Charter Hall Pty Ltd c/o Tactical Group

Acid Sulfate Soil and Salinity Management Plan

Compass 2 Warehouse & Distribution Centre - Lot 1 Eastern Creek Drive, Eastern Creek NSW

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Charter Hall Pty Ltd c/o Tactical Group

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WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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Abbreviations

AASS	Actual acid sulfate soils
AHD	Australian Height Datum
ASS	Acid sulfate soils
ASSMAC	Acid Sulfate Soils Management Advisory Committee
ASSSMP	Acid Sulfate Soils and Salinity Management Plan
ASS Manual	*Acid Sulfate Soil Manual* (ASSMAC 1998)
CEMP	Construction environmental management plan
CFA	Continuous flight augering
CRS	Chromium-reducible sulfur
GMP	Groundwater management plan
GPT	Gross pollutant trap
LGA	Local government area
mbgl	Metres below ground level
m AHD	Metres Australian Height Datum
NEPC	National Environment Protection Council
NEPM	*National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM) (2013 amendment)
PASS	Potential acid sulfate soils
pH_{FOX}	Field pH peroxide
PPE	Personal protective equipment
SCR	Selective catalytic reduction
SDS	Safety data sheet
sPOCAS	Suspension peroxide oxidation combined acidity and sulfur
S_{POS}	Peroxide oxidisable sulfur
SSD	State significant development
S_{TOS}	Total oxidisable sulfur
TPA	Total potential acidity
TRH	Total recoverable hydrocarbons
TSA	Total sulfidic acidity
VENM	Virgin excavated natural material

1 Introduction

1.1 Project background

WSP Australia Pty Ltd (WSP) was engaged by Charter Hall Holdings Pty Limited (Charter Hall) care of Tactical Group Pty Limited (Tactical) for the provision of selected environmental, geotechnical and waste consulting services. The overall engagement is associated with the proposed warehouse and distribution centre development (named 'Project Compass 2') at the property legally described as Lot 1 in Deposited Plan (DP) 1274322, or Lot 1 Eastern Creek Drive, Eastern Creek NSW (the site). Tactical has been appointed by Charter Hall to the role of project superintendent for the proposed development.

Charter Hall has acquired the site and in order to progress the project, Charter Hall needs to gain approval from the Development Consent Authority (DCA). As the proposed development is considered a State Significant Development (SSD), the development consent application process is subject to the NSW Government Planning Secretary's Environmental Assessment Requirements (SEARs), which requires an Environmental Impact Statement (EIS) to be prepared. The overall EIS comprises numerous disciplines, reports and plans – this report is one of the required components.

1.2 Description of the proposed development

The site is currently vacant and disused. WSP understands that the proposed development (herein collectively referred to as *'the development'*) is to generally involve the construction and full-time operation of a warehouse and distribution centre at the site and more specifically will include:

- minor earthworks involving cut and fill works;
- site preparation works and servicing;
- construction and occupation of warehouse, main office, ancillary office, dock office, loading docks, carparking, forklift charging room facilities; and,
- establishment of external hardstands and landscaping.

A final plan (Qanstruct drawing ref. TP-03, Revision B, dated 3/02/2022) of the proposed development provided to WSP by Tactical and has been included in Appendix C.

1.3 Purpose of this plan

The primary purpose of this *Acid Sulfate Soils and Salinity Management Plan (ASSSMP)* is to assist Charter Hall with addressing the relevant SEARs for acid sulfate soils and salinity. This is to be achieved by understanding their presence, extent and potential impacts on the proposed development, and provide options for their management in a property development context.

1.4 Objective of this plan

The overarching objectives of this ASSSMP are twofold and include:

- evaluation of the existing acid sulfate soils and salinity information from both publicly available sources and investigations conducted previously at the site in the context of the proposed development; and,

— preparation of this management plan which includes a guide and options on the identification, treatment and management of potential acid sulfate soils and salinity for the proposed development.

1.5 Relevant SEARS compliance table

The specific and relevant SEAR that has been addressed with this plan is described in Table 1.1.

Table 1.1 Relevant SEARs compliance table

Key issue no. & description	Issue & assessment requirements	How it is addressed	Section of this report
Issue 12. Ground and Water Conditions	Provide an assessment of salinity and acid sulfate soil impacts	This Acid Sulfate Soil and Salinity Management Plan provide an evaluation of, and management measures to minimise potential impacts on the proposed development	Entire report/ management plan

1.6 What is acid sulfate soil?

Acid Sulfate Soil (ASS) is the generic name given to soils and sediments which are rich in iron sulfides (pyrite). They have formed naturally, commonly in estuarine areas along the east coast of Australia as well as other parts of the continent and throughout the world. If permanently deprived of oxygen (e.g. if kept underwater), the sulfidic minerals in ASS cause no environmental harm and the materials are referred to as potential acid sulfate soils (PASS).

Coastal ASS occurs predominantly below 5 metres Australian Height Datum (AHD) and up to 10 m AHD in some estuarine environments. If exposed to atmospheric oxygen (through excavation or drainage for instance), the sulfidic minerals in the soil oxidise and can produce excess sulfuric acid leading to a significant drop in the soil pH, to pH 4 or less. Such soils are referred to as actual acid sulfate soils (AASS).

The potential impacts of acid sulfate soils are generally associated with earthworks, drilling, drainage and dewatering activities and include:

— Degradation of the receiving environment through reduced pH of groundwater and waterways.

— Death of aquatic flora and fauna.

— Undesirable odours and staining of soils.

— Development of geotechnical unsuitable materials.

— Development of aggressive soil to concrete or steel structures.

The field indicators of ASS include:

— Iron staining on any drain surfaces.

— Unusually clear or milky green water discharging from the site.

— Jarosite horizons or mottling due to iron in the subsurface.

— Corrosion of concrete or steel structures.

— Presence of any sulfurous odours.

1.7 What is salinity?

Urban salinity is caused by the mobilisation of salts in the soil profile by surface water or groundwater. Salts naturally occur in soil from sources such as weathering of rock and soil, soils formed on old sea beds, salt lakes or other saline soils, or from the ocean via wind and rain.

Development can cause changes to surface water or groundwater flows and cause salt to accumulate in areas of the site it might not otherwise. When the water table rises close to the surface, it can carry dissolved salts that are normally locked in the soil and rock profile to the surface.

Highly saline soils can reduce or preclude vegetation growth, can produce aggressive soil conditions which may be detrimental to concrete and steel or other building materials and can be highly prone to the erosive effects of water and wind.

2 Previous relevant investigations

WSP reviewed two reports pertaining to the site as part of this ASSSMP. Findings relevant to the salinity and acid sulfate soils risk associated with the development are summarised below.

WSP 2021, Environmental Due Diligence Assessment – Phase I and Phase II, Eastern Creek Drive Lot 4002 Eastern Creek Drive, Eastern Creek NSW 2766

The objective of the investigation was to identify and assess potential environmental risks and issues at the site in the context of proposed acquisition and development of a 25,000 m^2 warehouse with ancillary offices, loading dock and car parking.

The scope of works comprised a desktop study to review the environmental setting, history and environmental regulatory status. An intrusive investigation was also completed comprising the excavation of 10 test pits, drilling of 5 boreholes and laboratory analysis of soil samples, of which 10 samples were selectively analysed for salinity parameters (including aggressiveness and erosion risks). Information obtained from the desktop review is provided in Section 3.

The investigation identified that the site is underlain by fill comprising reworked natural silty clay and sandy clay to a maximum depth of 2.5 metres below ground level (mBGL). This fill was underlain by natural silty clay and sandy clay to a maximum depth of 4.6 mBGL, underlain by extremely weathered siltstone to the maximum investigation depth of 5.0 mBGL. The historical investigation locations are shown in Figure 1, Appendix A.

The findings of the salinity component of the investigation are summarised as follows:

— Subsoil (0.1 – 4.6 mBGL) conductivity ranged from 178 – 550 µS/cm indicating generally non-saline or slightly-saline conditions. One exception was sample TP06_0.3 which had an EC of 550 µS/cm; this is considered 'moderately saline';

— Siltstone (1.0 - 5.0 mBGL) conductivity ranged from 233 – 568 µS/cm indicating generally 'slightly-saline' to 'moderately saline' conditions;

— Sulfate concentrations ranged from 30 mg/kg to 280 mg/kg, indicating sulfate concentrations which are non-aggressive towards concrete;

— Chloride concentrations ranged from 80 mg/kg to 500 mg/kg, indicating chloride concentrations that are non-aggressive towards steel piles;

— pH levels ranged from 5.1 to 7.8 which shows slightly acidic to neutral soil conditions that have a low to moderate level of aggressiveness towards concrete and non-aggressiveness towards steel piles;

— CEC levels ranged from 12.4 m_{eq}/100g to 16.1 m_{eq}/100g; this is consistent with the observed clay content of the soils;

— Exchangeable sodium percentage (ESP) results were calculated to range from 27.5% to 44.7%. The three samples were collected from each of the lithology types encountered on Site. The three samples tested indicated highly sodic (>15%) soils; these were collected from varying depths downslope from the highest point on Site. This suggests that soils will be prone to erosion if not appropriately stabilised during construction.

The report concluded that soil at the surface was generally non-saline to moderately saline. The underlying residual clays were predominantly ranked slightly to moderately saline. The deeper weathered siltstone was found to generally be moderately saline. The subsurface in the down gradient south-east corner of the site was generally more saline than the up gradient north-west.

Soil salinity can impact upon plant growth, suitability of surface water bodies as habitat and affect construction materials and site infrastructure.

Soil testing for ESP indicated that soils on the site were generally highly sodic. Soil sodicity reduces the ability of colloids to bind together and thus increases the risk of soil erosion.

It was recommended that deeper structures (including footings, piles and service trenches) extending into the siltstone lithology should have salinity resistant materials incorporated into their design however, salinity did not present a significant risk of corrosion to shallow structures.

