REPORT TO

NSW DEPARTMENT OF EDUCATION

ON

SALINITY ASSESSMENT AND SALINITY MANAGEMENT PLAN

FOR

PROPOSED NEW PRIMARY SCHOOL IN MULGOA RISE

AT

1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Date: 29 July 2021

Ref: E33177Prpt4rev1-SAL

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E33177Prpt4-SAL	Final Report	5 November 2020
E33177Prpt4rev1-SAL	Final Report – revised to consider redesign	29 July 2021

Executive Summary

NSW Department of Education | School Infrastructure ('the client') commissioned JK Environments (JKE) to undertake a salinity assessment and prepare a salinity management plan for the proposed primary school development at 1-23 Forestwood Drive, Glenmore Park, NSW. The site location is shown on Figure 1 and the assessment was confined to the site boundaries as shown on Figure 2 attached in the appendices.

We understand that this report will be used to support the lodgement of a State Significant Development (SSD) development application. This report has been revised at the request of Richard Crookes Constructions to consider the redesign of the proposed school.

A geotechnical investigation was undertaken in conjunction with this assessment by JK Geotechnics (JKG). The results of the investigation are presented in a separate report. A Detailed Site Investigation (DSI) was undertaken in conjunction with this assessment by JKE. The results of the DSI are also presented in a separate report. These reports should be read in conjunction with this salinity report.

JKE have previously undertaken a Preliminary Site Investigation (PSI) at the site and a summary of this information is provided in Section 2.1 of this report.

Based on the information provided, we understand that the proposed development includes the construction of a new primary school. It is assumed that relatively minor cut/fill earthworks may be required. The development will occur over the northern half of the site, comprising four main buildings, and will not include basements. A carpark and games court are proposed at the eastern end of the site.

The primary aim of the assessment was to characterise the broad scale salinity conditions at the site in the context of the proposed development works. The assessment objectives were to:

- Assess the current site conditions via a site walkover inspection;
- Assess the soil and groundwater salinity conditions via implementation of a sampling and analysis program; and
- Provide salinity management recommendations (if/where required).

The scope of work included a review of site information, a site inspection, soil sampling from eight boreholes and groundwater sampling from three monitoring wells installed at the site.

The site information indicated that the site is underlain by Bringelly Shale of the Wianamatta Group, and that the site is located on the boundary of the Blacktown and Luddenham soil landscape profiles. Blacktown soils are characterised by moderate erodibility with some higher local occurrences low dispersivity ad localised areas of moderate salinity. Luddenham soil landscapes are characterised by highly erodible topsoils, moderate to high dispersivity and low salinity. The site is also located in an area mapped as moderate to high salinity potential. JKE note that considerable filling has occurred at the site and the characteristics of the fill may vary from these soil landscapes.

The results of the laboratory analysis indicated the following:

- The salinity of the soils ranges from non-saline to very saline. The majority of the samples are classed as slightly to moderately saline, and the salinity classification generally peaked between 0.5m below ground level (BGL) to 1.5mBGL;
- The soils are classed as mildly to very strongly alkaline, and the alkaline conditions generally increased with depth;
- The soils are typically classed as non-sodic;
- The groundwater beneath the site is classed as saline;
- The soils are non-aggressive towards buried concrete and mildly aggressive towards buried steel; and
- The groundwater is non-aggressive towards buried concrete and steel.

Based on the findings of the assessment, a salinity management plan has been prepared for the site and is included in Section 8 of this report. The conclusions of the salinity assessment and the salinity management plan were not altered for this revised report, as a result of the redesign.

The conclusions and recommendations should be read in conjunction with the limitations presented in the body of this report.

Table of Contents

List of Tables

Attachments

ABBREVIATIONS

Australian Height Datum	**AHD**
Acid Sulfate Soil	**ASS**
Below Ground Level	**BGL**
Borehole	**BH**
Cation Exchange Capacity	**CEC**
Calcium	**Ca**
Cement, Concrete and Aggregates Australia	**CCAA**
Chain of Custody	**COC**
Damp Proof Course	**DPC**
Department of Land and Water Conservation	**DLWC**
Dissolved Oxygen	**DO**
International Organisation of Standardisation	**ISO**
JK Environments	**JKE**
Local Government Authority	**LGA**
Map Grid of Australia	**MGA**
Magnesium	**Mg**
National Association of Testing Authorities	**NATA**
Potassium	**K**
Polyvinyl Chloride	**PVC**
Practical Quantitation Limit	**PQL**
Redox Potential	**Eh**
Site Assessment Criteria	**SAC**
Standard Penetration Test	**SPT**
Standard Sampling Procedure	**SSP**
Standing Water Level	**SWL**
Standard Sampling Procedure	**SSP**
Sodium	**Na**
Western Sydney Regional Organisation of Councils	**WSROC**

Units

deci Siemens per Metre	**dS/m**
Electrical Conductivity	**EC**
Exchangeable Sodium Percentage (Sodicity)	**ESP%**
Litres	**L**
Metres	**m**
Metres Below Ground Level	**mBGL**
Millivolts	**mV**
Millilitres	**ml**
Milliequivalents	**meq**
Milligrams per Litre	**mg/L**
Milligrams per Kilogram	**mg/kg**
ohm Centimetres	**ohm.cm**
Parts Per Million	**ppm**
micro Siemens per Centimetre	**µS/cm**

1 INTRODUCTION

NSW Department of Education | School Infrastructure ('the client') commissioned JK Environments (JKE) to undertake a salinity assessment and prepare a salinity management plan for the proposed primary school development at 1-23 Forestwood Drive, Glenmore Park, NSW. The site location is shown on Figure 1 and the assessment was confined to the site boundaries as shown on Figure 2 attached in Appendix A.

We understand that this report will be used to support the lodgement of a State Significant Development (SSD) development application. This report has been revised at the request of Richard Crookes Constructions to consider the redesign of the proposed school.

A geotechnical investigation was undertaken in conjunction with this assessment by JK Geotechnics (JKG). The results of the investigation are presented in a separate report (Ref: 33177PN2rpt rev1)[1]. A Detailed Site Investigation (DSI) was undertaken in conjunction with this assessment by JKE. The results of the DSI are presented in a separate report (Ref: E33177Prpt3-DSI, dated 5 November 2020)[2]. These reports should be read in conjunction with this salinity report.

JKE have previously undertaken a Preliminary Site Investigation (PSI) at the site and a summary of this information is provided in Section 2.1 of this report.

Background information on salinity is included in Appendix D.

1.1 Proposed Development Details

Based on the information provided, we understand that the proposed development includes the construction of a new primary school. It is assumed that relatively minor cut/fill earthworks may be required. The development will occur over the northern half of the site, comprising four main buildings, and will not include basements. A carpark and games court are proposed at the eastern end of the site.

A future development (with additional classrooms) may also be completed at a later date over the southern half of the site.

The concept plan is attached in Appendix B.

1.2 Aim and Objectives

The primary aim of the assessment was to characterise the broad scale salinity conditions at the site in the context of the proposed development works. The assessment objectives were to:

- Assess the current site conditions via a site walkover inspection;

[1] JK Geotechnics, (2021). *Report to Department of Education on Supplementary Geotechnical Investigation for New Primary School in Mulgoa Rise at 1-23 Forestwood Drive, Glenmore Park, NSW.* (Ref: 33177PN2rpt rev1). (referred to as JKG Report)

[2] JKE, (2020). *Report to Department of Education on Detailed Site Investigation for Proposed Mulgao Rise Public School at 1-23 Forestwood Drive, Glenmore Park, NSW.* (Ref: E33177Prpt3-DSI, dated 5 November 2020). (referred to as DSI)

- Assess the soil and groundwater salinity conditions via implementation of a sampling and analysis program; and
- Provide salinity management recommendations (if/where required).

1.3 Scope of Work

The assessment was undertaken generally in accordance with a JKE proposal (Ref: EP52030P-P52030PN Rev2) of 16 June 2020, a formal agreement in relation to a tender (Ref: SINSW00711/20) executed on 8 May 2020, and a variation approval from the client dated 18 September 2020. The scope of work included the following:

- Review site information including topography, soils maps, regional geology and hydro-geology in the vicinity of the site;
- A walkover site inspection to identify obvious visual indicators of salinity or potential problem areas;
- Design and implementation of a field sampling and laboratory analysis program;
- Interpretation of the analytical results based on established assessment criteria;
- Preparation of a report presenting the results of the assessment; and
- Preparation of a site-specific salinity management plan for the proposed development.

The report was reviewed and revised generally in accordance with a JKE proposal (Ref: EP4465Prev1) of 15 July 2021 and a written acceptance by Richard Crookes Constructions by Purchase Order (Ref: 1233/655778), with prior approval from the client.

The assessment was designed and the report was prepared with reference to regulations/guidelines outlined in the table below. Individual guidelines/documents are also referenced within the text of the report.

Table 1-1: Guidelines

Guidelines/Regulations/Documents
Site Investigations for Urban Salinity (2002)[3]
Salinity Code of Practice (2004)[4]
Managing Urban Stormwater – Soil and Construction (4th ed.) (2004)[5]
Salinity Potential in Western Sydney Map (2002)[6]
Piling – Design and Installation AS2159-2009 (2009)[7]
Industry Guide T56: Residential Slabs and Footings in Saline Environments (2018)[8]

[3] Department of Land and Water Conservation (DLWC), (2002). *Site Investigations for Urban Salinity,* (referred to as DLWC 2002)

[4] Western Sydney Regional Organisation of Councils (WSROC) and Department of Infrastructure, Planning and Natural Resources (DIPNR), (2003 amended 2004). *Western Sydney Salinity Code of Practice* (referred to as Salinity Code of Practice)

[5] NSW Government/Landcom, (2004). *Managing Urban Stormwater – Soil and Construction*, (4th ed.) (referred to as Blue Book)

[6] DIPNR, (2002). *1:100,000 Map – Salinity Potential in Western Sydney*, (referred to as Salinity Potential Map)

[7] Standards Australia, (2009). *Piling – Design and Installation, AS2159-2009* (referred to as AS2159-2009)

[8] Cement, Concrete and Aggregates Australia (CCAA), (2018). Industry Guide *T56: Residential Slabs and Footings in Saline Environments* (referred to as CCAA 2018)

2 SITE INFORMATION

2.1 Background

A PSI was previously undertaken by JKE in June 2020[9]. The PSI included a review of historical information, soil sampling from 12 boreholes, 10 test pits and groundwater sampling from one monitoring well installed on-site. The site was historically used quarrying activities and was rehabilitated from around the year 2000 via importation of material and controlled filling.

The PSI identified deep filling across the site. All boreholes and test pits were terminated in fill at a maximum depth of 12.45m below ground level (BGL). Groundwater seepage was encountered in boreholes BH2, BH6, BH8, BH10 and BH16 at depths ranging from 4.0mBGL to 7.2mBGL after completion of drilling. The standing water level (SWL) of the groundwater within MW8 was recorded at a depth of 2.05mBGL prior to sampling. Comparison of the SWL to the initial water seepage/water strike depths indicated that the groundwater aquifer was either confined or semi-confined and that the SWL may represent the potentiometric surface of the aquifer rather than the true groundwater table elevation.

The soil and groundwater sampling and analysis conducted during the PSI was focussed on site contamination. The PSI did not identify any soil or groundwater contamination that was assessed to pose a risk to on-site receptors and/or in relation to the proposed land use. No assessment of the salinity potential of the site was made during the PSI.

2.2 Site Identification

Table 2-1: Site Identification

Site Address:	1-23 Forestwood Drive, Glenmore Park, NSW
Lot & Deposited Plan:	Lot 1663 in DP 1166869
Current Land Use:	Vacant land
Proposed Land Use:	Primary School (Kindergarten to year 6)
Local Government Authority (LGA):	Penrith City Council
Site Area (m^2):	30,000 (approximately)
RL (AHD in m) (approx.):	58-64
Geographical Location (decimal degrees) (approx.):	Latitude: -33.802927 Longitude: 150.681562

[9] JKE, (2020). *Report to NSW Department of Education on Preliminary Site Investigation (PSI) – Contamination, for Proposed Mulgoa Rise Public School at 1-23 Forestwood Drive, Glenmore Park, NSW.* (Ref: E33177PArpt, dated 3 June 2020) (referred to as PSI)

2.3 Site Location and Regional Setting

The site is located in a predominantly residential and recreational area of Glenmore Park and is bound by Deerubbin Drive to the north, Darug Avenue to the west, Forestwood Drive to the south and Mulgoa Rise Field recreational grounds to the east/south-east. The majority of the surrounding properties were residential in nature. The site is located approximately 200m to the west of Surveyors Creek.

2.4 Topography

The site fell gently towards to the north-east with an overall slope of approximately 2°. The site topography was generally in-line with the surrounding natural elevation and topographic features.

2.5 Site Inspection

A walkover inspection of the site was undertaken by JKE on 12 October 2020. The inspection was focussed on assessing the site conditions relevant to salinity-related factors only. The site was reinspected on 23 July 2021 and the observations in relation to salinity factors were largely unaltered.

At the time of the inspection on 12 October 2020, the site was vacant, levelled grassed area. The area along the northern boundary was used as an informal parking area by heavy vehicles, and the area along the eastern boundary was used as an informal car park. The site was fenced by steel post and wire fencing along the southern boundary, and steel post/tubing along the eastern boundary. Visual inspection of the site extents revealed no obvious signs of soil erosion.

A section of bare earth was visible within the north-east of the site, which was considered a consequence of vehicle access and car parking associated with the adjacent playing fields. Some further scouring of this area was evident during the July 2021 inspection, potentially due to rain and heavier vehicle use. The vegetation across the site typically comprised native and exotic grasses and weeds, with native tree plantings within the council reserves bordering the site. The vegetation appeared generally in good health (based on a cursory inspection), and no obvious signs of salt scalding of the site surface were observed.

2.6 Surrounding Land Use

During the site inspection, JKE observed the following land uses in the immediate surrounds:

- North – vacant grassed lot beyond Deerubbin Drive as well as residential properties including an early learning centre (“Young Academics”) to the north-east;
- South – residential properties beyond Forestwood Drive;
- East – recreational land (Mulgoa Rise Field) including parking area, soccer fields, children’s playground and amenities; and
- West – residential properties beyond Darug Avenue.

3 GEOLOGY AND HYDROGEOLOGY

3.1 Regional Geology and Soils

Geological information presented in the Lotsearch report (attached in Appendix B) indicates that the site is underlain by Bringelly Shale of the Wianamatta Group, which typically consists of shale, carbonaceous claystone, claystone, laminite, fine to medium grained lithic sandstone, rare coal and tuff.

Soil landscape information presented in the Lotsearch report indicates that the site is located on the boundary of Luddenham and Blacktown soil landscapes. Luddenham soils are characterised by highly erodible topsoils, moderate to high dispersivity and low salinity. Blacktown soils are characterised by moderate erodibility with some higher local occurrences, low dispersivity and localised areas of moderate salinity. The South Creek soil landscape is also located nearby (<100m) from the site. South Creek soils are characterised by high to severe and widespread erodibility, moderate dispersivity and high salinity.

JKE note that the site has undergone considerable filling and information regarding the source(s) of the fill were not provided to JKE. The characteristics of the fill may vary from the above landscapes.

3.2 Salinity Hazard Map

The site is located within the area of Western Sydney included in the Salinity Potential Map. Based upon interpretation from the geological formations and soil groups presented on the map, the site is located in a region of moderate to high salinity potential.

The moderate classification is attributed to scattered areas of scalding and indicator vegetation, in areas where concentrations have not been mapped. Saline areas may occur in this zone, which have not been identified or may occur if risk factors change adversely.

Areas of high potential occur where soil, geology, topography and groundwater conditions predispose a site to salinity. These areas most commonly occur on lower slopes and drainage systems where water accumulation is high. These areas are most likely to occur in lower slopes, foot slopes, floodplains and creek lines where run-off is high, resulting in seasonally high water tables and soil saturation.

3.3 Acid Sulfate Soil Risk and Planning

The site is not located in an acid sulfate soil (ASS) risk area according to the risk maps prepared by the Department of Land and Water Conservation and the Penrith City Council.

3.4 Hydrogeology

Hydrogeological information presented in the Lotsearch report indicated that the regional aquifer on-site and in the areas immediately surrounding the site includes porous, extensive aquifers of low to moderate productivity. There were a total of 18 registered bores within the report buffer of 2,000m. The nearest registered bore was located approximately 800m from the site. Limited soil descriptions were provided within the driller's log for this bore, and no groundwater quality information for this bore was available.

The Wianamatta Formation is characterised by very low permeability, low storage and high groundwater salinity as a consequence of the depositional environment during the middle Triassic period. This typically renders the shale groundwater unsuitable for any use due to low yield and poor quality. A perched groundwater table condition may occur in the residual soils overlying the shale at some locations especially during prolonged wet conditions. This occurs due to the relatively higher permeability of soil at the soil-rock interface. Due to the shorter residence time, the perched water is typically less saline than flows within the bedrock.

3.5 Receiving Water Bodies and Surface Water Run-off

Considering the local topography and surrounding land features, JKE expected groundwater to flow eastwards towards Surveyors Creek. JKE note that at its closest point, Surveyors Creek comprises an ephemeral/intermittent gully feature with no ponded water.

Overland flows during rain events are anticipated to flow east/north-east in-line with the topography. The overland flows are expected to eventuate within the stormwater swale drain along the eastern boundary and collection pit in the north-eastern corner of the site, which is expected to discharge into Surveyors Creek to the east of the site.

4 SAMPLING AND ANALYSIS PLAN

4.1 Soil Sampling Rationale

The investigation included soil sampling from eight locations (boreholes BH311, BH312, BH314 to BH317, BH319 and BH320) targeted at the proposed built structures whilst also providing spatial coverage of the site. The sampling locations are shown on Figure 2 attached in Appendix A. This density is equivalent to approximately 2.5 sampling points per hectare (the area of the site is approximately 3 hectares) and meets the requirements for an 'initial site investigation' recommended in the DLWC 2002 document for 'moderately intensive construction'. The density was considered adequate to identify large areas of salinity impacted soils at the site.

Soil sampling for this assessment was confined to the depth of approximately 3m below existing ground level. This was considered adequate as it is assumed that only relatively minor cut/fill earthworks may be required for the proposed development. Reference can be made to the JKG report regarding the deeper soil aggressivity characteristics in the building footprints, which would be relevant to deeper piling scenarios.

4.2 Soil Sampling Methods

Fieldwork for this investigation was undertaken on 13 and 14 October 2020. Sampling locations were set out using a hand held GPS unit. Locations were marked using wooden pegs and were cleared for underground services prior to drilling.

The sample locations were drilled using a truck mounted hydraulically operated drill rig equipped with spiral flight augers. Soil samples were obtained from a Standard Penetration Test (SPT) sampler or directly from the auger when conditions did not allow use of the SPT sampler.

Soil samples were collected from the fill profiles encountered during the investigation based on distinct change in lithology or field observations. All samples were recorded on the borehole logs attached in Appendix E.

Samples were placed in plastic bags and sealed using twist ties. Sampling personnel used disposable nitrile gloves during sampling activities. The samples were labelled with the job number, sampling location, sampling depth and date.

On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA registered laboratory for analysis under standard COC procedures. Field sampling protocols adopted for this assessment are summarised in the appendices.

4.3 Groundwater Sampling Rationale

The assessment included the sampling from three groundwater monitoring wells within the site as shown on Figure 2 attached in Appendix A. The wells were positioned for site coverage and also targeted to the proposed building areas.

4.4 Monitoring Well Installation

The monitoring well construction details are documented on appropriate borehole logs presented in Appendix E. The well construction details are summarised in the following table:

Table 4-1: Monitoring Well Construction Details

Borehole Ref / Well Number	Installation Depth (BGL) (m)	Surface RL[1] (m) (approx.)	Casing & Screen[2] Depths (m)	Finishing Details (BGL) (m)
BH8 / MW8	6	60	- Casing from 0.1 to 3.0. - Screen from 3.0 to 6.0.	- Sand filter pack from 2.4 to 6.0. - Bentonite seal/plug from 0.1 to 2.4. - Finished with gatic cover flush with the surface surrounded by concrete grout.
BH311 / MW311	5	60.5	- Casing from 0.1 to 2.0. - Screen from 2.0 to 5.0.	- Sand filter pack from 1.5 to 5.0. - Bentonite seal/plug from 0.1 to 1.5. - Finished with gatic cover flush with the surface surrounded by concrete grout.
BH317 / MW317	6	62.5	- Casing from 0.1 to 2.0. - Screen from 2.0 to 4.0.	- Sand filter pack from 1.5 to 6.0. - Bentonite seal/plug from 0.1 to 1.5. - Finished with gatic cover flush with the surface surrounded by concrete grout.

Notes:

[1] RL: Reduced Level (AHD) based on interpretation of the survey contours on Figure 2

[2] 50mm diameter Class 18 PVC has been used for the wells

The surface RLs for the monitoring wells were interpolated from the contour plan provided by the client and are considered to be an approximation only. A detailed survey of the well heads was outside the scope of the assessment.

4.5 Monitoring Well Development and Groundwater Sampling

The monitoring wells were developed using a submersible electric pump on 14 October 2020. Groundwater samples were obtained from the monitoring wells using a low-flow peristaltic pump on 19 October 2020. The pH, temperature, electrical conductivity (EC), dissolved oxygen (DO) and redox potential (Eh) were monitored during sampling using calibrated field instruments. The sampling data sheets are attached in Appendix H. The samples were preserved in accordance with the requirements detailed in AS/NZS 5667.1-1998[10] and placed in an insulated container with ice.

On completion of the fieldwork, the samples were delivered in an insulated sample container to a NATA registered laboratory for analysis under standard chain of custody procedures.

4.6 Laboratory Analysis

Samples were analysed by Envirolab Services Pty Ltd (NATA accreditation number 2901). Reference should be made to the laboratory reports (Ref: 253574 and 253783) attached in the appendices for further details of the analytical methods. It is noted that report 253783 includes additional groundwater data relevant to the DSI which has not been discussed in this salinity report.

4.7 Analytical Schedule

The analytical schedule is outlined in the following table:

Table 4-2: Analytical Schedule

Analyte	Fill Samples	Natural Soil Samples	Natural Bedrock Samples	Groundwater Samples
pH	32	-	-	3
Electrical Conductivity (EC)	32	-	-	3
Resistivity	32	-	-	-
Texture (used to determine EC extract – ECe)	32	-	-	-
Sulphate	32	-	-	3
Chloride	32	-	-	3
Cation Exchange Capacity (CEC)	8	-	-	-

[10] Standards Australia, (1998). *Water Quality – Part 1: Sampling, Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples,* (AS/NZS 5667.1:1998)

5 SITE ASSESSMENT CRITERIA (SAC)

5.1 Soil Salinity and Plant Growth

The EC of a 1:5 soil:water extract is commonly used as an indicator of soil salinity conditions as the reading is directly related to the electrolyte (salt) concentration of the extract. In order to compare the laboratory data with published salinity classes, the results are converted to equivalent saturated paste (ECe) using texture adjustment values presented in DLWC 2002.

The following table provides a summary of plant response with reference to salinity:

Table 5-1: Plant Response to Soil Salinity

ECe (dS/m)	Salinity Class	Plant Response[1]
<2	Non-saline	Salinity effects mostly negligible
2-4	Slightly saline	Yields of very sensitive crops may be affected
4-8	Moderately saline	Yield of many crops affected
8-16	Very saline	Only tolerant crops yield satisfactorily
>16	Highly saline	Only a few very tolerant crops yield satisfactorily

Note:

1 - Plant Response to Salinity Class has been adopted from DLWC 2002

5.2 Soil pH and Plant Growth

Soil pH is a measure of the acidity or alkalinity of the soils and values have been assessed as an indicator of soil fertility with respect to plant growth. The optimal pH for plant growth is between 5.5 and 7. Beyond this range, effective revegetation of exposed soil following disturbance is increasingly difficult and the potential for erosion is considered to increase.

Highly alkaline soils are commonly associated with saline and sodic soil conditions and can limit the ability of plants to take up water and nutrients. Highly acidic soils exhibit aluminium toxicity toward plants and can limit the ability of plants to take up other essential nutrients including molybdenum.

Interpretation of soil pH with respect to plant growth is undertaken using the ratings published in Bruce and Rayment (1982)[11] presented in the following table:

[11] Bruce, R.C. and Rayment, G.E., (1982). *Analytical Methods and Interpretations used by the Agricultural Chemistry Branch for Soil and Land Use Surveys,* (referred to as Bruce and Rayment 1982)

Table 5-2: Plant Response to Soil pH

pH	Rating
<4.5	Extremely acidic
4.5-5.0	Very strongly acidic
5.1-5.5	Strongly acidic
5.6 – 7.3	Optimal plant growth
7.4-7.8	Mildly alkaline
7.9-8.4	Moderately alkaline
8.5-9.0	Strongly alkaline
>9.1	Very strongly alkaline

5.3 Cation Exchange Capacity (CEC) in Soil

The ability of soils to attract, retain and exchange cations (positively charged ions) is estimated by the calculated CEC value. CEC represents the major controlling factor in stability of clay soil structure, nutrient availability for plant growth, soil pH and the reaction of the soil to chemical applications (fertilisers, conditioners etc.).

High CEC soils have a greater capacity to retain nutrients, however, deficient soils require greater applications of nutrients to correct imbalances. Low CEC soils have a reduced capacity to retain nutrients and may result in leaching of nutrients from the soil in the event of excess nutrient applications.

Metson (1961)[12] developed a set of ratings for effective CEC and the most abundant cations. These are summarised below (values are in meq/100g):

Table 5-3: CEC Rating

Rating	eCEC	Exch Na	Exch K	Exch Ca	Exch Mg
Very low	<6	0-0.1	0-0.2	0-2	0-0.3
Low	6-12	0.1-0.3	0.2-0.3	2-5	0.3-1
Moderate	12-25	0.3-0.7	0.3-0.7	5-10	1-3
High	25-40	0.7-2	0.7-2	10-20	3-8
Very high	>40	>2	>2	>20	>8

[12] Metson, A.J, (1961). *Methods of Chemical Analysis for Soil Survey Samples* (referred to as Metson 1961)

5.3.1 Ratio of Exchangeable Calcium to Magnesium

To maintain soil structure there should be a ratio of around 4:1 to 6:1 calcium to magnesium for a balanced soil (Eckert 1987)[13]. At ratios of less than 4:1 calcium is considered to be deficient, whilst at ratios of greater than 6:1 soils are considered to be magnesium deficient.

5.4 Exchangeable Sodium Percentage or Sodicity (ESP%)

Exchangeable sodium is an important soil stability and salinity parameter. Excessive exchangeable sodium leads to unstable soils, increased runoff, potential salinity, dispersivity and water logging problems.

Normally the sodium content is expressed as a percentage of the CEC as other cations counteract the negative effects of sodium (known as ESP% and termed sodicity). The effect of the exchangeable sodium (exchangeable sodium percentage, ESP) varies with other soil factors such as the type of clay, the relative quantity of magnesium and the quantity of organic matter. However, Charman & Murphy (2000)[14] indicate that a soil is generally considered sodic if the ESP exceeds 6% and extremely sodic if the ESP exceeds 15%.

5.5 Groundwater Salinity

EC values in groundwater are dependent on numerous factors and can vary with changes in temperature and pH conditions. Suttar (1990)[15] has classed water into different types based on EC values as outlined in the table below.

Table 5-4: EC Ranges in Water

Water Type	EC (µS/cm)
Deionised Water	0.5 – 3
Pure Rainwater	<15
Freshwater Rivers	0 – 800
Marginal River Water	800 – 1600
Brackish Water	1600 – 4800
Saline Water	>4800
Seawater	51,500
Industrial Waters	100 – 10,000

[13] Eckert, D.J, (1987) .*Soil Test Interpretation: Basic Cation Saturation Ratios and Sufficiency Levels* (referred to as Eckert 1987)

[14] Charman, P.E.V and Murphy, B.W (eds), (2000).*Soils: Their Management and Properties,* (referred to as Charman and Murphy 2000)

[15] Suttar, S., (1990). *Ribbons of Blue Handbook, Scitech*, Victoria (referred to as Suttar 1990)

5.6 Recommendations for Concrete Slabs and Footings in Saline Soils

In the absence of endorsed recommendations for buildings in saline environments, reference is made to the CCAA 2018. The guide provides recommendations on the minimum concrete grade/strength required for slabs and footings in saline soils. Reference should be made to the CCAA 2018 publication for further information:

Table 5-5: Minimum Concrete Grade for Slabs and Footings in Saline Soils

ECe (dS/m)	Salinity Class	Concrete Grade[1]
<2	Non-saline	N20
2-4	Slightly saline	N20
4-8	Moderately saline	N25
8-16	Very saline	N32
>16	Highly saline	≥N40

Note:

1 - Concrete Grade for Salinity Class has been adopted from CCAA 2018

5.7 Recommendations for Durability with Reference to AS2159-2009

In designing for durability, reference should be made to the requirements listed in the AS2159-2009. The exposure classification for concrete and steel piles and foundations is outlined in the following tables.

Table 5-6: Exposure Classification for Concrete Piles

Exposure Conditions				Exposure Classification	
Sulphate (expressed as SO_4)		pH	Chlorides in Groundwater (ppm)	Soil Conditions A[1]	Soil Conditions B[2]
In Soil (ppm)	In Groundwater (ppm)				
<5,000	<1,000	>5.5	<6,000	Mild	Non-aggressive
5,000-10,000	1,000-3,000	4.5-5.5	6,000-12,000	Moderate	Mild
10,000-20,000	3,000-10,000	4-4.5	12,000-30,000	Severe	Moderate
>20,000	>10,000	<4	>30,000	Very severe	Severe

Notes:

1 - High permeability soils (eg sands and gravels) which are in groundwater

2 – Low permeability soils (eg silts and clays) or all soils above groundwater

Table 5-7: Exposure Classification for Steel Piles

Exposure Conditions				Exposure Classifications	
pH	Chlorides		Resistivity (ohm.cm)	Soil Conditions A[1]	Soil Conditions B[2]
	In Soil (ppm)	In Groundwater (ppm)			
>5	<5,000	<1,000	>5,000	Non-aggressive	Non-aggressive
4-5	5,000-20,000	1,000-10,000	2,000-5,000	Mild	Non-aggressive
3-4	20,000-50,000	10,000-20,000	1,000-2,000	Moderate	Mild
<3	>50,000	>20,000	<1,000	Severe	Moderate

Notes:

1 - High permeability soils (eg sands and gravels) which are in groundwater

2 – Low permeability soils (eg silts and clays) or all soils above groundwater

This assessment report has not assessed the data with regards to AS3600-2009, although we note that this report presents relevant data for consideration by the project structural engineer in this regard. Reference is also to be made to the JKG report for further details.

6 INVESTIGATION RESULTS

6.1 Subsurface Conditions

A summary of the subsurface conditions encountered during the investigation is presented in the table below. Reference should be made to the borehole logs attached in the appendices for further details.

Table 6-1: Summary of Subsurface Conditions

Profile	Description (metres below ground level - mBGL)
Fill	Fill was encountered at the surface in all boreholes and extended to the maximum terminal depth of 6mBGL. The fill typically comprised silty clay with inclusions of gravel, and to a much lesser extent, ash and building rubble (bricks, steel, plastic, glass, terracotta, tile fragments).
Natural Soil	Natural soil was not encountered during the investigation.
Bedrock	Bedrock was not encountered during the salinity investigation.
Groundwater	On completion of drilling, groundwater was encountered in BH311 and BH317 at depths of 4.4mBGL and 3.4mBGL respectively. All other boreholes remained dry on completion of drilling and a short time after.

6.2 Laboratory Results

A summary of the results is presented below.

Table 6-2: Summary of Laboratory Results

Analyte	Results
EC & ECe	The EC results ranged from 98µS/m to 960µS/m. The ECe results ranged from <2dS/m to 8dS/m.
Resistivity	Resistivity values were calculated based on the raw EC values. The resistivity values for the soil samples ranged from 1,042ohm.cm to 10,204ohm.cm.
pH	The results of the analysis ranged from 7.6 to 9.6.
CEC	The results of the analysis ranged from: • CEC – 18meq/100g to 25meq/100g; • Exchangeable Na – 0.5meq/100g to 1.2meq/100g; • Exchangeable K – 0.3meq/100g to 0.6meq/100g; • Exchangeable Ca – 8.8meq/100g to 17meq/100g; and • Exchangeable Mg – 6.5meq/100g to 9.4meq/100g.
Sulphate	The results ranged from 10mg/kg to 390mg/kg.
Chloride	The results ranged from 23mg/kg to 1,000mg/kg.

Analyte	Results
Groundwater	The results of the analysis ranged from: • pH – 6.8 to 7.3; • EC – 5,700µS/cm to 14,000µS/cm; • Chloride - 590mg/L to 2,900mg/L; and • Sulphate - 630mg/L to 2,200mg/L.

Note:

Na – Sodium, K – Potassium, Ca – Calcium, Mg – Magnesium

7 RESULTS INTERPRETATION

The soil laboratory results are compared to the relevant SAC in the attached report tables. Interpretation of the results against the SAC is provided in the following table.

Table 7-1: Interpretation of Laboratory Results

Parameter	Notes
Soil Salinity and Plant Growth	The ECe results generally ranged from <2dS/m to 8dS/m. The majority of the surficial samples were classed as non-saline. Subsurface samples were slightly saline to moderately saline. There was no obvious pattern of increasing salinity with depth or specific areas of increased salinity within the site.
Soil pH and Plant Growth	The soil pH results ranged from 7.6 to 9.6 and are classed as mildly alkaline to very strongly alkaline. The majority of the surficial soils were generally within the moderately alkaline range for plant growth. The soils may require treatment to make the soils suitable for plant growth.
CEC in Soil	The CEC values ranged from 18meq/100g to 25meq/100g. All of the samples were within the moderate range which is typical of soil formations in western Sydney (where the fill was most likely sourced) and are generally indicative of the low levels of organic matter within the soils.
Ratio of Calcium to Magnesium	The results indicate that the soils generally have more calcium than magnesium. The CEC of the soil is generally moderate. Lime and gypsum can be used to stabilise the soil which will improve soil structure for both engineering and fertility purposes.
ESP%	The ESP% values of the samples ranged from 2.3% to 6.3%. The majority of the ESP results were below the 5% threshold and were classed as non-sodic.
Groundwater Salinity	The laboratory results indicate that the groundwater is saline and within the 'saline' water type.
Concrete Slabs and Footings in Saline Soils (CCAA 2018)	The proposed earthworks are anticipated to expose soils generally classed as moderately saline at a depth of approximately 1m to 2m. The CCAA 2018 recommended concrete grade for slabs and footings in moderately saline soils is N25. Soils in the vicinity of borehole BH315 were classed as very saline. Cuts below the depth of 1m are anticipated to expose very saline soil in some areas of the site. In these areas the recommended concrete grade of N32 for very saline soils should be adopted. Reference should also be made to AS2159-2009 for minimum concrete strengths and reinforcement cover for concrete piles/foundations and to AS3600-2009.
Soil Conditions for Exposure Classification (AS2159-2009)	The boreholes drilled for the investigation have indicated that the subsurface conditions at the site generally comprise of low permeability soils (i.e. silts and clays). Based on this, the exposure classification outlined under 'Soil Conditions B' has been adopted for the assessment.
Exposure Classification for Concrete Piles/Foundations (AS2159-2009)	The soil pH and sulphate results indicate that the soils are non-aggressive towards buried concrete.

Parameter	Notes
	The groundwater pH, sulphate and chloride results indicate that the groundwater is non-aggressive towards buried concrete.
Exposure Classification for Steel Piles/Foundations (AS2159-2009)	The soil resistivity, pH and chloride results indicate that the soils are mildly aggressive towards buried steel. The groundwater pH and chloride results indicate that the groundwater is non-aggressive towards buried steel.

8 SALINITY MANAGEMENT PLAN

Salinity management recommendations outlined in this section have been designed generally in accordance with the amended Salinity Code of Practice. These recommendations should be reviewed (and if necessary, revised) in the event of any changes to the proposed development at the site.

Reference should also be made to the recommendations outlined in other relevant documentation, including but not limited to the local council salinity control/management plan, development consent conditions, geotechnical reports (i.e. the JKG report) and landscape design documentation.

8.1 Earthwork Recommendations

The earthwork recommendations are summarised in the table below:

Table 8-1: Earthwork Recommendations

Aspect	Recommendations
Earthworks Contractor	The salinity conditions and recommendations outlined in this section of the report should be reviewed by the earthworks contractor prior to the commencement of development works.
Bulk Earthwork Overview	Minor cut and fill earthworks are anticipated for the proposed development. JKE anticipate that the cut material will be used as fill in order to minimise the amount of material required for importation from an external source.
Cuts	Cuts to a depth of 1-2m across the site will generally expose moderately saline soils. Cuts deeper than approximately 1m in the central section (in the vicinity of BH315) may expose very saline soils. An appropriate concrete strength should be used for infrastructure which comes into contact with moderately to very saline soils exposed by cuts.
Filling	Minor filling across portions of the site may occur to achieve the final development level. Fill material sourced from areas of cuts below 1m in the central section of the site (in the vicinity of BH315) should be placed back at depth so as to minimise adverse salinity conditions associated with very saline soils. All fill material imported onto the site should meet the importation criteria for salinity as outlined in Section 9.
Staging of Works	Earthworks, including the stripping of vegetation and topsoil should be staged (where possible) to reduce the time of exposure of subsoils to erosion by wind and rain.
Erosion and Sediment Control	An erosion and sediment control plan should be prepared prior to the commencement of earthworks. The plan should be implemented during the development to manage and control sediment discharge from the site. The plan should remain in place during the earthworks phase until the pavement construction works are completed. All batter slopes should be stabilised to control erosion during development and post earthworks (refer to the Blue Book 2004).

Aspect	Recommendations
	Erosion control for stockpiles and disturbed areas should be planned during the development including the grading and sealing of partially completed earthwork surfaces during construction (refer to the Blue Book 2004).

8.2 Site Drainage, Surface Water and Storm Water Run-off

The recommendations for site drainage are summarised in the table below:

Table 8-2: Recommendations for Site Drainage

Aspect	Recommendations
Earthworks Contractor	The salinity conditions and recommendations outlined in this section of the report should be reviewed by the earthworks contractor prior to the commencement of development works.
Drainage Patterns	The proposed earthworks should be designed to minimise disturbance of the existing site drainage patterns. Where these patterns are altered, appropriate artificial drainage should be installed in order to minimise water logging and localised flooding.
Installation of Sub-soil Drains	Subsoil drains should be provided in areas where seepage discharge from the underlying natural soil may occur, such as retained cuts, cut slopes, significant changes in grade, etc (as applicable). Slabs, foundations and retaining walls should be designed with subsoil drains and good drainage to avoid water logging.
Surface water and Storm water run-off	Stormwater should be managed appropriately in order to reduce infiltration. Stormwater infrastructure should be designed to minimise leakage. Guttering and down pipes should be properly connected and maintained at all times. Surface water runoff should be directed around all stockpiles and work areas.

8.3 Design of Built Structures

The design of built structures should incorporate the following:

Table 8-3: Recommendations for Built Structures

Aspect	Recommendations
Structural Advice/Design	The salinity conditions and recommendations outlined in this section of the report should be reviewed by a qualified structural/civil engineer and factored into the design.
Damp Proof Course (DPC)	Appropriate damp proof course (DPC) and moisture barriers should be used as outlined in the WSROC document '*Western Sydney Salinity Code of Practice, June 2003*' and other relevant building codes and industry standards.
Exposure Class Masonry and Admixtures	Where required under the relevant building codes and standards, exposure class masonry must be used below the DPC, including for strip footings. This is especially important in areas where landscaping is located adjacent to built structures. An appropriate mortar and mixing ratio must be used with exposure class masonry. Admixtures for waterproofing and/or corrosion prevention should be used where necessary.

