Acid Sulfate Soils Management Plan

Project

Proposed Redevelopment
51 Masons Parade, Point Frederick, NSW

Prepared for

Brisbane Waters (NSW) Legacy (BWL)
(c/ Grindley Construction)

Date

26/10/2021

Report No

10827-ER-2-2 Rev 1

alliance
geotechnical & environmental solutions

Alliance Geotechnical Pty Ltd

Address: 8-10 Welder Road
Seven Hills, NSW
Phone: 1800 288 188
Office Email: info@allgeo.com.au
Web: www.allgeo.com.au

Document Control

Revision	Date	Author	Technical Reviewer	Project Manager
0	26/10/2021	J. Walker	N. Foster	A. Rooney
1	26/10/2021	J. Walker	N. Foster	A. Rooney
2	26/10/2021	J. Walker	N. Foster	A. Rooney

Important Information About This Report

This document is produced by Alliance solely for the use and benefit by the named client in accordance with the terms of the engagement between Alliance and the name client. Alliance (and the document Certifier if applicable) does not and shall not assume any liability or responsibility whatsoever to any third party arising out of any use or reliance by any third party on the content of this document.

This report must be reviewed in its entirety and in conjunction with the objectives, scope, and terms applicable to Alliance's engagement. The report must not be used for any purpose other than the purpose specified at the time Alliance was engaged to prepare the report.

The findings presented in this report are based on specific data and information made available during the course of this project. To the best of Alliance's knowledge, these findings represent a reasonable interpretation of the general condition of the site at the time of report completion.

No warranties are made as to the information provided in this report. All conclusions and recommendations made in this report are of the professional opinions of personnel involved with the project and while normal checking of the accuracy of data has been conducted, any circumstances outside the scope of this report or which are not made known to personnel and which may impact on those opinions is not the responsibility of Alliance.

Logs, figures, and drawings are generated for this report based on individual Alliance consultant interpretations of nominated data, as well as observations made at the time fieldwork was undertaken.

Data and/or information presented in this report must not be redrawn for its inclusion in other reports, plans or documents, nor should that data and/or information be separated from this report in any way.

Should additional information that may impact on the findings of this report be encountered or site conditions change, Alliance reserves the right to review and amend this report.

Executive Summary

Alliance Geotechnical Pty Ltd (Alliance) was engaged by Brisbane Waters (NSW) Legacy (BWL) (c/ Grindley Construction) to undertake an Acid Sulfate Soils Management Plan (ASSMP) at 51 Masons Parade, Point Frederick NSW (refer Figure 1, with the 'site' boundaries outlined in Figure 2).

At the commencement of the project, Alliance had the following project appreciation:

- Acid Sulfate Soils (ASS) are naturally occurring soils and sediments containing mainly iron sulfides and iron disulfides. Exposure of these soil sulfides to oxygen has the potential to produce sulfuric acid which can have a significant impact on the environment. Leaching of sulfuric acid into waterways can cause serious water quality problems, resulting in fish kills and also damage to infrastructure.
- Acid sulfate soils can be broken down into two types when can often be found together in the same soil profile. Actual Acid Sulfate Soils (AASS) are soils or sediments containing iron sulfides that are acidic due to the partial or total oxidation (aeration) with a pH of 4 or less in dry conditions. Potential Acid Sulfate Soils (PASS) are soils or sediments containing iron sulfides that have not yet oxidised and remain in predominantly anaerobic conditions generally below the groundwater table. The pH of PASS is commonly 5.5 or more, making them neutral or slightly alkaline.
- This report uses the term ASS interchangeably for PASS and AASS except where specifically referenced.
- The site is currently owned by Brisbane Waters Legacy;
- The site is currently occupied and being used for an seniors living facility;
- The site is proposed for redevelopment, including additional residential living units that provide seniors low-cost rental accommodation housing under the NSW Retirement Villages Act 1999, which will require demolition of existing structures, and construction of apartment style residential structures, roadways, and the installation of associated infrastructure and services.
- This ASSMP is required to assist the client to address acid sulfate soils risks presented in Alliance (2020c).

The objectives of this project were to:

- Document the procedures and standards to be followed to manage the risks posed by acid sulfate soils identified during previous investigations;
- Outline the management measures to be implemented to minimise the potential for adverse human health or environmental impacts resulting from the disturbance of ASS; and
- Manage the offsite disposal of excavated materials aligned to the NSW EPA Waste Classification Guidelines Part 1: Classifying Waste, November 2014 (NSW EPA, 2014a) and Waste Classification Guidelines Part 4: Acid Sulfate Soils (NSW EPA, 2014b)

The following scope of works was undertaken address the project objectives:

- A desktop review of previous reports;
- Assessment of data and reporting.

The nominated scope of works was undertaken with reference to relevant sections of ASSMAC (1998), NASSG (2018), NSW EPA (2014a) and NSW EPA (2014b).

On completion of the treatment and reuse or offsite disposal of impacted material, a post works closure report is to be prepared. The report should include, but not be limited too, information relating to the:

- Works completed including final grade and depth to remaining ASS;
- Locations and construction methods for the treatment pad/s;
- Daily monitoring undertaken (soil and water)
- Volume of soil material excavated;
- Volume and rate of lime application to excavated soils;
- Volume and rate of lime application (if any) to effluent;
- Validation results for soil and surface water (if any);
- Unexpected finds or contingency measures implemented;
- Volume and waste classification of material removed from the site;
- Load tracking records:
- Waste tracking records; and
- Waste disposal records.

This report must be read in conjunction with the ***Important Information About This Report*** statements at the front of this report.

TABLE OF CONTENTS

FIGURES

APPENDICES

1 Introduction

1.1 Background

Alliance Geotechnical Pty Ltd (Alliance) was engaged by Brisbane Waters (NSW) Legacy (BWL) (c/ Grindley Construction) to prepare an acid sulfate soils management plan (ASSMP) for proposed works at 51 Masons Parade, Point Frederick NSW (refer Figure 1, with the 'site' boundaries outlined in Figure 2).

At the commencement of the project, Alliance had the following project appreciation:

- Acid Sulfate Soils (ASS) are naturally occurring soils and sediments containing mainly iron sulfides and iron disulfides. Exposure of these soil sulfides to oxygen has the potential to produce sulfuric acid which can have a significant impact on the environment. Leaching of sulfuric acid into waterways can cause serious water quality problems, resulting in fish kills and also damage to infrastructure.
- Acid sulfate soils can be broken down into two types when can often be found together in the same soil profile. Actual Acid Sulfate Soils (AASS) are soils or sediments containing iron sulfides that are acidic due to the partial or total oxidation (aeration) with a pH of 4 or less in dry conditions. Potential Acid Sulfate Soils (PASS) are soils or sediments containing iron sulfides that have not yet oxidised and remain in predominantly anaerobic conditions generally below the groundwater table. The pH of PASS is commonly 5.5 or more, making them neutral or slightly alkaline.
- This report uses the term ASS interchangeably for PASS and AASS except where specifically referenced.
- The site is currently owned by Brisbane Waters Legacy;
- The site is currently occupied and used as an seniors living facility;
- The site is proposed for redevelopment, including additional residential living units that provide seniors low-cost rental accommodation housing under the NSW Retirement Villages Act 1999, which will require demolition of existing structures, and construction of apartment style residential structures, roadways, and the installation of associated infrastructure and services.
- This ASSMP is required to assist the client manage acid sulfate soils risks, identified previously by Alliance (2020c), during soil disturbance works that will be conducted as part of future redevelopment works at the site.

1.2 Objectives

The objectives of this project were to:

- Document the procedures and standards to be followed to manage the risks posed by acid sulfate soils identified during previous investigations;
- Outline the management measures to be implemented to minimise the potential for adverse human health or environmental impacts resulting from the disturbance of ASS; and

- Manage the offsite disposal of excavated materials aligned to the NSW EPA (2014a) *Waste Classification Guidelines Part 1: Classifying* Waste and NSW EPA (2014b) *Waste Classification Guidelines Part 4: Acid Sulfate Soils.*

1.3 Scope of Work

The following scope of works was undertaken address the project objectives:

- A desktop review of previous reports;
- A site walkover to inform an understanding of current site conditions;

Assessment of data and reporting. The nominated scope of works was undertaken with reference to relevant sections of ASSMAC (1998), NASSG (2018), NSW EPA (2014a) and NSW EPA (2014b).

2 Site Identification

2.1 Site Details

Site identification details are presented in **Table 2.1**.

Table 2.1 Site Identification Details

Cadastral Identification	Lot 51 in DP732632
Geographic Coordinates (SIX Maps)	6252325.399N, 1463519.749E
Site Area	Approximately 1.253 hectares
Local Government Authority	Central Coast Council
Current Zoning	B4 – Mixed Use

2.2 Site Layout

The layout of the site is present in **Figure 2**. The layout plan also includes locations on site of:

- Site access points;
- Current buildings / structures;
- Surface water bodies on site and immediately adjacent to the site.

A copy of a detail and level survey of the site is presented in **Appendix A**.

3 Site Environmental Setting

3.1 Geology

A review of the 1:100,000 Geological Series Sheet (1st Edition), indicates that the site is likely underlain by Quaternary (Qa), comprising alluvium, gravel, and sand.

3.2 Site Topography and Elevation

A detail and level survey plan of the site indicated that:

- the surface of the site was located at an elevation of approximately 4m Australian Height Datum (AHD) in the north and 11m AHD in the south.

3.3 Acid Sulfate Soils

A review of NSW Department of Land and Water Conservation Acid Sulfate Soil Risk Map for the site indicates that the site lies in an area mapped as *No known occurrence* with respect to acid sulfate soils (ASS). However, the site is within close proximity to disturbed terrain to the west (Brisbane Waters). Further assessment of ASS, in the context of this investigation is considered warranted.
(Source: https://www.environment.nsw.gov.au/eSpade2WebApp)

Further assessment of acid sulfate soils, in the context of this project is considered warranted.