WSP 2021, Eastern Creek Geotechnical Investigation, Geotechnical Interpretive Report

WSP was engaged to undertake a limited geotechnical investigation at the site part of its due diligence assessment context of proposed acquisition of the site. The objective of the investigation was to identify likely geotechnical conditions and potential constraints that would apply to a proposed warehouse development.

The scope of works comprised:

— Review of relevant and available information;

— Drilling of five boreholes to 5 mBGL or auger refusal; and

— Laboratory testing on selected samples in accordance with AS 1289 *Methods of testing soils for engineering purposes*. Four samples were tested for soil aggressivity suite (pH, sulfate and chlorides).

Fill thickness encountered across the site ranged from 0.3 m (in borehole BH01) to 2.5 m (in borehole BH02). Based on site observations cut material from elsewhere on site is being used to fill the southern portion of the lot associated with this investigation to form a platform for future construction. Filling to date suggests an average fill depth of 0.5 m and maximum fill depth of approximately 2.9 m could be encountered at the southern portion of the site.

Natural material was encountered in each borehole, starting from 0.3 mBGL (in borehole BH01) to 2.5 mBGL (in borehole BH02). The natural material typically comprised stiff to very stiff, medium and medium to high plasticity, sandy or silty clay, which was inferred to be alluvial soil. Residual soil (derived from weathered rock) transitioning into extremely weathered rock (inferred as Bringelly Shale) was encountered in all boreholes from, on average, approximately 2.5 mBGL, however, in borehole BH02, weathered rock was encountered at 4.6 mBGL due to the deeper fill profile. The historical investigation locations are shown in Figure 1, Appendix A.

Groundwater was not encountered in any boreholes during the fieldwork. Possible perched water was encountered in borehole BH02 at 2.5 mBGL (fill/alluvium boundary), however, further drilling did not yield any additional evidence of a water table at this location. The soil results for soil aggressivity are summarised in Table 2.1.

Table 2.1 Geotechnical interpretive report chemical laboratory test results

BOREHOLE ID	SAMPLE DEPTH (mBGL)	pH	SULPHATE (SO_4^{2-}) (mg/kg)	CHLORIDE (mg/kg)
BH01	1.50-1.95	5.8	160	180
BH02	1.50-1.95	7.3	70	370
BH04	2.50-2.95	7.8	140	910
BH05	1.50-1.95	5.5	140	130

An assessment of chemical test results was undertaken to provide a durability assessment in accordance with AS 2159 – 2009 Piling – Design and installation. Based on the chemical laboratory test results an exposure classification for concrete and steel of “non-aggressive” was recommended in accordance with AS 2159-2009.

An exposure classification was also assessed in accordance with AS 3600 – 2009 Concrete structures. In accordance with AS 3600-2009, an exposure classification of B1 was recommended for buried concrete.

3 Site setting

3.1 Site description

Details of the site location, ownership, zoning and current site use are provided in Table 2.1 below (refer to Figure 1, Appendix A for a recent Site location plan and layout).

Table 3.1 Summary of site identification and setting

Site address	Lot 1, Eastern Creek Drive, Eastern Creek NSW, 2766
Site Identification	Lot 1 in DP 1274322
Local government area	Blacktown City Council
Zoning	WSEA – SEPP (Western Sydney Employment Area) 2015
Local planning instrument	Blacktown Local Environmental Plan 2015
Current site use	Vacant land currently under development with earthworks taking place on the Site and on the site to the east
Potential site use	Warehouse and distribution centre
Surrounding site uses	The following surrounding land uses were observed: — North – Logistical warehouses and industrial properties with Wonderland Drive beyond. — East – Eastern portion of Lot 1 undergoing earthworks with industrial properties (including a pharmaceuticals company) beyond. — South – A vacant lot with Old Wallgrove Road beyond. Eastern Creek Drive with commercial properties, including a construction equipment supply company and an IT company, are located to the south-east. — West – Commercial warehouse of unknown use with further warehouses beyond.

3.2 Topography and surface hydrology

The natural topography of the surrounding area is generally level with an approximate elevation of 60 m Australian Height Datum (AHD).

At the time of the site inspection during previous investigations (WSP, 2021a) the north-west corner of the site was approximately 3 m higher in elevation than the south-east corner and the site sloped down towards the south-east.

The nearest natural water body, a small tributary of Eastern Creek, was previously located on the site, however, this appears to have been filled in to allow for development of the site. Reedy Creek is located approximately 900 m south-east of the site.

3.3 Soils and geology

Review of the 'Penrith 1:100 000 Geological Map' indicates the site is underlain by the Cambrian aged Wianamatta Group Bringelly Shale consisting of shale, carbonaceous claystone, claystone, laminate, fine to medium grained sandstone and rare coal and tuff.

A search of the Australian Soil Resource Information System (ASRIS) (www.asris.csiro.au) conducted during the WSP 2021a investigation indicated an extremely low probability of occurrence of acid sulfate soils (ASS) at the site. Refer to Figure 2, which presents the Acid Sulfate Soil Risk Map for Sydney.

A search of the eSpade land salinity maps (https://www.environment.nsw.gov.au/eSpade2WebApp) conducted during the WSP 2021a investigation indicated a moderate likelihood of salinity. Figure 3, Appendix A presents the Salinty Potential Map.

3.4 Hydrogeology

A search of the WaterNSW Continuous Water Monitoring Network database conducted on 26 November 2021 indicated no registered groundwater bores are located within a 500 m radius of the site.

3.5 Environmental Sensitivity

The following relate to environmental sensitivity for the area:

- The site is within a predominantly industrial area with no current residential properties identified within 500 m of the site.
- The nearest natural water body, a small tributary of Eastern Creek, has previously run through the site to a small dam that was located near the south-western corner of the site. Both of these surface water features have been subsequently infilled. Reedy Creek is located approximately 900 m south-east of the site.
- There is no registered beneficial use of groundwater within a 500 m radius of the site.
- The site is located within an area of extremely low probability of occurrence of acid sulfate soils (ASRIS, 2020).
- The site is located in an area of moderate probability of land salinity (eSpade).

4 Conceptual hydrogeological model

Urban salinity is caused by the mobilisation of salts in the soil profile by surface water or groundwater. Salts naturally occur in soil from sources such as weathering of rock and soil, soils formed on old sea beds, salt lakes or other saline soils, or from the ocean via wind and rain.

Development of bushland for urban use can change the movement of surface and groundwater resulting in a change in the way salts and other minerals interact. When the water table rises close to the surface, it carries dissolved salts that are normally locked in the soil and rock profile to the surface. The development is located in an urban expansion area. Significant development in the area commenced in the early 2000's with significant commercial /industrial development occurring to the north of the site predominantly comprising the construction of large warehousing. Between 2009 and 2014 further urban expansion had occurred to the west, east and south of the site. During 2020 land clearing across the site and immediately surrounding area had occurred. Based on the historical aerial photograph review, the development site had surrounding area has been stripped of natural vegetation striped between 2000 and 2020.

The Sydney Central Basin Groundwater Source is the only groundwater source expected within the Study area. The groundwater source is expected to be a shallow unconfined to semi-confined aquifer within porous and fractured siltstone and shale bedrock.

Recharge is expected to be primarily through the infiltration of rainfall. The low permeable natural clays and rock underlying the Project site are expected to slow the infiltration of rainfall, as the very low permeability of the rock and it's weathered residuum tend to preferentially shed rainfall as overland stormwater flow.

Localised ephemeral perched groundwater may be encountered on less permeable layers within the soil profile or at the soil-rock interface during times of heavy or extended rainfall. Rainfall infiltration is expected to occur favourably through localised areas of interbedded siltstone and minor sandstone, exploiting permeable and porous layers and localised fractures as vertical flow paths.

Existing stormwater infrastructure directs stormwater from Eastern Creek Drive and the local area to either the stormwater retention basin or to the stormwater overflow area located immediately to the east of the Site. The retention basin is expected to have limited connectivity with the groundwater.

The development is not expected to cause long term changes to groundwater levels and is therefore not expected to affect known or potential salinity affected areas.

The current hydrogeological model would temporarily alter during construction. Potential influences include:

— Interception of groundwater during excavation activities

— A change of natural drainage patterns as a consequence of construction.

Given that these changes would be temporary no significant impact on soil salinity is anticipated.

5 Management of PASS

5.1 Identification of PASS

As described in earlier Sections of this plan, the site has a probability rating of ASS presence being 'Extremely Low Probability of Occurrence' (ASRIS, 2021). There is however the possibility of encountering PASS in the portion of the site where a former farm dam, former detention basin and associated drainage lines were historically situated – refer to Figure 2 showing a plan of these areas (herein referred to as the *'higher risk PASS area'*).

During the proposed development works at the site (excavation and/or disturbance of soils in the former farm dam area) the preliminary visual checking of PASS will be based on material type, colour and consistency. Grey to dark grey and black, clays, silts and sands are generally suspected to be PASS.

ASS screening should be undertaken should one or more of the following indicators be identified during excavation works (from the National Acid Sulfate Soil Guidance [DAWR,2018]):

— presence of unripe muds (soft, sticky and can be squeezed between fingers, blue grey or dark greenish grey mud);

— presence of silty sands or sands (mid to dark grey);

— presence of bottom sediments (dark grey to black for example monosulfidic black oozes);

— peat or peaty soils;

— coffee rock horizons; or

— sulfurous smell for example hydrogen sulfide or 'rotten egg' gas.

A protocol for field screening is provided in Appendix B. Soils that record field a pH of below 6, following oxidation with peroxide (H_2O_2) (pH_{FOX}), should be managed as PASS and must be treated to mitigate the risk of acid generation. Other indicators of PASS, during the field peroxide test, that also assist in determination of ASS risk include the following:

— Change in colour of the soil from grey tones to brown tones.

— Effervescence.

— The release of sulfur smelling gases such as sulfur dioxide or hydrogen sulphide.

— A lowering of the soil pH by at least one unit.