Aspect	Recommendations
Adequate Drainage around Built Structures	Care should be taken to check that the infrastructure design process considers the existing patterns of surface and subsurface water movement through the site during both dry and wet periods. Construction of infrastructure, which may cause an increase in areas of surficial water logging through poor surface drainage, may cause the groundwater table to rise.
Durability of Concrete Piles/Foundations	The soils and groundwater are classed as non-aggressive towards buried concrete. The appropriate concrete strength and corrosion allowance outlined in the AS2159-2009 should be adopted. The CCAA 2018 publication recommends a concrete grade of N25 for residential slabs and footings exposed to moderately saline soil and N32 for very saline soils.
Durability of Steel Piles/Foundations	The soils are classed as mildly aggressive towards buried steel. The groundwater is classed as non-aggressive towards buried steel. Appropriate corrosion allowance for steel outlined in the AS2159-2009 should be adopted. Reference is to be made to the JKG report for further discussion in relation to AS3600-2009.

8.4 Gardens and Landscaped Areas

The recommendations for the design of gardens and landscaped areas are summarised in the table below:

Table 8-4: Recommendations for Gardens and Landscaped Areas

Aspect	Recommendations
Arborist Advice	The salinity conditions and recommendations outlined in this section of the report should be reviewed by a qualified Arborist/landscape consultant and factored into the landscape design.
Selection of Plants and Topsoil	The topsoil/fill at the site is generally moderately alkaline and non to slightly saline. Cuts to depths of 1m to 2m will generally expose moderately to strongly alkaline and moderately saline soil. These conditions are not considered favourable for plant growth. Nutrient rich topsoil should be used to promote plant growth in landscaped areas. Special attention should be paid to soil fertility to promote optimal conditions for successful revegetation. Suitable native plant species which require minimal watering should be established in landscaped areas. Consideration should be made to plant deep rooted native trees in landscaped areas. Topsoil imported onto the site should, as a minimum, meet the importation criteria for salinity as outlined in Section 9.
Landscape Design	Landscaped areas and garden beds should not be located adjacent to built structures unless they are designed appropriately so that watering of such areas does not lead to rising damp in the adjacent structures resulting in potential damage to bricks, concrete, steel etc. Landscaped areas and garden beds should be lowered such that soil in contact with built structures is below the damp proof course (DPC). Exposure grade bricks should be used below the DPC to minimise damp rise and potential damage.
Irrigation of Landscaped and Garden Areas	The use of potable water for irrigation should be kept to a minimum. This can be achieved by incorporating 'waterwise' gardening principles which include using sprinklers and drip irrigation system activated by timers etc. Irrigation systems should be periodically checked to ensure there is no leakage.

Aspect	Recommendations
Subsoil Drains	Subsoil drains should be installed beneath playing fields/ovals and other areas which require intense irrigation to maintain grass/turf cover. Such facilities should be designed with adequate grading to prevent water ponding and to channel excess run-off into the subsoil drains.
Use of 'Grey' water	Many new developments are encouraged to use recycled water or 'grey' water for irrigation purposes. Recycled water (grey water) is generally more saline than potable water and excessive use may result in increasing soil and groundwater salinity. In order to minimise potential plant dieback, consideration should be given to planting native salt tolerant plant species which require minimal watering. Advice from a qualified Arborist should be obtained for the conditions encountered at the site.

8.5 Footpaths and Hardstand Areas

The recommendations for the design of road, footpaths and hardstand areas are summarised in the table below:

Table 8-5: Recommendations for Roads, Footpaths and Hardstand Areas

Aspect	Recommendations
Earthworks Contractor	The salinity conditions and recommendations outlined in this section of the report should be reviewed by the earthworks contractor prior to the commencement of development works.
Graded Surfaces	All pavements, footpaths and hardstand areas should be graded to prevent surface water ponding. Subsoil drains should be provided in all such areas to collect stormwater and surface water run-off.
Corrosion of Concrete and Steel	Concrete and steel used in footpaths, carpark kerbs, gutters etc. should be designed to withstand the saline and aggressive conditions encountered at the site. Reference should be made to Section 8.3 for further information.
Installation of Services	Services should be installed in joint trenches and conduits. The conduits should be installed under hardstand areas at the time of construction.
Design of Landscaped Areas	Landscaped areas in the vicinity of car parks and hardstands should be designed as outlined in Section 8.4.

8.6 Ongoing Management

Salinity is a natural phenomenon which can change over time especially during extreme dry and wet periods. Regular inspections and maintenance of facilities should be undertaken in order to identify issues at an early stage. Early detection and prevention of adverse salinity conditions is important to ongoing management. Key ongoing management aspects are discussed in the following table:

Table 8-6: Key Ongoing Management Aspects

Aspect	Recommendations
Groundwater Management	A rising groundwater table may lead to adverse salinity conditions as the groundwater is considered to be saline. Planning and design should involve management of factors that could lead to a rise in the groundwater table level. Such measures include reducing the irrigation requirements and avoiding the use of infiltration pits to disperse surface water. Watering activities associated with the proposed landscaped/playing field areas will tend to increase groundwater recharge. Subsoil drains should be installed in these areas where deemed necessary by the design team so as to avoid excessive recharge of the groundwater system, reduce the potential for water logging and also increase the potential for on-site water re-cycling.
Salinity Compliance	Compliance documentation is recommended to verify that the management recommendations outlined in this report are implemented. If compliance input/ documentation is required from JKE, we would need to be engaged for this work at the commencement of the development. At this time, a site-specific compliance checklist would be provided. The checklist should be completed by the relevant contractors (i.e. earthworks, structural design, landscape, architects etc) after the completion of each stage of the development. JKE would typically not be in a position to provide a compliance 'sign-off' if we were not involved during the earthworks and construction phases of the project. In the event that an alternative consultant is selected to provide compliance documentation, we would strongly recommend that the consultant is engaged prior to the commencement of works.
Routine Inspections	Routine inspections of drainage facilities, landscaped areas, batter slopes, cut faces, walkways, pavements and hardstand areas should be undertaken by maintenance staff. A checklist of adverse salinity indicators should be maintained during the inspections. A qualified environmental consultant should be contacted in the event any of the salinity indicators are identified at the site.

9 SOIL SALINITY IMPORTATION CRITERIA

The proposed development may require the importation of fill/topsoil to achieve the desired finished levels. The salinity, corrosion and contamination conditions of the material should be checked prior to importation. The recommended salinity importation criteria are outlined in the following table:

Table 9-1: Salinity Importation Criteria

Parameter (units)	Acceptable Range	Potential Re-use Implications
pH	>5.5 - 7	Material in this range will generally be non-aggressive towards built structures and within the optimal range for plant growth. It is noted however that the site soils commonly have pH values of 8-9, therefore the importation of soils in this range would not be inconsistent with the existing soil conditions and would therefore be acceptable in most instances.
ECe (dS/m)	<2 - 4	Material in this range is non-saline to slightly saline and generally considered acceptable for plant growth. CCAA 2018 recommends a concrete grade of N20 for slabs and footings for these conditions.
CEC (meq/100g)	12 - 25	Material in this range is generally considered acceptable for plant growth.
ESP (%)	<5	Material in this range is generally less dispersive.
Sulphate and Chloride (mg/kg)	<5,000	Material in this range will generally be non-aggressive towards piles/foundations.
Resistivity (ohm.cm)	>5,000	Material in this range will generally be non-aggressive towards piles/foundations.

The acceptable ranges provided above are a guide only. A specific assessment is to occur on a case-by-case basis depending on the type of material being imported and the proposed use of each material type.

10 LIMITATIONS

The report limitations are outlined below:

- Salinity is a natural phenomenon and can change over time based on site conditions and climatic variations. Changes to existing drainage patters can also impact the salinity at the site. The results outlined in this report are a snap shot of conditions present at the time of the investigation and is bound to change over time;
- JKE accepts no responsibility for any unidentified salinity 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;
- JKE accepts no responsibility for non-compliance of salinity management recommends outlined in this report;
- This report has been prepared based on site conditions which existed at the time of the investigation; 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 report 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 report;
- 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 report 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 report;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the report;
- JKE has not undertaken any assessment of off-site areas that may be potential salinity sources or may have been impacted by adverse salinity conditions, except where specifically stated in the report;
- 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 land use. JKE should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a salinity viewpoint, and vice versa;
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose;
- Copyright in this report 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 report;

- If the client, or any person, provides a copy of this report to any third party, such third party must not rely on this report except with the express written consent of JKE; and
- Any third party who seeks to rely on this report 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.

Important Information About This Report

These notes have been prepared by JKE to assist with the assessment and interpretation of this report.

The Report is based on a Unique Set of Project Specific Factors
This report has been prepared in response to specific project requirements as stated in the JKE proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- The proposed land use is altered;
- The defined subject site is increased or sub-divided;
- The proposed development details including size, configuration, location, orientation of the structures or landscaped areas are modified;
- The proposed development levels are altered, eg addition of basement levels; or
- Ownership of the site changes.

JKE will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the assessment. If the subject site is sold, ownership of the assessment report should be transferred by JKE to the new site owners who will be informed of the conditions and limitations under which the assessment was undertaken. No person should apply an assessment for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions
Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (e.g. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater salinity concentrations may also vary over time through migration and accumulation of salts, importation of materials, construction and landscaping. The conclusions of an assessment report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Report is based on Professional Interpretations of Factual Data
Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of salinity, the likely impact on the proposed development and appropriate management measures.

Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Assessment Limitations
The assessment is designed to identify major salinity risks at the site. Implementing the management recommends can minimise the risks. No assessment can identify all risks as salinity is a natural phenomenon which can change over time. Even a rigorous professional assessment may not detect all potential salinity impacts on a site. Salinity may be present in areas that were not surveyed or sampled, or may accumulate in areas which showed no signs of salinity when sampled.

Misinterpretation of Site Assessments by Design Professionals

Costly problems can occur when other design professionals develop plans based on misinterpretation of an assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

Logs Should not be Separated from the Assessment Report

Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site management or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however contractors can still misinterpret the logs during bid preparation if separated from the text of the assessment. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the rest of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

To reduce the likelihood of borehole and test pit log misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely

Because an environmental site assessment is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

Appendix A: Report Figures

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

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

Title: **SITE LOCATION PLAN**

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Project No: E33177P

Figure No: 1

JKEnvironments

PLOT DATE: 26/10/2020 10:08:39 AM DWG FILE: Z:\5 EIS\5C EIS JOBS\33000'S\E33177PA GLENMORE PARK\DSI AND SAL\CAD\E33177P.DWG

LEGEND

APPROXIMATE SITE BOUNDARY	
BH(Fill Depth)	BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) - PSI
BH/MW(Fill Depth)	BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m) - PSI
TP (Fill Depth	TEST PIT LOCATION, NUMBER AND DEPTH OF FILL (m) - PSI
	SAMPLE LOCATION, NUMBER AND DEPTH OF FILL (m) - DSI
BH(Fill Depth)	DEEP GEOTECHNICAL BOREHOLES AND DEPTH OF FILL (m) BY JKG

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 10 20 30 40 50

SCALE 1:1000 @A3 METRES

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

Title: **SAMPLE LOCATION PLAN**

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Project No: E33177P

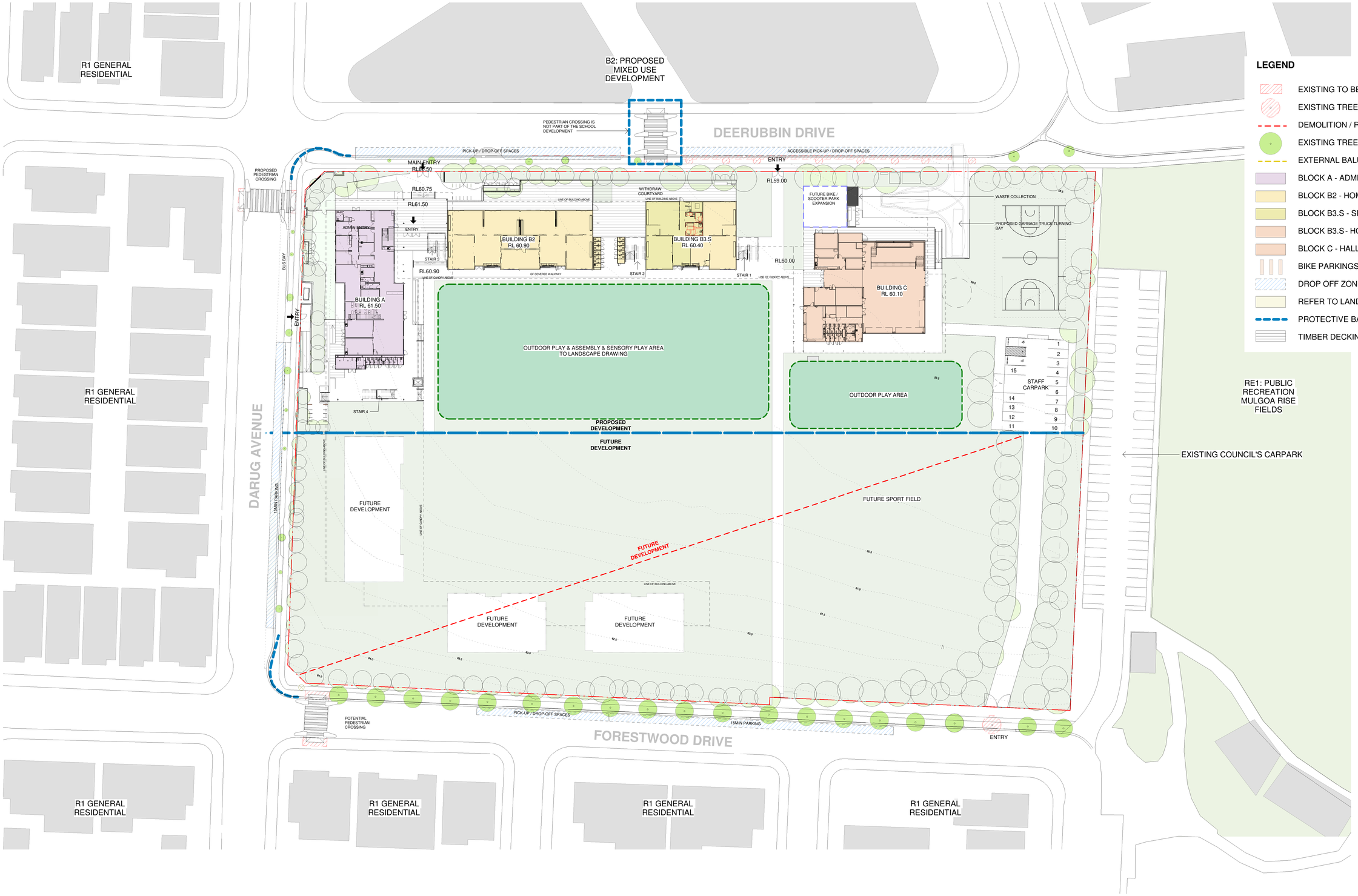
Figure No: 2

JKEnvironments

PLOT DATE: 2/11/2020 1:25:33 PM DWG FILE: Z:\5 EIS\5C EIS JOBS\33000'S\E33177PA GLENMORE PARK\DSI AND SAL\CAD\E33177P.DWG

Appendix B: Site Information

Concept Plan



LEGEND

- EXISTING TO BE DEMOLISHED
- EXISTING TREES TO BE REMOVED
- DEMOLITION / REMOVAL
- EXISTING TREES
- EXTERNAL BALUSTRADE
- BLOCK A - ADMIN AND LIBRARY
- BLOCK B2 - HOME BASES LEARNING
- BLOCK B3.S - SPECIALIST LEARNING AREA
- BLOCK B3.S - HOME BASES LEARNING
- BLOCK C - HALL
- BIKE PARKINGS
- DROP OFF ZONE
- REFER TO LANDSCAPE DRAWINGS
- PROTECTIVE BALUSTRADE
- TIMBER DECKING

Issue

No.	Date	Description	Chkd
1	12/04/2021	ISSUE FOR COORDINATION	
2	16/04/2021	SD ISSUE	
3	23/04/2021	ISSUE FOR COORDINATION	
4	04/05/2021	SSDA ISSUE	
5	14/07/2021	FOR INFORMATION	

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Drawing Title
SITE PLAN

PRELIMINARY

Project
NEW PRIMARY SCHOOL IN MULGOA RISE
at
1-23 Forestwood drive, Glenmore Park, NSW 2745, Australia
for
SINSW

Architect
NBRSARCHITECTURE.
Sydney
61 2 9922 2344 nbrsarchitecture.com

Nominated Architect:
Andrew Duffin NSW 5602
NBRS & Partners Pty Ltd VIC 51197

ABN 16 002 247 565

Date 14/07/2021 4:48:19 PM
Scale 1:500 @ A1

Drawing Reference 20415-NBRS-DR-A-SSDA-0110
Revision 5

0 5m 10m 15m 20m 25m 30m 35m 40m 1:500

Lotsearch Environmental Risk and Planning Report

LOTSEARCH

LOTSEARCH ENVIRO PROFESSIONAL

Date: 08 May 2020 11:38:16

Reference: LS012255 EP

Address: 1-23 Forestwood Drive, Glenmore Park, NSW 2745

Dataset Listing

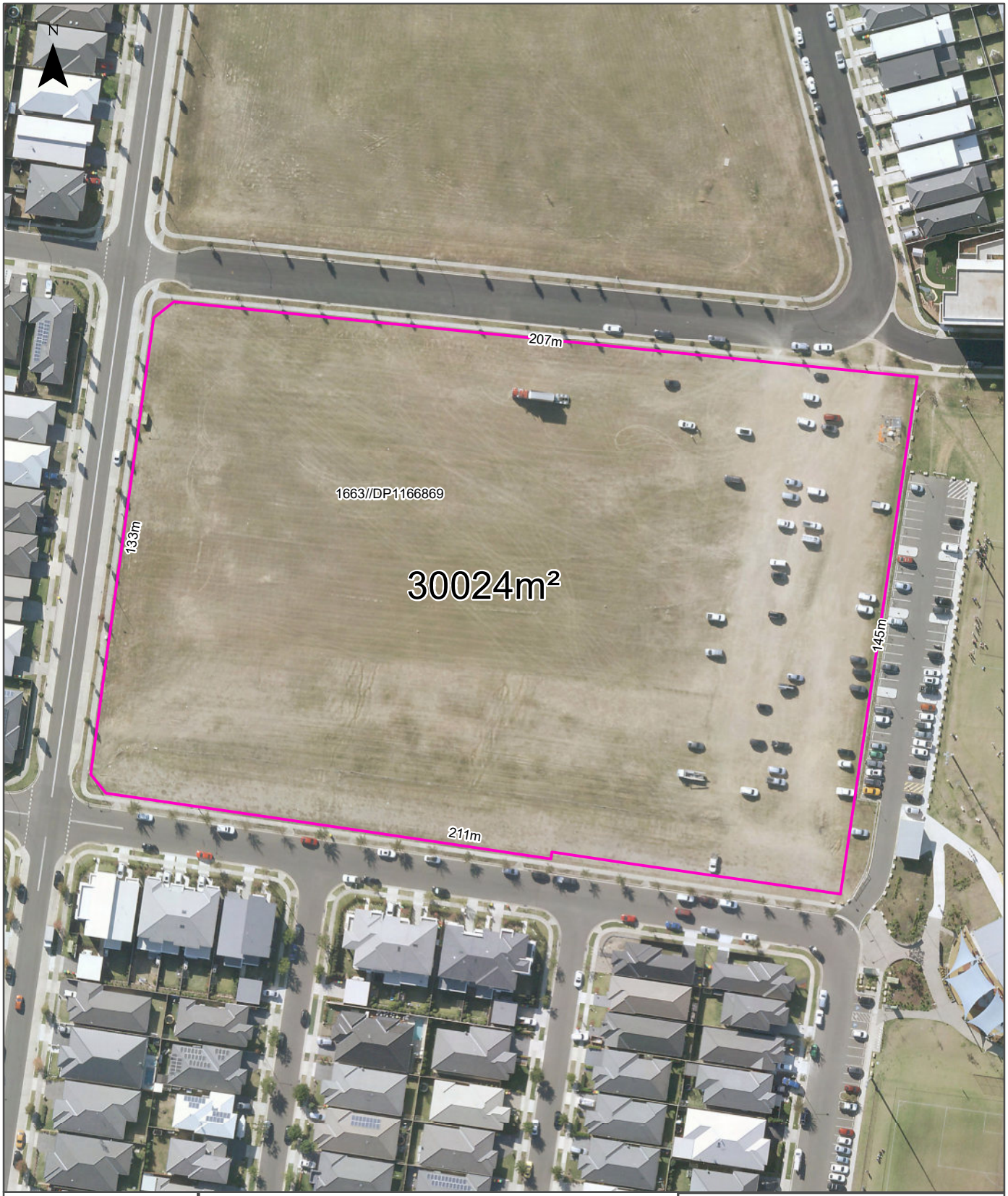
Datasets contained within this report, detailing their source and data currency:

Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	Dataset Buffer (m)	No. Features Onsite	No. Features within 100m	No. Features within Buffer
Cadastre Boundaries	NSW Department of Finance, Services & Innovation	13/03/2020	13/03/2020	Quarterly	-	-	-	-
Topographic Data	NSW Department of Finance, Services & Innovation	25/06/2019	25/06/2019	As required	-	-	-	-
List of NSW contaminated sites notified to EPA	Environment Protection Authority	15/04/2020	15/04/2020	Monthly	1000	0	0	0
Contaminated Land Records of Notice	Environment Protection Authority	21/04/2020	21/04/2020	Monthly	1000	0	0	0
Former Gasworks	Environment Protection Authority	21/04/2020	11/10/2017	Monthly	1000	0	0	0
National Waste Management Facilities Database	Geoscience Australia	12/02/2020	07/03/2017	Quarterly	1000	0	0	0
National Liquid Fuel Facilities	Geoscience Australia	05/02/2020	13/07/2012	Quarterly	1000	0	0	0
EPA PFAS Investigation Program	Environment Protection Authority	22/04/2020	22/04/2020	Monthly	2000	0	0	0
Defence PFAS Investigation & Management Program - Investigation Sites	Department of Defence	12/02/2020	12/02/2020	Monthly	2000	0	0	0
Defence PFAS Investigation & Management Program - Management Sites	Department of Defence	12/02/2020	12/02/2020	Monthly	2000	0	0	0
Airservices Australia National PFAS Management Program	Airservices Australia	22/04/2020	22/04/2020	Monthly	2000	0	0	0
Defence 3 Year Regional Contamination Investigation Program	Department of Defence	04/05/2020	04/05/2020	Monthly	2000	0	0	1
EPA Other Sites with Contamination Issues	Environment Protection Authority	04/02/2020	13/12/2018	Annually	1000	0	0	0
Licensed Activities under the POEO Act 1997	Environment Protection Authority	09/04/2020	09/04/2020	Monthly	1000	0	0	0
Delicensed POEO Activities still regulated by the EPA	Environment Protection Authority	09/04/2020	09/04/2020	Monthly	1000	0	0	0
Former POEO Licensed Activities now revoked or surrendered	Environment Protection Authority	09/04/2020	09/04/2020	Monthly	1000	0	1	4
UBD Business Directories (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directories (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory Dry Cleaners & Motor Garages/Service Stations (Premise & Intersection Matches)	Hardie Grant			Not required	500	0	0	0
UBD Business Directory Dry Cleaners & Motor Garages/Service Stations (Road & Area Matches)	Hardie Grant			Not required	500	-	0	0
Points of Interest	NSW Department of Finance, Services & Innovation	19/02/2020	19/02/2020	Quarterly	1000	0	0	5
Tanks (Areas)	NSW Department of Customer Service - Spatial Services	19/02/2020	19/02/2020	Quarterly	1000	0	0	0
Tanks (Points)	NSW Department of Customer Service - Spatial Services	19/02/2020	19/02/2020	Quarterly	1000	0	0	0
Major Easements	NSW Department of Finance, Services & Innovation	19/02/2020	19/02/2020	Quarterly	1000	0	0	3
State Forest	Forestry Corporation of NSW	18/01/2018	18/01/2018	As required	1000	0	0	0
NSW National Parks and Wildlife Service Reserves	NSW Office of Environment & Heritage	21/01/2020	30/09/2019	Annually	1000	0	0	1
Hydrogeology Map of Australia	Commonwealth of Australia (Geoscience Australia)	08/10/2014	17/03/2000	As required	1000	1	1	1
Botany Groundwater Management Zones	NSW Department of Planning, Industry and Environment	15/03/2018	01/10/2005	As required	1000	0	0	0

Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	Dataset Buffer (m)	No. Features Onsite	No. Features within 100m	No. Features within Buffer
Groundwater Boreholes	NSW Dept. of Primary Industries - Water NSW; Commonwealth of Australia (Bureau of Meteorology)	24/07/2018	23/07/2018	Annually	2000	0	0	18
Geological Units 1:100,000	NSW Department of Planning, Industry and Environment	20/08/2014		None planned	1000	1	-	4
Geological Structures 1:100,000	NSW Department of Planning, Industry and Environment	20/08/2014		None planned	1000	0	-	0
Naturally Occurring Asbestos Potential	NSW Dept. of Industry, Resources & Energy	04/12/2015	24/09/2015	Unknown	1000	0	0	0
Atlas of Australian Soils	Australian Bureau of Agriculture and Resource Economics and Sciences (ABARES)	19/05/2017	17/02/2011	As required	1000	1	1	2
Soil Landscapes	NSW Department of Planning, Industry and Environment	12/08/2014		None planned	1000	2	-	3
Environmental Planning Instrument Acid Sulfate Soils	NSW Department of Planning, Industry and Environment	24/04/2020	28/02/2020	Monthly	500	0	-	-
Atlas of Australian Acid Sulfate Soils	CSIRO	19/01/2017	21/02/2013	As required	1000	1	1	1
Dryland Salinity - National Assessment	National Land and Water Resources Audit	18/07/2014	12/05/2013	None planned	1000	1	1	1
Dryland Salinity Potential of Western Sydney	NSW Department of Planning, Industry and Environment	12/05/2017	01/01/2002	None planned	1000	1	2	3
Mining Subsidence Districts	NSW Department of Customer Service - Subsidence Advisory NSW	19/02/2020	19/02/2020	Quarterly	1000	0	0	0
Environmental Planning Instrument SEPP State Significant Precincts	NSW Department of Planning, Industry and Environment	24/04/2020	07/12/2018	Monthly	1000	0	0	0
Environmental Planning Instrument Land Zoning	NSW Department of Planning, Industry and Environment	26/03/2020	26/03/2020	Monthly	1000	1	3	20
Commonwealth Heritage List	Australian Government Department of the Agriculture, Water and the Environment	04/02/2020	31/07/2018	Quarterly	1000	0	0	0
National Heritage List	Australian Government Department of the Agriculture, Water and the Environment	04/02/2020	20/11/2019	Quarterly	1000	0	0	0
State Heritage Register - Curtilages	NSW Department of Planning, Industry and Environment	12/02/2020	09/11/2018	Quarterly	1000	0	0	0
Environmental Planning Instrument Heritage	NSW Department of Planning, Industry and Environment	24/04/2020	17/04/2020	Monthly	1000	0	0	1
Bush Fire Prone Land	NSW Rural Fire Service	04/02/2020	14/12/2019	Quarterly	1000	0	1	3
Remnant Vegetation of the Cumberland Plain	NSW Office of Environment & Heritage	07/10/2014	04/08/2011	Unknown	1000	0	0	6
Ramsar Wetlands of Australia	Department of the Agriculture, Water and the Environment	08/10/2014	24/06/2011	As required	1000	0	0	0
Groundwater Dependent Ecosystems	Bureau of Meteorology	14/08/2017	15/05/2017	Unknown	1000	0	0	2
Inflow Dependent Ecosystems Likelihood	Bureau of Meteorology	14/08/2017	15/05/2017	Unknown	1000	0	0	5
NSW BioNet Species Sightings	NSW Office of Environment & Heritage	06/05/2020	06/05/2020	Weekly	10000	-	-	-

Site Diagram

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Legend

- Site Boundary
- Internal Parcel Boundaries

Total Area: 30024m^2

Total Perimeter: 703m

Scale: 0 25 50 Meters

Data Sources: Aerial Imagery: © Aerometrex Pty Ltd

Disclaimers:

Measurements are approximate only and may have been simplified or smaller lengths removed for readability.

Parcels that make up a small percentage of the total site area have not been labelled for increased legibility.

Coordinate System: GDA 1994 MGA Zone 56

Date: 08 May 2020

Contaminated Land

1-23 Forestwood Drive, Glenmore Park, NSW 2745

List of NSW contaminated sites notified to EPA

Records from the NSW EPA Contaminated Land list within the dataset buffer:

Map Id	Site	Address	Suburb	Activity	Management Class	Status	Location Confidence	Dist (m)	Direction
N/A	No records in buffer								

The values within the EPA site management class in the table above, are given more detailed explanations in the table below:

EPA site management class	Explanation
Contamination being managed via the planning process (EP&A Act)	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. The contamination of this site is managed by the consent authority under the Environmental Planning and Assessment Act 1979 (EP&A Act) planning approval process, with EPA involvement as necessary to ensure significant contamination is adequately addressed. The consent authority is typically a local council or the Department of Planning and Environment.
Contamination currently regulated under CLM Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the Contaminated Land Management Act 1997 (CLM Act). Management of the contamination is regulated by the EPA under the CLM Act. Regulatory notices are available on the EPA's Contaminated Land Public Record of Notices.
Contamination currently regulated under POEO Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. Management of the contamination is regulated under the Protection of the Environment Operations Act 1997 (POEO Act). The EPA's regulatory actions under the POEO Act are available on the POEO public register.
Contamination formerly regulated under the CLM Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation under the Contaminated Land Management Act 1997 (CLM Act). The contamination was addressed under the CLM Act.
Contamination formerly regulated under the POEO Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed under the Protection of the Environment Operations Act 1997 (POEO Act).
Contamination was addressed via the planning process (EP&A Act)	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed by the appropriate consent authority via the planning process under the Environmental Planning and Assessment Act 1979 (EP&A Act).
Ongoing maintenance required to manage residual contamination (CLM Act)	The EPA has determined that ongoing maintenance, under the Contaminated Land Management Act 1997 (CLM Act), is required to manage the residual contamination. Regulatory notices under the CLM Act are available on the EPA's Contaminated Land Public Record of Notices.
Regulation being finalised	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the Contaminated Land Management Act 1997. A regulatory approach is being finalised.
Regulation under the CLM Act not required	The EPA has completed an assessment of the contamination and decided that regulation under the Contaminated Land Management Act 1997 is not required.
Under assessment	The contamination is being assessed by the EPA to determine whether regulation is required. The EPA may require further information to complete the assessment. For example, the completion of management actions regulated under the planning process or Protection of the Environment Operations Act 1997. Alternatively, the EPA may require information via a notice issued under s77 of the Contaminated Land Management Act 1997 or issue a Preliminary Investigation Order.

NSW EPA Contaminated Land List Data Source: Environment Protection Authority

Contaminated Land

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Contaminated Land: Records of Notice

Record of Notices within the dataset buffer:

Map Id	Name	Address	Suburb	Notices	Area No	Location Confidence	Distance	Direction
N/A	No records in buffer							

Contaminated Land Records of Notice Data Source: Environment Protection Authority

Terms of use and disclaimer for Contaminated Land: Record of Notices, please visit http://www.epa.nsw.gov.au/clm/clmdisclaimer.htm

Former Gasworks

Former Gasworks within the dataset buffer:

Map Id	Location	Council	Further Info	Location Confidence	Distance	Direction
N/A	No records in buffer					

Former Gasworks Data Source: Environment Protection Authority

Waste Management & Liquid Fuel Facilities

1-23 Forestwood Drive, Glenmore Park, NSW 2745

National Waste Management Site Database

Sites on the National Waste Management Site Database within the dataset buffer:

Site Id	Owner	Name	Address	Suburb	Class	Landfill	Reprocess	Transfer	Comments	Loc Conf	Dist (m)	Direction
N/A	No records in buffer											

National Liquid Fuel Facilities

National Liquid Fuel Facilties within the dataset buffer:

Map Id	Owner	Name	Address	Suburb	Class	Operational Status	Operator	Revision Date	Loc Conf	Dist (m)	Direction
N/A	No records in buffer										

PFAS Investigation & Management Programs

1-23 Forestwood Drive, Glenmore Park, NSW 2745

EPA PFAS Investigation Program

Sites that are part of the EPA PFAS investigation program, within the dataset buffer:

Id	Site	Address	Loc Conf	Dist	Dir
N/A	No records in buffer				

EPA PFAS Investigation Program: Environment Protection Authority

Defence PFAS Investigation Program

Sites being investigated by the Department of Defence for PFAS contamination within the dataset buffer:

Map ID	Base Name	Address	Loc Conf	Dist	Dir
N/A	No records in buffer				

Defence PFAS Investigation Program Data Custodian: Department of Defence, Australian Government

Defence PFAS Management Program

Sites being managed by the Department of Defence for PFAS contamination within the dataset buffer:

Map ID	Base Name	Address	Loc Conf	Dist	Dir
N/A	No records in buffer				

Defence PFAS Management Program Data Custodian: Department of Defence, Australian Government

Airservices Australia National PFAS Management Program

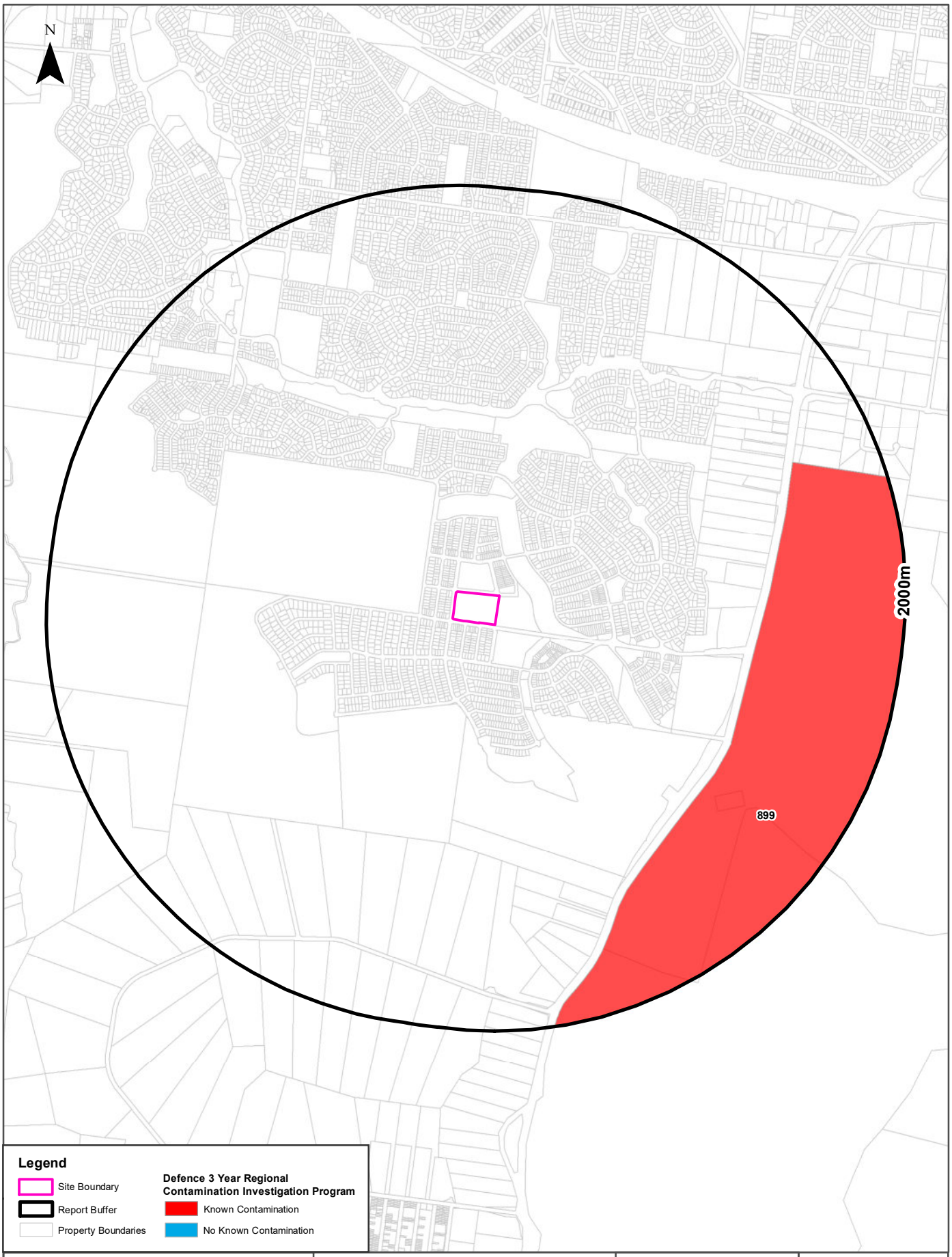
Sites being investigated or managed by Airservices Australia for PFAS contamination within the dataset buffer:

Map ID	Site Name	Impacts	Loc Conf	Dist	Dir
N/A	No records in buffer				

Airservices Australia National PFAS Management Program Data Custodian: Airservices Australia

Defence 3 Year Regional Contamination Investigation Program

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Data Sources: Property Boundaries & Topographic Data: © Department Finance, Services & Innovation 2020

Coordinate System: GDA 1994 MGA Zone 56

Date: 08 May 2020

Defence Sites

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Defence 3 Year Regional Contamination Investigation Program

Sites which have been assessed as part of the Defence 3 Year Regional Contamination Investigation Program within the dataset buffer:

Property ID	Base Name	Address	Known Contamination	Loc Conf	Dist	Dir
899	Defence Establishment Orchard Hills	Mulgoa, New South Wales	YES	Premise Match	1268m	South East

Defence 3 Year Regional Contamination Investigation Program, Data Custodian: Department of Defence, Australian Government

EPA Other Sites with Contamination Issues

1-23 Forestwood Drive, Glenmore Park, NSW 2745

EPA Other Sites with Contamination Issues

This dataset contains other sites identified on the EPA website as having contamination issues. This dataset currently includes:

- James Hardie asbestos manufacturing and waste disposal sites
- Radiological investigation sites in Hunter's Hill
- Pasminco Lead Abatement Strategy Area

Sites within the dataset buffer:

Site Id	Site Name	Site Address	Dataset	Comments	Location Confidence	Distance	Direction
N/A	No records in buffer						

EPA Other Sites with Contamination Issues: Environment Protection Authority

EPA Activities

1-23 Forestwood Drive, Glenmore Park, NSW 2745

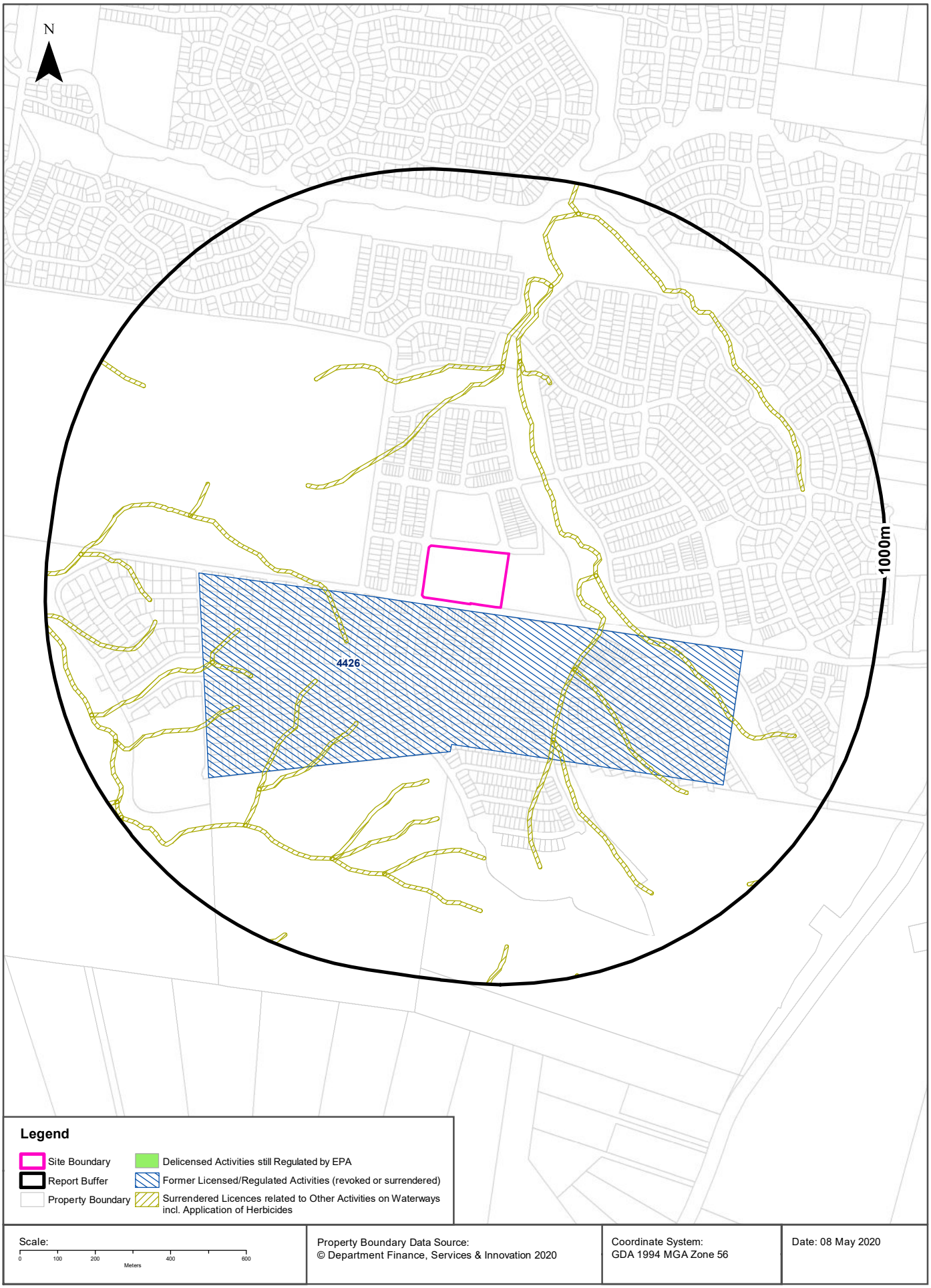
Licensed Activities under the POEO Act 1997

Licensed activities under the Protection of the Environment Operations Act 1997, within the dataset buffer:

EPL	Organisation	Name	Address	Suburb	Activity	Loc Conf	Distance	Direction
N/A	No records in buffer							

Delicensed & Former Licensed EPA Activities

1-23 Forestwood Drive, Glenmore Park, NSW 2745



EPA Activities

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Delicensed Activities still regulated by the EPA

Delicensed activities still regulated by the EPA, within the dataset buffer:

Licence No	Organisation	Name	Address	Suburb	Activity	Loc Conf	Distance	Direction
N/A	No records in buffer							

Delicensed Activities Data Source: Environment Protection Authority

Former Licensed Activities under the POEO Act 1997, now revoked or surrendered

Former Licensed activities under the Protection of the Environment Operations Act 1997, now revoked or surrendered, within the dataset buffer:

Licence No	Organisation	Location	Status	Issued Date	Activity	Loc Conf	Distance	Direction
4426	MULGOA QUARRIES PTY LTD	LOT 1 BRADLEY STREET, ORCHARD HILLS, NSW 2748	Surrendered	03/05/2001	Other Land-Based Extraction	Premise Match	18m	South
4653	LUHRMANN ENVIRONMENT MANAGEMENT PTY LTD	WATERWAYS THROUGHOUT NSW	Surrendered	06/09/2000	Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	144m	-
4838	Robert Orchard	Various Waterways throughout New South Wales - SYDNEY NSW 2000	Surrendered	07/09/2000	Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	144m	-
6630	SYDNEY WEED & PEST MANAGEMENT PTY LTD	WATERWAYS THROUGHOUT NSW - PROSPECT, NSW, 2148	Surrendered	09/11/2000	Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	144m	-

Former Licensed Activities Data Source: Environment Protection Authority

Historical Business Directories

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Business Directory Records 1950-1991
Premise or Road Intersection Matches

Universal Business Directory records from years 1991, 1986, 1982, 1970, 1961 & 1950, mapped to a premise or road intersection within the dataset buffer:

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Property Boundary or Road Intersection	Direction
	No records in buffer						

Business Directory Records 1950-1991
Road or Area Matches

Universal Business Directory records from years 1991, 1986, 1982, 1970, 1961 & 1950, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Road Corridor or Area
	No records in buffer					

Historical Business Directories

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Dry Cleaners, Motor Garages & Service Stations 1948-1993 Premise or Road Intersection Matches

Dry Cleaners, Motor Garages & Service Stations from UBD Business Directories, mapped to a premise or road intersection, within the dataset buffer.