3.4 Hydrogeology and Hydrology

A review of maps held on file by Alliance, indicated that surface water bodies located on or near the site included:

- An unnamed creek immediately north of the site.
- Brisbane Waters, approximately 160 m to the west of the site.

Based on prevailing site topography, groundwater flow direction in the vicinity of the site is inferred to be towards the south to west.

A search of https://realtimedata.waternsw.com.au/water.stm indicated that there are no registered groundwater features located within a 500m radius of the site.

A copy of the online search record is presented in **Appendix B**.

4 Previous Contamination Assessments

A copy of:

- Alliance (2020a), 'Sampling, Analytical and Quality Plan (SAQP) , Lot 51 in DP732632, 51 Masons Parade, Point Frederick NSW', dated May 2020, Ref: 10827-ER-1-1.
- Alliance (2020b), 'Detailed Site Investigation, Lot 51 in DP732632, 51 Masons Parade, Point Frederick NSW', dated June 2020, Ref: 10827-ER-1-2.
- Alliance (2020c), 'Acid Sulfate Soils Assessment, Lot 51 in DP732632, 51 Masons Parade, Point Frederick NSW', dated July 2020, Ref: 10827-ER-2-1.
- Alliance (2020d), 'Indicative Waste Classification Report, Lot 51 in DP732632, 51 Masons Parade, Point Frederick NSW', dated July 2020, Ref: 10827-ER-1-2.
- SWE (2021), 'Hazardous Materials Survey & Management Plan, Lot 51 in DP732632, 51 Masons Parade, Point Frederick NSW', Ref: S109616, dated March 2021.
- Alliance (2021), 'Targeted Groundwater Assessment, Lot 51 in DP 732632, 51 Masons Parade, Point Frederick NSW', dated 30 March 2021, Ref: 10827-ER-1-3 Rev 1

was provided to Alliance for review.

4.1.1 Alliance (2020a)

Alliance Geotechnical Pty Ltd (AG) was engaged by Grindley Constructions, to prepare a Sampling and Analysis Quality Plan (SAQP) for 51 Masons Parade, Point Frederick NSW.

Alliance understand that the current redevelopment proposal for the site will result in future use for high density residential purposes. It is understood that the proposed development will include demolition of current structures, and construction of a seven (7) storey apartment complex, on-ground carparking, an administration office and a community hall facility.

In light of the proposal, a contamination assessment of the site is required in accordance with SEPP55.

The objectives of this investigation were to:

- Provide a sampling framework for the proposed intrusive investigation of the site.

The scope of works undertaken to address the investigation objectives, included:

- The preparation of a Sampling, Analysis and Quality Plan (SAQP) to direct intrusive investigation of potential contamination in soil and groundwater onsite.

Based on the findings of desktop review information, in the context of the proposed redevelopment scenario, Alliance made the following conclusions:

- An SAQP has been generated to inform the intrusive detailed site investigation for the site, which when followed will assess the site's suitability, in the context of land contamination.

4.1.2 Alliance (2020b)

Alliance Geotechnical Pty Ltd (AG) was engaged by Brisbane Waters (NSW) Legacy (BWL) (c/ Grindley Construction), to undertake a Detailed Site Investigation for 51 Masons Parade, Point Frederick, NSW.

- The northern portion of the site is being considered for redevelopment, comprising demolition of existing structures and construction of apartments over seven (7) levels and ground level parking structures; and
- A contamination assessment of the site is required in accordance with the SEPP55.

The objectives of this investigation were to:

- Evaluate the possibility for contamination to be present at the site as a result of current and former land use activities;
- Identify risks to both human-health and environment receptors posed by contaminants identified from intrusive investigation at the site;
- Provide advice on the suitable (in the context of land contamination) of the soil and groundwater for the proposed land use setting at the site; and
- Provide recommendations for further investigation, management and/or remediation (if warranted).

The scope of works undertaken to address the investigation objectives, included:

- A desktop review of relevant information pertaining to the site;
- A site walkover to understand current site conditions;
- The preparation of a Sampling and Analysis Quality Plan (SAQP);
- Conduct an intrusive site investigation to establish ground conditions and to facilitate the collection of representative soil and groundwater samples;
- Laboratory analysis of selected samples collected during the field investigation; and
- An assessment of the contamination status of the site and the recommendation of any further remedial requirements associated with the redevelopment of the site (if necessary).

Conclusions

Based on the findings of desktop review information, fieldwork observations and laboratory analytical data, in the context of the proposed redevelopment scenario, Alliance makes the following conclusions:

- Site history records indicate that the site has been used historically for residential purposes;
- Based on the findings of the site history and land use, the most plausible sources of contamination were associated with historic filling, the weathering of building structures, pesticide use, and demolition of structures;
- Intrusive investigation at the site utilised 21 sampling locations for the description of site soils and collection of soil samples for laboratory analysis;
- A further 3 boreholes across the proposed development portion of the site were advanced, and groundwater wells installed for the description of site groundwater and collection of groundwater samples for laboratory analysis;
- Laboratory analytical results for TRH, BTEXN, PAH, OCP, OPP, PCB, HM, and Phenols reported concentrations below adopted investigation criteria in fill and natural soils;

- Asbestos was reported in soil sample TP19 analysed by the testing laboratory, in the form of friable asbestos;
- Laboratory analytical results for TRH, BTEXN, PAH, OCP, OPP, PCB, Phenols and Cations/Anions reported concentrations below adopted investigation criteria within groundwater; and
- Priority metals were reported at concentrations in groundwater below adopted investigation criteria, except for lead and zinc which exceeded the ANZG 95% protection of Marine Water criteria in GWM1, GWM3, GWM4 & DUP01, zinc in DUP01A, and nickel which exceeded the NEPM ASC health criteria in GWM3 & GWM4.

Recommendations

Based on the above conclusions, from a contamination perspective, the land in its current state is not suitable for the proposed development. The land could potentially made suitable for the proposed residential subdivision subject to the following recommendations being undertaken:

- A remedial action plan (RAP) should be prepared for the site, to address potentially unacceptable friable asbestos in soil related human health exposure risks at the site and nickel, lead and zinc in groundwater related exposure risks;
- The RAP should be prepared by a suitably experience environmental consultant with reference to NSW EPA (2020) and include (but not be limited to) the following:
    - a remedial goal for the site;
    - an assessment of remedial options available to address the identified asbestos risks. These options may include removal offsite, in-situ containment, ex-situ containment, or a combination of these;
    - the proposed testing to validate the site after remediation;
    - a contingency plan to address unexpected finds or if the selected remedial strategy fails; and
    - a site management plan (for the remediation works).
- Consideration should be given to undertaking lateral delineation assessment works around detected asbestos contamination, as well as a more detailed groundwater assessment across the site, should there be a need to obtain further certainty around the nature and extent of remedial works required. The delineation work could be undertaken
    - prior to preparation of the RAP; or
    - following preparation of the RAP, with a RAP addendum issued incorporating the findings of the delineation assessment;
- Records of the lawful transport and disposal of asbestos containing materials and any other wastes removed from site, should be retained.

4.1.3 Alliance (2020c)

Alliance Geotechnical Pty Ltd (AG) was engaged by Brisbane Waters (NSW) Legacy (BWL) (c/ Grindley Construction) to undertake an Acid Sulfate Soils Assessment at 51 Masons Parade, Point Frederick NSW.

Alliance understands that additional residential living units are proposed for the Legacy seniors living facility, which will require demolition of existing structures, and construction of an apartment style residential seniors living facility, roadways, and the installation of associated infrastructure and services. A contamination assessment of the site is required in accordance with the SEPP55.

The objectives of this project were to:

- Provide an assessment of acid sulfate soils on the site; and
- Provide recommendations on further assessment, management of remediation of acid sulfate soils (if identified).

Alliance undertook the following scope of works to address the project objective:

- A desktop review of relevant acid sulfate soils risk planning maps, previous investigation reports and other relevant information relating to the site;
- Conduct an intrusive site investigation to establish ground conditions and to facilitate the collection of representative soil samples;
- Laboratory analysis of selected samples collected during the field investigations; and
- Report the findings in accordance with Acid Sulfate Soils Manual 1998 (ASSMAC 1998) and the National Acid Sulfate Soil Guidance (Australian Government 2018) ASS and potential ASS risk across the project footprint.

Conclusions

Based on the desktop review data, fieldwork observations, and the laboratory analytical results, Alliance concludes that:

- Potential ASS were identified by preliminary laboratory analysis in eighteen (18) soil samples collected across the site, indicating that the soil materials which were encountered at depths between 0.5m and 4.5m bgl are potentially impacted by ASS;
- A further six (6) soil samples were submitted for CRS analysis and returned results indicating the presence of AASS and PASS collected from boreholes MW01-0.5, MW01-3.0, MW03-3.5, MW04-2.0, MW04-3.0 and MW04-4.5, indicating the presence of AASS and PASS from site surface to depths excavation across the site;
- The liming rate required for remediation of the AASS and PASS across the site is between 2.2 kg$CaCO_3$/tonne to 79 kg$CaCO_3$/tonne; and
- The identified potential ASS at the site are likely to be disturbed by the construction phase of the works.

Based on these conclusions, Alliance makes the following recommendations:

- An acid sulfate soils management plan (ASSMP) should be developed for the site so to:
    - Document the procedures and standards to be followed to manage the risks posed by potential ASS identified during construction;
    - Outline the management measures to be implemented to minimise the potential for adverse human health or environmental impacts resulting from the disturbance of ASS; and

Manage the offsite disposal of excavated materials aligned to the NSW EPA Waste Classification Guidelines Part 1: Classifying Waste, November 2014 (NSW EPA, 2014a) and Waste Classification Guidelines Part 4: Acid Sulfate Soils (NSW EPA, 2014b).

4.1.4 Alliance (2020d)

Alliance Geotechnical Pty Ltd (AG) was engaged by Grindley Construction Pty Ltd (the Client) to provide an indicative waste classification of in-situ soil material located at 51 Masons Parade, Point Frederick NSW (the site).

