water migration is not occurring onto exposed soils or into surface water drainage channels at the site. If these activities identify a source of the increased acidity, remedial actions will be implemented to prevent the further occurrence of acidification at the site.

If these activities do not identify the source of the added acidity, or alternatively, if conditions are not corrected by the addition of lime, consideration may be required to the construction of a subsurface limestone treatment trench along the site boundary to neutralise groundwater prior to movement off-site. The design of such a barrier will be highly dependent upon the stage of the disturbance works at the site and extent of the acidic plume identified in this section of the site. Disturbance works within the ASS area should not recommence until the barrier has been installed to limit the generation of additional acidic groundwater.

8. Conclusions

Site characterisation assessment data available for subsurface conditions across the site has identified the occurrence of PASS material, primarily consisting of natural soils.

Where existing and future assessment data identifies the presence of ASS/PASS materials that may be disturbed during construction activities, the measures identified in this ASSMP provide appropriate procedures to manage the risks associated with the proposed activities. If successfully implemented, these measures will minimise the environmental risks associated with disturbance of the PASS materials.

9. 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 enquires.

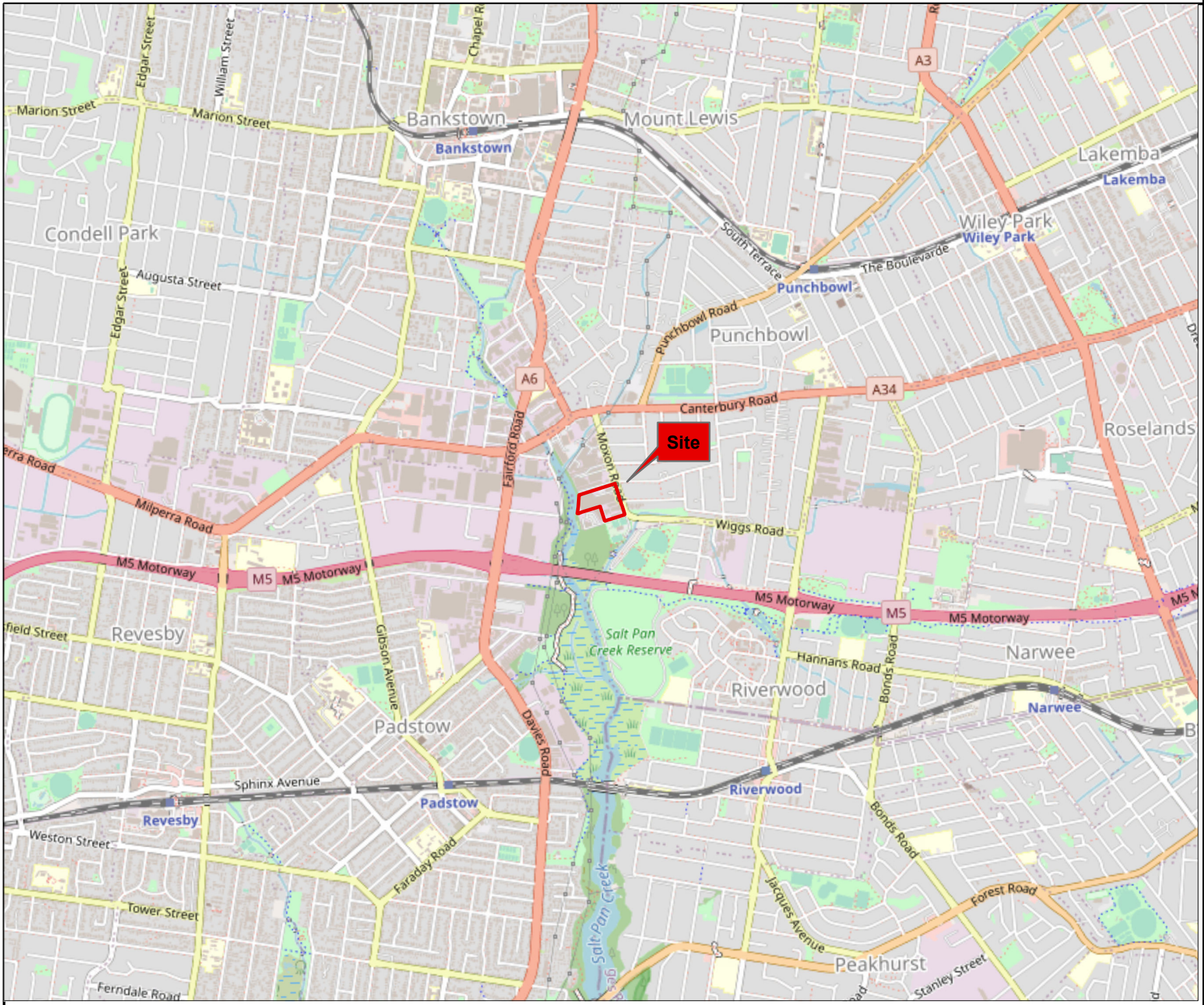
Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the 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: 63791