Note: The Universal Business Directories were published between 1948 and 1993. Dry Cleaners, Motor Garages & Service Stations have been extracted from all of these directories except the following years 1951, 1955, 1957, 1960, 1963, 1973, 1974, 1977, 1987.

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Property Boundary or Road Intersection	Direction
	No records in buffer						

Dry Cleaners, Motor Garages & Service Stations 1948-1993 Road or Area Matches

Dry Cleaners, Motor Garages & Service Stations from UBD Business Directories, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published.

Note: The Universal Business Directories were published between 1948 and 1993. Dry Cleaners, Motor Garages & Service Stations have been extracted from all of these directories except the following years 1951, 1955, 1957, 1960, 1963, 1973, 1974, 1977, 1987.

Map Id	Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Road Corridor or Area
	No records in buffer					

Aerial Imagery 2019

1-23 Forestwood Drive, Glenmore Park, NSW 2745

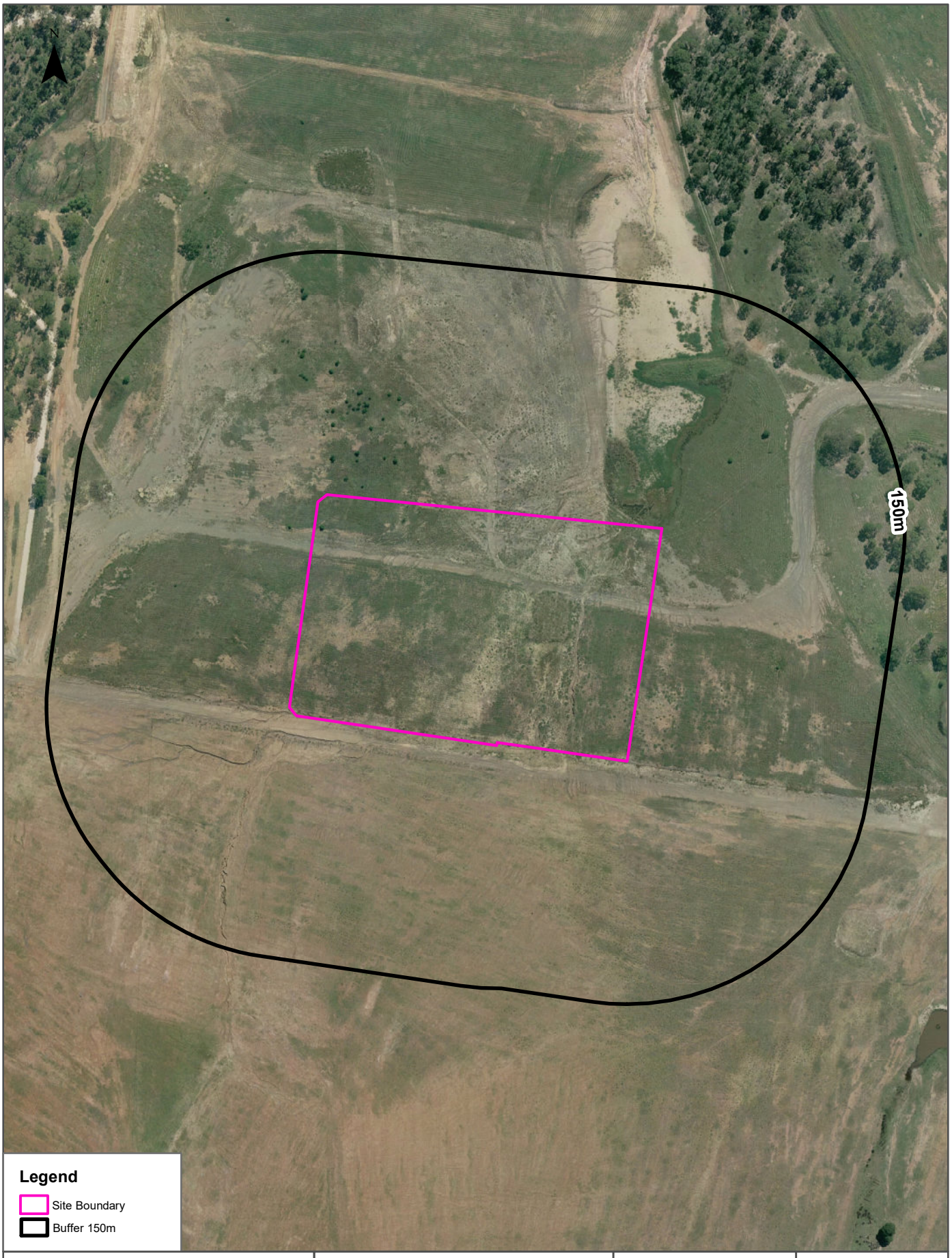
Scale: 0 30 60 90 120 Meters	Data Sources: Aerial Imagery © Aerometrex Pty Ltd	Coordinate System: GDA 1994 MGA Zone 56	Date: 08 May 2020