An appropriately experienced environmental consultant fromAlliance visited the site on the 1 June 2020 and collected a total of thirty-five (35) soil samples. Samples were collected within the area of the site's proposed excavation to provide understanding of possible soil waste streams requiring future offsite disposal.

Indicative Material Classification

Based on Alliance Geotechnical Pty Ltd.'s (AG) assessment of fieldwork observations and laboratory analytical data, and as of the date of this report, the material is chemically consistent with General Solid Waste (Non-putrescible) from site surface to depth of excavation. However, based on the previously completed Acid Sulfate Soils Assessment (10827-ER-2-1) by AG, for material to be suitable for offsite disposal, the soil material will require treatment with lime to neutralise any potential acidity generated by the oxidation of ASS. Lime treatment is to be completed in accordance with the site ASS Management Plan prior to offsite disposal.

4.1.5 SWE (2021)

Safe Work and Environments Pty Ltd (SWE) was commissioned by Alliance Geotechnical (Alliance) on behalf of Grindley Construction Pty Ltd to carry out a Hazardous Materials Survey of the site located at 51 Masons Parage, Point Frederick NSW, 2250.

The survey was undertaken by Alexandar Mitevski (Senior Hazardous Materials Consultant) between Wednesday 17th March 2021 to Monday the 22nd of March 2021 over three days.

The purpose of the survey was to identify the following hazardous construction materials:

- asbestos containing materials (ACM);
- lead based paints;
- synthetic Mineral Fibre (SMF); and
- polychlorinated biphenyls (PCBs).

The scope of works involved the following:

- Development of a task specific Safe Work Method Statement (SWMS);
- Walkthrough inspection of the site building/s;
- Identification of all visible and accessible hazardous materials including asbestos, lead, SMF & PCBs;
- Sampling of suspect materials where necessary/possible;
- Laboratory analysis of the samples where the inspector suspected the presence of asbestos containing materials; and

- Preparation of a Hazardous Materials Register and Management Plan in accordance with all relevant legislative requirements.

The objectives of the Hazardous Materials Survey and Management Plan are to:

- Identify hazardous materials within the building(s);
- Detail the survey methodology;
- Provide a qualitative risk assessment of the identified hazardous materials and provide information regarding health risks;
- Provide recommendations for control measures and management strategies;
- Prepare a Hazardous Materials Register for the site to ensure legislative compliance;
- Outline the responsible persons and details those persons responsibilities in relation to managing on site Asbestos Containing Materials;
- Detail the principles of hazardous materials management;
- Detail management strategies for in-situ asbestos and other hazardous materials;
- Provide information about Safe Working Practices for work involving asbestos and other hazardous materials;
- Detail the requirements for removal of Asbestos Containing Materials (ACM);
- Provide a template for Emergency Response Procedures; and
- Outline Asbestos Training and Awareness.

Summary of Findings

The majority ACM encountered on Site was in good condition and therefore are considered **Low Risk**.

Friable linoleum paper backing was found in villas 57-64, however this material was generally in good condition, this was conserved **Medium Risk.** If disturbed, please follow the control measures presented in **Section 7.2**.

Synthetic Mineral Fibres identified on site were considered **Low Risk**. The material is in good condition, with limited accessibility, it is unlikely to present a risk to health unless damaged, tooled, cut, sanded, or machined.

The Lead based paint systems identified on site varied in condition. It recommended that flaking and caulking sections of paint in high access area be removed and replaced with a lead-free substitute.

The settled dust containing elevated levels identified on flat surfaces was generally in low traffic areas. It is recommended that high traffic areas have the excess dust removed by a licensed contractor. Polychlorinated biphenyls were assumed to be present in various light fixtures in occupation, confirm the status of these once power has been isolated.

A full listing of all hazardous items identified, including a risk assessment of these has been included in the Hazardous Materials Register section of this report. It is recommended that all hazardous materials should be removed prior to any demolition or refurbishment works that would disturb these materials. All asbestos removal works are to be carried out in accordance with the National Code of Practice for the Safe Removal of Asbestos [NOHSC:2002 (2005)].

This survey was limited to accessible areas of the building with limited intrusive sampling carried out. Hence further inspection of building materials that may be concealed behind other building materials may be required in conjunction with future demolition, or similar work.

4.1.6 Alliance (2021)

Alliance Geotechnical Pty Ltd (Alliance) was engaged by Brisbane Waters (NSW) Legacy (BWL) (c/ Grindley Construction) to undertake a Target Groundwater Assessment (TGA) at 51 Masons Parade, Point Frederick NSW (refer **Figure 1,** with the 'site' boundaries & investigation area outlined in **Figure 2**).

Alliance understands that:

- Additional residential living units are proposed for the Brisbane Water Legacy (BWL) that provides seniors low-cost rental accommodation housing under the NSW Retirement Villages Act 1999, which will require demolition of existing structures, and construction of apartment style residential structures, roadways, and the installation of associated infrastructure and services.
- Previous contamination assessments have been completed for the site by Alliance in 2020 & SWE in 2021.
- Alliance (2020b) recommended that a remediation action plan (RAP) is required for the site, in order to address heavy metal in groundwater and asbestos in soil risks.
- SWE (2021) provided an Asbestos Register for all asbestos containing materials within the site, including the friable asbestos in the south of the site.
- A targeted groundwater assessment of the site is required to address groundwater contamination risks presented within the Alliance's DSI in 2020.

The objectives of this investigation were to:

- Evaluate the possibility for groundwater contamination to be present at the site as a result of current and former land use activities.
- Identify risks to both human-health and environment receptors posed by contaminants identified from intrusive investigation at the site.
- Provide advice on the suitability (in the context of land contamination) of the groundwater for the proposed land use setting at the site.
- Provide recommendations for further investigation, management and/or remediation (if warranted).

The scope of works undertaken to address the investigation objectives, included:

- A desktop review of relevant historical site information pertaining to the site.
- A site walkover to understand current site conditions.
- The preparation of a Sampling and Analysis Quality Plan (SAQP).
- Completion of an additional round of groundwater sampling from established groundwater wells to establish groundwater conditions and collect groundwater samples.
- Laboratory analysis of selected samples collected during the field investigation for contaminants of potential concern (COPC) identified by the review of site history and land use activities.
- An appraisal of the contamination status of the site and the recommendation of any further remedial requirements associated with the redevelopment of the site (if necessary).

Conclusions

Based on the findings of desktop review information, fieldwork observations and laboratory analytical data, in the context of the proposed redevelopment scenario, Alliance makes the following conclusions:

- Three groundwater monitoring wells, installed by Alliance in (2020b), were sampled.
- Groundwater was reported at depths ranging between 2.24 to 2.7 mBGL.
- Identified COPC in the sampled groundwater, including heavy metals, are considered unlikely to present an unacceptable human health risk.
- The concentrations of heavy metals reported in groundwater monitoring wells, and exceeding the ANZG (2018) ecological criteria, are considered representative of local groundwater quality entering the site, and not related to site activities.
- The asbestos risk for the site has been noted in the asbestos register and management plan, and is outside of the area of investigation and redevelopment, and so Alliance considers that the risk of asbestos is managed, and does not impact the proposed redevelopment of the site.
- Alliance considers that, as the asbestos and groundwater risks have been managed, a remedial action plan is no longer necessary for the site, in the context of the previously identified contaminants.

Based on the findings of this assessment, the land in its current state is considered suitable for future development of the site for continued medium-density residential land use.

5 Acid Sulfate Soils Assessment

The acid sulfate soils assessment undertaken by Alliance in Alliance (2020c) included collecting soil samples from four (4) boreholes advanced using a track mounted drill rig fitted with solid flight augers to a maximum depth of 6.0m bgl. The ASS assessment undertaken by Alliance in Alliance (2020c) was part of an overall indicative waste classification assessment which included collecting soil samples from test pits across the site. Soil samples were collected at every 0.5m interval for field peroxide testing. The assessment included preliminary screening followed by a detailed assessment for the presence of ASS. The works undertaken by Alliance is discussed in **Sections 4.1** and **4.2** below.

5.1 Field Peroxide Testing

Thirty-three (33) soil samples were subjected to preliminary field screen assessment at the laboratory to assess the likelihood for acid sulfate soils. This preliminary assessment is comprised of

- (pHf) - assessing the pH of the soil as it would likely be in the natural environment; and
- (pHfox) - assessing the pH of the soil following the addition of hydrogen peroxide to oxidise sulfides in the soil matrix.

The 33 soil samples were analysed for pHf to determine if the pH was less than the preliminary 'actual acid sulfate soil' screening criterion of pH<4. The reported pHf values were 5.4 or greater, indicating that actual acid sulfate soils are unlikely to be present onsite between the surface and 6.0m below ground level (bgl).

The soil samples were then subjected to hydrogen peroxide by the laboratory with the pH of the oxidised soil (pHfox) measured. Eighteen (18) of the samples analysed reported a pHfox result less than the preliminary screening criterion of <3.5. Soil sample MW03-3.5 reported the lowest pHfox value of 1.5 pH units with a maximum 4.9 pH units between pH and pHfox. A total of nineteen (19) soil samples reported an extreme reaction to the addition of hydrogen peroxide. The results indicated potential acid sulphate soils are likely to be present on the site between 0.0 and 6.0 m bgl.

5.2 Chromium Reducible Sulfur

A total of thirteen (13) soil samples were subjected to chromium reducible sulfur laboratory analysis.

The chromium reducible sulfur laboratory analytical results were compared with the action criteria adopted that would trigger a need for an acid sulfate soils management plan (ASSMP). Although the final design is yet to be finalised, for the purpose of selecting site specific action criteria, as per Table 4.4 of ASSMAC 1998, Alliance has assumed that the soil type present on site is '*coarse texture sands to loamy sands'* and that more than 1,000 tonnes of soil would be disturbed as part of the proposed works.

The sulfur trail and acid trail analytical results for the soil samples analysed did not trigger the adopted action criteria (0.03 % S oxidisable and 18 mol H+ / tonne, respectively), with the exception of soil samples:

- MW01-0.5;
- MW01-3.0;
- MW03-3.5;
- MW04-2.0;
- MW04-3.0; and
- MW04-4.5.