Where confirmation of the PASS status is desired, or a liming rate is required, samples should be submitted to the laboratory for the chromium reducible sulfur (CRS) suite.

5.2 Management during excavation

WSP recommends the following measures to manage PASS risk (if encountered) during excavations at the site:

— Minimise excavations within the higher risk PASS area to the extent practicable.

— Any soils excavated which exhibit one or more ASS indicators should be screened by peroxide field screening method within the shift that it is excavated, for assessment of suitability for reuse. Otherwise it should be assumed to be PASS and be transported to the acid sulfate soil treatment compound, or a licenced waste receiver for treatment, within 24 hours of excavation. Refer to Section 5.5 for more details on the compound.

— Former farm dam sediments (if encountered) should be screened by peroxide field screening method within the shift that it is excavated, for assessment of suitability for reuse. Otherwise it should be assumed to be PASS and be transported to the acid sulfate soil treatment compound, or a licenced waste receiver for treatment, within 24 hours of excavation.

- Any material that screening shows to be a potential risk should be transported to the acid sulfate soil treatment compound and managed in accordance with the protocol in Section 5.5, or otherwise disposed of to a licenced waste receiver able to treat the acid sulfate soil.
- Daily inspection of the worksite by an environmental consultant should be undertaken, to measure pH of stockpiles, embankments and of surface water puddles to check that acid-affected soils are not forming or being distributed around the site.
- Additional information on the treatment protocol for PASS is provided in Sections 5.5 to 5.8.

5.3 Reuse of treated PASS

Surplus soil generated from the excavation and construction activities will be retained on site where possible.

Provided the treatment process is conducted in accordance with the procedure outlined in Sections 5.5 to 5.8 and validation testing confirms the potential acidity has been mitigated, the material would be suitable (from an ASS perspective) for the planned reuse. It will also be necessary to assess the soil for its suitability with respect to compliance with land use criteria. Further considerations for reuse include the geotechnical suitability and the revegetation potential of the final surface. A thin layer of fresh topsoil may be needed to optimise revegetation in any landscaped areas, or dedicated topsoil imported to the site, depending on the nutrient status, texture and pH of the treated soil.

5.4 Transfer to landfill

The transport or transfer of any soil or treated ASS/PASS soil from the site to the landfill (if offsite disposal is required) will be via the public road network. As such, all truck loads must be covered and sediment managed so that no offsite pollution occurs.

No offsite transport or disposal is to occur without appropriate waste classification, and materials should be transported only to facilities licensed to accept the material. All offsite transport is to be carried out by transporters holding appropriate licenses for the waste classification and in accordance with the requirements of the NSW EPA (2014) W*aste Classification Guidelines – Part 1: Classifying Waste* and NSW EPA (2014) *Waste Classification Guidelines – Part 4: Acid Sulfate Soils*.

Appropriate tracking documentation should be maintained and reconciled with landfill records.

5.5 Treatment compound setup and process

ASS treatment should occur in a designated ASS treatment area or compound appropriately set up to receive, treat and store the volumes of spoil anticipated during the works. It would be expected that the compound would include the following:

- An unloading area.
- An untreated stockpile storage area.
- Treatment pad or bay(s).
- Treated stockpile area.
- Loadout area.
- Leachate collection system and storage tanks.

— Suitable bunding.

A treatment pad should be prepared in general accordance with Figure 5.1, as per the *Queensland Acid Sulfate Soil Technical Manual* (Dear et al. 2002). An impermeable layer and leachate collection system are required. The treatment pad should be located at least 40 m from any waterway and if possible, placed in a topographically high area to avoid inundation following heavy rain.

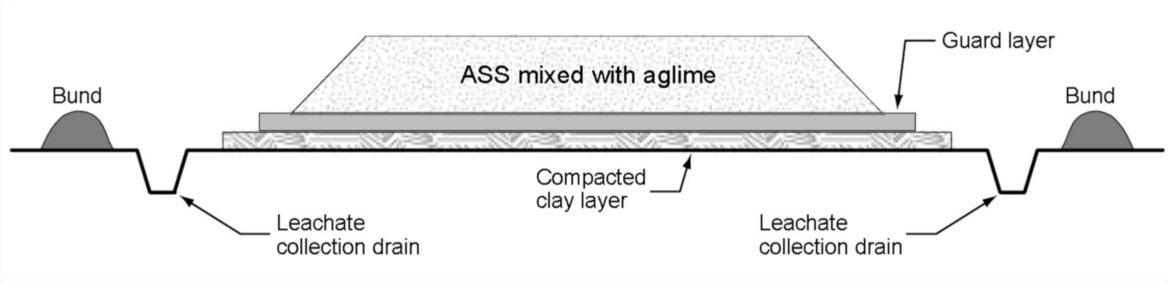

Figure 5.1 Cross-section of typical treatment pad (from Dear et al. 2002)

Soil for treatment should be either:

— Spread in thin (<200 mm) layers on the impervious pad, the required lime spread and then incorporated by rotary hoe / road stabiliser or similar or.

— Required lime spread evenly and distributed through the use of bulk bags with an open chute on one end over a low levelled stockpile and then thoroughly mixed with the aid of an excavator bucket or front-end loader. Due to the small volumes of spoil anticipated, in lieu of the use of a pugmill or allu bucket typically used for mixing of large soil volumes, the mixing approach may require more than a single pass to achieve the same homogenous blend.

Mixing by standard excavator bucket is not considered a suitable treatment / mixing technique.

5.6 Process management and verification testing

A stockpile register will be maintained by the contractor that allows for tracking of material from source, through the treatment process, to the disposal location. To facilitate the tracking process and ensure risks of PASS oxidising are managed, the following protocol should be implemented:

— Stockpiles should be kept to a (nominal) maximum of 100 m^3.

— Field screening of soil received from the worksite must occur within 48 hours of excavation and will comprise:

  — Four field samples collected from each quarter of the stockpile. Each sample should be a composite of five grab samples from the quarter of the stockpile being assessed. The samples will be screened using the field peroxide method (Appendix B).

  — Field screening results assessed and actioned as follows:

    — If all result show field pH peroxide (pH_{FOX}) >6, then the soil considered very low risk of being acid sulfate soil and suitable for onsite reuse or otherwise suitable for waste classification testing.

    — If one or more results show pH_{FOX} <6, submit a composite of the four samples for testing at the laboratory by CRS method.

    — This will provide confirmation that the soils are not acid sulfate generating or otherwise provide a treatment liming rate.

— Where test results show treatment is necessary, the recommended liming rate will be applied, and the lime mixed thoroughly before verification testing occurs. Note: under the DAWR, 2018 guidance the liming rate should be based on the net acidity excluding the acid neutralising capacity (ANC).

- Verification will include:
  - Collection of four samples for field screening as above.
  - If all screening results show no further liming required, then a composite will be formed for laboratory verification testing (and if offsite disposal is intended, waste classification analysis – see Section 7).
  - If laboratory results confirm that no further lime is required, the material will be considered appropriately treated and suitable for onsite reuse or offsite disposal (pending waste classification testing):
    - Note that the protocol for assessing whether sufficient lime has been applied, in accordance with DAWR, 2018, is to determine the added ANC by subtracting the untreated soil ANC from the treated soil ANC and using this figure for the purpose of acid base accounting. See below:
      - Net Acidity = TAA + S_{Cr} + NAS – (ANC after treatment – ANC before treatment.
      - Successful treatment requires the Net Acidity to be ≤ 0.
  - If further liming is required this will be applied, mixed and the verification testing repeated.
  - Records of the testing and verification works will be maintained throughout the works.

Care should be taken during the process not to over-lime the soil.

5.7 Lime storage

Lime should be added by hand (with appropriate PPE) at the rates specified in the laboratory transcripts, followed by careful but thorough mixing for the full depth of the stockpile, making sure that no dust is generated.

Relatively small quantities of lime are expected to be needed onsite and so it is recommended that it is stored in bags in an undercover area with adequate runoff and stormwater diversions. This will mitigate the risk of seepage from the lime presenting an environmental risk during heavy rain. Having lime provided in bags will also assist in more accurate measuring out of lime in accordance with laboratory recommended liming rates.

A current Safety Data Sheet (SDS) for the lime should be held onsite.

5.8 Leachate management

Leachate generated in the ASS treatment area needs to be collected and tested prior to discharge by any method. The recommended management of this water is that the pH be adjusted to ensure it is within an acceptable range for water (nominally considered to be 6.5 to 9) and the water used as dust suppression in the stockpile area.

If the water requires disposal offsite, or re-infiltration to groundwater, it must first be tested for a wider suite of analytes.

6 WASTE DISPOSAL

It is understood that all surplus soil generated from the construction activities will be retained on site where possible, which is the preferred option for waste management. However, the following sections have been included should offsite waste disposal be required.

6.1 Waste Classification

Disposal of virgin excavated PASS and co-mingled PASS with non-virgin material (fill) will be in accordance with the following guidelines:

— NSW EPA (2014) *Waste Classification Guidelines – Part 1: Classifying Waste.*

— NSW EPA (2014) *Waste Classification Guidelines – Part 4: Acid Sulfate Soils.*

Any facility accepting untreated PASS must be licensed to accept the material in accordance with NSW EPA (2014) guidelines. Evidence from the landfill demonstrating their approval to accept untreated PASS should be obtained prior to dispatching any materials. Comingled PASS and fill, or PASS and grout cannot be disposed of untreated. This material will require excavation, onsite treatment for PASS, waste classification and then disposal in accordance with the waste classification at a landfill licenced to accept it.

The following protocols should be followed to ensure that the material is appropriately classified for disposal assuming the facility is licensed to accept the material as stated.

6.2 Disposal of untreated potential acid sulfate soil

NSW EPA (2014) *Waste Classification Guidelines – Part 4: Acid Sulfate Soils* allows for disposal of PASS directly below the water table at facilities licenced to accept untreated PASS.