Aerial Imagery 2014

1-23 Forestwood Drive, Glenmore Park, NSW 2745

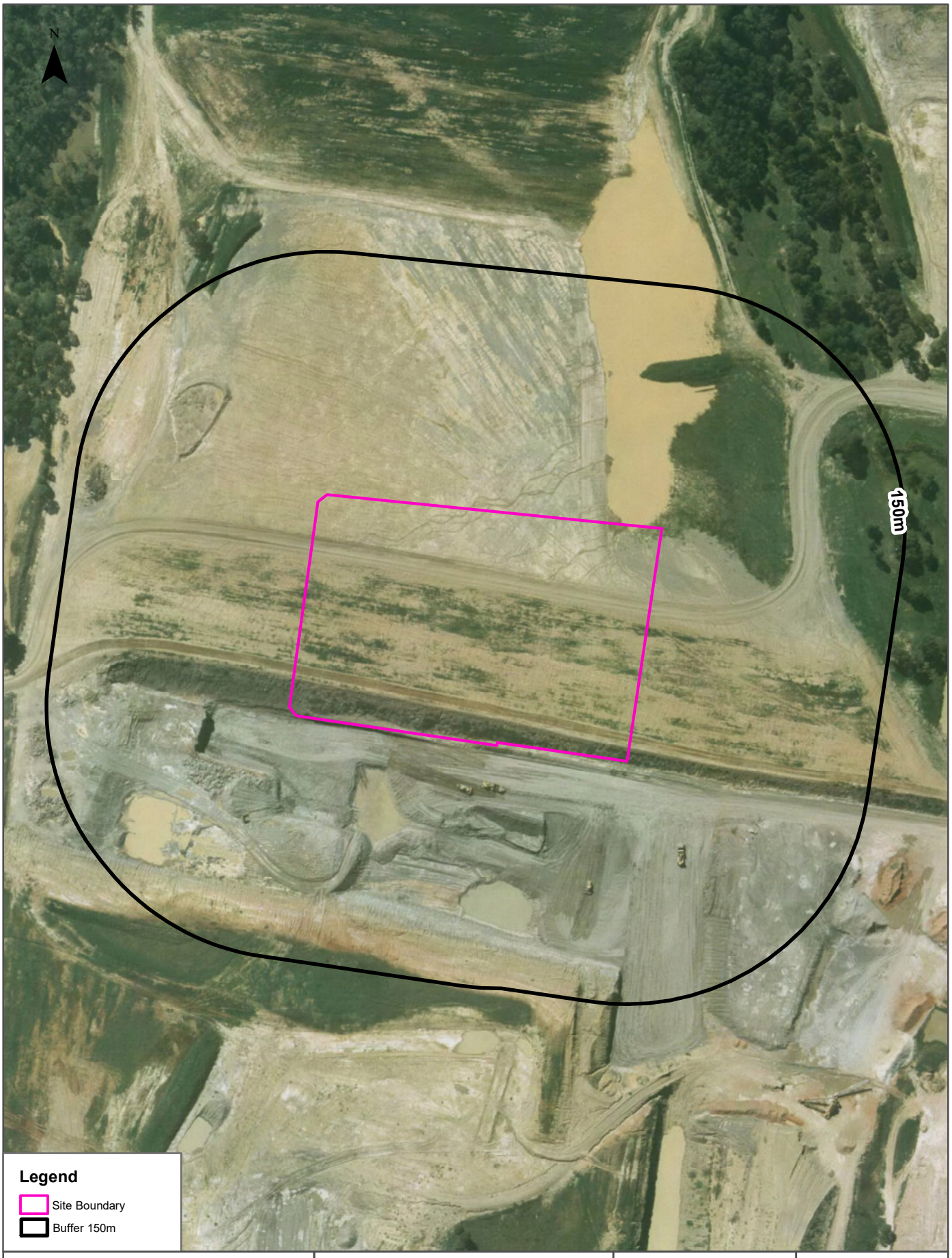
Aerial Imagery 2007

1-23 Forestwood Drive, Glenmore Park, NSW 2745



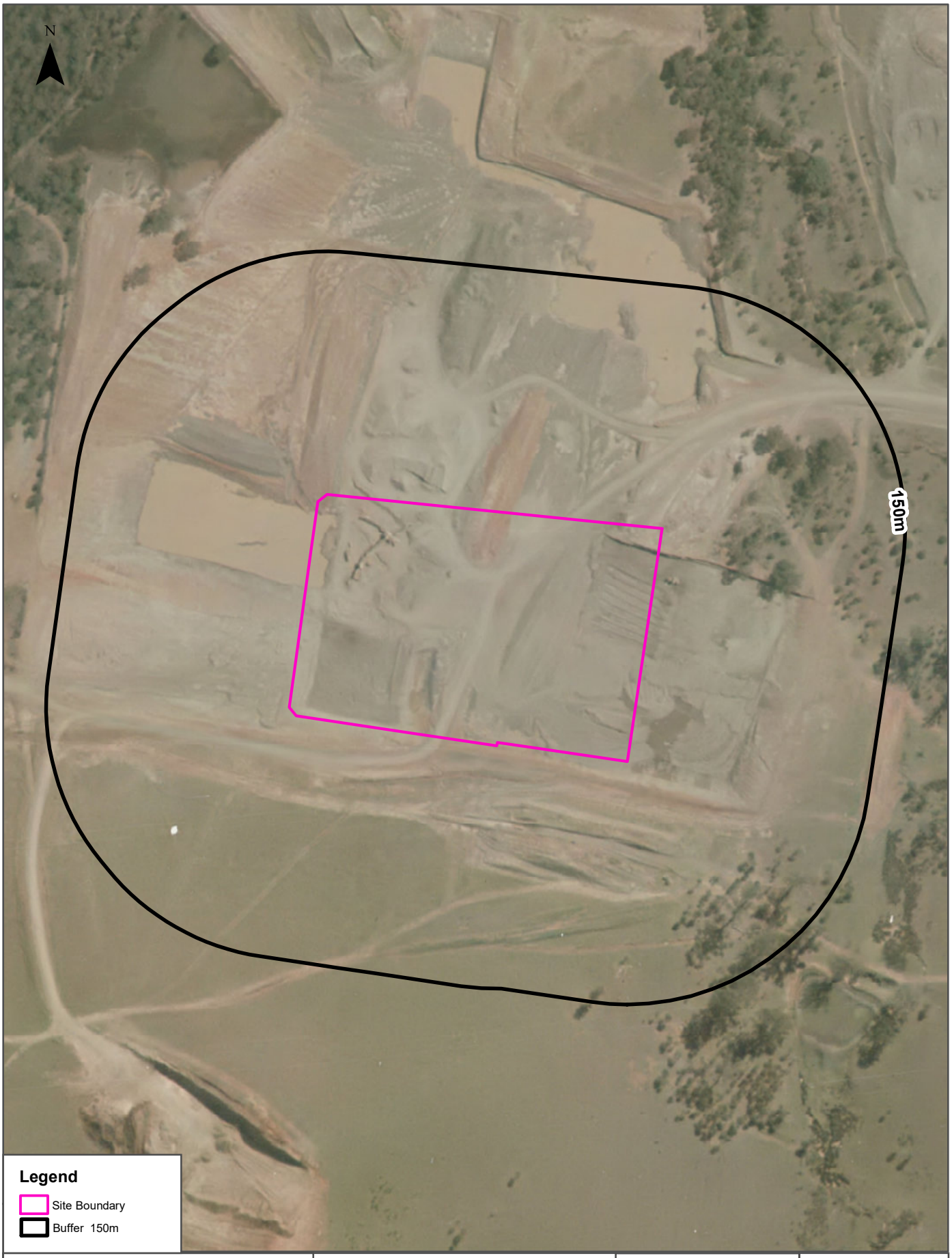
Aerial Imagery 2000

1-23 Forestwood Drive, Glenmore Park, NSW 2745



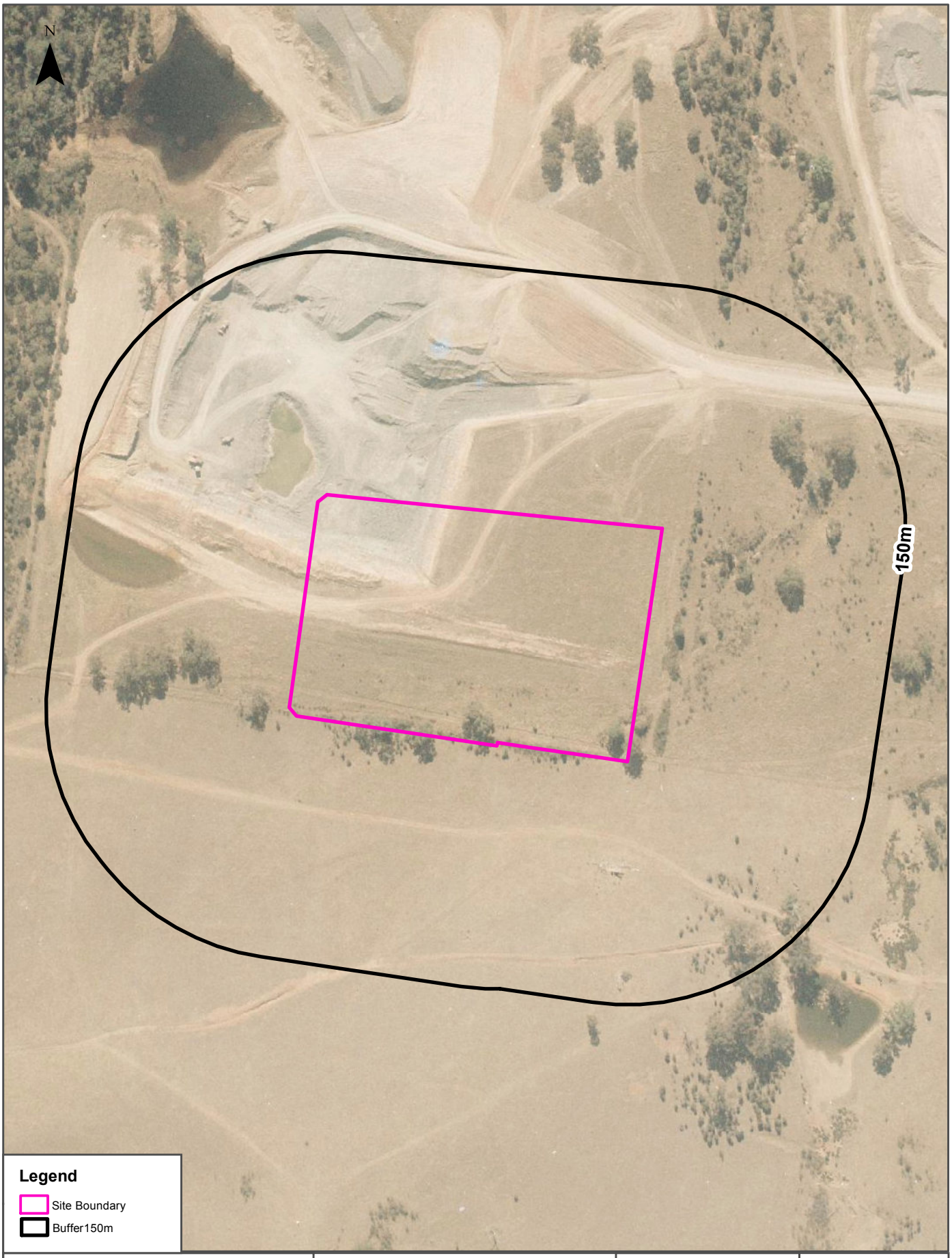
Aerial Imagery 1991

1-23 Forestwood Drive, Glenmore Park, NSW 2745



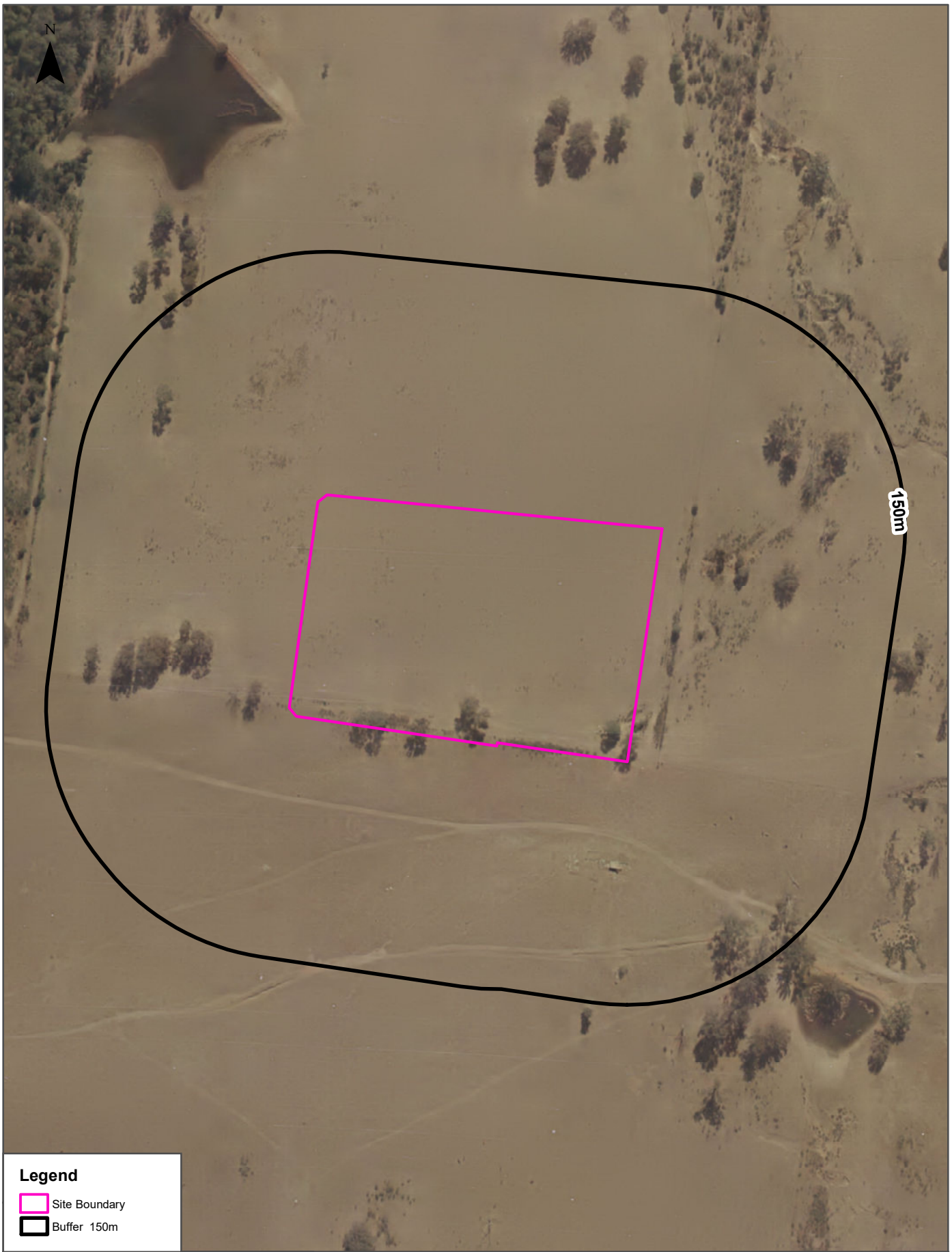
Aerial Imagery 1986

1-23 Forestwood Drive, Glenmore Park, NSW 2745



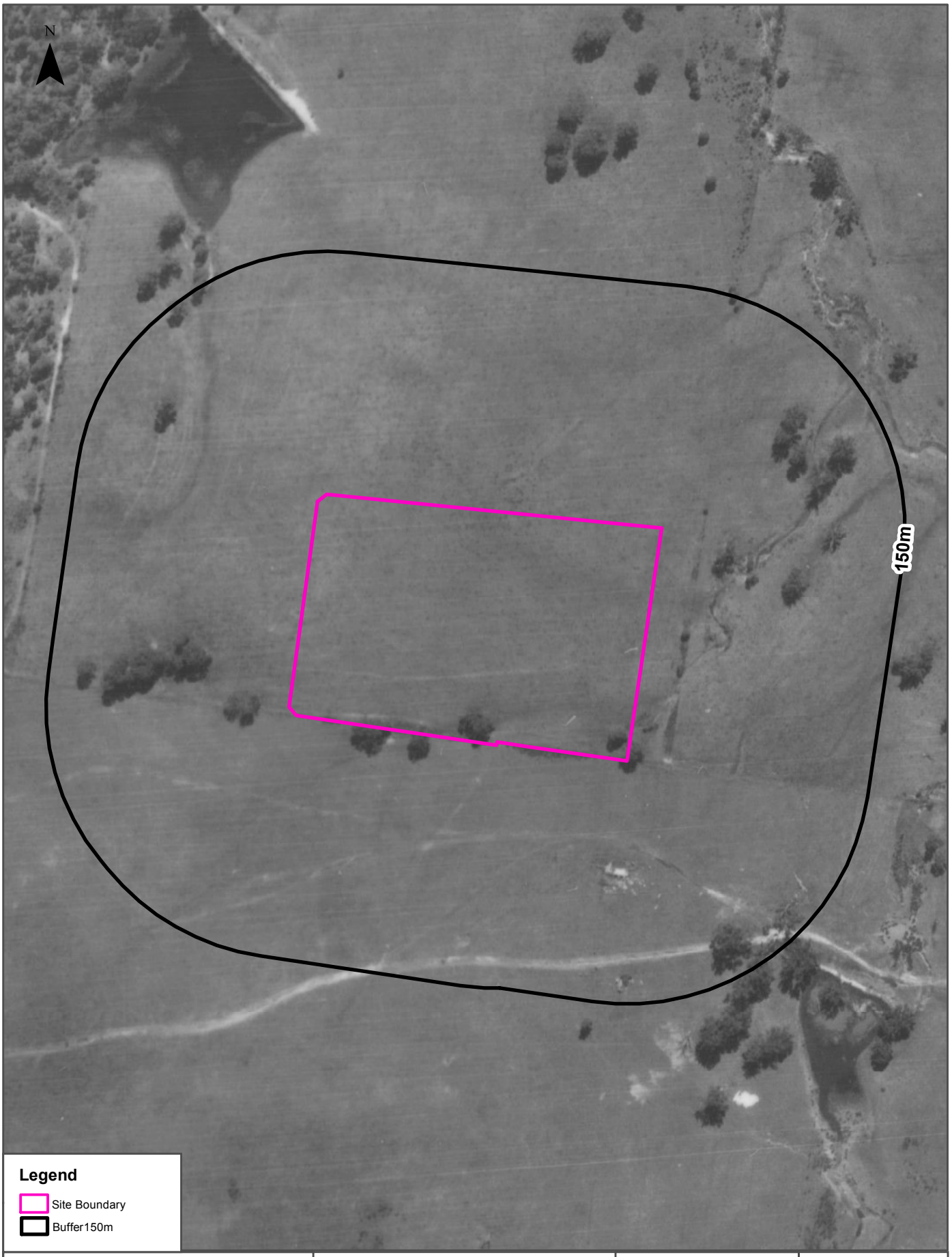
Aerial Imagery 1982

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Aerial Imagery 1978

1-23 Forestwood Drive, Glenmore Park, NSW 2745

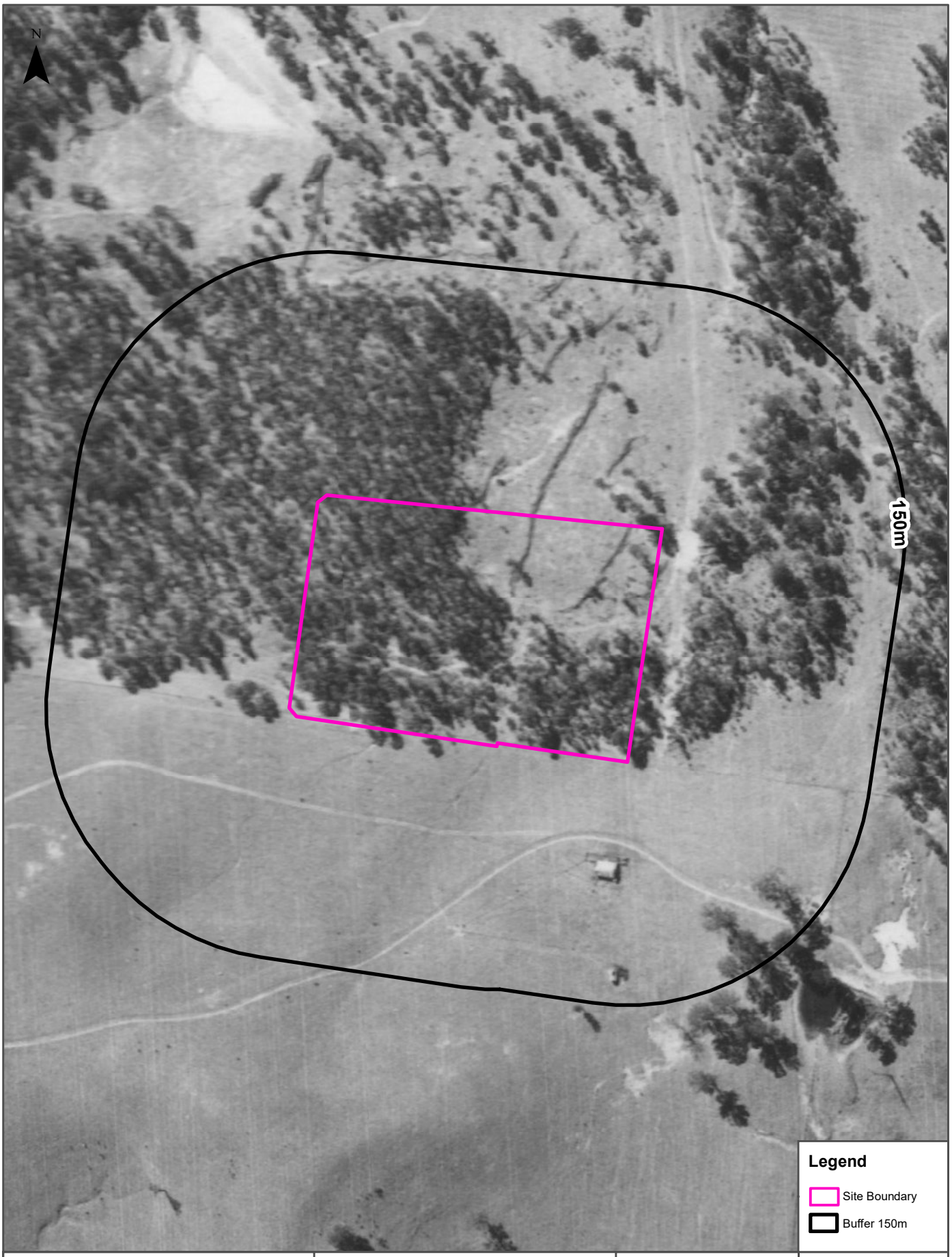


Aerial Imagery 1970

1-23 Forestwood Drive, Glenmore Park, NSW 2745

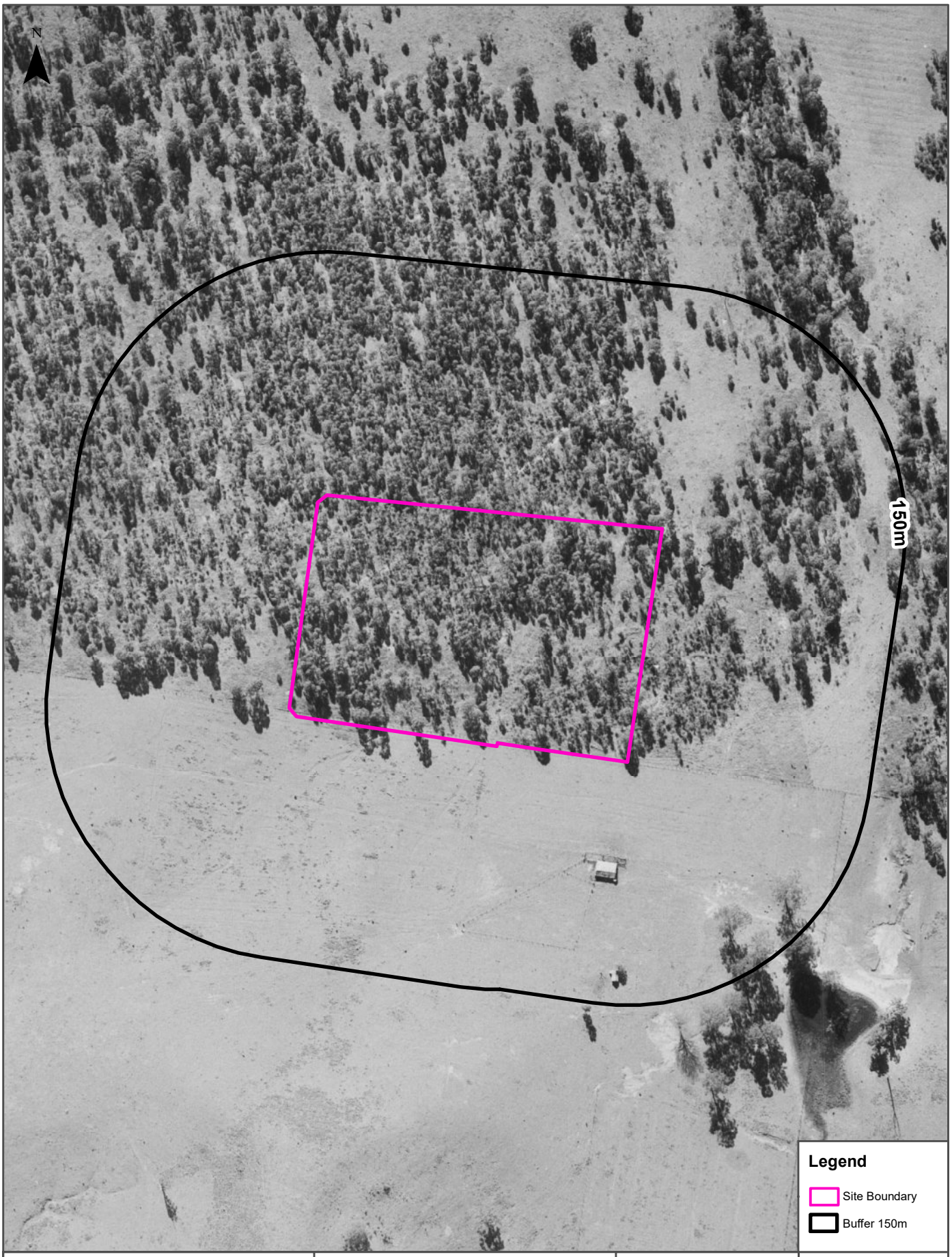
Aerial Imagery 1965

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Aerial Imagery 1961

1-23 Forestwood Drive, Glenmore Park, NSW 2745

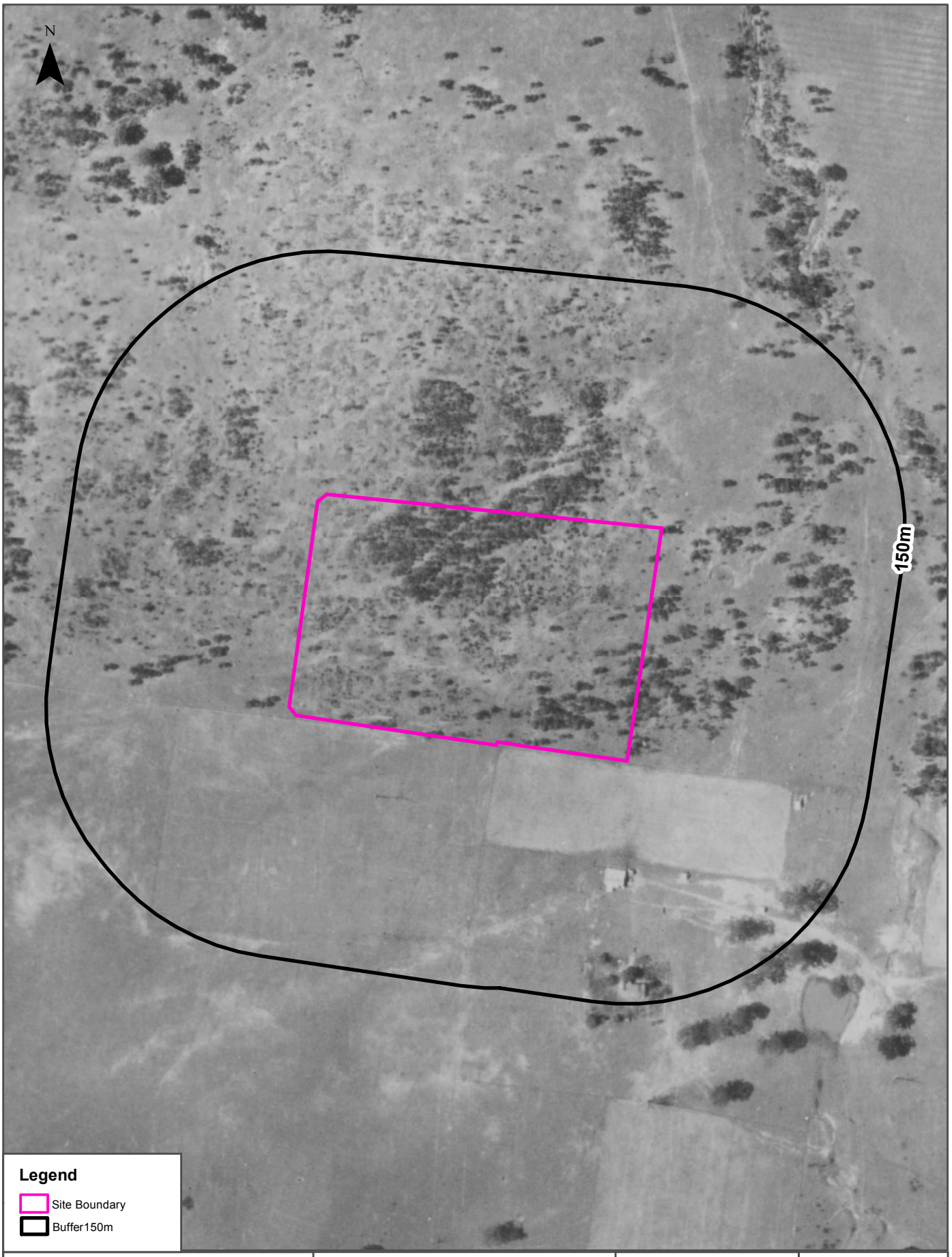


Aerial Imagery 1956

1-23 Forestwood Drive, Glenmore Park, NSW 2745

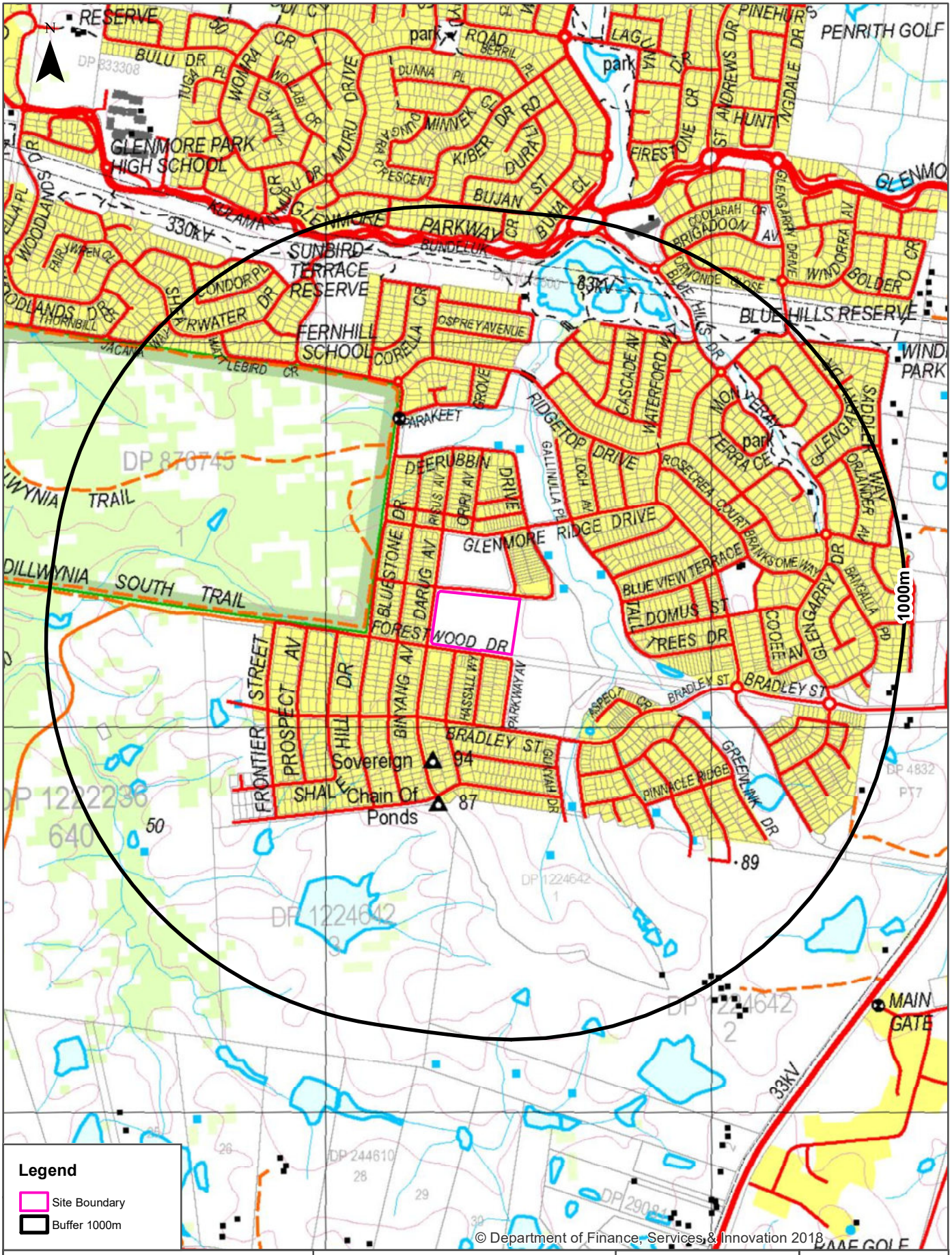
Aerial Imagery 1947

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Topographic Map 2015

1-23 Forestwood Drive, Glenmore Park, NSW 2745



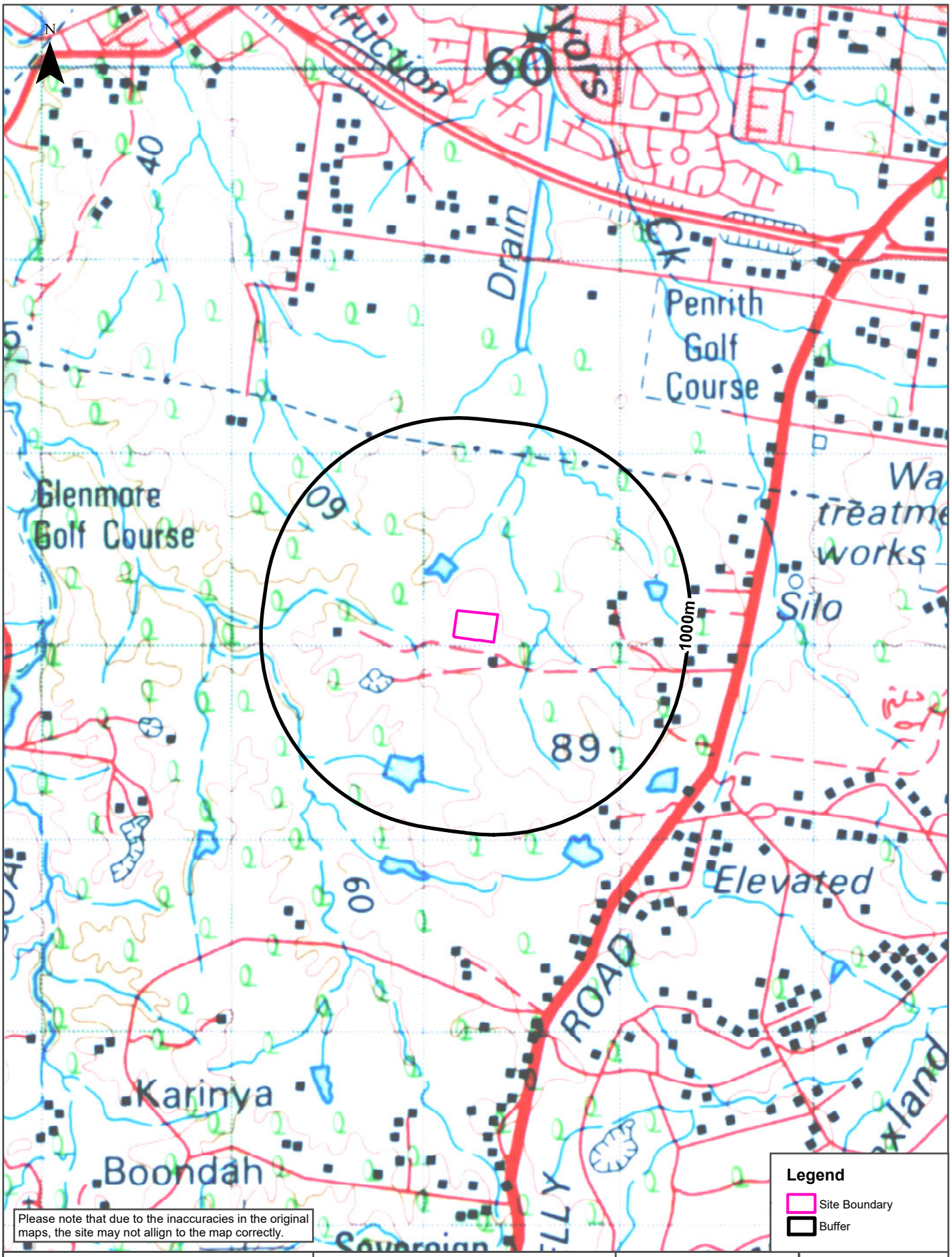
Legend

- Site Boundary
- Buffer 1000m

Scale:	Data Sources: Topographic Map Data © NSW Land and Property Information	Coordinate System: GDA 1994 MGA Zone 56	Date: 08 May 2020

Historical Map 1975

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Scale: 0 125 250 500 750 1,000 1,250 Meters

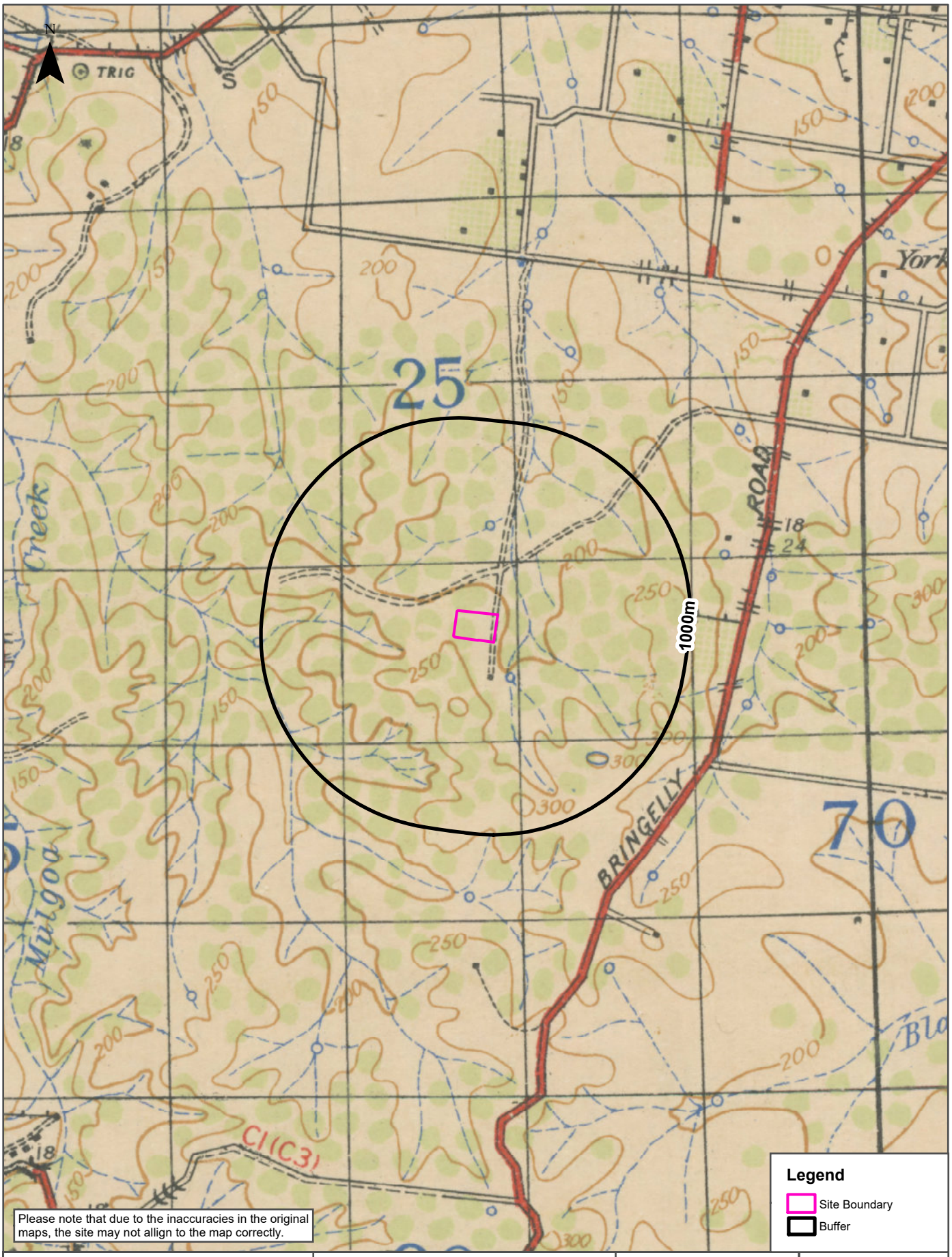
Data Sources: NATMAP 1:100,000
Topographic Maps Geoscience Australia

Coordinate System:
GDA 1994 MGA Zone 56

Date: 08 May 2020

Historical Map c.1942

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Scale: 0 125 250 500 750 1,000 1,250 Meters

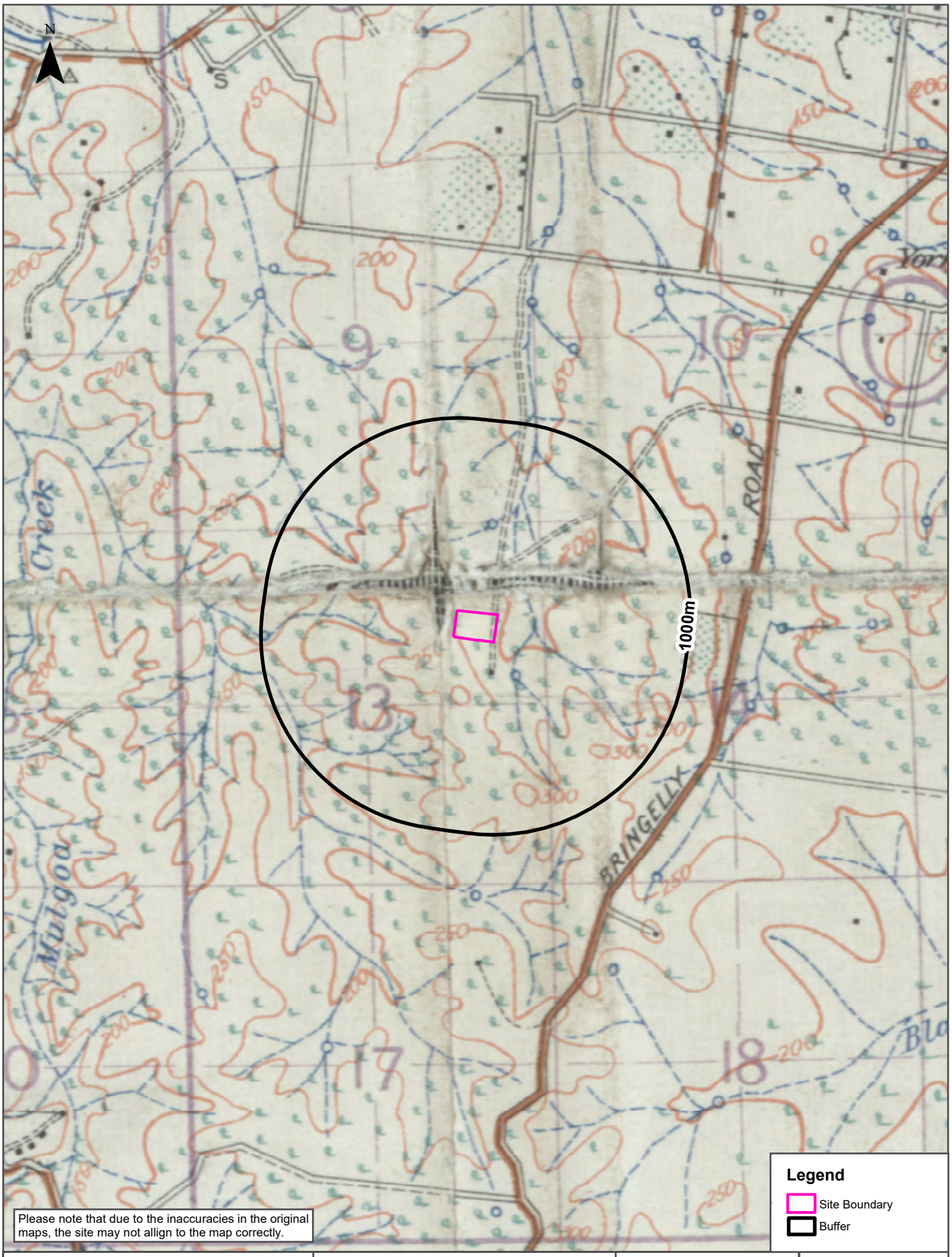
Data Sources: Australia 1:63360, Produced by Australian Section Imperial General Staff

Coordinate System: GDA 1994 MGA Zone 56

Date: 08 May 2020

Historical Map c.1929

1-23 Forestwood Drive, Glenmore Park, NSW 2745

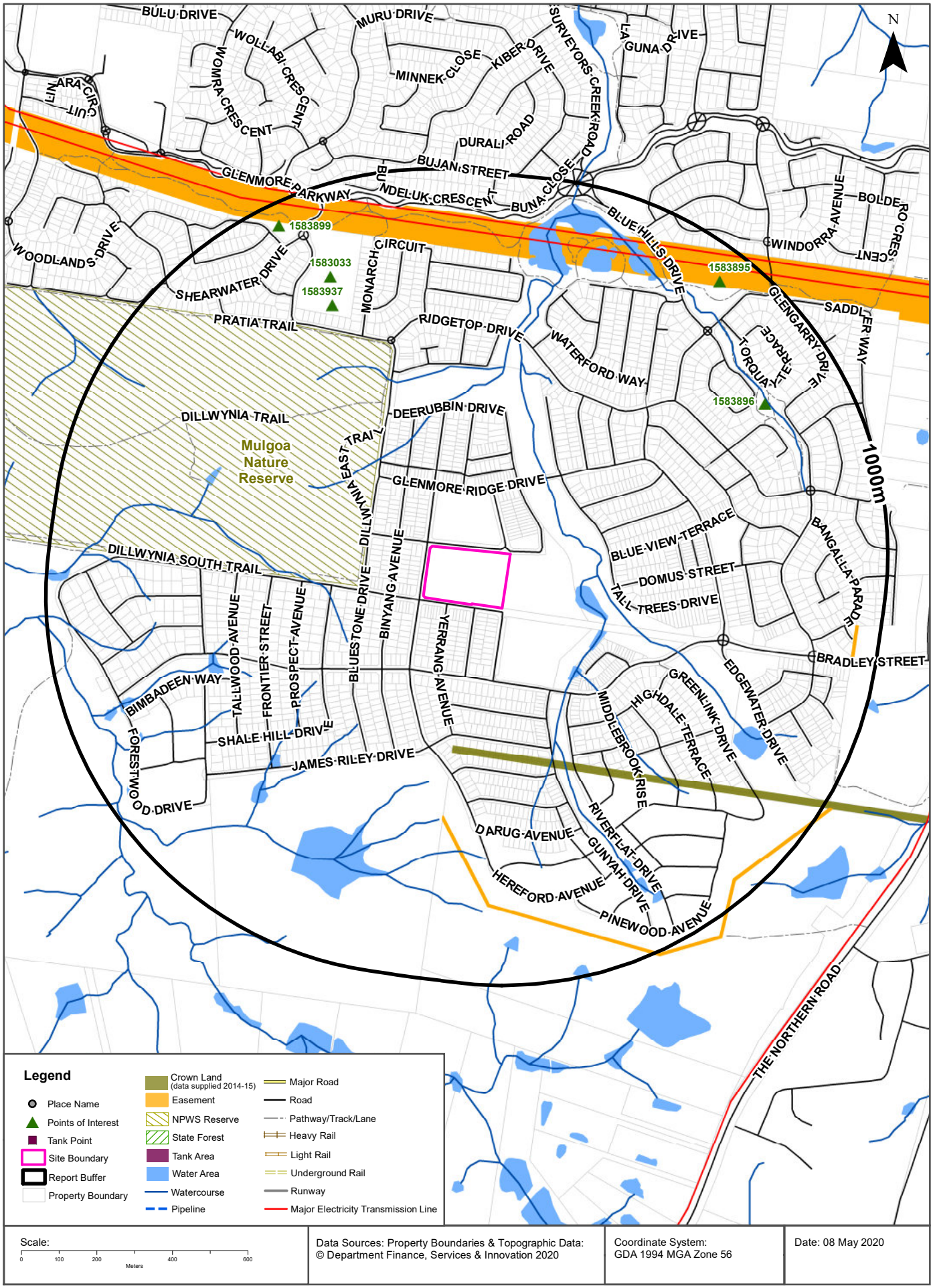


Scale:	Data Sources: Australia 1:63360, Produced by Australian Section Imperial General Staff	Coordinate System: GDA 1994 MGA Zone 56	Date: 08 May 2020

0 125 250 500 750 1,000 1,250 Meters

Topographic Features

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Topographic Features

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Points of Interest

What Points of Interest exist within the dataset buffer?

Map Id	Feature Type	Label	Distance	Direction
1583937	Parking Area	Parking Area	691m	North West
1583033	Special School	FERNHILL SCHOOL	764m	North West
1583896	Park	Park	783m	North East
1583895	Sports Field	BLUE HILLS RESERVE	911m	North East
1583899	Park	SUNBIRD TERRACE RESERVE	942m	North West

Topographic Features

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Tanks (Areas)

What are the Tank Areas located within the dataset buffer?
Note. The large majority of tank features provided by LPI are derived from aerial imagery & are therefore primarily above ground tanks.

Map Id	Tank Type	Status	Name	Feature Currency	Distance	Direction
	No records in buffer					

Tanks (Points)

What are the Tank Points located within the dataset buffer?
Note. The large majority of tank features provided by LPI are derived from aerial imagery & are therefore primarily above ground tanks.

Map Id	Tank Type	Status	Name	Feature Currency	Distance	Direction
	No records in buffer					

Major Easements

What Major Easements exist within the dataset buffer?
Note. Easements provided by LPI are not at the detail of local governments. They are limited to major easements such as Right of Carriageway, Electrical Lines (66kVa etc.), Easement to drain water & Significant subterranean pipelines (gas, water etc.).

Map Id	Easement Class	Easement Type	Easement Width	Distance	Direction
169846989	Primary	Right of way	5m	566m	South East
120115527	Primary	Undefined		785m	North
120118513	Primary	Undefined		933m	East

Topographic Features

1-23 Forestwood Drive, Glenmore Park, NSW 2745

State Forest

What State Forest exist within the dataset buffer?

State Forest Number	State Forest Name	Distance	Direction
N/A	No records in buffer		

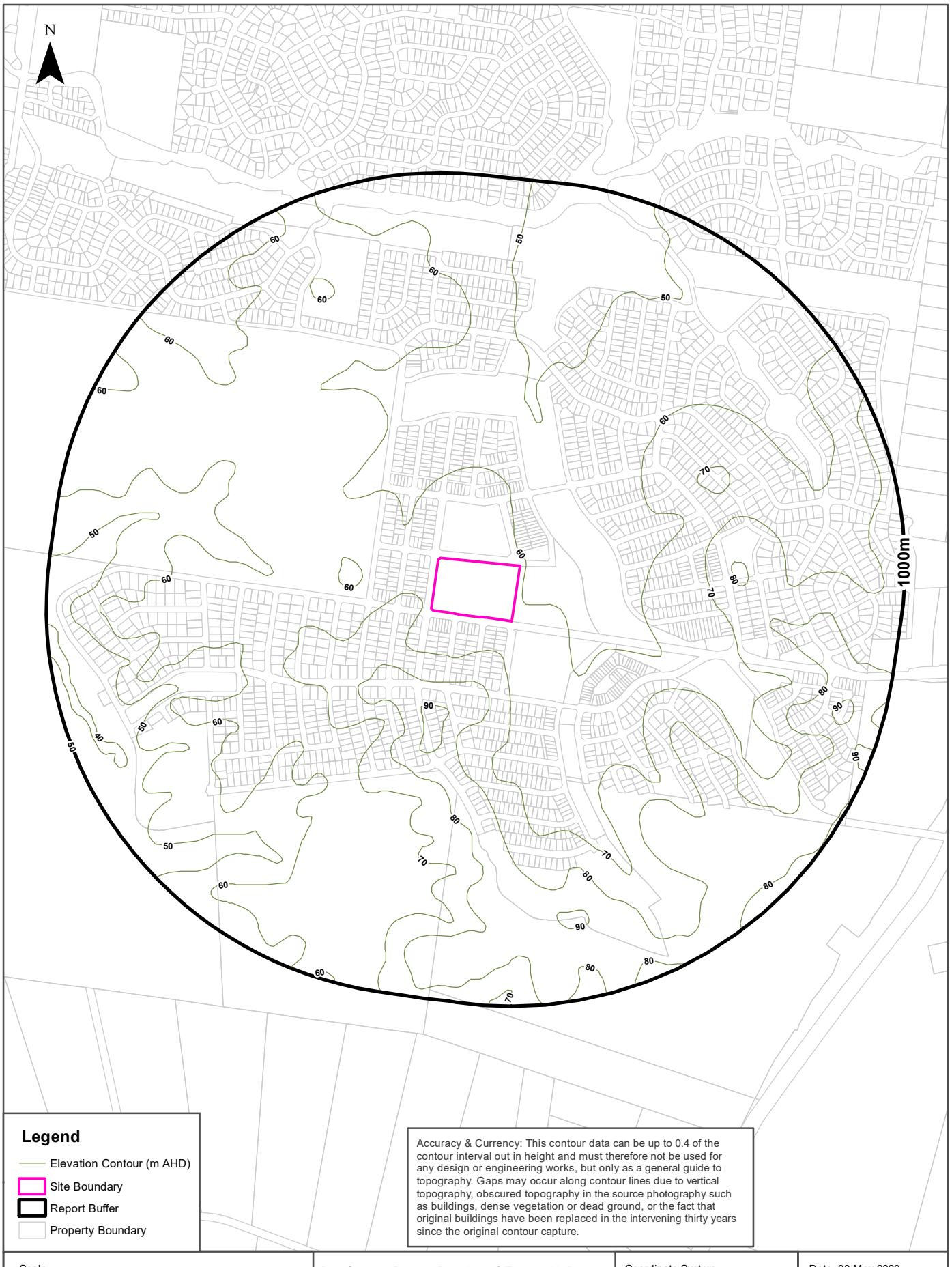
National Parks and Wildlife Service Reserves

What NPWS Reserves exist within the dataset buffer?

Reserve Number	Reserve Type	Reserve Name	Gazetted Date	Distance	Direction
N0712	NATURE RESERVE	Mulgoa Nature Reserve	23/12/1994	171m	North West

Elevation Contours (m AHD)

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Hydrogeology & Groundwater

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Hydrogeology

Description of aquifers on-site:

Description
Porous, extensive highly productive aquifers

Description of aquifers within the dataset buffer:

Description
Porous, extensive highly productive aquifers

Hydrogeology Map of Australia : Commonwealth of Australia (Geoscience Australia)

Botany Groundwater Management Zones

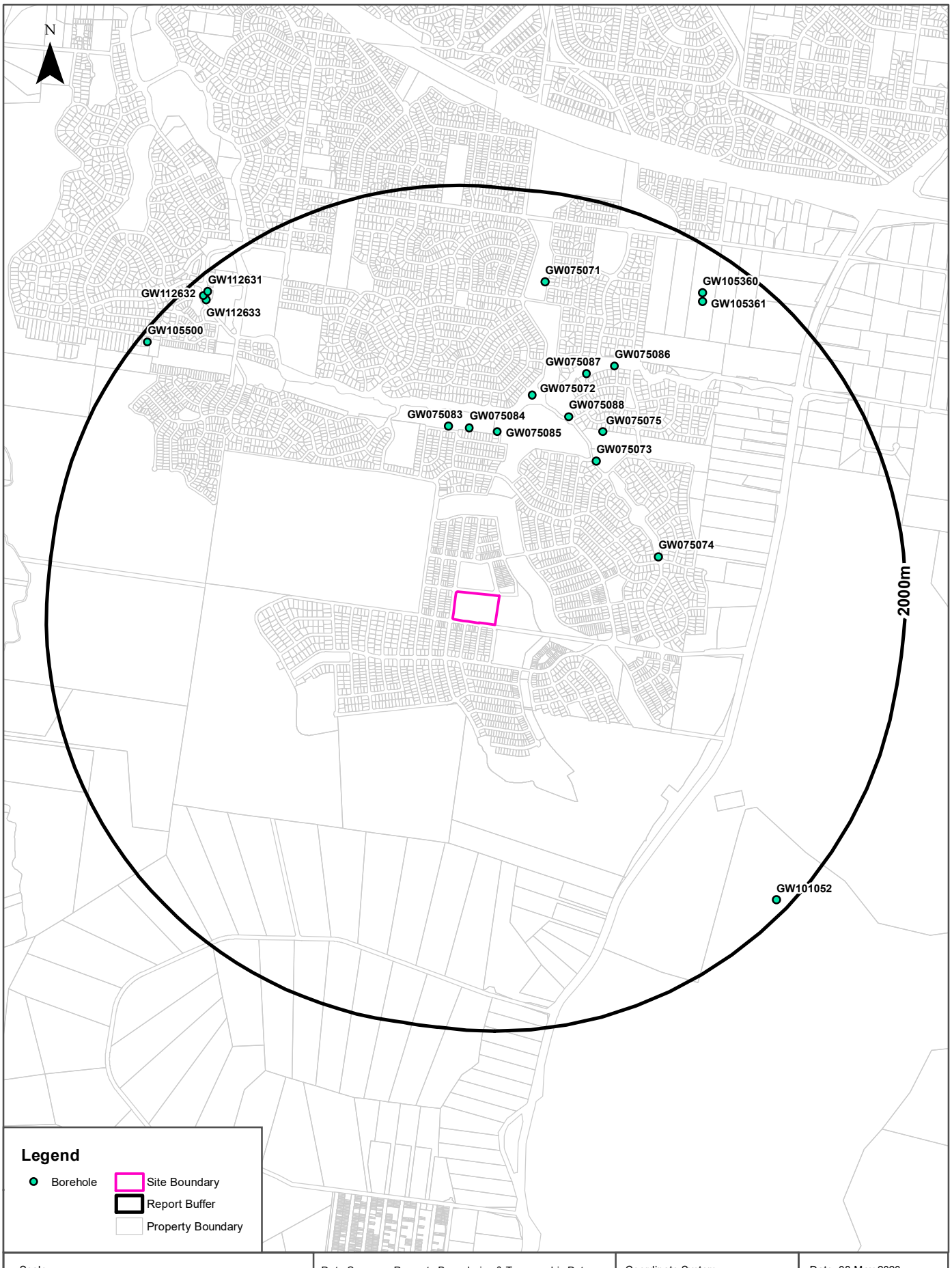
Groundwater management zones relating to the Botany Sand Beds aquifer within the dataset buffer:

Management Zone No.	Restriction	Distance	Direction
N/A	No records in buffer		

Botany Groundwater Management Zones Data Source : NSW Department of Primary Industries

Groundwater Boreholes

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Hydrogeology & Groundwater

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Groundwater Boreholes

Boreholes within the dataset buffer:

GW No.	Licence No	Work Type	Owner Type	Authorised Purpose	Intended Purpose	Name	Complete Date	Final Depth (m)	Drilled Depth (m)	Salinity (mg/L)	SWL (m bgl)	Yield (L/s)	Elev (AHD)	Dist	Dir
GW075085		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK BORE - LAKESIDE No.1	24/03/2003	5.30	5.50				50.35	801m	North
GW075084		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK BORE - LAKESIDE No.2	24/03/2003	5.50	6.00				55.03	807m	North
GW075074		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK AT GLENGARRY	14/08/2001	6.00	6.00				60.12	807m	East
GW075083		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK BORE - LAKESIDE No.3	24/03/2003	4.50	5.00				60.64	814m	North
GW075073		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK BORE AT LAKESIDE	14/08/2001	6.50	6.50				51.11	816m	North East
GW075088		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK BORE - BLUE HILLS R/ABOUT	25/03/2003	8.90	8.90				49.15	945m	North East
GW075075		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK AT BLUE HILLS OVAL	14/08/2001	2.50	2.50				53.44	955m	North East
GW075072		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK BORE AT THUNDER DOME	13/08/2001	6.50	6.50				45.83	1001m	North
GW075087		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK BORE - NADA PLACE	25/03/2003	1.60	1.60				53.88	1175m	North East
GW075086		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK BORE - MANDALONG TCE	24/03/2003	3.80	4.00				59.31	1265m	North East
GW075071		Bore	NSW Office of Water		Monitoring Bore	GLENMORE PARK AT ENGLEWOOD RESERVE	13/08/2001	7.20	7.20				41.99	1560m	North
GW105361	10BL160480	Bore		Monitoring Bore	Monitoring Bore		06/03/2004	7.00	7.00					1761m	North East
GW105360	10BL160480	Bore		Monitoring Bore	Monitoring Bore		06/03/2003	2.00	2.00					1795m	North East
GW112633	10BL603226	Bore	Private	Monitoring Bore	Monitoring Bore	Woolworths	03/09/2009	9.00	9.00					1894m	North West

GW No.	Licence No	Work Type	Owner Type	Authorised Purpose	Intended Purpose	Name	Complete Date	Final Depth (m)	Drilled Depth (m)	Salinity (mg/L)	SWL (m bgl)	Yield (L/s)	Elev (AHD)	Dist	Dir
GW112632	10BL603226	Bore	Private	Monitoring Bore	Monitoring Bore	Woolworths	03/09/2009	9.00	9.00					1916m	North West
GW112631	10BL603226	Bore	Private	Monitoring Bore	Monitoring Bore	Woolworths	03/09/2009	9.00	9.00					1920m	North West
GW101052	10BL158231	Bore	Private	Monitoring Bore	Monitoring Bore		05/08/1997	32.20	32.20	6560	13.60		69.41	1938m	South East
GW105500	10BL162542, 10WA108629	Bore		Domestic	Domestic		12/12/2003	144.00	144.00	1020		1.100		1955m	North West

Hydrogeology & Groundwater

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Driller's Logs

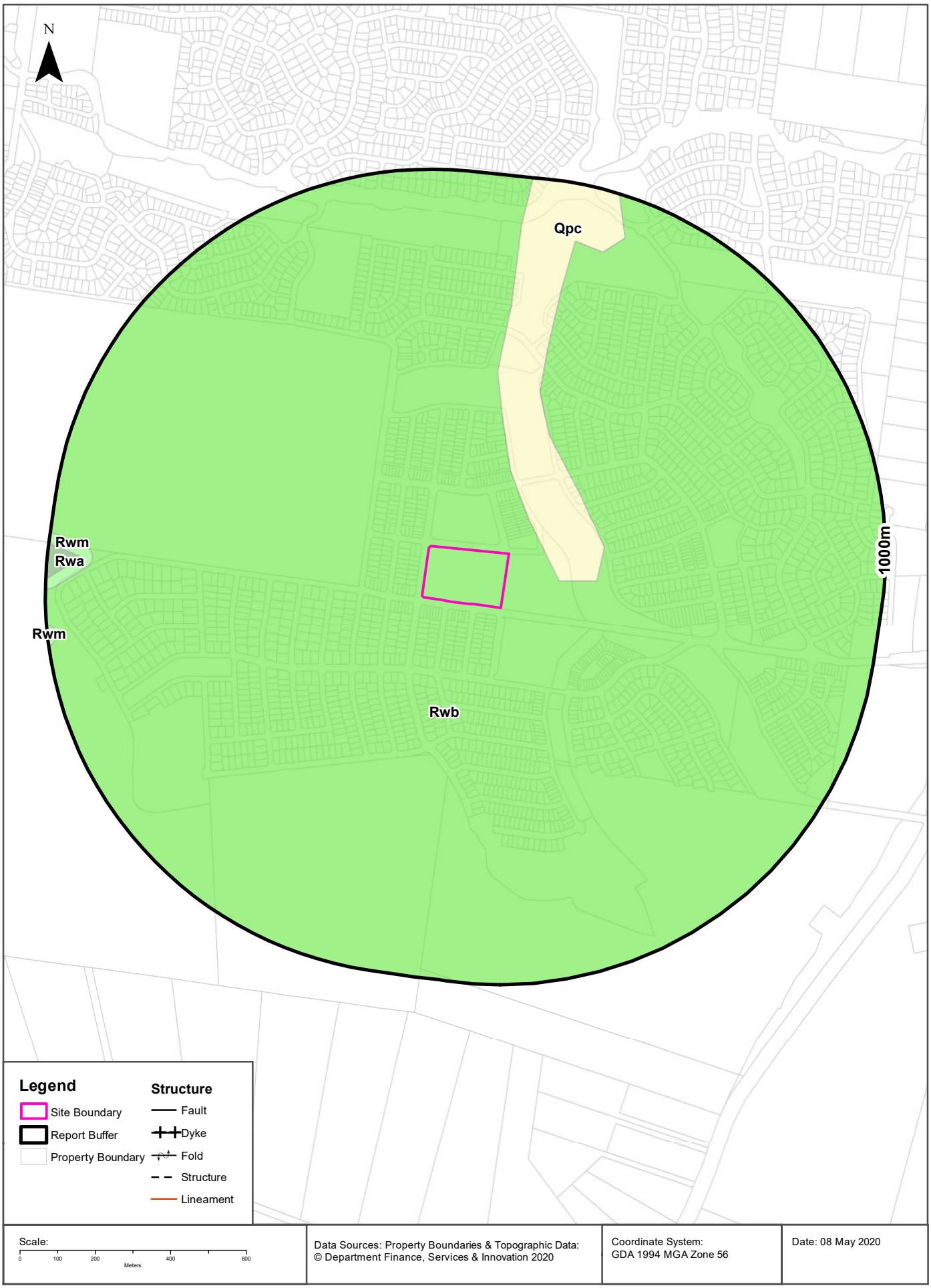
Drill log data relevant to the boreholes within the dataset buffer:

Groundwater No	Drillers Log	Distance	Direction
GW075085	0.00m-2.00m CLAY, BROWN 2.00m-4.00m CLAY, LIGHT BROWN 4.00m-5.50m SHALE, BROWN	801m	North
GW075074	0.00m-0.50m TOPSOIL 0.50m-3.00m CLAY, BROWN 3.00m-4.50m CLAY, GREY 4.50m-6.00m SHALE	807m	East
GW075084	0.00m-1.00m CLAY, BROWN 1.00m-3.50m SHALE, BROWN 3.50m-6.00m SHALE, GREY	807m	North
GW075083	0.00m-1.00m CLAY, BROWN 1.00m-3.50m SHALE, BROWN 3.50m-5.00m SHALE, GREY	814m	North
GW075073	0.00m-0.50m TOPSOIL 0.50m-6.00m CLAY, BROWN 6.00m-6.50m SHALE	816m	North East
GW075088	0.00m-1.00m CLAY, BROWN 1.00m-6.00m SHALE, BROWN 6.00m-8.90m SHALE, GREY	945m	North East
GW075075	0.00m-0.30m TOPSOIL 0.30m-1.50m CLAY, BROWN 1.50m-2.50m SHALE	955m	North East
GW075072	0.00m-0.50m TOPSOIL 0.50m-4.00m CLAY, BROWN 4.00m-6.50m SANDY CLAY	1001m	North
GW075087	0.00m-1.00m CLAY, WEATHERED 1.00m-1.50m SHALE, BROWN 1.50m-1.60m IRONSTONE	1175m	North East
GW075086	0.00m-1.00m CLAY, BROWN 1.00m-3.00m SHALE, BROWN 3.00m-4.00m SHALE, GREY	1265m	North East
GW075071	0.00m-0.50m TOPSOIL 0.50m-4.50m CLAY, BROWN 4.50m-7.20m SANDY CLAY	1560m	North
GW105361	0.00m-6.70m BROWN CLAY 6.70m-7.00m SHALE	1761m	North East
GW105360	0.00m-2.00m TOPSOIL DARK CHOCOLATE	1795m	North East
GW112633	0.00m-4.00m SILT AND SHALE GREY 4.00m-9.00m SILT AND SHALE WET AND GREY	1894m	North West
GW112632	0.00m-4.00m SILT AND SHALE GREY 4.00m-9.00m SILT AND SHALE WET/ GREY	1916m	North West
GW112631	0.00m-4.00m SILT AND SHALE GREY 4.00m-9.00m SILT AND SHALE WET GREY	1920m	North West

Groundwater No	Drillers Log	Distance	Direction
GW101052	0.00m-1.20m FILL: brown and brown-red, some iron stone gravel plastic, reworked material, slight moisture. 1.20m-3.00m CLAY: light grey with red-brown streaks, silty low plasticity, firm, slight moisture. 3.00m-4.00m SHALE/SILTSTONE: brown-grey, moderately weathered semi-competent and friable, trace of brown clay bands. 4.00m-6.00m SHALE/SILTSTONE: slightly weathered, medium grey, carbonaceous in parts, low-medium hardness, competent, minor fine grained sandstone, partly ferruginised 6.00m-7.00m SHALE/SILTSTONE: slightly weathered, medium grey, carbonaceous in parts, low-medium hardness, competent, some brown-grey massive claystone, softer 7.00m-9.00m SHALE/SILTSTONE: slightly weathered, medium grey, carbonaceous in parts, low-medium hardness, competent 9.00m-10.00m SHALE/SILTSTONE: slightly weathered, dark grey, carbonaceous, low-medium hardness, competent 10.00m-11.00m SHALE/SILTSTONE: slightly weathered, medium grey, carbonaceous in parts, low-medium hardness, competent 11.00m-14.00m SHALE/SILTSTONE: slightly weathered, medium grey, carbonaceous in parts, low-medium hardness, competent, base of weathering at 12 m, increasing hardness 14.00m-15.00m SHALE/SILTSTONE: slightly weathered, dark grey, carbonaceous, low-medium hardness, competen 15.00m-22.00m SHALE/SILTSTONE: slightly weathered, medium grey, carbonaceous in parts, low-medium hardness, competent 22.00m-23.00m SHALE/SILTSTONE: slightly weathered, medium grey, carbonaceous in parts, low-medium hardness, competent 23.00m-24.00m SHALE/SILTSTONE: slightly weathered, dark grey, carbonaceous, low-medium hardness, competent 24.00m-25.00m SHALE/SILTSTONE: slightly weathered, medium grey, carbonaceous in parts, low-medium hardness, competent 25.00m-27.00m SHALE/SILTSTONE: slightly weathered, dark grey, dominantly carbonaceous, moderately hard, appears massive, competent 27.00m-28.00m SHALE/SILTSTONE: slightly weathered, dark grey, dominantly carbonaceous, moderately hard, appears massive, competent, some brown-grey massive claystone, softer 28.00m-29.00m SHALE/SILTSTONE: slightly weathered, dark grey, dominantly carbonaceous, moderately hard, appears massive, competent 29.00m-30.00m SHALE/SILTSTONE: slightly weathered, dark grey, dominantly carbonaceous, moderately hard, appears massive, competent, some brown-grey massive claystone, softer 30.00m-32.00m SHALE/SILTSTONE: slightly weathered, dark grey, dominantly carbonaceous, moderately hard, appears massive, competen	1938m	South East
GW105500	0.00m-4.00m CLAY 4.00m-65.00m SHALE 65.00m-110.00m SANDSTONE/SHALE 110.00m-144.00m SANDSTONE	1955m	North West

Geology 1:100,000

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Geology

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Geological Units

What are the Geological Units onsite?