5.3 Liming Rate

The reported liming rate for the treatment of ASS that were reported by the investigation range between 2.2 kg $CaCO_3$ / tonne to 79 kg $CaCO_3$ / tonne. Alliance considers that a conservative approach should be adopted for the treatment of ASS and recommends application of lime at a rate of **79 kg $CaCO_3$ / tonne of ASS**.

The laboratory results are summarised in the **Table 5.3** below and laboratory documentation is attached in **Appendix B** of Alliance (2020c).

Table 5.3 ASS Summary Table

Sample ID/ depth (m)	Net Acidity – Acidity units (mol H^+/tonne)	Net Acidity – Sulfur units (%S)	Liming Rate (Kg $CaCO_3$/T)
MW01/0.5	46	0.007	3.4
MW01/3.0	280	0.45	21
MW03/3.5	1100	1.7	79
MW04/2.0	100	0.17	7.7
MW04/3.0	50	0.08	3.7
MW04/4.5	29	0.05	2.2

6 ASS Screening & Assessment Criteria

Assessment of ASS is generally divided into two components:

- Measuring the pH values of soil to understand the likely presence of PASS; and
- Chemical analysis, by a NATA accredited laboratory, to confirm the presence/absence of ASS.

The indicators of ASS and the assessment criteria are provided in *Acid Sulfate Soil Management Guidelines*, NSW Acid Sulfate Soil Management Advisory Committee, August 1998 (ASSMAC, 1998), and have been summarised in **Sections 5.1** and **5.2**.

6.1 Screening

Field screening can be utilised to assess the effectiveness of the treatment prior to sample collection for submission to the testing laboratory for validation and/or waste classification purposes. A summary of the values and the associated management measures are outlined in **Table 6.1.1**.

Table 6.1 pHF and pHFOX Indicators of ASS

pHF Value	pHFOX Value	pH Change	Effervescence	Management
Greater than 5.5	Greater than 4.5	Less than 2	Non to mild	AASS and PASS unlikely. No action required.
Greater than 5.6	less than 3	Greater than 2	Mild - extreme	PASS suitable for burial below the water table within 16 hours.
Greater than 4.5 but less than 6	Greater than 3.5	Less than 1	Non to mild	AASS and PASS unlikely. No action required.
Greater than 4 but less than 5.6	less than 3	Greater than 1	Mild - strong	Some AASS possible and PASS may exist. Material requires treatment.
Less than or equal to 4	Less than 4	Less than 1	Non to mild	AASS are likely. Material requires treatment.
Less than or equal to 4	less than 3	Greater than 2	Mild - strong	AASS and PASS likely. Material requires treatment.

6.2 Assessment Criteria

The action criteria for ASS is dependent on the volume of material as well as the soil type to be excavated. **Table 4.2** outlines the action criteria provided in the *Acid Sulfate Soil Manual,* August 1998, (ASSMAC). As greater than 1,000 tonnes is proposed to be excavated during the proposed development works, Alliance have applied 0.03% S oxidisable and 18 mol H^+ / tonne in the assessment of soils within the site.

Table 6.2 Action Criteria Based on ASS Soil Analysis for Three Broad Texture Categories

Type of Material		*Action Criteria 1-1000 tonnes disturbed*		*Action Criteria if more than 1000 tonnes disturbed*	
Texture range.McDonald et al. (1990)	*Approx. clay content (% < 0.002 mm)*	*Sulfur trail % S oxidisable (oven-dry basis) eg STOS or SPOS*	*Acid trail mol H^+/tonne (oven-dry basis) eg, TPA or TSA*	*Sulfur trail % S oxidisable (oven-dry basis) eg STOS or SPOS*	*Acid trail mol H^+/tonne (oven-dry basis) eg, TPA or TSA*
Coarse Texture Sands to loamy sands	≤5	0.03	18	0.03	18
Medium Texture Sandy loams to light clays	5 - 40	0.06	36	0.03	18
Fine Texture Medium to heavy clays and silty clays	≥40	0.1	62	0.03	18

6.3 Waste Disposal Criteria

NSW EPA (2014b) indicates that offsite disposal of ASS can be managed in three ways:

1. excavation and offsite disposal of PASS by placement under the water table within 24 hours (must be received at the proposed disposal location within 16 hours); OR
2. onsite treatment with subsequent validation sampling confirming neutralising of the ASS and assessment for chemical parameters as well; OR
3. disposal of untreated ASS to a facility licenced to accept the untreated ASS.

In addition to the acid sulfate soils assessment, NSW EPA stipulate that a waste classification analysis be carried out on material requiring offsite disposal in accordance with the NSW EPA *Waste Classification Guidelines* 2014.

Should offsite disposal of PASS for reburial or offsite disposal of untreated ASS at a licenced facility be selected as a disposal option, the proposed facility should be contacted to determine any licence specific conditions on disposal that may exist. The initial site screening, prior to offsite disposal of PASS for reburial, will generally consist of field screening with the pH_F of 5.6 pH units or higher. Regardless of the classification of the soil, disposal will be at the discretion of the receiving facility. Approval to dispose of the excavated material at the receiving facility will be required prior to transport from the site.

6.3.1 Assessment Criteria for Treated ASS

Following application of lime and subsequent mixing, samples of the treated soil are to be collected at a rate outlined in **Section 6.8**. Initial sample analysis should be undertaken using field screening techniques (refer **Section 6.4**) with the results compared to assessment criteria outlined in **Table 6.1**. Field screening results (pH_F and pH_{FOX}) less than 5.5 and 4.5 pH units respectively are to trigger further lime application, re-mixing, and re-screening.

Sample results returning field screening results (pH_F and pH_{FOX}) greater than 5.5 and 4.5 pH units respectively should be submitted for laboratory analysis for pH_F and pH_{FOX} in combination with waste classification sample collection as outlined in **Section 6.8**. The laboratory results are then to be assessed against the criteria outlined in **Table 6.2**.

6.4 Effluent Disposal Criteria

Should effluent be generated from the ASS treatment area or dewatering be required, it will require chemical assessment prior to discharge. The relevant criteria for assessment of effluent to be discharged to stormwater are outlined in the *NEPM (2013)*. The trigger values for marine water for a level of protection for 95% of species is considered appropriate given the location of the site and proximity to Brisbane Water. Groundwater assessed at the site is unsuitable for discharge to municipal stormwater without further assessment/treatment due to the detected concentrations of contaminants of concern Alliance (2020b).

Dewatering of groundwater from the site must only be undertaken following approval, in the form of a licence, from Water NSW. Discharge of groundwater, post treatment, into the municipal stormwater system should be undertaken following approval from Central Coast Council . If groundwater is expected to be encountered during the proposed development, a groundwater management plan would be required. Alternatively, a licenced waste removal contractor could be engaged to remove the effluent subject to sampling assessment outlined by the chosen contractor.

7 Soil Management Strategy

The following management strategies have been prepared in general accordance with guidance provided in *Acid Sulfate Soil Management Guidelines*, NSW Acid Sulfate Soil Management Advisory Committee, August 1998 (ASSMAC, 1998) and the NSW DECC (2007) *Acid Sulfate Soil Remediation Guidelines for Coastal Floodplains in New South Wales* (NSW DECC, 2007).

Based on the assessment of the analytical results (refer **Section 5**) the soil material is likely to be excavated and disposed offsite as acid sulfate soils (either treated or untreated but subject to the licenced disposal facility conditions and waste classification).

Treatment of ASS (where required) will be conducted in designated treatment areas using the liming rate provided in **Section 5.3.**

7.1 Roles and Responsibilities

The assigned Principal Contractor must:

- be responsible for the proposed project work until the work is completed;
- ensure that persons involved with proposed project work have undertaken occupational health and safety training;
- keep records of induction training for site workers and site-specific training;
- ensure that subcontractors (if any) provide safe work method statements for the activities for which they are engaged;
- monitor subcontractors to ensure that they are complying with the safe work method statements; and
- maintain a hazardous substance register for hazardous substances used or present on the site.

The Principal Contractor is responsible for co-ordinating health and safety activities for the project. Other responsibilities of the Principal Contractor include:

- compliance with work health and safety and environmental legislation, regulations, standards, codes, and the site-specific rules relating to safety contained in this ASSMP;
- ensuring that sufficient funds are available to procure the necessary health and safety equipment such as personal protective equipment (PPE);
- managing accident and emergency procedures; and
- managing workplace injury management and rehabilitation.

The Principal Contractor has the authority to suspend or modify work practices and administrate disciplinary actions for individuals whose conduct does not meet the minimum site requirements set forth herein.

It should be noted that lime should be treated with care as incorrect use and/ or handling can result in adverse impacts on human health and the surrounding environment. As such persons associated with application or treatment of the ASS should be suitably trained for the type of work being undertaken. A job safety analysis (JSA) (or a safe work method statement (SWMS)) should be in place prior to undertaking works involving ASS. The JSA or SWMS should be reviewed and approved by the principal contractor.

A suitably qualified and experienced environmental consultant is required to assess the treatment of ASS including collection of validation samples. Further the environmental consultant will be responsible for providing a waste classification assessment for offsite disposal of material.