6.3 Disposal of treated PASS

The most likely disposal option will be a general solid waste landfill licensed to receive treated ASS and contaminant-impacted soil. The following requirements consistent with PASS disposal ‘above the water table’ must be adhered to:

— The material is to be treated as per the protocol in Section 5.

— The material is to be classified for waste disposal in accordance with Step 5 of the NSW EPA (2014) *Waste Classification Guidelines – Part 1: Classifying Waste.*

— When the classification has been established, the soil should be disposed of to a landfill that can lawfully accept that class of waste.

Prior arrangements should be made with the occupier of the landfill to ensure that it is licensed to accept the waste. The landfill should be informed that the material 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 (2014) *Waste Classification Guidelines – Part 1: Classifying Waste*.

6.4 Disposal of actual acid sulfate soil

Where AASS is encountered, or PASS is excavated and not disposed of within the 24-hour time restriction, it must be treated prior to disposal (see Section 5). It cannot be disposed of untreated (as PASS).

Treatment can either occur on within the site, or at a facility licenced to treat ASS.

7 SALINITY MANAGEMENT

The project is not expected to cause significant changes to groundwater levels and is therefore not expected to worsen known or potential salinity affected areas. Salinity management strategies are described in the following subsections with further details available in:

- WSROC 2003, *Western Sydney Salinity Code of Practice*.
- DIPNR 2003, *Building in a saline environment.*
- DIPNR 2003, *Roads and Salinity*.
- DIPNR 2004, *Waterwise parks and gardens.*
- DLWC 2002, *Site Investigations for Urban Salinity*.

7.1 Management of erosion

Soil erosion during construction on the site will require careful management. Following construction, erosion risks post-development are expected to be minimal given that approximately 95% of the site surface will comprise concrete hardstand and/or warehouse roofing. Surface water runoff from the site is to be diverted into lined stormwater drains. Levels of erosion should be able to be maintained within normally acceptable levels by adopting effective soil erosion and sedimentation control practices, including:

- Plan for soil and water management concurrently with engineering design and in advance of any earthworks.
- Minimise the area and duration of soil exposure by staged development and controlled clearing.
- Stockpile stripped soil for reuse and protect from erosion.
- Control stormwater run-off by diverting clean run-off from stripped areas, minimising slope gradient, length and run-off velocities.
- Trap soil and water pollutants using silt traps, sediment basins, perimeter banks, silt fences and nutrient traps as appropriate.
- Quick rehabilitation of disturbed areas.

Use of construction materials must also take into consideration salinity impact to proposed materials, adopting guidance from Australian Standards and Council Engineering Design Specifications.

All personnel on the site involved with earthworks, land clearing or construction should be made fully aware of the issues associated with Urban Salinity. Sediment and erosion control plans must take into account saline soils.

7.2 Management of stormwater and drainage

The following principles should be considered in development of the project:

- The design and layout of retaining walls, underground services and stormwater should have minimal cut.
- Adequate surface drainage should be installed and maintained during construction.
- Implementation of measures to avoid the infiltration of stormwater during construction.
- Designing stormwater detention ponds and stormwater to reduce infiltration.
- Minimise the disturbance to natural drainage patterns.

— Avoidance of water collecting in low lying areas such as along batters and embankments, depressions or trenches. This can lead to salt mobilisation through saturated zones and can lead to concentration of salts at the surface where evaporation is occurring.

— minimise water use onsite.

7.3 Management of dispersive (sodic) soils

The following management recommendations are made to address the vulnerability of the site to dispersive (those that are subsequently highly prone to erosion) soils.

7.3.1 Potential Treatments

Soil compaction reduces dispersion potential. Compaction of clays should be specified to be close to the maximum dry density and at a moisture content 1% to 2% above Optimum Moisture Content to reduce tunnel erosion potential.

In areas where the proposed development is susceptible to dispersion (e.g. steep batter slopes), soils may need to be treated using chemical amelioration. Gypsum, for example, is effective in reducing the dispersion potential of soils. Gypsum increases the electrolyte concentration in the soil and displaces sodium with calcium in the clay structure.

7.3.2 Potential infrastructure design and construction approaches

In almost all cases, tunnel and surface erosion results from the surface disturbance of soil allowing rainwater or stormwater to come into contact with dispersible subsoils. Changes to hydrology, including concentrating flow in culverts, runoff from hardstand areas, ponding of rainfall and land contouring increases the risk of tunnel erosion. Typical activities that increase the risk of exposing dispersive subsoils to rainfall and stormwater include:

— the removal of topsoil;

— soil excavation and ground profiling;

— trenching and supply of services;

— road and culvert construction; and

— the construction of dams and detention basins.

7.3.3 Earthworks Design

Some of the risks presented by a potentially dispersive site can be managed through earthworks design.

The risk of dispersion can be reduced by minimising the extent and depth of areas of cut within areas of potentially dispersive soils and instead designing these areas to be at grade or in fill.

Areas of fill should be filled with non-dispersive soils unless the dispersive soils are designed by a geotechnical engineer to be encapsulated within non-dispersive soils.

Following construction, soil dispersion post-development is expected to be minimal given that approximately 95% of the site surface will comprise concrete hardstand and/or warehouse roofing.

Landscape areas should be designed at gradients of less than 20% unless specifically designed in consultation with a geotechnical engineer.

7.3.4 Utility and Drainage Design

Give preference to design of at-ground or above-ground utilities which avoid the need for trenching through areas of potentially dispersive soils. Any trenching that is required for services should be designed to avoid long runs down slope which could increase the chances of tunnel erosion occurring.

Drainage design should avoid use of table drains, trenched pipes and culverts in areas containing dispersive soils. Runoff from areas of dispersive soils should not be designed to discharge directly to waterways or stormwater drains where it may adversely water quality.

7.3.5 Potential non-structural control measures

A construction management plan should be prepared in advance of the start of construction identifying the hazards associated with dispersive soils and construction practices to mitigate their impact.

Sediment and erosion controls should be installed prior to the commencement of any works and maintained throughout the course of construction until disturbed areas have been revegetated/ established.

The amount of time land is exposed should be minimised though staged development and/or staged working where possible. Particular care should be taken to avoid allowing soils to desiccate and crack, since these soils are then vulnerable to tunnel erosion after heavy rainfall.

Soil compaction should be verified through geotechnical supervision and field and laboratory testing.

Stockpiling of dispersive soil should be avoided where possible. Stockpiles should be protected from surface and rainwater.

Earthworks surfaces should be shaped to avoid ponding of surface water and discharged to relatively erosion resistant areas (e.g. garden beds mixed with gypsum, existing well vegetated areas with ample topsoil and stony elevated areas) away from dispersive soils.

Exposed dispersive subsoils should be protected as soon as possible to protect them from rainfall and surface water.

Runoff from areas of dispersive soils should not be discharged directly to waterways or stormwater drains.

Topsoil should not be removed or land re-profiled unless this forms part of the final earthworks design.

8 RESPONSIBILITIES

A copy of this ASSSMP should be made available for all relevant personnel working on the project and a copy should be kept on site for reference during construction. The recommendations of the ASSSMP should be referenced in conjunction with the construction environmental management plan (CEMP) as well as other works plans to include safe work method statements (SWMS).

Prior to commencement of works, all field staff will be inducted to the site and will be made familiar with their obligations under the site management plans and associated environmental and worker health and safety requirements. Any staff involved in sediment excavation and/or handling will be made familiar with the procedures discussed in this ASSSMP.

Table 8.1 details stakeholders' responsibilities while involved with the Project.

Table 8.1 Summary of responsibilities

POSITION/ ORGANISATION	REPORTS TO	SUMMARY OF RESPONSIBILITIES
Contractor	Tactical	— Prepare or commission project management plans (including construction environmental management plan (CEMP) and occupational health and safety management plan. — Induct all staff involved in excavation works in the ASSSMP requirements. — Ensure works and subcontractor works are undertaken in compliance with this ASSSMP. — Ensure routine compliance monitoring and associated reporting is carried out.
Environmental consultant (EC) - to be advised	Contractor	— Provide environmental consulting services as required. — Maintain and update this ASSSMP as required. — Assist with verification of treatment and waste classification works. — Prepare the environmental and validation documentation associated with the works (as needed).

9 MONITORING AND REPORTING

Table 9.1 provides a summary of the recommended monitoring and reporting activities required to manage ASS during the construction process.

Table 9.1 Summary of recommended monitoring and reporting activities

ACTIVITY	PARAMETER	RESPONSIBILITY	FREQUENCY
MONITORING			
Monitoring of disturbed soil for ASS	Visual observations, Field pH, pH_{FOX}, CRS suite if required.	EC	Daily
Screening of excavation spoil and verification testing of treated material	Field pH, pH_{FOX}, CRS suite if required.	EC	Within 48 hrs of excavation
Monitoring of leachate collection sump from ASS storage or treatment areas	pH for reuse as dust suppression in the treatment compound	site supervisor or engineer or other nominated, trained personnel	Daily for pH (during ASS treatment)
Monitoring of leachate collection sump from ASS storage or treatment areas	Laboratory suite for reinjection if water can't be reused as dust suppression in the stockpile area.	EC	Batch-based
Water quality surrounding dewatering works	pH and other field parameters	EC	Weekly (during ASS treatment)
TREATMENT VERIFICATION TESTING			
PASS treatment verification	Field pH, pH_{FOX}, CRS suite.	EC	Batch-based

10 Limitations

This Report is provided by WSP Australia Pty Limited (WSP) for Charter Hall Holdings Pty Ltd (Client) in response to specific instructions from the Client and in accordance with WSP's proposal dated 26 October 2021 and agreement with the Client dated 26 October 2021 (Agreement).

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Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and / or recommendations in the Report are based in whole or in part on information provided by the Client and other parties identified in the report (Information), those Conclusions are based on assumptions by WSP of the reliability, adequacy, accuracy and completeness of the Information and have not been verified.