Symbol	Description	Unit Name	Group	Sub Group	Age	Dom Lith	Map Sheet	Dataset
Rwb	Shale, carbonaceous claystone,claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff	Bringelly Shale	Wianamatta Group (undifferentiated)		Middle Triassic		Penrith	1:100,000

What are the Geological Units within the dataset buffer?

Symbol	Description	Unit Name	Group	Sub Group	Age	Dom Lith	Map Sheet	Dataset
Qpc	Gravel, sand, silt, clay	Cranebrook Formation			Quaternary		Penrith	1:100,000
Rwa	Dark-grey to black claystone-siltstone and fine sandstone -siltstone laminate	Ashfield Shale	Wianamatta Group (undifferentiated)		Middle Triassic		Penrith	1:100,000
Rwb	Shale, carbonaceous claystone,claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff	Bringelly Shale	Wianamatta Group (undifferentiated)		Middle Triassic		Penrith	1:100,000
Rwm	Fine to medium-grained quartz-lithic sandstone	Minchinbury Sandstone	Wianamatta Group (undifferentiated)		Middle Triassic		Penrith	1:100,000

Geological Structures

What are the Geological Structures onsite?

Feature	Name	Description	Map Sheet	Dataset
No features				1:100,000

What are the Geological Structures within the dataset buffer?

Feature	Name	Description	Map Sheet	Dataset
No features				1:100,000

Geological Data Source : NSW Department of Industry, Resources & Energy

Naturally Occurring Asbestos Potential

1-23 Forestwood Drive, Glenmore Park, NSW 2745

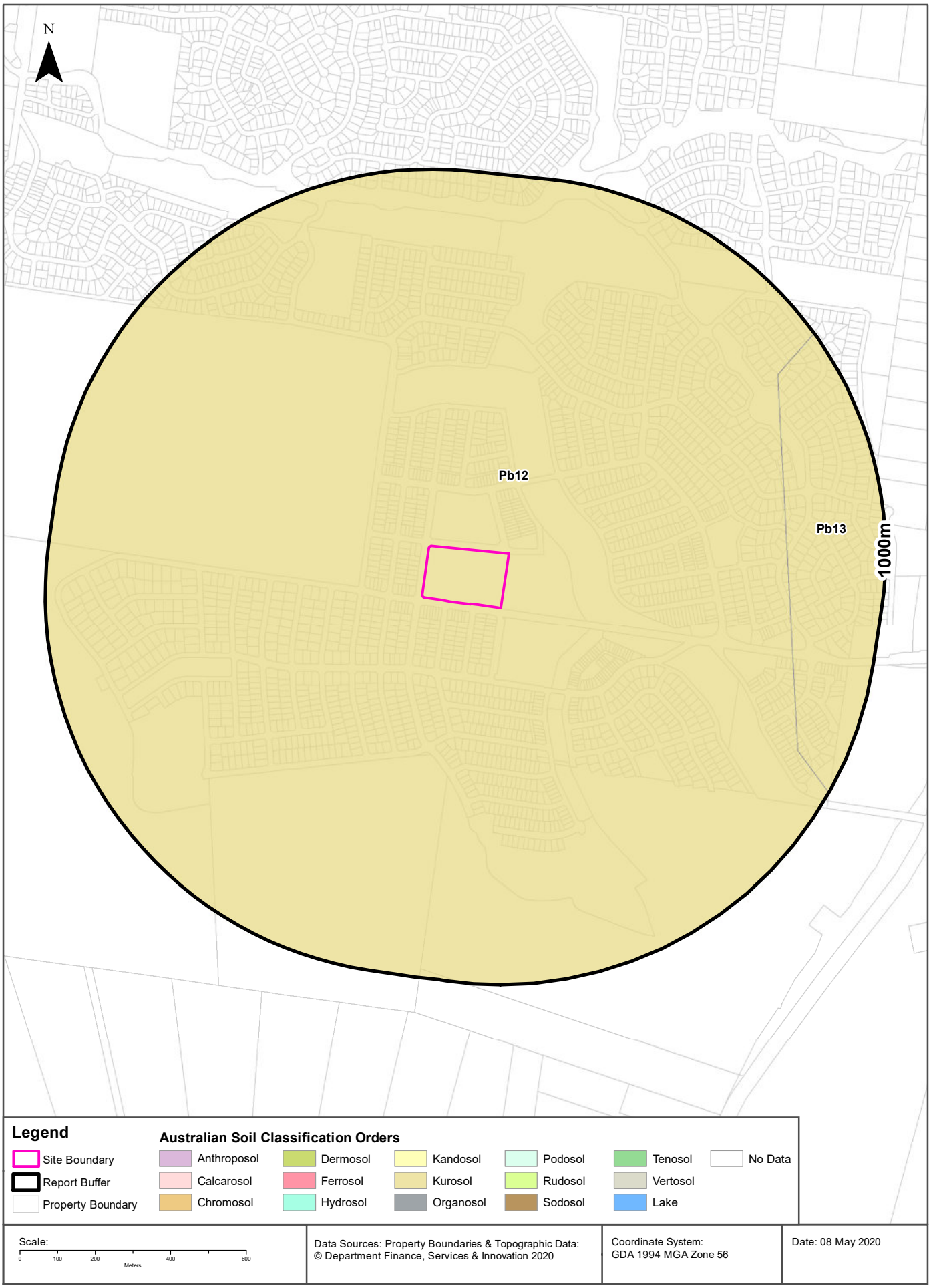
Naturally Occurring Asbestos Potential

Naturally Occurring Asbestos Potential within the dataset buffer:

Potential	Sym	Strat Name	Group	Formation	Scale	Min Age	Max Age	Rock Type	Dom Lith	Description	Dist	Dir
No records in buffer												

Atlas of Australian Soils

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Soils

1-23 Forestwood Drive, Glenmore Park, NSW 2745

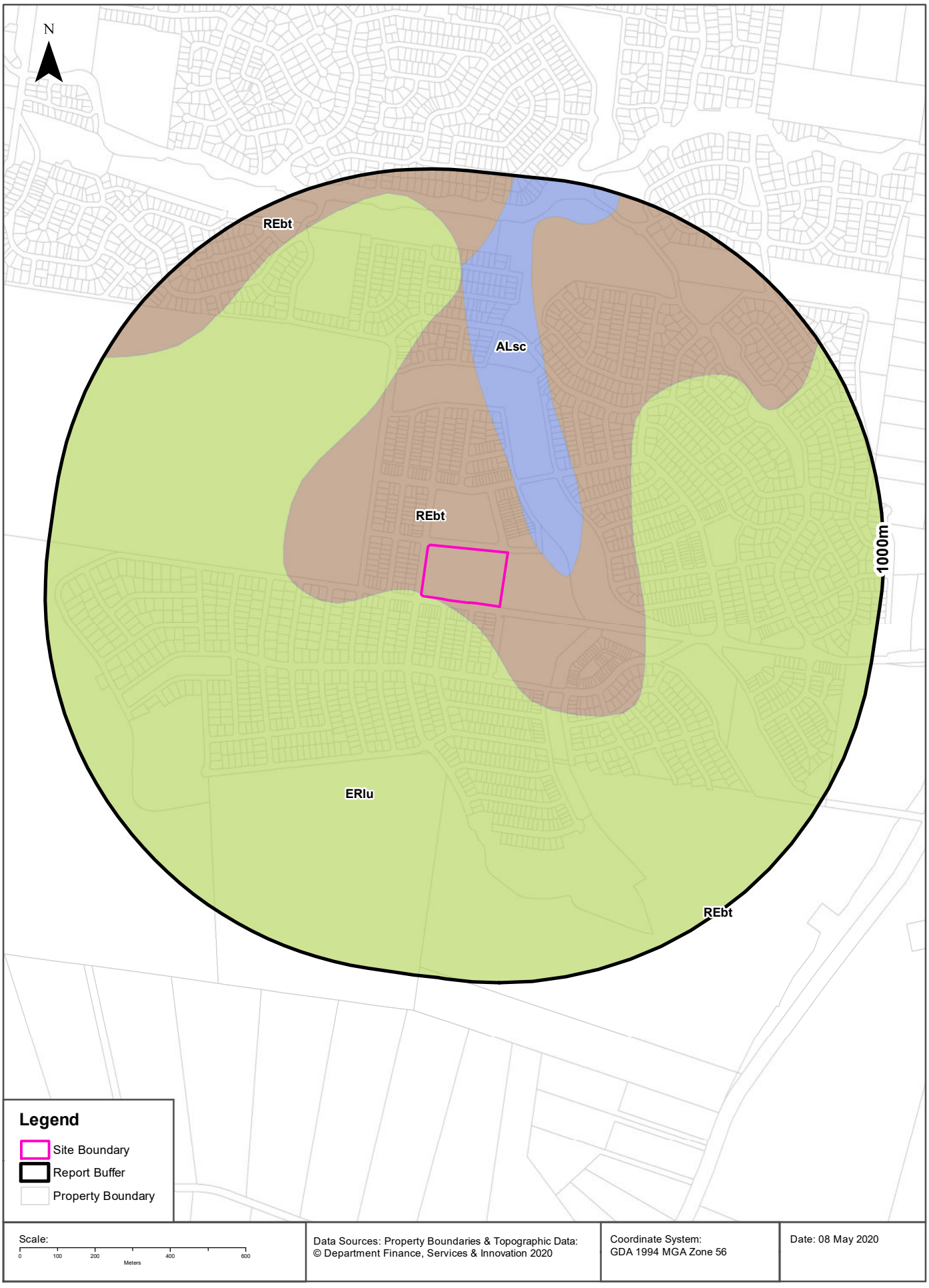
Atlas of Australian Soils

Soil mapping units and Australian Soil Classification orders within the dataset buffer:

Map Unit Code	Soil Order	Map Unit Description	Distance
Pb12	Kurosol	Gently rolling to rounded hilly country with some steep slopes and broad valleys: chief soils are hard acidic red soils (Dr2.21) with hard neutral and acidic yellow mottled soils (Dy3.42 and Dy3.41) on lower slopes and in valleys. Associated are small areas of various soils including (Gn3.54) on some ridges, (Dr3.31) on some slopes; (Dr2.23) in saddles and some mid-slope positions, and some low- lying swampy areas of (Uf6) soils and (Uc1.2) soils with peaty surfaces. Small areas of other soils such as (Db1.2) are likely throughout.	0m
Pb13	Kurosol	Ridge and valley country of gently undulating ridge tops and steep side slopes often with slumping, also rounded hilly to steep hilly areas and relatively narrow valleys: chief soils are hard acidic red soils (Dr2.21) with hard acidic yellow mottled soils (Dy3.41); in places some ironstone gravels occur in both these soils. Associated are hard neutral and alkaline red soils (Dr2.22 and Dr2.23) in saddles and some mid-slope positions; (Dy3.42 and Dy3.43) soils, usually in depressions; and small areas of undescribed soils in wet soaks and valley areas. Small areas of other soils are likely throughout.	737m

Soil Landscapes

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Soils

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Soil Landscapes

What are the onsite Soil Landscapes?

Soil Code	Name	Group	Process	Map Sheet	Scale
ERlu	LUDDENHAM		EROSIONAL	Penrith	1:100,000
REbt	BLACKTOWN		RESIDUAL	Penrith	1:100,000

What are the Soil Landscapes within the dataset buffer?

Soil Code	Name	Group	Process	Map Sheet	Scale
ALsc	SOUTH CREEK		ALLUVIAL	Penrith	1:100,000
ERlu	LUDDENHAM		EROSIONAL	Penrith	1:100,000
REbt	BLACKTOWN		RESIDUAL	Penrith	1:100,000

Acid Sulfate Soils

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Environmental Planning Instrument - Acid Sulfate Soils

What is the on-site Acid Sulfate Soil Plan Class that presents the largest environmental risk?

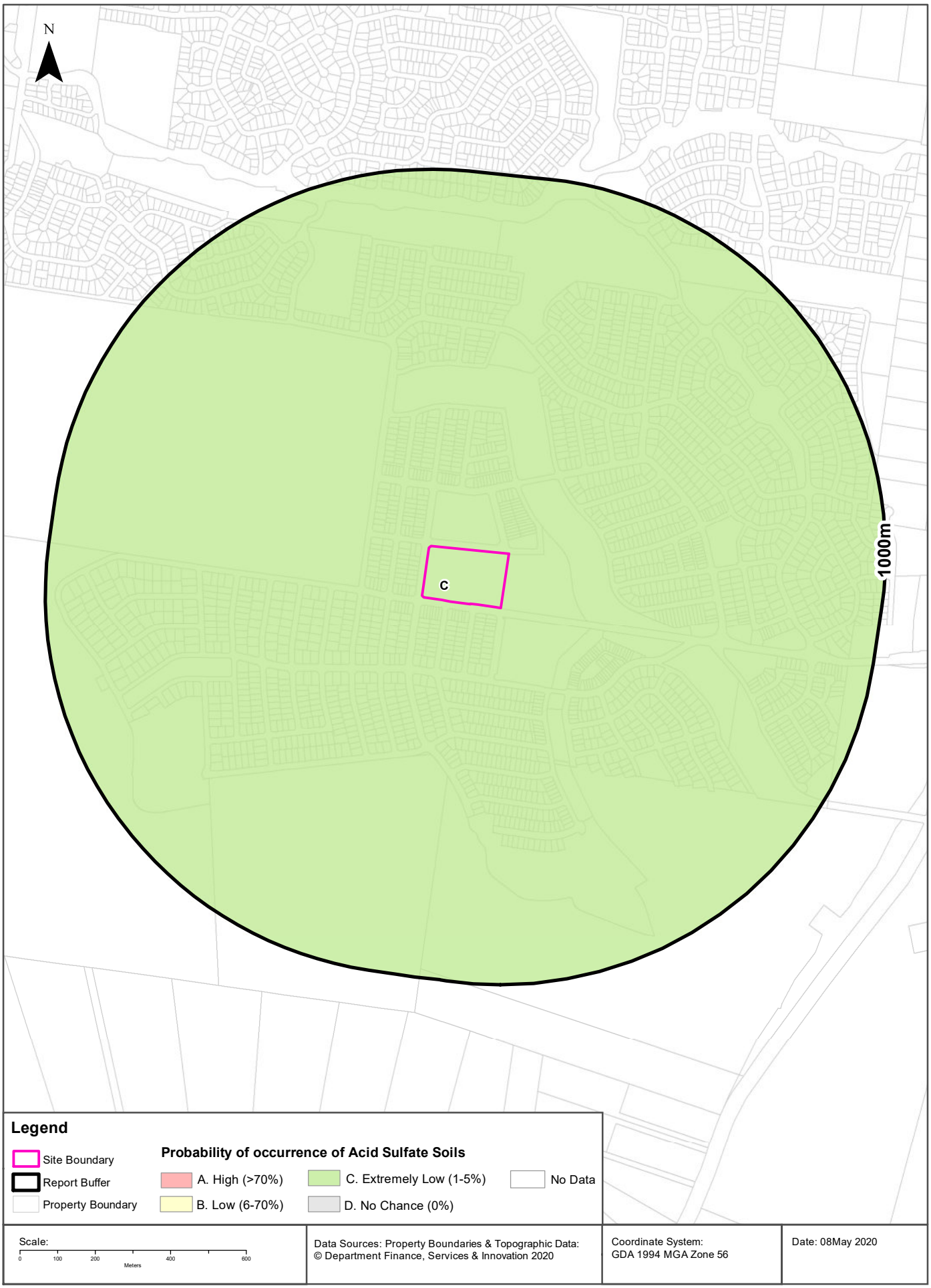
Soil Class	Description	EPI Name
N/A		

If the on-site Soil Class is 5, what other soil classes exist within 500m?

Soil Class	Description	EPI Name	Distance	Direction
N/A				

Atlas of Australian Acid Sulfate Soils

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Acid Sulfate Soils

1-23 Forestwood Drive, Glenmore Park, NSW 2745

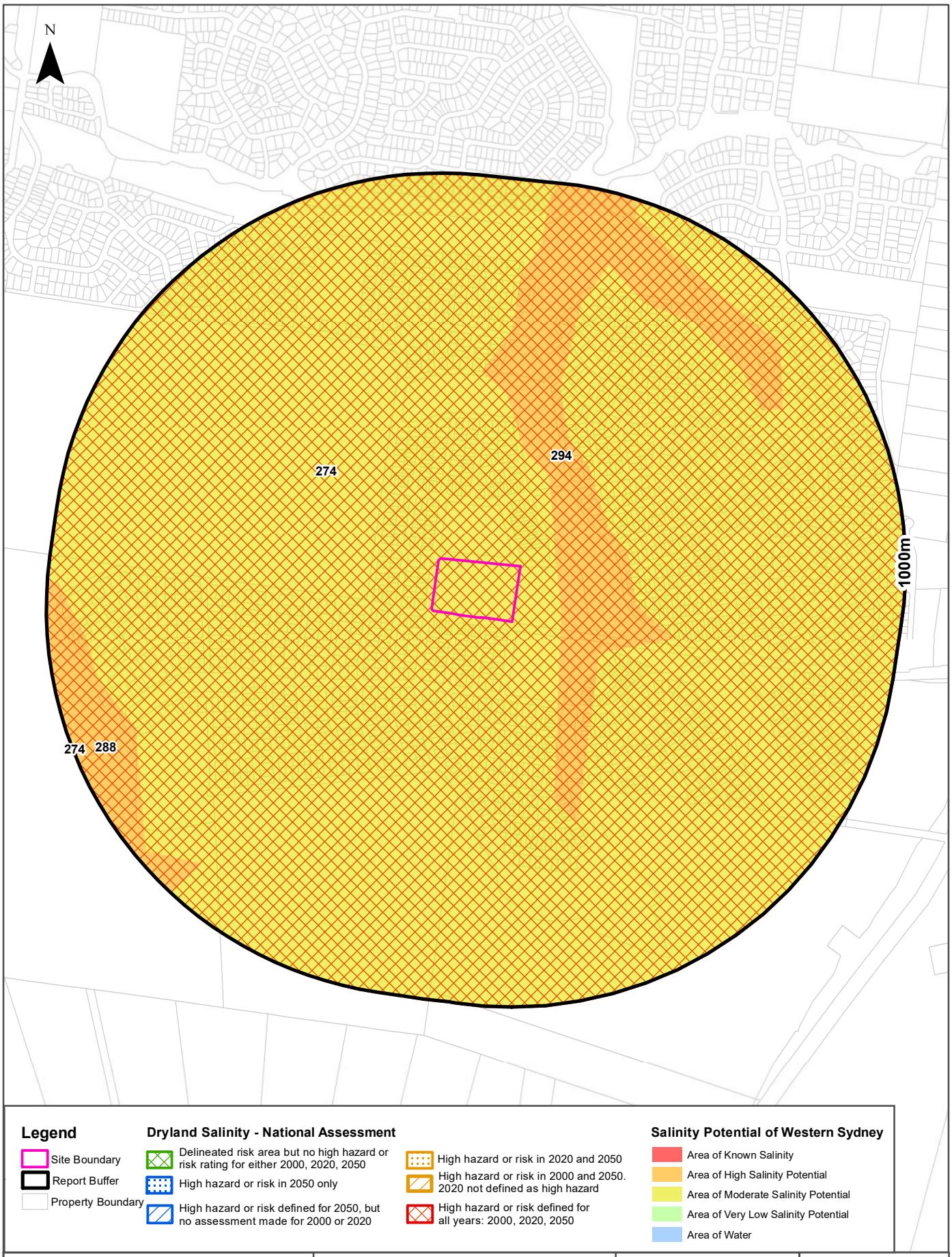
Atlas of Australian Acid Sulfate Soils

Atlas of Australian Acid Sulfate Soil categories within the dataset buffer:

Class	Description	Distance
C	Extremely low probability of occurrence. 1-5% chance of occurrence with occurrences in small localised areas.	0m

Dryland Salinity

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Dryland Salinity

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Dryland Salinity - National Assessment

Is there Dryland Salinity - National Assessment data onsite?

Yes

Is there Dryland Salinity - National Assessment data within the dataset buffer?

Yes

What Dryland Salinity assessments are given?

Assessment 2000	Assessment 2020	Assessment 2050	Distance	Direction
High hazard or risk	High hazard or risk	High hazard or risk	0m	Onsite

Dryland Salinity Data Source : National Land and Water Resources Audit
The Commonwealth and all suppliers of source data used to derive the maps of "Australia, Forecast Areas Containing Land of High Hazard or Risk of Dryland Salinity from 2000 to 2050" do not warrant the accuracy or completeness of information in this product. Any person using or relying upon such information does so on the basis that the Commonwealth and data suppliers shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information. Any persons using this information do so at their own risk.
In many cases where a high risk is indicated, less than 100% of the area will have a high hazard or risk.

Dryland Salinity Potential of Western Sydney

Dryland Salinity Potential of Western Sydney within the dataset buffer?

Feature Id	Classification	Description	Distance	Direction
274	MODERATE	Area of Moderate Salinity Potential	0m	Onsite
294	HIGH	Area of High Salinity Potential	95m	North East
288	HIGH	Area of High Salinity Potential	827m	South West

Dryland Salinity Potential of Western Sydney Data Source : NSW Office of Environment and Heritage

Mining Subsidence Districts

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Mining Subsidence Districts

Mining Subsidence Districts within the dataset buffer:

District	Distance	Direction
There are no Mining Subsidence Districts within the report buffer		

State Environmental Planning Policy

1-23 Forestwood Drive, Glenmore Park, NSW 2745

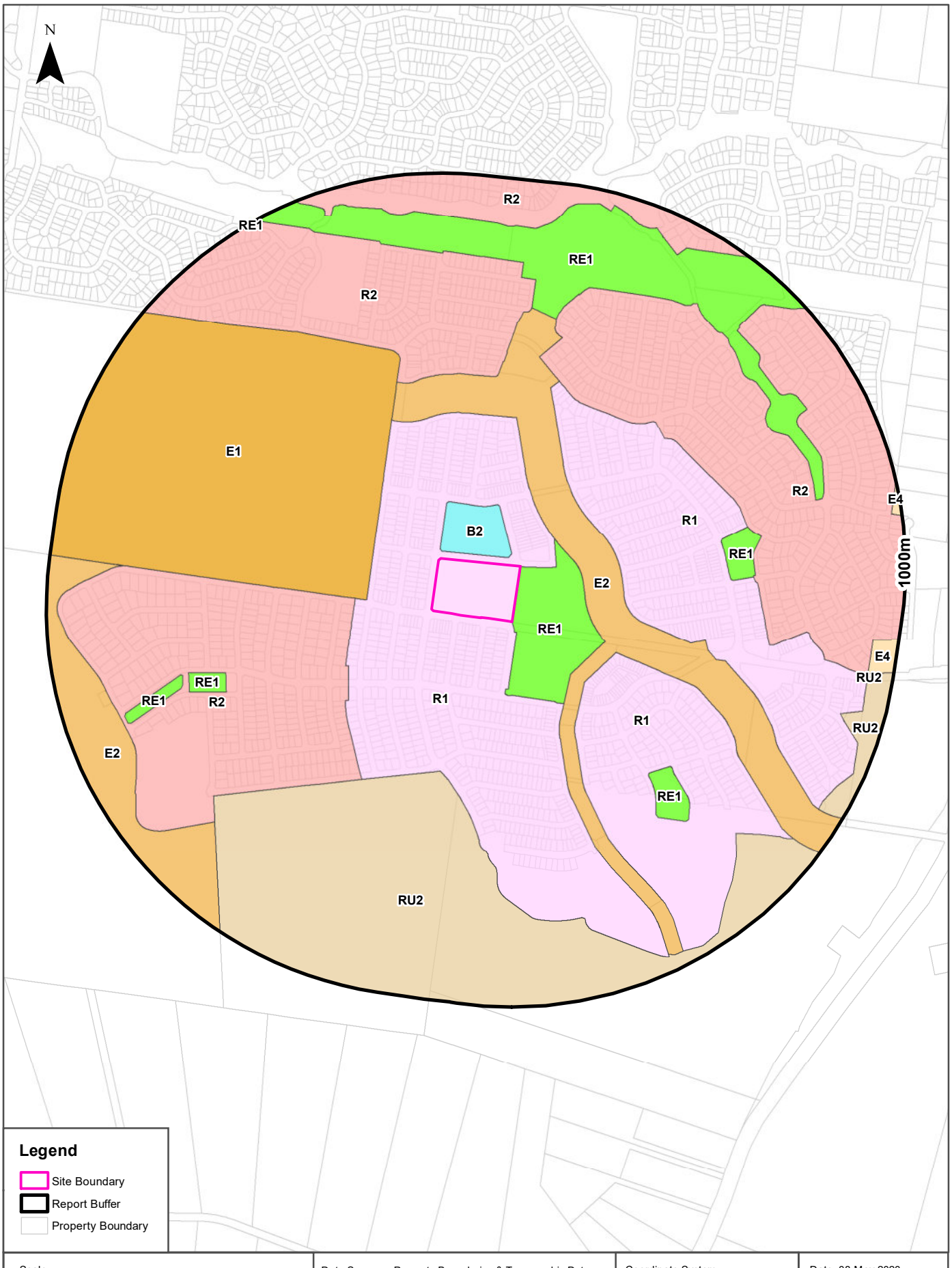
State Significant Precincts

What SEPP State Significant Precincts exist within the dataset buffer?

Map Id	Precinct	EPI Name	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
N/A	No Records in Buffer							

EPI Planning Zones

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Environmental Planning Instrument

1-23 Forestwood Drive, Glenmore Park, NSW 2745

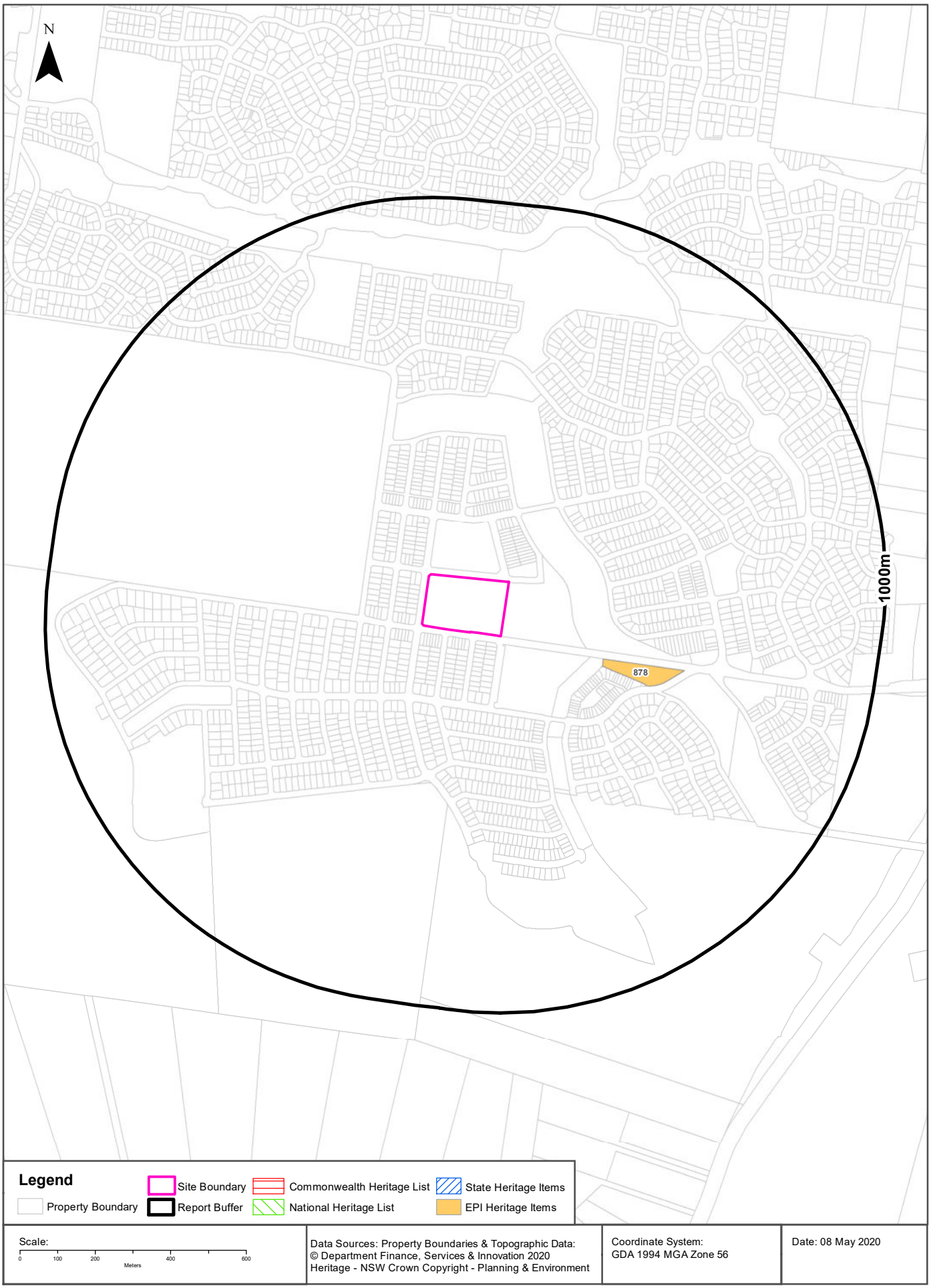
Land Zoning

What EPI Land Zones exist within the dataset buffer?

Zone	Description	Purpose	EPI Name	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
R1	General Residential		Penrith Local Environmental Plan 2010	20/12/2019	20/12/2019	20/12/2019	Amendment No 23	0m	Onsite
RE1	Public Recreation		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	0m	South East
B2	Local Centre		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	19m	North
E2	Environmental Conservation		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	114m	East
E1	National Parks and Nature Reserves		Penrith Local Environmental Plan 2010	22/09/2010	22/09/2010	20/12/2019		171m	West
R2	Low Density Residential		Penrith Local Environmental Plan 2010	20/12/2019	20/12/2019	20/12/2019	Amendment No 23	201m	West
R1	General Residential		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	215m	East
R1	General Residential		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	245m	South East
RU2	Rural Landscape		Penrith Local Environmental Plan 2010	27/09/2019	27/09/2019	20/12/2019	Amendment No 22	409m	South
R2	Low Density Residential		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	453m	North East
R2	Low Density Residential		Penrith Local Environmental Plan 2010	27/09/2019	27/09/2019	20/12/2019	Amendment No 22	463m	North
RE1	Public Recreation		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	525m	East
RE1	Public Recreation		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	530m	South East
RE1	Public Recreation		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	560m	West
RE1	Public Recreation		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	650m	North
RE1	Public Recreation		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	669m	West
E2	Environmental Conservation		Penrith Local Environmental Plan 2010	20/12/2019	20/12/2019	20/12/2019	Amendment No 23	788m	South West
RU2	Rural Landscape		Penrith Local Environmental Plan 2010	22/09/2010	22/09/2010	20/12/2019		885m	East
E4	Environmental Living		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	933m	East
RU2	Rural Landscape		Penrith Local Environmental Plan 2010	28/01/2015	25/02/2015	20/12/2019	Amendment No 4	933m	East

Heritage Items

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Heritage

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Commonwealth Heritage List

What are the Commonwealth Heritage List Items located within the dataset buffer?

Place Id	Name	Address	Place File No	Class	Status	Register Date	Distance	Direction
N/A	No records in buffer							

Heritage Data Source: Australian Government Department of the Environment and Energy - Heritage Branch
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National Heritage List

What are the National Heritage List Items located within the dataset buffer?
Note. Please click on Place Id to activate a hyperlink to online website.

Place Id	Name	Address	Place File No	Class	Status	Register Date	Distance	Direction
N/A	No records in buffer							

Heritage Data Source: Australian Government Department of the Environment and Energy - Heritage Branch
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State Heritage Register - Curtilages

What are the State Heritage Register Items located within the dataset buffer?

Map Id	Name	Address	LGA	Listing Date	Listing No	Plan No	Distance	Direction
N/A	No records in buffer							

Heritage Data Source: NSW Crown Copyright - Office of Environment & Heritage
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Environmental Planning Instrument - Heritage

What are the EPI Heritage Items located within the dataset buffer?

Map Id	Name	Classification	Significance	EPI Name	Published Date	Commenced Date	Currency Date	Distance	Direction
878	Scarred tree and Aboriginal artefact scatter	Item - General	Local	Penrith Local Environmental Plan 2010	20/12/2019	20/12/2019	20/12/2019	279m	East

Heritage Data Source: NSW Crown Copyright - Planning & Environment
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Natural Hazards - Bush Fire Prone Land

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Data Sources: Bush Fire Prone Land: © NSW Rural Fire Service 2020. Property Boundaries: © Department Finance, Services & Innovation 2020

Coordinate System: GDA 1994 MGA Zone 56

Date: 08 May 2020

Natural Hazards

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Bush Fire Prone Land

What are the nearest Bush Fire Prone Land Categories that exist within the dataset buffer?

Bush Fire Prone Land Category	Distance	Direction
Vegetation Buffer	13m	North East
Vegetation Category 1	113m	North East
Vegetation Category 2	169m	South East

Ecological Constraints - Remnant Vegetation of the Cumberland Plain

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Ecological Constraints

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Remnant Vegetation of the Cumberland Plain

What remnant vegetation of the Cumberland Plain exists within the dataset buffer?

