ENVIRONMENTAL INVESTIGATION SERVICES

REPORT

TO

JDH ARCHITECTS

ON

PRELIMINARY STAGE 1/2 CONTAMINATION ASSESSMENT & PRELIMINARY SALINITY ASSESSMENT

FOR

PROPOSED SCHOOL DEVELOPMENT

AT

ST IVES NORTH PUBLIC SCHOOL
87 MEMORIAL AVENUE, ST IVES, NSW

18 JUNE 2018 **REF: E31387Krpt**

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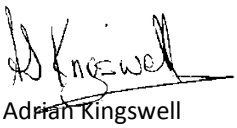

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EXECUTIVE SUMMARY

JDH Architects ('the client') commissioned Environmental Investigation Services (EIS) to undertake a preliminary stage 1/stage 2 contamination assessment and preliminary salinity assessment for the proposed school development at St Ives North Public School, 87 Memorial Avenue, St Ives, NSW ('the site'). For the purpose of this report the wider school property has been referred to as 'the site'. The site location is shown on Figure 1.

Soil sampling for the assessments was generally limited to the proposed new building footprints. These areas are referred to as the 'investigation areas' within this report and are shown on Figure 2.

A geotechnical investigation was undertaken previously to this assessment by JK Geotechnics. The results of the investigation are presented in a separate report (Ref. 31387rpt, dated 8 May 2018). This report should be read in conjunction with the JK report.

The objectives, scope and findings of the salinity assessment are documented in the report attached in Appendix A.

The primary aims of the assessment were to identify any past or present potentially contaminating activities at the site, identify the potential for site contamination, and make a preliminary assessment of the soil contamination conditions. The assessment objectives were to:

- Provide an appraisal of the past site use(s) based on a review of background information;
- Identify potential contamination sources/areas of environmental concern (AEC) and contaminants of potential concern (CoPC);
- Prepare a conceptual site model (CSM);
- Make a preliminary assessment of the soil contamination conditions within the investigation area(s);
- Assess the risks posed by the contaminants via a Tier 1 risk assessment;
- Assess whether the investigation area(s) is/are suitable or can be made suitable for the proposed development (from a contamination viewpoint).

The Stage 1/Stage 2 ESA included a review of site information and fill/soil sampling from a total of eight boreholes. The site information identified various potential sources of contamination/AEC, including fill, historical agricultural land use and hazardous building materials (i.e. from former demolition). The site inspection did not identify any obvious sources of potential contamination.

Elevated concentrations of contaminants above the site assessment criteria (SAC) were not identified during the investigation. On this basis, EIS are of the opinion that potential risks associated with contamination (i.e. the CoPC) within the investigation areas are low.

Due to the presence of uncontrolled fill, the likelihood of asbestos being present is possible, however the data collected during the investigation suggests that significant and widespread asbestos issues are unlikely to be encountered.

Further investigation and/or remediation is not considered to be required. Potential risks associated with unidentified occurrence of asbestos or other sources of contamination can be addressed via the implementation of an unexpected finds protocol and, if required, appropriate management during the development works. An unexpected finds protocol is included in Section 10.3 of this report.

Overall, EIS are of the opinion that the investigation area(s) can be made suitable for the proposed development outlined in Section 1.1, subject to the implementation of the unexpected finds protocol outlined in Section 10.3.

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

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ABBREVIATIONS

Asbestos Fines/Fibrous Asbestos	**AF/FA**
Ambient Background Concentrations	**ABC**
Added Contaminant Limits	**ACL**
Asbestos Containing Material	**ACM**
Australian Drinking Water Guidelines	**ADWG**
Area of Environmental Concern	**AEC**
Australian Height Datum	**AHD**
Acid Sulfate Soil	**ASS**
Above-Ground Storage Tank	**AST**
Below Ground Level	**BGL**
Benzo(a)pyrene Toxicity Equivalent Factor	**BaP TEQ**
Bureau of Meteorology	**BOM**
Benzene, Toluene, Ethylbenzene, Xylene	**BTEX**
Cation Exchange Capacity	**CEC**
Contaminated Land Management	**CLM**
Contaminant(s) of Potential Concern	**CoPC**
Chain of Custody	**COC**
Conceptual Site Model	**CSM**
Development Application	**DA**
Data Quality Indicator	**DQI**
Data Quality Objective	**DQO**
Detailed Site Investigation	**DSI**
Ecological Investigation Level	**EIL**
Environmental Investigation Services	**EIS**
Ecological Screening Level	**ESL**
Environmental Management Plan	**EMP**
Excavated Natural Material	**ENM**
Environment Protection Authority	**EPA**
Environmental Site Assessment	**ESA**
Ecological Screening Level	**ESL**
Fibre Cement Fragment(s)	**FCF**
General Approval of Immobilisation	**GAI**
Health Investigation Level	**HILs**
Hardness Modified Trigger Values	**HMTV**
Health Screening Level	**HSLs**
International Organisation of Standardisation	**ISO**
Lab Control Spike	**LCS**
Light Non-Aqueous Phase Liquid	**LNAPL**
Map Grid of Australia	**MGA**
National Association of Testing Authorities	**NATA**
National Environmental Protection Measure	**NEPM**
Organochlorine Pesticides	**OCP**
Organophosphate Pesticides	**OPP**
Polycyclic Aromatic Hydrocarbons	**PAH**
Potential ASS	**PASS**
Polychlorinated Biphenyls	**PCBs**

ABBREVIATIONS

Photo-ionisation Detector	**PID**
Protection of the Environment Operations	**POEO**
Practical Quantitation Limit	**PQL**
Quality Assurance	**QA**
Quality Control	**QC**
Remediation Action Plan	**RAP**
Relative Percentage Difference	**RPD**
Site Assessment Criteria	**SAC**
Sampling, Analysis and Quality Plan	**SAQP**
Site Audit Statement	**SAS**
Site Audit Report	**SAR**
Site Specific Assessment	**SSA**
Source, Pathway, Receptor	**SPR**
Specific Contamination Concentration	**SCC**
Standard Penetration Test	**SPT**
Standard Sampling Procedure	**SSP**
Standing Water Level	**SWL**
Trip Blank	**TB**
Toxicity Characteristic Leaching Procedure	**TCLP**
Total Recoverable Hydrocarbons	**TRH**
Trip Spike	**TS**
Upper Confidence Limit	**UCL**
United States Environmental Protection Agency	**USEPA**
Underground Storage Tank	**UST**
Virgin Excavated Natural Material	**VENM**
Volatile Organic Compounds	**VOC**
World Health Organisation	**WHO**
Work Health and Safety	**WHS**

Units

Litres	**L**
Metres BGL	**mBGL**
Metres	**m**
Millivolts	**mV**
Millilitres	**ml or mL**
Milliequivalents	**meq**
micro Siemens per Centimetre	**µS/cm**
Micrograms per Litre	**µg/L**
Milligrams per Kilogram	**mg/kg**
Milligrams per Litre	**mg/L**
Parts Per Million	**ppm**
Percentage	**%**

1 INTRODUCTION

JDH Architects ('the client') commissioned Environmental Investigation Services (EIS)[1] to undertake a preliminary stage 1/stage 2 contamination assessment and preliminary salinity assessment for the proposed school development at St Ives North Public School, 87 Memorial Avenue, St Ives, NSW ('the site'). For the purpose of this report the wider school property has been referred to as 'the site'. The site location is shown on Figure 1.

Soil sampling for the assessments was generally limited to the proposed new building footprints. These areas are referred to as the 'investigation areas' within this report and are shown on Figure 2.

A geotechnical investigation was undertaken previously to this assessment by JK Geotechnics[2]. The results of the investigation are presented in a separate report (Ref. 31387rpt, dated 8 May 2018[3]). This report should be read in conjunction with the JK report.

The objectives, scope and findings of the salinity assessment are documented in the report attached in Appendix A.

1.1 Proposed Development Details

It is understood the proposed development includes construction of a new three storey building in the south-west corner of the site and a new toilet block in the central north of the site.

1.2 Aims and Objectives

The primary aims of the assessment were to identify any past or present potentially contaminating activities at the site, identify the potential for site contamination, and make a preliminary assessment of the soil contamination conditions. The assessment objectives were to:

- Provide an appraisal of the past site use(s) based on a review of background information;
- Identify potential contamination sources/areas of environmental concern (AEC) and contaminants of potential concern (CoPC);
- Prepare a conceptual site model (CSM);
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- Assess whether the investigation area(s) is/are suitable or can be made suitable for the proposed development (from a contamination viewpoint).

[1] Environmental consulting division of Jeffery & Katauskas Pty Ltd (J&K)

[2] Geotechnical consulting division of J&K

[3] Referred to as JK Geotechnics (2018 Report)

1.3 Scope of Work

The assessment was undertaken generally in accordance with an EIS proposal (Ref: EP46568K) of 12 February 2018 and written acceptance from the client of 23 March 2018. The scope of work included the following:

- Review of site information, including background and site history information from a Lotsearch Pty Ltd *Environmental Risk and Planning Report*;
- A walkover site inspection;
- Design and implementation of a sampling, analysis and quality plan (SAQP), including soil sampling from eight locations;
- Interpretation of the analytical results against the adopted Site Assessment Criteria (SAC), including a Tier 1 risk assessment;
- Data Quality Assessment; and
- Preparation of a report.

The scope of work was undertaken with reference to the National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)[4], other guidelines made under or with regards to the Contaminated Land Management Act (1997)[5] and State Environmental Planning Policy No.55 – Remediation of Land (1998)[6]. A list of reference documents/guidelines is included in the appendices.

[4] National Environment Protection Council (NEPC), (2013). *National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013).* (referred to as NEPM 2013)

[5] Contaminated Land Management Act 1997 (NSW) (referred to as CLM Act 1997)

[6] *State Environmental Planning Policy No. 55 – Remediation of Land 1998* (NSW) (referred to as SEPP55)

2 SITE INFORMATION

2.1 Site Identification

Table 2-1: Site Identification

Site Address:	87 Memorial Avenue, St Ives, NSW
Lot & Deposited Plan:	Lot 24 in DP30558
Current Land Use:	St Ives North Public School
Proposed Land Use:	Continued use as primary school
Local Government Authority:	Ku-ring-gai Council
Current Zoning:	SP2 – Infrastructure, Educational Establishment
Site Area (m^2):	~23,000 Footprint of Investigation areas: - 2,300 (proposed three storey building) - 45 (proposed toilet block)
Geographical Location (decimal degrees) (approx.):	Latitude: -33.718864 Longitude: 151.163231

2.2 Site Location and Regional Setting

The site is located in a predominantly residential area of St Ives. The site is bounded by Memorial Avenue to the west and Toolang Road to the north. The site is located approximately 100m to the west of Kuring-gai Creek.

2.3 Topography

The site is located within a gently undulating topography generally sloping down towards the north-east at approximately 4^o. Parts of the site appear to have been levelled to account for the slope and accommodate the existing development.

2.4 Site Inspection

A walkover inspection of the site was undertaken by EIS on 2 June 2018. The inspection was limited to accessible areas of the site and did not include an internal inspection of buildings. The inspection focussed predominantly on the investigation areas, however a cursory walkover of the site was also undertaken for completeness.

At the time of the inspection the site was occupied by St Ives North Public School and comprised various buildings, including permanent and demountable buildings, grassed and paved recreational areas and paved parking areas. A summary of the other inspection findings are outlined in the following subsections. Where relevant the investigations areas are referred to as 'southern' (i.e. three story building), and 'northern' (i.e. toilet block) in order to differentiate between the areas (see Figure 2).

2.4.1 Buildings, Structures and Roads

The southern investigation area was generally asphaltic concrete or concrete paved with the existing Building F and Building A situated within the eastern and southern portions. A covered outdoor learning area (COLA) structure and Building H were present to the east, and Building E to the north-east of the southern investigation area.

In the northern investigation area the ground surface was concrete paved and no buildings or structures were present. A single storey building was present to the immediate south of the investigation area (Building G) and demountable classrooms and Building D were present to the east, north and west.

2.4.2 Visible or Olfactory Indicators of Contamination

Visible or olfactory indicators of contamination were not observed during the inspection.

2.4.3 Presence of Drums/Chemicals, Waste and Fill Material

Drums/chemicals or other waste was not observed during the inspection.

It is assumed that there is a maintenance shed/store within the school, although this was not inspected. Based on EIS' experience with other schools projects, this area would be unlikely to include the storage of significant quantities of dangerous goods such as paint, paint thinners and/or mower fuel.

Fill material was observed in areas of exposed fill across the playground in the eastern areas of the site and in garden beds and other landscaped areas.

2.4.4 Drainage and Services

Surface runoff from the site was expected to flow towards the east. Local stormwater drains were observed throughout the site and it was assumed that these discharged into the regional stormwater system.

2.4.5 Sensitive Environments

The Kuring-gai Municipality Reserve, an extensive area of natural vegetation, is located to the immediate east of the school.

2.4.6 Landscaped Areas and Visible Signs of Plant Stress

Various trees and shrubs were located throughout the site. The vegetation appeared to be in reasonable condition based on a cursory inspection, with no obvious or extensive dieback observed. Grass coverage was generally good, with the exception of some areas beneath large trees and isolated areas of the playground.

2.5 Surrounding Land Use

The surrounding land use included residential properties to the north, west and south and the Kuring-gai Municipal Reserve to the east of the site. There were no land uses in the surrounds that were considered to be obvious off-site sources of contamination.

2.6 Underground Services

The 'Dial Before You Dig' (DBYD) plans were reviewed for the assessment in order to establish whether any major underground services exist at the site or in the immediate vicinity that could act as a preferential pathway for contamination migration. Major services were not identified that would be expected to act as preferential pathways for contamination migration.

3 GEOLOGY AND HYDROGEOLOGY

3.1 Regional Geology

Regional geological information presented in the Lotsearch report (attached in the appendices) indicated that the western extent of the site is underlain by Ashfield Shale of the Wianamatta Group, which typically consists of black to dark grey shale and laminate and the eastern extent of the site is underlain by Triassic aged deposits of medium to coarse-grained quartz sandstone, and very minor shale and laminate lenses.

3.2 Acid Sulfate Soil (ASS) 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.

ASS information presented in the Lotsearch report (attached in the appendices) indicated that the site is located within a Class 5 area. Works in Class 5 areas that could pose an environmental risk in terms of ASS include works within 500m of adjacent Class 1,2,3,4 land which are likely to lower the water table below 1m AHD on the adjacent Class 1,2,3,4 land.

3.3 Hydrogeology

Hydrogeological information presented in the Lotsearch report (attached in the appendices) 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 33 registered bores within the report buffer of 2,000m. In summary:

- The nearest registered bore was located approximately 854m from the site. This was utilised for irrigation purposes;
- The majority of the bores were registered for monitoring purposes; and
- There were no nearby bores (i.e. within 800m) registered for domestic or irrigation uses.

The information reviewed for this assessment indicated that the subsurface conditions at the site are likely to consist of relatively low permeability (residual) soils overlying shallow bedrock. The potential for viable groundwater abstraction and use of groundwater under these conditions is considered to be low. Use of groundwater is not proposed as part of the development.

Considering the local topography and surrounding land features, EIS would generally expect groundwater to flow towards the east.

3.4 Receiving Water Bodies

Surface water bodies were not identified in the immediate vicinity of the site. The closest surface water body is Kuring-gai Creek located approximately 100m to the east of the site. This is down-gradient from site and is considered to be a potential receptor.

4 SITE HISTORY INFORMATION

4.1 Review of Historical Aerial Photographs

Historical aerial photographs were included in the Lotsearch report (attached in the appendices). EIS has reviewed the photographs and summarised relevant information in the following table:

Table 4-1: Summary of Historical Aerial Photographs

Year	Details
1943	The purpose of this is to note specific site features and speculate on possible land uses. Eg: The site appeared to be vacant and grassed (agricultural purposes). A small structure was observed in the northern investigation area. Natural bushland (Kuring-gai Municipal Reserve) was visible in the north-east corner of the site and extending along the eastern boundary of the site. To the north, west and south the surrounding land use appeared to also be for agricultural purposes.
1955	The site and surrounds appeared similar to the 1943 photograph.
1961	The site appeared to have been cleared with a large building (existing Building F) and a smaller building present in the south-west of the site. Several areas of exposed/scoured soil were visible across the site. Memorial Avenue was observed running the length of the western boundary. Beyond the avenue to the west the land appeared to have been developed for low density residential plots.
1965	Further development of the school site was visible with building observed along the western side of the site and in the south-west area. Scouring was also visible in the centre of the site. The land to the north-west, west, and south all appeared to have undergone development for low density residential properties.
1970	The school site was further developed with paved area visible across the western portion of the site and additional building in the central area. Further residential development of the surrounding land to the north, south and west was observed.
1982	With the exception of a grass covered playground to the north-east and tennis courts in the south-east section, the site and surrounding land use appeared similar to the 1970 photograph.
1991	The site and immediate surrounds appeared similar to the 1982 photograph.
2005	Several new structures were visible in the southern investigation area (COLA structures). The immediate surrounds appeared similar to the 1991 photograph.
2009	Several new structures were visible in the central part of the site (additional COLA structures). The immediate surrounds appeared similar to the 2005 photograph.
2016	Demountable classrooms were visible in the north-east corner of the site. The immediate surrounds appeared similar to the 2009 photograph.

4.2 NSW EPA Records

The Lotsearch report (attached in the appendices) included information from the NSW EPA databases for the following:

- Records maintained in relation to contaminated land under Section 58 of the CLM Act 1997;
- Records of sites notified in accordance with the Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997 (2015)[7]; and
- Licensed activities under the Protection of the Environment Operations Act (1997)[8].

The search included the site area and surrounding areas in the report buffer of 1,000m. The search indicated the following:

- There were no records for the site or any properties in the report buffer under Section 58 of the CLM Act 1997;
- The site has not been notified with regards to the Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997. There was one notified property within the report buffer, (Caltex Service Station), this property is not considered to pose a contamination risk to the site due to the property being over 800m away from the site and cross gradient; and
- There were no records for licenced activities at the site under the POEO Act 1997. Current and historical licenses were identified for several properties within the report buffer, including application of herbicides along waterways, however these activities are considered unlikely to pose a contamination risk to the site.

4.3 Historical Business Directory and Additional Lotsearch Information

Historical business records for the site and surrounding areas in the report buffer were included in the Lotsearch report (attached in the appendices). The records indicated that there were four motor garages and service station businesses registered within the report buffer during the 1970s and 1980s. These were all located over 800m cross-gradient of the site.

EIS are of the opinion that the historical businesses in the report buffer are unlikely to represent potential off-site sources of site contamination.

In addition to the above, EIS have reviewed additional information contained within the Lotsearch report and note the following:

- There were no local or state heritage items at the site or in the immediate surrounds; and
- There were no significant ecological constraints at the site or in the immediate surrounds.

[7] NSW EPA, (2015). *Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997.* (referred to as Duty to Report Contamination)

[8] Protection of the Environment Operations Act 1997 (NSW) (referred to as POEO Act 1997)

4.4 Summary of Site History Information

A time line summary of the historical land uses and activities is presented in the table below. The information presented in the table is based on a weight of evidence assessment of the site history documentation and observations made by EIS.

Table 4-2: Summary of Historical Land Uses

Year(s)	Potential Land Use / Activities
Circa 1920	Agricultural (orchards). The 1920 historical map included in the Lotsearch Report identified the site to be in the centre of an area marked on the map as 'Orchards'.
Between 1961 and 1970	Potential filling of the site. The aerial photographs indicated the site and surrounding area to have been developed for the school and residential properties. Filling of the site may have occurred to generate existing site levels for the construction of the school building and other preparatory works.

4.5 Integrity of Site History Information

The majority of the site history information was obtained from government organisations as outlined in the relevant sections of this report. The veracity of the information from these sources is considered to be relatively high. A certain degree of information loss can be expected given the lack of specific land use details over time. EIS have relied upon the Lotsearch report and have not independently verified any information contained within. However, it is noted that the Lotsearch report is generated based on databases maintained by various government agencies and is expected to be reliable.

5 CONCEPTUAL SITE MODEL

NEPM (2013) defines a CSM as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM for the site is presented in the following sub-sections and is based on the site information (including the site inspection information) and the review of site history information. Reference should also be made to the figures attached in the appendices.

A review of the CSM in relation to source, pathway and receptor (SPR) linkages has been undertaken as part of the Tier 1 risk assessment process, as outlined in Section 10.

5.1 Potential Contamination Sources/AEC and CoPC

The potential contamination sources/AEC and CoPC are presented in the following table:

Table 5-1: Potential (and/or known) Contamination Sources/AEC and Contaminants of Potential Concern

Source / AEC	CoPC
Fill material – The site appears to have been historically filled to achieve the existing levels. The fill may have been imported from various sources and could be contaminated. The JK Geotechnics 2018 investigation indicated that fill was present at the site to depths ranging between 0.25m and 0.5m bgl.	Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), petroleum hydrocarbons (referred to as total recoverable hydrocarbons – TRHs), benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), organophosphate pesticides (OPPs), polychlorinated biphenyls (PCBs) and asbestos.
Historical agricultural use – The historical maps and aerial photographs indicated the site to have been used for grazing and or orchard purposes. This could have resulted in contamination across the site via use of machinery, application of pesticides and building/demolition of various structures.	Heavy metals, TRH, PAHs, OCPs, PCBs and asbestos
Use of pesticides – Pesticides may have been used beneath the buildings and/or around the site.	Heavy metals and OCPs EIS note that pesticides only became commercially available in the 1940s. Prior to this time pesticides were predominantly heavy metal compounds.
Hazardous Building Material – Hazardous building materials may be present as a result of former building and demolition activities. These materials may also be present in the existing buildings/ structures on site.	Asbestos, lead and PCBs

5.2 Mechanism for Contamination, Affected Media, Receptors and Exposure Pathways

The mechanisms for contamination, affected media, receptors and exposure pathways relevant to the potential contamination sources/AEC are outlined in the following CSM table:

Table 5-2: CSM

Potential mechanism for contamination	The potential mechanisms for contamination are most likely to include 'top-down' impacts and spills. There is a potential for sub-surface releases to have occurred if deep fill (or other buried industrial infrastructure) is present, although this is considered to be the least likely mechanism for contamination.
Affected media	Soil/soil vapour have been identified as potentially affected media. The potential for groundwater impacts is considered to be relatively low. However, groundwater would need to be considered in the event significant contamination was identified in soil.
Receptor identification	Human receptors include site users (teachers, support staff, maintenance staff and primary school children), construction workers and intrusive maintenance workers. Off-site human receptors include adjacent residential land users. Ecological receptors include terrestrial organisms and plants within unpaved areas (including the proposed landscaped areas and gardens).
Potential exposure pathways	Potential exposure pathways relevant to the human receptors include ingestion, dermal absorption and inhalation of dust (all contaminants), vapours (volatile TRH, naphthalene, BTEX) and asbestos fibres. The potential for exposure would typically be associated with the construction works, and future use of unpaved areas (i.e. the gardens) and the buildings (i.e. vapour inhalation). Potential exposure pathways for ecological receptors include primary contact and ingestion.
Potential exposure mechanisms	The following have been identified as potential exposure mechanisms for site contamination: • Vapour intrusion into the proposed basement and/or building (either from soil contamination or volatilisation of contaminants from groundwater); • Contact (dermal, ingestion or inhalation) with exposed soils in landscaped areas and/or unpaved areas; • Migration of groundwater off-site and into nearby water bodies, including aquatic ecosystems and those being used for recreation; and • Migration of groundwater off-site into areas where groundwater is being utilised as a resource (i.e. for irrigation).

Presence of preferential pathways for contaminant movement	The stormwater infrastructure may act as preferential pathways for contaminant migration. This would be dependent on the contaminant type and transport mechanisms.

6 SAMPLING, ANALYSIS AND QUALITY PLAN

6.1 Data Quality Objectives (DQO)

Data Quality Objectives (DQOs) were developed to define the type and quality of data required to achieve the project objectives outlined in Section 1.2. The DQOs were prepared with reference to the process outlined in Schedule B2 of NEPM (2013) and the Guidelines for the NSW Site Auditor Scheme, 3rd Edition (2017)[9]. The seven-step DQO approach for this project is outlined in the following sub-sections.

The DQO process is validated in part by the Data Quality Assurance/Quality Control (QA/QC) Evaluation. The Data (QA/QC) Evaluation is summarised in Section 8.1 and the detailed evaluation is provided in the appendices.

6.1.1 Step 1 - State the Problem

The CSM identified potential sources of contamination/AEC at the site that may pose a risk to human health and the environment. Investigation data is required to assess the contamination status of the site, assess the risks posed by the contaminants in the context of the proposed development/intended land use, and assess whether remediation is required. A waste classification is required prior to off-site disposal of excavated soil/bedrock. The assessment was constrained in-part, by access limitations associated with the existing structures on site.

6.1.2 Step 2 - Identify the Decisions of the Study

The objectives of the assessment are outlined in Section 1.2. The decisions to be made reflect these objectives and are as follows:

- Did the inspection, or does the background information identify potential contamination sources/AEC?
- Are any results above the SAC?
- Do potential risks associated with contamination exist, and if so, what are they?
- Is there a requirement for further investigation and/or remediation?
- Is the investigation area(s) suitable for the proposed development, or can the investigation area(s) be made suitable subject to further characterisation and/or remediation?

6.1.3 Step 3 - Identify Information Inputs

The primary information inputs required to address the decisions outlined in Step 2 include the following:

- Existing relevant environmental data from previous reports;
- Site information, including site observations and site history documentation;
- Sampling of potentially affected media, including soil;

[9] NSW EPA (2017). *Guidelines for the NSW Site Auditor Scheme, 3rd ed.* (referred to as Site Auditor Guidelines 2017)

- Observations of sub-surface variables such as soil type, photo-ionisation detector (PID) concentrations, odours and staining;
- Laboratory analysis of soils for the CoPC identified in the CSM; and
- Field and laboratory QA/QC data.

6.1.4 Step 4 - Define the Study Boundary

The sampling will be confined to the site boundaries as shown in Figure 2 (spatial boundary). The sampling was completed on 2 June 2018 (temporal boundary). The assessment of potential risk to adjacent land users has been made based on data collected within the site boundary.

Sampling was not undertaken within the existing building footprint due to access constraints.

6.1.5 Step 5 - Develop an Analytical Approach (or Decision Rule)

6.1.5.1 Tier 1 Screening Criteria

The laboratory data will be assessed against relevant Tier 1 screening criteria (referred to as SAC), as outlined in Section 7. Exceedances of the SAC do not necessarily indicate a requirement for remediation or a risk to human health and/or the environment. Exceedances are considered in the context of the CSM and valid SPR-linkages.

For this assessment, the individual results have been assessed as either above or below the SAC. Statistical evaluation of the dataset via calculation of mean values and/or 95% upper confidence limit (UCL) values has not been undertaken due to the spatial distribution of the data and the number of samples submitted for analysis.

6.1.5.2 Field and Laboratory QA/QC

Field QA/QC included analysis of an intra-laboratory duplicate and trip blank sample. Further details regarding the sampling and analysis undertaken, and the acceptable limits adopted, is provided in the Data Quality (QA/QC) Evaluation in the appendices.

The suitability of the laboratory data is assessed against the laboratory QA/QC criteria which is outlined in the attached laboratory reports. These criteria were developed and implemented in accordance with the laboratory's National Association of Testing Authorities, Australia (NATA) accreditation and align with the acceptable limits for QA/QC samples as outlined in NEPM (2013) and other relevant guidelines.

In the event that acceptable limits are not met by the laboratory analysis, other lines of evidence are reviewed (e.g. field observations of samples, preservation, handling etc) and, where required, consultation with the laboratory is undertaken in an effort to establish the cause of the non-

conformance. Where uncertainty exists, EIS typically adopt the most conservative concentration reported (or in some cases, consider the data from the affected sample as an estimate).

6.1.5.3 Appropriateness of Practical Quantitation Limits (PQLs)

The PQLs of the analytical methods are considered in relation to the SAC to confirm that the PQLs are less than the SAC. In cases where the PQLs are greater than the SAC, a discussion of this is provided.

6.1.6 Step 6 – Specify Limits on Decision Errors

To limit the potential for decision errors, a range of quality assurance processes are adopted. A quantitative assessment of the potential for false positives and false negatives in the analytical results is undertaken with reference to Schedule B(3) of NEPM (2013) using the data quality assurance information collected.

Decision errors can be controlled through the use of hypothesis testing. The test can be used to show either that the baseline condition is false or that there is insufficient evidence to indicate that the baseline condition is false. The null hypothesis is an assumption that is assumed to be true in the absence of contrary evidence. For this assessment, the null hypothesis has been adopted which is that, there is considered to be a complete SPR linkage for the CoPC identified in the CSM unless this linkage can be proven not to (or unlikely to) exist. The null hypothesis has been adopted for this assessment.

6.1.7 Step 7 - Optimise the Design for Obtaining Data

The most resource-effective design will be used in an optimum manner to achieve the assessment objectives. Adjustment of the assessment design can occur following consultation or feedback from project stakeholders. For this investigation, the design was optimised via consideration of the various lines of evidence used to select the sample locations, the media being sampled, and also by the way in which the data were collected.

The sampling plan and methodology are outlined in the following sub-sections.

6.2 Soil Sampling Plan and Methodology

The soil sampling plan and methodology adopted for this assessment is outlined in the table below:

Table 6-1: Soil Sampling Plan and Methodology

Aspect	Input
Sampling Density	Samples were collected from eight locations as shown on the attached Figure 2. The sampling plan was not designed to meet the minimum sampling density for hotspot identification, as outlined in the NSW EPA Contaminated Sites Sampling Design Guidelines (1995)[10].

[10] NSW EPA, (1995), *Contaminated Sites Sampling Design Guidelines.* (referred to as EPA Sampling Design Guidelines 1995)

Aspect	Input
Sampling Plan	The sampling locations were placed on a judgemental sampling plan and were broadly positioned for coverage of the investigation areas, taking into consideration areas that were not easily accessible. This sampling plan was considered suitable to make a preliminary assessment of potential risks associated with the AEC and CoPC identified in the CSM, and assess whether further investigation is warranted.
Set-out and Sampling Equipment	Sampling locations were set out using a tape measure. In-situ sampling locations were cleared for underground services by an external contractor prior to sampling as outlined in the SSP. Samples were collected using a drill rig equipped with spiral flight augers. Soil samples were obtained from a Standard Penetration Test (SPT) split-spoon sampler, or directly from the auger when conditions did not allow use of the SPT sampler.
Sample Collection and Field QA/QC	Soil samples were obtained on 2 June 2018 in accordance with the standard sampling procedure (SSP) attached in the appendices. Soil samples were collected from the fill and natural profiles based on field observations. The sample depths are shown on the logs attached in the appendices. Samples were placed in glass jars with plastic caps and teflon seals with minimal headspace. Samples for asbestos analysis were placed in zip-lock plastic bags. During sampling, soil at selected depths was split into primary and duplicate samples for field QA/QC analysis.
Field Screening	A portable Photoionisation Detector (PID) fitted with a 10.6mV lamp was used to screen the samples for the presence of volatile organic compounds (VOCs). PID screening for VOCs was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled zip-lock plastic bags following equilibration of the headspace gases. PID calibration records are maintained on file by EIS. Fill/spoil at the sampling locations was visually inspected during the works for the presence of fibre cement fragments.
Decontami-nation and Sample Preservation	Sampling personnel used disposable nitrile gloves during sampling activities. Re-usable sampling equipment was decontaminated as outlined in the SSP. Soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with the SSP. On completion of the fieldwork, the samples were stored temporarily in fridges in the EIS warehouse before being delivered in the insulated sample container to a NATA registered laboratory for analysis under standard chain of custody (COC) procedures.

