7 November 2025
Ref: E37821PletRev1-ASSMP

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Attention: Amy Eccles

PRELIMINARY ACID SULFATE SOIL ASSESSMENT AND ACID SULFATE SOIL MANAGEMENT PLAN
PROPOSED ALTERATIONS AND ADDITIONS
11A MONASH CRESCENT, CLONTARF, NSW

1 INTRODUCTION

Courtney Smith ('the client') commissioned JK Environments (JKE) to undertake a preliminary acid sulfate soil (ASS) assessment and prepare an ASS Management Plan (ASSMP) for the proposed alterations and additions at 11A Monash Crescent, Clontarf, NSW ('the site'). The site is identified as Lot 52 in DP9745 and the site location is shown on the attached Figure 1.

The assessment was undertaken generally in accordance with a JKE proposal (Ref: EP72425P) of 29 July 2025 and written acceptance from the client dated 5 August 2025. The aim of the assessment was to establish whether ASS may be disturbed during the proposed development works, to inform the preparation of an ASSMP.

JKE has previously investigated ASS conditions on the neighbouring property. Our geotechnical division, JK Geotechnics (JKG) have undertaken various investigations at the site (JKG Project Ref: 37642YF). A summary of relevant information is provided in Section 2.1 of this letter.

1.1 Assessment Guidelines and Background

The ASS assessment and preparation of this letter were undertaken with reference to the National Acid Sulfate Soil Guidance (2018) documents and the Acid Sulfate Soil Management Advisory Committee (ASSMAC) Acid Sulfate Soil Manual (1998)[1].

ASS materials include potential acid sulfate soils (PASS or sulfidic soil materials) and actual acid sulfate soils (AASS or sulfuric soil materials). These are often found in the same profile, with AASS overlying PASS. AASS and PASS are defined further as follows:

[1] Acid Sulfate Soils Management Advisory Committee (ASSMAC), (1998). *Acid Sulfate Soils Manual* (ASS Manual 1998)

- PASS are soil materials which contain Reduced Inorganic Sulfur (RIS) such as pyrite. The field pH of these soils in their undisturbed state is usually more than pH 4 and is commonly neutral to alkaline (pH 7–9). These soil materials are invariably saturated with water in their natural state. Their texture may be peat, clay, loam, silt or sand and is often dark grey in colour and soft in consistence, but these materials may also exhibit colours that are dark brown, or medium to pale grey to white; and
- AASS are soil materials which contained RIS such as pyrite that have undergone oxidation. This oxidation results in low pH (that is pH less than 4) and often a yellow (jarosite) and/or orange to red mottling (ferric iron oxides) in the soil profile. Actual ASS contains Actual Acidity, and commonly also contains RIS (the source of Potential Sulfuric Acidity) as well as Retained Acidity.

Further background information on ASS and the assessment process is provided in the appendices.

1.2 Proposed Development Details

It is understood that the proposed development includes minor alterations to the existing residence and construction of new stairs to access an existing small basement, which is located below the front of the existing house. This will primarily result in the realignment of the staircase from the south-eastern wall, where it is currently located, approximately 1.5m further to the north-west, where it will be located more towards the centre of the house.

Realignment of the staircase in the house will also result in the realignment of the stairs providing access to the existing basement. The current proposal is to retain the existing stairs and cover with the new structure including the basement stair opening, although removal of the lower steps of the existing stair will still be required. The new stairs will be located further to the north-west and will step down into the basement, which is at reduced level (RL) 0.43m. The partially demolished existing wall to allow for the construction of the new stair will only be demolished down to RL0.755m, which is above the mean high water spring tide in order to avoid for the need of ongoing dewatering during the works. In the long-term the structure will be a water-tight structure. The proposed alterations and additions will match existing floor and site levels comprising of a proposed Finished Floor Level of RL3.02m for the house, RL2.94m for the garage and rear patio area and RL0.43m for the basement.

At the rear of the property the stairs providing access to Clontarf beach will also be realigned and will be straightened such that they run perpendicular to the sea wall. We have been provided with a report prepared by Horton Coastal Engineering dated 24 October 2025 that contains a coastal engineering risk management of the existing seawall. The detailed design and construction plan/methods for this work were not available at the date of preparing this ASSMP.

The garage at the front of the property will be demolished and reconstructed to include a double garage, a bin storage area, sauna and wellness area. At the rear of the property the stairs providing access to Clontarf beach will also be realigned and will be straightened such that they run perpendicular to the sea wall.