7.2 Excavation

Excavation work will be required within the proposed locations to depths of approximately 6.0m bgl and Installation of building foundations including potential drilling to bedrock. **Table 7.2** presents the appropriate management strategy for the excavation of material located onsite. A graphic representation of the soil material is provided in borehole logs from Alliance (2020c), **Appendix A.**

Table 7.2 Management Requirements for Soil Materials

Designation	Approximate depth (m bgl)	Soil type	Management
Onsite Treatment/ offsite disposal	Site surface to excavation depth	Sand and clayey sand	Material excavated and transported to the designated pads for lime treatment for offsite disposal. Once treated, sample excavated material as outlined in **Section 7.8** for re-use onsite or waste classification and offsite disposal. OR Excavation and re-burial beneath groundwater at an offsite licensed facility (subject to acceptance and pH screening results). OR extraction and offsite disposal to a facility licenced to accept untreated ASS (subject to disposal facility's specific conditions)

Indicative waste classifications were provided within the waste classification and acid sulfate soils assessment in Alliance (2020c) and Alliance (2020d). However, further sample collection and analysis will be required to provide appropriate waste classifications for all material to be disposed offsite, including from areas not assessed during previous assessments. Results would require comparison to the NSW EPA *Waste Classification Guidelines* (NSW EPA, 2014a)

The ASS requiring treatment (if selected as the management option) will be excavated and placed in designated treatment areas with lime application at the rate outlined in **Section 5.3.** Following completion of excavation to the design level, a sample is to be collected from the existing surface and subject to field screening. Should the results indicate ASS, lime will be spread across the area of excavation at the rates outlined in **Section 5.3**. The surface will then be covered the same day with geofabric.

7.3 Stockpiling

The excavated soil material is to be placed into designated ASS treatment areas if not transported directly offsite to an appropriately licenced facility. The stockpiled material should be placed in layers to allow application of lime and associated mixing as outlined in **Section 7.6**. The stockpiles are to be covered to minimise potential rainfall contact will ASS or treated ASS material. Once the stockpiled material has been treated as outlined in **Section 7.6,** validation samples should be collected by an appropriately experienced environmental consultant and transported to a NATA accredited laboratory for analysis. Stockpiled material is to remain in the designated area until the NATA accredited laboratory reports indicate that the stockpiled material has been successfully treated and is suitable for reuse onsite or adequately classified for offsite disposal as outlined in **Section 7.8**.

Records of sources of excavated material and the location of the treatment areas should be maintained as outlined in **Section 9**.

7.4 Field Screening

Onsite field screening is a procedure available to monitor the effectiveness of the initial treatment method and to reduce the reoccurrence of ASS validation results failing. The first component of the procedure includes adding deionised water to the pH_F soil sample in a shallow test tube or similar and mix such that a grout mix paste is generated. Insert the calibrated pH meter and record the data.

The second component of the field screening (pH_{FOX}) requires the addition of peroxide to the second sample from the same stockpile. The peroxide is to be 30% hydrogen peroxide adjusted to pH between 4.5 and 5.5. The pH_{FOX} test should be conducted in a heat resistant test tube or similar as vigorous reactions can result in generation of temperatures greater than 80°C. Add a few millilitres to cover the soil with the hydrogen peroxide and stir the mixture. Slowly add the hydrogen peroxide (dependant on the reaction) until a grout like paste is generated. Insert the calibrated pH meter and record the data.

Comparison of pH_F and the pH_{Fox} results with the trigger levels in **Section 6.1** will determine whether the stockpiled material has likely been successfully treated for ASS or if the stockpiled material requires additional lime mixing.

Once the field screening results indicate that the stockpiled material has been successfully treated as outlined in **Table 6.1,** validation samples should be collected by an appropriately experienced environmental consultant and transported to a NATA accredited laboratory for analysis. Stockpiled material is to remain in the designated area until the NATA accredited laboratory reports indicate that the stockpile has been successfully treated and is suitable for reuse onsite or adequately classified for offsite disposal as outlined in **Section 7.8**.

It should be noted that hydrogen peroxide and pH adjusting chemicals should be treated with care as incorrect use and/or handling can result in adverse impacts on human health. As such, person associated with field screening should be suitably trained with a safe work method statement or similar generated. This document will require review and approval by the principal contractor prior to undertaking the works. Further, any waste generated should be handled and managed as outlined in **Section 6.3** or as outlined in the waste management procedures provided in the overarching environmental management plan for the project.

7.5 Preparation of the Treatment Area

Prior to placement of soil in the designated treatment area/s, the area/s (or pad/s) will be graded such that water will flow to one corner with a sump installed to allow extraction of the water (if required). Water could be generated during dust suppression or rainfall events and should be designed with consideration of the size of the pad/s. A plastic liner (two layers of HDPE) with no leakage at overlaps is to be installed across the treatment pad/s. Hay bales, earthen mounds or similar will be placed around the designated treatment pad/s with the plastic overtopping the bales, earthen mounds or similar secured. This will effectively provide a bunded area/s. Coarse crushed sandstone, coarse crushed gravel or similar drainage medium is to be placed over the plastic liner and is to be a minimum of 0.2 m thick. Subdividing large treatment pads may be preferable to enable sequencing of treatment batches and validation of the same.

All excavated material that is AASS and PASS and is unsuitable for offsite disposal for burial (at an appropriately licenced facility) is to be immediately placed in the treatment pad/s on the drainage material.

Tarps or HDPE plastic should be available to cover the stockpiles to minimise rainfall contacting the ASS. This will minimise the size of the required sump of the containment areas.

7.6 Treatment of ASS

The excavated material requiring treatment is to be placed in the bunded area in a layer not greater than 0.3 m thick. Lime is to be applied to the soil at a liming rate of:

- 79 kg of $CaCO_3$ / tonne of ASS

This application rate assumes fine agricultural lime less than 200 µm (micron). Application of alternate lime would require an assessment of the effective neutralising value with the assessment of suitability undertaken by a suitably experience environmental consultant. Further, it should be noted that, as validation data becomes available from the treated soils, the liming rate may require adjustment based on this additional information.

The lime requires mixing through the soil matrix to effectively neutralise the ASS. The mixing should be undertaken immediately following application to the soil.

Should available treatment area/s be insufficient to receive the material requiring treatment at less than 0.3 m in thickness, additional material requiring treatment is to be placed in 0.3 m layers on the treatment pad/s after lime application and mixing is undertaken on the lower 0.3 m layer (following collection of treatment validation soil samples).

Alternatively, treated soil can be removed from site for storage at a suitably licenced facility (licenced to accept PASS and AASS) while waiting waste classification results.

Following treatment of the excavated material, validation samples are to be collected by an appropriately experienced environmental consultant at the rate outlined in **Section 7.8**. Should the validation samples indicate that the ASS has not been effectively neutralised, further lime application and mixing followed by additional validation sample collection will be required. An amended liming rate will be determined based on the failed analytical results (if required).

It should be noted that lime should be treated with care as incorrect use and/ or handling can result in adverse impacts on human health and the surrounding environment. As such, person associated with application or treatment of the ASS should be suitably trained with a safe work method statement or similar generated. This document will require review and approval by the principal contractor for the project.

If periods of high rainfall are forecast, the stockpiles will be covered with measures implemented to divert non-impacted stormwater from the treatment pad/s.

7.7 Treatment of Effluent

Effluent generated from the treatment area will require assessment and potential treatment prior to offsite discharge. Alternatively, a licenced liquid waste removal contractor could be engaged to remove the effluent.

Where the effluent is proposed for discharge to stormwater, sampling is required to assess treatment requirements (if any) prior to discharge. Water samples are to be collected by a suitably qualified and experienced environmental consultant. The water samples are to be subjected to field screening (using a calibrated water quality meter) and laboratory analysis, as a minimum for:

- pH, dissolved oxygen, temperature, electric conductivity (water quality meter);
- metals (aluminium, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, and zinc) (laboratory);
- PAH;
- TRH;
- BTEX;
- pH (laboratory);
- Electrical Conductivity; and
- total dissolved solids (laboratory).

Discharge of effluent into Council stormwater system should be undertaken following an approval from Central Coast Council. A groundwater dewatering management plan would be required prior to undertaking the dewatering works.

Where required, lime is to be added to the effluent to adjust the pH to the level acceptable for discharge. It is considered likely that adjusting the pH will result in precipitation of metals concentrations should they exceed the NEPM (2013) water quality guidelines. A suitably qualified and experienced environmental consultant should be engaged to assist in determining the appropriate application rate for treatment of the effluent. Items to be considered are the type of neutralising agent (e.g. agricultural lime has a low solubility in water) and the method of application. Further, care should be exercised such that the water doesn't become alkaline.

Additional water samples will be required from the treated effluent prior to discharge to confirm successful treatment.

7.8 Off-Site Disposal

It should be noted that acceptance of the waste is at the discretion of the receiving body. As such, the waste classification assessment report is to be submitted to the proposed disposal facility, for approval, prior to transport off site.

Wastes are to be classified, managed, and disposed in accordance with the relevant council and NSW EPA guidelines and Legislation.

7.8.1 Sample Collection

Soil material proposed for offsite disposal is to be sampled at the rate outlined in **Table 6.8.1.**

Table 7.8.1. Stockpile Sampling Density for ASS Treatment, Validation and Waste Classification

Stockpile Volume (m^3)	Number of Samples
<75	3
75 - <100	4
100 - <125	5
125 - <150	6
150 - <175	7
175 - <200	8

Treatment validation soil samples are to be analysed for:

- Field screen (pHf/pHfox).

Waste classification soil samples (if required) are to be analysed for

- metals (arsenic, cadmium, chromium, lead, mercury, and nickel);
- total recoverable hydrocarbons (TRH);
- polycyclic aromatic hydrocarbons (PAH);
- benzene, toluene, ethylbenzene, and xylene (BTEX);
- organochlorine pesticides (OCP);
- polychlorinated biphenyls (PCB); and
- Asbestos.

Where existing data is available, this should be used in the first instance when classifying material for offsite disposal.

Soil samples are to be collected and waste classification reports are to be completed by a suitably qualified and experienced environmental consultant. Treated ASS can, at best, be classified as CT1 General Solid Waste treated acid sulfate soils and the treated material is only suitable for disposal to a suitably licenced waste disposal facility. The analytical results require comparison to the contaminant concentrations outlined in Waste Classification Guidelines Part 1: Classifying Waste, November 2014a, NSW EPA. The landfill should be informed that the ASS has been treated in accordance with the neutralising techniques outlined in the ASS Manual and that the waste has also been classified in accordance with the NSW EPA 2014a.