6.3 Analytical Schedule

The analytical schedule is outlined in the following table:

Table 6-2: Analytical Schedule

Analyte/CoPC	Fill Samples	Natural Soil Samples
Heavy Metals	8	8
TRH/BTEX	8	8
PAHs	8	8
OCPs/OPPs	8	-
PCBs	8	-
Asbestos	8	-

6.3.1 Laboratory Analysis

Samples were analysed by an appropriate, NATA Accredited laboratory using the analytical methods detailed in Schedule B(3) of NEPM 2013. Reference should be made to the laboratory reports attached in the appendices for further details.

Table 6-3: Laboratory Details

Samples	Laboratory	Report Reference
All primary samples and field QA/QC samples including (intra-laboratory duplicate and trip blank samples)	Envirolab Services Pty Ltd NSW, NATA Accreditation Number – 2901 (ISO/IEC 17025 compliance)	193227

7 SITE ASSESSMENT CRITERIA (SAC)

The SAC were derived from the NEPM 2013 and other guidelines as discussed in the following sub-sections. The guideline values for individual contaminants are presented in the attached report tables and further explanation of the various criteria adopted is provided in the appendices.

7.1 Soil

Soil data were compared to relevant Tier 1 screening criteria in accordance with NEPM (2013) as outlined below.

7.1.1 Human Health

- Health Investigation Levels (HILs) for a 'residential with accessible soils' exposure scenario (HIL-A);
- Health Screening Levels (HSLs) for a 'low-high density residential' exposure scenario (HSL-A & HSL-B). HSLs were calculated based on the soil type and the depth of the sample from the existing ground surface as the proposed building floor level is expected to be constructed approximately at the existing grade;
- Where exceedances of the HSLs were reported for hydrocarbons (TRH/BTEX and naphthalene), the soil health screening levels for direct contact presented in the CRC Care Technical Report No. 10 – Health screening levels for hydrocarbons in soil and groundwater Part 1: Technical development document (2011)[11] were considered; and
- Asbestos was assessed on the basis of presence/absence. Asbestos HSLs were not adopted as detailed asbestos quantification was not undertaken.

7.1.2 Environment (Ecological – terrestrial ecosystems)

- Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) for an 'urban residential and public open space' (URPOS) exposure scenario. These have only been applied to the top 2m of soil as outlined in NEPM (2013). The criteria for benzo(a)pyrene has been increased from the value presented in NEPM (2013) based on the information presented in the CRC Care Technical Report No. 39 – Risk-based management and guidance for benzo(a)pyrene (2017)[12];
- ESLs were calculated based on the soil type. EILs for selected metals were calculated based on the most conservative added contaminant limit (ACL) values presented in Schedule B(1) of NEPM (2013) and published ambient background concentration (ABC) values presented in the document titled Trace Element Concentrations in Soils from Rural and Urban Areas of Australia

[11] Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC Care), (2011). Technical Report No. 10 - *Health screening levels for hydrocarbons in soil and groundwater Part 1: Technical development document*

[12] CRC Care, (2011). *Technical Report No. 39 - Risk-based management and guidance for benzo(a)pyrene*

(1995)[13]. These data were used to select the added contaminant limit (ACL) values presented in Schedule B(1) of NEPM (2013), and published ambient background concentration (ABC) presented in the document titled Trace Element Concentrations in Soils from Rural and Urban Areas of Australia (1995)[14]. This method is considered to be adequate for the Tier 1 screening.

7.1.3 Waste Classification

Data for the waste classification assessment were assessed in accordance with the Waste Classification Guidelines, Part 1: Classifying Waste (2014)[15] as outlined in the following table:

Table 7-1: Waste Categories

Category	Description
General Solid Waste (non-putrescible)	• If Specific Contaminant Concentration (SCC) ≤ Contaminant Threshold (CT1) then Toxicity Characteristics Leaching Procedure (TCLP) not needed to classify the soil as general solid waste; and • If TCLP ≤ TCLP1 and SCC ≤ SCC1 then treat as general solid waste.
Restricted Solid Waste (non-putrescible)	• If SCC ≤ CT2 then TCLP not needed to classify the soil as restricted solid waste; and • If TCLP ≤ TCLP2 and SCC ≤ SCC2 then treat as restricted solid waste.
Hazardous Waste	• If SCC > CT2 then TCLP not needed to classify the soil as hazardous waste; and • If TCLP > TCLP2 and/or SCC > SCC2 then treat as hazardous waste.
Virgin Excavated Natural Material (VENM)	Natural material (such as clay, gravel, sand, soil or rock fines) that meet the following: • That has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial mining or agricultural activities; • That does not contain sulfidic ores or other waste; and • Includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved from time to time by a notice published in the NSW Government Gazette.

[13] Olszowy, H., Torr, P., and Imray, P., (1995), *Trace Element Concentrations in Soils from Rural and Urban Areas of Australia. Contaminated Sites Monograph Series No. 4*. Department of Human Services and Health, Environment Protection Agency, and South Australian Health Commission.

[14] Olszowy, H., Torr, P., and Imray, P., (1995), *Trace Element Concentrations in Soils from Rural and Urban Areas of Australia. Contaminated Sites Monograph Series No. 4*. Department of Human Services and Health, Environment Protection Agency, and South Australian Health Commission.

[15] NSW EPA, (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Waste Classification Guidelines 2014)

8 RESULTS

8.1 Summary of Data (QA/QC) Evaluation

The data evaluation is presented in the appendices. In summary, EIS are of the opinion that the data are adequately precise, accurate, representative, comparable and complete to serve as a basis for interpretation to achieve the investigation objectives.

8.2 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 8-1: Summary of Subsurface Conditions

Profile	Description (metres below ground level - mBGL)
Pavement	Asphaltic concrete/Concrete pavement was encountered in boreholes BH201, BH204, BH205, BH206, BH207 and BH208 and ranged in thickness between 50mm and 150mm.
Fill	Fill material was encountered at the surface or beneath the pavement in all boreholes and extended to depths of approximately 0.25m to 1.3m. The fill typically comprised of: gravelly sand, sandy clay and silty clay. The fill contained inclusions of: asphalt gravel; root fibres; ash; igneous gravel; ironstone gravel; and timber. Neither odours nor staining were observed in the fill during the investigation. Potential asbestos containing material was not observed.
Natural Soil	Silty clay and silty sand natural soil was encountered beneath the fill in boreholes BH204, BH205, BH206, and BH207 at depths of 0.3m to 0.6m. Neither odours nor staining were observed in the natural soil during the investigation.
Bedrock	Extremely weathered sandstone bedrock was encountered in boreholes BH201, BH202, BH203, and BH208 directly beneath the fill material at depths of between 1.0m to 1.2m. Neither odours nor staining were observed in the bedrock during the investigation.
Groundwater	Groundwater seepage was not encountered in the boreholes during drilling. All boreholes remained dry on completion of drilling and a short time after.

8.3 Field Screening

PID soil sample headspace readings are presented in attached report tables and the COC documents attached in the appendices. The results ranged from 0ppm to 0.2ppm equivalent isobutylene. These results indicate very minor PID detectable VOCs.

8.4 Soil Laboratory Results

The soil laboratory results are compared to the relevant SAC in the attached report tables. A summary of the results assessed against the SAC is presented below:

8.4.1 Human Health and Environmental (Ecological) Assessment

Table 8-2: Summary of Soil Laboratory Results – Human Health and Environmental (Ecological)

Analyte	Results Compared to SAC
Heavy Metals	All heavy metals results were below the SAC.
TRH	All TRH results were below the SAC.
BTEX	All BTEX results were below the SAC.
PAHs	All PAH results were below the SAC.
OCPs and OPPs	All OCP and OPP results were below the SAC. All pesticide concentrations were below the laboratory PQLs.
PCBs	All PCB results were below the SAC. All PCB concentrations were below the laboratory PQLs.
Asbestos	All asbestos results were below the SAC (i.e. asbestos was absent in the samples analysed for the investigation).

8.4.2 Waste Classification Assessment

The laboratory results were assessed against the criteria presented in Part 1 of the Waste Classification Guidelines, as summarised previously in this report. The results are presented in the report tables attached in the appendices. A summary of the results is presented below.

Table 8-3: Summary of Soil Laboratory Results Compared to CT and SCC Criteria

Analyte	No. of Samples Analysed	No. of Results > CT Criteria	No. of Results > SCC Criteria	Comments
Heavy Metals	16	0	0	All results were below the CT1 criteria
TRH	16	0	0	All results were below the CT1 criteria
BTEX	16	0	0	All results were below the CT1 criteria

Analyte	No. of Samples Analysed	No. of Results > CT Criteria	No. of Results > SCC Criteria	Comments
Total PAHs	16	0	0	All results were below the CT1 criteria
Benzo(a)pyrene	16	0	0	All results were below the CT1 criteria
OCPs & OPPs	8	0	0	All results were below the CT1 criteria
PCBs	8	0	0	All results were below the CT1 criteria
Asbestos	8	-	-	Asbestos was not detected in the samples analysed.

9 WASTE CLASSIFICATION ASSESSMENT

9.1 Waste Classification of Fill

Based on the results of the assessment, and at the time of reporting, the fill material is classified as **General Solid Waste (non-putrescible)**. Surplus fill should be disposed of to a facility that is appropriately licensed to receive this waste stream. The facility should be contacted to obtain the required approvals prior to commencement of excavation.

9.2 Classification of Natural Soil and Bedrock

Based on the scope of work undertaken for this assessment, and at the time of reporting, EIS are of the opinion that the natural soil and bedrock at the site meets the definition of **VENM** for off-site disposal or re-use purposes. VENM is considered suitable for re-use on-site, or alternatively, the information included in this report may be used to assess whether the material is suitable for beneficial reuse at another site as fill material. In accordance with Part 1 of the Waste Classification Guidelines, the VENM is pre-classified as general solid waste and can also be disposed of accordingly to a facility that is licensed to accept it.

10 DISCUSSION AND CONCLUSIONS

10.1 Tier 1 Risk Assessment and Review of CSM

For a contaminant to represent a risk to a receptor, the following three conditions must be present:

1. Source – The presence of a contaminant;
2. Pathway – A mechanism or action by which a receptor can become exposed to the contaminant; and
3. Receptor – The human or ecological entity which may be adversely impacted following exposure to contamination.

If one of the above components is missing, the potential for adverse risks is relatively low.

10.1.1 Soil

Elevated concentrations of contaminants above the SAC were not identified during the investigation. Therefore, no actual sources of contamination were identified, no complete SPR linkages have been identified, and potential risks associated with the CoPC are assessed by EIS to be relatively low.

10.2 Decision Statements

The decision statements are addressed below:

Did the inspection, or does the historical information identify potential contamination sources/AEC?

The inspection did not identify any obvious sources of potential contamination. The background assessment identified various potential sources of contamination/AEC, including fill, historical agricultural land use and hazardous building materials (i.e. from former demolition).

Agricultural/horticultural activities are listed in Table 1 of the SEPP55 Planning Guidelines as activities that may cause contamination.

Are any results above the SAC?

None of the soil results were above the SAC.

Do potential risks associated with contamination exist, and if so, what are they?

EIS are of the opinion that potential risks associated with contamination within the investigation areas are low. Due to the presence of uncontrolled fill, the likelihood of asbestos being present is possible, however the data collected during the investigation suggests that significant and widespread issues are unlikely to be encountered.

Is there a requirement for further investigation and/or remediation?

Further investigation and/or remediation is not considered to be required. Potential risks associated with the unidentified occurrence of asbestos or other sources of contamination can be addressed via the implementation of an unexpected finds protocol and, if required, appropriate management during the development works.

Is the investigation area(s) suitable for the proposed development, or can the investigation area(s) be made suitable subject to further characterisation and/or remediation?

EIS are of the opinion that the investigation area(s) can be made suitable for the proposed development outlined in Section 1.1, subject to the implementation of the unexpected finds protocol outlined in Section 10.3.

10.3 Unexpected Finds Protocol

As part of the implementation of this protocol, a suitably qualified contaminated land consultant[16] should be engaged to inspect the site following the initial site preparation works. For the northern investigation area the inspection should occur following removal/scrape back of the existing grass. For the southern investigation area the inspection should occur following demolition of the existing structures and removal of the pavements. A letter should be prepared to document the findings of the inspection(s) and provide further commentary on contamination and any unexpected finds.

Unexpected finds would typically be able to be identified by visual or olfactory indicators and could include:

- Waste materials in fill, including building and demolition waste;
- Fibre cement fragments (e.g. ACM);
- Stained fill/soil;
- Odorous soils (e.g. hydrocarbon odours); and/or
- Ash, slag and/or coal wash.

The following should be implemented in the event of an unexpected find:

- All work in the immediate vicinity should cease, and the contaminated land consultant (who was engaged to complete the initial inspection(s) should be contacted immediately to inspect and document the find;
- Temporary barricades should be erected to isolate the area;
- The consultant should develop and implement a strategy to assess the issue and provide guidance on the appropriate course of action; and

[16] EIS recommend that the consultancy engaged for the work be a member of the Australian Contaminated Land Consultants Associated (ACLCA), and/or the individual undertaking the works be certified under one of the NSW EPA endorsed certified practitioner schemes

- Any actions should be implemented and validated to demonstrate that there are no unacceptable risks to the receptors.

11 CONCLUSIONS AND RECOMMENDATIONS

The contamination assessment included a desktop site history assessment and fill/soil sampling from a total of eight boreholes. The background assessment identified various potential sources of contamination/AEC, including fill, historical agricultural land use and hazardous building materials (i.e. from former demolition). The site inspection did not identify any obvious sources of potential contamination.

Elevated concentrations of contaminants above the SAC were not identified during the investigation. On this basis, EIS are of the opinion that potential risks associated with contamination (i.e. the CoPC) within the investigation areas are low.

Due to the presence of uncontrolled fill, the likelihood of asbestos being present is possible, however the data collected during the investigation suggests that significant and widespread asbestos issues are unlikely to be encountered.

Further investigation and/or remediation is not considered to be required. Potential risks associated with unidentified occurrence of asbestos or other sources of contamination can be addressed via the implementation of an unexpected finds protocol and, if required, appropriate management during the development works. An unexpected finds protocol is included in Section 10.3 of this report.

Overall, EIS are of the opinion that the investigation area(s) can be made suitable for the proposed development outlined in Section 1.1, subject to the implementation of the unexpected finds protocol outlined in Section 10.3.

12 LIMITATIONS

The report limitations are outlined below:

- EIS accepts no responsibility for any unidentified contamination 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;
- Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work;
- 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 EIS proposal; and terms of contract between EIS 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, EIS has not undertaken any verification process, except where specifically stated in the report;
- EIS has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report;
- EIS 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;
- EIS have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or landuse. EIS should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa; and
- 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.

LIST OF IN-TEXT TABLES

IMPORTANT INFORMATION ABOUT THIS REPORT

These notes have been prepared by EIS 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 EIS 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.

EIS/J&K 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 EIS 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 contaminant concentrations may also vary over time through contaminant migration, natural attenuation of organic contaminants, ongoing contaminating activities and placement or removal of fill material. 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 contamination, the likely impact on the proposed development and appropriate remediation 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
Although information provided by a site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur; only the most likely contaminants are screened.

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 remediation 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.

REPORT FIGURES

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.5.1557
AERIAL IMAGE ©: 2015 GOOGLE INC.

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

Title: **SITE LOCATION PLAN**

Location: ST IVES NORTH PUBLIC SCHOOL
ST IVES, NSW

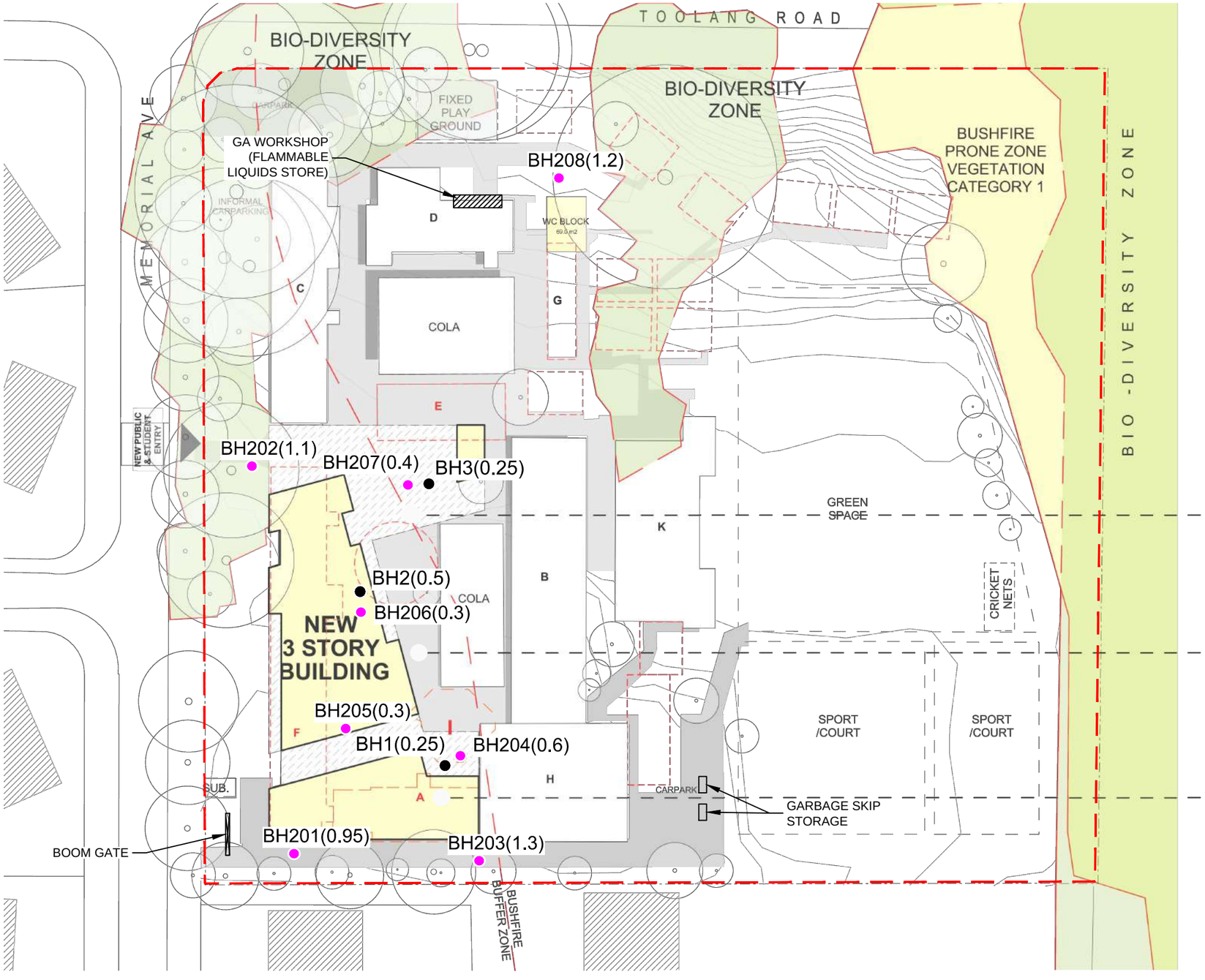
Report No: E31387K

Figure No: 1

ENVIRONMENTAL INVESTIGATION SERVICES

EIS

PLOT DATE: 5/06/2018 10:54:40 AM DWG FILE: S:\5 EIS\5C EIS JOBS\31000'S\E31387K ST IVES NORTH\CAD\E31387K.DWG



LEGEND

APPROXIMATE SITE BOUNDARY	
BH (Fill Depth)	BOREHOLE LOCATION, EIS (JUNE 2018), NUMBER AND DEPTH OF FILL (m)
BH(Fill Depth)	BOREHOLE LOCATION, JK GEOTECHNICS (MAY 2018), NUMBER AND DEPTH OF FILL (m)

0 8 16 24 32 40
SCALE 1:800 @A3 METRES

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

Title: **SAMPLE LOCATION PLAN**

Location: ST IVES NORTH PUBLIC SCHOOL
ST IVES, NSW

Report No: E31387K

Figure No: 2

ENVIRONMENTAL INVESTIGATION SERVICES

EIS

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LABORATORY SUMMARY TABLES

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ABC:	Ambient Background Concentration
ACM:	Asbestos Containing Material
ADWG:	AustralianDrinking Water Guidelines
AF:	Asbestos Fines
ANZECC:	Australian and New Zealand Environment Conservation Council
B(a)P:	Benzo(a)pyrene
CEC:	Cation Exchange Capacity
CRC:	Cooperative Research Centre
CT:	Contaminant Threshold
EILs:	Ecological Investigation Levels
ESLs:	Ecological Screening Levels
FA:	Fibrous Asbestos
GIL:	Groundwater Investigation Levels
HILs:	Health Investigation Levels
HSLs:	Health Screening Levels
HSL-SSA:	Health Screening Level-SiteSpecific Assessment
NA:	Not Analysed
NC:	Not Calculated
NEPM:	National Environmental Protection Measure
NHMRC:	National Health and Medical Research Council
NL:	Not Limiting
NSL:	No Set Limit
OCP:	Organochlorine Pesticides
OPP:	Organophosphorus Pesticides
PAHs:	Polycyclic Aromatic Hydrocarbons
ppm:	Parts per million
PCBs:	Polychlorinated Biphenyls
PCE:	Perchloroethylene (Tetrachloroethylene or Teterachloroethene)
pH_{KCL} :	pH of filtered 1:20, 1M KCL extract, shaken overnight
pH_{ox} :	pH of filtered 1:20 1M KCl after peroxide digestion
PQL:	Practical Quantitation Limit
RS:	Rinsate Sample
RSL:	Regional Screening Levels
SAC:	Site Assessment Criteria
SCC:	Specific Contaminant Concentration
S_{Cr}:	Chromium reducible sulfur
S_{POS}:	Peroxide oxidisable Sulfur
SSA:	Site Specific Assessment
SSHSLs:	Site Specific Health Screening Levels
TAA:	Total Actual Acidity in 1M KCL extract titrated to pH6.5
TB:	Trip Blank
TCA:	1,1,1 Trichloroethane (methyl chloroform)
TCE:	Trichloroethylene (Trichloroethene)
TCLP:	Toxicity Characteristics Leaching Procedure
TPA:	Total Potential Acidity, 1M KCL peroxide digest
TS:	Trip Spike
TRH:	Total Recoverable Hydrocarbons
TSA:	Total Sulfide Acidity (TPA-TAA)
UCL:	Upper Level Confidence Limit on Mean Value
USEPA	United States Environmental Protection Ager
VOCC:	Volatile Organic Chlorinated Compounds
WHO:	World Health Organisation
XW:	Extremely weathered (sandstone)

Table Specific Explanations:

HIL Tables:

- The chromium results are for Total Chromium which includes Chromium III and VI. For initial screening purposes, we have assumed that the samples contain only Chromium VI unless demonstrated otherwise by additional analysis.
- Carcinogenic PAHs is a toxicity weighted sum of analyte concentrations for a specific list of PAH compounds relative to B(a)P. It is also refered to as the B(a)P Toxic Equivalence Quotient (TEQ).
- Statistical calculations are undertaken using ProUCL (USEPA). Statistical calculation is usually undertaken using data from fill samples.

EIL/ESL Table:

- ABC Values for selected metals have been adopted from the published background concentrations presented in Olszowy et. al., (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (the 25th percentile values for old suburbs with high traffic have been quoted).

Waste Classification and TCLP Table:

- Data assessed using the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014).
- The assessment of Total Moderately Harmful pesticides includes: Dichlorovos, Dimethoate, Fenitrothion, Ethion, Malathion and Parathion.
- Assessment of Total Scheduled pesticides include: HBC, alpha-BHC, gamma-BHC, beta-BHC, Heptachlor, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, pp-DDE, Dieldrin, Endrin, pp-DDD, pp-DDT, Endrin Aldehyde.

TABLE A
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013.
HIL-D: 'Commercial/Industrial'

All data in mg/kg unless stated otherwise			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	Carcinogenic PAHs	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos		
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Site Assessment Criteria (SAC)			3000	900	3600	240000	1500	730	6000	400000	4000	40	80	2000	2500	45	530	3600	50	2000	7	Detected/Not Detected
Sample Reference	**Sample Depth**	**Sample Description**																				
BH201	0.15-0.3	Fill: gravelly sand	8	<0.4	11	35	13	<0.1	32	54	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH201	1.3-1.5	XW sandstone	<4	<0.4	13	<1	15	<0.1	<1	2	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH202	0-0.2	Fill: silty sand	<4	<0.4	11	6	18	<0.1	2	40	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH202	1.3-1.5	XW sandstone	6	<0.4	24	<1	14	<0.1	<1	2	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH203	0-0.2	Fill: silty sand	6	<0.4	12	13	31	<0.1	9	61	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH203	1.7-2.0	XW sandstone	8	<0.4	19	<1	9	<0.1	<1	1	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH204	0.05-0.2	Fill: silty sand	7	<0.4	22	8	36	0.2	2	24	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH204	0.6-0.9	Silty clay	<4	<0.4	22	<1	12	<0.1	1	2	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH205	0.05-0.3	Fill: sandy clay	23	<0.4	17	10	25	0.2	3	18	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH205	0.5-0.8	Silty sand	<4	<0.4	25	<1	15	<0.1	1	2	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH206	0.1-0.2	Fill: sandy clay	28	<0.4	17	13	21	0.1	3	25	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH206	0.3-0.45	Sandy clay	4	<0.4	19	<1	13	<0.1	<1	2	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH207	0.1-0.3	Fill: silty clay	7	<0.4	26	<1	19	<0.1	1	4	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH207	0.7-0.95	Silty clay	<4	<0.4	6	<1	19	<0.1	<1	<1	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH208	0.15-0.35	Fill: sandy clay	11	<0.4	34	1	14	<0.1	2	14	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH208	1.3-1.8	XW sandstone	<4	<0.4	10	1	7	<0.1	2	6	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			16	16	16	16	16	16	16	16	16	16	8	8	8	8	8	8	8	8	8	8
Maximum Value			28	<PQL	34	35	36	0.2	32	61	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	NC

Concentration above the SAC **VALUE**

TABLE B
SOIL LABORATORY RESULTS COMPARED TO HSLs
All data in mg/kg unless stated otherwise

					C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Field PID Measurement
PQL - Envirolab Services					25	50	0.2	0.5	1	1	1	ppm
NEPM 2013 HSL Land Use Category					**HSL-A/B:LOW/HIGH DENSITY RESIDENTIAL**							
Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**								
BH201	0.15-0.3	Fill: gravelly sand	0m to < 1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.1
BH201	1.3-1.5	XW sandstone	1m to <2m	Sand	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH202	0-0.2	Fill: silty sand	0m to < 1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.2
BH202	1.3-1.5	XW sandstone	1m to <2m	Sand	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH203	0-0.2	Fill: silty sand	0m to < 1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH203	1.7-2.0	XW sandstone	1m to <2m	Sand	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH204	0.05-0.2	Fill: silty sand	0m to < 1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH204	0.6-0.9	Silty clay	0m to < 1m	Clay	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH205	0.05-0.3	Fill: sandy clay	0m to < 1m	Clay	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH205	0.5-0.8	Silty sand	0m to < 1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH206	0.1-0.2	Fill: sandy clay	0m to < 1m	Clay	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH206	0.3-0.45	Sandy clay	0m to < 1m	Clay	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH207	0.1-0.3	Fill: silty clay	0m to < 1m	Clay	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH207	0.7-0.95	Silty clay	0m to < 1m	Clay	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH208	0.15-0.35	Fill: sandy clay	0m to < 1m	Clay	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
BH208	1.3-1.8	XW sandstone	1m to <2m	Sand	<25	<50	<0.2	<0.5	<1	<1	<0.1	0
Total Number of Samples					16	16	16	16	16	16	16	16
Maximum Value					<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.2

Concentration above the SAC **VALUE**

The guideline corresponding to the elevated value is highlighted in grey in the Site Assessment Criteria Table below

TABLE C
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013 EILs AND ESLs
All data in mg/kg unless stated otherwise

Land Use Category				URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																	
							AGED HEAVY METALS-EILs						EILs		ESLs							
				pH	CEC ($cmol_c/kg$)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	$>C_{16}$-C_{34} (F3)	$>C_{34}$-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services				-	1	-	4	1	1	1	1	1	0.1	0.1	25	50	100	100	0.2	0.5	1	3	0.05
Ambient Background Concentration (ABC)				-	-	-	NSL	13	28	163	5	122	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**																				
BH201	0.15-0.3	Fill: gravelly sand	Coarse	NA	NA	NA	8	11	35	13	32	54	<0.1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH201	1.3-1.5	XW sandstone	Coarse	NA	NA	NA	<4	13	<1	15	<1	2	<0.1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH202	0-0.2	Fill: silty sand	Coarse	NA	NA	NA	<4	11	6	18	2	40	<0.1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH202	1.3-1.5	XW sandstone	Coarse	NA	NA	NA	6	24	<1	14	<1	2	<0.1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH203	0-0.2	Fill: silty sand	Coarse	NA	NA	NA	6	12	13	31	9	61	<0.1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH203	1.7-2.0	XW sandstone	Coarse	NA	NA	NA	8	19	<1	9	<1	1	<0.1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH204	0.05-0.2	Fill: silty sand	Coarse	NA	NA	NA	7	22	8	36	2	24	<0.1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH204	0.6-0.9	Silty clay	Fine	NA	NA	NA	<4	22	<1	12	1	2	<0.1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH205	0.05-0.3	Fill: sandy clay	Fine	NA	NA	NA	23	17	10	25	3	18	<0.1	<0.1	<25	<50	110	<100	<0.2	<0.5	<1	<1	<0.05
BH205	0.5-0.8	Silty sand	Coarse	NA	NA	NA	<4	25	<1	15	1	2	<0.1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH206	0.1-0.2	Fill: sandy clay	Fine	NA	NA	NA	28	17	13	21	3	25	<0.1	<0.1	<25	<50	130	<100	<0.2	<0.5	<1	<1	<0.05
BH206	0.3-0.45	Sandy clay	Fine	NA	NA	NA	4	19	<1	13	<1	2	<0.1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH207	0.1-0.3	Fill: silty clay	Fine	NA	NA	NA	7	26	<1	19	1	4	<0.1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH207	0.7-0.95	Silty clay	Fine	NA	NA	NA	<4	6	<1	19	<1	<1	<0.1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH208	0.15-0.35	Fill: sandy clay	Fine	NA	NA	NA	11	34	1	14	2	14	<0.1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH208	1.3-1.8	XW sandstone	Coarse	NA	NA	NA	<4	10	1	7	2	6	<0.1	NA	<25	<50	110	<100	<0.2	<0.5	<1	<1	<0.05
Total Number of Samples				0	0	0	16	16	16	16	16	16	16	8	16	16	16	16	16	16	16	16	16
Maximum Value				<PQL	<PQL	<PQL	28	34	35	36	32	61	<PQL	<PQL	<PQL	<PQL	130	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Concentration above the SAC — VALUE