Client: Tactical Group

Version: R05 Rev A | Date 2/03/2023

Drawn By: YY/RF | Checked By: JN

Scale 1:30,000

0 350 700

metres

Coord. Sys. GDA 1994 MGA Zone 56

45-57 Moxon Road
Punchbowl NSW

SITE LOCATION

FIGURE 1

File Name: \\JBSGNSWFP01\Projects\Projects\Punchbowl\63791_01_SiteLocation.mxd
Reference: Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA

Legend:

- Approximate Site Boundary
- NSW Cadastre (DFSI, 2022)

Site Features

- Structure
- Stockpile
- Stormwater Discharge Point
- Stormwater Retention Basin
- Water Tank
- Chemical Storage Tank

JBS&G

Job No: 63791	
Client: Tactical Group	
Version: R05 Rev A	Date: 02-Mar-2023
Drawn By: RF	Checked By: JN

Scale 1:1,500

0 10 20
metres

Coord. Sys. GDA 1994 MGA Zone 56

45-57 Moxon Road
Punchbowl NSW

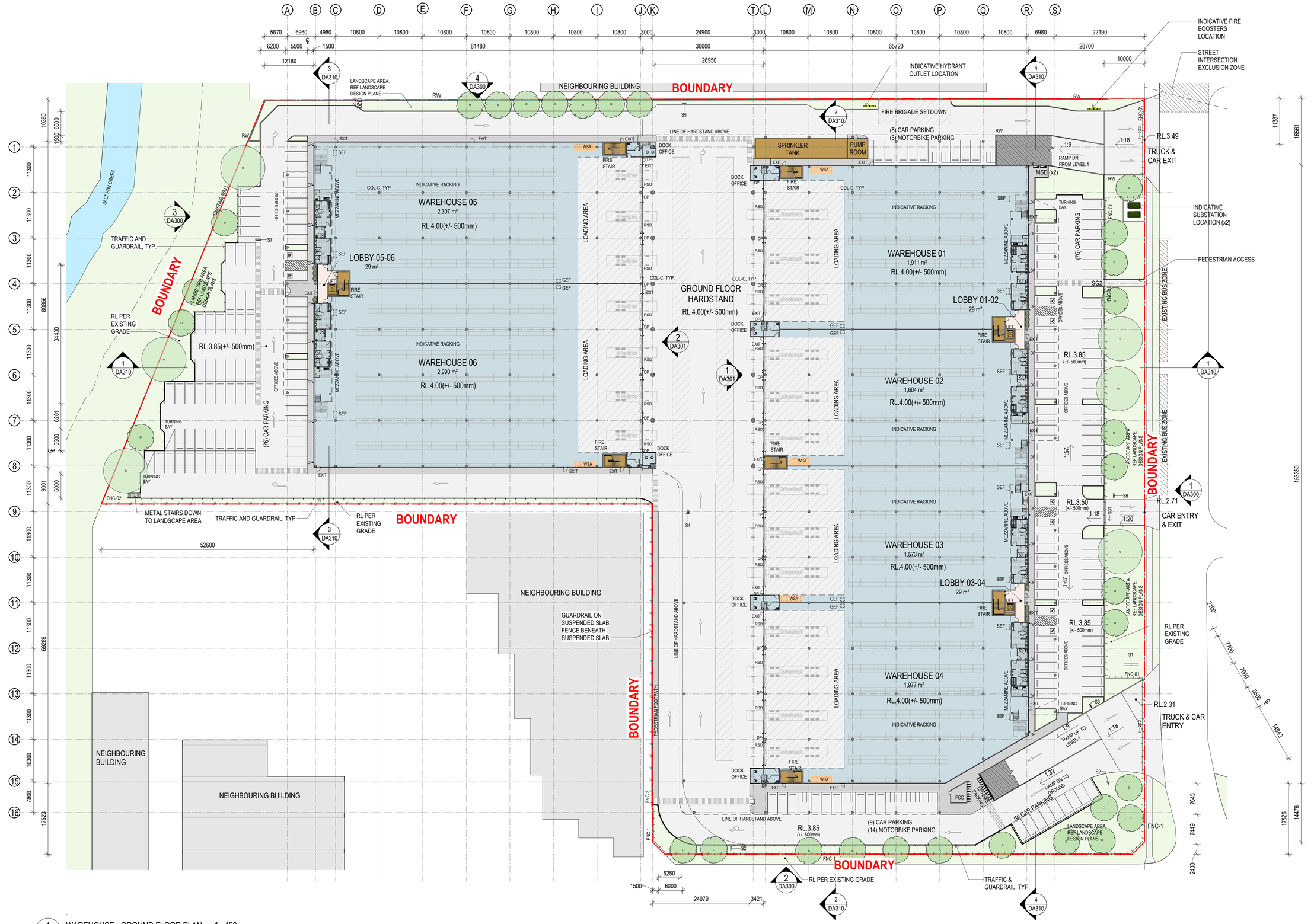
SITE LAYOUT AND FEATURES

FIGURE 2

File Name: \\JBSG-NSW-FS01\FolderRedirection$\areynolds\Documents\Projects\Punchbowl\63791_02_SiteLayout.mxd
Reference: www.nearmap.com - 20221120

Appendix A Development Plans

Hale



GENERAL LEGEND:

B1 - BOLLARD TYPE 1