7.8.2 Offsite Disposal for Reburial

Although not recommended by Alliance, PASS which could be present onsite and proposed for removal and offsite reburial below the water table will require transport and acceptance at a suitably licenced facility within 16 hours. Each truck load will require measurement of the pH of the soil prior to leaving site. Where the soil is less than 5.6 pH units (or alternate pH as directed by the receiving facility), the load will be considered unsuitable for offsite disposal and will be placed in the treatment areas. Where the pH of the load is greater than 5.6 pH units (or the alternate pH as outlined by the receiving facility), the material will be considered suitable for offsite disposal. Records of pH measurement and the corresponding truck registration details are to be maintained as outlined in **Section 9**. Further, a record sheet of pH at the time of loading, as well as other relevant details will be retained in the truck for providing to the landfill facility. If additional forms are required by the receiving body, the associated documentation will require completion as required.

The sample collected from each truck load will be subjected to pH screening using a calibrated meter. Deionised water will be added to the soil sample in a shallow test tube or similar and mixed such that a grout mix paste is generated. The pH probe will be inserted, and the data recorded and any additional records required by the receiving facility should be provided.

Each load will be covered and transported to the licenced landfill facility immediately after excavation and pH testing (to confirm suitability for offsite disposal as PASS). No loads are to leave site after 2:30pm to allow sufficient time to arrive at the disposal facility prior to its closure. In the event that a load is rejected, or the load does not arrive at the disposal facility on the same day (i.e. vehicle breakdown or similar) the load is to be returned to the site for treatment as outlined in **Section 7.6**. The load and waste tracking records are to be updated accordingly (refer **Section 9**).

8 Dewatering Management Strategy

Alliance understands that the proposed development is unlikely to require dewatering during bulk excavation works. Any dewatering of groundwater from the site should be undertaken following an approval to abstract from Department of Industry – Water. Discharge of groundwater into the municipal stormwater system should be undertaken following an approval from Central Coast Council. A groundwater dewatering management plan will be required prior to undertaking any dewatering works.

9 Monitoring

Soil sample collection and review of data to assess the effectiveness of the treatment of ASS is required and should be undertaken at the rate outlined in **Section 7.8**. Where the samples are to assess the successful treatment of ASS, analysis is required by a laboratory accredited by National Association of Testing Authorities (NATA) for pH_F, pH_{FOX} and chromium reducible sulfur (if required by the receiving facility).

Effluent samples (if generated) are also to be submitted to a NATA accredited laboratory for the parameters outlined in **Section 7.7**.

Monitoring of site works (to be included in the final report as outlined in **Section 12**) is to include, but not be limited to, records of:

- Field screening results (pH_F and pH_{FOX}) for the various soil layers;
- Date and volume of soil material excavated;
- Location of placement of the excavated material;
- Treatment measures implemented (if ASS) including liming rate, mixing methodology and date mixed;
- Validation analytical results confirming treatment of the ASS (if any);
- Amendments to treatment measures following review of the failed validation analytical results (if required);
- Disposal location of the excavated material;
- Records of truck and loads leaving the site;
- Waste tracking documentation;
- Waste disposal receipts;
- Copies of specific documentation required by the receiving facility (if any);
- Water quality meter measurements (including date) for effluent in sumps associated with the treatment pad/s (if relevant); and
- Calibration records for meters.

9.1 Soil

Records of encountered soil types will be compared to the laboratory results for effectiveness of the field screening as well as used as a guide for amending liming rates (if required). An example field screening sheet has been included in **Appendix B**.

Prior to offsite disposal of soil material, a waste classification assessment report will be required for submission to the receiving body.

9.1.1 AASS

Sample collection and review of the data to assess the success of the treatment of ASS is required and should be undertaken at the rate outlined in **Table 7.8.1**. Due to the likely volume of soil material requiring treatment, a robust recording system will be required.

In addition, waste tracking documentation (where relevant) will be required as well as disposal receipts from the receiving facility. Tracking of all truck loads leaving or entering the site will be required with the following information recorded:

- Date and time;
- Truck registration;
- Approximate volume;
- Soil type;
- Disposal location; and

9.1.2 PASS

Soil material considered to be PASS and proposed for offsite disposal and reburial (refer **Section 7.8.2**) will require additional sampling and data collection. Each load of soil proposed for offsite disposal to a suitably licenced facility will require pH testing (refer **Section 7.4**) with the data recorded on the tracking sheet. This sheet is to be retained by the truck and provided to the receiving facility on arrival. Additional documentation may be required by the receiving facility and should be completed and retained with the vehicle for delivery with each load (as required).

9.2 Surface Water and Groundwater

Groundwater seepage into drains is the most significant pathway for acid discharge from acid sulfate soil landscapes. The anticipated depth of excavation is considered unlikely to extend beyond the groundwater table. As such, changes to site drainage may have implications for acid generation onsite. When acid sulfate soils are drained, the sulfide can become exposed to oxygen and produce sulfuric acid. This can directly affect the ecology of surrounding wetlands and the export of acid from acid sulfate soils and the drainage pattern of any out-flowing streams. Consideration of potential changes to the hydrologic regime may be necessary to predict the magnitude of the impacts on acid sulfate soils, and in the design/redesign of drainage or water management systems.

If the excavation works are resulting in the generation of acid sulfate soils, remediation by injection of an alkaline solution must be completed to buffer any acid generation.

If effluent is generated and directed to the holding sump of the treatment pad/s, this effluent can be reused on the treatment pad/s for dust suppression. Alternatively, the water would require assessment using a water quality meter and may be suitable for use for dust suppression on the remainder of the site. Advice should be sought from an experienced environmental consultant and the assessment of the results will be required to provide guidance on the likelihood for adverse impact on soils and vegetation.

Should offsite discharge be the proposed management strategy, water samples would be required for submission to a NATA accredited laboratory for analysis for the parameters outlined in **Section 7.7.** The water samples are to be collected by an experienced environmental consultant. The analytical results are to be compared to the relevant guidelines (refer **Section 6.4**). Following comparison of the laboratory results to the respective guidelines, there may be a requirement for treatment of the effluent prior to discharge. Following treatment additional monitoring samples may be required. A water quality report should be prepared prior to discharge.

Should discharge into local stormwater be the proposed management strategy, an approval would be required from the Central Coast Council. An assessment of discharge water may be required. Where the effluent is not suitable for discharge, or immediate disposal is required, collection by a suitably licensed water transport company for disposal to a suitably licenced disposal facility will be required. Records of water quality monitoring, volume generated, volume removed, waste disposal records, waste tracking records, water quality reports and waste disposal receipts are required.

.

10 Contingencies

While this ASSMP provides a framework for management of the soil material based on the current understanding of the site conditions, potential changes to site conditions may occur during site works. Some potential contingencies are outlined in **Sections 10.1** to **10.3.**

10.1 Soil Excavations

Extended delays due to equipment failure has the potential for ASS material within excavations and trenches to be exposed to air resulting in oxidation of the PASS and generation of AASS. This could result in acidification of the soil and/or groundwater. In the event of extended delays, the existing surface should be kept wet, or lime applied to the excavation batter walls at the approximate rates outlined in **Section 7.6**.

During excavation there is a potential that ASS may spill from the excavation equipment, transport equipment or from the treatment area during mixing (low likelihood). Spilt ASS has the potential to impact on surface soils and/or groundwater (if effluent is generated). Spilt soil should be collected, transported (where required) and placed in the treatment area as soon as practical.

Increased size of excavations due to changed site conditions have the potential for excavations to remain open for longer period of time and the surrounding groundwater to be depressed. This could result in the oxidation of PASS in the walls and base of the excavation. Acidification of the soil, groundwater and potential impacts on ground infrastructure that may be installed could occur. In the event of extended delays, the soil should be kept wet, or lime applied to the excavation batter walls at the rate outlined in **Section 7.6.**

Should a load of PASS be rejected at the licenced receiving facility, the load is to be transported back to site for placement in the treatment pads as soon as possible (and on the same day). An investigation is to be undertaken into the reason for the rejection. Appropriate measures are to be implemented to reduce the likelihood of reoccurrence.

10.2 Stockpiles

Extra soil material generated during excavation work could result in insufficient stockpiling area with the designated treatment area. This could result in excavated PASS oxidising with potential impact on surface soils and/or groundwater (if effluent is generated) if placed outside the treatment area. Excavation should cease once the treatment area is at capacity until temporary storage of the ASS, such as skip bins, is organised for containment. Following treatment, successful validation, and removal of material from the treatment area, the temporary contained material should be placed in the treatment area for application of lime and mixing as outlined in **Section 7.6.**

There is potential that insufficient lime is available at the time of excavation. his could result in PASS oxidising within the treatment area. Should the material contained with the treatment area not be treated with lime, acid effluent may be generated during dust suppression activities or during precipitation. To minimise the potential for generation of acidic effluent, when lime is not available for treatment, stockpiled material is to be covered at all times until an alternate lime source is found.

The mixing methodology may not result in even distribution of lime throughout the ASS matrix. Should the validation sample results indicate ineffective mixing, alternate measure will be used including the use of rotary hoe attachment.

Lime application may not occur in the event of equipment breakdown or delayed delivery. This could result in oxidation of PASS within the treatment area and the generation of acid effluent during dust suppression activities or rain events. To minimise the potential for generation of acidic effluent, when lime is not available for treatment, stockpiled material is to be covered at all times until an alternate lime source is found and successfully mixed.

10.3 Surface Water

Unexpected precipitation has the potential to result in effluent generation from the stockpiled soil in the treatment area (assuming the stockpiled material is not covered). There is a potential that this effluent may be impacted if remediation activities have not been completed. While a sump or similar containment measure exists, the potential for overtopping cannot be precluded. As such, tarps or HDPE plastic should be placed over the stockpiled material as soon as possible to minimise further stormwater contact with the soil. Stormwater runoff that has not contacted the stockpiled material is suitable for management through the existing stormwater management systems.

There is a potential that an unforeseen rainfall event could fill open excavations. Should the excavations be open for less than 24 hours or the contingency measures outlined in **Section 10.1** be implemented, the potential for acid effluent generation from the excavations is considered unlikely. However, where the contingencies outlined above have not been implemented and the excavation have been open for greater than 24 hours, acidic effluent may be generated. The water should be collected and contained with analysis by a suitably experienced and qualified environmental consultant as outlined in **Section 7.7**.