The guideline corresponding to the elevated value is highlighted in grey in the EIL and ESL Assessment Criteria Table below

EIL AND ESL ASSESSMENT CRITERIA

Land Use Category				URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																	
							AGED HEAVY METALS-EILs						EILs		ESLs							
				pH	CEC ($cmol_c/kg$)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	$>C_{16}$-C_{34} (F3)	$>C_{34}$-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services				-	1	-	4	1	1	1	1	1	0.1	0.1	25	50	100	100	0.2	0.5	1	3	0.05
Ambient Background Concentration (ABC)				-	-	-	NSL	13	28	163	5	122	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**																				
BH201	0.15-0.3	Fill: gravelly sand	Coarse	NA	NA	NA	100	203	88	1263	35	192	170	180	180	120	300	2800	50	85	70	105	33
BH201	1.3-1.5	XW sandstone	Coarse	NA	NA	NA	100	203	88	1263	35	192	170	--	180	120	300	2800	50	85	70	105	33
BH202	0-0.2	Fill: silty sand	Coarse	NA	NA	NA	100	203	88	1263	35	192	170	180	180	120	300	2800	50	85	70	105	33
BH202	1.3-1.5	XW sandstone	Coarse	NA	NA	NA	100	203	88	1263	35	192	170	--	180	120	300	2800	50	85	70	105	33
BH203	0-0.2	Fill: silty sand	Coarse	NA	NA	NA	100	203	88	1263	35	192	170	180	180	120	300	2800	50	85	70	105	33
BH203	1.7-2.0	XW sandstone	Coarse	NA	NA	NA	100	203	88	1263	35	192	170	--	180	120	300	2800	50	85	70	105	33
BH204	0.05-0.2	Fill: silty sand	Coarse	NA	NA	NA	100	203	88	1263	35	192	170	180	180	120	300	2800	50	85	70	105	33
BH204	0.6-0.9	Silty clay	Fine	NA	NA	NA	100	203	88	1263	35	192	170	--	180	120	1300	5600	60	105	125	45	33
BH205	0.05-0.3	Fill: sandy clay	Fine	NA	NA	NA	100	203	88	1263	35	192	170	180	180	120	1300	5600	60	105	125	45	33
BH205	0.5-0.8	Silty sand	Coarse	NA	NA	NA	100	203	88	1263	35	192	170	--	180	120	300	2800	50	85	70	105	33
BH206	0.1-0.2	Fill: sandy clay	Fine	NA	NA	NA	100	203	88	1263	35	192	170	180	180	120	1300	5600	60	105	125	45	33
BH206	0.3-0.45	Sandy clay	Fine	NA	NA	NA	100	203	88	1263	35	192	170	--	180	120	1300	5600	60	105	125	45	33
BH207	0.1-0.3	Fill: silty clay	Fine	NA	NA	NA	100	203	88	1263	35	192	170	180	180	120	1300	5600	60	105	125	45	33
BH207	0.7-0.95	Silty clay	Fine	NA	NA	NA	100	203	88	1263	35	192	170	--	180	120	1300	5600	60	105	125	45	33
BH208	0.15-0.35	Fill: sandy clay	Fine	NA	NA	NA	100	203	88	1263	35	192	170	180	180	120	1300	5600	60	105	125	45	33
BH208	1.3-1.8	XW sandstone	Coarse	NA	NA	NA	100	203	88	1263	35	192	170	--	180	120	300	2800	50	85	70	105	33

TABLE D
SOIL LABORATORY RESULTS COMPARED TO WASTE CLASSIFICATION GUIDELINES
All data in mg/kg unless stated otherwise

			HEAVY METALS								PAHs		OC/OP PESTICIDES				Total	TRH					BTEX COMPOUNDS				ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Total Endosulfans	Chloropyrifos	Total Moderately Harmful	Total Scheduled	PCBs	C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes	
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	25	50	100	100	250	0.2	0.5	1	3	100
General Solid Waste CT1			100	20	100	NSL	100	4	40	NSL	200	0.8	60	4	250	<50	<50	650		NSL		10,000	10	288	600	1,000	-
General Solid Waste SCC1			500	100	1900	NSL	1500	50	1050	NSL	200	10	108	7.5	250	<50	<50	650		NSL		10,000	18	518	1,080	1,800	-
Restricted Solid Waste CT2			400	80	400	NSL	400	16	160	NSL	800	3.2	240	16	1000	<50	<50	2600		NSL		40,000	40	1,152	2,400	4,000	-
Restricted Solid Waste SCC2			2000	400	7600	NSL	6000	200	4200	NSL	800	23	432	30	1000	<50	<50	2600		NSL		40,000	72	2,073	4,320	7,200	-
Sample Reference	**Sample Depth**	**Sample Description**																									
BH201	0.15-0.3	Fill: gravelly sand	8	<0.4	11	35	13	<0.1	32	54	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	Not Detected
BH201	1.3-1.5	XW sandstone	<4	<0.4	13	<1	15	<0.1	<1	2	<0.05	<0.05	NA	NA	NA	NA	NA	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	NA
BH202	0-0.2	Fill: silty sand	<4	<0.4	11	6	18	<0.1	2	40	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	Not Detected
BH202	1.3-1.5	XW sandstone	6	<0.4	24	<1	14	<0.1	<1	2	<0.05	<0.05	NA	NA	NA	NA	NA	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	NA
BH203	0-0.2	Fill: silty sand	6	<0.4	12	13	31	<0.1	9	61	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	Not Detected
BH203	1.7-2.0	XW sandstone	8	<0.4	19	<1	9	<0.1	<1	1	<0.05	<0.05	NA	NA	NA	NA	NA	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	NA
BH204	0.05-0.2	Fill: silty sand	7	<0.4	22	8	36	0.2	2	24	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	Not Detected
BH204	0.6-0.9	Silty clay	<4	<0.4	22	<1	12	<0.1	1	2	<0.05	<0.05	NA	NA	NA	NA	NA	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	NA
BH205	0.05-0.3	Fill: sandy clay	23	<0.4	17	10	25	0.2	3	18	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	120	Not Detected
BH205	0.5-0.8	Silty sand	<4	<0.4	25	<1	15	<0.1	1	2	<0.05	<0.05	NA	NA	NA	NA	NA	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	NA
BH206	0.1-0.2	Fill: sandy clay	28	<0.4	17	13	21	0.1	3	25	<0.05	<0.05	<0.1	<0.1	<0.1	0.2	<0.1	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	140	Not Detected
BH206	0.3-0.45	Sandy clay	4	<0.4	19	<1	13	<0.1	<1	2	<0.05	<0.05	NA	NA	NA	NA	NA	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	NA
BH207	0.1-0.3	Fill: silty clay	7	<0.4	26	<1	19	<0.1	1	4	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	Not Detected
BH207	0.7-0.95	Silty clay	<4	<0.4	6	<1	19	<0.1	<1	<1	<0.05	<0.05	NA	NA	NA	NA	NA	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	NA
BH208	0.15-0.35	Fill: sandy clay	11	<0.4	34	1	14	<0.1	2	14	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	<100	Not Detected
BH208	1.3-1.8	XW sandstone	<4	<0.4	10	1	7	<0.1	2	6	<0.05	<0.05	NA	NA	NA	NA	NA	<0.2	<0.5	<1	<1	<PQL	<25	<50	<100	100	NA
Total Number of samples			16	16	16	16	16	16	16	16	16	16	8	8	8	8	8	16	16	16	16	16	16	16	16	16	8
Maximum Value			28	<PQL	34	35	36	0.2	32	61	<PQL	<PQL	<PQL	<PQL	<PQL	0.2	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	140	NC

Concentration above the CT1 — **VALUE**
Concentration above SCC1 — **VALUE**
Concentration above the SCC2 — **VALUE**

TABLE E

SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS

All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Sample Ref = BH207 (0.1-0.2)	Arsenic	4	7	8	7.5	13
Dup Ref = HWDup	Cadmium	0.4	<0.4	<0.4	NC	NC
	Chromium	1	26	31	28.5	18
Envirolab Report: 193227	Copper	1	<1	2	1.3	120
	Lead	1	19	19	19.0	0
	Mercury	0.1	<0.1	<0.1	NC	NC
	Nickel	1	1	2	1.5	67
	Zinc	1	4	5	4.5	22
	Naphthalene	0.1	<0.1	<0.1	NC	NC
	Acenaphthylene	0.1	<0.1	<0.1	NC	NC
	Acenaphthene	0.1	<0.1	<0.1	NC	NC
	Fluorene	0.1	<0.1	<0.1	NC	NC
	Phenanthrene	0.1	<0.1	<0.1	NC	NC
	Anthracene	0.1	<0.1	<0.1	NC	NC
	Fluoranthene	0.1	<0.1	<0.1	NC	NC
	Pyrene	0.1	<0.1	<0.1	NC	NC
	Benzo(a)anthracene	0.1	<0.1	<0.1	NC	NC
	Chrysene	0.1	<0.1	<0.1	NC	NC
	Benzo(b,j+k)fluoranthene	0.2	<0.2	<0.2	NC	NC
	Benzo(a)pyrene	0.05	<0.05	<0.05	NC	NC
	Indeno(123-cd)pyrene	0.1	<0.1	<0.1	NC	NC
	Dibenzo(ah)anthracene	0.1	<0.1	<0.1	NC	NC
	Benzo(ghi)perylene	0.1	<0.1	<0.1	NC	NC
	Total OCPs	0.1	<0.1	<0.1	NC	NC
	Total OPPs	0.1	<0.1	<0.1	NC	NC
	Total PCBs	0.1	<0.1	<0.1	NC	NC
	TRH C_6-C_{10} (F1)	25	<25	<25	NC	NC
	TRH >C_{10}-C_{16} (F2)	50	<50	<50	NC	NC
	TRH >C_{16}-C_{34} (F3)	100	<100	<100	NC	NC
	TRH >C_{34}-C_{40} (F4)	100	<100	<100	NC	NC
	Benzene	0.2	<0.2	<0.2	NC	NC
	Toluene	0.5	<0.5	<0.5	NC	NC
	Ethylbenzene	1	<1	<1	NC	NC
	m+p-xylene	2	<2	<2	NC	NC
	o-xylene	1	<1	<1	NC	NC

Explanation:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

Results > 10 times PQL = RPD value <= 50% are acceptable

Results between 5 & 10 times PQL = RPD value <= 75% are acceptable

Results < 5 times PQL = RPD value <= 100% are acceptable

If result is LPQL then 50% of the PQL is used for the calculation

RPD Results Above the Acceptance Criteria VALUE

TABLE F

SUMMARY OF FIELD QA/QC RESULTS

ANALYSIS	Envirolab PQL		TB[S]
			2/06/2018
	mg/kg	µg/L	mg/kg
Benzene	1	0.2	<0.2
Toluene	1	0.5	<0.5
Ethylbenzene	1	1	<1
m+p-xylene	2	2	<2
o-xylene	1	1	<1

Explanation:

[W] Sample type (water)

[S] Sample type (sand)

BTEX concentrations in trip spikes are presented as % recovery

Values above PQLs/Acceptance criteria **VALUE**

Appendix A: Preliminary Salinity Assessment Report

ENVIRONMENTAL INVESTIGATION SERVICES

REPORT

TO

JDH ARCHITECTS

ON

PRELIMINARY SALINITY ASSESSMENT

FOR

PROPOSED SCHOOL DEVELOPMENT

AT

ST IVES NORTH PUBLIC SCHOOL, 87 MEMORIAL AVENUE, ST IVES, NSW

18 JUNE 2018 **REF: E31387Krpt-SAL**

Postal Address: PO Box 976, North Ryde BC NSW 1670
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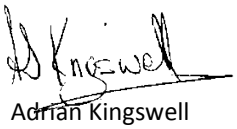

Adrian Kingswell
Principal | Environmental Scientist

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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**
Environmental Investigation Services	**EIS**
International Organisation of Standardisation	**ISO**
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**
Virgin Excavated Natural Material	**VENM**
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

JDH Architects ('the client') commissioned Environmental Investigation Services (EIS)[1] to undertake a preliminary salinity assessment for the proposed school development at St Ives North Public School, 87 Memorial Avenue, St Ives, NSW. This report forms Appendix A of the EIS report E31387Krpt (dated 18 June 2018, and referred to herein as 'the main report') and should be read in conjunction with the main report.

For the purpose of this report, the wider school property has been referred to as 'the site'. Soil sampling for the assessment was generally limited to the proposed new building footprints, referred to as the 'investigation areas'. Reference should be made to Figure 1 and Figure 2 attached to the main report for further details of these areas.

Background information on salinity is included in the appendices.

1.1 Proposed Development Details

It is understood the proposed development includes construction of a new three storey building in the south-west corner of the site and a new toilet block in the central north of the site.

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;
- Assess the soil salinity conditions via implementation of a preliminary 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 an EIS proposal (Ref: EP46568K) of 12 February 2018 and written acceptance from the client of 23 March 2018. The scope of work included the following:

- Review of site information, including background and site history information from a Lotsearch Pty Ltd *Environmental Risk and Planning Report*;
- 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; and
- Preparation of a report presenting the results of the assessment.

[1] Environmental consulting division of Jeffery & Katauskas Pty Ltd (J&K)

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[2])
Salinity Code of Practice (2004)[3]
Managing Urban Stormwater – Soil and Construction (4th ed.) (2004)[4]
Salinity Potential in Western Sydney Map (2002[5])
Piling – Design and Installation AS2159-2009 (2009)[6]
T56: Guide to Residential Slabs and Footings in Saline Environments (2005[7])

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

[3] 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)

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

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

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

[7] Cement, Concrete and Aggregates Australia (CCAA), (2005). *T56: Guide to Residential Slabs and Footings in Saline Environments* (referred to as CCAA 2005)

2 SITE INFORMATION

2.1 Site Description

The site is located in a predominantly residential area of St Ives. The site is bounded by Memorial Avenue to the west and Toolang Road to the north. The site is located approximately 100m to the west of Kuring-gai Creek. The site is located within a gently undulating topography generally sloping down towards the north-east at approximately 4^{o}. Parts of the site appear to have been levelled to account for the slope and accommodate the existing development.

A walkover inspection of the site was undertaken on 2 June 2018. The inspection was limited to accessible areas of the site and did not include an internal inspection of any buildings. The inspection focussed predominantly on the investigation areas, however a cursory walkover of the site was also undertaken for completeness.

At the time of the inspection there were no obvious salinity impacts observed within the investigation areas or the immediate surrounds. There were no salt scalds at the surface or on pavements, and all vegetation appeared to be in a reasonable condition.

3 GEOLOGY AND HYDROGEOLOGY

3.1 Regional Geology and Soils

Regional geological information presented in the Lotsearch report (attached in the appendices) indicated that the western extent of the site is underlain by Ashfield Shale of the Wianamatta Group, which typically consists of black to dark grey shale and laminate. The eastern extent of the site is underlain by Triassic aged deposits of medium to coarse-grained quartz sandstone, and very minor shale and laminate lenses.

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 not located in a region of known salinity potential.

3.3 Hydrogeology

Hydrogeological information presented in the Lotsearch report (attached in the appendices) 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 33 registered bores within the report buffer of 2,000m. The closest bore was over 850m away from the site.

3.4 Receiving Water Bodies and Surface Water Run-off

Surface water bodies were not identified in the immediate vicinity of the site. The closest surface water body is Kuring-gai Creek located approximately 100m to the east of the site. This is down-gradient from site and is considered to be a potential receptor.

Considering the local topography and surrounding land features, EIS would generally expect surface water to flow towards the west.

4 SAMPLING AND ANALYSIS PLAN

4.1 Soil Sampling Rationale

The investigation included the drilling of eight boreholes (BH201 to BH208 inclusive). Soil sampling for the salinity assessment was undertaken from a selection of two locations (BH205 and BH208) – one in the southern investigation area and one in the northern investigation area. When considering the extent of the development footprint, this density 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 within each of the proposed development areas.

Soil sampling for this assessment was confined to the depth of approximately 2m below existing ground level. This was considered adequate as the proposed development includes only minimal excavations.

4.2 Soil Sampling Methods

The soil sampling methods are outlined in the main report.

4.3 Laboratory Analysis

Samples were analysed by Envirolab Services Pty Ltd (NATA accreditation number 2901). Reference should be made to the laboratory reports (Ref: 193227) attached in the appendices for further details of the analytical methods.

4.4 Analytical Schedule

The analytical schedule is outlined in the following table:

Table 4-1: Analytical Schedule

Analyte	Fill Samples	Natural Soil Samples
pH	3	1
Electrical Conductivity (EC)	3	1
Resistivity	3	1
Texture (used to determine EC extract – ECe)	2	-
Sulphate	3	1
Chloride	3	1

5 SITE ASSESSMENT CRITERIA (SAC)

5.1 Soil Salinity and Plant Growth

The electrical conductivity (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[8]) presented below:

[8] 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[9]) 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

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

Very high	>40	>2	>2	>20	>8

Note:
CEC – Cation Exchange Capacity, Na – Sodium, K – Potassium, Ca – Calcium, Mg – Magnesium

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[10]). At ratios of less than 4:1 calcium is considered to be deficient, whilst at ratios of greater than 6:1 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[11]) indicate that a soil is generally considered sodic if the ESP exceeds 6% and extremely sodic if the ESP exceeds 15%.

5.5 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 2005. 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 2005 publication for further information:

Table 5-4: 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

[10] Eckert, D.J, (1987) .*Soil Test Interpretation: Basic Cation Saturation Ratios and Sufficiency Levels* (referred to as Eckert 1987)
[11] Charman, P.E.V and Murphy, B.W (eds), (2000).*Soils: Their Management and Properties,* (referred to as Charman and Murphy 2000)

>16	Highly saline	≥N40

Note:

1 - Concrete Grade for Salinity Class has been adopted from CCAA 2005

5.6 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 5-5: 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 5-6: 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

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)
Pavement	Asphaltic concrete/Concrete pavement was encountered in boreholes BH201, BH204, BH205, BH206, BH207 and BH208 and ranged in thickness between 50mm and 150mm.
Fill	Fill material was encountered at the surface or beneath the pavement in all boreholes and extended to depths of approximately 0.25m to 1.3m. The fill typically comprised of: gravelly sand, sandy clay and silty clay. The fill contained inclusions of: asphalt gravel; root fibres; ash; igneous gravel; ironstone gravel; and timber. Neither odours nor staining were observed in the fill during the investigation. Potential asbestos containing material was not observed.
Natural Soil	Silty clay and silty sand natural soil was encountered beneath the fill in boreholes BH204, BH205, BH206, and BH207 at depths of 0.3m to 0.6m. Neither odours nor staining were observed in the natural soil during the investigation.
Bedrock	Extremely weathered sandstone bedrock was encountered in boreholes BH201, BH202, BH203, and BH208 directly beneath the fill material at depths of between 1.0m to 1.2m. Neither odours nor staining were observed in the bedrock during the investigation.
Groundwater	Groundwater seepage was not encountered in the boreholes during drilling. All 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 25µS/m to 110µS/m. All ECe results were less than the practical quantification limit (PQL).

Analyte	Results
Resistivity	Resistivity values were calculated based on the raw EC values. The resistivity values for the soil samples ranged from 9,091ohm.cm to 40,000ohm.cm.
pH	The results of the analysis ranged from 4.7 to 6.6.
CEC	The results of the analysis ranged from: • CEC – 3.4meq/100g to 6.4meq/100g; • Exchangeable Na – less than the PQL to 0.15meq/100g; • Exchangeable K – all results were less than the PQL; • Exchangeable Ca – 2.6meq/100g to 5.4meq/100g; and • Exchangeable Mg – 0.64meq/100g to 0.84meq/100g.
Sulphate	The results ranged from 25mg/kg to 100mg/kg.
Chloride	All results were less than the PQL

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 were all less than the PQL. All samples were classed as non-saline.
Soil pH and Plant Growth	The soil pH results ranged from 4.7 to 6.6 and are classed as very strongly acidic to optimal plant growth pH range. The majority of the surficial soils were generally within the optimum range for plant growth. The acidic conditions generally increased with depth. The proposed excavations will generally expose acidic soils and may require treatment with lime or gypsum in order to make the soils suitable for plant growth.
CEC in Soil	The CEC values ranged from 3.4meq/100g to 6.4meq/100g in the very low to low range. The majority of the samples were within the very low to low range which is typical of the soil formation encountered at the site and are generally indicative of the low levels of organic matter within the soils.

Parameter	Notes
Ratio of Calcium to Magnesium	The results indicate that the soils have more calcium than magnesium. The CEC of the soil is generally very low to low. 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 2.9%. The majority of the ESP results were below the 5% threshold and were classed as non-sodic.
Concrete Slabs and Footings in Saline Soils (CCAA 2005)	The proposed earthworks are anticipated to expose soils generally classed as non-saline across the site. The CCAA 2005 recommended concrete grade for slabs and footings in non-saline soils is N20. Reference should also be made to AS2159-2009 for minimum concrete strengths and reinforcement cover for concrete piles/foundations.
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 mildly aggressive towards buried concrete.
Exposure Classification for Steel Piles/Foundations (AS2159-2009)	The soil resistivity, pH and chloride results indicate that the soils are non-aggressive towards buried steel.

8 DISCUSSION AND RECOMMENDATIONS

Based on the findings of the preliminary assessment, significantly saline and/or aggressive soil conditions are not expected to be encountered during the development works (as described in Section 1.1) where excavations beyond a depth of 2m are not proposed. EIS recommend that the structural engineer review the exposure classification and salinity results within this report and factor these into the design accordingly.

9 LIMITATIONS

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.

EIS 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.

Reference should also be made to the limitations presented in the main report which also apply to this preliminary salinity assessment report.

LIST OF IN-TEXT TABLES

IMPORTANT INFORMATION ABOUT THIS REPORT

These notes have been prepared by EIS 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 EIS 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.

EIS/J&K 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 EIS 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.

LABORATORY SUMMARY TABLES

TABLE S1
SUMMARY OF SOIL LABORATORY RESULTS - EC and ECe

Borehole Number	Sample Depth (m)	Sample Description	EC (µS/cm)	ECe (dS/m)	Salinity Class[1]
Sample Depth Range - 0.05m to 2.0m					
BH205	0.05-0.3	Fill: sandy clay	51	<2	**Non-Saline**
BH205	1.5-2.0	Silty clay	25	<2	**Non-Saline**
BH208	0.15-0.35	Fill: sandy clay	110	<2	**Non-Saline**
BH208	0.7-0.95	Fill: sandy clay	44	<2	**Non-Saline**
Total Number of Samples			4	0	-
Minimum Value			25	0	-
Maximum Value			110	0	-

Explanation

1 - Salinity Class has been adopted from '*Site Investigations for Urban Salinity*' DLWC 2002.

(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**

Abbreviations

EC - Electrical Conductivity
ECe - Extract Electrical Conductivity

TABLE S2
SUMMARY OF RESISTIVITY CALCULATION ON SOIL EC RESULTS

Borehole Number	Sample Depth (m)	Sample Description	EC (µS/cm)	Resistivity[1] (ohm.cm)	Classification[2] Condition B
Sample Depth Range - 0.05m to 2.0m					
BH205	0.05-0.3	Fill: sandy clay	51	19,608	Non-Aggressive
BH205	1.5-2.0	Silty clay	25	40,000	Non-Aggressive
BH208	0.15-0.35	Fill: sandy clay	110	9,091	Non-Aggressive
BH208	0.7-0.95	Fill: sandy clay	44	22,727	Non-Aggressive
Total Number of Samples			4	4	-
Minimum Value			25	9,091	-
Maximum Value			110	40,000	-

Explanation

1 - Resistivity values have been calculated on the laboratory EC values presented in Table B

2 - Classification derived from the Australian Standard 2159-2009 Piling Design and Installation (Table 6.5.2 [A] & [C])
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**

Abbreviations

EC - Electrical Conductivity

TABLE S3
SUMMARY OF SOIL LABORATORY RESULTS - pH

Borehole Number	Sample Depth (m)	Sample Description	pH	Classification for Concrete Piles[1] Soil Condition B[2]	Classification for Steel Piles[1] Soil Condition B[2]
Sample Depth Range - 0.05m to 2.0m					
BH205	0.05-0.3	Fill: sandy clay	5.7	**Non-Aggressive**	**Non-Aggressive**
BH205	1.5-2.0	Silty clay	4.7	**Mildly Aggressive**	**Non-Aggressive**
BH208	0.15-0.35	Fill: sandy clay	6.6	**Non-Aggressive**	**Non-Aggressive**
BH208	0.7-0.95	Fill: sandy clay	5.7	**Non-Aggressive**	**Non-Aggressive**
Total Number of Samples			4	-	-
Minimum Value			4.7	-	-
Maximum Value			6.6	-	-

Explanation

1 - pH Classification derived from the Australian Standard 2159-2009 Piling Design and Installation (Tables 6.4.2 [C] & 6.5.2 [C])

2 - 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 S4
SUMMARY OF SOIL LABORATORY RESULTS - SULPHATE & CHLORIDES

Borehole Number	Sample Depth (m)	Sample Description	Sulphate (mg/kg)	Chloride (mg/kg)	Classification for Concrete Piles[1] SO4 - Soil Condition B[2]	Classification for Steel Piles[1] Cl - Soil Condition B[2]
Sample Depth Range - 0.05m to 2.0m						
BH205	0.05-0.3	Fill: sandy clay	53	<10	Non-Aggressive	Non-Aggressive
BH205	1.5-2.0	Silty clay	25	<10	Non-Aggressive	Non-Aggressive
BH208	0.15-0.35	Fill: sandy clay	100	<10	Non-Aggressive	Non-Aggressive
BH208	0.7-0.95	Fill: sandy clay	41	<10	Non-Aggressive	Non-Aggressive
Total Number of Samples			4	0	-	-
Minimum Value			25	0	-	-
Maximum Value			100	0	-	-

Explanation

1 - Classification derived from the Australian Standard 2159-2009 Piling Design and Installation (Tables 6.4.2 [C] & 6.5.2 [C])

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

Sulphate (SO4) 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 (Cl) 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 S5
SUMMARY OF SOIL LABORATORY RESULTS - CEC & ESP

Borehole Number	Sample Depth (m)	Sample Description	Total CEC	Ca	K	Mg	Na	ESP[1]
			(meq/100g)					%
BH205	0.05-0.3	Fill: sandy clay	3.4	2.6	<0.1	0.64	<0.1	2.9
BH208	0.15-0.35	Fill: sandy clay	6.4	5.4	<0.1	0.84	0.15	2.3
Total Number of Samples			2	2	0	2	1	2
Minimum Value			3.40	2.60	0.00	0.64	0.15	2.34
Maximum Value			6.40	5.40	0.00	0.84	0.15	2.94

Explanation

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

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

Abbreviation

CEC: Cation Exchange Capacity
ESP: Exchangeable Sodium Percentage (Each Na/CEC)
Mg: Exchangeable Magnesium
Na: Exchangeable Sodium
K: Exchangeable Potassium
Ca: Exchangeable Calcium

Appendix A: Background on Salinity

BACKGROUND ON SALINITY

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.

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.

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.