2 SITE INFORMATION

2.1 Summary of Existing Information

2.1.1 JKG Investigations

JKG has undertaken several intrusive investigations and the property and have most recently issued a report in 2025 relating to the proposed development described in Section 1.2 of this letter. The investigations identified subsurface condition comprising 'fill' to depths ranging from approximately 0.7m to 1.5m, although it was acknowledged that deeper fill may exist in some areas such as behind retaining walls. The fill was underlain by marine sands to at least 4m deep. JKG noted that the marine sand was likely to extend to at least approximately 25m deep based on previous drilling in the neighbouring property at 13 Monash Crescent. Reference is to be made to the attached Figure 2 for the JKG investigation locations.

Groundwater seepage was encountered during drilling in BH201 and approximately 2.5m depth, or at approximately RL0.4m. The groundwater was expected to be tidal given the sites proximity to Middle Harbour.

The geotechnical report indicated that continuous flight auger (CFA) piles or screw piles are considered suitable for this site. JKE note that screw piles generally do not result in spoil benign generated and are therefore preferred in the context of risk mitigation when managing ASS materials.

2.1.2 JKE Investigation on Neighbouring Property

JKE previously completed preliminary ASS assessments on the neighbouring property at 13 Monash Crescent (JKE Project Ref: E33691P). These assessments included sampling and analysis of soils to a maximum depth of approximately 2.1m, which is equivalent to approximately RL0.1m. The deepest sample was collected from just below the groundwater table measured at the time. Net acidity results and the chromium reducible sulfur results were below the laboratory limits of reporting, indicating the soils were not PASS or AASS.

2.2 Site Information and Description

Table 2-1: Site Identification

Site Address:	11A Monash Crescent, Clontarf, NSW
Lot & Deposited Plan:	Lot 52 DP9745
Current Land Use:	Residential
Site Area (m^2):	478.9
Site Elevation (metres Australian Height Datum – mAHD approx.)	2.9
Geographical Location (GDA94 – MGA56) (approx.)	Easting: 338320.141 Northing: 6257662.867

Based on a review of aerial photographs and the site description in the JKG report, it is understood that the site is located on the foreshore of Middle Harbour. A ridgeline is located to the north of the site and the land falls steeply from the ridgeline, towards a flat, littoral zone where the site is situated. Clontarf Beach is located adjacent to the south-western site boundary and was observed to be underwater at high tide. The site itself is relatively flat.

At the time of the inspection, the site was occupied by a three-storey residence, a garage and a pool. A majority of the site was paved which restricted access for intrusive geotechnical investigations.

The rear or south-western end of the site included a tiled patio and in-ground pool and was retained by a sea wall. This wall was approximately 1.8m high with sandstone blocks visible at base. A stormwater PVC pipe discharged through the eastern end of sea wall into the harbour.

There were no mangroves observed in the vicinity.

2.3 Regional Geology

The geological map of Sydney (1983)[2] indicated the site to be underlain Quaternary aged deposits of coarse quartz sand with varying amounts of shell fragments.

2.4 Acid Sulfate Soil Risk Map

A review of the ASS risk map prepared by Department of Land and Water Conservation (1997)[3] indicated that the site is located in an area classed as having a 'low probability' of ASS occurrence between 1m and 3m below the ground surface.

2.5 Manly Council Local Environmental Plan (LEP) 2013

A review of the Manly Local council LEP indicated that the site is located across the boundary between a Class 3 and Class 5 risk area. The Class 3 risk area covers the north-eastern half of the site approximately.

Potential risks from disturbance of ASS materials in these risk areas generally relate to the following works:

- Class 3 - works at depths beyond 1m below existing ground level or works by which the water table is likely to be lowered beyond 1m below existing ground level; and
- Class 5 - works within 500m of adjacent Class 1, 2, 3, 4 land which are likely to lower the water table below 1m AHD on the adjacent land.

Refer to appendices for further details on each risk class.

[2] Department of Mineral Resources, (1983). *1:100,000 Geological Map of Sydney (Series 9130)*

[3] Department of Land and Water Conservation, (1997). *1:25,000 Acid Sulfate Soil Risk Map - Sydney Heads (Series 9130N2, Ed 2)*

3 ASSESSMENT CONCLUSION

Based on the weight of evidence collected and evaluated for this assessment, there is considered to be a low potential for ASS conditions, most likely in the form of PASS, to exist at the site. PASS may occur around the groundwater level, or deeper beneath the groundwater level. Disturbance of soils above RL0.5m AHD is unlikely to disturb PASS or require any management actions.