Description	Crown Cover	Distance	Direction
11 - Alluvial Woodland	Crown cover less than 10%	126m	North East
10 - Shale Plains Woodland	Crown cover less than 10%	164m	East
9 - Shale Hills Woodland	Crown cover greater than 10%	186m	North West
11 - Alluvial Woodland	Crown cover greater than 10%	209m	North
9 - Shale Hills Woodland	Crown cover less than 10%	325m	East
10 - Shale Plains Woodland	Crown cover greater than 10%	509m	North

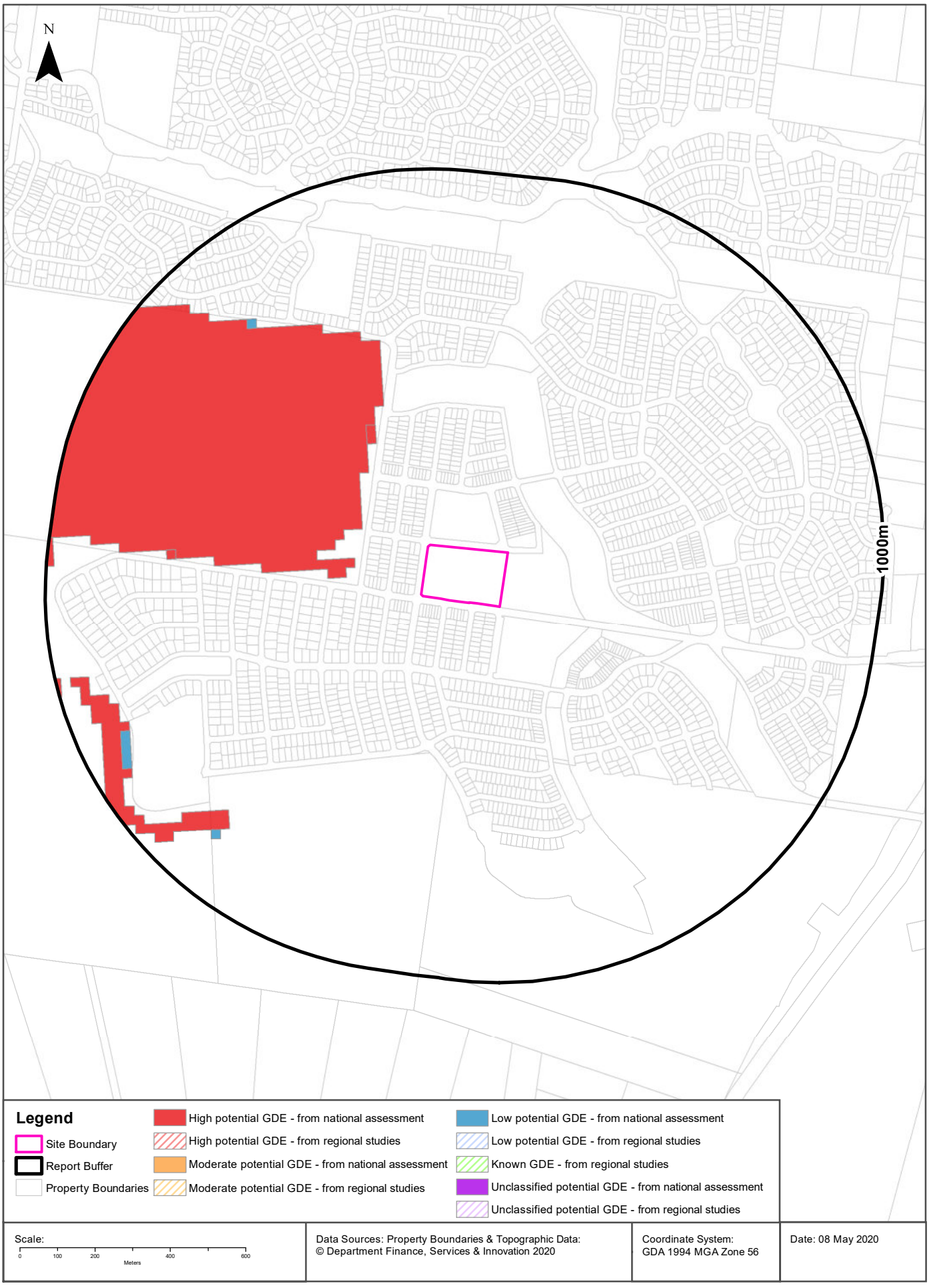
Ramsar Wetlands

What Ramsar Wetland areas exist within the dataset buffer?

Map Id	Ramsar Name	Wetland Name	Designation Date	Source	Distance	Direction
N/A	No records in buffer					

Ecological Constraints - Groundwater Dependent Ecosystems Atlas

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Ecological Constraints

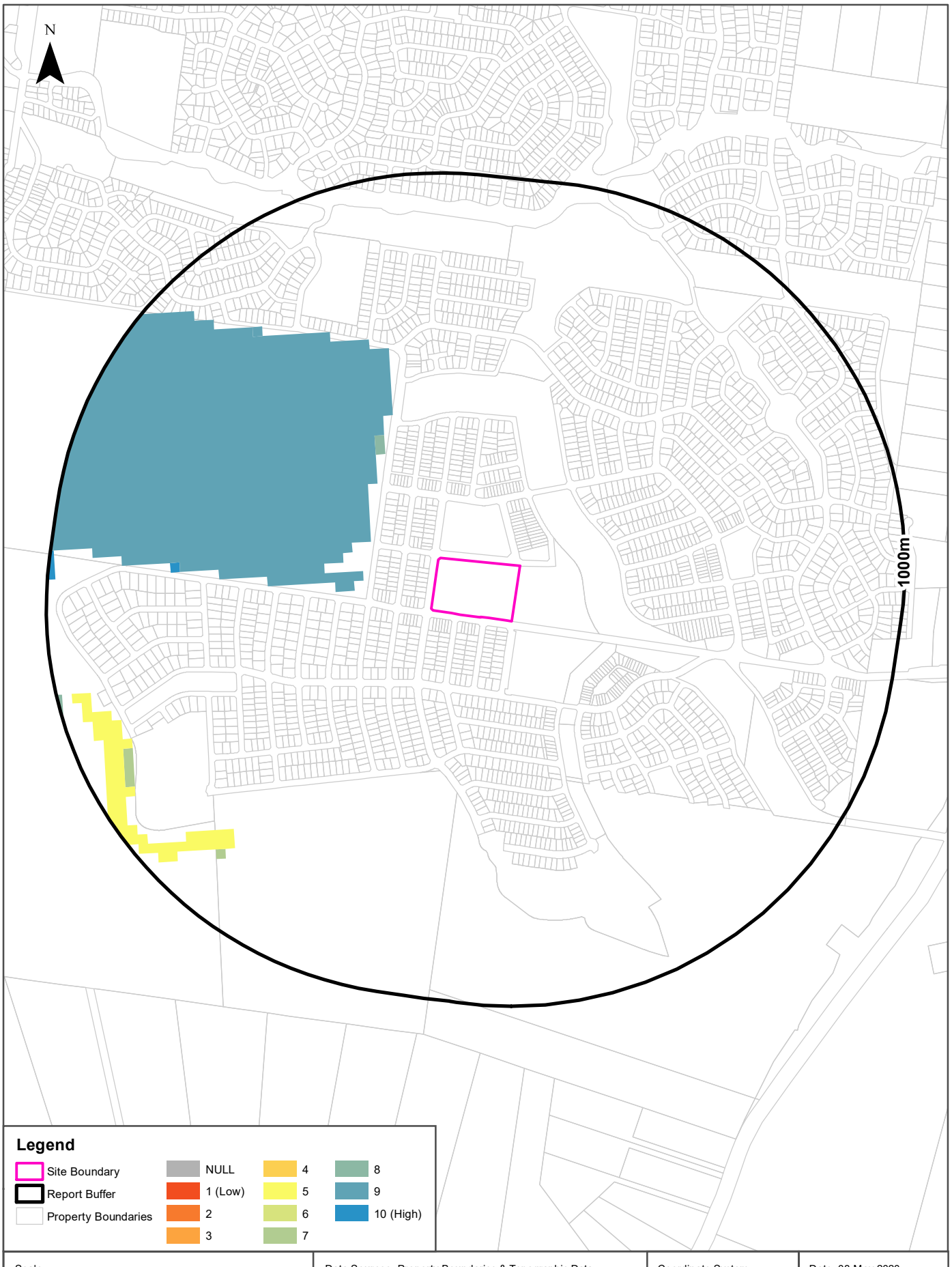
1-23 Forestwood Drive, Glenmore Park, NSW 2745

Groundwater Dependent Ecosystems Atlas

Type	GDE Potential	Geomorphology	Ecosystem Type	Aquifer Geology	Distance
Terrestrial	High potential GDE - from national assessment	Undulating to low hilly country, mainly on shale.	Vegetation	Consolidated sedimentary	179m
Terrestrial	Low potential GDE - from national assessment	Undulating to low hilly country, mainly on shale.	Vegetation	Consolidated sedimentary	737m

Ecological Constraints - Inflow Dependent Ecosystems Likelihood

1-23 Forestwood Drive, Glenmore Park, NSW 2745



Ecological Constraints

1-23 Forestwood Drive, Glenmore Park, NSW 2745

Inflow Dependent Ecosystems Likelihood

Type	IDE Likelihood	Geomorphology	Ecosystem Type	Aquifer Geology	Distance
Terrestrial	9	Undulating to low hilly country, mainly on shale.	Vegetation	Consolidated sedimentary	179m
Terrestrial	8	Undulating to low hilly country, mainly on shale.	Vegetation	Consolidated sedimentary	304m
Terrestrial	10	Undulating to low hilly country, mainly on shale.	Vegetation	Consolidated sedimentary	658m
Terrestrial	5	Undulating to low hilly country, mainly on shale.	Vegetation	Consolidated sedimentary	767m
Terrestrial	7	Undulating to low hilly country, mainly on shale.	Vegetation	Consolidated sedimentary	820m

Ecological Constraints

1-23 Forestwood Drive, Glenmore Park, NSW 2745

NSW BioNet Atlas

Species on the NSW BioNet Atlas that have a NSW or federal conservation status, a NSW sensitivity status, or are listed under a migratory species agreement, and are within 10km of the site?

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Amphibia	Heleioporus australiacus	Giant Burrowing Frog	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Amphibia	Litoria aurea	Green and Golden Bell Frog	Endangered	Not Sensitive	Vulnerable	
Animalia	Amphibia	Pseudophryne australis	Red-crowned Toadlet	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Actitis hypoleucos	Common Sandpiper	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Amaurornis moluccana	Pale-vented Bush-hen	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Anseranas semipalmata	Magpie Goose	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Anthochaera phrygia	Regent Honeyeater	Critically Endangered	Not Sensitive	Critically Endangered	
Animalia	Aves	Apus pacificus	Fork-tailed Swift	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Ardea ibis	Cattle Egret	Not Listed	Not Sensitive	Not Listed	CAMBA;JAMBA
Animalia	Aves	Ardenna tenuirostris	Short-tailed Shearwater	Not Listed	Not Sensitive	Not Listed	ROKAMBA;JAMBA
Animalia	Aves	Artamus cyanopterus cyanopterus	Dusky Woodswallow	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Botaurus poiciloptilus	Australasian Bittern	Endangered	Not Sensitive	Endangered	
Animalia	Aves	Burhinus grallarius	Bush Stone-curlew	Endangered	Not Sensitive	Not Listed	
Animalia	Aves	Calidris acuminata	Sharp-tailed Sandpiper	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo (inland subspecies)	Vulnerable	Category 2	Not Listed	
Animalia	Aves	Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	Category 2	Not Listed	
Animalia	Aves	Certhionyx variegatus	Pied Honeyeater	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Charadrius veredus	Oriental Plover	Not Listed	Not Sensitive	Not Listed	ROKAMBA;JAMBA
Animalia	Aves	Chthonicola sagittata	Speckled Warbler	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Daphoenositta chrysoptera	Varied Sittella	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Ephippiorhynchus asiaticus	Black-necked Stork	Endangered	Not Sensitive	Not Listed	
Animalia	Aves	Gallinago hardwickii	Latham's Snipe	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Glossopsitta pusilla	Little Lorikeet	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Haliaeetus leucogaster	White-bellied Sea-Eagle	Vulnerable	Not Sensitive	Not Listed	CAMBA

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Aves	Hieraaetus morphnoides	Little Eagle	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Hirundapus caudacutus	White-throated Needletail	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Ixobrychus flavicollis	Black Bittern	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Lathamus discolor	Swift Parrot	Endangered	Category 3	Critically Endangered	
Animalia	Aves	Limosa limosa	Black-tailed Godwit	Vulnerable	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Lophochroa leadbeateri	Major Mitchell's Cockatoo	Vulnerable	Category 2	Not Listed	
Animalia	Aves	Lophoictinia isura	Square-tailed Kite	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Merops ornatus	Rainbow Bee-eater	Not Listed	Not Sensitive	Not Listed	JAMBA
Animalia	Aves	Neophema pulchella	Turquoise Parrot	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Ninox connivens	Barking Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Ninox strenua	Powerful Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Numenius minutus	Little Curlew	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Petroica boodang	Scarlet Robin	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Petroica phoenicea	Flame Robin	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Pezoporus wallicus wallicus	Eastern Ground Parrot	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Phaethon lepturus	White-tailed Tropicbird	Not Listed	Not Sensitive	Not Listed	CAMBA;JAMBA
Animalia	Aves	Plegadis falcinellus	Glossy Ibis	Not Listed	Not Sensitive	Not Listed	CAMBA
Animalia	Aves	Pluvialis squatarola	Grey Plover	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Rostratula australis	Australian Painted Snipe	Endangered	Not Sensitive	Endangered	
Animalia	Aves	Stagonopleura guttata	Diamond Firetail	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Sterna hirundo	Common Tern	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Stictonetta naevosa	Freckled Duck	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Thinornis rubricollis	Hooded Plover	Critically Endangered	Not Sensitive	Vulnerable	
Animalia	Aves	Tringa glareola	Wood Sandpiper	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Tringa nebularia	Common Greenshank	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Tyto novaehollandiae	Masked Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Tyto tenebricosa	Sooty Owl	Vulnerable	Category 3	Not Listed	
Animalia	Gastropoda	Meridolum corneovirens	Cumberland Plain Land Snail	Endangered	Not Sensitive	Not Listed	
Animalia	Mammalia	Cercartetus nanus	Eastern Pygmy-possum	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Not Sensitive	Endangered	
Animalia	Mammalia	Dasyurus viverrinus	Eastern Quoll	Endangered	Not Sensitive	Endangered	
Animalia	Mammalia	Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	Not Sensitive	Not Listed	

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Mammalia	Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Miniopterus australis	Little Bent-winged Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Miniopterus orianae oceanensis	Large Bent-winged Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Myotis macropus	Southern Myotis	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Petauroides volans	Greater Glider	Not Listed	Not Sensitive	Vulnerable	
Animalia	Mammalia	Petaurus australis	Yellow-bellied Glider	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Petaurus norfolcensis	Squirrel Glider	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Petrogale penicillata	Brush-tailed Rock-wallaby	Endangered	Not Sensitive	Vulnerable	
Animalia	Mammalia	Phascolarctos cinereus	Koala	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Scoteanax rueppellii	Greater Broad-nosed Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Vespadelus troughtoni	Eastern Cave Bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Reptilia	Antaresia stimsoni	Stimson's Python	Vulnerable	Not Sensitive	Not Listed	
Animalia	Reptilia	Aspidites ramsayi	Woma	Vulnerable	Not Sensitive	Not Listed	
Animalia	Reptilia	Caretta caretta	Loggerhead Turtle	Endangered	Not Sensitive	Endangered	
Animalia	Reptilia	Chelonia mydas	Green Turtle	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Reptilia	Eulamprus leuraensis	Blue Mountains Water Skink	Endangered	Not Sensitive	Endangered	
Animalia	Reptilia	Hoplocephalus bungaroides	Broad-headed Snake	Endangered	Category 2	Vulnerable	
Animalia	Reptilia	Suta flagellum	Little Whip Snake	Vulnerable	Not Sensitive	Not Listed	
Animalia	Reptilia	Tiliqua occipitalis	Western Blue-tongued Lizard	Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Acacia pubescens	Downy Wattle	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Dillwynia tenuifolia		Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Eucalyptus benthamii	Camden White Gum	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Eucalyptus leucoxylon subsp. pruinosa	Yellow Gum	Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Eucalyptus nicholii	Narrow-leaved Black Peppermint	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Eucalyptus scoparia	Wallangarra White Gum	Endangered	Not Sensitive	Vulnerable	
Plantae	Flora	Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Hibbertia puberula		Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Isotoma fluviatilis subsp. fluviatilis		Not Listed	Not Sensitive	Extinct	
Plantae	Flora	Macadamia integrifolia	Macadamia Nut	Not Listed	Not Sensitive	Vulnerable	
Plantae	Flora	Macadamia tetraphylla	Rough-shelled Bush Nut	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Marsdenia viridiflora subsp. viridiflora	Native Pear	Endangered Population	Not Sensitive	Not Listed	

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Plantae	Flora	Melaleuca deanei	Deane's Paperbark	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Micromyrtus minutiflora		Endangered	Not Sensitive	Vulnerable	
Plantae	Flora	Persoonia hirsuta	Hairy Geebung	Endangered	Category 3	Endangered	
Plantae	Flora	Persoonia nutans	Nodding Geebung	Endangered	Not Sensitive	Endangered	
Plantae	Flora	Pimelea spicata	Spiked Rice-flower	Endangered	Not Sensitive	Endangered	
Plantae	Flora	Pterostylis chaetophora		Vulnerable	Category 2	Not Listed	
Plantae	Flora	Pterostylis saxicola	Sydney Plains Greenhood	Endangered	Category 2	Endangered	
Plantae	Flora	Pultenaea parviflora		Endangered	Not Sensitive	Vulnerable	
Plantae	Flora	Rhodamnia rubescens	Scrub Turpentine	Critically Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Senna acclinis	Rainforest Cassia	Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Syzygium paniculatum	Magenta Lilly Pilly	Endangered	Not Sensitive	Vulnerable	
Plantae	Flora	Tetratheca glandulosa		Vulnerable	Not Sensitive	Not Listed	

Data does not include NSW category 1 sensitive species.

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Where Lotsearch has had to georeference features from supplied addresses, a location confidence has been assigned to the data record. This indicates a confidence to the positional accuracy of the feature. Where applicable, a code is given under the field heading “LC” or “LocConf”. These codes lookup to the following location confidences:

LC Code	Location Confidence
Premise match	Georeferenced to the site location / premise or part of site
General area or suburb match	Georeferenced with the confidence of the general/approximate area
Road match	Georeferenced to the road or rail
Road intersection	Georeferenced to the road intersection
Feature is a buffered point	Feature is a buffered point
Land adjacent to geocoded site	Land adjacent to Georeferenced Site
Network of features	Georeferenced to a network of features

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Appendix C: Laboratory Results Summary Tables

ABBREVIATIONS AND EXPLANATIONS FOR SALINITY TABLES

Abbreviations used in the Tables:

Ca	Calcium
CEC	Cation Exchange Capacity
DO	Dissolved Oxygen
EC	Electrical Conductivity
ECe	Extract Electrical Conductivity
Eh	Redox Potential
ESP	Exchangeable Sodium Percentage (Each Na/CEC)
K	Potassium
Mg	Magnesium
Na	Sodium
SWL	Standing Water Level

Units used in the Tables

°C	Degrees Celsius
dS/m	deciSiemens per metre
m	meters
meq/100g	milliequivalents per 100 grams
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mV	millivolts
ohm.cm	ohm centimetre
µS/cm	microSiemens per centimetre

Notes on Specific Tables

SUMMARY OF SOIL LABORATORY RESULTS - EC and ECe

- The salinity Class has been adopted from 'Site Investigations for Urban Salinity' DLWC 2002.
- The chart function assumes an ECe value of 1.9 for values that are less than the practical quatitation limit.

SUMMARY OF RESISTIVITY CALCULATION ON SOIL EC RESULTS

- The resistivity values have been calculated on the laboratory EC values.
- The classification has been derived from the Australian Standard 2159-2009 Piling Design and Installation (Table 6.5.2 [A] & [C])
- Table 6.5.2 [A] of Australian Standard 2159-2009 recommends using a Moderate Exposure Classification for Steel Piles in Fresh Water - Soft Running Water

SUMMARY OF SOIL LABORATORY RESULTS - pH

- The pH Classification has been derived from the Australian Standard 2159-2009 Piling Design and Installation (Tables 6.4.2 [C] & 6.5.2 [C])
- Table 6.5.2 [A] of Australian Standard 2159-2009 recommends using a Moderate Exposure Classification for Steel Piles in Fresh Water - Soft Running Water

SUMMARY OF SOIL LABORATORY RESULTS - SULFATE & CHLORIDES

- The classification has been derived from the Australian Standard 2159-2009 Piling Design and Installation (Table 6.5.2 [A] & [C])
- The chart function assumes an concentration of 0.5mg/kg for values that are less than the practical quatitation limit.

SUMMARY OF SOIL LABORATORY RESULTS - CEC & ESP

- The Sodicity rating has been adopted from the publication 'Site Investigations for Urban Salinity' DLWC 2002.

SUMMARY OF GROUNDWATER LABORATORY RESULTS

- The classification has been derived from the Australian Standard 2159-2009 Piling Design and Installation (Table 6.5.2 [A] & [C]) .
- Table 6.4.2 [A] recommends using a Mild Exposure Classification for Concrete Piles in Fresh Water - Treat as in Soil Condition 'A'.
- Table 6.5.2 [A] recommends using a Moderate Exposure Classification for Steel Piles in Fresh Water - Soft Running Water.

TABLE A
SUMMARY OF SOIL LABORATORY RESULTS - EC and ECe

Borehole Number	Sample Depth (m)	Sample Description	EC (µS/cm)	ECe (dS/m)	Salinity Class
BH311	0-0.2	Fill: Clayey Silt	200	<2	NON SALINE
BH311	0-0.2	Laboratory Duplicate	200	<2	NON SALINE
BH311	0.8-1	Fill: Silty Clay	530	4.7	MODERATELY SALINE
BH311	1.3-1.5	Fill: Silty Clay	480	4.3	MODERATELY SALINE
BH311	2.8-3	Fill: Silty Clay	220	<2	NON SALINE
BH312	0-0.2	Fill: Silty Clay	98	<2	NON SALINE
BH312	0.8-1	Fill: Silty Clay	260	2.3	SLIGHTLY SALINE
BH312	1.3-1.5	Fill: Silty Clay	450	4	MODERATELY SALINE
BH312	2.8-3	Fill: Silty Clay	530	4.7	MODERATELY SALINE
BH314	0-0.2	Fill: Silty Gravelly Clay	160	<2	NON SALINE
BH314	0.8-1	Fill: Silty Clay	480	4.4	MODERATELY SALINE
BH314	1.3-1.5	Fill: Silty Clay	270	2.5	SLIGHTLY SALINE
BH314	1.3-1.5	Laboratory Duplicate	280	2.5	SLIGHTLY SALINE
BH314	2.8-3	Fill: Silty Clay	310	2.8	SLIGHTLY SALINE
BH315	0-0.2	Fill: Silty Clay	260	2.4	SLIGHTLY SALINE
BH315	0.8-1	Fill: Silty Clay	810	7.3	MODERATELY SALINE
BH315	1.8-2	Fill: Silty Clay	890	8	VERY SALINE
BH315	2.8-3	Fill: Silty Clay	960	7.7	MODERATELY SALINE
BH316	0-0.2	Fill: Silty Clay	120	<2	NON SALINE
BH316	0.8-1	Fill: Silty Clay	660	4.6	MODERATELY SALINE
BH316	1.3-1.5	Fill: Silty Clay	470	4.2	MODERATELY SALINE
BH316	2.8-3	Fill: Silty Clay	460	4.2	MODERATELY SALINE
BH317	0-0.2	Fill: Silty Clay	330	2.3	SLIGHTLY SALINE
BH317	0-0.2	Laboratory Duplicate	340	2.4	SLIGHTLY SALINE
BH317	0.8-1	Fill: Silty Clay	530	4.2	MODERATELY SALINE
BH317	1.3-1.5	Fill: Silty Clay	460	4.1	MODERATELY SALINE
BH317	2.8-3	Fill: Silty Clay	510	3.6	SLIGHTLY SALINE
BH319	0-0.2	Fill: Silty Gravelly Clay	440	3.1	SLIGHTLY SALINE
BH319	0.8-1	Fill: Silty Clay	420	3.8	SLIGHTLY SALINE
BH319	1.3-1.5	Fill: Silty Clay	450	4.1	MODERATELY SALINE
BH319	2.8-3	Fill: Silty Clay	390	3.5	SLIGHTLY SALINE
BH320	0-0.2	Fill: Silty Gravelly Clay	360	2.5	SLIGHTLY SALINE
BH320	0.8-1	Fill: Silty Clay	450	3.2	SLIGHTLY SALINE
BH320	1.3-1.5	Fill: Silty Clay	400	3.6	SLIGHTLY SALINE
BH320	1.3-1.5	Laboratory Duplicate	430	3.9	SLIGHTLY SALINE
BH320	2.8-3	Fill: Silty Clay	390	3.5	SLIGHTLY SALINE
Total Number of Samples			36	36	-
Minimum Value			98	<PQL	-
Maximum Value			960	8	

ECe Values (dS/m)	Salinity Class
<2	NON SALINE
2 to 4	SLIGHTLY SALINE
4 to 8	MODERATELY SALINE
8 to 16	VERY SALINE
>16	HIGHLY SALINE

TABLE B
SUMMARY OF RESISTIVITY CALCULATION ON SOIL EC RESULTS

Borehole Number	Sample Depth (m)	Sample Description	EC (µS/cm)	Resistivity (ohm.cm)	Classification Condition B
BH311	0-0.2	Fill: Clayey Silt	200	5,000	Non Aggressive
BH311	0-0.2	Laboratory Duplicate	200	5,000	Non Aggressive
BH311	0.8-1	Fill: Silty Clay	530	1,887	Mildly Aggressive
BH311	1.3-1.5	Fill: Silty Clay	480	2,083	Non Aggressive
BH311	2.8-3	Fill: Silty Clay	220	4,545	Non Aggressive
BH312	0-0.2	Fill: Silty Clay	98	10,204	Non Aggressive
BH312	0.8-1	Fill: Silty Clay	260	3,846	Non Aggressive
BH312	1.3-1.5	Fill: Silty Clay	450	2,222	Non Aggressive
BH312	2.8-3	Fill: Silty Clay	530	1,887	Mildly Aggressive
BH314	0-0.2	Fill: Silty Gravelly Clay	160	6,250	Non Aggressive
BH314	0.8-1	Fill: Silty Clay	480	2,083	Non Aggressive
BH314	1.3-1.5	Fill: Silty Clay	270	3,704	Non Aggressive
BH314	1.3-1.5	Laboratory Duplicate	280	3,571	Non Aggressive
BH314	2.8-3	Fill: Silty Clay	310	3,226	Non Aggressive
BH315	0-0.2	Fill: Silty Clay	260	3,846	Non Aggressive
BH315	0.8-1	Fill: Silty Clay	810	1,235	Mildly Aggressive
BH315	1.8-2	Fill: Silty Clay	890	1,124	Mildly Aggressive
BH315	2.8-3	Fill: Silty Clay	960	1,042	Mildly Aggressive
BH316	0-0.2	Fill: Silty Clay	120	8,333	Non Aggressive
BH316	0.8-1	Fill: Silty Clay	660	1,515	Mildly Aggressive
BH316	1.3-1.5	Fill: Silty Clay	470	2,128	Non Aggressive
BH316	2.8-3	Fill: Silty Clay	460	2,174	Non Aggressive
BH317	0-0.2	Fill: Silty Clay	330	3,030	Non Aggressive
BH317	0-0.2	Laboratory Duplicate	340	2,941	Non Aggressive
BH317	0.8-1	Fill: Silty Clay	530	1,887	Mildly Aggressive
BH317	1.3-1.5	Fill: Silty Clay	460	2,174	Non Aggressive
BH317	2.8-3	Fill: Silty Clay	510	1,961	Mildly Aggressive
BH319	0-0.2	Fill: Silty Gravelly Clay	440	2,273	Non Aggressive
BH319	0.8-1	Fill: Silty Clay	420	2,381	Non Aggressive
BH319	1.3-1.5	Fill: Silty Clay	450	2,222	Non Aggressive
BH319	2.8-3	Fill: Silty Clay	390	2,564	Non Aggressive
BH320	0-0.2	Fill: Silty Gravelly Clay	360	2,778	Non Aggressive
BH320	0.8-1	Fill: Silty Clay	450	2,222	Non Aggressive
BH320	1.3-1.5	Fill: Silty Clay	400	2,500	Non Aggressive
BH320	1.3-1.5	Laboratory Duplicate	430	2,326	Non Aggressive
BH320	2.8-3	Fill: Silty Clay	390	2,564	Non Aggressive
Total Number of Samples			36	36	-
Minimum Value			98	1,042	-
Maximum Value			960	10,204	-

Classification is based on Soil condition 'B' - low permeability soils (e.g. silts & clays) or all soils above groundwater.

Resistivity Values (ohm.cm)	Classification for Steel Piles
>5,000	Non-Aggressive
2,000 - 5,000	Non-Aggressive
1,000 - 2,000	Mildly Aggressive
<1,000	Moderately Aggressive

TABLE C
SUMMARY OF SOIL LABORATORY RESULTS - pH

Borehole Number	Sample Depth (m)	Sample Description	pH	Classification for Concrete Piles Condition B	Classification for Steel Piles Condition B
BH311	0-0.2	Fill: Clayey Silt	8.3	Non-Aggressive	Non-Aggressive
BH311	0-0.2	Laboratory Duplicate	8.3	Non-Aggressive	Non-Aggressive
BH311	0.8-1	Fill: Silty Clay	7.6	Non-Aggressive	Non-Aggressive
BH311	1.3-1.5	Fill: Silty Clay	8.4	Non-Aggressive	Non-Aggressive
BH311	2.8-3	Fill: Silty Clay	9.6	Non-Aggressive	Non-Aggressive
BH312	0-0.2	Fill: Silty Clay	8	Non-Aggressive	Non-Aggressive
BH312	0.8-1	Fill: Silty Clay	9	Non-Aggressive	Non-Aggressive
BH312	1.3-1.5	Fill: Silty Clay	8.3	Non-Aggressive	Non-Aggressive
BH312	2.8-3	Fill: Silty Clay	8.9	Non-Aggressive	Non-Aggressive
BH314	0-0.2	Fill: Silty Gravelly Clay	8.2	Non-Aggressive	Non-Aggressive
BH314	0.8-1	Fill: Silty Clay	9	Non-Aggressive	Non-Aggressive
BH314	1.3-1.5	Fill: Silty Clay	9.4	Non-Aggressive	Non-Aggressive
BH314	1.3-1.5	Laboratory Duplicate	9.4	Non-Aggressive	Non-Aggressive
BH314	2.8-3	Fill: Silty Clay	9.4	Non-Aggressive	Non-Aggressive
BH315	0-0.2	Fill: Silty Clay	8.3	Non-Aggressive	Non-Aggressive
BH315	0.8-1	Fill: Silty Clay	8.6	Non-Aggressive	Non-Aggressive
BH315	1.8-2	Fill: Silty Clay	8.7	Non-Aggressive	Non-Aggressive
BH315	2.8-3	Fill: Silty Clay	8.7	Non-Aggressive	Non-Aggressive
BH316	0-0.2	Fill: Silty Clay	8.3	Non-Aggressive	Non-Aggressive
BH316	0.8-1	Fill: Silty Clay	8.1	Non-Aggressive	Non-Aggressive
BH316	1.3-1.5	Fill: Silty Clay	8.6	Non-Aggressive	Non-Aggressive
BH316	2.8-3	Fill: Silty Clay	8	Non-Aggressive	Non-Aggressive
BH317	0-0.2	Fill: Silty Clay	9.1	Non-Aggressive	Non-Aggressive
BH317	0-0.2	Laboratory Duplicate	9.2	Non-Aggressive	Non-Aggressive
BH317	0.8-1	Fill: Silty Clay	8.6	Non-Aggressive	Non-Aggressive
BH317	1.3-1.5	Fill: Silty Clay	8.9	Non-Aggressive	Non-Aggressive
BH317	2.8-3	Fill: Silty Clay	8.9	Non-Aggressive	Non-Aggressive
BH319	0-0.2	Fill: Silty Gravelly Clay	8.6	Non-Aggressive	Non-Aggressive
BH319	0.8-1	Fill: Silty Clay	8.5	Non-Aggressive	Non-Aggressive
BH319	1.3-1.5	Fill: Silty Clay	9	Non-Aggressive	Non-Aggressive
BH319	2.8-3	Fill: Silty Clay	9	Non-Aggressive	Non-Aggressive
BH320	0-0.2	Fill: Silty Gravelly Clay	8.4	Non-Aggressive	Non-Aggressive
BH320	0.8-1	Fill: Silty Clay	8.3	Non-Aggressive	Non-Aggressive
BH320	1.3-1.5	Fill: Silty Clay	8.9	Non-Aggressive	Non-Aggressive
BH320	1.3-1.5	Laboratory Duplicate	8.9	Non-Aggressive	Non-Aggressive
BH320	2.8-3	Fill: Silty Clay	8.8	Non-Aggressive	Non-Aggressive
Total Number of Samples			36	-	-
Minimum Value			7.6	-	-
Maximum Value			9.6	-	-

Classification is based on Soil condition 'B' - low permeability soils (e.g. silts & clays) or all soils above groundwater.

pH Value	Classification for Concrete Piles
>5.5	Non-Aggressive
4.5 - 5.5	Mildly Aggressive
4 - 4.5	Moderately Aggressive
<4	Severely Aggressive

pH Value	Classification for Steel Piles
>5	Non-Aggressive
4.0 - 5.0	Non-Aggressive
3.0 - 4.0	Mildly Aggressive
<3	Moderately Aggressive

TABLE D
SUMMARY OF SOIL LABORATORY RESULTS - SULPHATE & CHLORIDES

Borehole Number	Sample Depth (m)	Sample Description	Chloride (mg/kg)	Sulphate (mg/kg)	Classification for Concrete Piles Sulfate - Condition B	Classification for Steel Piles Chloride - Condition B
BH311	0-0.2	Fill: Clayey Silt	110	76	Non-Aggressive	Non-Aggressive
BH311	0-0.2	Laboratory Duplicate	100	75	Non-Aggressive	Non-Aggressive
BH311	0.8-1	Fill: Silty Clay	370	270	Non-Aggressive	Non-Aggressive
BH311	1.3-1.5	Fill: Silty Clay	210	390	Non-Aggressive	Non-Aggressive
BH311	2.8-3	Fill: Silty Clay	68	81	Non-Aggressive	Non-Aggressive
BH312	0-0.2	Fill: Silty Clay	27	34	Non-Aggressive	Non-Aggressive
BH312	0.8-1	Fill: Silty Clay	77	87	Non-Aggressive	Non-Aggressive
BH312	1.3-1.5	Fill: Silty Clay	260	210	Non-Aggressive	Non-Aggressive
BH312	2.8-3	Fill: Silty Clay	250	290	Non-Aggressive	Non-Aggressive
BH314	0-0.2	Fill: Silty Gravelly Clay	69	38	Non-Aggressive	Non-Aggressive
BH314	0.8-1	Fill: Silty Clay	230	330	Non-Aggressive	Non-Aggressive
BH314	1.3-1.5	Fill: Silty Clay	58	100	Non-Aggressive	Non-Aggressive
BH314	1.3-1.5	Laboratory Duplicate	61	100	Non-Aggressive	Non-Aggressive
BH314	2.8-3	Fill: Silty Clay	76	99	Non-Aggressive	Non-Aggressive
BH315	0-0.2	Fill: Silty Clay	130	84	Non-Aggressive	Non-Aggressive
BH315	0.8-1	Fill: Silty Clay	820	220	Non-Aggressive	Non-Aggressive
BH315	1.8-2	Fill: Silty Clay	1000	160	Non-Aggressive	Non-Aggressive
BH315	2.8-3	Fill: Silty Clay	990	220	Non-Aggressive	Non-Aggressive
BH316	0-0.2	Fill: Silty Clay	23	20	Non-Aggressive	Non-Aggressive
BH316	0.8-1	Fill: Silty Clay	450	390	Non-Aggressive	Non-Aggressive
BH316	1.3-1.5	Fill: Silty Clay	240	320	Non-Aggressive	Non-Aggressive
BH316	2.8-3	Fill: Silty Clay	320	300	Non-Aggressive	Non-Aggressive
BH317	0-0.2	Fill: Silty Clay	160	82	Non-Aggressive	Non-Aggressive
BH317	0-0.2	Laboratory Duplicate	160	82	Non-Aggressive	Non-Aggressive
BH317	0.8-1	Fill: Silty Clay	320	270	Non-Aggressive	Non-Aggressive
BH317	1.3-1.5	Fill: Silty Clay	180	330	Non-Aggressive	Non-Aggressive
BH317	2.8-3	Fill: Silty Clay	210	320	Non-Aggressive	Non-Aggressive
BH319	0-0.2	Fill: Silty Gravelly Clay	190	300	Non-Aggressive	Non-Aggressive
BH319	0.8-1	Fill: Silty Clay	250	260	Non-Aggressive	Non-Aggressive
BH319	1.3-1.5	Fill: Silty Clay	250	140	Non-Aggressive	Non-Aggressive
BH319	2.8-3	Fill: Silty Clay	240	110	Non-Aggressive	Non-Aggressive
BH320	0-0.2	Fill: Silty Gravelly Clay	160	240	Non-Aggressive	Non-Aggressive
BH320	0.8-1	Fill: Silty Clay	260	270	Non-Aggressive	Non-Aggressive
BH320	1.3-1.5	Fill: Silty Clay	220	220	Non-Aggressive	Non-Aggressive
BH320	1.3-1.5	Laboratory Duplicate	220	250	Non-Aggressive	Non-Aggressive
BH320	2.8-3	Fill: Silty Clay	240	180	Non-Aggressive	Non-Aggressive
Total Number of Samples			36	36	-	-
Minimum Value			23	20	-	-
Maximum Value			1000	390	-	-

Classification is based on Soil condition 'B' - low permeability soils (e.g. silts & clays) or all soils above groundwater.

Sulfate Values	Classification for Concrete Piles
<5,000	Non-Aggressive
5,000 - 10,000	Mildly Aggressive
10,000 - 20,000	Moderately Aggressive
>20,000	Severely Aggressive

Chloride Values	Classification for Steel Piles
<5,000	Non-Aggressive
5,000 - 20,000	Non-Aggressive
20,000 - 50,000	Mildly Aggressive
>50,000	Moderately Aggressive

TABLE E
SUMMARY OF SOIL LABORATORY RESULTS - CEC & ESP

Borehole Number	Sample Depth (m)	Sample Description	Exchangeable Ca	Exchangeable K	Exchangeable Mg	Exchangeable Na	CEC	ESP	Ca:Mg
			(meq/100g)					%	
BH311	0-0.2	Fill: Clayey Silt	8.8	0.5	9	1.2	19	6.3%	0.98
BH311	0-0.2	Laboratory Duplicate	9.2	0.5	9.4	1.2	20	6.0%	0.98
BH312	0.8-1	Fill: Silty Clay	14	0.4	7.6	0.72	23	3.1%	1.84
BH314	1.3-1.5	Fill: Silty Clay	16	0.6	6.5	0.52	23	2.3%	2.46
BH315	0-0.2	Fill: Silty Clay	10	0.4	7.6	0.5	19	2.6%	1.32
BH316	0.8-1	Fill: Silty Clay	9.9	0.4	8	0.63	19	3.3%	1.24
BH317	1.3-1.5	Fill: Silty Clay	16	0.4	7.7	0.64	25	2.6%	2.08
BH319	0-0.2	Fill: Silty Gravelly Clay	17	0.4	7.1	0.7	25	2.8%	2.39
BH320	0.8-1	Fill: Silty Clay	9.4	0.3	7.6	0.84	18	4.7%	1.24
Total Number of Samples			9	9	9	9	9	9	9
Minimum Value			8.80	0.30	6.50	0.50	18.0	2.3%	0.98
Maximum Value			17.00	0.60	9.40	1.20	25.0	6.3%	2.46

ESP Value	Sodicity Rating
< 5%	Non-Sodic
5% to 15%	Sodic
> 15%	Highly Sodic

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TABLE F
SUMMARY OF GROUNDWATER LABORATORY RESULTS

Sample Reference	Field Measurements						Laboratory Results				Classification for Concrete Piles Soil Condition B	Classification for Steel Piles Soil Condition B
	SWL (m)	pH	EC (µS/cm)	Temp (°C)	Eh (mV)	DO (mg/L)	pH	EC (µS/cm)	Sulfate (mg/L)	Chloride (mg/L)		
MW8	2	6.9	4,769	19	-99.5	0.5	7.1	5,700	630	590	Non-Aggressive	Non-Aggressive
MW311	1.49	6.6	11,688	19	-97.7	1.3	6.8	14,000	2,200	2,900	Non-Aggressive	Non-Aggressive
MW317	2.39	7.1	6,574	20.8	-102.6	0.8	7.3	7,400	710	1,300	Non-Aggressive	Non-Aggressive
Total Number of Samples	3	3	3	3	3	3	3	3	3	3	-	-
Minimum Value	1.49	6.6	4,769	19	-102.6	0.5	6.8	5,700	630	590	-	-
Maximum Value	2.39	7.1	11,688	20.8	-97.7	1.3	7.3	14,000	2,200	2,900	-	-

Exposure Classification for Concrete Piles

Classification is based on Soil condition 'B' - low permeability soils (e.g. silts and clays) or all soils above groundwater.

pH	Sulfate (mg/L)	Chloride (mg/L)	Classification B
> 5.5	<1,000	<6,000	Non-Aggressive
4.5 - 5.5	1,000 - 3,000	6,000 - 12,000	Mildly Aggressive
4.0 - 4.5	3,000 - 10,000	12,000 - 30,000	Moderately Aggressive
< 4	>10,000	>30,000	Severely Aggressive

Exposure Classification for Steel Piles

Classification is also based on Soil condition 'B' - low permeability soils (e.g. silts and clays) or all soils above groundwater.

pH	Chloride (mg/L)	Classification B
> 5	<1,000	Non-Aggressive
4.0 - 5.0	1,000 - 10,000	Non-Aggressive
3.0 - 4.0	10,000 - 20,000	Mildly Aggressive
<3	>20,000	Moderately Aggressive

Appendix D: Background on Salinity

Background on Salinity

A. General Information on Salinity

Salinity is the accumulation and concentration of salt at or near the ground surface or within surface water bodies. Salt is naturally present in the landscape through deposition of salt from the ocean in coastal areas and through weathering of bedrock that contains salt, accumulated during deposition of original sediments in a prehistoric marine environment. The salts are commonly soluble chlorides, sulphates or carbonates of sodium and magnesium.