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 B: Site Information including Site History

Lotsearch Environmental Risk and Planning Report

LOTSEARCH

LOTSEARCH ENVIRO PROFESSIONAL

Date: 22 May 2018 12:29:52

Reference: LS003425

Address: St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

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Location Confidences

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
1	Georeferenced to the site location / premise or part of site
2	Georeferenced with the confidence of the general/approximate area
3	Georeferenced to the road or rail
4	Georeferenced to the road intersection
5	Feature is a buffered point
6	Land adjacent to Georeferenced Site
7	Georeferenced to a network of features

Dataset Listing

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

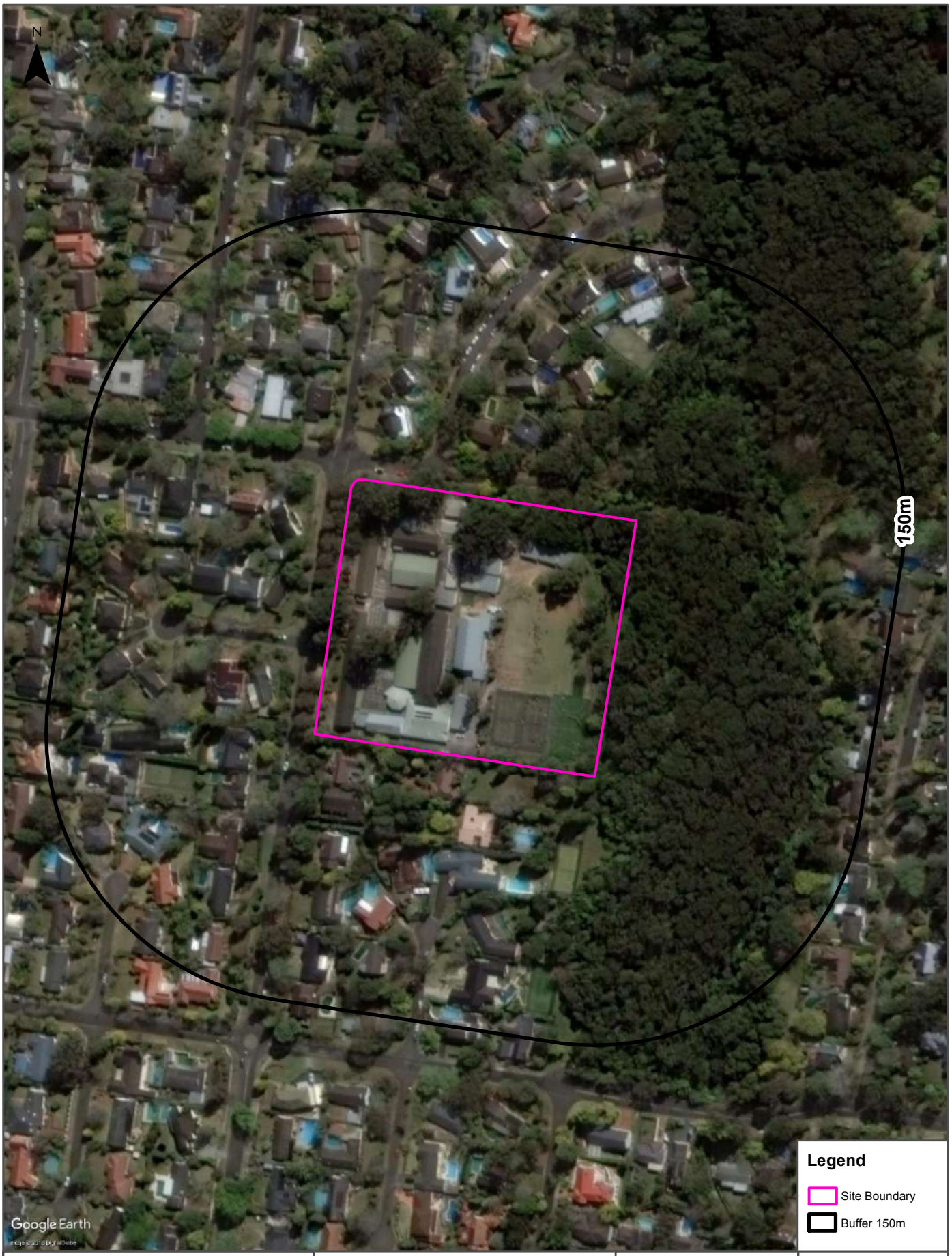
Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	Dataset Buffer (m)	No. Features Onsite	No. Features within 100m	No. Features within Buffer
Cadastre Boundaries	Dept. Finance, Services & Innovation	22/05/2018	22/05/2018	Daily	-	-	-	-
Topographic Data	Dept. Finance, Services & Innovation	09/04/2018	09/04/2018	As required	-	-	-	-
List of NSW contaminated sites notified to EPA	Environment Protection Authority	22/05/2018	16/04/2018	Monthly	1000	0	0	1
Contaminated Land Records of Notice	Environment Protection Authority	22/05/2018	22/05/2018	Monthly	1000	0	0	0
Former Gasworks	Environment Protection Authority	22/05/2018	11/10/2017	Monthly	1000	0	0	0
National Waste Management Site Database	Geoscience Australia	22/05/2018	07/03/2017	Quarterly	1000	0	0	0
EPA PFAS Investigation Program	Environment Protection Authority	22/05/2018	22/05/2018	Monthly	2000	0	0	0
EPA Other Sites with Contamination Issues	Environment Protection Authority	11/01/2018	11/01/2018	Quarterly	1000	0	0	0
Licensed Activities under the POEO Act 1997	Environment Protection Authority	10/04/2018	10/04/2018	Monthly	1000	0	0	0
Delicensed POEO Activities still Regulated by the EPA	Environment Protection Authority	10/04/2018	10/04/2018	Monthly	1000	0	0	0
Former POEO Licensed Activities now revoked or surrendered	Environment Protection Authority	10/04/2018	10/04/2018	Monthly	1000	0	3	3
UPSS Environmentally Sensitive Zones	Environment Protection Authority	14/04/2015	12/01/2010	As required	1000	0	0	1
UBD Business to Business Directory 1991 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business to Business Directory 1991 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business to Business Directory 1986 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business to Business Directory 1986 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1982 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1982 (Road & Area Matches)	Hardie Grant			Not required	150	-	2	2
UBD Business Directory 1978 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1978 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1975 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1975 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1970 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1970 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1965 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1965 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1961 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1961 (Road & Area Matches)	Hardie Grant			Not required	150	-	0	0
UBD Business Directory 1950 (Premise & Intersection Matches)	Hardie Grant			Not required	150	0	0	0
UBD Business Directory 1950 (Road & Area Matches)	Hardie Grant			Not required	150	-	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
UBD Business Directory Drycleaners & Motor Garages/Service Stations (Premise & Intersection Matches)	Hardie Grant			Not required	1000	0	0	4
UBD Business Directory Drycleaners & Motor Garages/Service Stations (Road & Area Matches)	Hardie Grant			Not required	1000	-	0	19
Points of Interest	Dept. Finance, Services & Innovation	09/04/2018	09/04/2018	Annually	1000	1	1	26
Tanks (Areas)	Dept. Finance, Services & Innovation	09/04/2018	09/04/2018	Annually	1000	0	0	0
Tanks (Points)	Dept. Finance, Services & Innovation	09/04/2018	09/04/2018	Annually	1000	0	0	0
Major Easements	Dept. Finance, Services & Innovation	09/04/2018	09/04/2018	As required	1000	0	0	6
State Forest	Dept. Finance, Services & Innovation	18/01/2018	18/01/2018	As required	1000	0	0	0
NSW National Parks and Wildlife Service Reserves	NSW Office of Environment & Heritage	18/01/2018	30/09/2017	Annually	1000	0	0	0
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 Primary Industries	15/03/2018	01/10/2005	As required	1000	0	0	0
Groundwater Boreholes	NSW Dept. of Primary Industries - Office of Water / Water Administration Ministerial Corporation; Commonwealth of Australia (Bureau of Meteorology)	21/03/2016	01/12/2015	Annually	2000	0	0	33
Geological Units 1:100,000	NSW Dept. of Industry, Resources & Energy	20/08/2014		None planned	1000	2	-	2
Geological Structures 1:100,000	NSW Dept. of Industry, Resources & Energy	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
Soil Landscapes	NSW Office of Environment & Heritage	12/08/2014		None planned	1000	2	-	7
Atlas of Australian Soils	CSIRO	19/05/2017	17/02/2011	As required	1000	1	1	2
Standard Local Environmental Plan Acid Sulfate Soils	NSW Planning and Environment	07/10/2016	07/10/2016	As required	500	1	-	-
Atlas of Australian Acid Sulfate Soils	CSIRO	19/01/2017	21/02/2013	As required	1000	1	1	2
Dryland Salinity - National Assessment	National Land and Water Resources Audit	18/07/2014	12/05/2013	None planned	1000	0	0	0
Dryland Salinity Potential of Western Sydney	NSW Office of Environment & Heritage	12/05/2017	01/01/2002	None planned	1000	-	-	-
Mining Subsidence Districts	Dept. Finance, Services & Innovation	13/07/2017	01/07/2017	As required	1000	0	0	0
SEPP 14 - Coastal Wetlands	NSW Planning and Environment	17/12/2015	24/10/2008	Annually	1000	0	0	0
SEPP 26 - Littoral Rainforest	NSW Planning and Environment	17/12/2015	05/02/1988	Annually	1000	0	0	0
SEPP 71 - Coastal Protection	NSW Planning and Environment	17/12/2015	01/08/2003	Annually	1000	0	0	0
SEPP Major Developments 2005	NSW Planning and Environment	09/03/2013	25/05/2005	Under Review	1000	0	0	0
SEPP Strategic Land Use Areas	NSW Planning and Environment	01/08/2017	28/01/2014	Annually	1000	0	0	0
LEP - Land Zoning	NSW Planning and Environment	11/04/2018	16/03/2018	Quarterly	1000	1	4	47
LEP - Minimum Subdivision Lot Size	NSW Planning and Environment	04/04/2018	23/03/2018	Quarterly	0	0	-	-
LEP - Height of Building	NSW Planning and Environment	04/04/2018	23/03/2018	Quarterly	0	0	-	-
LEP - Floor Space Ratio	NSW Planning and Environment	04/04/2018	23/03/2018	Quarterly	0	1	-	-
LEP - Land Application	NSW Planning and Environment	04/04/2018	23/03/2018	Quarterly	0	1	-	-
LEP - Land Reservation Acquisition	NSW Planning and Environment	04/04/2018	09/03/2018	Quarterly	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
State Heritage Items	NSW Office of Environment & Heritage	04/04/2018	30/09/2016	Quarterly	1000	0	0	0
Local Heritage Items	NSW Planning and Environment	04/04/2018	23/03/2018	Quarterly	1000	0	0	7
Bush Fire Prone Land	NSW Rural Fire Service	10/05/2018	23/01/2018	Quarterly	1000	2	3	3
Native Vegetation of the Sydney Metropolitan Area	NSW Office of Environment & Heritage	01/03/2017	16/12/2016	As required	1000	5	6	14
RAMSAR Wetlands	Commonwealth of Australia Department of 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	2
NSW BioNet Species Sightings	NSW Office of Environment & Heritage	14/05/2018	14/05/2018	Daily	10000	-	-	-

Aerial Imagery 2017

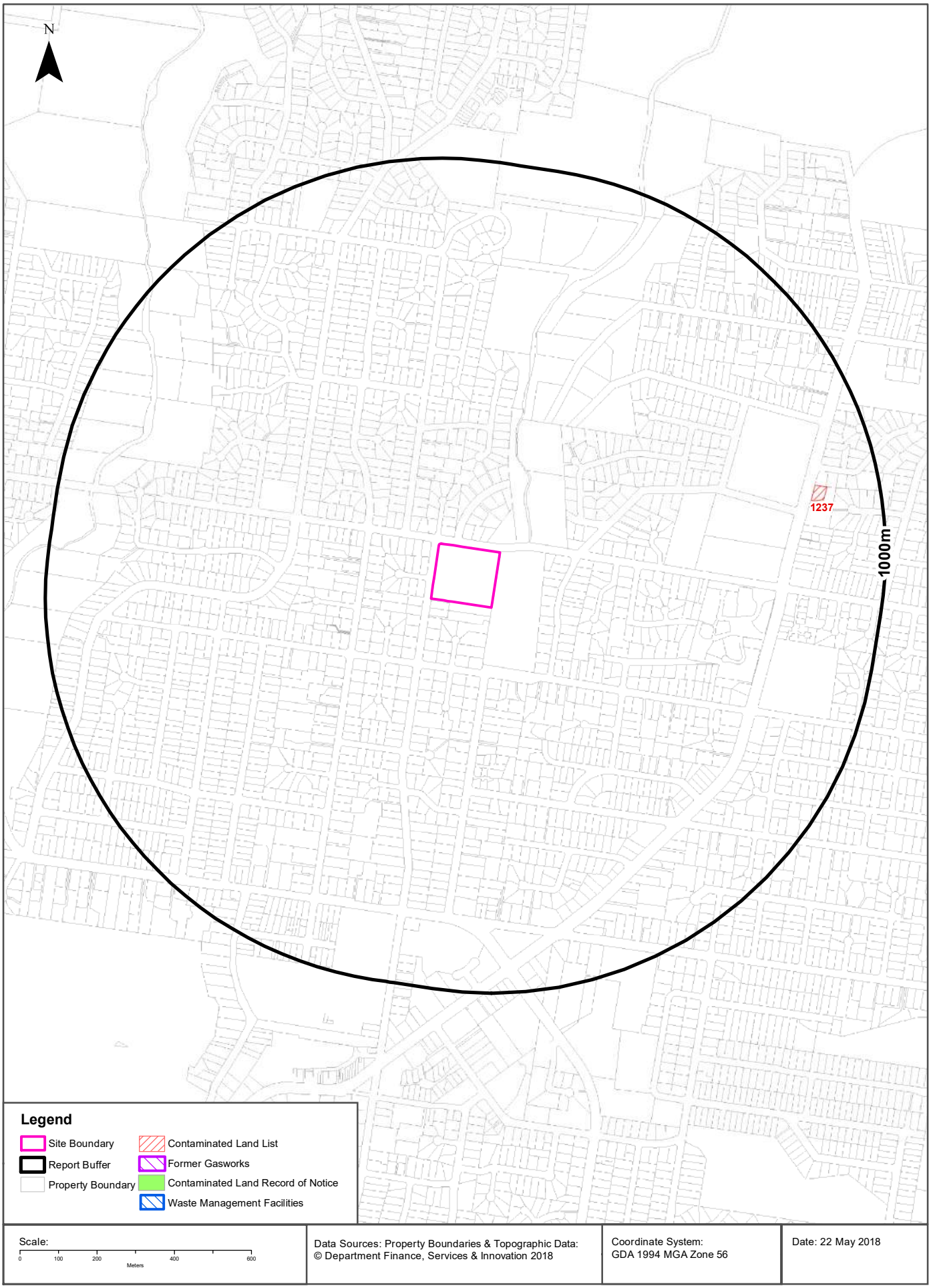
St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Scale: 0 25 50 100 Meters	Data Source Aerial Imagery: © 2018 Google Inc, used with permission. Google and the Google logo are registered trademarks of Google Inc.	Coordinate System: GDA 1994 MGA Zone 56	Date: 17 May 2018

Contaminated Land & Waste Management Facilities

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Contaminated Land & Waste Management Facilities

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

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
1237	Caltex Service Station	363 Mona Vale Road	St Ives	Service Station	Regulation under CLM Act not required	Current EPA List	Premise Match	816m	East

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 & Waste Management Facilities

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

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

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

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											

Waste Management Facilities Data Source: Geoscience Australia

EPA PFAS Investigation Program

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

EPA PFAS Investigation Program

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

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

EPA PFAS Investigation Program: Environment Protection Authority

EPA Other Sites with Contamination Issues

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

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

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

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Licensed Activities under the POEO Act 1997

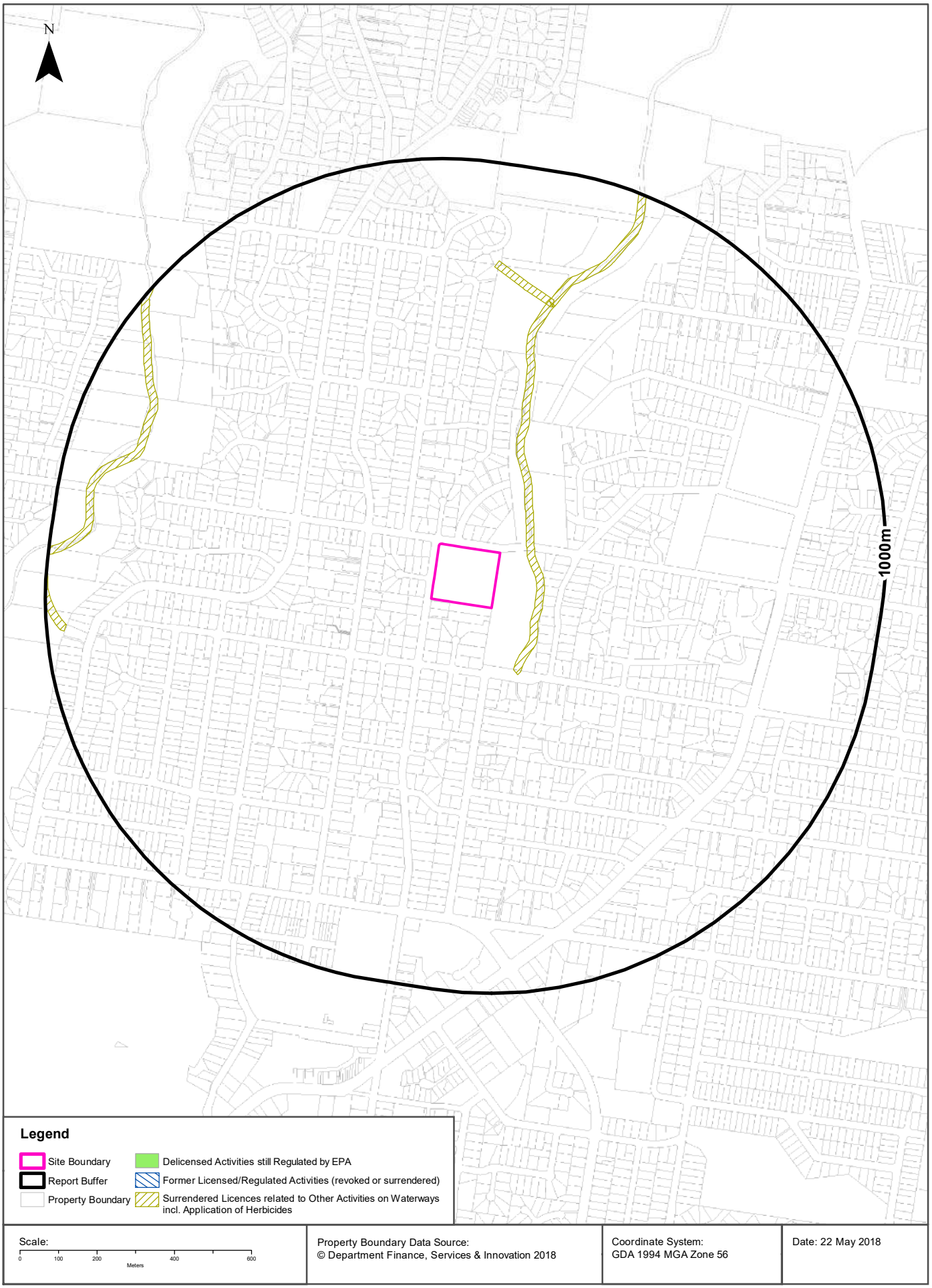
Licensed activities under the Protection of the Environment Operations Act 1997, within the dataset buffer:

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

POEO Licence Data Source: Environment Protection Authority

Delicensed & Former Licensed EPA Activities

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



EPA Activities

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

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

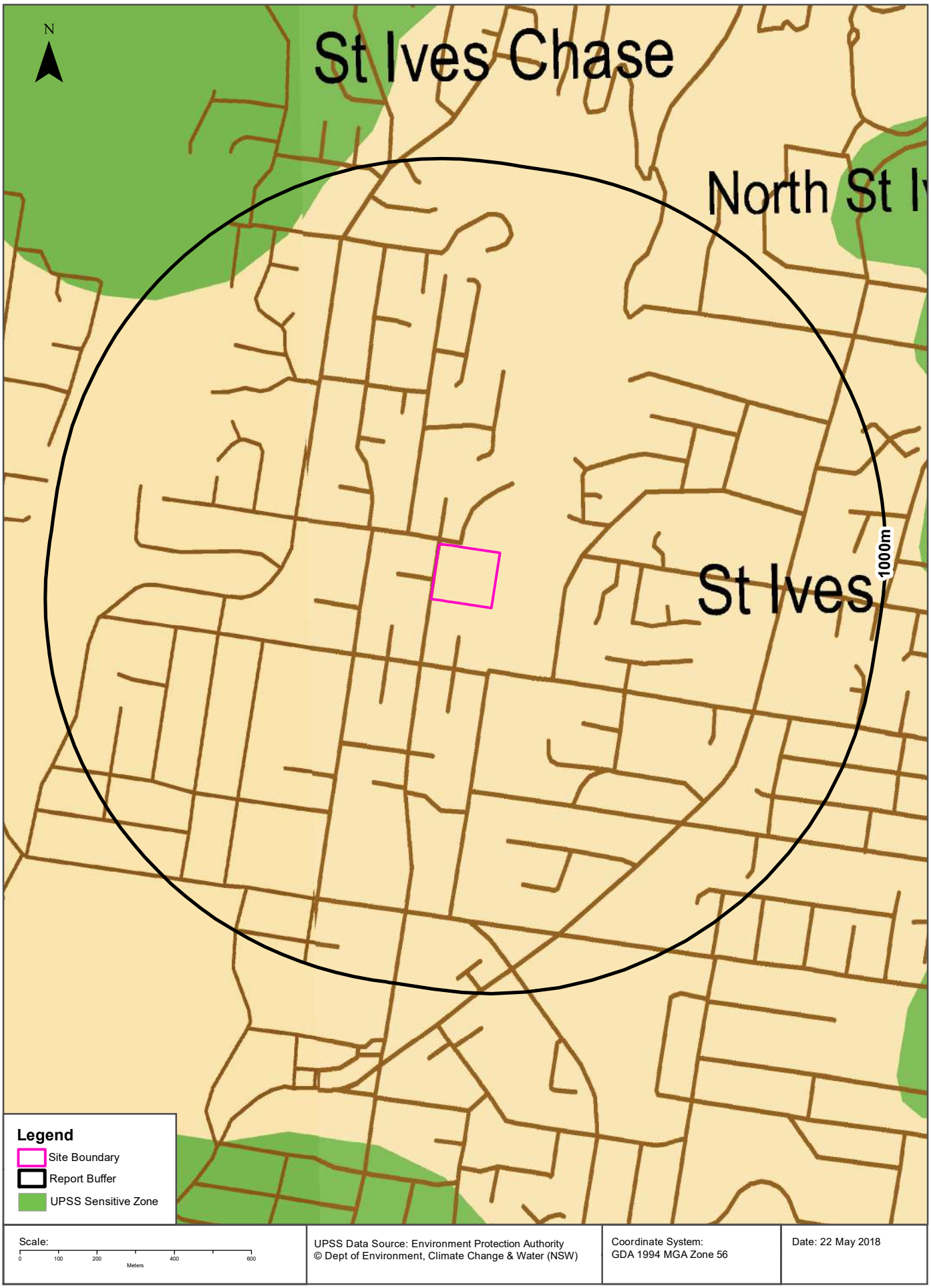
Former Licensed activities under the Protection of the Environment Operations Act 1997, now revoked or surrendered, within the dataset buffer:

Licence No	Organisation	Location	Status	Issued Date	Activity	Loc Conf	Distance	Direction
4653	LUHRMANN ENVIRONMENT MANAGEMENT PTY LTD	WATERWAYS THROUGHOUT NSW	Surrendered		Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	69m	-
4838	Robert Orchard	Various Waterways throughout New South Wales - SYDNEY NSW 2000	Surrendered		Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	69m	-
6630	SYDNEY WEED & PEST MANAGEMENT PTY LTD	WATERWAYS THROUGHOUT NSW - PROSPECT, NSW, 2148	Surrendered		Other Activities / Non Scheduled Activity - Application of Herbicides	Network of Features	69m	-

Former Licensed Activities Data Source: Environment Protection Authority

UPSS Sensitive Zones

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Scale: 0 100 200 400 600 Meters	UPSS Data Source: Environment Protection Authority © Dept of Environment, Climate Change & Water (NSW)	Coordinate System: GDA 1994 MGA Zone 56	Date: 22 May 2018

Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

1991 Business to Business Directory Records Premise or Road Intersection Matches

Records from the 1991 UBD Business to Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1991 Business to Business Directory Records Road or Area Matches

Records from the 1991 UBD Business to Business Directory, 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:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

1986 Business to Business Directory Records Premise or Road Intersection Matches

Records from the 1986 UBD Business to Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1986 Business to Business Directory Records Road or Area Matches

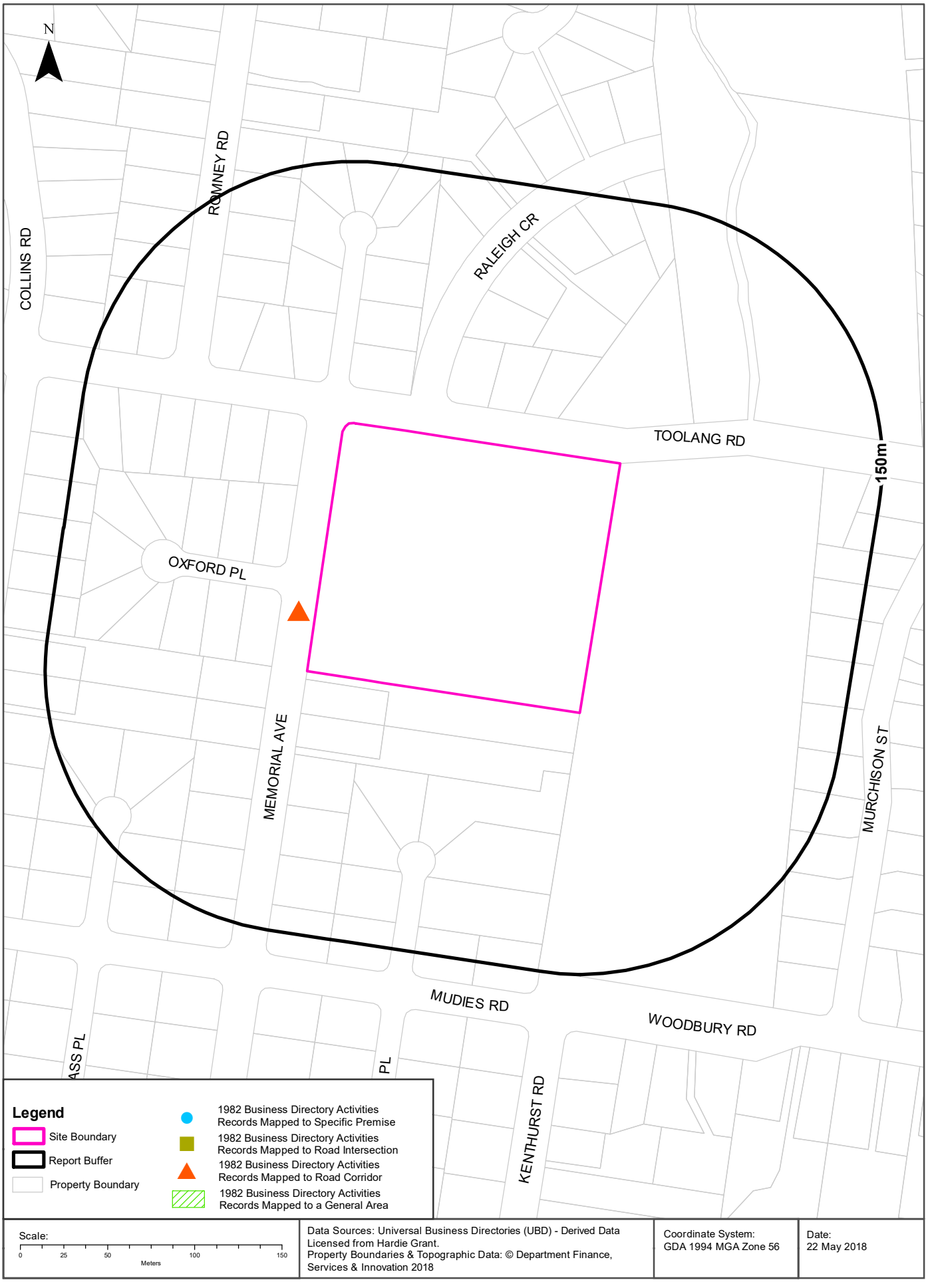
Records from the 1986 UBD Business to Business Directory, mapped to a road or an area, within the dataset buffer. Records are mapped to the road when a building number is not supplied, cannot be found, or the road has been renumbered since the directory was published:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1982 Historical Business Directory Records

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

1982 Business Directory Records
Premise or Road Intersection Matches

Records from the 1982 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1982 Business Directory Records
Road or Area Matches

Records from the 1982 UBD Business Directory, 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:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
MASSEURS - MASSEUSES. (M1380)	Village Fitness Centre, Memorial Ave., St. Ives. 2075.	46639	Road Match	0m
PHYSICAL CULTURE TEACHERS&/OR GYMNASIUMS. (P4020)	Village Fitness Centre, Memorial Ave., St. Ives. 2075.	63920	Road Match	0m

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

1978 Business Directory Records
Premise or Road Intersection Matches

Records from the 1978 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1978 Business Directory Records
Road or Area Matches

Records from the 1978 UBD Business Directory, 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:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

1975 Business Directory Records
Premise or Road Intersection Matches

Records from the 1975 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1975 Business Directory Records
Road or Area Matches

Records from the 1975 UBD Business Directory, 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:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

1970 Business Directory Records
Premise or Road Intersection Matches

Records from the 1970 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1970 Business Directory Records
Road or Area Matches

Records from the 1970 UBD Business Directory, 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:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

1965 Business Directory Records
Premise or Road Intersection Matches

Records from the 1965 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1965 Business Directory Records
Road or Area Matches

Records from the 1965 UBD Business Directory, 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:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

1961 Business Directory Records
Premise or Road Intersection Matches

Records from the 1961 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1961 Business Directory Records
Road or Area Matches

Records from the 1961 UBD Business Directory, 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:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

1950 Business Directory Records
Premise or Road Intersection Matches

Records from the 1950 UBD Business Directory, mapped to a premise or road intersection, within the dataset buffer:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Feature Point	Direction
N/A	No records in buffer				

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

1950 Business Directory Records
Road or Area Matches

Records from the 1950 UBD Business Directory, 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:

Business Activity	Premise	Ref No.	Location Confidence	Distance to Road Corridor or Area
N/A	No records in buffer			

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Dry Cleaners, Motor Garages & Service Stations 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:

Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Feature Point	Direction
MOTOR GARAGES &/OR ENGINEERS &/OR SERVICE STATIONS.	Golden Fleece Service Station.. 355 Mona Vale Rd., St. Ives.	50138	1978	Premise Match	838m	East
MOTOR GARAGES &/OR ENGINEERS.	Golden Fleece Service Station., 355 Mona Vale Rd., St. Ives.	58950	1975	Premise Match	838m	East
MOTOR GARAGES & SERVICE STATIONS.	Caltex Hassel Park Service Station, 363 Mona Vale Rd., St. Ives.	64343	1986	Premise Match	839m	East
MOTOR GARAGES &/OR ENGINEERS &/OR SERVICE STATIONS. (M6860)	Golden Fleece St. Ives Service Station, 363 Mona Vale Rd., St. Ives.2075.	56873	1982	Premise Match	839m	East

Business Directory Content Derived from Universal Business Directories (UBD) - Licensed from Hardie Grant

Historical Business Directories

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Dry Cleaners, Motor Garages & Service Stations 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:

Business Activity	Premise	Ref No.	Year	Location Confidence	Distance to Road Corridor or Area
Motor Garages & Engineers - St. Ives	Collins, E., Pittwater Rd.	123370	1965	Road Match	703m
MOTOR GARAGES &/OR ENGINEERS	Collins, E., Pittwater Rd., St. Ives	83608	1950	Road Match	703m
MOTOR SERVICE STATIONS-PETROL, Etc.	Collins, E., Pittwater Rd., St. Ives	85885	1950	Road Match	703m
Motor Garages & Engineers - St. Ives	Gillott, A. H. Pty. Ltd., Mona Vale Rd.	123371	1965	Road Match	703m
MOTOR GARAGES & ENGINEERS	Gillott, A. H. Pty. Ltd., Mona Vale Rd., St Ives	347228	1961	Road Match	703m
MOTOR SERVICE STATIONS-PETROL, Etc.	Gillott, A. H., Pittwater Rd., St. Ives	85993	1950	Road Match	703m
MOTOR GARAGES & ENGINEERS(M6S6)	Gillott,A. H. Pty. Ltd.,Mona Vale Rd.ST. IVES	337865	1970	Road Match	703m
MOTOR SERVICE STATIONS-PETROL,OIL,Etc. (M716)	Gillott,A. Pty. Ltd.,Mona Vale Rd.ST. IVES	341141	1970	Road Match	703m
MOTOR GARAGES &/OR ENGINEERS	Glllott, A. H., Pittwater Rd., St. Ives	83807	1950	Road Match	703m
MOTOR GARAGES &/OR ENGINEERS	Knight's Service Station, Pittwater Rd., St. Ives	83965	1950	Road Match	703m
MOTOR SERVICE STATIONS-PETROL, Etc.	Knight's Service Station, Pittwater Rd., St. Ives	86114	1950	Road Match	703m
MOTOR GARAGES &/OR ENGINEERS	Knights Garage, Pittwater Rd., St. Ives	83967	1950	Road Match	703m
MOTOR SERVICE STATIONS-PETROL, Etc.	Show Ground Service Station, Pittwater Rd., St. Ives	86386	1950	Road Match	703m
Motor Service Stations - Petrol, Oil, Etc. - St. Ives	Showground Service Station, Mona Vale Rd.	126143	1965	Road Match	703m
MOTOR SERVICE STATIONS-PETROL,OIL,Etc. (M716)	Showground Service Station,Mona Vale Rd.ST. IVES	341464	1970	Road Match	703m
MOTOR GARAGES &/OR ENGINEERS	St. Ives Service Station, Pittwater Rd., St. Ives	84405	1950	Road Match	703m
MOTOR SERVICE STATIONS-PETROL, Etc.	St. Ives Service Station, Pittwater Rd., St. Ives	86413	1950	Road Match	703m
Motor Service Stations - Petrol, Oil, Etc. - St. Ives	Woods, N. O., Pittwater Rd.	126144	1965	Road Match	703m
MOTOR SERVICE STATIONS-PETROL, Etc.	Woods, N. O., Pittwater Rd., St. Ives	86545	1950	Road Match	703m