Based on the above assessment, an ASSMP is provided below and this plan must be implemented during the proposed development works.

4 ACID SULFATE SOIL MANAGEMENT PLAN (ASSMP)

4.1 Conceptual Site Model

The soils above the groundwater level are unlikely to include ASS materials and there is considered to be a low potential for PASS to be encountered around or below the groundwater table (i.e. generally below RL0.5m). The main construction-related activities that have the potential to disturb PASS include: bulk excavation works or piling (excluding screw piling) below RL0.5m. Based on the proposed works it does not appear that dewatering activities will be required during construction associated with the new stairs/existing basement area. The need for any dewatering relating to the seawall works will need to be assessed once the detailed design and construction plan are known.

Given that soil sampling has not occurred, and access to investigate the site sufficiently is currently constrained, this ASSMP is based on the following:

- Additional investigation will need to occur when the site is accessible. This is a requirement of the ASSMP; and
- Contingency management measures and other requirements are included for the management of PASS materials, should PASS conditions be encountered during the additional investigation.

4.2 Roles and Responsibilities

The client or their nominated representative must engage a suitably qualified consultant to undertake further investigation of ASS conditions in soil (and groundwater if deemed necessary) prior to any activities involving soil disturbance below RL0.5m AHD, or prior to any dewatering should dewatering be required.

The primary role and responsibility for implementing the management measures in this ASSMP (or any updated ASSMP) is the construction contractor. The construction contractor is responsible for obtaining a copy of this (or any updated) ASSMP and taking reasonable steps so that it is adequately implemented.

The construction contractor is to engage a validation consultant to monitor the works and validate the implementation of the ASSMP. The construction contractor and validation consultant are also to refer to any specific development consent requirements of the local consent authority. The consent authority must also specify whether any other plans or permits etc are required prior to the commencement of any works under this ASSMP, and the construction contractor/client is to ensure such plans/permits etc are obtained.

4.3 Investigation Requirements

Prior to any soil disturbance below RL0.5m (or any dwatering), an intrusive ASS investigation must be undertaken by a suitably qualified consultant, in accordance with the guidelines referenced in Section 1.1 of this letter. Soil sampling and analysis must occur from an appropriate number of locations and to the required depths based on the maximum depth of soil disturbance, in order to establish if ASS materials will be disturbed during the proposed development works.

Based on the geotechnical recommendations by JKG, it is expected that more detailed investigation of the subsurface soil and groundwater conditions is required to inform the structural design. The ASS investigation must also consider the impacts of dewatering concurrently in the event that it is anticipated that dewatering may be necessary. It is noted that dewatering is not expected for the works associated with the new stairs/existing basement; it is uncertain through if dewatering will be needed for works associated with the seawall and this is to be confirmed during the detailed design and construction planning process.

On completion of the investigation, a report must be prepared presenting the results and providing an addendum ASSMP to reflect the findings. Alternatively, in the event that the investigation identifies there is no ASS-related risks that require management, a clear conclusion must be drawn in this regard within the report and there would be no need for an ASSMP. A copy of the report must be provided to the certifier and Northern Beaches Council (any specific conditions of the development consent must also be adhered to in this regard).

4.4 Preferred Strategies for Management

The preferred strategy for managing environmental risks associated with PASS is to eliminate disturbance of the PASS. Where this cannot occur, disturbance is to be limited to the extent practicable and the disturbance is to be managed under the ASSMP.

At this stage, the strategy for management is conceptual and is based on the assumption that PASS occurs below RL0.5m AHD. The strategy for the management of PASS includes ex-situ treatment of excavated PASS followed by waste classification and off-site disposal.

Once the design and construction methodologies are finalised, the validation consultant is to undertake a review of these details in consultation with the client/construction contractor. If the scope of the ASSMP is not considered to be adequate to address the potential environmental risks associated with the disturbance of PASS materials during the development, an addendum or revised ASSMP is to be prepared. This must be submitted to the certifier and Northern Beaches Council prior to commencement of works that disturb or expose PASS.