COL-C - CONCRETE COLUMN
COL-S - STEEL COLUMN
RSD - ROLLER SHUTTER DOOR
FCC - FIRE CONTROL CENTRE
FNC-1 - PALISADE
FNC-2 - CHAIN WIRE
DP - DOWNPIPES
RW - RETAINING WALL
GEF - GROUND EXHAUST FAN
SEF - SMOKE EXHAUST FAN
SD/FD - SMOKE / FIRE DAMPER
TG1 - TELESCOPIC GATE
TYP - (TYPICAL)
SG1 - SLIDING GATE
SG2 - SWING GATE - PEDESTRIAN
SG3 - TELESCOPIC GATE

- SITE BOUNDARY
- LOT BOUNDARY
- BUILDING SETBACK
- TO BE DEMOLISHED
- EXISTING TREE TO BE RETAINED - REFER TO ARBORIST REPORT
- S# SIGNAGE - REFER TO SIGNAGE DETAILS
- FIRE SERVICES
- LANDSCAPE AREA
- WASTE AREA

ISSUE FOR DA

1 DA300 WAREHOUSE - GROUND FLOOR PLAN 1 : 450

SBA ARCHITECTS
Commercial Industrial Residential Retail Industrial Design
Suite 702, 83 Mount Street, North Sydney, NSW 2060
T: 02 9929 9988 F: 02 9929 9990
E: info@sbaarch.com.au W: www.sbaarch.com.au

ISSUE	DESCRIPTION	DATE
15	ISSUE FOR DA	06.04.2023
14	ISSUE FOR DA	28.03.2023
13	ISSUE FOR DA	22.02.2023
12	ISSUE FOR DA	15.02.2023
11	ISSUE FOR DA	23.01.2023
10	PRELIMINARY	14.12.2022
9	ISSUE FOR COORDINATION	12.12.2022
8	ISSUE FOR COORDINATION	07.12.2022