11 Post Construction Monitoring

Post construction monitoring will only be conducted if groundwater treatment is required and will consist of monthly monitoring events from groundwater monitoring wells onsite. Water samples will be collected by a suitable trained and experienced environmental consultant with monitoring continuing until rectification measures have been successful.

12 Reporting

On completion of the treatment and reuse or offsite disposal of impacted material, a post works closure report is to be prepared. The report should include, but not be limited too, information relating to the:

- Works completed including final grade and depth to remaining ASS;
- Locations and construction methods for the treatment pad/s;
- Daily monitoring undertaken (soil and water)
- Volume of soil material excavated;
- Volume and rate of lime application to excavated soils;
- Volume and rate of lime application (if any) to effluent;
- Validation results for soil and surface water (if any);
- Unexpected finds or contingency measures implemented;
- Volume and waste classification of material removed from the site;
- Load tracking records:
- Waste tracking records; and
- Waste disposal records.

This report must be read in conjunction with the ***Important Information About This Report*** statements at the front of this report.

13 References

Alliance (2020a), ‘Sampling, Analytical and Quality Plan (SAQP), Lot 51 in DP732632, 51 Masons Parade, Point Frederick NSW’, dated May 2020, Ref: 10827-ER-1-1.

Alliance (2020b), ‘Detailed Site Investigation, Lot 51 in DP732632, 51 Masons Parade, Point Frederick NSW’, dated June 2020, Ref: 10827-ER-1-2.

Alliance (2020c), ‘Acid Sulfate Soils Assessment, Lot 51 in DP732632, 51 Masons Parade, Point Frederick NSW’, dated July 2020, Ref: 10827-ER-2-1.

Alliance (2020d), ‘Indicative Waste Classification Report, Lot 51 in DP732632, 51 Masons Parade, Point Frederick NSW’, dated July 2020, Ref: 10827-ER-1-2.

Alliance (2021), ‘Targeted Groundwater Assessment, Lot 51 in DP 732632, 51 Masons Parade, Point Frederick NSW’, dated 30 March 2021, Ref: 10827-ER-1-3 Rev 1

NSW EPA 2016, ‘Environmental Guidelines: Solid Waste Landfills, Second Edition’, dated 2016, ref: EPA 2016/0259

NSW EPA 2017, ‘Contaminated Land Management, Guidelines for the NSW Site Auditor Scheme (3rd edition)’, dated October 2017, ref: EPA 2017P0269.

NSW EPA 2020a, ‘Assessment and management of hazardous ground gases’ dated May 2020, ref: EPA 2019P2047

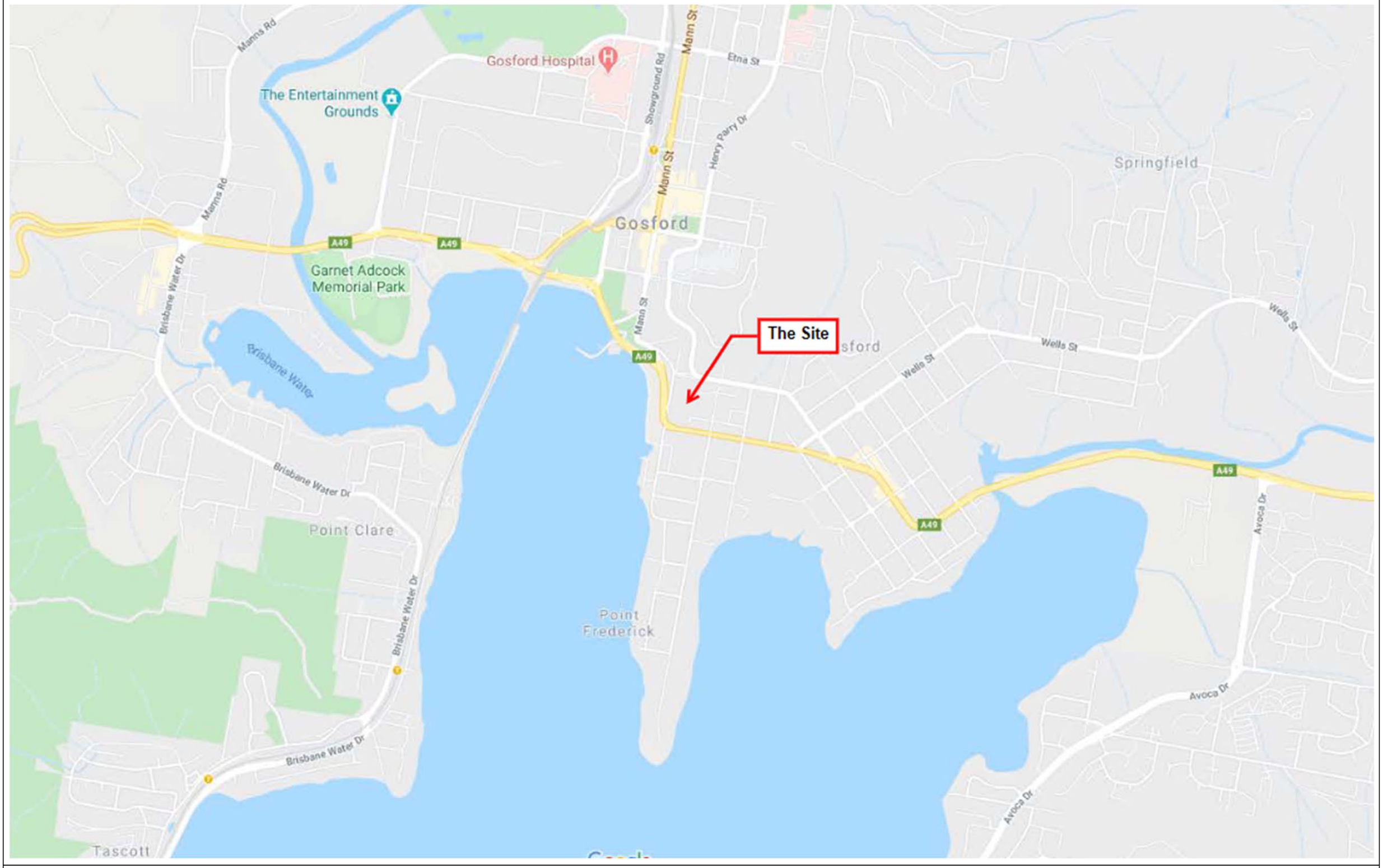
NSW EPA 2020b, ‘Contaminated Land Guidelines: Consultants reporting on contaminated land’ dated May 2020, ref: EPA2020P2233.

Sullivan, L, Ward, N, Toppler, N and Lancaster, G 2018, ‘National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods manual’ dated June 2018

SWE (2021), ‘Hazardous Materials Survey & Management Plan, Lot 51 in DP732632, 51 Masons Parade, Point Frederick NSW’, Ref: S109616, dated March 2021.

VIC EPA 2009 ‘Industrial Waste Resource Guidelines’ dated June 2009, ref: IWRG702.

FIGURES



Site Locality

alliance	Client Name:	Brisbane Waters (NSW) Legacy BWL (c/ Grindley Construction)	Figure Number:	1
	Project Name:	Acid Sulfate Soils Management Plan	Figure Date:	25 October 2021
	Project Location:	51 Masons Road, Point Frederick NSW	Report Number:	10827-ER-2-2