4.5 Management of PASS

Excavated PASS will be managed by the addition of lime to neutralise acid that may be produced following exposure of the PASS to air. The waste classification of the treated material is then to be confirmed in accordance with the NSW EPA Waste Classification Guidelines - Part 1: Classifying Waste (2014)[4] and NSW EPA Waste Classification Guidelines - Part 4: Acid Sulfate Soils (2014)[5], and disposed off-site to landfill.

A slightly alkaline, low solubility product such as agricultural lime should be used. This form of lime is chemically stable and any excess lime takes a significant period of time (years) to influence soil pH beyond the depth of application. The lime particles eventually become coated with an insoluble layer of ferrihydrite (Fe[OH]3) that inhibits further reaction. Long term alteration of groundwater conditions is not expected to occur as a result of the use of lime. Controlled applications of agricultural limes are generally not harmful to plants, humans and most aquatic species and, therefore, are considered suitable for use on the soils for this project.

The construction contractor is to ensure that an appropriate Work Health and Safety Plan (WHSP) and Construction Environmental Management Plan (CEMP) is prepared prior to the use of lime and commencement of construction/management works.

Reference is to be made to the following table for the ex-situ treatment and management procedure for PASS spoil generated from below RL0.5m AHD:

Table 4-1: Ex-situ Treatment/Management of PASS

Procedure	Details
Step 1: Lime selection and Liming Rate Calculations	A suitable lime product is to be selected as discussed above. A neutralising value (NV), effective neutralising value (ENV) and overall liming rate for ex-situ treatment of PASS is to be calculated based on the type of lime (and its properties) selected, the acid base accounting results from the additional investigation (Section 4.3 of this letter) and in accordance with the ASS Manual 1998. Liming rates can be confirmed via treatment trials during the initial stage of excavation/piling works, and refined as required. It is also noted that because piling spoil may include a mixture of PASS (from below the groundwater table) and non-PASS (from above the groundwater) materials, this may reduce the amount of lime needed for adequate neutralisation.
Step 2: Set up treatment area/s	A treatment area for the mixing of excavated PASS with agricultural lime must be established. Treatment must occur either within a leak-proof containment area such as a bunded area on hardstand or within a skip bin, or in a designated area where the ground surface is protected by a guard layer of lime. The pad of lime acting as the guard layer should be at least 100mm thick and this thickness should be maintained for the duration of treatment works. The purpose of this guard layer is to minimise the risk of acidic water leaching from the base of the treatment area into the underlying soils and potentially the groundwater table. Dependent upon the rate of spoil generation, several bunded treatment areas may be necessary for stockpiling and treatment. An earthworks strategy should be prepared to ensure that sufficient space is available to accommodate treatment of the PASS.

[4] NSW EPA, (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Part 1 of the Waste Classification Guidelines 2014)
[5] NSW EPA, (2014). *Waste Classification Guidelines, Part 4: Acid Sulfate Soils.* (referred to as Part 4 of the Waste Classification Guidelines 2014)

Procedure	Details
<u>Step 3</u>: Manage water run-off/infiltration	PASS will be generated from below the water table and the treated material will be wet. The treatment area must be designed to adequately manage any water run-off from the treated materials. For on ground treatment areas, this could consist of sandbags filled with a mixture of lime and sand, and a lime guard layer at the base. It is anticipated that any water that seeps from the treatment area would be treated to some degree by the guard layer of lime and/or the sandbags. If skip bins are used, bunding should not be necessary provided that the bins are covered to prevent infill from rainfall. Although we note that skip bins are may not be appropriate where larger quantities of spoil require treatment.
<u>Step 4</u>: Excavation & handling	During piling works, separation of PASS and non-PASS material is unlikely to be possible. In this case all piling spoil should be treated as PASS. Segregation of PASS and non-PASS may be possible for bulk excavations. PASS spoil should be immediately transferred to the designated treatment area and spread out in 150mm thick layers. If possible, the layers should be allowed to dry in order to aid the mixing process, although dried PASS must not be left untreated overnight. The layers should then be interspersed with the appropriate amount of lime to aid in the effective mixing of lime and soil. Lime must be applied to the excavated material within the treatment area as soon as possible. If circumstances prevent the immediate spreading and treatment of the material, the surface area of the stockpile should be minimised by forming a relatively high coned shape and avoiding 'spreading-out' of the stockpile. This will limit the surface area exposed to oxidation. Water infiltration must be minimised by covering the stockpile during wet weather. This will limit the formation and transport of acid leachate due to rainfall. The stockpile should be bunded to prevent erosion of the PASS and any movement of potentially acid leachate. Upstream/up-slope surface runoff water must also be diverted around the stockpile. The earthworks strategy should include adequate consideration and planning for the excavation and handling procedures.
<u>Step 5</u>: Lime treatment & validation testing	An excavator or other suitable equipment (as deemed appropriate by the construction contractor) should be used to thoroughly mix the lime through the soil. Once treatment occurs, samples are to be collected from the treated soil at the rates required in the *National Acid Sulfate Soil Guidance: National acid sulfate soils sampling and identification methods manual* (2018). Assuming the works occur progressively, a minimum of one sample is required per batch of treated soil prior to off-site disposal, with no less than three samples in total for the project on the assumption that excavation and disposal will be a rolling process and there will be no more than 500m^3 of material to be treated. The guidance recommends that samples be collected of the treated soil at the following rates: • <250m^3 – two samples; • 251-500m^3 – three samples; • 1,000m^3 – four samples; and • >1,000m^3 – four samples plus 1 per additional 500m^3. Field pH may be used as a preliminary indicator where deemed appropriate by the validation consultant.