Aerial Imagery 2016

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Scale:	Data Sources: Aerial Imagery © Department Finance, Services & Innovation	Coordinate System: GDA 1994 MGA Zone 56	Date: 22 May 2018

0 50 100
Meters

Aerial Imagery 2009

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Scale:
0 25 50 100
Meters

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Coordinate System:
GDA 1994 MGA Zone 56

Date: 17 May 2018

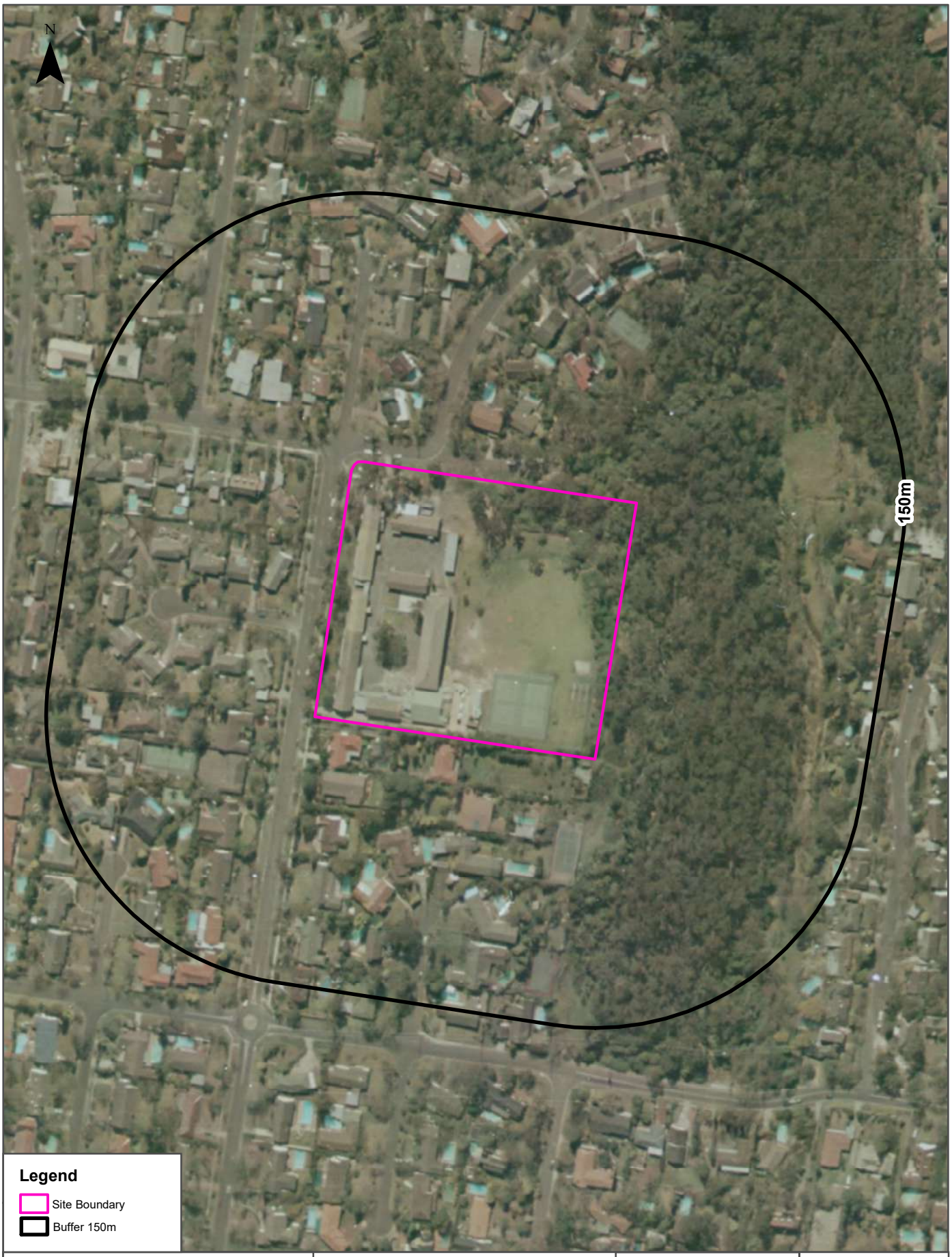
Aerial Imagery 2005

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Scale: 0 25 50 100 Meters	Data Source Aerial Imagery: © 2018 Google Inc, used with permission. Google and the Google logo are registered trademarks of Google Inc.	Coordinate System: GDA 1994 MGA Zone 56	Date: 17 May 2018

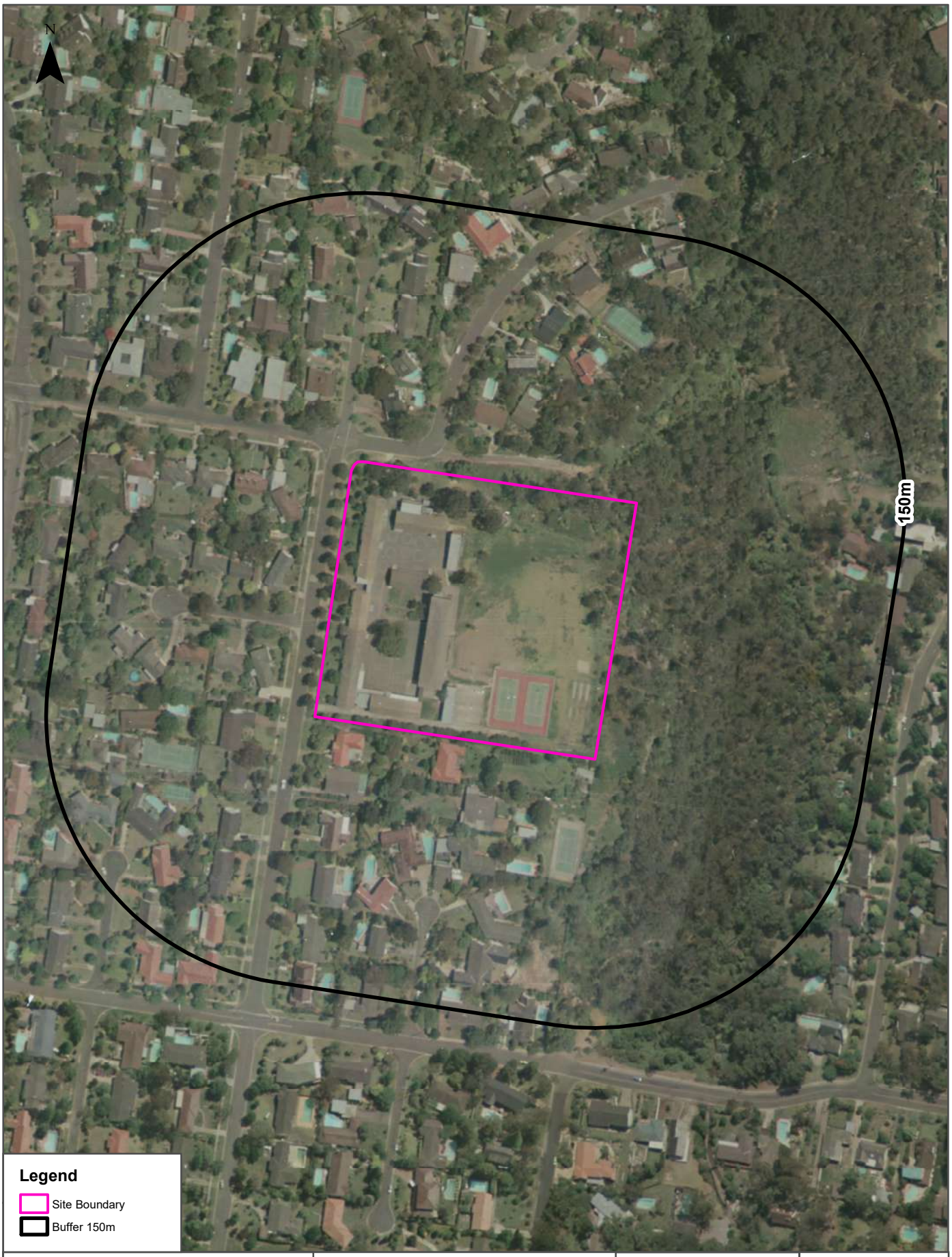
Aerial Imagery 1991

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Aerial Imagery 1982

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Aerial Imagery 1970

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Aerial Imagery 1965

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

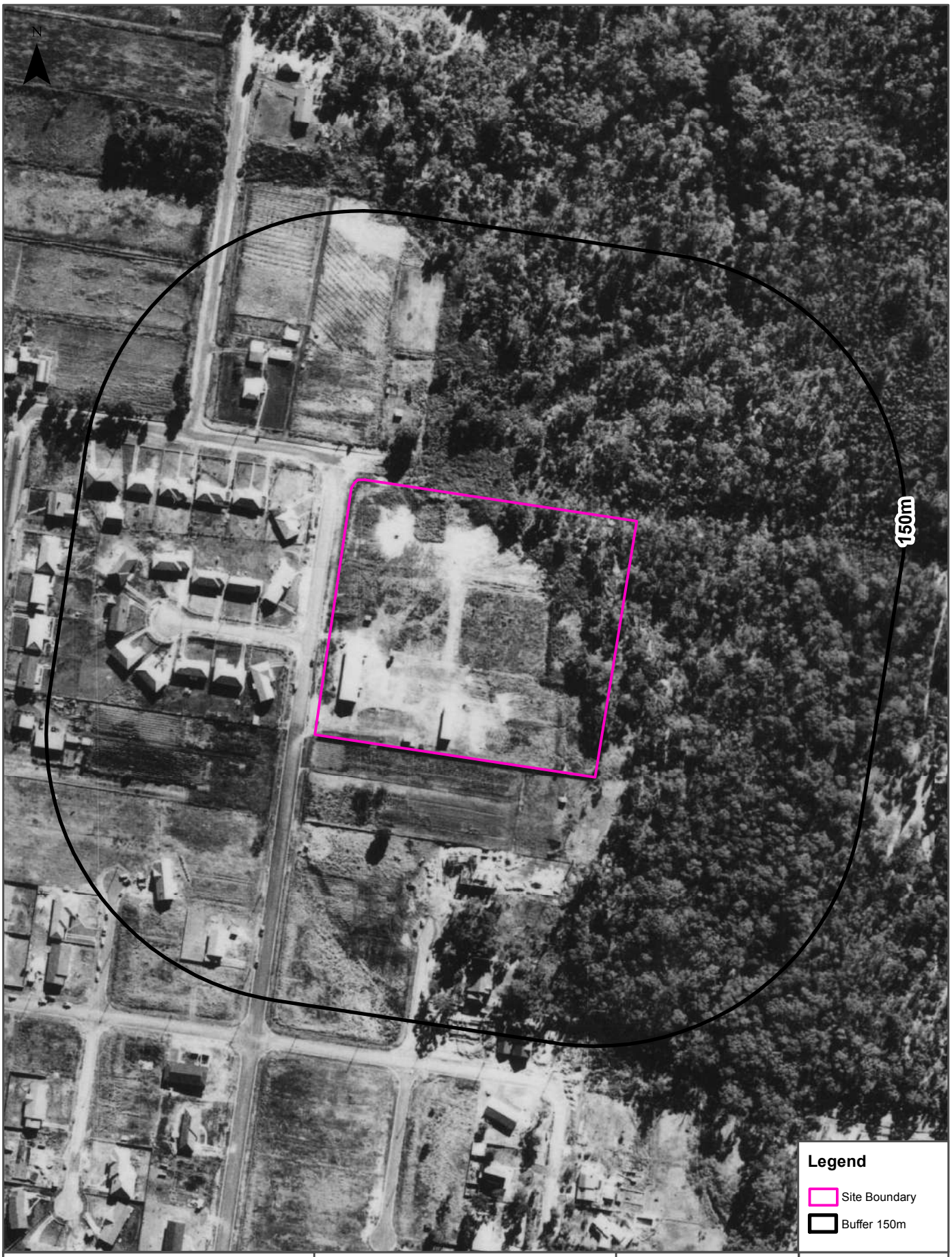
Data Source Aerial Imagery:
© NSW Department Finance, Services & Innovation

Coordinate System:
GDA 1994 MGA Zone 56

Date: 18 May 2018

Aerial Imagery 1961

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Data Source Aerial Imagery:
© NSW Department Finance, Services & Innovation

Coordinate System:
GDA 1994 MGA Zone 56

Date: 17 May 2018

Aerial Imagery 1955

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Aerial Imagery 1943

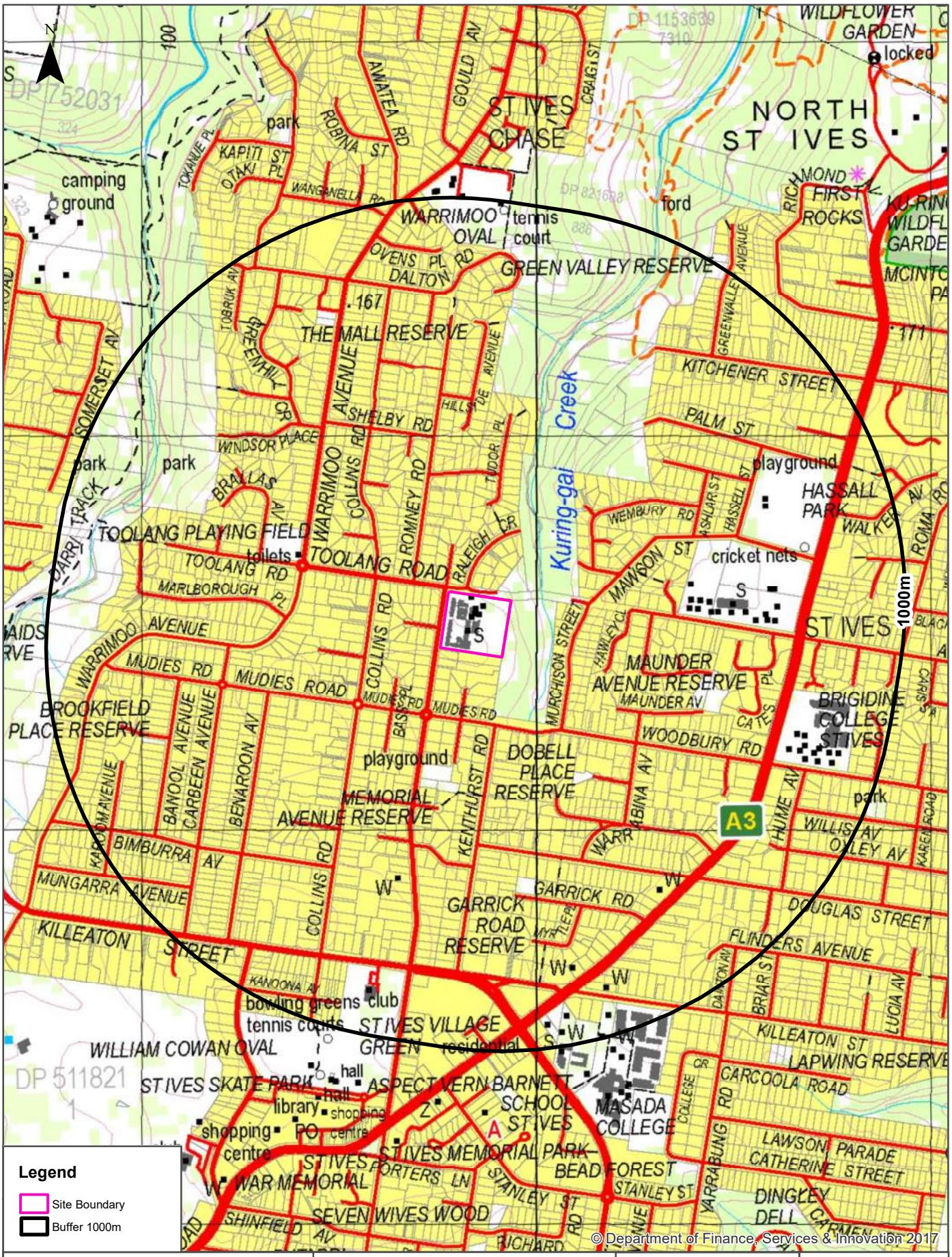
St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Scale:	Data Sources: Aerial Imagery © Department Finance, Services & Innovation	Coordinate System: GDA 1994 MGA Zone 56	Date: 22 May 2018

0 25 50 100 150
Meters

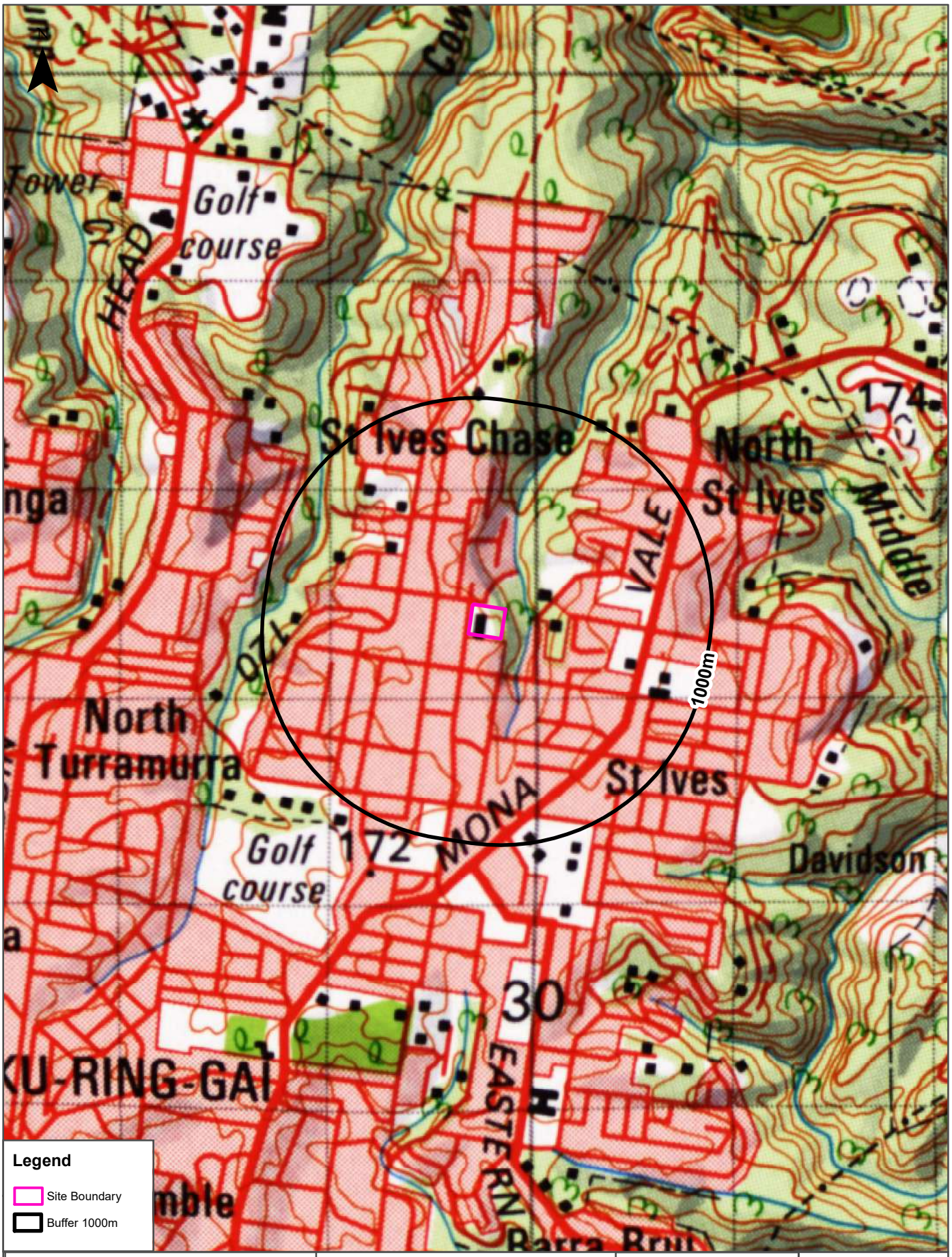
Topographic Map 2015

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Historical Map 1975

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Historical Map 1942

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

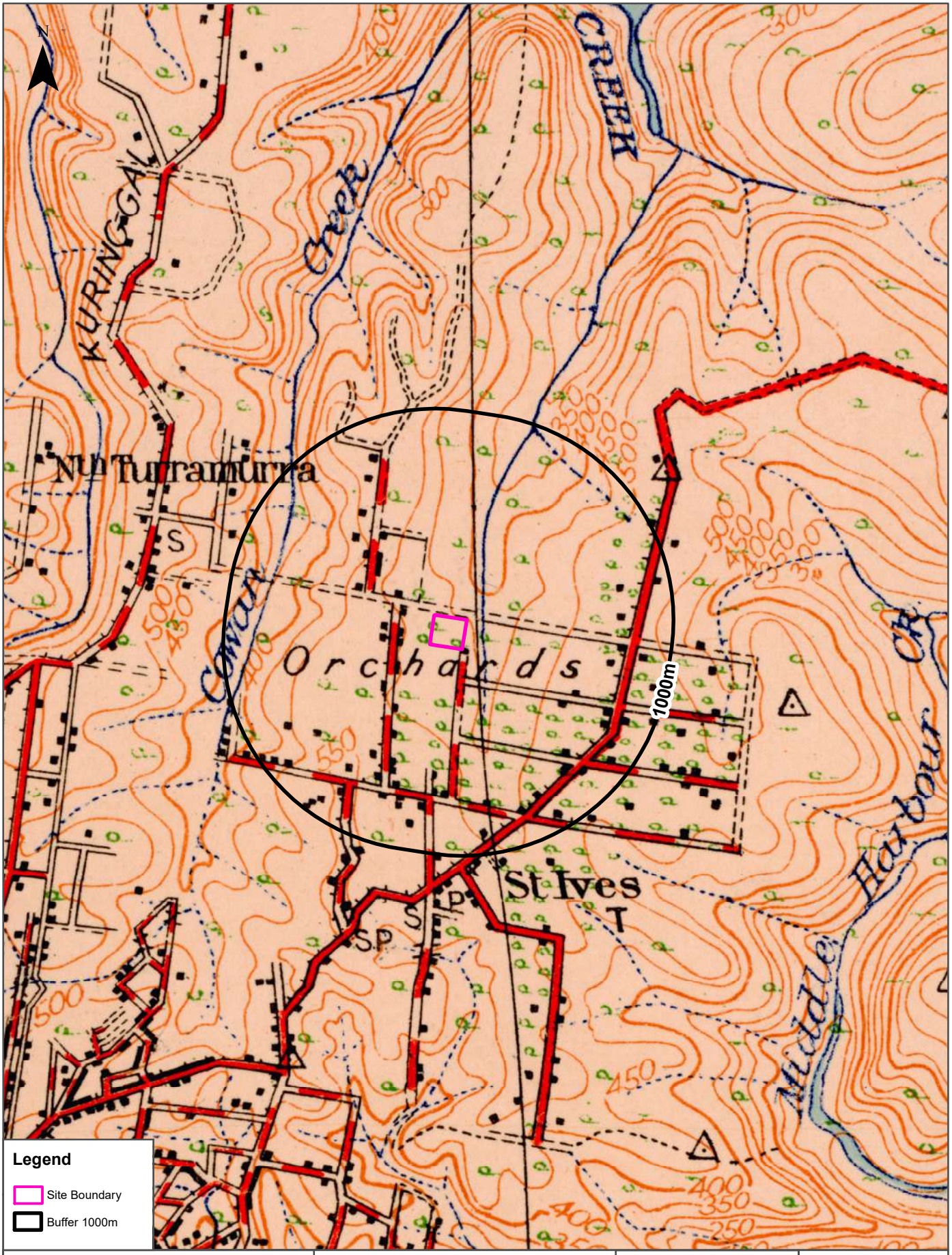
Data Sources: Australia 1:63360, Sheet 417, Broken Bay, New South Wales. Prepared by Commonwealth Section Imperial General Staff

Coordinate System: GDA 1994 MGA Zone 56

Date: 18 May 2018

Historical Map 1920

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



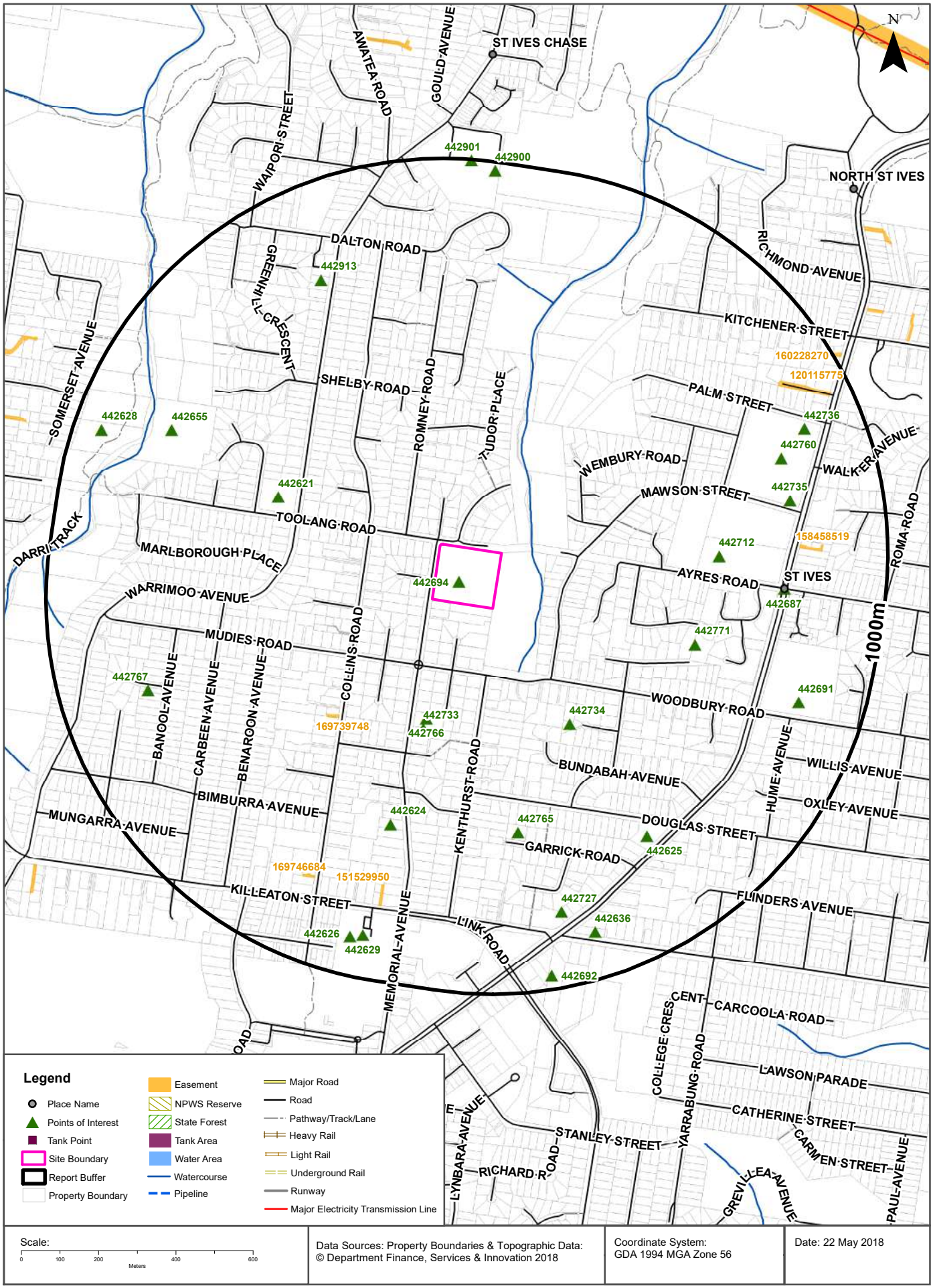
Data Sources: Australia 1:63360, Sheet 417, Broken Bay, New South Wales. Prepared by Commonwealth Section Imperial General Staff

Coordinate System: GDA 1994 MGA Zone 56

Date: 18 May 2018

Topographic Features

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Topographic Features

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Points of Interest

What Points of Interest exist within the dataset buffer?

Map Id	Feature Type	Label	Distance	Direction
442694	Primary School	ST IVES NORTH PUBLIC SCHOOL	0m	Onsite
442766	Park	PLAYGROUND	308m	South
442733	Park	MEMORIAL AVENUE RESERVE	336m	South
442734	Park	DOBELL PLACE RESERVE	360m	South East
442621	Sports Field	TOOLANG PLAYING FIELD	437m	North West
442771	Park	MAUNDER AVENUE RESERVE	532m	East
442712	Primary School	SYDNEY GRAMMAR ST IVES PREPARATORY SCHOOL	563m	East
442765	Park	GARRICK ROAD RESERVE	584m	South
442624	Place Of Worship	BAPTIST CHURCH	594m	South
442625	Place Of Worship	UNITING CHURCH	712m	South East
442687	Suburb	ST IVES	737m	East
442913	Park	THE MALL RESERVE	752m	North West
442655	Park	Park	756m	North West
442735	Sports Court	CRICKET NETS	758m	East
442760	Sports Field	HASSALL PARK	763m	East
442767	Park	BROOKFIELD PLACE RESERVE	772m	West
442727	Place Of Worship	PRESBYTERIAN CHURCH	807m	South
442691	High School	BRIGIDINE COLLEGE ST IVES	827m	East
442736	Park	PLAYGROUND	846m	North East
442636	Place Of Worship	SYNAGOGUE	879m	South
442629	Club	ST IVES BOWLING AND RECREATION CLUB	888m	South
442626	Sports Field	BOWLING GREENS	899m	South
442628	Park	Park	926m	West
442692	Place Of Worship	CATHOLIC CHURCH	964m	South
442900	Sports Court	TENNIS COURT	978m	North
442901	Sports Field	WARRIMOO OVAL	998m	North

Topographic Features

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

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
169739748	Primary	Right of way	Variable	386m	South West
151529950	Primary	Right of way	4.5m	752m	South
158458519	Primary	Right of way	Variable	771m	East
169746684	Primary	Right of way	3.5m & Var	780m	South West
120115775	Primary	Undefined		838m	North East
160228270	Primary	Right of way	variable	999m	North East

Topographic Features

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

State Forest

What State Forest exist within the dataset buffer?