The Conclusions are reflective of the current Site conditions and cannot be regarded as absolute without further extensive intrusive investigations, outside the scope of the services set out in the Agreement and are indicative of the environmental condition of the Site at the time of preparing the Report. As a general principle, vertical and horizontal soil or groundwater conditions are not uniform. No monitoring, common or intrusive testing or sampling technique can eliminate the possibility that monitoring or testing results or samples taken, are not totally representative of soil and / or groundwater conditions encountered at the Site. It should also be recognised that Site conditions, including subsurface conditions can change with time due to the presence and concentration of contaminants, changing natural forces and man-made influences.

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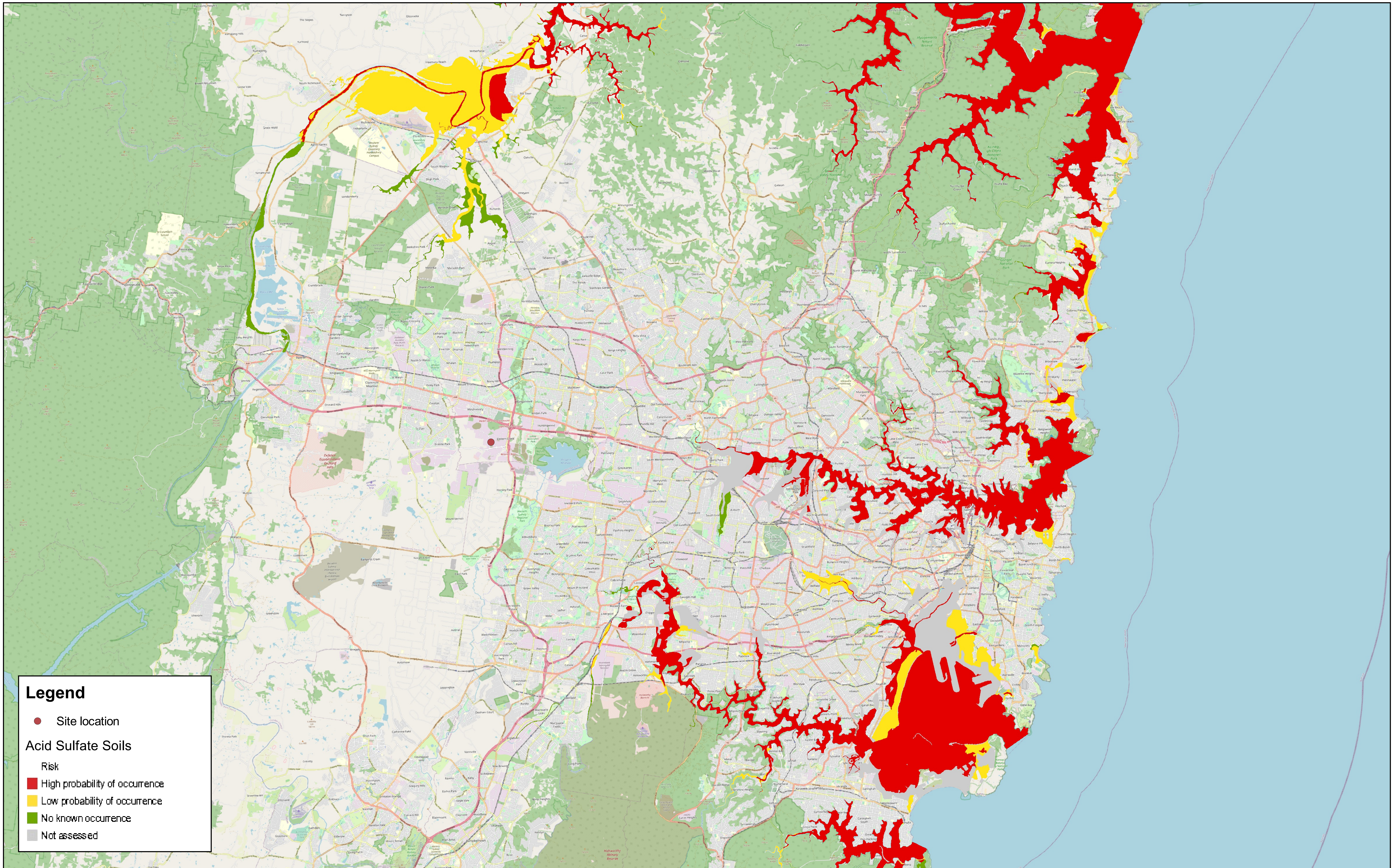
Appendix A

Figures

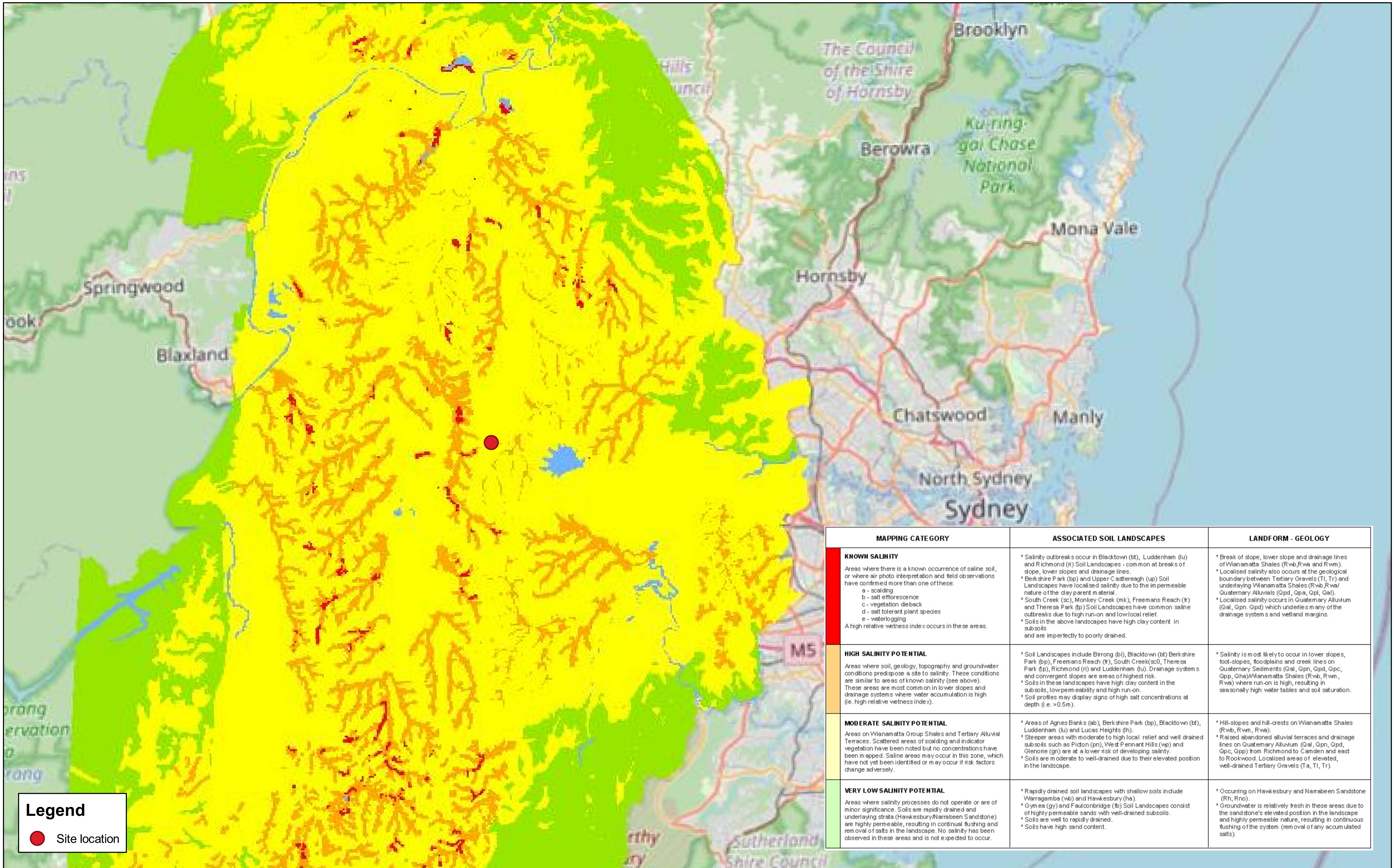
Data source: © Metropmap 2021

Figure 1.
Historical Investigation Locations
Compass 2 Warehouse & Distribution Centre
Lot 1 Eastern Creek Drive, Eastern Creek NSW



Data source: © NSW Government & Department of Planning, Industry & Environment 1998

Figure 2.
Acid Sulfate Soil Risk Map
Compass 2 Warehouse & Distribution Centre
Lot 1 Eastern Creek Drive, Eastern Creek NSW