Procedure	Details
	Validation testing is to occur at a NATA accredited laboratory and will include acid base accounting using the chromium reducible sulfur method described in the *National Acid Sulfate Soil Guidance: National acid sulfate soils identification and laboratory methods manual* (2018). The validation net acidity results should be zero or less than the laboratory practical quantitation limits (PQL), depending on how the laboratory report their results. It is noted that the validation testing takes at least 3-5 business days, therefore suitable allowances should be incorporated into the project timeline and earthworks plan.
<u>Step 6:</u> Waste classification and off-site disposal	Following treatment, the material must be tested and the waste classification should be confirmed in accordance with the Parts 1 and 4 of the Waste Classification Guidelines 2014. All neutralised material should be disposed of off-site to a facility licensed by the NSW EPA to accept treated PASS.

4.6 Dewatering (contingency plan)

Dewatering is not expected to be required for the works relating to the stairs/existing basement area, however the need for any dewatering will need to be reassessed once the detailed design and construction plan are known. If dewatering is required, once the details of dewatering are confirmed and the hydrogeological and water quality information is available, if it is established that dewatering of PASS will occur, an *Acid Sulfate Soil Dewatering Management Plan* is to be prepared by the validation consultant and integrated into the addendum ASSMP. This is to be designed with reference to the *National Acid Sulfate Soil Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments* (2018) and must consider the site-specific requirements of the dewatering.

The dewatering plan is to be submitted to the relevant consent authorities as required. We note that Water NSW should be contacted for advice in relation to obtaining relevant approvals for dewatering, prior to preparation of the management plan. The NSW Government *Minimum requirements for building site groundwater investigations and reporting, information for developers and consultants* (2022) document is expected to apply. There are various assessment requirements within this document that will also facilitate the preparation of the *Acid Sulfate Soil Dewatering Management Plan* and we recommend that the associated geotechnical and hydrogeological investigations (and hydrogeological modelling) occur concurrently to the extent practicable.

4.7 PASS Management Contingency Plan

If soil monitoring indicates the presence of significantly more acidic material than expected and if the established liming rate appears inadequate, the following is to occur:

- The pH of soils exposed to oxygen in the treatment area will be measured to establish the source of the acidic conditions; and
- Under the direction of the validation consultant, material found to be acidic may be selectively excavated and neutralised with additional lime in accordance with the ex-situ treatment methods in Section 7.5. Where exposed PASS remains in-situ and exposed at the surface at any stage during the works, the exposed PASSS is to be dusted with lime.

4.8 Documentation

On completion of the works requiring management under the ASSMP, a validation report is to be prepared by the validation consultant. The validation report is to document the works completed, present the validation testing results and comment on the adequacy of the overall compliance with the ASSMP/addendum ASSMP. Any other specific conditions imposed in the development consent must also be adequately addressed.