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

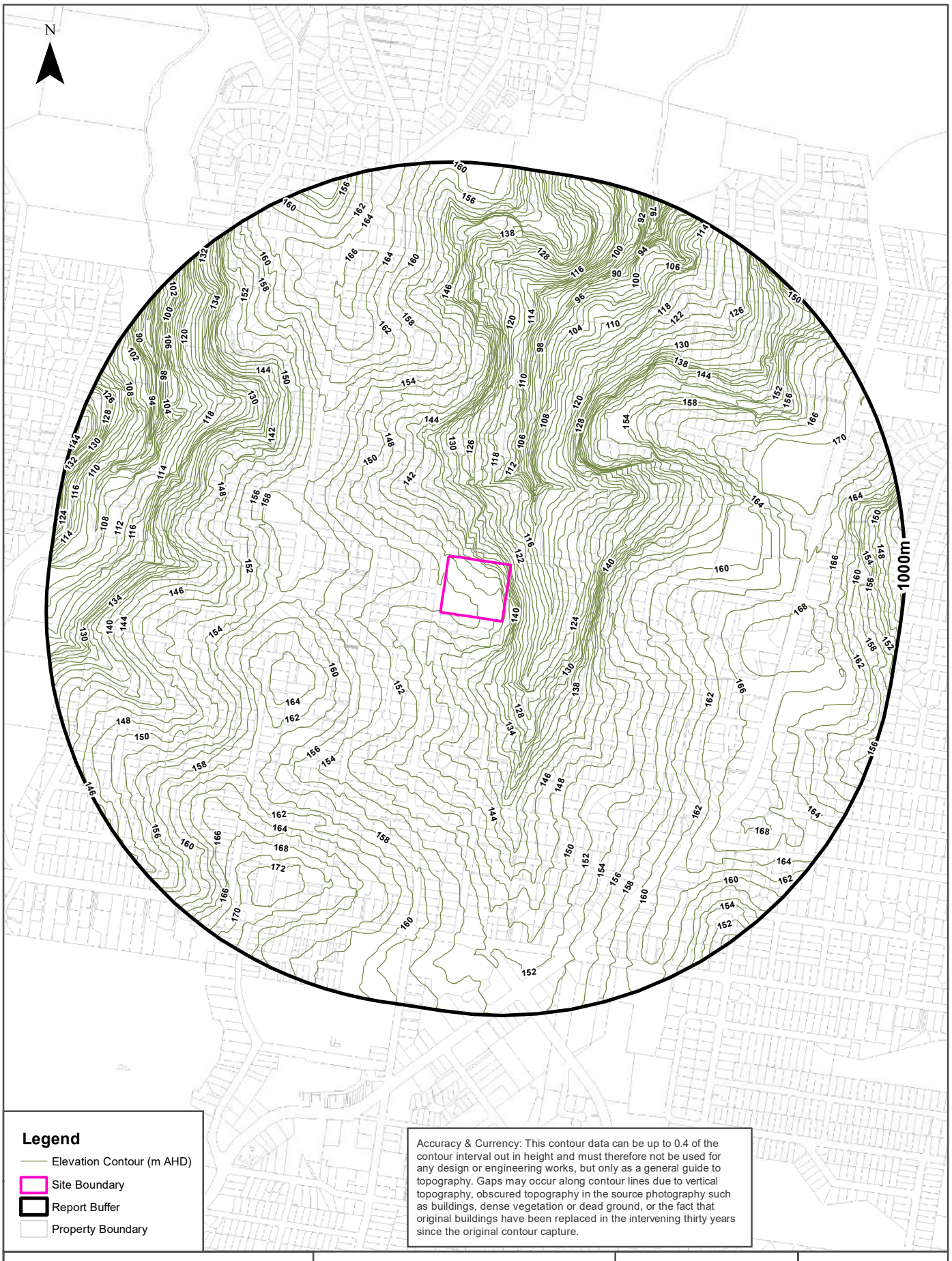
National Parks and Wildlife Service Reserves

What NPWS Reserves exist within the dataset buffer?

Reserve Number	Reserve Type	Reserve Name	Gazetted Date	Distance	Direction
N/A	No records in buffer				

Elevation Contours (m AHD)

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Hydrogeology & Groundwater

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Hydrogeology

Description of aquifers on-site:

Description
Porous, extensive aquifers of low to moderate productivity

Description of aquifers within the dataset buffer:

Description
Porous, extensive aquifers of low to moderate productivity

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

Botany Groundwater Management Zones

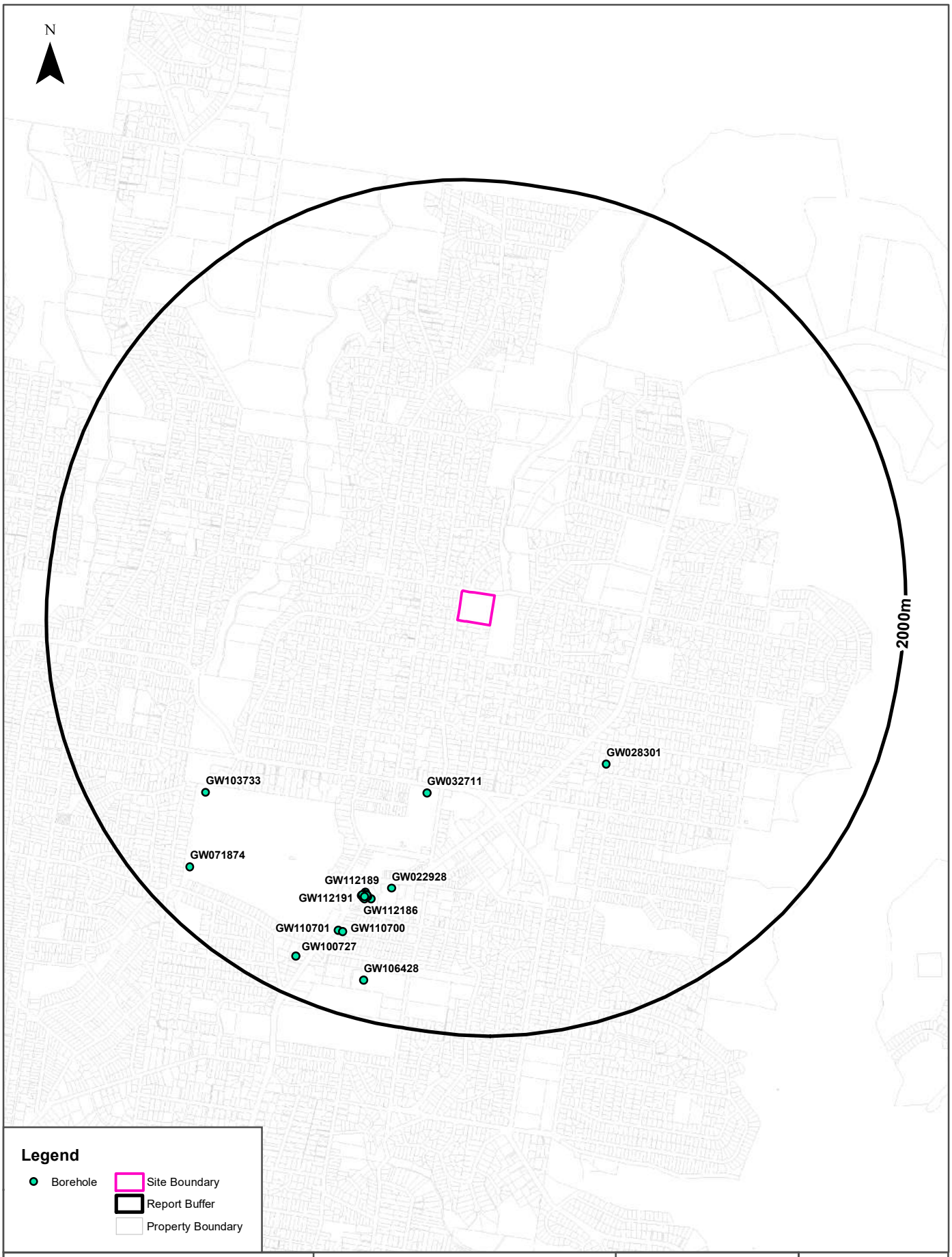
Groundwater management zones relating to the Botany Sand Beds aquifer within the dataset buffer:

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

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Hydrogeology & Groundwater

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Groundwater Boreholes

Boreholes within the dataset buffer:

GW No.	Licence No	Work Type	Owner Type	Purpose	Contractor	Complete Date	Final Depth (m)	Drilled Depth (m)	Salinity (mg/L)	SWL (m)	Yield (L/s)	Elev (AHD)	Dist	Dir
GW032711	10BL019887	(Unknown)	Private	Irrigation		01/01/1966	42.60	42.70					854m	South
GW028301	10BL016162, 10WA108119	Bore open thru rock	Private	General Use		01/03/1966	68.50	68.60					885m	South East
GW022928	10BL016460	Bore	Private	General Use		01/03/1958	50.20	50.30	Good				1345 m	South
GW112189	10BL161283	Bore	Private	Monitoring		31/01/2003	6.00	6.00					1398 m	South
GW112193	10BL161283	Bore	Private	Monitoring		30/01/2003	6.00	6.00					1408 m	South
GW103904	10BL159957	Bore		Monitoring	Macquarie Drilling	15/10/1998		4.00					1410 m	South
GW103905	10BL159957	Bore		Monitoring	Macquarie Drilling	15/10/1998		4.00					1410 m	South
GW103896	10BL159957	Bore		Monitoring	Engineering Explorations Pty Ltd	09/10/2000	3.50	3.50					1410 m	South
GW103894	10BL159957	Bore		Monitoring	Engineering Explorations Pty Ltd	09/10/2000	3.50	3.50					1410 m	South
GW103899	10BL159957	Bore		Monitoring	Engineering Explorations Pty Ltd	10/10/2000	5.00	5.00					1410 m	South
GW103901	10BL159957	Bore		Monitoring	Engineering Explorations Pty Ltd	10/10/2000	3.50	3.50					1410 m	South
GW103906	10BL159957	Bore		Monitoring	Macquarie Drilling	15/10/1998	4.00	4.00					1410 m	South
GW112187	10BL161283	Bore	Private	Monitoring		30/01/2003	6.00	6.00					1410 m	South
GW103900	10BL159957	Bore		Monitoring	Engineering Explorations Pty Ltd	10/10/2000	3.50	3.50					1410 m	South
GW103898	10BL159957	Bore		Monitoring	Engineering Explorations Pty Ltd	10/10/2000	0.50	0.50					1410 m	South
GW103903	10BL159957	Bore		Monitoring	Engineering Explorations Pty Ltd	11/10/2000	1.00	1.00					1410 m	South
GW103907	10BL159957	Bore		Monitoring	Macquarie Drilling	14/10/1998	3.50	3.50					1410 m	South
GW103897	10BL159957	Bore		Monitoring	Engineering Explorations Pty Ltd	09/10/2000	3.50	3.50					1410 m	South
GW103895	10BL159957	Bore		Monitoring	Engineering Explorations Pty Ltd	09/10/2000	3.50	3.50					1410 m	South
GW103902	10BL159957	Bore		Monitoring	Engineering Explorations Pty Ltd	11/10/2000	3.50	3.50					1410 m	South
GW112185	10BL161283	Bore	Private	Monitoring		30/01/2003	6.00	6.00					1414 m	South
GW112190	10BL161283	Bore	Private	Monitoring		31/01/2003	6.00	6.00					1416 m	South

GW No.	Licence No	Work Type	Owner Type	Purpose	Contractor	Complete Date	Final Depth (m)	Drilled Depth (m)	Salinity (mg/L)	SWL (m)	Yield (L/s)	Elev (AHD)	Dist	Dir
GW112188	10BL161283	Bore	Private	Monitoring		30/01/2003	6.00	6.00					1419 m	South
GW112192	10BL161283	Bore	Private	Monitoring		31/01/2003	6.00	6.00					1421 m	South
GW112191	10BL161283	Bore	Private	Monitoring		31/01/2003	6.00	6.00					1421 m	South
GW112186	10BL161283	Bore	Private	Monitoring		30/01/2003	6.00	6.00					1425 m	South
GW112194	10BL161283	Bore	Private	Monitoring		30/01/2003	6.00	6.00					1430 m	South
GW103733	10BL158065, 10CA109357	Bore		Irrigation	Slade Drilling	02/11/1997	151.00	151.00					1484 m	South West
GW110700	10BL603198	Well	Private	Monitoring	Numac Drilling Services Pty Ltd	31/07/2009	7.00	7.00		5.30			1616 m	South
GW110701	10BL603198	Well	Private	Monitoring	Numac Drilling Services Pty Ltd	31/07/2009	7.00	7.00		5.30			1618 m	South West
GW071874	10BL153808, 10CA109357	Bore	Private	Irrigation, Recreation	Intertec Drilling Services	01/03/1994	46.00	46.00	440	3.00	12.000	130.00	1770 m	South West
GW106428	10BL163470, 10WA108742	Bore	Private	Domestic, Stock	Intertec Drilling Services	29/09/2007	180.00	180.00	810	67.00	0.150		1810 m	South
GW100727	10BL157820, 10WA108387	Bore	Private	Domestic	Intertec Drilling Services	06/12/1996	140.00	140.00	1050	72.00	0.300		1815 m	South West

Hydrogeology & Groundwater

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Driller's Logs

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

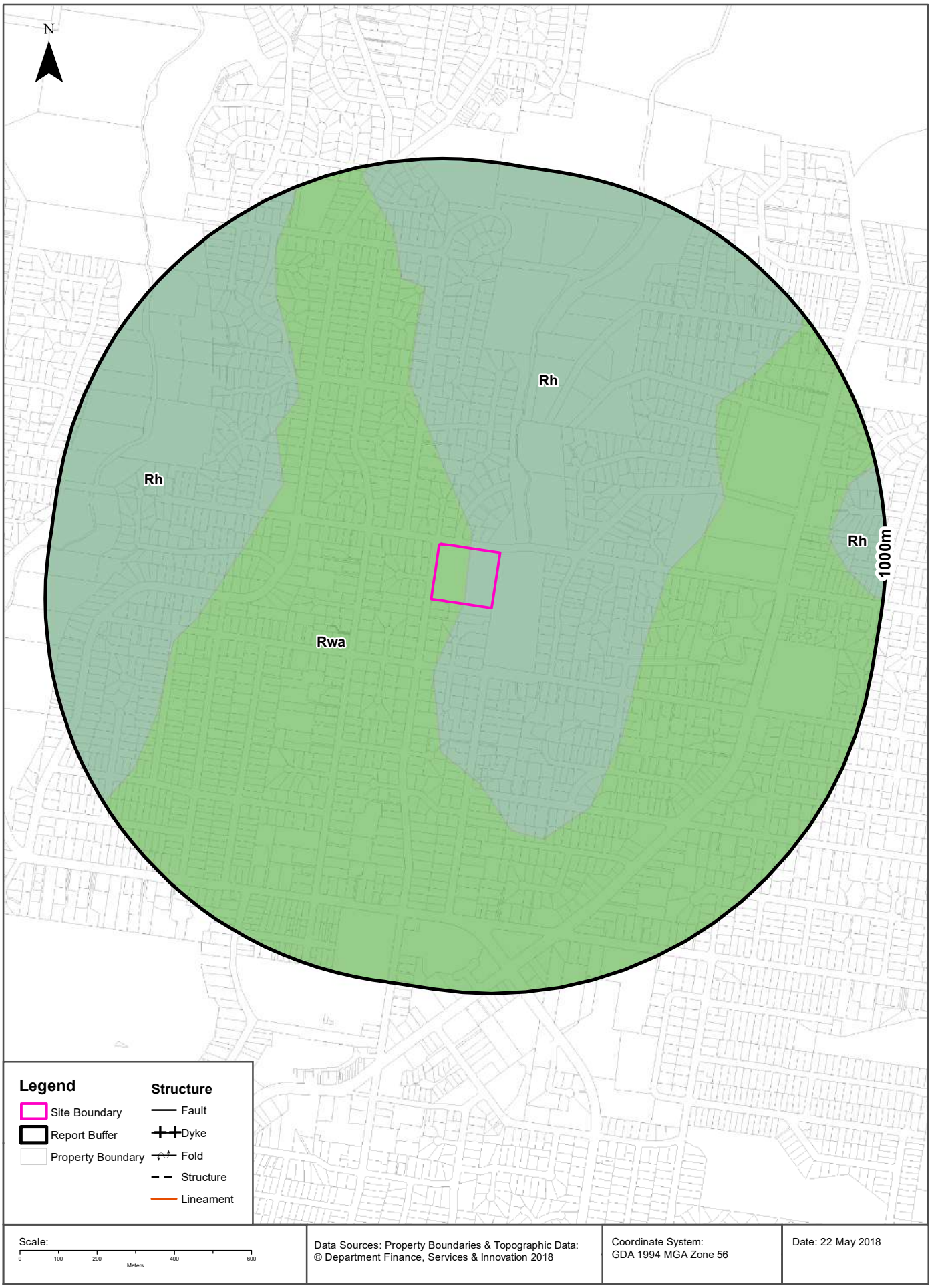
Groundwater No	Drillers Log	Distance	Direction
GW032711	0.00m-42.67m Clay Nominal 0.00m-42.67m Shale Nominal 0.00m-42.67m Sandstone Nominal	854m	South
GW028301	0.00m-0.91m Clay 0.91m-6.70m Clay Light Brown Yellow 6.70m-8.83m Shale Grey 6.70m-8.83m Clay Seams 8.83m-18.28m Shale Dark Brown Sticky 18.28m-25.90m Sandstone Medium 25.90m-31.39m Sandstone Grey 25.90m-31.39m Shale Bands 31.39m-32.91m Shale Grey 32.91m-38.10m Sandstone Cream Traces 32.91m-38.10m Shale 38.10m-39.62m Sandstone Cream Soft 39.62m-44.19m Sandstone Hard 44.19m-50.29m Sandstone Grey 50.29m-50.90m Sandstone Soft 50.90m-51.81m Sandstone Grey Shale Water Supply 51.81m-68.58m Sandstone Grey Water Supply	885m	South East
GW022928	0.00m-3.04m Loam 3.04m-6.09m Clay White Red 6.09m-9.14m Clay White Shaley 9.14m-12.19m Clay White Red 12.19m-18.28m Shale Grey Water Supply 18.28m-24.38m Sandstone Shaley Water Supply 24.38m-27.43m Shale Grey 27.43m-39.62m Sandstone Cream Water Supply 27.43m-39.62m Shale Grey 39.62m-48.76m Shale Grey Water Supply 48.76m-50.29m Sandstone White	1345m	South
GW103894	0.00m-0.15m CONCRETE 0.15m-1.00m SILTY SAND 1.00m-2.00m SILTY CLAY 2.00m-3.50m CLAY,ORANGE AND GREY	1410m	South
GW103895	0.00m-1.20m GRAVELLY SAND 1.20m-1.50m FILL/CLAY,ORANGE 1.50m-3.50m CLAY,ORANGE,GREY,VERY STIFF	1410m	South
GW103896	0.00m-1.10m fill,sandy clay,medium plasticity,orange brown 1.10m-3.50m clay,grey, stiff,weathred rock	1410m	South
GW103897	0.00m-1.50m FILL,TOPSOIL,DARK BROWN,SILTY SAND 1.50m-3.50m CLAY,GREY WITH WEATHERED ROCK	1410m	South
GW103898	0.00m-0.10m BITUMEN 0.10m-0.50m FILL,SILTY SAND,BROWN,DAMP,GRAVEL	1410m	South
GW103899	0.00m-1.00m FILL/SAND CLAY:GREY/GREEN 1.00m-5.00m CLAY/SILTY CLAY,GREY,STIFF,MOIST	1410m	South
GW103900	0.00m-1.50m FILL,SANDY CLAY,ORANGE/BROWN 1.50m-3.50m CLAY,PINK/OARNGE,VERY STIFF	1410m	South
GW103901	0.00m-1.00m FILL:SILTY SAND/CLAYEY/GREEN BROWN 1.00m-3.50m SILTY CLAY:GREENY BROWN,SHALE	1410m	South
GW103902	0.00m-0.50m ASPALTH/FILL,SAND,DARK BROWN 0.50m-3.50m SILTY CLAY-ORANGE BROWN,GREY,HARD	1410m	South
GW103903	0.00m-0.10m TOPSOIL,SILTY SAND 0.10m-1.00m SILTY CLAY,ORANGE BROWN	1410m	South
GW103904	0.00m-1.00m FILL:SANDY CLAYEY SILT 1.00m-1.80m CONCRETE 1.80m-2.20m SILTY SAND 2.20m-4.00m SANDY CLAYEY SILT:NON PLASTIC	1410m	South

Groundwater No	Drillers Log	Distance	Direction
GW103905	0.00m-0.10m FILL:CLAYEY SANDY SILT 0.10m-2.00m CLAYEY SANDY SILT 2.00m-2.10m SILTY SAND 2.10m-3.00m CLAYEY SANDY SILT 3.00m-4.00m CLAYEY SANDY SILT AS ABOVE,BEC. PEATY	1410m	South
GW103906	0.00m-0.10m ASPHALT 0.10m-0.20m FILL:ROADBASE 0.20m-0.40m FILL:SANDSTONE,VERY WEATHERED,RED 0.40m-0.80m FILL,SANDSTONE,WHITE 0.80m-2.20m CLAY:MEDIUM TO FIRM 2.20m-4.00m CLAY:MEDIUM TO FIRM	1410m	South
GW103907	0.00m-0.40m FILL:SILT,SAND AND GRAVEL 0.40m-2.00m CLAY:STIFF/YELLO/ORANGE 2.00m-3.50m CLAYEY SAND,ORANGE BROWN	1410m	South
GW103733	0.00m-2.00m CLAYS SOFT SANDSTON E 2.00m-4.00m SANDSTONE 4.00m-12.00m SHALE 12.00m-150.00m SANDSTONE 150.00m-151.00m SHALE	1484m	South West
GW110700	0.00m-0.70m CONCRETE 0.70m-0.80m FILL 0.80m-3.00m CLAY GREY BROWN, HARD 3.00m-5.50m SHALE GREY/ CLAY 5.50m-7.00m SHALE WEATHERED / GREY	1616m	South
GW110701	0.00m-0.70m CONCRETE 0.70m-0.80m FILL 0.80m-3.00m CLAY GREY BROWN HARD 3.00m-5.50m SHALE GREY/ CLAY 5.50m-7.00m SHALE GREY/ WEATHERED	1618m	South West
GW071874	0.00m-4.00m clay 4.00m-5.00m sandstone, wthed 5.00m-8.00m sandstone, fine 8.00m-9.00m shale 9.00m-12.00m sandstone, med course 12.00m-15.00m sandstone, grey course grain (fractures) 15.00m-20.00m sandstone, grey med fine 20.00m-46.00m sandstone, fine grain	1770m	South West
GW106428	0.00m-2.40m clay, brown red 2.40m-6.30m sandstone, brown 6.30m-15.00m shale, grey weathered 15.00m-34.60m shale, grey harder 34.60m-40.50m sandstone, grey 40.50m-40.70m clay, white 40.70m-49.00m sandstone, grey 49.00m-49.50m sandstone, fine quartiz 49.50m-79.80m sandstone, grey 79.80m-80.20m clay, light grey 80.20m-96.50m sandstone, grey 96.50m-96.60m sandstone, fracture 96.60m-127.00m sandstone, grey 127.00m-127.50m sandstone, fracture quartz 127.50m-180.00m sandstone, grey	1810m	South

Groundwater No	Drillers Log	Distance	Direction
GW100727	0.00m-0.40m TOPSOIL 0.40m-2.80m DARK RED CLAY 2.80m-15.30m LIGHT GREY CLAY 15.30m-44.10m SHALE, DARK GREY SOME FRACTURED ZONES 44.10m-48.00m SANSTONE LIGHT GREY F.G. CEMENTED 48.00m-55.00m SANDSTONE LIGHT GREY M.G. CEMENTED 55.00m-57.40m SHALE, DARK GREY 57.40m-59.60m SANDSTONE LIGHT GREY C.G. 59.60m-61.40m SANDSTONE LIGHT GREY QUARTZ MATRIX 61.40m-63.20m SHALE DARK GREY 63.20m-69.50m SANDSTONE, LIGHT GREY MED. GRAIN 69.50m-75.10m SHALE DARK GREY 75.10m-80.00m SANDSTONE LIGHT GREY F.G. CEMENTED 80.00m-82.60m SANDSTONE, LIGHT GREY QAURTZ MATRIX 82.60m-88.80m SANDSTONE, LIGHT GREY F.G. 88.80m-96.00m SHALE DARK GREY 96.00m-113.00m SANDSTONE LIGHT GREY F.G. 113.00m-120.30m SHALE DARK GREY 120.30m-121.10m SADNSTONE LIGHT GREY F.G. CEMENTED 121.10m-123.40m SHALE DARK GREY 123.40m-129.30m SANDSTONE LIGHT GREY F.G. CEMENTED 129.30m-130.60m SANDSTONE, SHALE CROSS-BED 130.60m-133.30m SHALE DARK GREY 133.30m-138.80m SANDSTONE LIGHT GREY F.G. CEMENTED 138.80m-140.00m SANDSTONE,SHALE CROSS-BED	1815m	South West

Geology 1:100,000

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Geology

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Geological Units

What are the Geological Units onsite?

Symbol	Description	Unit Name	Group	Sub Group	Age	Dom Lith	Map Sheet	Dataset
Rh	Medium to coarse grained quartz sandstone, very minor shale and laminate lenses				Triassic		Sydney	1:100,000
Rwa	Black to dark grey shale and laminate	Ashfield Shale	Wianamatta Group		Triassic		Sydney	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
Rh	Medium to coarse grained quartz sandstone, very minor shale and laminate lenses				Triassic		Sydney	1:100,000
Rwa	Black to dark grey shale and laminate	Ashfield Shale	Wianamatta Group		Triassic		Sydney	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

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Naturally Occurring Asbestos Potential

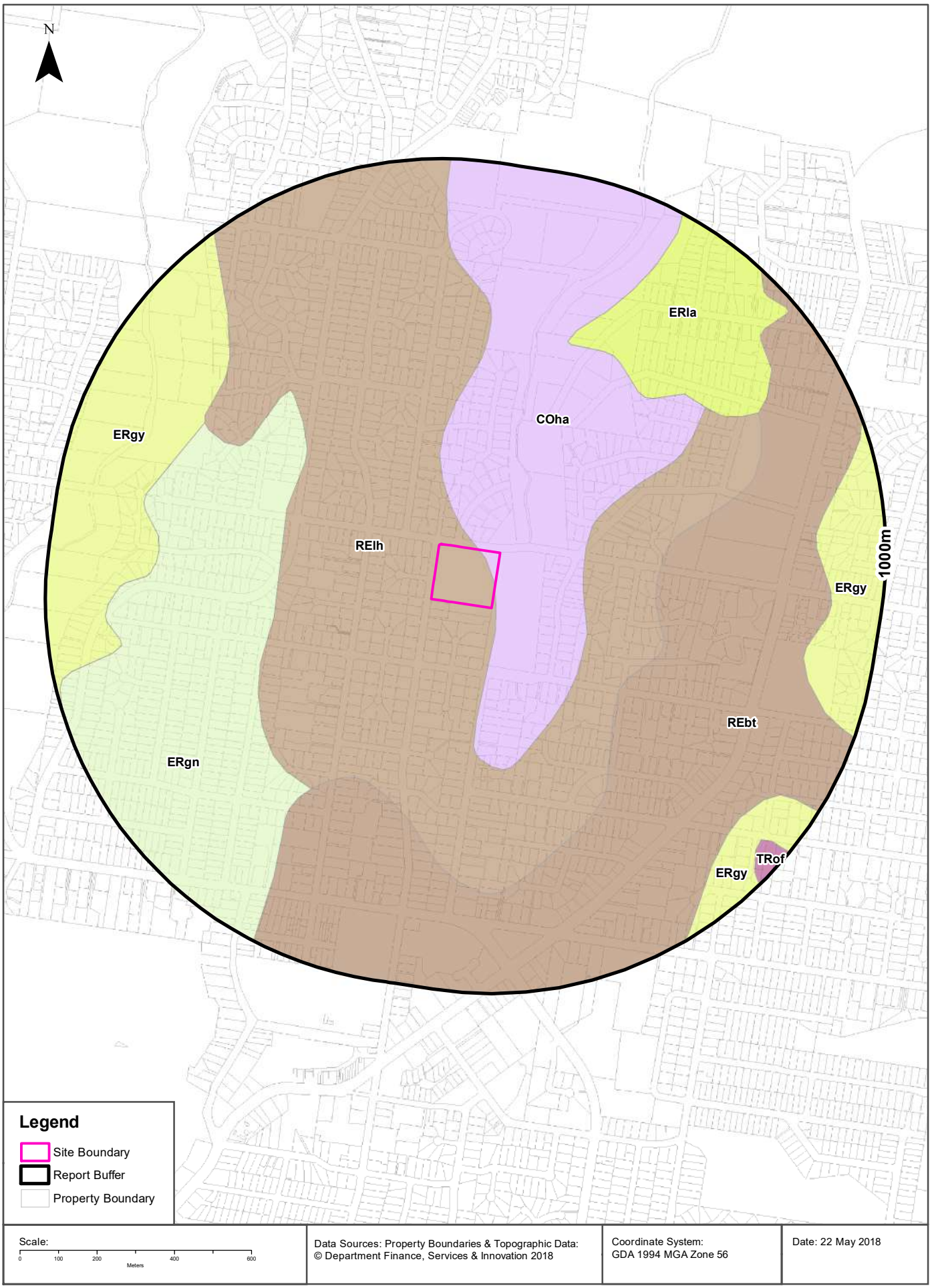
Naturally Occurring Asbestos Potential within the dataset buffer:

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

Mining Subsidence District Data Source: © State of New South Wales through NSW Department of Industry, Resources & Energy

Soil Landscapes

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Soils

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Soil Landscapes

What are the onsite Soil Landscapes?