MAPPING CATEGORY	ASSOCIATED SOIL LANDSCAPES	LANDFORM - GEOLOGY
KNOWN SALINITY Areas where there is a known occurrence of saline soil, or where air photo interpretation and field observations have confirmed more than one of these: a - scalding b - salt efflorescence c - vegetation dieback d - salt tolerant plant species e - waterlogging A high relative wetness index occurs in these areas.	* Salinity outbreaks occur in Blacktown (bt), Luddenham (lu) and Richmond (ri) Soil Landscapes - common at breaks of slope, lower slopes and drainage lines. * Berkshire Park (bp) and Upper Castlereagh (up) Soil Landscapes have localised salinity due to the impermeable nature of the clay parent material. * South Creek (sc), Monkey Creek (mk), Freemans Reach (fr) and Theresa Park (tp) Soil Landscapes have common saline outbreaks due to high run-on and low local relief. * Soils in the above landscapes have high clay content in subsoils and are imperfectly to poorly drained.	* Break of slope, lower slope and drainage lines of Wianamatta Shales (Rwb,Rwa and Rwn). * Localised salinity also occurs at the geological boundary between Tertiary Gravels (Tl, Tr) and underlaying Wianamatta Shales (Rwb,Rwa/ Quaternary Alluvials (Qpd, Qpa, Qpl, Qal). * Localised salinity occurs in Quaternary Alluvium (Qal, Qpn. Qpd) which underlies many of the drainage systems and wetland margins.
HIGH SALINITY POTENTIAL Areas where soil, geology, topography and groundwater conditions predispose a site to salinity. These conditions are similar to areas of known salinity (see above). These areas are most common in lower slopes and drainage systems where water accumulation is high (ie. high relative wetness index).	* Soil Landscapes include Birrong (bi), Blacktown (bt) Berkshire Park (bp), Freemans Reach (fr), South Creek(sc0, Theresa Park (tp), Richmond (ri) and Luddenham (lu). Drainage systems and convergent slopes are areas of highest risk. * Soils in these landscapes have high clay content in the subsoils, low permeability and high run-on. * Soil profiles may display signs of high salt concentrations at depth (i.e. >0.5m).	* Salinity is most likely to occur in lower slopes, foot-slopes, floodplains and creek lines on Quaternary Sediments (Qal, Qpn, Qpd, Qpc, Qpp, Qha)/Wianamatta Shales (Rwb, Rwn, Rwa) where run-on is high, resulting in seasonally high water tables and soil saturation.
MODERATE SALINITY POTENTIAL Areas on Wianamatta Group Shales and Tertiary Alluvial Terraces. Scattered areas of scalding and indicator vegetation have been noted but no concentrations have been mapped. Saline areas may occur in this zone, which have not yet been identified or may occur if risk factors change adversely.	* Areas of Agnes Banks (ab), Berkshire Park (bp), Blacktown (bt), Luddenham (lu) and Lucas Heights (lh). * Steeper areas with moderate to high local relief and well drained subsoils such as Picton (pn), West Pennant Hills (wp) and Glenorie (gn) are at a lower risk of developing salinty. * Soils are moderate to well-drained due to their elevated position in the landscape.	* Hill-slopes and hill-crests on Wianamatta Shales (Rwb, Rwn, Rwa). * Raised abandoned alluvial terraces and drainage lines on Quaternary Alluvium (Qal, Qpn, Qpd, Qpc, Qpp) from Richmond to Camden and east to Rookwood. Localised areas of elevated, well-drained Tertiary Gravels (Ta, Tl, Tr).
VERY LOW SALINITY POTENTIAL Areas where salinity processes do not operate or are of minor significance. Soils are rapidly drained and underlaying strata (Hawkesbury/Narrabeen Sandstone) are highly permeable, resulting in continual flushing and removal of salts in the landscape. No salinity has been observed in these areas and is not expected to occur.	* Rapidly drained soil landscapes with shallow soils include Warragamba (wb) and Hawkesbury (ha). * Gymea (gy) and Faulconbridge (fb) Soil Landscapes consist of highly permeable sands with well-drained subsoils. * Soils are well to rapidly drained. * Soils have high sand content.	* Occurring on Hawkesbury and Narrabeen Sandstone (Rh, Rno). * Groundwater is relatively fresh in these areas due to the sandstone's elevated position in the landscape and highly permeable nature, resulting in continuous flushing of the system (removal of any accumulated salts).

Data source: © NSW Government & Department of Planning, Industry & Environment 2002

0 5 10 km

Figure 3.
Salinity Potential Map
Compass 2 Warehouse & Distribution Centre
Lot 1 Eastern Creek Drive, Eastern Creek NSW

Appendix B

Field peroxide method

B1 Soil Field Tests

Adapted from WQA, 2018 *National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods manual*.

This Appendix provides information on how to perform field pH tests and interpret their results. It is important to note that, while a useful exploratory tool, field tests are indicative only. They cannot be used as a substitute for laboratory analysis to determine the presence or absence of acid sulfate soils (ASS).

Further laboratory analysis is also needed to quantify the acidity and other hazards.

Details on the laboratory analyses required for ASS are provided in the *National Acid Sulfate Soils Identification and Laboratory Methods Manual* (Sullivan et al., 2018).

B2 Soil field test equipment

It is important that prior to conducting the field tests, the appropriate testing equipment is obtained. For a basic set up the following items are required:

- pH meter and electrode (charged and calibrated).
- At least 2 buffer solutions (for example pH 4.0 and pH 7.0).
- Centrifuge tubes or beakers – wide, unbreakable, heat resistant and clear (for example Falcon 50 mL polypropylene).
- Centrifuge tube or jar rack marked with soil sample depths – use a separate rack for pHF tests and pH_{FOX} tests in case they bubble over.
- Stirrers for centrifuge tubes.
- 30% hydrogen peroxide (H2O2) pH adjusted to 4.5–5.5.
- Storage bottle for H2O2.
- Sodium hydroxide (NaOH) to raise pH of peroxide to 4.5–5.5 (pH 5.5 ideal).
- Deionised (DI) water.
- Squirt bottle for DI water.
- Tissues.
- Gloves and safety glasses.
- Protective clothing.
- Bucket to collect used soil and hydrogen peroxide.
- Bucket and brush to clean tubes for next sample.
- Recording sheets.
- Excess water for rinsing.
- First aid kit – especially eye wash solutions.
- 1 M hydrochloric (HCl) acid to test for shell presence.

B2.1 Conducting field tests – some considerations

When the analytical results are reported, both the field test results and informative soil profile descriptions will aid the interpretation of the laboratory results and help provide a better understanding of the soil properties and behaviour on the site, especially with respect to the acidity hazard.

When performing pH_F tests, soil samples must be analysed as soon as possible after sampling. If Reduced Inorganic Sulfur (RIS) are present, they are often capable of rapid oxidation causing substantially lowered pH_F values. Delayed determinations of pH_F may provide results that do not faithfully represent pH conditions in the field at the time of sampling.

The rate of reaction in the pH_{FOX} test is temperature dependent and can take up to an hour to complete under cold conditions. It is important to allow sufficient time for the reaction to occur, especially in cool weather.

Field pH tests should be performed on site, however, there are many areas (for example wetlands) where performing field tests in situ can prove difficult (for example too wet, mosquito problems). In such situations, samples should be preserved (for example kept on dry ice), taken to a suitable location for the conduct of field tests and the delay in time between sampling and 'field' analysis recorded with the field test results.

B2.2 On-site chemical and material safety precautions

B2.2.1 HYDROGEN PEROXIDE

Care needs to be taken when using hydrogen peroxide (H_2O_2) in the field. Hydrogen peroxide (30%) is used as the primary reagent in the pH_{FOX} test. The concentration is 10 times stronger than the peroxide commonly found in household medicine cabinets. The reaction of peroxide with soil containing RIS may produce sulfurous gases and generate heat in excess of 90 °C.

Caution: 30% hydrogen peroxide is a strong oxidising agent and should be handled carefully with appropriate eye and skin protection. This test is suitable for experienced operators only.

The peroxide when first received may have a pH of 3.5 or lower. Chemical companies commonly put stabilisers in the peroxide to prevent it from decomposing and releasing oxygen by keeping the pH low. The pH required for the pH_{FOX} is pH 4.5–5.5; this may be obtained by adding sodium hydroxide (NaOH; pH14).

Since both of these chemicals are highly corrosive and many of the long-term side effects are not fully known, it is recommended the following precautions are taken when performing field tests.

Always:

— Use gloves, safety glasses, laboratory coat or protective clothes.

— Conduct pH peroxide test in a well-ventilated area.

— Use test tubes capable of withstanding rapid heat changes and high temperatures.

— Avoid skin and eye contact with peroxide.

— Label all peroxide bottles with safety data information.

B2.2.2 Other chemicals

Several other chemicals are used in the field when sampling suspected ASS materials. Buffering solutions and potassium chloride (KCl) solutions are used to calibrate and maintain pH meters and care should be exercised when using these substances. Follow the appropriate safety directions on Safety Data Sheets (SDS).

Hydrochloric acid (HCl) is used when performing tests to assess the presence of carbonates in soil material (see Field carbonate test). Hydrochloric acid is strongly acidic and is very corrosive to the skin, therefore, caution is required when using it. Again, follow the appropriate directions outlined in the SDS.

Store HCl separately from buffer solutions as HCl gas may slowly diffuse through the plastic bottles and alter the buffer solutions.

B2.3 Field pH tests

B2.3.1 Introduction

The pH_F and pH_{FOX} tests have been developed for rapid assessment in the field for the likelihood of ASS. These tests are easy to conduct, quick, and have a minimum set-up cost. The field tests have been developed to give reasonable indication for many soils (provided the tests are performed properly). Although these field tests may provide an indication of ASS presence, they are purely qualitative, indicative, and do not give quantitative measures of the amount of acid that has been or could be produced through the RIS oxidation process.

Field pH tests should be part of any ASS investigation. The field pH tests (both pH_F and pH_{FOX}) should be conducted at 0.25 m intervals on the soil profile, ensuring at least one test per soil layer/horizon.

It is recommended that field tests be conducted on-site. If the tests cannot be performed in the field, tests should be conducted as soon as possible, ensuring appropriate sample and preservation procedures are observed (see the Sample handling, transport and storage section in Section 5 of the ASSSMP for further details) and delays between sampling and the ‘field’ analysis are recorded with the results.

Samples suspected of containing monosulfides should undergo field pH testing immediately.

The field pH tests outlined below are from the Queensland Acid Sulfate Soils Investigation Team (QASSIT) Acid Sulfate Soils Laboratory Methods Guidelines (Ahern et al. 2004).