5 LIMITATIONS

The letter limitations are outlined below:

- JKE accepts no responsibility for any unidentified AASS or PASS issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- The ASSMP includes provisions for further investigation to occur following demolition when the site is accessible. These investigations must occur in order to confirm the requirements for management of environmental risks from the disturbance of ASS materials;
- This letter has been prepared based on site conditions which existed at the time of the assessment; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- The conclusions presented in this letter are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the letter;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this letter have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the letter;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the letter;
- JKE accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- JKE have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or landuse. JKE should be contacted immediately in such circumstances;
- This letter has been prepared for the particular project described and no responsibility is accepted for the use of any part of this letter in any other context or for any other purpose;
- Copyright in this letter is the property of JKE. JKE has used a degree of care, skill and diligence normally exercised by consulting professionals in similar circumstances and locality. No other warranty

expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this letter;

- If the client, or any person, provides a copy of this letter to any third party, such third party must not rely on this letter except with the express written consent of JKE; and
- Any third party who seeks to rely on this letter without the express written consent of JKE does so entirely at their own risk and to the fullest extent permitted by law, JKE accepts no liability whatsoever, in respect of any loss or damage suffered by any such third party.

If you have any questions concerning the contents of this letter, please do not hesitate to contact us.

Kind Regards

Brendan Page
Principal Environmental Scientist
CEnvP SC

<u>Appendices:</u>
Appendix A: Figures
Appendix B: Information on Acid Sulfate Soils

Appendix A: Figures

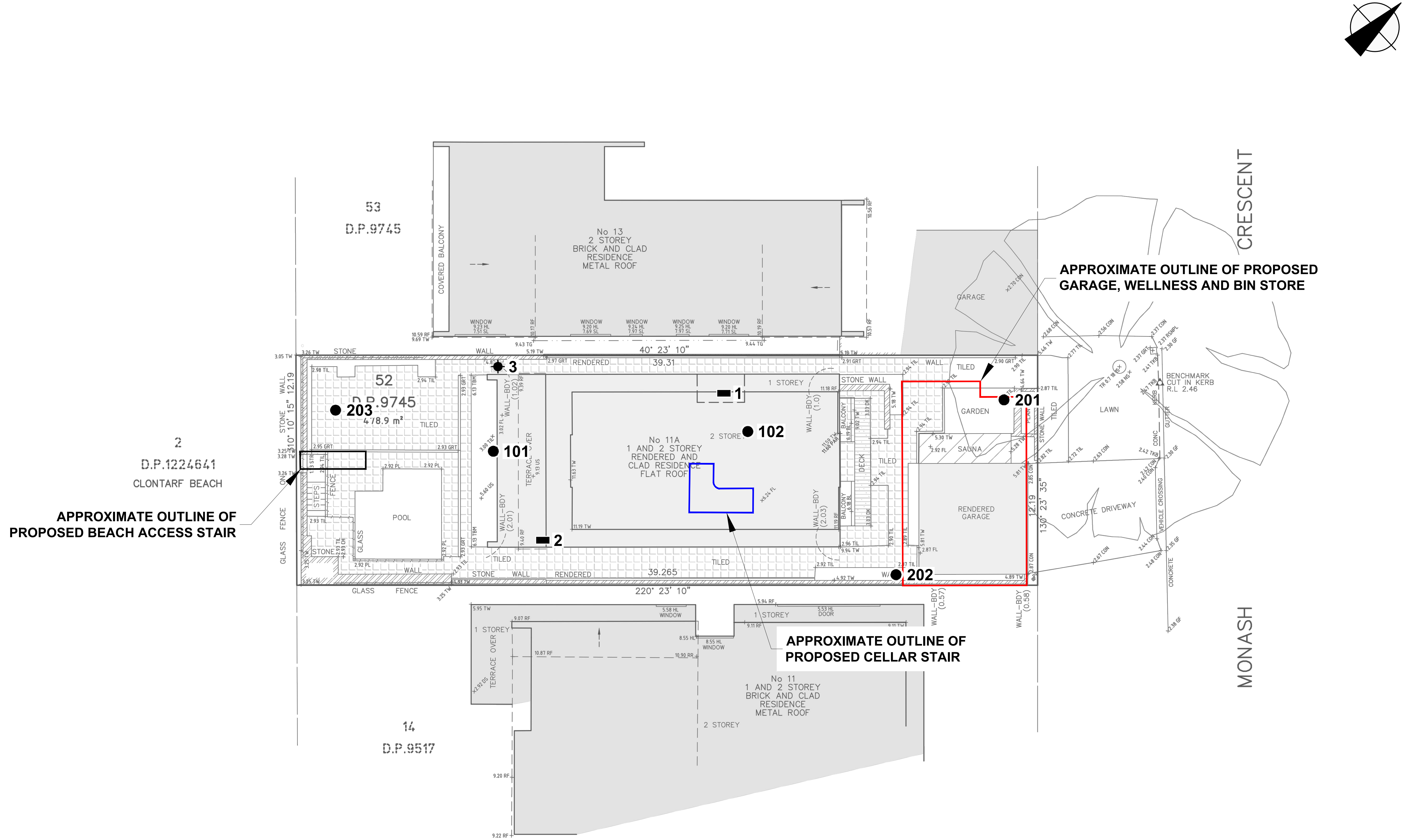
AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the Environmental report.