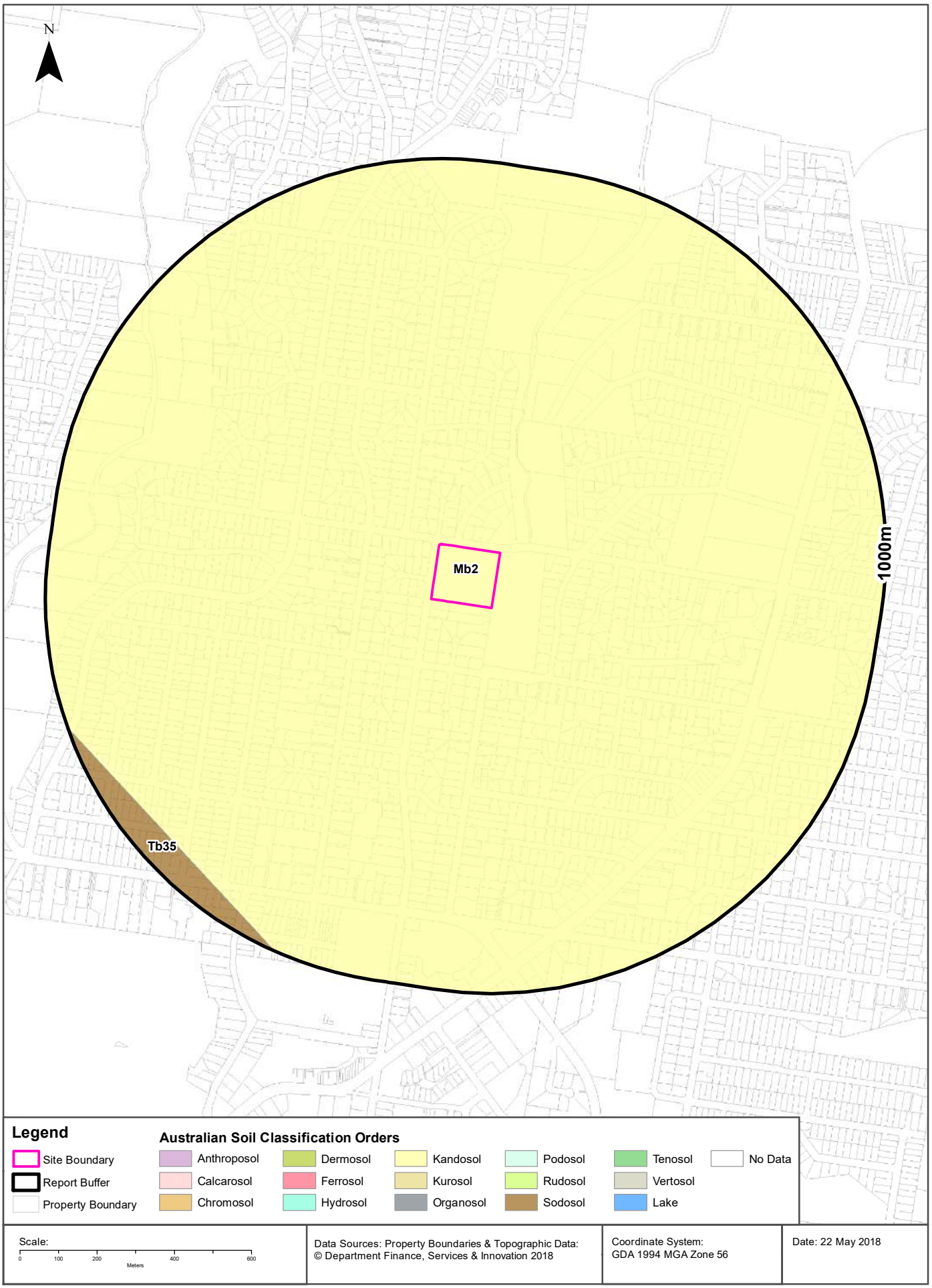
Soil Code	Name	Group	Process	Map Sheet	Scale
COha	HAWKESBURY		COLLUVIAL	Sydney	1:100,000
RElh	LUCAS HEIGHTS		RESIDUAL	Sydney	1:100,000

What are the Soil Landscapes within the dataset buffer?

Soil Code	Name	Group	Process	Map Sheet	Scale
COha	HAWKESBURY		COLLUVIAL	Sydney	1:100,000
ERgn	GLENORIE		EROSIONAL	Sydney	1:100,000
ERgy	GYMEA		EROSIONAL	Sydney	1:100,000
ERla	LAMBERT		EROSIONAL	Sydney	1:100,000
REbt	BLACKTOWN		RESIDUAL	Sydney	1:100,000
RElh	LUCAS HEIGHTS		RESIDUAL	Sydney	1:100,000
TRof	OXFORD FALLS		TRANSFERRAL	Sydney	1:100,000

Atlas of Australian Soils

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Soils

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

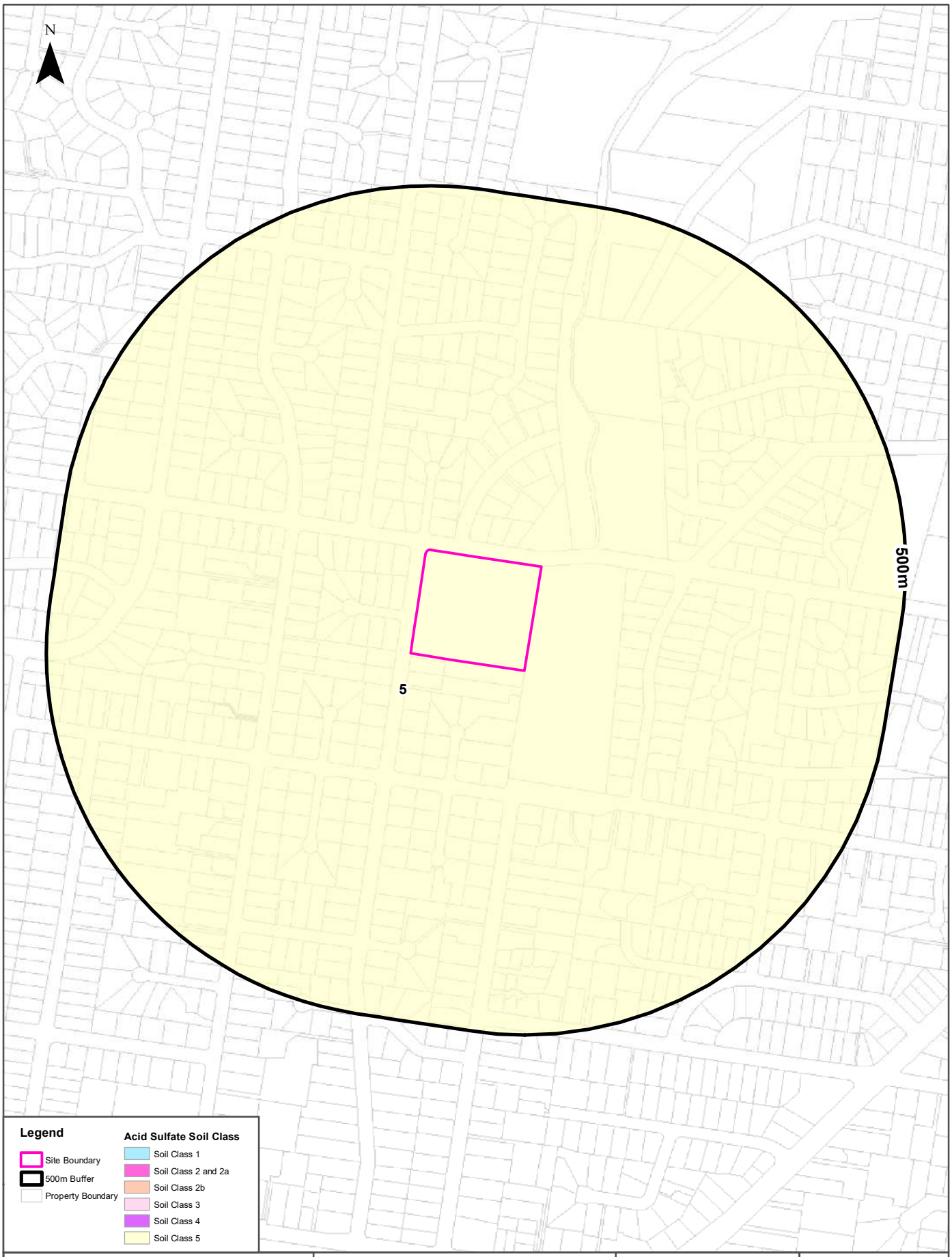
Atlas of Australian Soils

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

Map Unit Code	Soil Order	Map Unit Description	Distance
Mb2	Kandosol	Dissected sandstone plateau of moderate to strong relief with sandstone pillars, ledges, and slabs-- level to undulating ridges, irregularly benched slopes, steep ridges, cliffs, canyons, narrow sandy valleys: chief soils are (i) on areas of gentle to moderate relief, acid yellow leached earths (Gn2.74) and (Gn2.34) and acid leached yellow earths (Gn2.24)-sometimes these soils contain ironstone gravel; and (ii) on, or adjacent to, areas of strong relief, siliceous sands (Uc1.2), leached sands (Uc2.12) and (Uc2.2), and shallow forms of the above (Gn2) soils. Associated are: (i) on flat to gently undulating remnants of the original plateau surface, leached sands (Uc2.3), siliceous sands (Uc1.2), sandy earths (Uc5.22), and (Gn2) soils as for (i) above (these areas are in part comparable with unit Cb29); (ii) on flat ironstone gravelly remnants of the original plateau surface, (Gn2) soils as for unit Mb5(i); (iii) on gently undulating ridges where interbedded shales are exposed, shallow, often stony (Dy3.41), (Dr2.21), and related soils similar to unit Tb35; (iv) narrow valleys of (Uc2.3) soils flanked by moderate slopes of (Dy3.41) soils; (v) escarpments of steep hills with shallow (Dy) and (Dr) soils between sandstone pillars; and (vi) shallow (Um) soils, such as (Um6.21) on steep hills of basic rocks. As mapped, minor areas of units Mg20, Mm1, and Mw8 are included. Data are limited.	0m
Tb35	Sodosol	Dissected plateau remnants--flat to undulating ridge tops with moderate to steep side slopes: chief soils are hard acidic yellow and yellow mottled soils (Dy3.41), (Dy2.21), and (Dy2.41) and hard acidic red soils (Dr2.21); many shallow profiles occur and profile thickness varies considerably over short distances. Associated are: (Gn3.54), (Gn3.14), and possibly other (Gn3) soils; (Db1.2) soils on some ridges; (Dy5.81) soils in areas transitional to unit Mb2; soils common to unit Mb2; and eroded lateritic remnants. Small areas of other soils are likely. Flat ferruginous shale or sandstone fragments are common on and/or in and/or below the soils of this unit.	920m

Acid Sulfate Soils

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Acid Sulfate Soils

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Standard Local Environmental Plan Acid Sulfate Soils

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

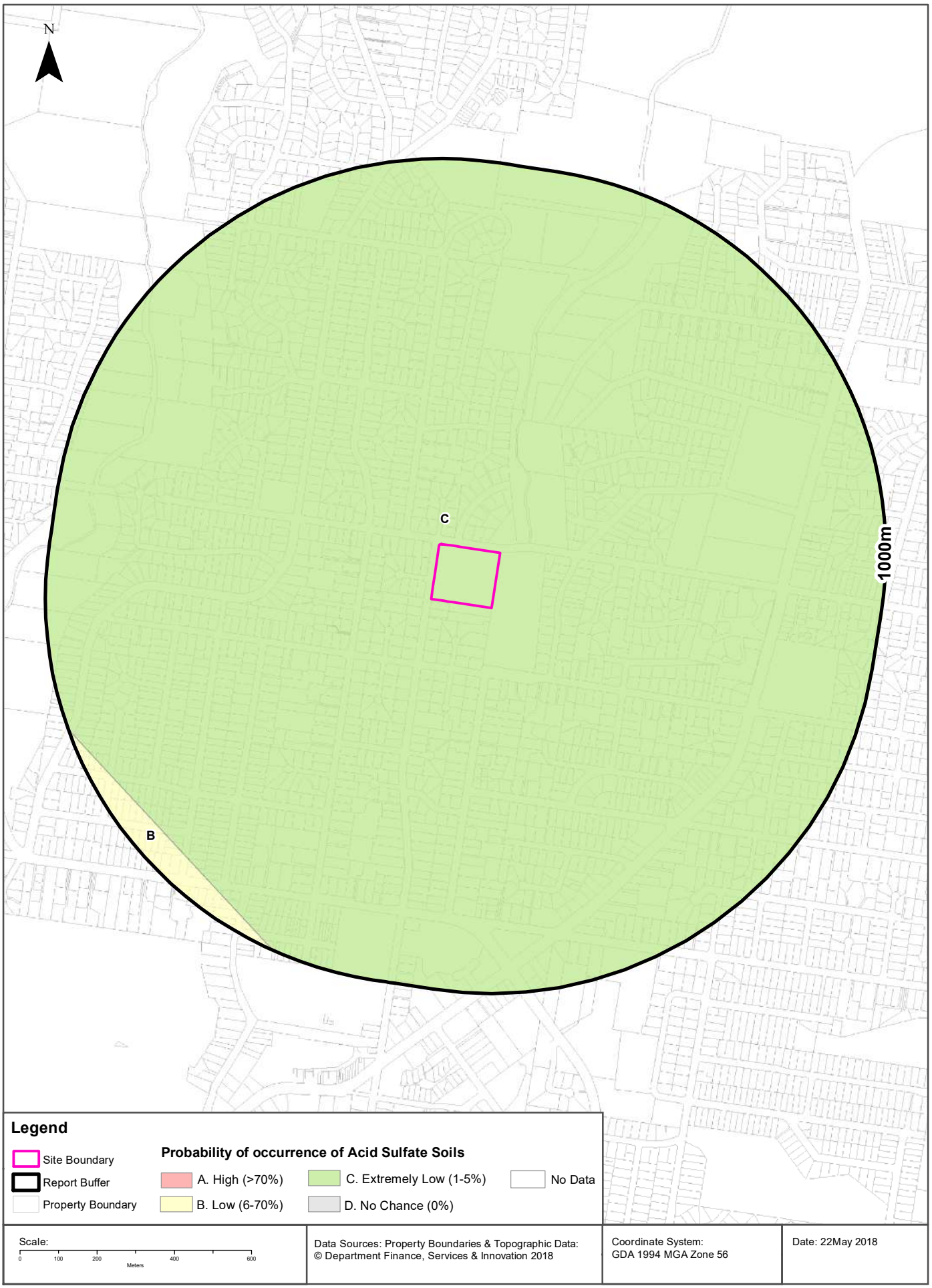
Soil Class	Description	LEP
5	Works within 500 metres of adjacent Class 1, 2, 3, or 4 land that is below 5 metres AHD and by which the watertable is likely to be lowered below 1 metre AHD on adjacent Class 1, 2, 3 or 4 land, present an environmental risk	Ku-ring-gai Local Environmental Plan 2015

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

Soil Class	Description	LEP	Distance	Direction
None				

Atlas of Australian Acid Sulfate Soils

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Acid Sulfate Soils

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

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
B	Low Probability of occurrence. 6-70% chance of occurrence.	921m

Dryland Salinity

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Dryland Salinity - National Assessment

Is there Dryland Salinity - National Assessment data onsite?

No

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

No

What Dryland Salinity assessments are given?

Assessment 2000	Assessment 2020	Assessment 2050	Distance	Direction
N/A	N/A	N/A	N/A	N/A

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
N/A	Outside Data Coverage			

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

Mining Subsidence Districts

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Mining Subsidence Districts

Mining Subsidence Districts within the dataset buffer:

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

Environmental Zoning

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

State Environmental Planning Policy Protected Areas

Are there any State Environmental Planning Policy Protected Areas onsite or within the dataset buffer?

Dataset	Onsite	Within Site Buffer	Distance
SEPP14 - Coastal Wetlands	No	No	N/A
SEPP26 - Littoral Rainforests	No	No	N/A
SEPP71 - Coastal Protection Zone	No	No	N/A

SEPP Protected Areas Data Source: NSW Department of Planning & Environment

State Environmental Planning Policy Major Developments (2005)

State Environmental Planning Policy Major Developments within the dataset buffer:

Map Id	Feature	Effective Date	Distance	Direction
N/A	No records within buffer			

SEPP Major Development Data Source: NSW Department of Planning & Environment

State Environmental Planning Policy Strategic Land Use Areas

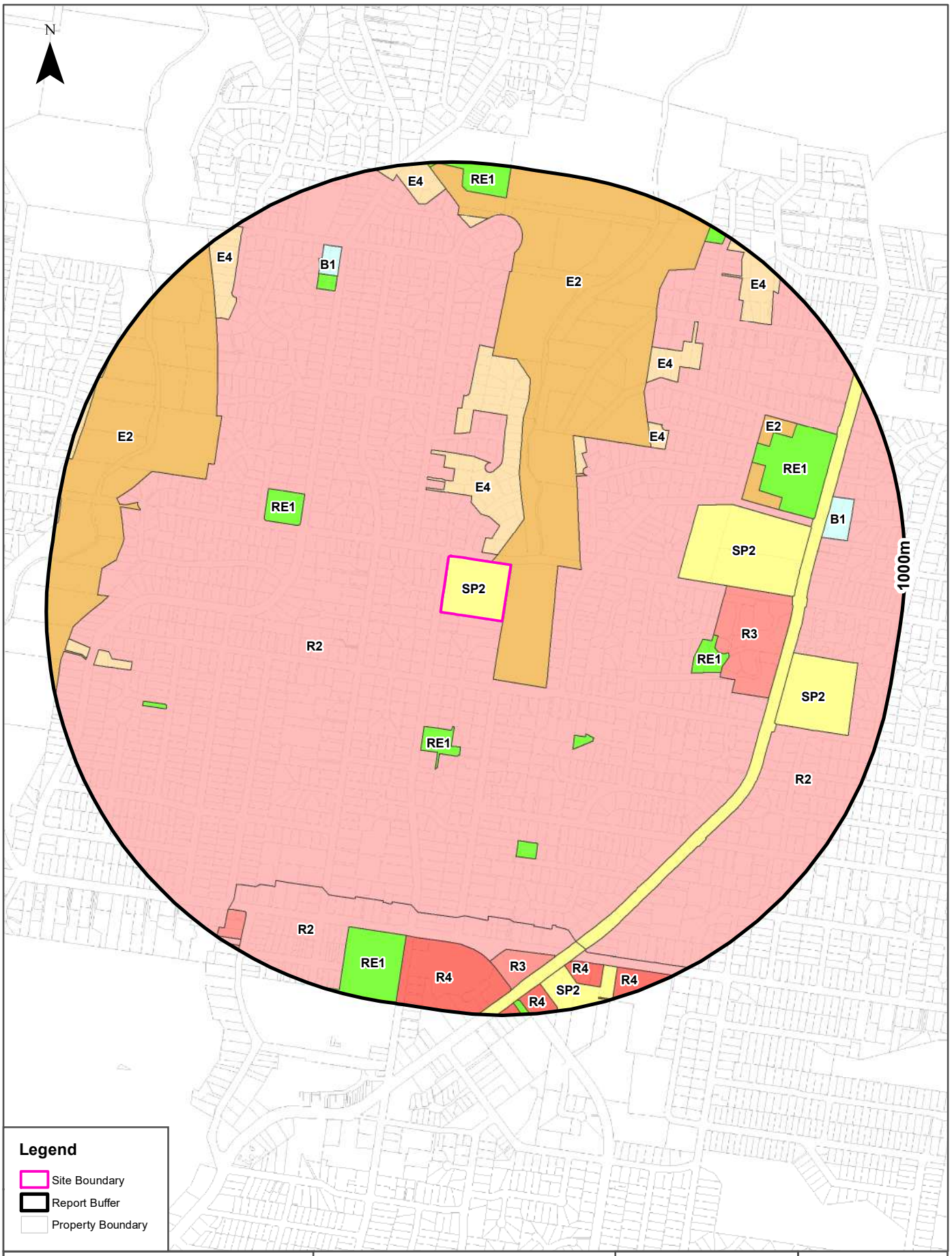
State Environmental Planning Policy Strategic Land Use Areas onsite or within the dataset buffer:

Strategic Land Use	SEPPNo	Effective Date	Amendment	Amendment Year	Distance	Direction
No records within buffer						

SEPP Strategic Land Use Data Source: NSW Department of Planning & Environment

LEP Planning Zones

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Local Environmental Plan

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Land Zoning

What Local Environmental Plan Land Zones exist within the dataset buffer?

Zone	Description	Purpose	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
SP2	Infrastructure	Educational Establishment	Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		0m	Onsite
E2	Environmental Conservation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		0m	North East
R2	Low Density Residential		Ku-ring-gai Local Environmental Plan 2015	19/01/2018	19/01/2018	19/01/2018	Amendment No 14	0m	West
E4	Environmental Living		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		20m	North
E4	Environmental Living		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		283m	North East
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		283m	South
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		342m	South East
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		388m	North West
SP2	Infrastructure	Educational Establishment	Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		424m	East
E4	Environmental Living		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		463m	North East
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		494m	East
R3	Medium Density Residential		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		534m	East
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		558m	South
E4	Environmental Living		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		576m	North East
E2	Environmental Conservation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		607m	East
E2	Environmental Conservation		Ku-ring-gai Local Environmental Plan 2015	19/01/2018	19/01/2018	19/01/2018	Amendment No 14	641m	North West
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		655m	East
E2	Environmental Conservation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		696m	North East
SP2	Infrastructure	Classified Road	Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		703m	North East
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		734m	North West
SP2	Infrastructure	Educational Establishment	Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		734m	East
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		736m	West
R2	Low Density Residential		Ku-ring-gai Local Environmental Plan 2015	19/01/2018	19/01/2018	19/01/2018	Amendment No 14	739m	South East
R2	Low Density Residential		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		746m	South
B1	Neighbourhood Centre		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		766m	North West
B1	Neighbourhood Centre		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		789m	East
E4	Environmental Living		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		794m	West

Zone	Description	Purpose	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Distance	Direction
E4	Environmental Living		Ku-ring-gai Local Environmental Plan 2015	19/01/2018	19/01/2018	19/01/2018	Amendment No 14	823m	North
R4	High Density Residential		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		825m	South
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		825m	South
R3	Medium Density Residential		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		833m	South
E4	Environmental Living		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		834m	North
SP2	Infrastructure	Classified Road	Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		834m	South
E4	Environmental Living		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		850m	North East
R2	Low Density Residential		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		860m	South East
R4	High Density Residential		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		881m	South
SP2	Infrastructure	Educational Establishment	Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		887m	South
E4	Environmental Living		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		896m	West
R3	Medium Density Residential		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		909m	South West
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		919m	North
R4	High Density Residential		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		924m	South
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		957m	North East
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		962m	South
E4	Environmental Living		Ku-ring-gai Local Environmental Plan 2015	19/01/2018	19/01/2018	19/01/2018	Amendment No 14	986m	North West
R3	Medium Density Residential		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		989m	South West
RE1	Public Recreation		Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018		995m	South East
R3	Medium Density Residential		Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/01/2013	08/02/2013	29/09/2017		997m	South East

Local Environmental Plan

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Minimum Subdivision Lot Size

What are the onsite Local Environmental Plan Minimum Subdivision Lot Sizes?

Symbol	Minimum Lot Size	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Percentage of Site Area
No Data							

Maximum Height of Building

What are the onsite Local Environmental Plan Maximum Height of Buildings?

Symbol	Maximum Height of Building	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Percentage of Site Area
No Data							

Floor Space Ratio

What are the onsite Local Environmental Plan Floor Space Ratios?

Symbol	Floor Space Ratio	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Percentage of Site Area
41	0.30	LEP	05/03/2015	02/04/2015	19/01/2018		0.1

Land Application

What are the onsite Local Environmental Plan Land Applications?

Application Type	LEP or SEPP	Published Date	Commenced Date	Currency Date	Amendment	Percentage of Site Area
Included	Ku-ring-gai Local Environmental Plan 2015	19/01/2018	19/01/2018	19/01/2018	Amendment No 14	100

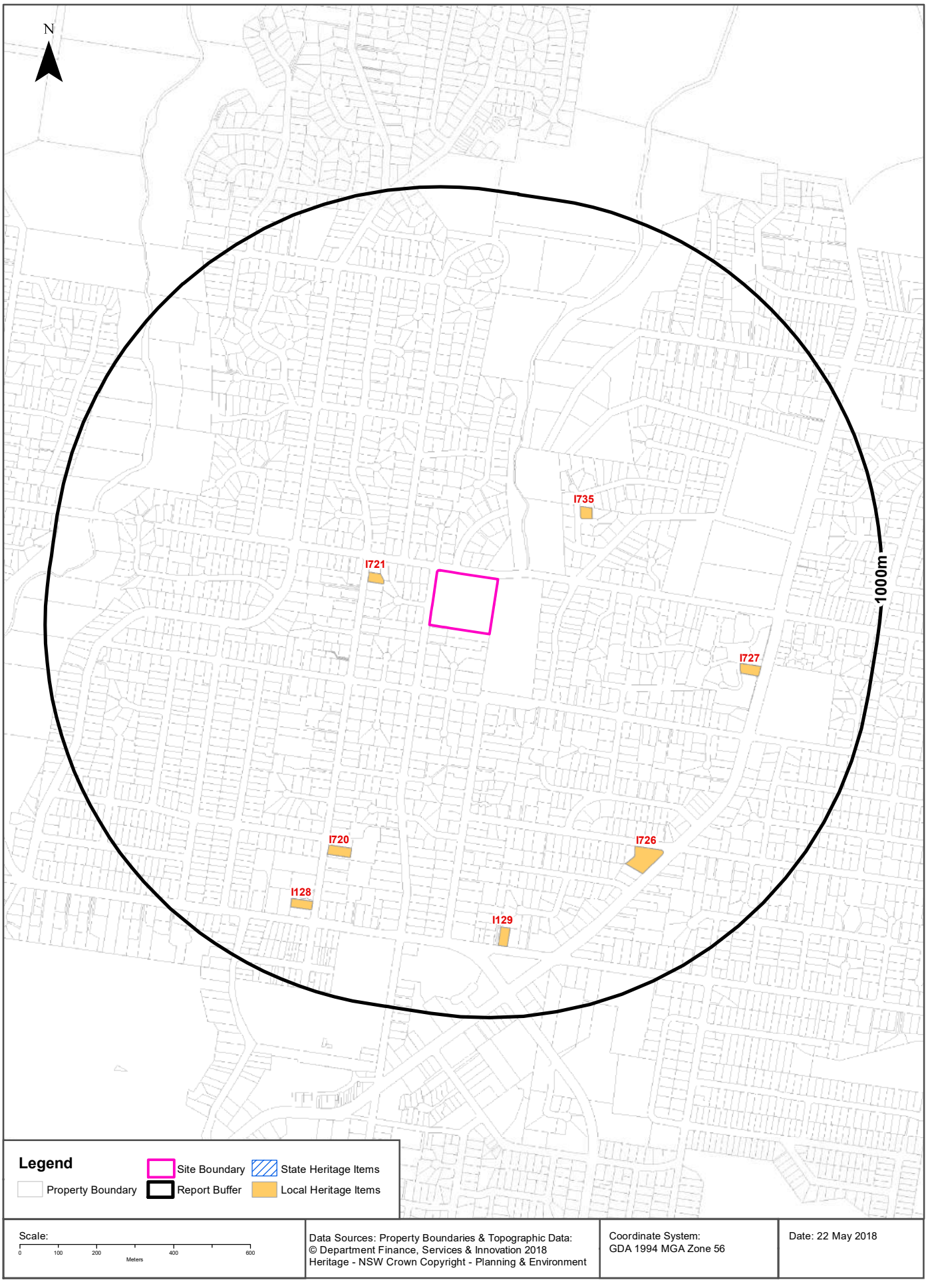
Land Reservation Acquisition

What are the onsite Local Environmental Plan Land Reservation Acquisitions?