B2.3.2 Field pH test (pH_F) – NSM-1.1

The procedure for the pH_F is outlined below:

1. Calibrate battery powered field pH meter according to manufacturer’s instructions.
2. Prepare the centrifuge tubes in a tube rack. Mark the rack with the depths to identify the top and bottom of the profile. Use separate racks for the pH_F and pH_{FOX} tests to prevent cross contamination from violent pH_{FOX} reactions.
3. Conduct tests at intervals on the soil profile of 0.25 m, or at least one test per soil layer/horizon, whichever is lesser.
4. For each layer place approximately half a teaspoon of soil into each of the pH_F and pH_{FOX} tubes. It is important the two sub-samples come from the same depth and are similar in characteristics. For example, do not take half a teaspoon of grey mud from the 0–0.25 m depth for one test and then select half a teaspoon from the same depth layer that has yellow mottles for the other test.
5. Place enough deionised (DI) water in the pHF test tube to make a paste similar to ‘grout mix’ or ‘white sauce’; stir the soil:water paste to ensure all soil ‘lumps’ are removed (demineralised water can be substituted; never use tap water). Water must be added to the soil samples within 10 min of sampling to reduce the risk of RIS oxidation; monosulfidic material may start to oxidise in less than 5 min, substantially affecting pHF results.
6. Immediately place the pH spear point electrode into the soil:water paste, ensuring the spear point is completely submerged. Never stir the paste with the electrode as this may damage the semi-permeable glass membrane.
7. Measure the pHF with the calibrated pH meter.
8. Wait for the reading to stabilise and record the pH measurement.

9 All measurements should be recorded on a data sheet.

B2.3.3 Field pH peroxide test (pH_{FOX}) – NSM-1.2

It is recommended that 30% hydrogen peroxide (H_2O_2) be used in the pH_{FOX} test.

Hydrogen peroxide (30%) is highly corrosive and care should be taken when handling and using the peroxide. Safety glasses and gloves should be worn when handling and using peroxide. All chemical bottles should be clearly labelled and Safety Data Sheets (SDS) should be kept with the chemicals at all times. Appropriate health and safety precautions should be adhered to. Peroxide should be kept in the fridge when not in use.

The procedure for the field pH peroxide test (pH_{FOX}) is outlined below:

1 Adjust the pH of the H_2O_2 to between 4.5 and 5.5 before going into the field. While stirring, add a few drops of dilute NaOH and regularly check the pH with a calibrated electrode until the correct range is reached. Allow the peroxide to stand for 15 min and then recheck the pH. As H_2O_2 degrades over time, only buffer small quantities at a time and refrigerate when not in use.

2 Calibrate battery powered field pH meter according to manufacturer's instructions.

3 Prepare heat-resistant centrifuge tubes in a tube rack. Mark the rack with the depths to identify the top and bottom of the profile. Use separate racks for the pH_F and pH_{FOX} tests to prevent cross contamination from violent pH_{FOX} reactions.

4 Conduct pH_{FOX} tests at intervals on the soil profile of 0.25 m or at least one per horizon, whichever is lesser.

5 To the pH_{FOX} tube, prepared while sampling for pH_F, add sufficient 30% H_2O_2 (at room temperature) to cover the soil, then stir the mixture.

6 Rate the reaction of soil and peroxide using the reaction scale in Table B.1.

7 Allow approximately 15 min for any reactions to occur. The reaction may be rapid and vigorous if substantial RIS is present. If the reaction is violent and the soil:peroxide mix may overtop the tube, use a wash bottle to add small amounts of deionised or demineralised water to cool and calm the reaction. Do not add too much water as this may dilute the mixture and affect the pH value.

8 Add a further 1–2 mL of H_2O_2, mix, allow to react for 15 min and rate the reaction. Continue this process until the soil:peroxide mixture reaction has slowed. This will ensure most of the RIS have reacted.

9 If there is no initial reaction, individual tubes containing the soil:peroxide mixture can be placed in direct sunlight. This may encourage the initial reaction to occur.

10 Wait for the soil:peroxide mixture to cool. This may take up to 10 min as the reaction can exceed 90 °C. Check the temperature rating of the pH meter and probe as high temperatures can damage the electrode and result in inaccurate readings. A more accurate pH is recorded if a temperature probe is used, however, this may be impractical in some field situations.

11 Place the spear point pH electrode into the soil:peroxide mixture, ensuring the spear point is completely submerged. Never stir the paste with the electrode as this may damage the semi- permeable glass membrane.

12 Measure the pH_{FOX} with the calibrated pH meter.

13 Wait for the reading to stabilise and record the pH_{FOX} measurement.

14 All measurements should be recorded on a data sheet.

B2.3.4 Rating soil reactions of the pH_{FOX} test

Table B.1 indicates the reaction scale for pH_{FOX} tests. The rate of the reaction generally indicates the level of RIS present, but depends also on texture and other soil constituents. A soil containing very little RIS may only have a slight reaction

(L), however a soil containing high levels of RIS (remember the exact level of RIS cannot be determined using the pH_{FOX} test) is more likely to have an extreme/volcanic reaction (X–V), although there are exceptions. This rating scale alone should not be used to identify ASS. It is not a very reliable feature in isolation as there are other factors including manganese and organic acids which may trigger reactions. Reactions with organic matter tend to be more ‘frothing’ and do not tend to generate as much heat as sulfidic reactions. Manganese reactions can be quite extreme, but do not tend to lower the pH_{FOX}.

Table B.1 Soil reaction rating scale for the pH_{FOX} test

REACTION SCALE	RATE OF REACTION
L	Low reaction
M	Medium reaction
H	High reaction
X	Extreme reaction
V	Volcanic reaction

Source: DER (2015a).

B2.3.5 Interpretation of field PH tests

The pH_F test can help identify Actual ASS. While a pH_F of less than or equal to 4 is indicative of the presence of Actual ASS, it is not conclusive of the presence of ASS on its own, as naturally occurring, non ASS soils such as many organic soils (for example peats) and heavily leached soils may also have pH_F less than or equal to 4. To identify as an Actual ASS, other evidence must be presented that indicates that the low pH_F has been mainly caused by the oxidation of RIS. Such information includes the presence of jarosite in the soil layer/horizon, or the location of other Actual ASS or PASS materials within or in the nearby vicinity to the sampling location.

The difference between the pH_F and the pH_{FOX} is helpful in the preliminary identification of PASS. Combined the pH_F and pH_{FOX} results can be a useful aid with soil sample selection for laboratory analysis during Stage 2 of the field site investigations.

The pH_{FOX} result when compared to the pH_F result can give an indication of the presence of RIS in the sample. To ensure accurate results both of these tests must be conducted in the field as soon as possible after the sample is collected as the pH of the soil sample can change relatively quickly with time (hours to days) even when recommended sample preservation techniques are employed. For example, it is not unusual for soil pH test carried out at a laboratory to differ considerably (that is greater than a pH unit) from soil pH test measured in the field after even one day of storage, and as such, a laboratory determination of pH_F at a later date cannot be relied upon to represent field conditions at the time of sampling.

Soil field pH_F and pH_{FOX} tests whilst useful exploratory tools, however, are not determinative and cannot be substituted for laboratory analysis for either the identification of ASS materials and quantification of the acidity hazards these materials pose. A recent review of the utility of these field tests in Western Australia indicated that these tests only accurately identified ASS materials in 60 to 80 per cent of cases (DER 2015a).

A comparison of pH_F and pH_{FOX} test results can often give a strong indication of the presence of ASS. The greater the drop in pH from pH_F following the addition of peroxide, the greater the likelihood of PASS, although there are exceptions. A combination of a large difference between the two pH tests, a strong reaction with peroxide and a low pH after peroxide oxidation (that is pH_{FOX} less than 3) strongly indicates the presence of PASS.

However, it is important to note that the definitive confirmation of either the presence or absence of PASS materials in the field can only be accomplished by appropriate laboratory testing.

Table B.2 and Table B.3 provide some guidance on the interpretation of pH_F and pH_{FOX} test results, respectively.

Table B.2 Interpretation of some pH_F test ranges

pH VALUE	RESULTS	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 B.3 Interpretation of pH_{FOX} test results

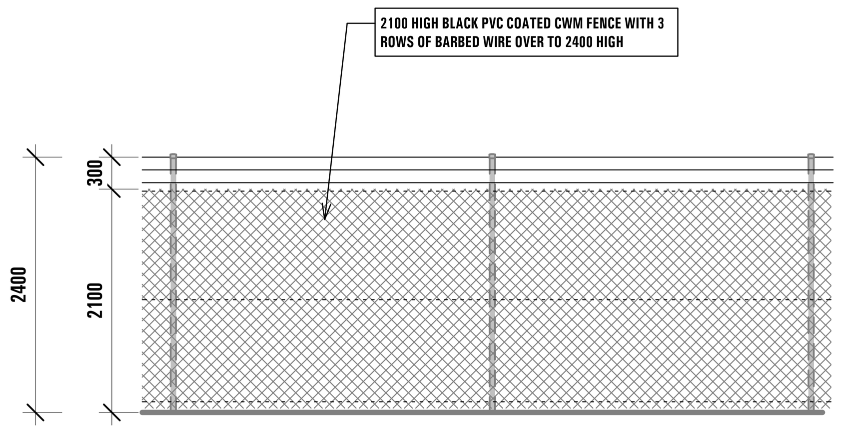
pH VALUE AND REACTION	RESULT	COMMENTS
Strong reaction of soil with H_2O_2 (that is X or V)	Useful indicator of the presence of RIS but cannot be used alone	Organic rich substrates such as peat and coffee rock, and soil constituents like manganese oxides, can also cause a reaction. Care must be exercised 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 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 VALUE AND REACTION	RESULT	COMMENTS
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 pHF 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).