Title:	**SITE LOCATION PLAN**
Location:	11A MONASH CRESCENT, CLONTARF, NSW
Project No: E37821P	Figure No: 1

JKEnvironments

PLOT DATE: 25/08/2025 3:47:36 PM DWG FILE: K:\5C EIS JOBS\37000'S\E37821P CLONTARF\CAD\E37821P.DWG



LEGEND

- ● BOREHOLE
- ⊕ BOREHOLE AND DCP TEST
- ▬ TEST PIT

NOTES:

1. TEST LOCATIONS 1, 2 AND 3 ARE FROM OUR PREVIOUS 2002 INVESTIGATION (APPROXIMATE).
2. TEST LOCATIONS 101 AND 102 AND ARE FROM OUR PREVIOUS 2003 INVESTIGATION (APPROXIMATE).
3. BOREHOLES 201, 202 AND 203 ARE FROM OUR CURRENT GEOTECHNICAL INVESTIGATION.

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SCALE 1:200 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title: **INVESTIGATION LOCATION PLAN**

Location: 11A MONASH CRESCENT, CLONTARF, NSW

Report No: 37642YF

Figure No: 2

JKGeotechnics

PLOT DATE: 30/10/2025 10:42:11 AM DWG FILE: J:\6F GEOTECHNICAL JOBS\37000'S\37642YF CLONTARF\CAD\37642YF.DWG

Appendix B: Information on Acid Sulfate Soils

A. Background

Acid Sulfate Soil (ASS) is formed from iron rich alluvial sediments and sulfate (found in seawater) in the presence of sulfate reducing bacteria and plentiful organic matter. These conditions are generally found in mangroves, salt marsh vegetation or tidal areas and at the bottom of coastal rivers and lakes. ASS materials are distinguished from other soil or sediment materials (referred to as 'soil materials' throughout the National Acid Sulfate Soils Guidance) by having properties and behaviour that have either:

1) Been affected considerably by the oxidation of Reduced Inorganic Sulfur (RIS), or
2) The capacity to be affected considerably by the oxidation of their RIS constituents.

Acid sulfate soil materials include potential acid sulfate soils (PASS or sulfidic soil materials) and actual acid sulfate soils (AASS or sulfuric soil materials). These are often found in the same profile, with AASS overlying PASS. PASS and AASS are defined further below:

- PASS are soil materials which contain RIS such as pyrite. The field pH of these soils in their undisturbed state is usually more than pH 4 and is commonly neutral to alkaline (pH 7–9). These soil materials are invariably saturated with water in their natural state. Their texture may be peat, clay, loam, silt or sand and is often dark grey in colour and soft in consistence, but these materials may also exhibit colours that are dark brown, or medium to pale grey to white; and
- AASS are soil materials which contained RIS such as pyrite that have undergone oxidation. This oxidation results in low pH (that is pH less than 4) and often a yellow (jarosite) and/or orange to red mottling (ferric iron oxides) in the soil profile. Actual ASS contains Actual Acidity, and commonly also contains RIS (the source of Potential Sulfuric Acidity) as well as Retained Acidity.

B. The ASS Planning Maps

The ASS planning maps provide an indication of the relative potential for disturbance of ASS to occur at locations within the council area. These maps do not provide an indication of the actual occurrence of ASS at a site or the likely severity of the conditions.

The maps are divided into five classes dependent upon the type of activities/works that if undertaken, may represent an environmental risk through the development of acidic conditions associated with ASS:

Table 1: Risk Classes

Risk Class	Description
Class 1	All works.
Class 2	All works below existing ground level and works by which the water table is likely to be lowered.
Class 3	Works at depths beyond 1m below existing ground level or works by which the water table is likely to be lowered beyond 1m below existing ground level.
Class 4	Works at depths beyond 2m below existing ground level or works by which the water table is likely to be lowered beyond 2m below existing ground level.
Class 5	Works within 500m of adjacent Class 1, 2, 3, 4 land which are likely to lower the water table below 1m AHD on the adjacent land.