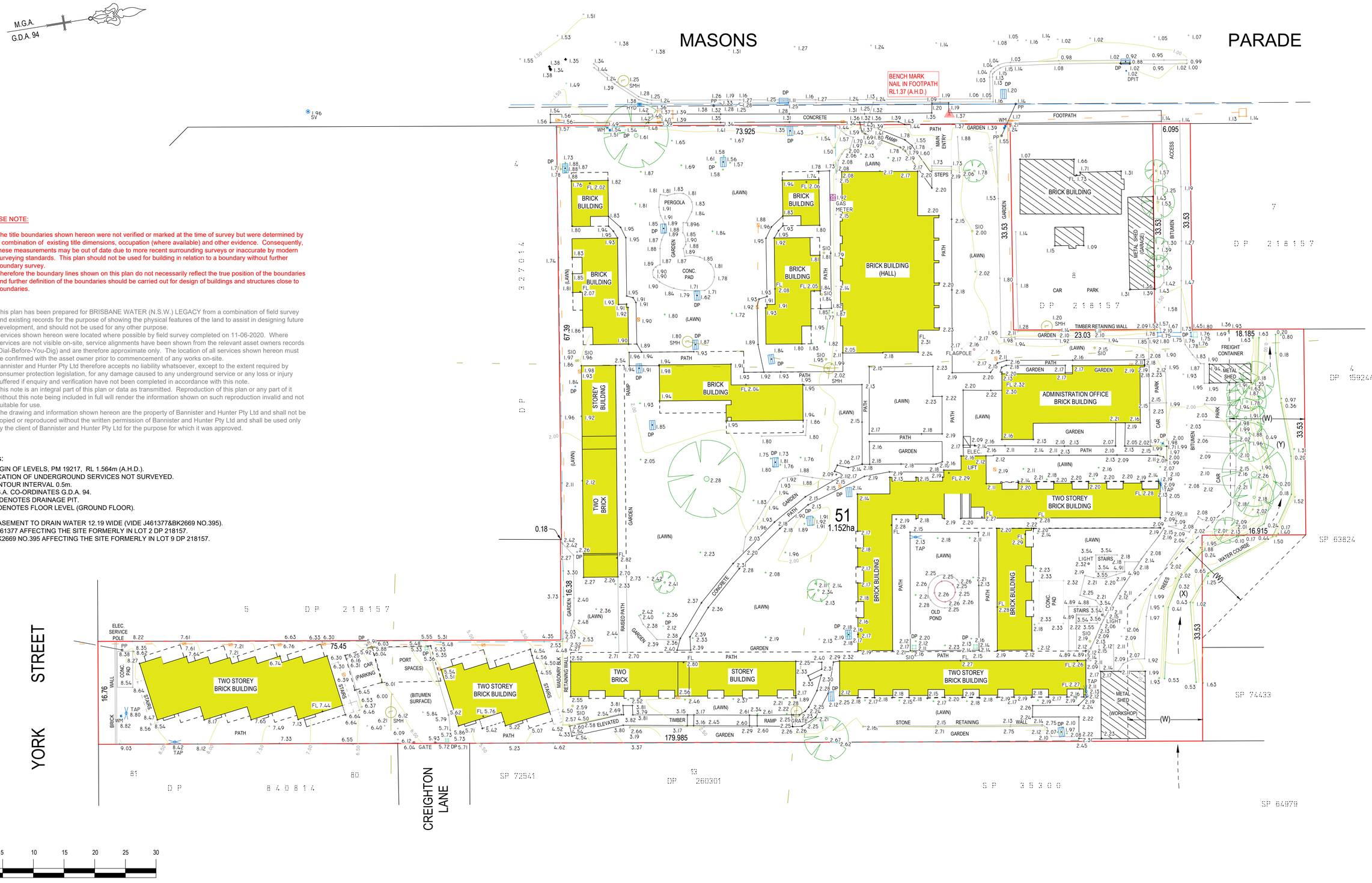
N

Site Layout and Sampling Point Plan

Client Name:	Brisbane Waters (NSW) Legacy BWL (c/ Grindley Construction)	Figure Number:	2
Project Name:	Acid Sulfate Soils Management Plan	Figure Date:	25 October 2021
Project Location:	51 Masons Road, Point Frederick NSW	Report Number:	10827-ER-2-2

N

APPENDIX A – Detail and Level Survey



PLEASE NOTE:

1. The title boundaries shown hereon were not verified or marked at the time of survey but were determined by a combination of existing title dimensions, occupation (where available) and other evidence. Consequently, these measurements may be out of date due to more recent surrounding surveys or inaccurate by modern surveying standards. This plan should not be used for building in relation to a boundary without further boundary survey.
2. Therefore the boundary lines shown on this plan do not necessarily reflect the true position of the boundaries and further definition of the boundaries should be carried out for design of buildings and structures close to boundaries.

3. This plan has been prepared for BRISBANE WATER (N.S.W.) LEGACY from a combination of field survey and existing records for the purpose of showing the physical features of the land to assist in designing future development, and should not be used for any other purpose.
4. Services shown hereon were located where possible by field survey completed on 11-06-2020. Where services are not visible on-site, service alignments have been shown from the relevant asset owners records (Dial-Before-You-Dig) and are therefore approximate only. The location of all services shown hereon must be confirmed with the asset owner prior to commencement of any works on-site.
5. Bannister and Hunter Pty Ltd therefore accepts no liability whatsoever, except to the extent required by consumer protection legislation, for any damage caused to any underground service or any loss or injury suffered if enquiry and verification have not been completed in accordance with this note.
6. This note is an integral part of this plan or data as transmitted. Reproduction of this plan or any part of it without this note being included in full will render the information shown on such reproduction invalid and not suitable for use.
7. The drawing and information shown hereon are the property of Bannister and Hunter Pty Ltd and shall not be copied or reproduced without the written permission of Bannister and Hunter Pty Ltd and shall be used only by the client of Bannister and Hunter Pty Ltd for the purpose for which it was approved.

Notes:

1. ORIGIN OF LEVELS, PM 19217, RL 1.564m (A.H.D.).
2. LOCATION OF UNDERGROUND SERVICES NOT SURVEYED.
3. CONTOUR INTERVAL 0.5m.
4. M.G.A. CO-ORDINATES G.D.A. 94.
5. DP DENOTES DRAINAGE PIT.
6. FL DENOTES FLOOR LEVEL (GROUND FLOOR).

(W) EASEMENT TO DRAIN WATER 12.19 WIDE (VIDE J461377&BK2669 NO.395).
(X) J461377 AFFECTING THE SITE FORMERLY IN LOT 2 DP 218157.
(Y) BK2669 NO.395 AFFECTING THE SITE FORMERLY IN LOT 9 DP 218157.

0 5 10 15 20 25 30

SCALE 1 : 300

Legend:

WATER, STOP VALVE, HYDRANT
GAS
TELECOM, PIT
SEWER, MANHOLE, LAMPHOLE
ELECTRICITY, POWER POLE, LIGHT POLE
TOP OF BANK
BOTTOM OF BANK
EXISTING SURFACE CONTOUR

TREE SHAPES ARE DIAGRAMMATIC ONLY AND MAY BE IRREGULAR AND LEANING. TREE POSITIONS ADJACENT TO ANY PROPOSED WORKS MUST BE VERIFIED.

www.dialbeforeyoudig.au
DIAL1100 BEFORE YOU DIG

CAUTION

UNDERGROUND SERVICES SHOWN ON THIS PLAN ARE APPROXIMATE ONLY AND "DIAL BEFORE YOU DIG" MUST BE CONTACTED PRIOR TO ANY WORKS BEING CONDUCTED ON THIS SITE

DATE	NO.	REVISION DESCRIPTION

SCALE 1:300
BASE DRAWING SIZE A1

SURVEYED BY: PM
DATE OF SURVEY: 11/06/2020

DRAWN BY: MW
DATE: 17/06/2020

CHECKED BY: RB
DATE: 19/08/2020

Client:
BRISBANE WATER (N.S.W.) LEGACY

BANNISTER & HUNTER

75 Mann Street, Gosford, N.S.W. 2250
Phone: (02) 4324 2566
Web: www.bannisterhunter.com.au
Email: admin@bannisterhunter.com.au

PLAN : SHOWING DETAIL OVER LOT 51 IN D.P.732632, BRISBANE WATER (N.S.W.) LEGACY AT NO.51-57 MASONS PARADE, GOSFORD.

Ref. No:	16195
Ccad Ref:	16195
Acad Ref:	16195-02c
SHEET No:	2 of 2
Date:	17th June 2020
Datum:	A.H.D.
REVISION	-

APPENDIX B – Groundwater Records

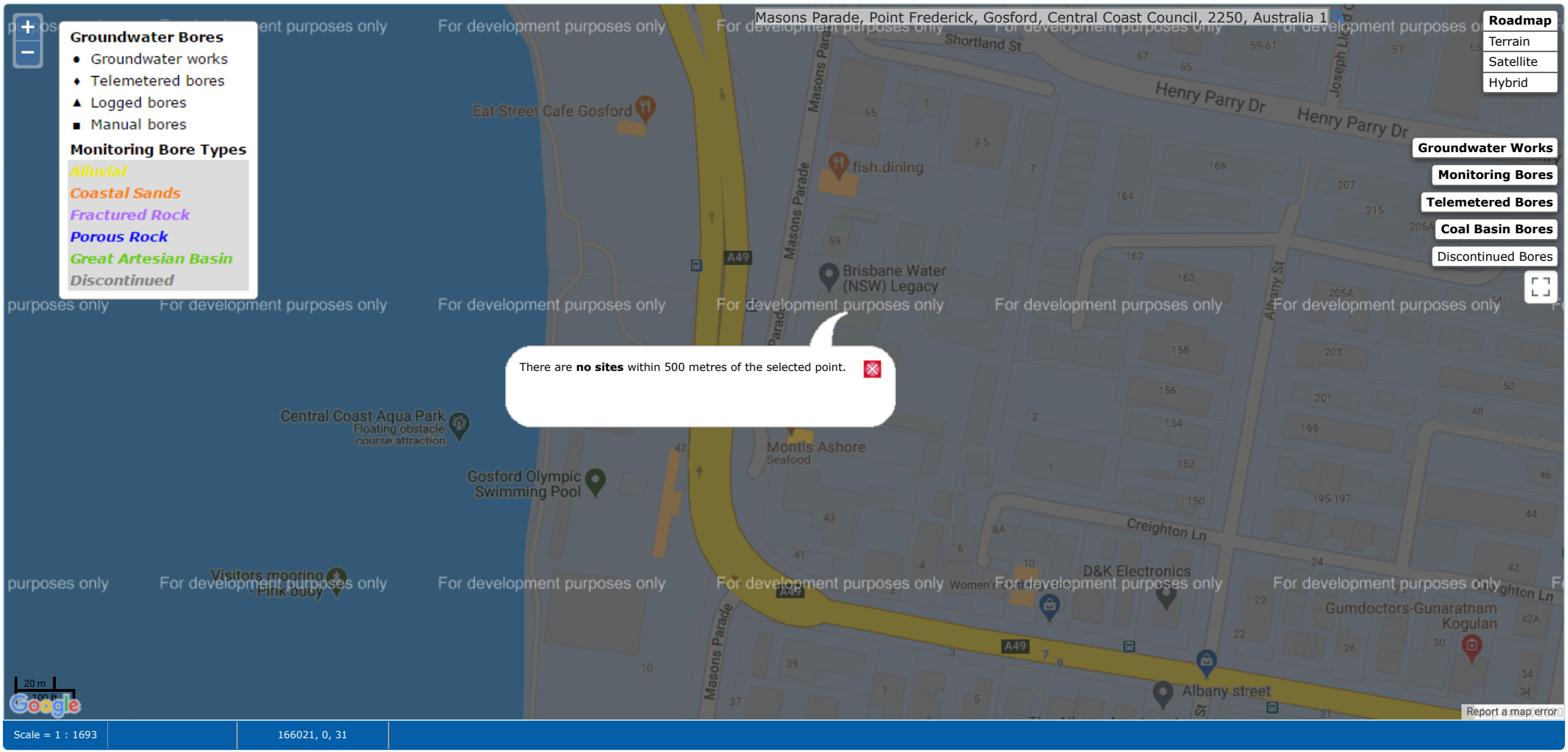
All Groundwater Site Details

All Groundwater Map

bookmark this page

All data times are Eastern Standard Time

Map | Info



Scale = 1 : 1693 | 166021, 0, 31

/