Appendix C

Provided Final Development Plan



FENCING - 01 (CWM)

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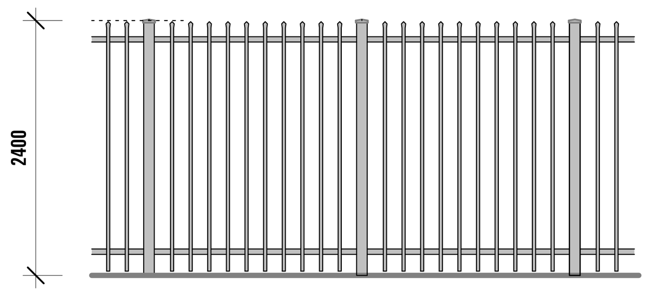

FENCING - 02 (PALISADE)

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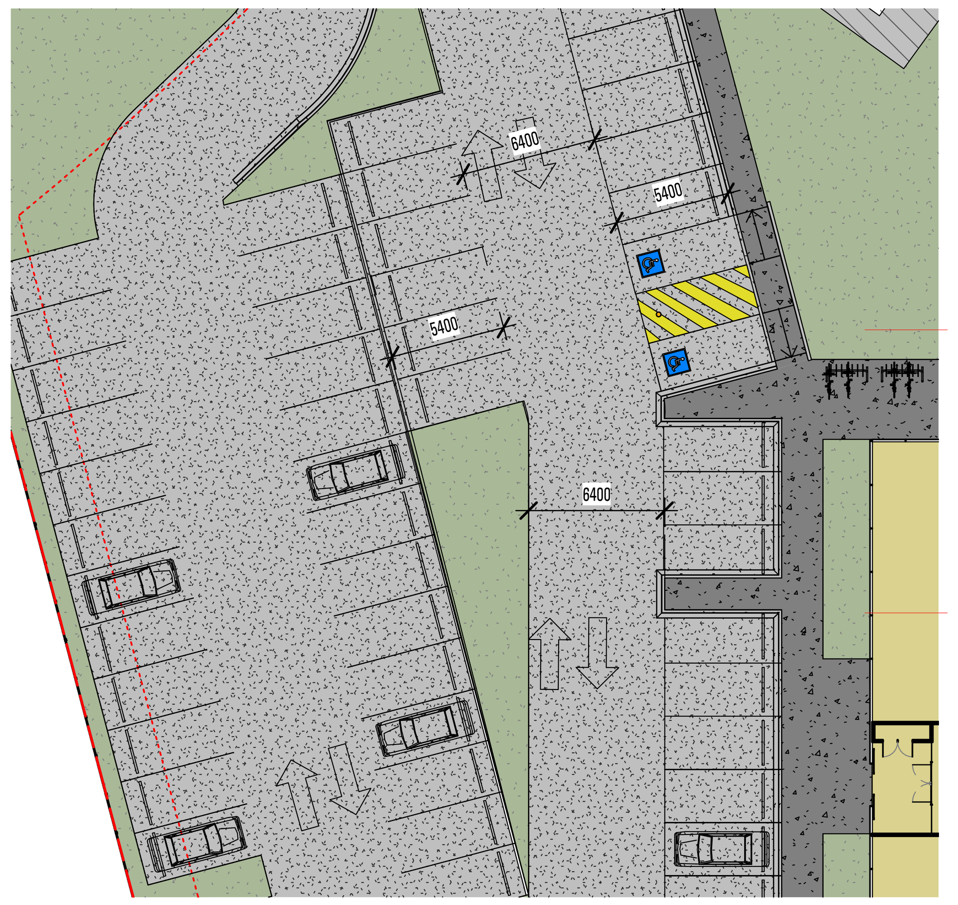
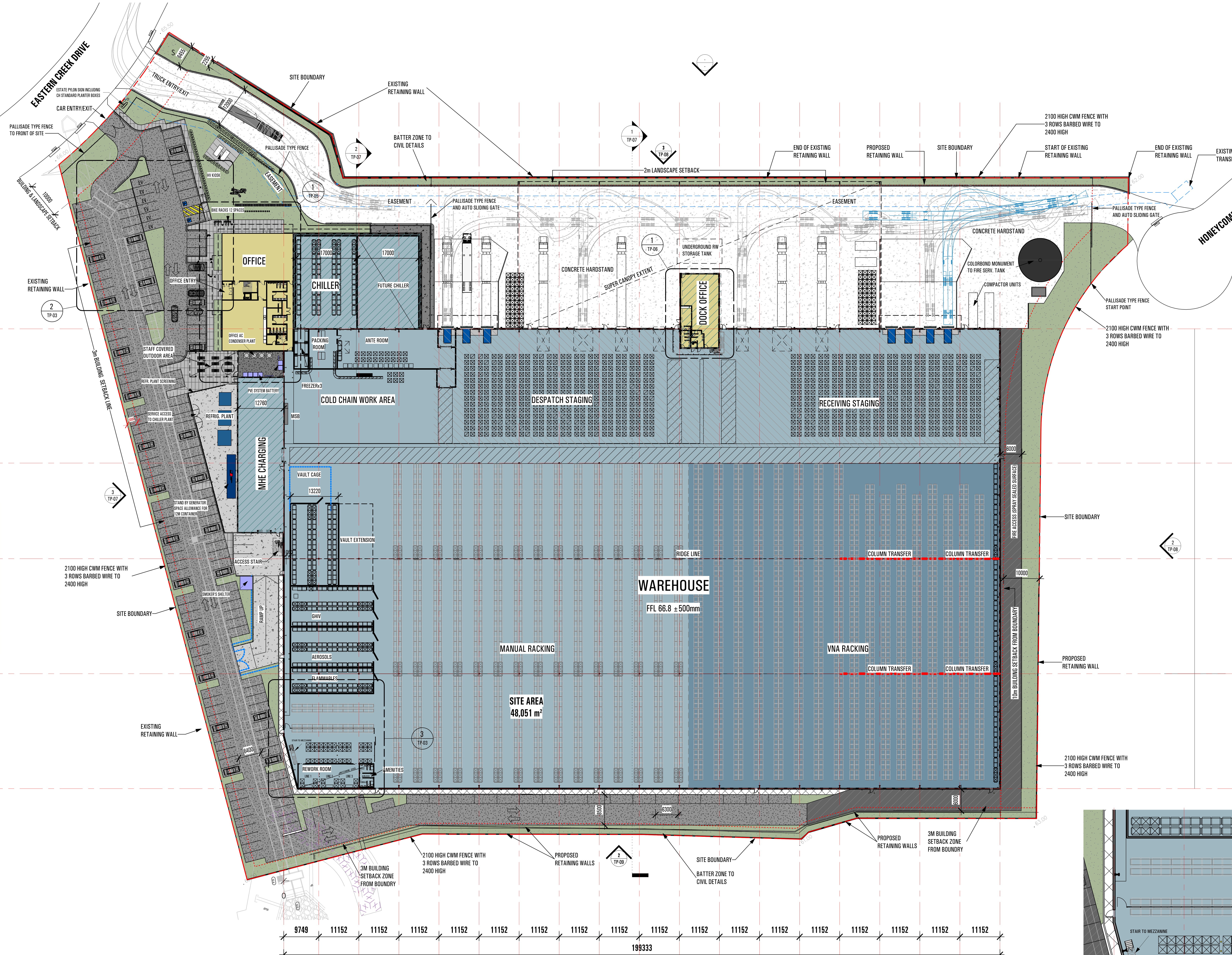


2 CAR PARK DETAIL

1 : 250

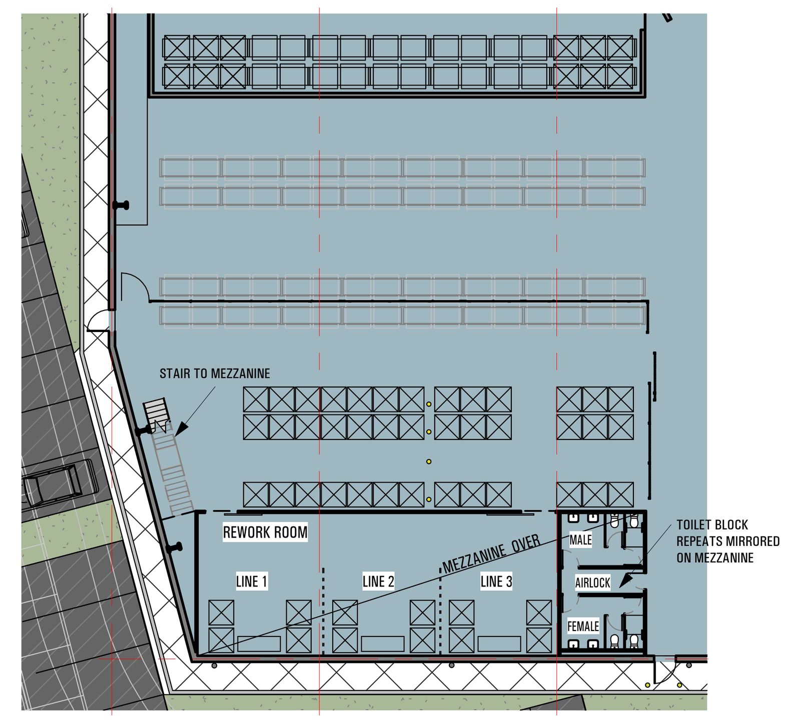
DEVELOPMENT SUMMARY

TOTAL SITE AREA (APPROX)	**48,053 M²**
WAREHOUSE AREA (GFA)	20,280 M²
FORKLIFT CHARGING	500 M²
FREEZER	920 M²
TOTAL WAREHOUSE (GFA)	**21,700 M²**
WAREHOUSE STAGING AREAS (HATCHED) - EXCLUDED FROM GFA.	5,120 M²
2 STOREY DOCK OFFICE	450 M²
2 STOREY MAIN OFFICE	1,300 M²
TOTAL OFFICE AREA	**1,750 M²**
TOTAL BUILDING AREA	**28,570 M²**
TOTAL SITE EFFICIENCY	**59.5%**
CAR PARKING CALCULATION	
CAR PARKING SPACES	184 NO.
LANDSCAPE CALCULATION	
ACTUAL PROVIDED LANDSCAPED AREA 6% OF TOTAL SITE AREA	2,915M²



1 SITE PLAN

1 : 500



3 REWORK AREA DETAIL

1 : 250

PROJECT NERIO

LOT 1, EASTERN CREEK DRIVE, EASTERN CREEK NSW.

Charter Hall

SHEET NAME:	**SITE PLAN**			
JOB NO. 4387-21	**SCALE:** As indicated	@B1 SIZED SHEET	PROJECT NORTH
Drawing No: TP-03	**ISSUE DATE:**	3/02/2022	
REVISION: B	**DRAWN BY:**	FF	

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