C. The ASS Risk Maps

The ASS risk maps provide an indication of the probability of occurrence of ASS materials at a particular location based on interpretation from geological and soil landscape maps. The maps provide classes based on high probability, low probability, no known occurrence and areas of disturbed terrain (site specific assessment necessary) and the likely depth at which ASS materials are likely to be encountered.

D. Interpretation of ASS Field Tests

Tables A1 and A2 below provide some guidance on the interpretation of pH_F and pH_{FOX} test results, as detailed in the *National Acid Sulfate Soil Guidance: National acid sulfate soils sampling and identification methods manual* (2018):

Table A1: Interpretation of some pH_F test ranges

pH value	Result	Comments
$pH_F \leq 4$, jarosite not observed in the soil layer/horizon	May indicate an AASS indicating previous oxidation of RIS or may indicate naturally occurring, non ASS soils.	Generally not conclusive as naturally occurring, non ASS soils, such as many organic soils (for example peats) and heavily leached soils, often also return $pH_F \leq 4$.
$pH_F \leq 4$, jarosite observed in the soil layer/horizon	The soil material is an AASS.	Jarosite and other iron precipitate minerals in ASS such as schwertmannite require a pH < 4 to form and indicate prior oxidation of RIS.
$pH_F > 7$	Expected in waterlogged, unoxidised, or poorly drained soils.	Marine muds commonly have a pH > 7 which reflects a seawater (pH 8.2) influence. Oxidation of samples with H_2O_2 can help indicate if the soil materials contain RIS.

Source: Adapted from DER (2015a).

Table A2: Interpretation of pH_{FOX} test results

pH value and reaction	Result	Comments
Strong reaction of soil with H_2O_2 (that is X or V)	Useful indicator of the presence of RIS but cannot be used alone	Organic rich substrates such as peat and coffee rock, and soil constituents like manganese oxides, can also cause a reaction. Care must be exercised in interpreting these results. Laboratory analyses are required to confirm if appreciable RIS is present.
pH_{FOX} value at least one unit below field pH_F and strong reaction with H_2O_2 (that is X or V)	May indicate PASS	The difference between pH_F and pH_{FOX} is termed the ΔpH. Generally the larger the ΔpH the more indicative of PASS. The lower the final pH_{FOX} the better the likelihood of an appreciable RIS content. For example, a change from pH_F of 8 to pH_{FOX} of 7 (that is a ΔpH of 1) would not indicate PASS, however, a unit change from pH_F of 3.5 to pH_{FOX} of 2.5 would be indicative of PASS. Laboratory analyses are required to confirm if appreciable RIS is present.
$pH_{FOX} < 3$, large ΔpH and a strong reaction with H_2O_2 (that is X or V)	Strongly indicates PASS	The lower the pH_{FOX} below 3, the greater the likelihood that appreciable RIS is present. A combination of all three parameters – pH_{FOX}, ΔpH and reaction strength – gives the

pH value and reaction	Result	Comments
		best indication of PASS. Laboratory analyses are required to confirm that appreciable RIS is present.
A pH_{FOX} 3–4 and Low, Medium or Strong reaction with H_2O_2	Inconclusive	RIS may be present; however, organic matter may also be responsible for the decrease in pH. Laboratory analyses are required to confirm the presence of RIS.
pH_{FOX} 4–5	Inconclusive	RIS may be present in small quantities, or poorly reactive under rapid oxidation, or the sample may contain shell/ carbonate which neutralises some or all acid produced on oxidation. Equally, the pH_{FOX} value may be due to the production of organic acids with no RIS present. Laboratory analyses are required to confirm if appreciable RIS is present.
$pH_{FOX} > 5$, small or no ΔpH, but Low, Medium or Strong reaction with H_2O_2	Inconclusive	For neutral to alkaline pH_F with shell or white concretions, the fizz test with 1 M HCl can be used to identify the presence of carbonates. Laboratory analyses are required to confirm if appreciable RIS is present and further testing is required to confirm that effective self-neutralising materials are present.

Source: Adapted from DER (2015a).