In Sydney, salinity issues are typically associated with the Wianamatta Group shales and their derived soil landscapes. The natural vegetation of western Sydney is dominated by large isolated trees with deep root systems that remove subsurface moisture. Slow rates of percolation through the relatively impermeable clay soil and uptake of a large proportion of rainfall by the trees results in limited recharge of the groundwater system by rainfall. The depth to groundwater has developed a natural equilibrium and there is little tendency for salt contained in the groundwater or subsoils to rise to the surface.

B. Salinity and Urban Development

Salinity becomes a problem in urban areas when changes in the land use result in changes to the way water moves through the environment. This can result in vegetation die-back, decrease in water quality and damage to urban infrastructure.

Removal of deep rooted tree species during development and replacement with urban infrastructure, houses and industrial developments reduces the mechanism for the removal of subsurface moisture.

The development of urban salinity is commonly associated with changes in the hydrological cycle through the environment (rainfall, surface run-off, water infiltration and groundwater system). An increase in the quantity of water reaching the groundwater table as a result of vegetation clearance, irrigation of parklands, leaking water infrastructure and changes in drainage patterns, can cause a relatively rapid rise in the groundwater table. Earthworks that include excavation of natural soil profiles and exposure of more saline subsurface soils or shale bedrock may also result in an increase in salt concentrations at the ground surface.

Construction of roads, pipelines and buildings commonly results in removal of topsoil leading to exposure of the subsoils and interception of surficial and shallow subsurface drainage. In addition, over-irrigation of urban gardens, leaking water infrastructure and concentrated drainage patterns can result in increased water movement through the subsoil to the groundwater system leading to a relatively rapid rise in the groundwater table.

A rise in groundwater levels and impediments to subsurface drainage patterns can transport salt formerly stored in the bedrock to the surficial soil profile. This may result in salt encrustation of exposed soils, building foundations, roads, drainage infrastructure and corrosion of metal, concrete and other building materials. Increasing salt concentrations in surficial soils (and consequently in surface waters) may also result in die-off

of the existing vegetation, further reducing the hydrological load on the groundwater system and resulting in further groundwater table rises.

C. Potential Salinity Impacts on Urban Development

Some of the adverse impacts that can arise from saline conditions include:

- Salt scalds caused by a rise in the subsoil moisture content that mobilises salt to the ground surface;
- Salt scalds caused by modification of former drainage patterns which leads to the day lighting of subsurface seepage (either perched water or groundwater) in areas lower in the catchment, either at breaks in the slope or within drainage lines;
- A rise in groundwater table or accumulation of salt rich seepage leading to corrosion of subsurface facilities including concrete structures, metal pipework, cables, foundations, underground services, etc;
- Rising damp, where salt rich moisture is drawn into building and pavement materials by capillary action leading to deterioration of brick, mortar and concrete;
- Structural cracking, damage or building collapse which may occur as a result of shifting and or sinking foundations;
- Plant die-back associated with a rise in groundwater table level that mobilises excess salt to the plant root zone; and
- Subsurface water discharge and subsequent pollution of streams and drainage channels.

D. Soils and Groundwater Planning Strategy in Western Sydney

The aim of the DLWC 2002 document is to provide a framework for the sustainable development and management of new developments in the western region of Sydney. In relation to salinity management, the development should be designed and constructed such that there is no significant increase in the water table level and no adverse salinity impacts.

The proposed development controls that relate to soils and groundwater issues are summarised below:

1. A water management strategy should be prepared to address the following:
    - Reduction of potable water usage onsite;
    - Development of best practice measures for stormwater reuse for open space irrigation;
    - Reduction of potable water demand;
    - Reduction of adverse impacts on local groundwater regimes;
    - Reduction of change in local flow regimes; and
    - Preparation of water maintenance and a monitoring management system.
2. A salinity management plan should be prepared that includes a groundwater management strategy related to:
    - Adoption of small landscaped areas to reduce irrigation requirements;
    - Use of native and other low water requirement plants;
    - Use of mulch cover (not in drainage lines);
    - Use of low flow watering facilities for landscaped areas;
    - Implementation of a tree planting program, especially in high recharge areas, of native, deep rooted, large growing species to assist retention of the groundwater at existing levels;

- Retention of existing native tree cover where possible; and
- Not permitting infiltration pits or tanks to disperse surface water.

3. An assessment of soil and rock conditions at the site, including erosion, expansive and dispersive soil conditions, and plant growth potential should be undertaken.
4. Use of the Blue Book (2004) as a guide to prepare soil and water management plans. The approved plan and subsequent works are to be supervised by appropriately qualified experienced personnel.

Appendix E: Borehole Logs

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH311 1/1

SDUP308: 0-0.2m

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED PUBLIC SCHOOL

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Job No.: E33177P **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 13/10/20 **Datum:** -

Plant Type: JK500 **Logged/Checked by:** C.R./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
							0			FILL: Clayey silt, low to medium plasticity, brown, trace of igneous gravel and root fibres.	w<PL			
						N = 27 8,12,15	1			FILL: Silty clay, low to medium plasticity, dark brown mottled orange and red brown, trace of siltstone gravel.				
						N = 17 18,16,11	2			FILL: Silty clay, low to medium plasticity, dark grey and dark orange brown, trace of siltstone gravel.				
										FILL: Silty clay, low to medium plasticity, light grey, trace of siltstone gravel.				
						N = 14 3,7,7	3			FILL: Silty clay, low to medium plasticity, dark brown and orange brown, trace of siltstone gravel.				
5 MINS AFTER COMPLET-ION OF AUGERING ▼							4			FILL: Silty clay, low to medium plasticity, brown, trace of siltstone gravel and brick fragments.	w≈PL			GROUNDWATER MONITORING WELL INSTALLED TO 5.0m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 2.0m TO 5.0m. CASING 0.1m TO 2.0m. 2mm SAND FILTER PACK 1.5m TO 5.0m. BENTONITE SEAL 0.1m TO 1.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
							5			END OF BOREHOLE AT 5.0m				
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH312** **1/1**

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED PUBLIC SCHOOL

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Job No.: E33177P **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 13/10/20 **Datum:** -

Plant Type: JK500 **Logged/Checked by:** C.R./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION							0			FILL: Silty clay, low to medium plasticity, brown, trace of siltstone gravel and root fibres.	w<PL			
						N = 20 10,11,9				FILL: Silty clay, low to medium plasticity, grey mottled dark orange brown, with siltstone gravel.				
							1							
						N = 17 7,9,8				FILL: Silty clay, low to medium plasticity, brown and grey brown, trace of ironstone and siltstone gravel.				
							2							
						N = 12 4,5,7	3			FILL: Gravel, fine to coarse grained, angular, dark grey, siltstone.	D			INSUFFICIENT RETURN
										FILL: Silty clay, low to medium plasticity, brown and grey brown, trace of siltstone gravel.	w<PL			INSUFFICIENT RETURN
							4			END OF BOREHOLE AT 3.45m				
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH314 1/1

SDUP309: 0-0.2m

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED PUBLIC SCHOOL

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Job No.: E33177P **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 13/10/20 **Datum:** -

Plant Type: JK500 **Logged/Checked by:** C.R./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION							0			FILL: Silty gravelly clay, low to medium plasticity, brown, fine to medium grained ironstone gravel, trace of root fibres.	w<PL			
						N = 29 14,14,15	1			FILL: Silty clay, low to medium plasticity, brown and red brown, trace of siltstone gravel.				
						N = 12 3,5,7	2			FILL: Silty clay, low to medium plasticity, brown and dark brown, trace of siltstone gravel, and plastic fragments.				
						N = 18 6,7,11	3			FILL: Clayey gravel, fine to coarse grained, angular, grey, siltstone.	D			
										END OF BOREHOLE AT 3.45m				
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH315 1/1

SDUP310: 0-0.2m

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED PUBLIC SCHOOL

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Job No.: E33177P **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 13/10/20 **Datum:** -

Plant Type: JK500 **Logged/Checked by:** C.R./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION							0			FILL: Silty clay, low to medium plasticity, brown, trace of siltstone gravel and root fibres.	w<PL			
						N = 26 5,9,17	1			FILL: Silty clay, low to medium plasticity, light grey and brown, trace of igneous and siltstone gravel.				
						N = 18 11,11,7	2			FILL: Silty clay, low to medium plasticity, dark orange brown mottled red brown and grey, trace of ironstone and siltstone gravel and root fibres.				
						N = 16 10,6,10	3			FILL: Silty clay, medium plasticity, brown and grey brown, trace of siltstone gravel.	w≈PL			
										FILL: Silty clay, medium plasticity, grey brown, trace of siltstone gravel.				
										END OF BOREHOLE AT 3.45m				
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH316** **1/1**

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED PUBLIC SCHOOL

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Job No.: E33177P **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 13/10/20 **Datum:** -

Plant Type: JK500 **Logged/Checked by:** C.R./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION							0			FILL: Silty clay, low to medium plasticity, light brown and grey, trace of siltstone gravel and root fibres.	w<PL			INSUFFICICENT RETURN
						N = 14 6,7,7				FILL: Silty clay, low to medium plasticity, light brown and grey brown, trace of siltstone gravel.				
							1			FILL: Silty clay, low to medium plasticity, brown and orange brown, trace of ironstone gravel.				
						N = 23 8,9,14				FILL: Silty clay, low to medium plasticity, brown mottled red brown and orange brown, trace of siltstone gravel.				
							2							
										FILL: Silty clay, low to medium plasticity, brown, trace of siltstone gravel.				
						N = 22 6,8,14	3			FILL: Silty clay, low to medium plasticity, light grey, with siltstone gravel.				
										END OF BOREHOLE AT 3.45m				
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH317 1/1

SDUP307: 0-0.2m

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED PUBLIC SCHOOL

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Job No.: E33177P **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 13/10/20 **Datum:** -

Plant Type: JK500 **Logged/Checked by:** C.R./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	■		■	■			0			FILL: Silty clay, low to medium plasticity, red brown and grey brown, trace of igneous and siltstone gravel.	w<PL			
						N = 12 4,5,7	1			FILL: Silty clay, low to medium plasticity, red brown and dark orange brown, trace of siltstone gravel.				
				■										
						N = 16 4,6,10				FILL: Silty clay, low to medium plasticity, dark brown and dark grey, with siltstone gravel.				
	■		■				2			FILL: Gravelly sand, fine to medium grained, light grey, fine to medium grained igneous gravel.	D			POSSIBLE ROADBASE
	■		■							FILL: Silty clay, low to medium plasticity, grey brown, trace of igneous, ironstone and siltstone gravel.	w<PL			
						N = 13 4,5,8	3			FILL: Silty clay, low to medium plasticity, red brown, trace of siltstone gravel.				
▼ ON COMPLET-ION OF AUGERING	■		■				4			FILL: Silty clay, low to medium plasticity, brown, trace of siltstone gravel.				GROUNDWATER MONITORING WELL INSTALLED TO 6.0m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 2.0m TO 6.0m. CASING 0.1m TO 2.0m. 2mm SAND FILTER PACK 1.5m TO 6.0m. BENTONITE SEAL 0.1m TO 1.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
							5			FILL: Sandstone cobbles, yellow brown.	D			MODERATE 'TC' BIT RESISTANCE
										FILL: Silty gravelly clay, low to medium plasticity, dark brown and dark grey, fine to medium grained siltstone gravel.	w≈PL			
							6			END OF BOREHOLE AT 6.0m				
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH319** **1/1**

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED PUBLIC SCHOOL

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Job No.: E33177P **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 13/10/20 **Datum:** -

Plant Type: JK500 **Logged/Checked by:** C.R./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION							0			FILL: Silty gravelly clay, low to medium plasticity, brown, fine to medium grained siltstone gravel.	w<PL			
						N = 22 6,12,10				FILL: Silty clay, low to medium plasticity, brown and grey, with siltstone gravel.				
							1			FILL: Silty clay, low to medium plasticity, brown, with sandstone gravel, trace of siltstone gravel.				
										FILL: Silty clay, low to medium plasticity, brown mottled red brown and grey, trace of siltstone gravel.				
						N = 22 6,8,14				FILL: Silty clay, low to medium plasticity, brown and grey brown, trace of siltstone gravel.				
							2							
						N = 18 5,8,10	3							
										FILL: Silty clay, low to medium plasticity, orange brown mottled grey, with siltstone gravel.				INSUFFICIENT RETURN
										END OF BOREHOLE AT 3.45m				
							4							
							5							
							6							
							7							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH320 1/1

SDUP312: 0-0.2m

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED PUBLIC SCHOOL

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Job No.: E33177P **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 14/10/20 **Datum:** -

Plant Type: JK500 **Logged/Checked by:** C.R./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■	■			0			FILL: Silty gravelly clay, low to medium plasticity, brown, fine to medium grained siltstone gravel.	w<PL			
	■		■	■		N = 30 2,11,19				FILL: Silty clay, low to medium plasticity, brown, trace of siltstone gravel.				
	■		■	■			1							
	■			■		N = 27 6,14,13				FILL: Silty clay, low to medium plasticity, grey brown, trace of ironstone and siltstone gravel.				
	■		■				2			FILL: Silty clay, low to medium plasticity, grey brown, trace of siltstone gravel.				
	■		■	■		N = 31 8,12,19								
							3			FILL: Silty clay, low to medium plasticity, grey, with siltstone gravel.				INSUFFICIENT RETURN
										END OF BOREHOLE AT 3.45m				
							4							
							5							
							6							
							7							

JKGeotechnics

BOREHOLE LOG

Borehole No. 8 1 / 1

SDUP8: 0.0m-0.2m

Client: NSW DEPARTMENT OF EDUCATION

Project: PROPOSED PUBLIC SCHOOL

Location: 1-23 FORESTWOOD DRIVE, GLENMORE PARK, NSW

Job No.: 33177PN **Method:** SPIRAL AUGER **R.L. Surface:** ~60 m

Date: 11/5/20 **Datum:** ASSUMED

Plant Type: JK500 **Logged/Checked By:** J.L./N.E.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m ASSUMED)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION										FILL: Silty clay, medium plasticity, brown mottled red brown, trace of medium to coarse grained igneous and siltstone gravel, roots and root fibres.	w<PL			GRASS COVER TOP 100mm ROOT AFFECTED
					N = 20 3,10,10								>600 >600 >600	APPEARS WELL COMPACTED
						59	1							
					N = 25 8,8,17								>600 >600 >600	
AFTER 1 HR ON 7 DAYS						58	2							
										FILL: Gravelly silty clay, medium plasticity, grey and brown, medium to coarse grained igneous and siltstone gravel.				
					N = 15 9,8,7	57	3							
						56	4							GROUNDWATER MONITORING WELL INSTALLED TO 6.0m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 3.0m TO 6.0m. CASING 0.1m TO 3.0m. 2mm SAND FILTER PACK 2.4m TO 6.0m. BENTONITE SEAL 0.1m TO 2.4m. COMPLETED WITH A CONCRETED GATIC COVER.
										FILL: Silty clay, medium plasticity, brown mottled orange brown and grey, trace of fine to medium grained siltstone gravel.	w>PL			
					N = 12 2,5,7								210 220 260	
						55	5							
										FILL: Gravelly silty clay, medium plasticity, grey, medium to coarse grained siltstone gravel.				APPEARS MODERATELY COMPACTED
					N = 5 2,2,3	54	6						150 160	
										END OF BOREHOLE AT 6.45 m				

ENVIRONMENTAL LOGS EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the environmental report in regard to classification methods, field procedures and certain matters relating to the logging of soil and rock. Not all notes are necessarily relevant to all reports.

Where geotechnical borehole logs are utilised for environmental purpose, reference should also be made to the explanatory notes included in the geotechnical report. Environmental logs are not suitable for geotechnical purposes.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Environmental studies include gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 *'Geotechnical Site Investigations'*. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geoenvironmental practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) are referred to as 'laminite'.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the

structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1–2004 (R2016) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)'*.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as 'N_c' on the borehole logs, together with the number of blows per 150mm penetration.

LOGS

The borehole or test pit logs presented herein are an interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than 'straight line' variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse environmental characteristics or behaviour. If the volume and nature of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing has not been undertaken to confirm the soil classification and rock strengths indicated on the environmental logs unless noted in the report.

SYMBOL LEGENDS

SOIL


FILL


TOPSOIL


CLAY (CL, CI, CH)


SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)


SANDY CLAY (CL, CI, CH)


SILTY CLAY (CL, CI, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CI, CH)


CLAYEY GRAVEL (GC)


SANDY SILT (ML, MH)


PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK


CONGLOMERATE


SANDSTONE


SHALE/MUDSTONE


SILTSTONE


CLAYSTONE


COAL


LAMINITE


LIMESTONE


PHYLLITE, SCHIST


TUFF


GRANITE, GABBRO


DOLERITE, DIORITE


BASALT, ANDESITE


QUARTZITE

OTHER MATERIALS


BRICKS OR PAVERS


CONCRETE


ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
ine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Laboratory Classification Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity $Cu > 4$ and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

$$C_U = \frac{D_{60}}{D_{10}} \qquad and \qquad C_C = \frac{(D_{30})^2}{D_{10}\, D_{60}}$$

Where D_{10}, D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

NOTES:

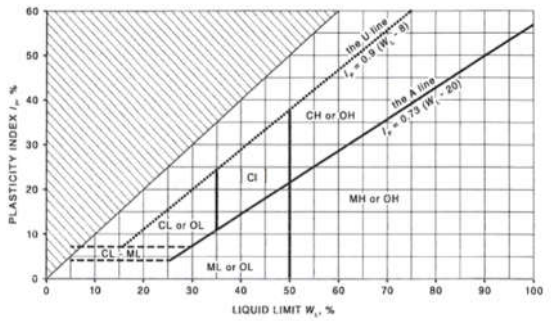
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

2 Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.

3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown.
		Extent of borehole/test pit collapse shortly after drilling/excavation.
		Groundwater seepage into borehole or test pit noted during drilling or excavation.
Samples	ES	Sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos analysis.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
	PFAS	Soil sample taken over depth indicated, for analysis of Per- and Polyfluoroalkyl Substances.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25 PID = 100	Vane shear reading in kPa of undrained shear strength. Photoionisation detector reading in ppm (soil sample headspace test).
Moisture Condition (Fine Grained Soils)	w > PL $w \approx$ PL w < PL $w \approx$ LL w > LL	Moisture content estimated to be greater than plastic limit. Moisture content estimated to be approximately equal to plastic limit. Moisture content estimated to be less than plastic limit. Moisture content estimated to be near liquid limit. Moisture content estimated to be wet of liquid limit.
(Coarse Grained Soils)	D M W	DRY – runs freely through fingers. MOIST – does not run freely but no free water visible on soil surface. WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS S F St VSt Hd Fr ( )	VERY SOFT – unconfined compressive strength ≤ 25kPa. SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa. FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa. STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa. VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa. HARD – unconfined compressive strength > 400kPa. FRIABLE – strength not attainable, soil crumbles. Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.
Density Index/ Relative Density (Cohesionless Soils)	VL L MD D VD ( )	**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)** VERY LOOSE ≤ 15 / 0 – 4 LOOSE > 15 and ≤ 35 / 4 – 10 MEDIUM DENSE > 35 and ≤ 65 / 10 – 30 DENSE > 65 and ≤ 85 / 30 – 50 VERY DENSE > 85 / > 50 Bracketed symbol indicates estimated density based on ease of drilling or other assessment.

Log Column	Symbol	Definition
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as: RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock. EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock. ALLUVIAL – soil deposited by creeks and rivers. ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents. MARINE – soil deposited in a marine environment. AEOLIAN – soil carried and deposited by wind. COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits. LITTORAL – beach deposited soil.

Classification of Material Weathering

Term		Abbreviation		Definition
Residual Soil		RS		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered		XW		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	Distinctly Weathered (Note 1)	HW	DW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately Weathered		MW		The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered		SW		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh		FR		Rock shows no sign of decomposition of individual minerals or colour changes.

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: *'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'*. There is some change in rock strength.

Rock Material Strength Classification

Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Guide to Strength	
			Point Load Strength Index $Is_{(50)}$ (MPa)	Field Assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium Strength	M	6 to 20	0.3 to 1	Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High Strength	H	20 to 60	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Appendix F: Laboratory Reports & COC Documents

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CERTIFICATE OF ANALYSIS 253574

Client Details

Client	Environmental Investigation Services
Attention	Brendan Page
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E33177P, Glenmore Park**
Number of Samples	32 Soil
Date samples received	16/10/2020
Date completed instructions received	16/10/2020

Analysis Details

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

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

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

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	23/10/2020
Date of Issue	22/10/2020

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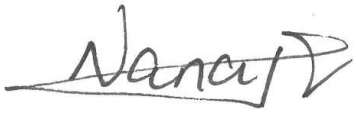
Results Approved By
Diego Bigolin, Team Leader, Inorganics
Jaimie Loa-Kum-Cheung, Metals Supervisor
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		253574-1	253574-2	253574-3	253574-4	253574-5
Your Reference	UNITS	BH311	BH311	BH311	BH311	BH312
Depth		0-0.2	0.8-1	1.3-1.5	2.8-3	0-0.2
Date Sampled		13/10/2020	13/10/2020	13/10/2020	13/10/2020	14/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
pH 1:5 soil:water	pH Units	8.3	7.6	8.4	9.6	8.0
Chloride, Cl 1:5 soil:water	mg/kg	110	370	210	68	27
Sulphate, SO4 1:5 soil:water	mg/kg	76	270	390	81	34
Resistivity in soil*	ohm m	50	19	21	46	100

Misc Inorg - Soil						
Our Reference		253574-6	253574-7	253574-8	253574-9	253574-10
Your Reference	UNITS	BH312	BH312	BH312	BH314	BH314
Depth		0.8-1	1.3-1.5	2.8-3	0-0.2	0.8-1
Date Sampled		14/10/2020	14/10/2020	14/10/2020	13/10/2020	13/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
pH 1:5 soil:water	pH Units	9.0	8.3	8.9	8.2	9.0
Chloride, Cl 1:5 soil:water	mg/kg	77	260	250	69	230
Sulphate, SO4 1:5 soil:water	mg/kg	87	210	290	38	330
Resistivity in soil*	ohm m	39	22	19	62	21

Misc Inorg - Soil						
Our Reference		253574-11	253574-12	253574-13	253574-14	253574-15
Your Reference	UNITS	BH314	BH314	BH315	BH315	BH315
Depth		1.3-1.5	2.8-3	0-0.2	0.8-1	1.8-2
Date Sampled		13/10/2020	13/10/2020	13/10/2020	13/10/2020	13/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
pH 1:5 soil:water	pH Units	9.4	9.4	8.3	8.6	8.7
Chloride, Cl 1:5 soil:water	mg/kg	58	76	130	820	1,000
Sulphate, SO4 1:5 soil:water	mg/kg	100	99	84	220	160
Resistivity in soil*	ohm m	36	33	38	12	11

Misc Inorg - Soil						
Our Reference		253574-16	253574-17	253574-18	253574-19	253574-20
Your Reference	UNITS	BH315	BH316	BH316	BH316	BH316
Depth		2.8-3	0-0.2	0.8-1	1.3-1.5	2.8-3
Date Sampled		13/10/2020	13/10/2020	13/10/2020	13/10/2020	13/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
pH 1:5 soil:water	pH Units	8.7	8.3	8.1	8.6	8.0
Chloride, Cl 1:5 soil:water	mg/kg	990	23	450	240	320
Sulphate, SO4 1:5 soil:water	mg/kg	220	20	390	320	300
Resistivity in soil*	ohm m	10	83	15	21	22

Misc Inorg - Soil						
Our Reference		253574-21	253574-22	253574-23	253574-24	253574-25
Your Reference	UNITS	BH317	BH317	BH317	BH317	BH319
Depth		0-0.2	0.8-1	1.3-1.5	2.8-3	0-0.2
Date Sampled		13/10/2020	13/10/2020	13/10/2020	13/10/2020	14/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
pH 1:5 soil:water	pH Units	9.1	8.6	8.9	8.9	8.6
Chloride, Cl 1:5 soil:water	mg/kg	160	320	180	210	190
Sulphate, SO4 1:5 soil:water	mg/kg	82	270	330	320	300
Resistivity in soil*	ohm m	30	19	22	20	23

Misc Inorg - Soil						
Our Reference		253574-26	253574-27	253574-28	253574-29	253574-30
Your Reference	UNITS	BH319	BH319	BH319	BH320	BH320
Depth		0.8-1	1.3-1.5	2.8-3	0-0.2	0.8-1
Date Sampled		14/10/2020	14/10/2020	14/10/2020	14/10/2020	14/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
pH 1:5 soil:water	pH Units	8.5	9.0	9.0	8.4	8.3
Chloride, Cl 1:5 soil:water	mg/kg	250	250	240	160	260
Sulphate, SO4 1:5 soil:water	mg/kg	260	140	110	240	270
Resistivity in soil*	ohm m	24	22	26	28	22

Misc Inorg - Soil			
Our Reference		253574-31	253574-32
Your Reference	UNITS	BH320	BH320
Depth		1.3-1.5	2.8-3
Date Sampled		14/10/2020	14/10/2020
Type of sample		Soil	Soil
Date prepared	-	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020
pH 1:5 soil:water	pH Units	8.9	8.8
Chloride, Cl 1:5 soil:water	mg/kg	220	240
Sulphate, SO4 1:5 soil:water	mg/kg	220	180
Resistivity in soil*	ohm m	25	25

Texture and Salinity*						
Our Reference		253574-1	253574-2	253574-3	253574-4	253574-5
Your Reference	UNITS	BH311	BH311	BH311	BH311	BH312
Depth		0-0.2	0.8-1	1.3-1.5	2.8-3	0-0.2
Date Sampled		13/10/2020	13/10/2020	13/10/2020	13/10/2020	14/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Electrical Conductivity 1:5 soil:water	µS/cm	200	530	480	220	98
Texture Value	-	9.0	9.0	9.0	9.0	9.0
Texture	-	CLAY LOAM	CLAY LOAM	CLAY LOAM	CLAY LOAM	CLAY LOAM
ECe	dS/m	<2	4.7	4.3	<2	<2
Class	-	NON SALINE	MODERATELY SALINE	MODERATELY SALINE	NON SALINE	NON SALINE

Texture and Salinity*						
Our Reference		253574-6	253574-7	253574-8	253574-9	253574-10
Your Reference	UNITS	BH312	BH312	BH312	BH314	BH314
Depth		0.8-1	1.3-1.5	2.8-3	0-0.2	0.8-1
Date Sampled		14/10/2020	14/10/2020	14/10/2020	13/10/2020	13/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Electrical Conductivity 1:5 soil:water	µS/cm	260	450	530	160	480
Texture Value	-	9.0	9.0	9.0	9.0	9.0
Texture	-	CLAY LOAM	CLAY LOAM	CLAY LOAM	CLAY LOAM	CLAY LOAM
ECe	dS/m	2.3	4.0	4.7	<2	4.4
Class	-	SLIGHTLY SALINE	MODERATELY SALINE	MODERATELY SALINE	NON SALINE	MODERATELY SALINE

Texture and Salinity*						
Our Reference		253574-11	253574-12	253574-13	253574-14	253574-15
Your Reference	UNITS	BH314	BH314	BH315	BH315	BH315
Depth		1.3-1.5	2.8-3	0-0.2	0.8-1	1.8-2
Date Sampled		13/10/2020	13/10/2020	13/10/2020	13/10/2020	13/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Electrical Conductivity 1:5 soil:water	µS/cm	270	310	260	810	890
Texture Value	-	9.0	9.0	9.0	9.0	9.0
Texture	-	CLAY LOAM	CLAY LOAM	CLAY LOAM	CLAY LOAM	CLAY LOAM
ECe	dS/m	2.5	2.8	2.4	7.3	8.0
Class	-	SLIGHTLY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE	MODERATELY SALINE	VERY SALINE

Texture and Salinity*						
Our Reference		253574-16	253574-17	253574-18	253574-19	253574-20
Your Reference	UNITS	BH315	BH316	BH316	BH316	BH316
Depth		2.8-3	0-0.2	0.8-1	1.3-1.5	2.8-3
Date Sampled		13/10/2020	13/10/2020	13/10/2020	13/10/2020	13/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Electrical Conductivity 1:5 soil:water	µS/cm	960	120	660	470	460
Texture Value	-	8.0	9.0	7.0	9.0	9.0
Texture	-	LIGHT MEDIUM CLAY	CLAY LOAM	MEDIUM CLAY	CLAY LOAM	CLAY LOAM
ECe	dS/m	7.7	<2	4.6	4.2	4.2
Class	-	MODERATELY SALINE	NON SALINE	MODERATELY SALINE	MODERATELY SALINE	MODERATELY SALINE

Texture and Salinity*						
Our Reference		253574-21	253574-22	253574-23	253574-24	253574-25
Your Reference	UNITS	BH317	BH317	BH317	BH317	BH319
Depth		0-0.2	0.8-1	1.3-1.5	2.8-3	0-0.2
Date Sampled		13/10/2020	13/10/2020	13/10/2020	13/10/2020	14/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Electrical Conductivity 1:5 soil:water	µS/cm	330	530	460	510	440
Texture Value	-	7.0	8.0	9.0	7.0	7.0
Texture	-	MEDIUM CLAY	LIGHT MEDIUM CLAY	CLAY LOAM	MEDIUM CLAY	MEDIUM CLAY
ECe	dS/m	2.3	4.2	4.1	3.6	3.1
Class	-	SLIGHTLY SALINE	MODERATELY SALINE	MODERATELY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE

Texture and Salinity*						
Our Reference		253574-26	253574-27	253574-28	253574-29	253574-30
Your Reference	UNITS	BH319	BH319	BH319	BH320	BH320
Depth		0.8-1	1.3-1.5	2.8-3	0-0.2	0.8-1
Date Sampled		14/10/2020	14/10/2020	14/10/2020	14/10/2020	14/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020	20/10/2020	20/10/2020
Electrical Conductivity 1:5 soil:water	µS/cm	420	450	390	360	450
Texture Value	-	9.0	9.0	9.0	7.0	7.0
Texture	-	CLAY LOAM	CLAY LOAM	CLAY LOAM	MEDIUM CLAY	MEDIUM CLAY
ECe	dS/m	3.8	4.1	3.5	2.5	3.2
Class	-	SLIGHTLY SALINE	MODERATELY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE	SLIGHTLY SALINE

Texture and Salinity*			
Our Reference		253574-31	253574-32
Your Reference	UNITS	BH320	BH320
Depth		1.3-1.5	2.8-3
Date Sampled		14/10/2020	14/10/2020
Type of sample		Soil	Soil
Date prepared	-	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020
Electrical Conductivity 1:5 soil:water	µS/cm	400	390
Texture Value	-	9.0	9.0
Texture	-	CLAY LOAM	CLAY LOAM
ECe	dS/m	3.6	3.5
Class	-	SLIGHTLY SALINE	SLIGHTLY SALINE

CEC						
Our Reference		253574-1	253574-6	253574-11	253574-13	253574-18
Your Reference	UNITS	BH311	BH312	BH314	BH315	BH316
Depth		0-0.2	0.8-1	1.3-1.5	0-0.2	0.8-1
Date Sampled		13/10/2020	14/10/2020	13/10/2020	13/10/2020	13/10/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/10/2020	21/10/2020	21/10/2020	21/10/2020	21/10/2020
Date analysed	-	21/10/2020	21/10/2020	21/10/2020	21/10/2020	21/10/2020
Exchangeable Ca	meq/100g	8.8	14	16	10	9.9
Exchangeable K	meq/100g	0.5	0.4	0.6	0.4	0.4
Exchangeable Mg	meq/100g	9.0	7.6	6.5	7.6	8.0
Exchangeable Na	meq/100g	1.2	0.72	0.52	0.50	0.63
Cation Exchange Capacity	meq/100g	19	23	23	19	19

CEC				
Our Reference		253574-23	253574-25	253574-30
Your Reference	UNITS	BH317	BH319	BH320
Depth		1.3-1.5	0-0.2	0.8-1
Date Sampled		13/10/2020	14/10/2020	14/10/2020
Type of sample		Soil	Soil	Soil
Date prepared	-	21/10/2020	21/10/2020	21/10/2020
Date analysed	-	21/10/2020	21/10/2020	21/10/2020
Exchangeable Ca	meq/100g	16	17	9.4
Exchangeable K	meq/100g	0.4	0.4	0.3
Exchangeable Mg	meq/100g	7.7	7.1	7.6
Exchangeable Na	meq/100g	0.64	0.70	0.84
Cation Exchange Capacity	meq/100g	25	25	18

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity (non NATA). Resistivity (calculated) may not correlate with results otherwise obtained using Resistivity-Current method, depending on the nature of the soil being analysed.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
INORG-123	Determined using a "Texture by Feel" method.
Metals-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	253574-2
Date prepared	-			20/10/2020	1	20/10/2020	20/10/2020		20/10/2020	20/10/2020
Date analysed	-			20/10/2020	1	20/10/2020	20/10/2020		20/10/2020	20/10/2020
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	8.3	8.3	0	98	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	110	100	10	86	#
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	76	75	1	89	#
Resistivity in soil*	ohm m	1	Inorg-002	<1	1	50	50	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	253574-22
Date prepared	-			[NT]	11	20/10/2020	20/10/2020		20/10/2020	20/10/2020
Date analysed	-			[NT]	11	20/10/2020	20/10/2020		20/10/2020	20/10/2020
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	11	9.4	9.4	0	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	11	58	61	5	87	#
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	11	100	100	0	85	#
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	11	36	36	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	20/10/2020	20/10/2020		[NT]	[NT]
Date analysed	-			[NT]	21	20/10/2020	20/10/2020		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	21	9.1	9.2	1	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	21	160	160	0	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	21	82	82	0	[NT]	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	21	30	30	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	31	20/10/2020	20/10/2020		[NT]	[NT]
Date analysed	-			[NT]	31	20/10/2020	20/10/2020		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	31	8.9	8.9	0	[NT]	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	31	220	220	0	[NT]	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	31	220	250	13	[NT]	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	[NT]	31	25	23	8	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			20/10/2020	1	20/10/2020	20/10/2020		20/10/2020	[NT]
Date analysed	-			20/10/2020	1	20/10/2020	20/10/2020		20/10/2020	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	200	200	0	99	[NT]
Texture Value	-		INORG-123	[NT]	1	9.0	9.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	11	20/10/2020	20/10/2020		20/10/2020	[NT]
Date analysed	-			[NT]	11	20/10/2020	20/10/2020		20/10/2020	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	11	270	280	4	97	[NT]
Texture Value	-		INORG-123	[NT]	11	9.0	9.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	20/10/2020	20/10/2020		[NT]	[NT]
Date analysed	-			[NT]	21	20/10/2020	20/10/2020		[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	21	330	340	3	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	21	7.0	7.0	0	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	31	20/10/2020	20/10/2020		[NT]	[NT]
Date analysed	-			[NT]	31	20/10/2020	20/10/2020		[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	31	400	430	7	[NT]	[NT]
Texture Value	-		INORG-123	[NT]	31	9.0	9.0	0	[NT]	[NT]

QUALITY CONTROL: CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			21/10/2020	1	21/10/2020	21/10/2020		21/10/2020	[NT]
Date analysed	-			21/10/2020	1	21/10/2020	21/10/2020		21/10/2020	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	1	8.8	9.2	4	129	[NT]
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	1	0.5	0.5	0	128	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	1	9.0	9.4	4	129	[NT]
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	1	1.2	1.2	0	116	[NT]

Result Definitions

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

Quality Control Definitions

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

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

Report Comments

MISC_INORG_DRY:
Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

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

SAMPLE RECEIPT ADVICE

Client Details

Client	Environmental Investigation Services
Attention	Brendan Page

Sample Login Details

Your reference	E33177P, Glenmore Park
Envirolab Reference	253574
Date Sample Received	16/10/2020
Date Instructions Received	16/10/2020
Date Results Expected to be Reported	23/10/2020

Sample Condition

Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	32 Soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	19.2
Cooling Method	None
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

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

Sample ID	Misc Inorg - Soil	Texture and Salinity*	CEC
BH311-0-0.2	✓	✓	✓
BH311-0.8-1	✓	✓	
BH311-1.3-1.5	✓	✓	
BH311-2.8-3	✓	✓	
BH312-0-0.2	✓	✓	
BH312-0.8-1	✓	✓	✓
BH312-1.3-1.5	✓	✓	
BH312-2.8-3	✓	✓	
BH314-0-0.2	✓	✓	
BH314-0.8-1	✓	✓	
BH314-1.3-1.5	✓	✓	✓
BH314-2.8-3	✓	✓	
BH315-0-0.2	✓	✓	✓
BH315-0.8-1	✓	✓	
BH315-1.8-2	✓	✓	
BH315-2.8-3	✓	✓	
BH316-0-0.2	✓	✓	
BH316-0.8-1	✓	✓	✓
BH316-1.3-1.5	✓	✓	
BH316-2.8-3	✓	✓	
BH317-0-0.2	✓	✓	
BH317-0.8-1	✓	✓	
BH317-1.3-1.5	✓	✓	✓
BH317-2.8-3	✓	✓	
BH319-0-0.2	✓	✓	✓
BH319-0.8-1	✓	✓	
BH319-1.3-1.5	✓	✓	
BH319-2.8-3	✓	✓	
BH320-0-0.2	✓	✓	
BH320-0.8-1	✓	✓	✓
BH320-1.3-1.5	✓	✓	
BH320-2.8-3	✓	✓	

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

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12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
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Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.
Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.
TAT for Micro is dependent on incubation. This varies from 3 to 6 days.