CLIENT: HALE CAPITAL DEVELOPMENT MANAGEMENT

MOXON ROAD MULTI-LEVEL WAREHOUSE, PUNCHBOWL

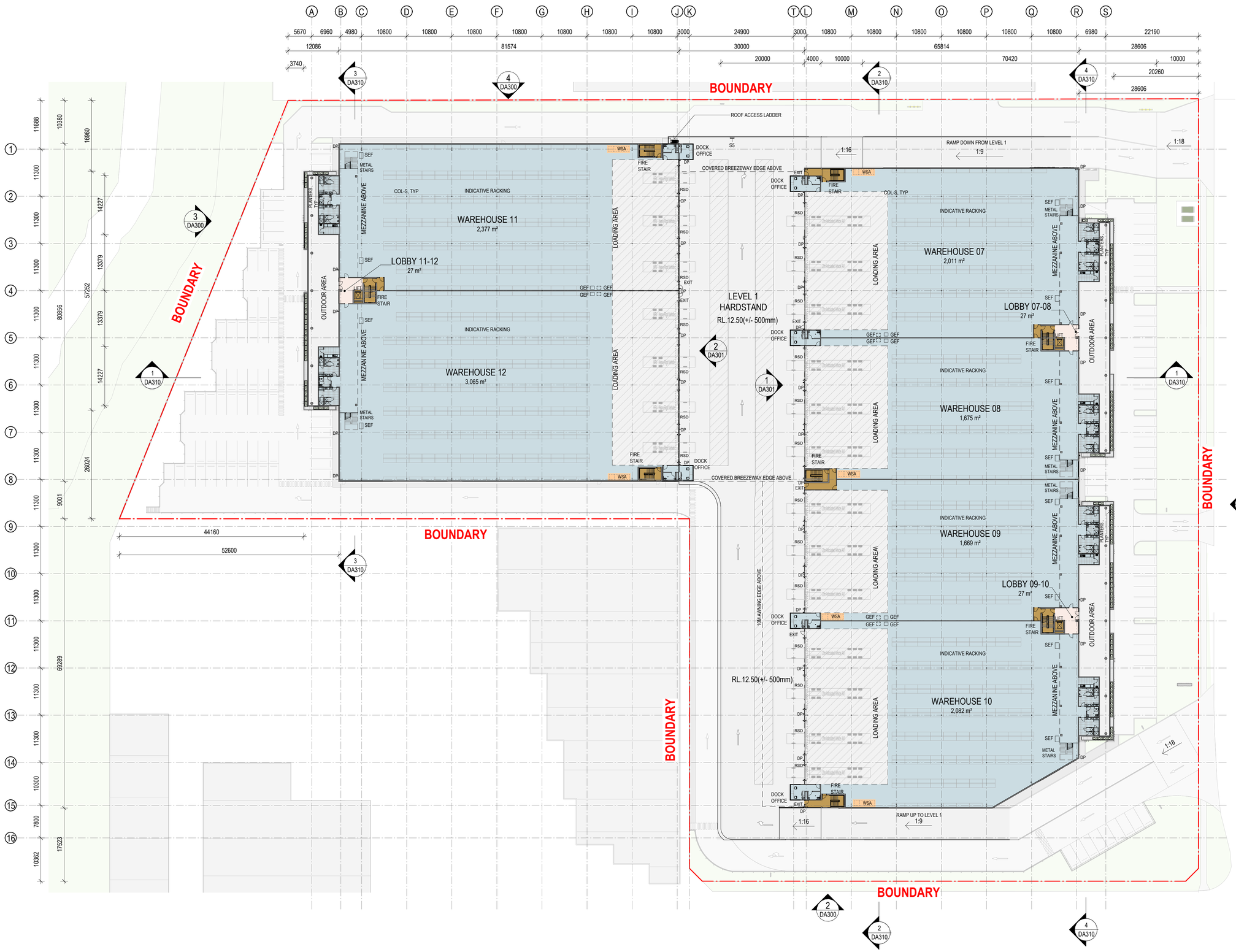
45-57 MOXON ROAD, PUNCHBOWL

NORTH

TITLE: WAREHOUSE GF PLAN

DATE	SCALE	JOB NO.	DWG NO.	REVISION
06.04.2023	As indicated @ A1	22146	DA100	15

Hale



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GEF - GROUND EXHAUST FAN
SEF - SMOKE EXHAUST FAN
SD/FD - SMOKE / FIRE DAMPER
TG1 - TELESCOPIC GATE
TYP - (TYPICAL)
SG1 - SLIDING GATE
SG2 - SWING GATE - PEDESTRIAN
SG3 - TELESCOPIC GATE

- SITE BOUNDARY
- LOT BOUNDARY
- BUILDING SETBACK
- TO BE DEMOLISHED
- EXISTING TREE TO BE RETAINED - REFER TO ARBORIST REPORT
- S# SIGNAGE - REFER TO SIGNAGE DETAILS
- FIRE SERVICES
- LANDSCAPE AREA
- WASTE AREA

ISSUE FOR DA

1 WAREHOUSE LEVEL 1 PLAN 1 : 450

SBA ARCHITECTS
Commercial Industrial Residential Retail Industrial Design
Suite 702, 83 Mount Street, North Sydney, NSW 2060
T: 02 9929 6988 F: 02 9929 6959
E: info@sbaarch.com.au W: www.sbaarch.com.au

ISSUE	DESCRIPTION	DATE
13	ISSUE FOR DA	06.04.2023
12	ISSUE FOR DA	28.03.2023
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10	ISSUE FOR DA	15.02.2023
9	ISSUE FOR DA	23.01.2023
8	PRELIMINARY	14.12.2022
7	ISSUE FOR COORDINATION	07.12.2022
6	ISSUE FOR COORDINATION	28.11.2022

CLIENT: HALE CAPITAL DEVELOPMENT MANAGEMENT

MOXON ROAD MULTI-LEVEL WAREHOUSE, PUNCHBOWL

45-57 MOXON ROAD, PUNCHBOWL

NORTH

TITLE: WAREHOUSE L1 FLOOR PLAN

DATE	SCALE	JOB NO.	DWG NO.	REVISION
06.04.2023	As indicated @ A1	22146	DA102	13