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	EIS Job Number: E33177P Date Results Required: STANDARD Page: 1 of 2	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: bpage@jkenvironments.com.au

Location:	Glenmore Park	Sample Preserved in Esky on Ice
Sampler:	CR/MMP	Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	pH	EC	ECe (texture)	Sulphate	Chloride	Resistivity	CEC					
13.10.20	1	BH311	0-0.2	P	F: Clayey silt	X	X	X	X	X	X	X					
13.10.20	2	BH311	0.8-1	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	3	BH311	1.3-1.5	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	4	BH311	2.8-3	P	F: Silty clay	X	X	X	X	X	X						
14.10.20	5	BH312	0-0.2	P	F: Silty clay	X	X	X	X	X	X						
14.10.20	6	BH312	0.8-1	P	F: Silty clay	X	X	X	X	X	X	X					
14.10.20	7	BH312	1.3-1.5	P	F: Silty clay	X	X	X	X	X	X						
14.10.20	8	BH312	2.8-3	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	9	BH314	0-0.2	P	F: Silty gravelly clay	X	X	X	X	X	X						
13.10.20	10	BH314	0.8-1	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	11	BH314	1.3-1.5	P	F: Silty clay	X	X	X	X	X	X	X					
13.10.20	12	BH314	2.8-3	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	13	BH315	0-0.2	P	F: Silty clay	X	X	X	X	X	X	X					
13.10.20	14	BH315	0.8-1	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	15	BH315	1.8-2	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	16	BH315	2.8-3	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	17	BH316	0-0.2	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	18	BH316	0.8-1	P	F: Silty clay	X	X	X	X	X	X	X					
13.10.20	19	BH316	1.3-1.5	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	20	BH316	2.8-3	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	21	BH317	0-0.2	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	22	BH317	0.8-1	P	F: Silty clay	X	X	X	X	X	X						
13.10.20	23	BH317	1.3-1.5	P	F: Silty clay	X	X	X	X	X	X	X					
13.10.20	24	BH317	2.8-3	P	F: Silty clay	X	X	X	X	X	X						
14.10.20	25	BH319	0-0.2	P	F: Silty gravelly clay	X	X	X	X	X	X	X					

Remarks (comments/detection limits required):	Sample Containers: G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag			
Relinquished By: B. Page	Date: 15.10.20	Time: 445pm	Received By: Ray	Date: 16/10/2020 10:30

ENVIROLAB

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

Job No: 253574

Date Received: 16/10/2020
Time Received: 1030
Received By: R
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

COC recd 16/10 1030
Samples recd 15/10/20 154

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD	EIS Job Number: E33177P	JKEnvironments
12 ASHLEY STREET		
CHATSWOOD NSW 2067		
P: (02) 99106200	Date Results Required: STANDARD	REAR OF 115 WICKS ROAD
F: (02) 99106201		MACQUARIE PARK, NSW 2113
		P: 02-9888 5000 F: 02-9888 5001
Attention: Aileen	Page: 2 of 2	Attention: bpage@jkenvironments.com.au

Location:	Glenmore Park	Sample Preserved in Esky on Ice
Sampler:	CR/MMP	Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	pH	EC	ECe (texture)	Sulphate	Chloride	Resistivity	CEC					
14.10.20	26	BH319	0.8-1	P	F: Silty clay	X	X	X	X	X	X						
14.10.20	27	BH319	1.3-1.5	P	F: Silty clay	X	X	X	X	X	X						
14.10.20	28	BH319	2.8-3	P	F: Silty clay	X	X	X	X	X	X						
14.10.20	29	BH320	0-0.2	P	F: Silty gravelly clay	X	X	X	X	X	X						
14.10.20	30	BH320	0.8-1	P	F: Silty clay	X	X	X	X	X	X	X					
14.10.20	31	BH320	1.3-1.5	P	F: Silty clay	X	X	X	X	X	X						
14.10.20	32	BH320	2.8-3	P	F: Silty clay	X	X	X	X	X	X						

Remarks (comments/detection limits required):	Sample Containers: G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag	253574

Relinquished By:	Date:	Time:	Received By:	Date:
B. Page	15.10.20	445pm		16/10/2020

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CERTIFICATE OF ANALYSIS 253783

Client Details

Client	Environmental Investigation Services
Attention	Brendan Page
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E33177P, Glenmore Park**
Number of Samples	7 Water
Date samples received	20/10/2020
Date completed instructions received	20/10/2020

Analysis Details

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

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

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

Report Details

Date results requested by	27/10/2020
Date of Issue	26/10/2020

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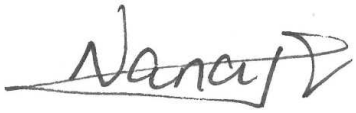
Results Approved By
Dragana Tomas, Senior Chemist
Hannah Nguyen, Senior Chemist
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

vTRH(C6-C10)/BTEXN in Water						
Our Reference		253783-1	253783-2	253783-3	253783-4	253783-5
Your Reference	UNITS	MW8	MW311	MW317	WDUP301	WDUP302
Date Sampled		19/10/2020	19/10/2020	19/10/2020	19/10/2020	19/10/2020
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	21/10/2020	21/10/2020	21/10/2020	21/10/2020	22/10/2020
Date analysed	-	22/10/2020	22/10/2020	22/10/2020	22/10/2020	23/10/2020
TRH C_6 - C_9	µg/L	<10	<10	<10	<10	<10
TRH C_6 - C_{10}	µg/L	<10	<10	<10	<10	<10
TRH C_6 - C_{10} less BTEX (F1)	µg/L	<10	<10	<10	<10	<10
Benzene	µg/L	<1	<1	<1	<1	<1
Toluene	µg/L	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	<1	<1	<1	<1	<1
m+p-xylene	µg/L	<2	<2	<2	<2	<2
o-xylene	µg/L	<1	<1	<1	<1	<1
Naphthalene	µg/L	<1	<1	<1	<1	<1
Surrogate Dibromofluoromethane	%	72	107	71	76	100
Surrogate toluene-d8	%	119	101	97	110	97
Surrogate 4-BFB	%	117	73	94	95	101

vTRH(C6-C10)/BTEXN in Water			
Our Reference		253783-6	253783-7
Your Reference	UNITS	TS-W301	TB-W301
Date Sampled		19/10/2020	19/10/2020
Type of sample		Water	Water
Date extracted	-	21/10/2020	21/10/2020
Date analysed	-	22/10/2020	22/10/2020
Benzene	µg/L	97%	<1
Toluene	µg/L	99%	<1
Ethylbenzene	µg/L	110%	<1
m+p-xylene	µg/L	110%	<2
o-xylene	µg/L	110%	<1
Naphthalene	µg/L	[NA]	<1
Surrogate Dibromofluoromethane	%	97	114
Surrogate toluene-d8	%	97	100
Surrogate 4-BFB	%	101	130

svTRH (C10-C40) in Water						
Our Reference	UNITS	253783-1	253783-2	253783-3	253783-4	253783-5
Your Reference		MW8	MW311	MW317	WDUP301	WDUP302
Date Sampled		19/10/2020	19/10/2020	19/10/2020	19/10/2020	19/10/2020
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	21/10/2020	21/10/2020	21/10/2020	21/10/2020	21/10/2020
Date analysed	-	22/10/2020	21/10/2020	21/10/2020	21/10/2020	21/10/2020
TRH C_{10} - C_{14}	µg/L	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	µg/L	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	µg/L	<100	<100	<100	<100	<100
TRH >C_{10} - C_{16}	µg/L	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	µg/L	<50	<50	<50	<50	<50
TRH >C_{16} - C_{34}	µg/L	<100	<100	<100	<100	<100
TRH >C_{34} - C_{40}	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	76	86	82	86	82

PAHs in Water - Low Level						
Our Reference		253783-1	253783-2	253783-3	253783-4	253783-5
Your Reference	UNITS	MW8	MW311	MW317	WDUP301	WDUP302
Date Sampled		19/10/2020	19/10/2020	19/10/2020	19/10/2020	19/10/2020
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	21/10/2020	21/10/2020	21/10/2020	21/10/2020	21/10/2020
Date analysed	-	22/10/2020	22/10/2020	22/10/2020	22/10/2020	22/10/2020
Naphthalene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d14	%	86	94	99	95	101

HM in water - dissolved						
Our Reference		253783-1	253783-2	253783-3	253783-4	253783-5
Your Reference	UNITS	MW8	MW311	MW317	WDUP301	WDUP302
Date Sampled		19/10/2020	19/10/2020	19/10/2020	19/10/2020	19/10/2020
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	21/10/2020	21/10/2020	21/10/2020	21/10/2020	21/10/2020
Date analysed	-	21/10/2020	21/10/2020	21/10/2020	21/10/2020	21/10/2020
Arsenic-Dissolved	µg/L	40	1	7	8	<1
Cadmium-Dissolved	µg/L	<0.1	0.2	<0.1	<0.1	0.2
Chromium-Dissolved	µg/L	<1	<1	<1	<1	<1
Copper-Dissolved	µg/L	<1	1	<1	<1	1
Lead-Dissolved	µg/L	<1	<1	<1	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	20	7	4	4	7
Zinc-Dissolved	µg/L	12	7	3	1	6

Miscellaneous Inorganics				
Our Reference	UNITS	253783-1	253783-2	253783-3
Your Reference		MW8	MW311	MW317
Date Sampled		19/10/2020	19/10/2020	19/10/2020
Type of sample		Water	Water	Water
Date prepared	-	20/10/2020	20/10/2020	20/10/2020
Date analysed	-	20/10/2020	20/10/2020	20/10/2020
pH	pH Units	7.1	6.8	7.3
Electrical Conductivity	µS/cm	5,700	14,000	7,400
Chloride, Cl	mg/L	590	2,900	1,300
Sulphate, SO4	mg/L	630	2,200	710

Cations in water Dissolved				
Our Reference		253783-1	253783-2	253783-3
Your Reference	UNITS	MW8	MW311	MW317
Date Sampled		19/10/2020	19/10/2020	19/10/2020
Type of sample		Water	Water	Water
Date digested	-	21/10/2020	21/10/2020	21/10/2020
Date analysed	-	21/10/2020	21/10/2020	21/10/2020
Calcium - Dissolved	mg/L	70	230	96
Magnesium - Dissolved	mg/L	200	480	260
Hardness	mgCaCO 3 /L	990	2,500	1,300

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Metals-022	Determination of various metals by ICP-MS.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Org-023	Water samples are analysed directly by purge and trap GC-MS.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	[NT]
Date extracted	-			22/10/2020	1	21/10/2020	21/10/2020		21/10/2020	[NT]
Date analysed	-			23/10/2020	1	22/10/2020	22/10/2020		22/10/2020	[NT]
TRH C_6 - C_9	µg/L	10	Org-023	<10	1	<10	<10	0	99	[NT]
TRH C_6 - C_{10}	µg/L	10	Org-023	<10	1	<10	<10	0	99	[NT]
Benzene	µg/L	1	Org-023	<1	1	<1	<1	0	104	[NT]
Toluene	µg/L	1	Org-023	<1	1	<1	<1	0	110	[NT]
Ethylbenzene	µg/L	1	Org-023	<1	1	<1	<1	0	110	[NT]
m+p-xylene	µg/L	2	Org-023	<2	1	<2	<2	0	85	[NT]
o-xylene	µg/L	1	Org-023	<1	1	<1	<1	0	114	[NT]
Naphthalene	µg/L	1	Org-023	<1	1	<1	<1	0	[NT]	[NT]
Surrogate Dibromofluoromethane	%		Org-023	96	1	72	101	34	93	[NT]
Surrogate toluene-d8	%		Org-023	99	1	119	98	19	85	[NT]
Surrogate 4-BFB	%		Org-023	100	1	117	99	17	115	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	253783-2
Date extracted	-			21/10/2020	1	21/10/2020	21/10/2020		21/10/2020	21/10/2020
Date analysed	-			21/10/2020	1	22/10/2020	22/10/2020		21/10/2020	21/10/2020
TRH C_{10} - C_{14}	µg/L	50	Org-020	<50	1	<50	<50	0	96	98
TRH C_{15} - C_{28}	µg/L	100	Org-020	<100	1	<100	<100	0	88	93
TRH C_{29} - C_{36}	µg/L	100	Org-020	<100	1	<100	<100	0	113	102
TRH >C_{10} - C_{16}	µg/L	50	Org-020	<50	1	<50	<50	0	96	98
TRH >C_{16} - C_{34}	µg/L	100	Org-020	<100	1	<100	<100	0	88	93
TRH >C_{34} - C_{40}	µg/L	100	Org-020	<100	1	<100	<100	0	113	102
Surrogate o-Terphenyl	%		Org-020	94	1	76	81	6	68	86

QUALITY CONTROL: PAHs in Water - Low Level						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	253783-2
Date extracted	-			21/10/2020	1	21/10/2020	21/10/2020		21/10/2020	21/10/2020
Date analysed	-			22/10/2020	1	22/10/2020	22/10/2020		22/10/2020	22/10/2020
Naphthalene	µg/L	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	87	113
Acenaphthylene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	90	116
Fluorene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	114	119
Phenanthrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	104	91
Anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	93	111
Pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	96	117
Benzo(a)anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chrysene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	98	86
Benzo(b,j+k)fluoranthene	µg/L	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	107	105
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	µg/L	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	90	1	86	97	12	82	94

QUALITY CONTROL: HM in water - dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	253783-2
Date prepared	-			21/10/2020	1	21/10/2020	21/10/2020		21/10/2020	21/10/2020
Date analysed	-			21/10/2020	1	21/10/2020	21/10/2020		21/10/2020	21/10/2020
Arsenic-Dissolved	µg/L	1	Metals-022	<1	1	40	40	0	94	105
Cadmium-Dissolved	µg/L	0.1	Metals-022	<0.1	1	<0.1	<0.1	0	97	108
Chromium-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	96	99
Copper-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	104	89
Lead-Dissolved	µg/L	1	Metals-022	<1	1	<1	<1	0	102	90
Mercury-Dissolved	µg/L	0.05	Metals-021	<0.05	1	<0.05	<0.05	0	107	99
Nickel-Dissolved	µg/L	1	Metals-022	<1	1	20	20	0	95	90
Zinc-Dissolved	µg/L	1	Metals-022	<1	1	12	11	9	97	93

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date prepared	-			20/10/2020	[NT]	[NT]	[NT]	[NT]	20/10/2020	[NT]
Date analysed	-			20/10/2020	[NT]	[NT]	[NT]	[NT]	20/10/2020	[NT]
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	98	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	97	[NT]
Chloride, Cl	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	106	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]	[NT]	[NT]	[NT]	116	[NT]

QUALITY CONTROL: Cations in water Dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date digested	-			21/10/2020	[NT]	[NT]	[NT]	[NT]	21/10/2020	[NT]
Date analysed	-			21/10/2020	[NT]	[NT]	[NT]	[NT]	21/10/2020	[NT]
Calcium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	104	[NT]
Magnesium - Dissolved	mg/L	0.5	Metals-020	<0.5	[NT]	[NT]	[NT]	[NT]	108	[NT]

Result Definitions

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

Quality Control Definitions

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

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

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SAMPLE RECEIPT ADVICE

Client Details

Client	Environmental Investigation Services
Attention	Brendan Page

Sample Login Details

Your reference	E33177P, Glenmore Park
Envirolab Reference	253783
Date Sample Received	20/10/2020
Date Instructions Received	20/10/2020
Date Results Expected to be Reported	27/10/2020

Sample Condition

Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	7 Water
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	10.7
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

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12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

Sample ID	vTRH(C6-C10)/BTEXN in Water	svTRH (C10-C40) in Water	PAHs in Water - Low Level	HM in water - dissolved	pH	Electrical Conductivity	Chloride, Cl	Sulphate, SO4	Cations in water Dissolved
MW8	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW311	✓	✓	✓	✓	✓	✓	✓	✓	✓
MW317	✓	✓	✓	✓	✓	✓	✓	✓	✓
WDUP301	✓	✓	✓	✓					
WDUP302	✓	✓	✓	✓					
TS-W301	✓								
TB-W301	✓								

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.
Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.
TAT for Micro is dependent on incubation. This varies from 3 to 6 days.

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	JKE Job Number: E33177P Date Results Required: STANDARD Page: 1 of 1	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Brendan Page BPage@jkenvironments.com.au

Location:	Glenmore Park	Sample Preserved in Esky on Ice
Sampler:	CR	Tests Required

Date Sampled	Lab Ref:	Sample Number	Sample Containers	PID	Sample Description	Combo 2	Combo 3L	VOCs	pH / EC	8 Metals	PAHs	TRH/BTEX	BTEX	Hardness	Sulfate	Chloride
19.10.20	1	MW8	G1, V, H, PVC	0	Groundwater		X		X					X	X	X
19.10.20	2	MW311	G1, V, H, PVC	0.3	Groundwater		X		X					X	X	X
19.10.20	3	MW317	G1, V, H, PVC	1	Groundwater		X		X					X	X	X
19.10.20	4	WDUP301	G1, V, H, PVC	-	Duplicate		X									
19.10.20	5	WDUP302	G1, V, H, PVC	-	Duplicate		X									
19.10.20	6	TS-W301	V	-	Trip Spike								X			
19.10.20	7	TB-W301	V	-	Trip Blank								X			

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

Job No: 253783
Date Received: 20/10/2020
Time Received: 10:45
Received By: RL
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Remarks (comments/detection limits required):

All analysis PQLs to ANZECC (2000) Detection Limits Please

Sample Containers:
G1 - 100mL Amber Glass Bottle G2 - 1L Amber Glass Bottle
V - BTEX Vial H - HNO3 Wash PVC
PVC - HDPE Plastic Bottles

Relinquished By:	Date:	Time:	Received By:	Date:
	20/10/2020	10:10 am	RKhazeen	20/10/2020 10.45

10.7.

Appendix G: Report Explanatory Notes

Standard Sampling Procedure (SSP)

These protocols specify the basic procedures to be used when sampling soils or groundwater for environmental site assessments undertaken by JKE.

The purpose of these protocols is to provide standard methods for: sampling, decontamination procedures for sampling equipment, sample preservation, sample storage and sample handling. Deviations from these procedures must be recorded.

A. <u>Soil Sampling:</u>

- Prepare a borehole/test pit log or made a note of the sample description for stockpiles.
- Layout sampling equipment on clean plastic sheeting to prevent direct contact with ground surface. The work area should be at a distance from the drill rig/excavator such that the machine can operate in a safe manner.
- Ensure all sampling equipment has been decontaminated prior to use.
- Remove any surface debris from the immediate area of the sampling location.
- Collect samples and place in glass jar with a Teflon seal. This should be undertaken as quickly as possible to prevent the loss of any volatiles. If possible, fill the glass jars completely.
- Collect samples for asbestos analysis and place in a zip-lock plastic bag.
- Label the sampling containers with the JKE job number, sample location (eg. BH1), sampling depth interval and date. If more than one sample container is used, this should also be indicated (eg. 2 = Sample jar 1 of 2 jars).
- Photoionisation detector (PID) screening of volatile organic compounds (VOCs) should be undertaken on samples using the soil sample headspace method. Headspace measurements are taken following equilibration of the headspace gasses in partly filled zip-lock plastic bags. PID headspace data is recorded on the borehole/test pit log and the chain of custody forms.
- Record the lithology of the sample and sample depth on the borehole/test pit log generally in accordance with AS1726-1993[16].
- Store the sample in a sample container cooled with ice or chill packs. On completion of the sampling the sample container should be delivered to the lab immediately or stored in the refrigerator prior to delivery to the lab. All samples are preserved in accordance with the standards outlined in the report.
- Check for the presence of groundwater after completion of each borehole using an electronic dip metre or water whistle. Boreholes should be left open until the end of fieldwork. All groundwater levels in the boreholes should be rechecked on the completion of the fieldwork.
- Backfill the boreholes/test pits with the excavation cuttings or clean sand prior to leaving the site.

B. <u>Decontamination Procedures for Soil Sampling Equipment</u>

- All sampling equipment should be decontaminated between every sampling location. This excludes single use PVC tubing used for push tubes etc. Equipment and materials required for the decontamination include:
  - Phosphate free detergent (Decon 90);
  - Potable water;
  - Stiff brushes; and
  - Plastic sheets.
- Ensure the decontamination materials are clean prior to proceeding with the decontamination.
- Fill both buckets with clean potable water and add phosphate free detergent to one bucket.

[16] Standards Australia, (1993), *Geotechnical Site Investigations.* (AS1726-1993)

- In the bucket containing the detergent, scrub the sampling equipment until all the material attached to the equipment has been removed.
- Rinse sampling equipment in the bucket containing potable water.
- Place cleaned equipment on clean plastic sheets.

If all materials are not removed by this procedure, high-pressure water cleaning is recommended. If any equipment is not completely decontaminated by both these processes, then the equipment should not be used until it has been thoroughly cleaned.

C. Groundwater Sampling

Groundwater samples are more sensitive to contamination than soil samples and therefore adhesion to this protocol is particularly important to obtain reliable, reproducible results. The recommendations detailed in AS/NZS 5667.1:1998 are considered to form a minimum standard.

The basis of this protocol is to maintain the security of the borehole and obtain accurate and representative groundwater samples. The following procedure should be used for collection of groundwater samples from previously installed groundwater monitoring wells.

- After monitoring well installation, at least three bore volumes should be pumped from the monitoring wells (well development) to remove any water introduced during the drilling process and/or the water that is disturbed during installation of the monitoring well. This should be completed prior to purging and sampling.
- Groundwater monitoring wells should then be left to recharge for at least three days before purging and sampling. Prior to purging or sampling, the condition of each well should observed and any anomalies recorded on the field data sheets. The following information should be noted: the condition of the well, noting any signs of damage, tampering or complete destruction; the condition and operation of the well lock; the condition of the protective casing and the cement footing (raised or cracked); and, the presence of water between protective casing and well.
- Take the groundwater level from the collar of the piezometer/monitoring well using an electronic dip meter. The collar level should be taken (if required) during the site visit using a dumpy level and staff.
- Purging and sampling of piezometers/monitoring wells is done on the same site visit when using micro-purge (or other low flow) techniques.
- Layout and organize all equipment associated with groundwater sampling in a location where they will not interfere with the sampling procedure and will not pose a risk of contaminating samples. Equipment generally required includes:
  - Micropore filtration system or Stericup single-use filters (for heavy metals samples);
  - Filter paper for Micropore filtration system; Bucket with volume increments;
  - Sample containers: teflon bottles with 1 ml nitric acid, 75mL glass vials with 1 mL hydrochloric acid, 1 L amber glass bottles;
  - Bucket with volume increments;
  - Flow cell;
  - pH/EC/Eh/T meters;
  - Plastic drums used for transportation of purged water;
  - Esky and ice;
  - Nitrile gloves;
  - Distilled water (for cleaning);
  - Electronic dip meter;
  - Low flow pump pack and associated tubing; and
  - Groundwater sampling forms.

- If single-use stericup filtration is not used, clean the Micropore filtration system thoroughly with distilled water prior to use and between each sample. Filter paper should be changed between samples. 0.45um filter paper should be placed below the glass fibre filter paper in the filtration system.
- Ensure all non-disposable sampling equipment is decontaminated or that new disposable equipment is available prior to any work commencing at a new location. The procedure for decontamination of groundwater equipment is outlined at the end of this section.
- Disposable gloves should be used whenever samples are taken to protect the sampler and to assist in avoidance of contamination.
- Groundwater samples are obtained from the monitoring wells using low flow/micro-purge sampling equipment to reduce the disturbance of the water column and loss of volatiles.
- During pumping to purge the well, the pH, temperature, conductivity, dissolved oxygen, redox potential and groundwater levels are monitored (where possible) using calibrated field instruments to assess the development of steady state conditions. Steady state conditions are generally considered to have been achieved when the difference in the pH measurements was less than 0.2 units and the difference in conductivity was less than 10%.
- All measurements are recorded on specific data sheets.
- Once steady state conditions are considered to have been achieved, groundwater samples are obtained directly from the pump tubing and placed in appropriate glass bottles or plastic bottles.
- All samples are preserved in accordance with water sampling requirements detailed in the NEPM 2013 and placed in an insulated container with ice. Groundwater samples are preserved by immediate storage in an insulated sample container with ice as outlined in the report text.
- Record the sample on the appropriate log in accordance with AS1726:1993. At the end of each water sampling complete a chain of custody form.

D. <u>Decontamination Procedures for Groundwater Sampling Equipment</u>

- All equipment associated with the groundwater sampling procedure (other than single-use items) should be decontaminated between every sampling location.
- The following equipment and materials are required for the decontamination procedure:
  - Phosphate free detergent;
  - Potable water;
  - Distilled water; and
  - Plastic Sheets or bulk bags (plastic bags).
- Fill one bucket with clean potable water and phosphate free detergent, and one bucket with distilled water.
- Flush potable water and detergent through pump head. Wash sampling equipment and pump head using brushes in the bucket containing detergent until all materials attached to the equipment are removed.
- Flush pump head with distilled water.
- Change water and detergent solution after each sampling location.
- Rinse sampling equipment in the bucket containing distilled water.
- Place cleaned equipment on clean plastic sheets.
- If all materials are not removed by this procedure that equipment should not be used until it has been thoroughly cleaned

Appendix H: Groundwater Field Records

Groundwater Development Sheets

JKEnvironments

Client:	NSW Department of Education	**Job No.:**	E33177P
Project:	Proposed Public School	**Well No.:**	MW8
Location:	1-23 Forestwood Drive, GLENMORE PARK, NSW	**Depth (m):**	6

WELL FINISH DETAILS

	Gatic Cover ☒	Standpipe ☐	Other (describe) ☐

WELL DEVELOPMENT DETAILS

Method:	TYPHOON	**SWL – Before (m):**	2.00
Date:	14/10/20	**Time – Before:**	13:00
Undertaken By:	CR/MMB	**SWL – After (m):**	~~2.15~~ 2.00
Total Vol. Removed:	32	**Time – After:**	13:15
PID Reading (ppm):	0.2		

Comments:

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
2	18.3	1.5	4735	6.93	-136.6
4	18.4	0.7	4777	6.88	-138.1
6	18.2	0.6	4806	6.86	-139.8
8	18.2	0.5	4832	6.85	-141.5
10	18.2	0.5	4844	6.85	-142.4
12	18.2	0.4	4849	6.84	-143.2
14	18.2	0.4	4863	6.84	-143.8
16	18.2	0.4	4857	6.84	-144.4
20	18.2	0.4	4861	6.84	-144.8
22	18.3	0.5	4875	6.85	-141.0
24	18.2	0.4	4885	6.84	-142.7
26	18.2	0.3	4889	6.84	-143.8
28	18.2	0.3	4890	6.83	-145.3
32	18.2	0.4	4891	6.83	-144.8

Comments: Odours (YES / (NO)) NAPL/PSH (YES / (NO)) Sheen (YES / (NO)) Steady State Achieved (YES / NO)

YSI Used: 5

clear water

Tested By:	CR
Date Tested:	14/10/20.
Checked By:	BP
Date:	21/10/20

Remarks:

- Steady state conditions
- Difference in the pH less than 0.2 units, difference in the conductiveity less than 10% and SWL stable/not in drawdown
- Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry

JKEnvironments

Client:	NSW Department of Education	**Job No.:**	E33177P
Project:	Proposed Public School	**Well No.:**	MW311
Location:	1-23 Forestwood Drive, GLENMORE PARK, NSW	**Depth (m):**	5

WELL FINISH DETAILS

	Gatic Cover ☒	Standpipe ☐	Other (describe) ☐

WELL DEVELOPMENT DETAILS

Method:	TYPHOON	**SWL – Before (m):**	1.61
Date:	14/10/20	**Time – Before:**	1235
Undertaken By:	CR/MRMP	**SWL – After (m):**	12.50
Total Vol. Removed:	30	**Time – After:**	4.28
PID Reading (ppm):	0.4		

Comments:

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
2	18.6	3.9	11670	6.68	-112.0
4	18.3	3.2	11641	6.61	-118.1
6	18.3	2.9	11632	6.62	-113.9
8	18.3	2.8	11507	6.63	-115.6
10	18.4	2.9	11468	6.63	-116.7
12	18.4	1.6	11530	6.57	-110.6
14	18.5	2.6	11477	6.63	-119.9
16	18.1	2.1	11540	6.66	-120.5
18	18.8	3.5	11667	6.71	-119.5
20	18.7	4.4	11250	6.68	-119.5
22	18.7	4.0	11671	6.66	-114.1
24	18.9	4.3	11731	6.68	-120.1
26	18.5	2.4	11715	6.57	-117.6
28	18.4	2.9	11639	6.58	-118.3
30	18.6	3.3	11690	6.60	-118.3

Comments: Odours (YES / (NO)) NAPL/PSH (YES / (NO)) Sheen (YES / (NO)) Steady State Achieved ((YES) / NO)

YSI Used: 5

moderate silt load

Tested By:	CR
Date Tested:	14/10/20
Checked By:	RP
Date:	21/10/20

Remarks:

- Steady state conditions
- Difference in the pH less than 0.2 units, difference in the conductiveity less than 10% and SWL stable/not in drawdown
- Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry

JKEnvironments

Client:	NSW Department of Education	**Job No.:**	E33177P
Project:	Proposed Public School	**Well No.:**	MW317
Location:	1-23 Forestwood Drive, GLENMORE PARK, NSW	**Depth (m):**	6

WELL FINISH DETAILS

	Gatic Cover ☒	Standpipe ☐	Other (describe) ☐

WELL DEVELOPMENT DETAILS

Method:	SYP100A	**SWL – Before (m):**	2.04m
Date:	14/10/20	**Time – Before:**	12:00
Undertaken By:	CE/MMP	**SWL – After (m):**	4.4m
Total Vol. Removed:	44	**Time – After:**	12:30
PID Reading (ppm):	0.6		

Comments:

DEVELOPMENT MEASUREMENTS

Volume Removed (L)	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
2	19.5	2.9	3517	7.15	16.1
4	19.2	2.2	3299	7.13	-33.8
6	19.7	11.5	1015	7.55	-64.0
8	19.2	7.4	4426	7.17	-73.0
10	19.3	7.11	5401	7.10	-93.0
12	20.1	1.0	4718	7.07	-99.9
14	19.5	0.6	5067	7.06	-104.7
16	19.8	1.0	5896	7.09	-102.2
18	19.7	2.0	3963	7.16	-103.6
20	20.1	2.2	6210	7.13	-106.5
22	20.1	0.8	6464	7.14	-113.3
24	20.0	0.8	6353	7.14	-114.8
26	20.0	1.0	6394	7.18	-116.0
30	20.2	2.7	6433	7.21	-117.5
32	20.3	3.1	6200	7.18	-120.9
34	20.5	1.9	6037	7.13	-120.8
36	20.3	0.7	6142	7.15	-123.3
38	20.2	0.7	6234	7.16	-124.8
40	20.1	0.9	6044	7.16	-122.2
42	20.4	1.5	6626	7.20	-121.8
44	20.2	1.5	6618	7.19	-121.9

Comments: Odours (YES / (NO)), NAPL/PSH (YES / (NO)), Sheen (YES / (NO)), Steady State Achieved ((YES) / NO)

YSI Used: 5

HIGH SILT LOAD

Tested By:	CYL
Date Tested:	14/10/20
Checked By:	BP
Date:	21/10/20

Remarks:

- Steady state conditions
- Difference in the pH less than 0.2 units, difference in the conductiveity less than 10% and SWL stable/not in drawdown
- Minimum 3 monitoring well volumes purged, unless well purged until it is effectively dry

Groundwater Sampling Sheets

JKEnvironments

Client:	NSW Department of Education	Job No.:	E33177P
Project:	Proposed Public School	Well No.:	MW8
Location:	1-23 Forestwood Drive, GLENMORE PARK, NSW	Depth (m):	6

WELL FINISH

X	Gatic Cover		Standpipe		Other (describe)

WELL PURGE DETAILS:

Method:	PERISTALTIC	SWL – Before:	2.00
Date:	19/10/20	Time – Before:	15:45
Undertaken By:	CR	Total Vol Removed:	3.0 L
Pump Program No:	5.5	PID (ppm):	0.0

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
2	2.01	0.4	CLEAR	19.6	4.5	3203	6.99	-95.7
4	2.02	0.8	CLEAR	19.4	1.5	3685	6.92	-97.3
7.5	2.02	1.5	CLEAR	19.2	0.7	4685	6.89	-98.3
11	2.02	2.4	CLEAR	19.3	0.6	4783	6.89	-98.8
15	2.02	3	CLEAR	19.0	0.5	4769	6.88	-99.5

Comments: Odours (YES / (NO)), NAPL/PSH (YES / (NO)), Sheen (YES / (NO)), Steady State Achieved (YES / NO)

Sampling Containers Used: 2 x glass amber, 3 x BTEX vials, 1 x HNO3 plastic, 0 x H2SO4 plastic, 1 x unpreserved plastic

YSI used: 5

Tested By: Craig Ridley	**Remarks:**
Date Tested: 19/10/20	- Steady state conditions - difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown
Checked By: RR	
Date: 21/10/20	

JKEnvironments

Client:	NSW Department of Education	Job No.:	E33177P
Project:	Proposed Public School	Well No.:	MW311
Location:	1-23 Forestwood Drive, GLENMORE PARK, NSW	Depth (m):	5

WELL FINISH

X	Gatic Cover		Standpipe		Other (describe)

WELL PURGE DETAILS:

Method:	PERISTALTIC	SWL – Before:	1.49
Date:	19/10/20	Time – Before:	1500
Undertaken By:	CR	Total Vol Removed:	3L
Pump Program No:	5.5	PID (ppm):	0.3

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
2	1.59	0.4	CLEAR	20.3	2.4	12070	6.60	-84.1
~~5~~ 5	1.65	~~1.0~~ 1.0	CLEAR	19.5	2.4	11847	6.63	-87.3
7.5	1.68	1.5	CLEAR	19.3	2.0	11772	6.61	-89.9
10	1.72	2	CLEAR	19.2	1.7	11755	6.61	-93.4
12.5	1.74	2.5	CLEAR	19.0	1.3	11772	6.59	-93.8
15	1.76	3	CLEAR	19.0	1.3	11688	6.60	-97.7

Comments: Odours (YES / (NO)), NAPL/PSH (YES / (NO)), Sheen (YES / (NO)), Steady State Achieved ((YES) / NO)

Sampling Containers Used: 2 x glass amber, 3 x BTEX vials, (x HNO3 plastic, 6 x H2SO4 plastic, 1 x unpreserved plastic

YSI used: 5 WOUP302

Tested By: Craig Ridley	**Remarks:**
Date Tested: 19/10/20	- Steady state conditions
Checked By: BP	- difference in the pH less than 0.2 units, difference in conductivity less than 10%
Date: 21/10/20	10% and SWL stable/not in drawdown

JKEnvironments

Client:	NSW Department of Education	**Job No.:**	E33177P
Project:	Proposed Public School	**Well No.:**	MW317
Location:	1-23 Forestwood Drive, GLENMORE PARK, NSW	**Depth (m):**	6

WELL FINISH

X	Gatic Cover		Standpipe		Other (describe)

WELL PURGE DETAILS:

Method:	PERISTALTIC	**SWL – Before:**	2.39
Date:	19/10/20	**Time – Before:**	14:15
Undertaken By:	CR	**Total Vol Removed:**	4L
Pump Program No:	5.5	**PID (ppm):**	1.0

PURGING / SAMPLING MEASUREMENTS

Time (min)	SWL (m)	Vol (L)	Notes	Temp (°C)	DO (mg/L)	EC (µS/cm)	pH	Eh (mV)
2	2.42	0.3	turbid	20.2	0.8	6431	6.85	150.3
5	2.44	1.0	slightly turbid.	20.4	1.6	6693	7.01	-4.8
8	2.45	1.3	CLEAR	20.2	1.3	6583	7.05	-54.6
10	2.47	2.2	CLEAR	20.1	1.1	6505	7.07	-78.5
13	2.50	2.5	CLEAR	20.1	1.0	6477	7.09	-90.2
16	2.51	3.2	CLEAR	20.4	0.9	6547	7.09	-94.1
20	2.53	4.0	CLEAR	20.8	0.8	6514	7.10	-102.6

Comments: Odours (YES / NO), NAPL/PSH (YES / NO), Sheen (YES / NO), Steady State Achieved (YES / NO)

Sampling Containers Used: 2 x glass amber, 3 x BTEX vials, 1 x HNO3 plastic, 0 x H2SO4 plastic, 1 x unpreserved plastic

YSI used: 5.

WO BP301

Tested By: Craig Ridley	**Remarks:**
Date Tested: 19/10/20	- Steady state conditions
Checked By:	- difference in the pH less than 0.2 units, difference in conductivity less than 10% 10% and SWL stable/not in drawdown
Date: 21/10/20	

Calibration Documents

JKEnvironments

WATER QUALITY METER CALIBRATION FORM

Client:	NSW Department of Education		
Project:	Proposed Public School		
Location:	1-23 Forestwood Drive, GLENMORE PARK, NSW		
Job Number:	E33177P		
DISSOLVED OXYGEN			
Make: YSI 5	Model:		
Date of calibration: 14/10/2020	Name of Calibrator: MMP		
Span value: 70% to 130%			
Measured value: 101 %			
Measured reading Acceptable (Yes/No): YES			
pH			
Make: YSI 5	Model:		
Date of calibration: 14/10/20	Name of Calibrator: MMP		
Buffer 1: Theoretical pH = 7.01± 0.01	Expiry date: 12/21	Lot No: 339904	
Buffer 2: Theoretical pH = 4.01± 0.01	Expiry date: 09/21	Lot No: 351749	
Measured reading of Buffer 1: 7.35			
Measured reading of Buffer 2: 4.36			
Slope:	Measured reading Acceptable (Yes/No): YES		
EC			
Make: YSI 5	Model:		
Date: 14/10/20	Name of Calibrator: MMP	Temperature: 21.2 °C	
Calibration solution: CONDUCTIVITY STANDARD	Expiry date: 11/21	Lot No: 3547G2	
Theoretical conductivity at temperature (see solution container):	1305 µS/cm		
Measured conductivity: 1237 µS/cm	Measured reading Acceptable (Yes/No): YES		
REDOX			
Make: YSI 5	Model:		
Date of calibration: 14/10/20	Name of Calibrator: MMP		
Calibration solution: ORP TEST SOLUTION	Expiry date: 01/25	Lot No: 4923	
Theoretical redox value: 240mV			
Measured redox reading: 220.8 mV	Measured reading Acceptable (Yes/No): YES		

JKEnvironments

WATER QUALITY METER CALIBRATION FORM

Client:	NSW Department of Education		
Project:	Proposed Public School		
Location:	1-23 Forestwood Drive, GLENMORE PARK, NSW		
Job Number:	E33177P		
DISSOLVED OXYGEN			
Make: YSI 5	Model:		
Date of calibration: 19/10/20	Name of Calibrator: CR.		
Span value: 70% to 130%			
Measured value: 102			
Measured reading Acceptable (Yes/No): YES			
pH			
Make: YSI 5	Model:		
Date of calibration: 19/10/20	Name of Calibrator: CR		
Buffer 1: Theoretical pH = 7.01± 0.01	Expiry date: 12/21	Lot No: 355904	
Buffer 2: Theoretical pH = 4.01± 0.01	Expiry date: 09/21	Lot No: 351749	
Measured reading of Buffer 1: 7.04			
Measured reading of Buffer 2: 4.15			
Slope:	Measured reading Acceptable (Yes/No): YES		
EC			
Make: YSI 5	Model:		
Date: 19/5/20	Name of Calibrator: CR	Temperature: 20.8 °C	
Calibration solution: CONDUCTIVITY STANDARDS	Expiry date: 11/21	Lot No: 354762	
Theoretical conductivity at temperature (see solution container): 1305 µS/cm			
Measured conductivity: 1335. µS/cm	Measured reading Acceptable (Yes/No): YES		
REDOX			
Make: YSI 5.	Model:		
Date of calibration: 19/5/20	Name of Calibrator: CR		
Calibration solution: ORP TEST SOLUTION	Expiry date: 01/25	Lot No: 4923	
Theoretical redox value: 240mV			
Measured redox reading: 239.8 mV	Measured reading Acceptable (Yes/No): YES.		