Reservation	LEP	Published Date	Commenced Date	Currency Date	Amendment	Comments	Percentage of Site Area
No Data							

Heritage Items

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Heritage

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

State Heritage Items

What are the State Heritage 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							

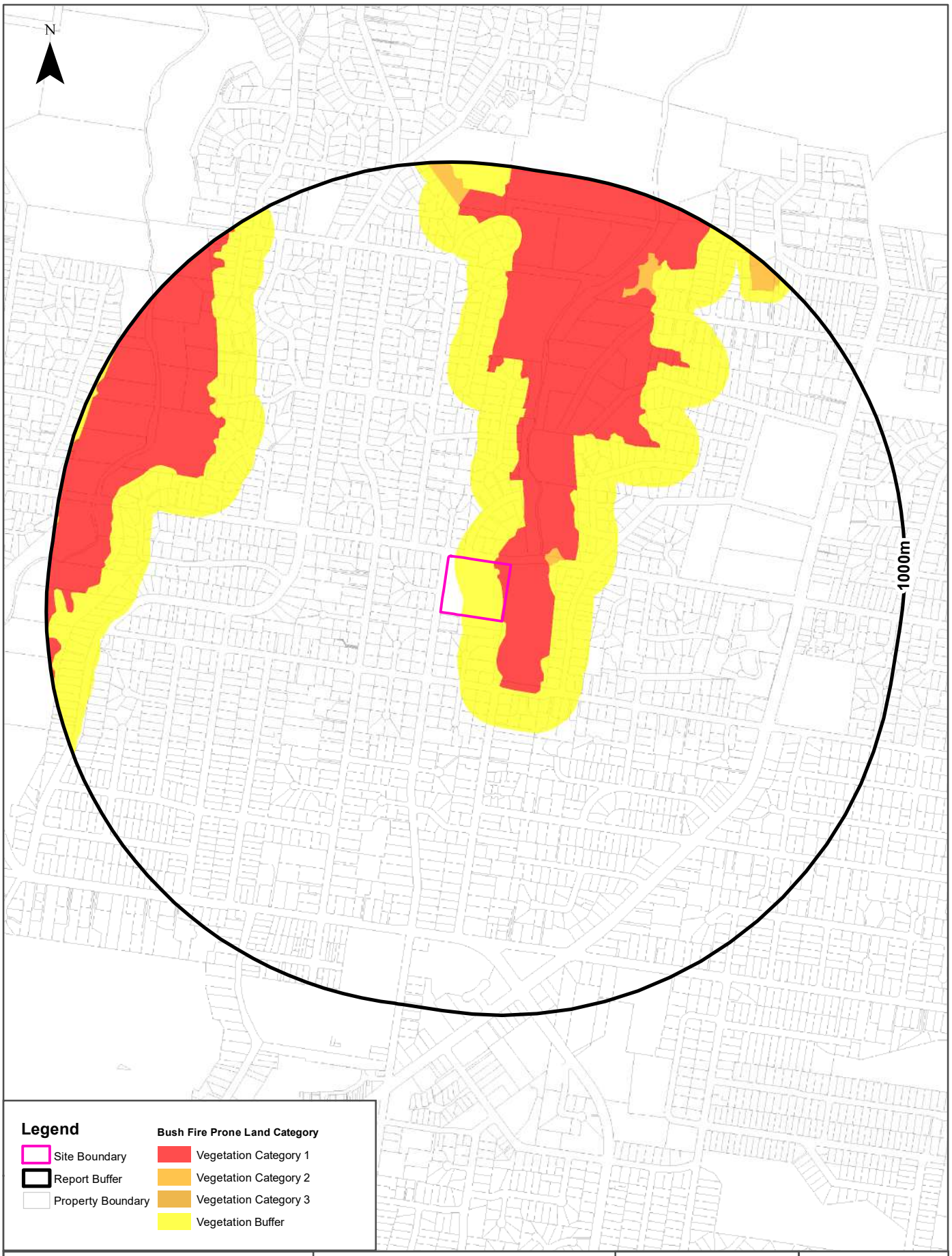
Local Heritage Items

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

Map Id	Name	Classification	Significance	LEP or Act	Published Date	Commenced Date	Currency Date	Distance	Direction
I721	Dwelling house	Item - General	Local	Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018	135m	West
I735	Dwelling house	Item - General	Local	Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018	267m	North East
I720	Dwelling house	Item - General	Local	Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018	616m	South West
I727	Dwelling house "Hillcrest"	Item - General	Local	Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018	655m	East
I726	Uniting Church Hall Former Presbyterian Church	Item - General	Local	Ku-ring-gai Local Environmental Plan 2015	05/03/2015	02/04/2015	19/01/2018	670m	South East
I129	Dwelliing House	Item - General	Local	Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/02/2013	08/02/2013	08/07/2016	764m	South
I128	Dwelliing House "Chester"	Item - General	Local	Ku-ring-gai Local Environmental Plan (Local Centres) 2012	25/02/2013	08/02/2013	08/07/2016	783m	South West

Natural Hazards - Bush Fire Prone Land

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Data Sources: Bush Fire Prone Land: © NSW Rural Fire Service 2018. Property Boundaries: © Department Finance, Services & Innovation 2018

Coordinate System: GDA 1994 MGA Zone 56

Date: 22 May 2018

Natural Hazards

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

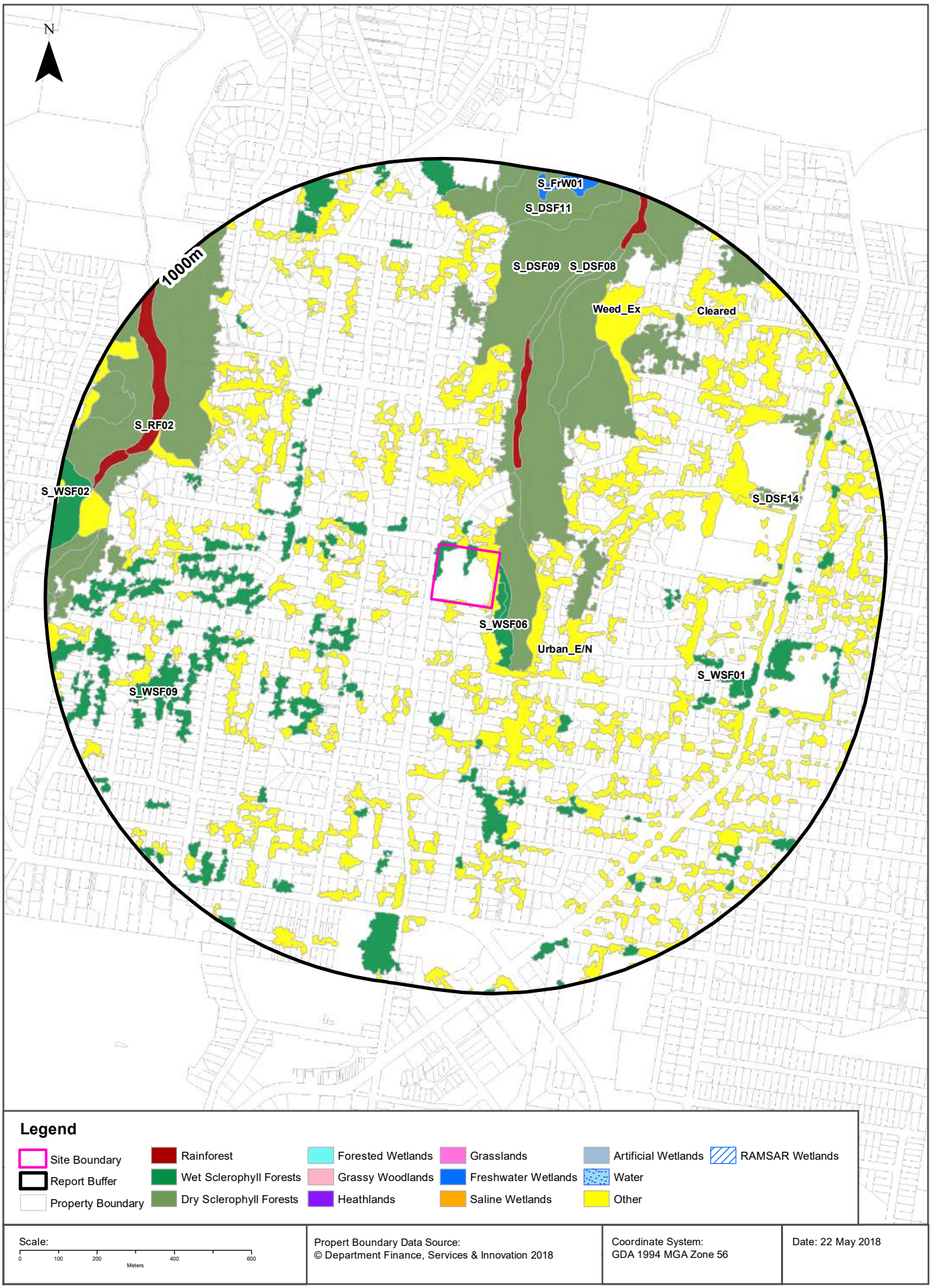
Bush Fire Prone Land

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

Bush Fire Prone Land Category	Distance	Direction
Vegetation Buffer	0m	Onsite
Vegetation Category 1	0m	Onsite
Vegetation Category 2	85m	East

Ecological Constraints - Native Vegetation & RAMSAR Wetlands

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Ecological Constraints

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Native Vegetation

What native vegetation exists within the dataset buffer?

Map ID	Map Unit Name	Threatened Ecological Community NSW	Threatened Ecological Community EPBC Act	Understorey	Disturbance	Disturbance Index	Dominant Species	Dist	Direction
S_DSF09	S_DSF09: Coastal Sandstone Gully Forest			11: Semi sheltered dry/mesic	13: Weeds	2: Moderate	A.costata/E.piperita/C.gummifera/S.glomulifera/E.resinifera	0m	Onsite
S_WSF06	S_WSF06: Coastal Shale-Sandstone Forest			00: Not assessed	24: Urban mixed use	4: Very high	E.racemosa/E.punctataE.resinifera/A.costata	0m	Onsite
S_WSF09	S_WSF09: Sydney Turpentine-Ironbark Forest	Sydney Turpentine Ironbark Forest	Turpentine Ironbark Forest (possible)	00: Not assessed	24: Urban mixed use	4: Very high	E.pilularis/S.glomuliferaA.costata/E.resinifera	0m	Onsite
S_WSF09	S_WSF09: Sydney Turpentine-Ironbark Forest	Sydney Turpentine Ironbark Forest	Turpentine Ironbark Forest (possible)	11: Semi sheltered dry/mesic	24: Urban mixed use	4: Very high	E.resinifera/S.glomulifera/C.gummifera	0m	Onsite
Urban_E/N	Urban_E/N: Urban Exotic/Native			00: Not assessed	00: Not assessed	0: Not assessed	Urban Exotic/Native	0m	Onsite
Weed_Ex	Weed_Ex: Weeds and Exotics			00: Not assessed	00: Not assessed	0: Not assessed	Exotic Species >90%cover	71m	South East
S_RF02	S_RF02: Coastal Sandstone Gallery Rainforest			10: Mesic/rainforest	13: Weeds	3: High	C.apetalum/T.laurina/C.serratifolia	223m	North
S_WSF01	S_WSF01: Blue Gum High Forest	Blue Gum High Forest	Blue Gum High Forest (possible)	00: Not assessed	24: Urban mixed use	4: Very high	E.salignaE.pilularis/S.glomullifera/E.paniculata/A.costata	292m	South West
S_DSF11	S_DSF11: Sydney North Exposed Sandstone Woodland			12: Dry xeric shrubs	25: Edge disturbances only	1: Low	C.gummifera/E.haemastoma/A.costataE.sieberi	340m	North East
S_DSF08	S_DSF08: Coastal Sandstone Riparian Forest			37: Riparian mesic scrub	13: Weeds	2: Moderate	E.piperita/A.costa/T.laurina	504m	North
S_DSF14	S_DSF14: Sydney Ironstone Bloodwood-Silvertop Ash Forest	Duffys Forest Ecological Community		24: Urban and hard surface	24: Urban mixed use	4: Very high	E.sieberi/C.gummifera/E.haemastoma	656m	East
Cleared	Cleared			00: Not assessed	00: Not assessed	0: Not assessed	Cleared	765m	North East
S_WSF02	S_WSF02: Coastal Enriched Sandstone Moist Forest			10: Mesic/rainforest	13: Weeds	3: High	A.costata/E.piperitaE.umbra/C.gummifera	912m	West
S_FrW01	S_FrW01: Coastal Upland Damp Heath Swamp	Coastal Upland Swamp		18: Swampy sedges, shrubs, ferns and herbs	22: Fire	1: Low	B.ericifolia/Hakea spp/sedges	919m	North

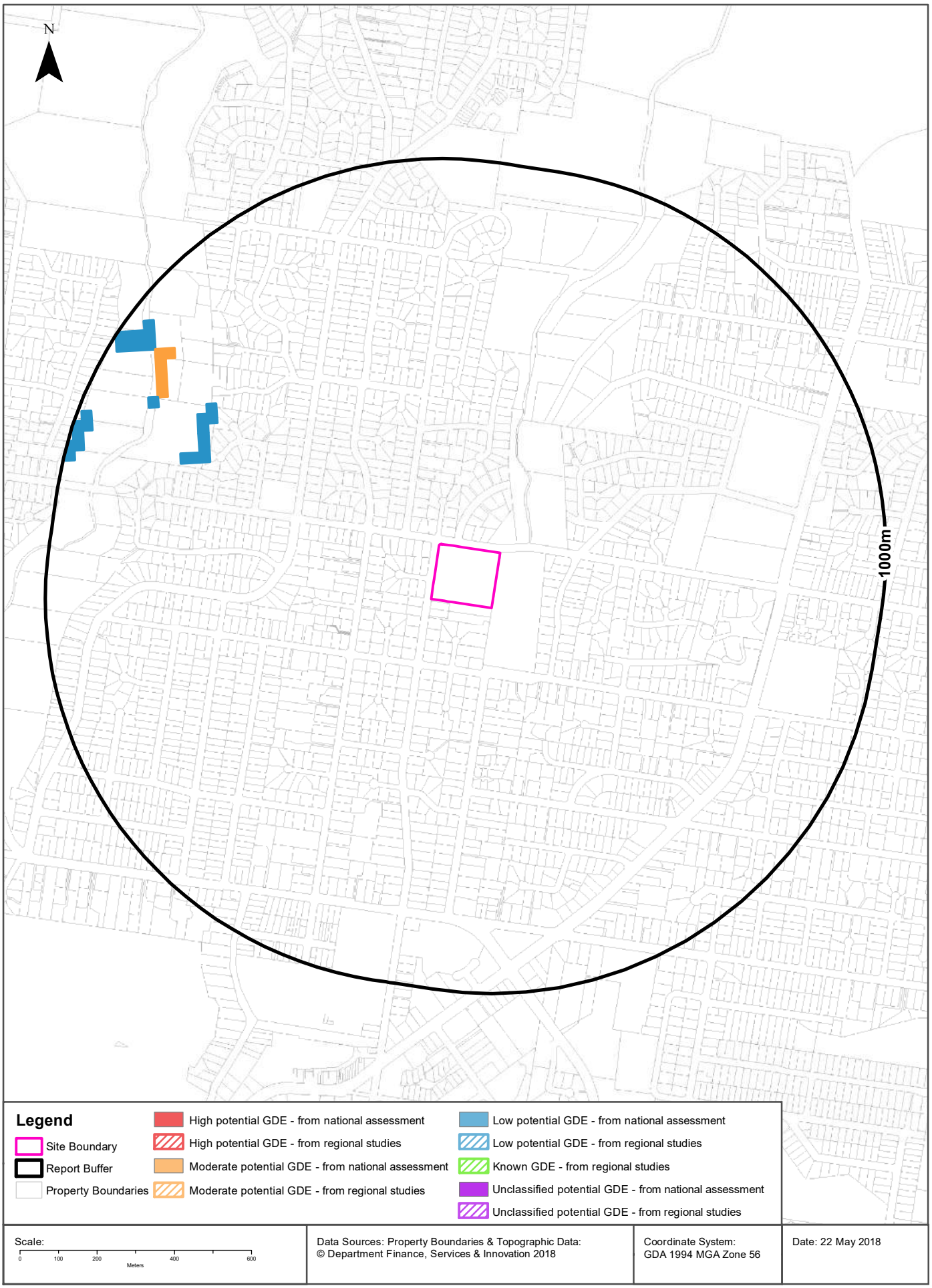
RAMSAR Wetlands

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

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Ecological Constraints

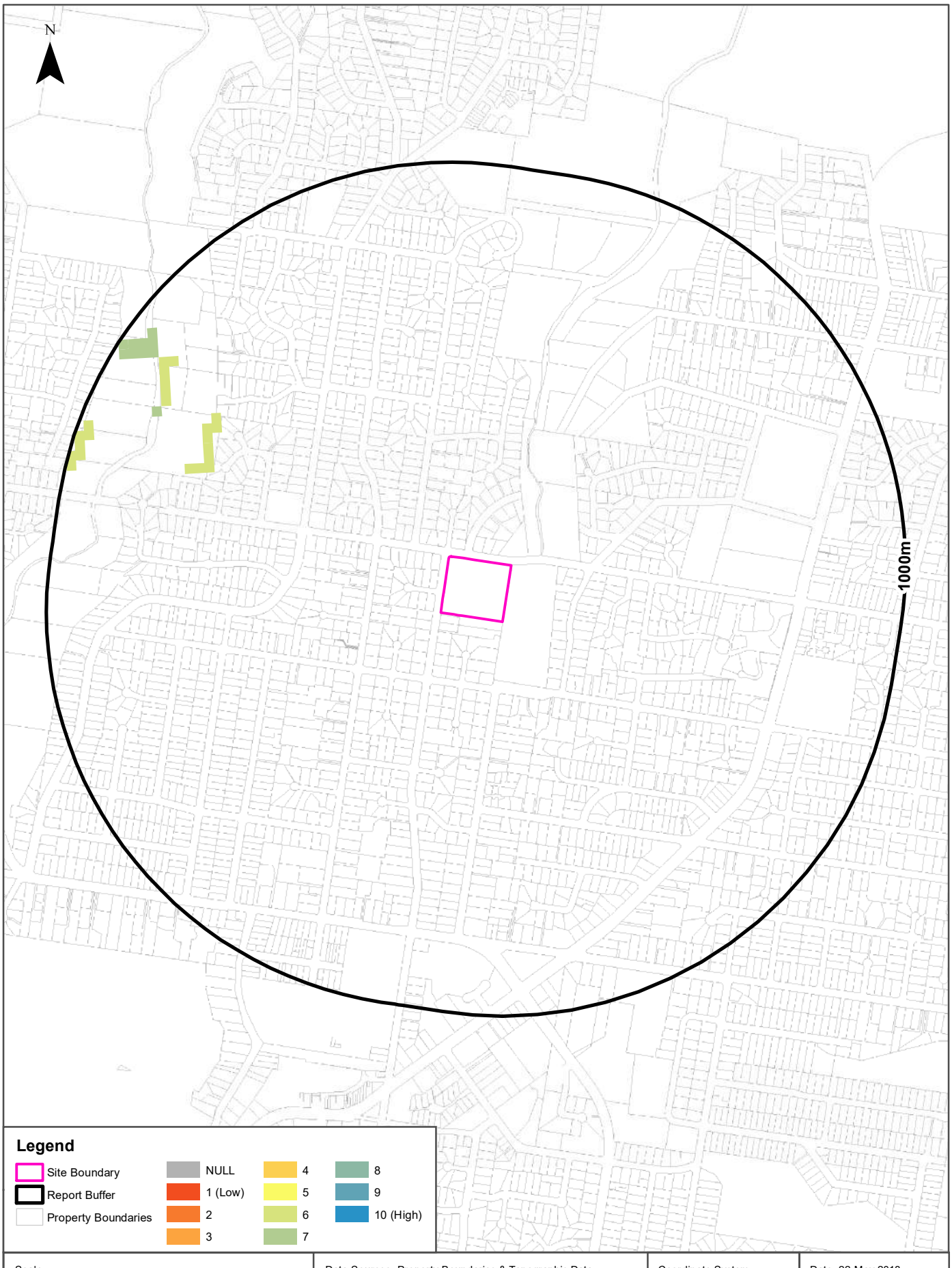
St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Groundwater Dependent Ecosystems Atlas

Type	GDE Potential	Geomorphology	Ecosystem Type	Aquifer Geology	Distance
Terrestrial	Low potential GDE - from national assessment	Deeply dissected sandstone plateaus.	Vegetation	Consolidated sedimentary	632m
Terrestrial	Moderate potential GDE - from national assessment	Deeply dissected sandstone plateaus.	Vegetation	Consolidated sedimentary	802m

Ecological Constraints - Inflow Dependent Ecosystems Likelihood

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075



Ecological Constraints

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

Inflow Dependent Ecosystems Likelihood

Type	IDE Likelihood	Geomorphology	Ecosystem Type	Aquifer Geology	Distance
Terrestrial	6	Deeply dissected sandstone plateaus.	Vegetation	Consolidated sedimentary	632m
Terrestrial	7	Deeply dissected sandstone plateaus.	Vegetation	Consolidated sedimentary	811m

Inflow Dependent Ecosystems Likelihood Data Source: The Bureau of Meteorology

Ecological Constraints

St Ives North Public School, 87 Memorial Avenue, St. Ives, NSW 2075

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	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	Artamus cyanopterus cyanopterus	Dusky Woodswallow	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Botaurus poiciloptilus	Australasian Bittern	Endangered	Not Sensitive	Endangered	
Animalia	Aves	Calidris acuminata	Sharp-tailed Sandpiper	Not Listed	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Calidris ferruginea	Curlew Sandpiper	Endangered	Not Sensitive	Critically Endangered	ROKAMBA;CAMBA; JAMBA
Animalia	Aves	Callocephalon fimbriatum	Gang-gang Cockatoo	Endangered Population, Vulnerable	Category 3	Not Listed	
Animalia	Aves	Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	Category 2	Not Listed	
Animalia	Aves	Cecropis daurica	Red-rumped Swallow	Not Listed	Not Sensitive	Not Listed	ROKAMBA
Animalia	Aves	Daphoenositta chrysoptera	Varied Sittella	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Egretta sacra	Eastern Reef Egret	Not Listed	Not Sensitive	Not Listed	CAMBA
Animalia	Aves	Ephippiorhynchus asiaticus	Black-necked Stork	Endangered	Not Sensitive	Not Listed	
Animalia	Aves	Esacus magnirostris	Beach Stone-curlew	Critically Endangered	Not Sensitive	Not Listed	
Animalia	Aves	Falco hypoleucos	Grey Falcon	Endangered	Category 2	Not Listed	
Animalia	Aves	Glossopsitta pusilla	Little Lorikeet	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Haematopus fuliginosus	Sooty Oystercatcher	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Haematopus longirostris	Pied Oystercatcher	Endangered	Not Sensitive	Not Listed	
Animalia	Aves	Haliaeetus leucogaster	White-bellied Sea-Eagle	Vulnerable	Not Sensitive	Not Listed	CAMBA
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	

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Aves	Limicola falcinellus	Broad-billed Sandpiper	Vulnerable	Not Sensitive	Not Listed	ROKAMBA;CAMBA; JAMBA
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	Nettapus coromandelianus	Cotton Pygmy-Goose	Endangered	Not Sensitive	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	Pachycephala olivacea	Olive Whistler	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Pandion cristatus	Eastern Osprey	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Petroica boodang	Scarlet Robin	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Polytelis swainsonii	Superb Parrot	Vulnerable	Category 3	Vulnerable	
Animalia	Aves	Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Ptilinopus superbus	Superb Fruit-Dove	Vulnerable	Not Sensitive	Not Listed	
Animalia	Aves	Tyto novaehollandiae	Masked Owl	Vulnerable	Category 3	Not Listed	
Animalia	Aves	Tyto tenebricosa	Sooty Owl	Vulnerable	Category 3	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	Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	Endangered	Not Sensitive	Endangered	
Animalia	Mammalia	Miniopterus australis	Little Bentwing-bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Mormopterus norfolkensis	Eastern Freetail-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	Phascolarctos cinereus	Koala	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Mammalia	Pseudomys gracilicaudatus	Eastern Chestnut Mouse	Vulnerable	Not Sensitive	Not Listed	
Animalia	Mammalia	Pseudomys novaehollandiae	New Holland Mouse	Not Listed	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	

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Animalia	Reptilia	Chelonia mydas	Green Turtle	Vulnerable	Not Sensitive	Vulnerable	
Animalia	Reptilia	Dermochelys coriacea	Leatherback Turtle	Endangered	Not Sensitive	Endangered	
Animalia	Reptilia	Myuchelys bellii	Bell’s Turtle, Western Sawshelled Turtle	Endangered	Not Sensitive	Vulnerable	
Animalia	Reptilia	Varanus rosenbergi	Rosenberg's Goanna	Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Acacia bynoeana	Bynoe's Wattle	Endangered	Not Sensitive	Vulnerable	
Plantae	Flora	Acacia gordonii		Endangered	Not Sensitive	Endangered	
Plantae	Flora	Acacia pubescens	Downy Wattle	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Acacia terminalis subsp. terminalis	Sunshine Wattle	Endangered	Not Sensitive	Endangered	
Plantae	Flora	Caladenia tessellata	Thick Lip Spider Orchid	Endangered	Category 2	Vulnerable	
Plantae	Flora	Callistemon linearifolius	Netted Bottle Brush	Vulnerable	Category 3	Not Listed	
Plantae	Flora	Cryptostylis hunteriana	Leafless Tongue Orchid	Vulnerable	Category 2	Vulnerable	
Plantae	Flora	Darwinia biflora		Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Darwinia peduncularis		Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Deyeuxia appressa		Endangered	Not Sensitive	Endangered	
Plantae	Flora	Diuris bracteata		Endangered	Category 2	Extinct	
Plantae	Flora	Epacris purpurascens subsp. purpurascens		Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Epacris purpurascens var. purpurascens		Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Eucalyptus camfieldii	Camfield's Stringybark	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	Galium australe	Tangled Bedstraw	Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Genoplesium baueri	Bauer's Midge Orchid	Endangered	Category 2	Endangered	
Plantae	Flora	Genoplesium plumosum	Tallong Midge Orchid	Critically Endangered	Category 2	Endangered	
Plantae	Flora	Grammitis stenophylla	Narrow-leaf Finger Fern	Endangered	Category 3	Not Listed	
Plantae	Flora	Grevillea caleyi	Caley's Grevillea	Critically Endangered	Category 3	Endangered	
Plantae	Flora	Grevillea hilliana	White Yiel Yiel	Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	Vulnerable	Not Sensitive	Not Listed	
Plantae	Flora	Grevillea parviflora subsp. parviflora	Small-flower Grevillea	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Haloragodendron lucasii		Endangered	Not Sensitive	Endangered	
Plantae	Flora	Hibbertia puberula		Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Hibbertia spanantha	Julian's Hibbertia	Critically Endangered	Category 2	Critically Endangered	

Kingdom	Class	Scientific	Common	NSW Conservation Status	NSW Sensitivity Class	Federal Conservation Status	Migratory Species Agreements
Plantae	Flora	Hibbertia superans		Endangered	Not Sensitive	Not Listed	
Plantae	Flora	Lasiopetalum joyceae		Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Leptospermum deanei		Vulnerable	Not Sensitive	Vulnerable	
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	Melaleuca biconvexa	Biconvex Paperbark	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Melaleuca deanei	Deane's Paperbark	Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Microtis angusii	Angus's Onion Orchid	Endangered	Category 2	Endangered	
Plantae	Flora	Persoonia hirsuta	Hairy Geebung	Endangered	Category 3	Endangered	
Plantae	Flora	Persoonia mollis subsp. maxima		Endangered	Not Sensitive	Endangered	
Plantae	Flora	Persoonia nutans	Nodding Geebung	Endangered	Not Sensitive	Endangered	
Plantae	Flora	Persoonia pauciflora	North Rothbury Persoonia	Critically Endangered	Category 3	Critically Endangered	
Plantae	Flora	Pimelea curviflora subsp. curviflora		Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Pimelea curviflora var. curviflora		Vulnerable	Not Sensitive	Vulnerable	
Plantae	Flora	Prostanthera junonis	Somersby Mintbush	Endangered	Not Sensitive	Endangered	
Plantae	Flora	Prostanthera marifolia	Seaforth Mintbush	Critically Endangered	Category 3	Critically Endangered	
Plantae	Flora	Pterostylis nigricans	Dark Greenhood	Vulnerable	Category 2	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.

Data obtained 21/05/2018

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Appendix C: Borehole Logs

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. **201** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: JDH ARCHITECTS

Project: PROPOSED CAPITAL WORKS PROJECT

Location: ST IVES NORTH, PUBLIC SCHOOL, ST IVES, NSW

Job No. E31387K **Method:** SPIRAL AUGER JK205 **R.L. Surface:**

Date: 2/6/18 **Datum:**

Logged/Checked by: H.W./K.T.

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 COMPL -ETION							0			CONCRETE: 150mm.t.				
									-	FILL: Gravelly sand, fine to medium grained, dark grey, trace of asphalt gravel.	M			
						N = 3 2,1,2	0.5			FILL: Sandy clay, low to medium plasticity, yellow, traces of root fibres and ash.	w≈PL			
							1		-	Extremely Weathered sandstone: Sandy CLAY, fine to coarse grained, yellow mottled red.	XW			
							1.5			END OF BOREHOLE AT 1.5m				
							2							
							2.5							
							3							
							3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. **202** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: JDH ARCHITECTS

Project: PROPOSED CAPITAL WORKS PROJECT

Location: ST IVES NORTH, PUBLIC SCHOOL, ST IVES, NSW

Job No. E31387K **Method:** SPIRAL AUGER JK205 **R.L. Surface:**

Date: 2/6/18 **Datum:**

Logged/Checked by: H.W./K.T.

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 COMPL -ETION	■		■				0			FILL: Silty sand, fine to medium grained, dark brown, trace of root fibres.	M			GRASS COVER
	■		■			N = 20 4,9,11	0.5			FILL: Sandy clay, low to medium plasticity, yellow and red, traces of ironstone gravel, root fibres and ash.	w≈PL			
	■						1		-	Extremely Weathered sandstone: Sandy CLAY, fine to medium grained, red and yellow.	XW			
							1.5			END OF BOREHOLE AT 1.5m				
							2							
							2.5							
							3							
							3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. **203** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: JDH ARCHITECTS

Project: PROPOSED CAPITAL WORKS PROJECT

Location: ST IVES NORTH, PUBLIC SCHOOL, ST IVES, NSW

Job No. E31387K **Method:** SPIRAL AUGER JK205 **R.L. Surface:**

Date: 2/6/18 **Datum:**

Logged/Checked by: H.W./K.T.

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 COMPL -ETION	■		■				0			FILL: Silty sand, fine to medium grained, dark brown, traces of igneous gravel and ironstone gravel.	M			MULCH COVER
	■		■			N = 8 3,4,4	0.5			FILL: Silty clay, medium to high plasticity, yellow and red, traces of timber, ironstone gravel and ash.	w>PL			
	■						1							
	■						1.5		-	Extremely Weathered sandstone: Silty CLAY, fine to medium grained, yellow mottled red.	XW			
							2			END OF BOREHOLE AT 2.0m				
							2.5							
							3							
							3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. **204** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: JDH ARCHITECTS

Project: PROPOSED CAPITAL WORKS PROJECT

Location: ST IVES NORTH, PUBLIC SCHOOL, ST IVES, NSW

Job No. E31387K **Method:** SPIRAL AUGER JK205 **R.L. Surface:**

Date: 2/6/18 **Datum:**

Logged/Checked by: H.W./K.T.

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 COMPL -ETION	■		■				0			ASPHALTIC CONCRETE: 50mm.t.				
									-	FILL: Silty sand, fine to medium grained, grey, traces of ironstone gravel and ash.	M			
							0.5							
	■					N = 12 3,4,8			CI-CH	Silty CLAY: medium to high plasticity, light brown mottled yellow.	w>PL			
							1							
										as above, but white.				
	■						1.5							
							2			END OF BOREHOLE At 2.0M				
							2.5							
							3							
							3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. **205** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: JDH ARCHITECTS

Project: PROPOSED CAPITAL WORKS PROJECT

Location: ST IVES NORTH, PUBLIC SCHOOL, ST IVES, NSW

Job No. E31387K **Method:** SPIRAL AUGER JK205 **R.L. Surface:**

Date: 2/6/18 **Datum:**

Logged/Checked by: H.W./K.T.

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 COMPL -ETION							0			ASPHALTIC CONCRETE: 50mm.t.				
									-	FILL: Sandy clay, low to medium plasticity, dark grey, traces of igneous gravel.	W<PL			
						N = 7 3,2,5	0.5		SM	Silty SAND: fine to medium grained, orange mottled red, trace of ironstone gravel.	w≈PL			
							1							
							1.5		CI-CH	Silty CLAY: medium to high plasticity, red brown mottled yellow.	w>PL			
							2			END OF BOREHOLE AT 2.0m				
							2.5							
							3							
							3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. **206** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: JDH ARCHITECTS

Project: PROPOSED CAPITAL WORKS PROJECT

Location: ST IVES NORTH, PUBLIC SCHOOL, ST IVES, NSW

Job No. E31387K **Method:** SPIRAL AUGER JK205 **R.L. Surface:**

Date: 2/6/18 **Datum:**

Logged/Checked by: H.W./K.T.

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 COMPL -ETION							0			CONCRETE: 100mm.t.				
									-	FILL: Sandy clay, fine to medium plasticity, dark grey, trace of igneous gravel and asphalt.	w<PL			
						N = 18 10,11,7	0.5		CI-CH	Sandy CLAY: medium to high plasticity, orange mottled red, trace of ironstone gravel.	w≈PL			'TC' BIT RESISTANCE
							1							
							1.5							
										END OF BOREHOLE AT 1.6m				
							2							
							2.5							
							3							
							3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. **207** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: JDH ARCHITECTS

Project: PROPOSED CAPITAL WORKS PROJECT

Location: ST IVES NORTH, PUBLIC SCHOOL, ST IVES, NSW

Job No. E31387K **Method:** SPIRAL AUGER JK205 **R.L. Surface:**

Date: 2/6/18 **Datum:**

Logged/Checked by: H.W./K.T.

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 COMPL -ETION	■		■				0			CONCRETE: 100mm.t.				
									-	FILL: Silty clay, medium to high plasticity, dark brown and orange brown, traces of igneous gravel.	w≈PL			
						N = 18 6,9,9	0.5		CI-CH	Silty CLAY: medium to high plasticity, grey mottled yellow.	w>PL			
	■						1							
							1.5							
										END OF BOREHOLE AT 1.6m				
							2							
							2.5							
							3							
							3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. **208** **1/1**

Environmental logs are not to be used for geotechnical purposes

Client: JDH ARCHITECTS

Project: PROPOSED CAPITAL WORKS PROJECT

Location: ST IVES NORTH, PUBLIC SCHOOL, ST IVES, NSW

Job No. E31387K **Method:** SPIRAL AUGER JK205 **R.L. Surface:**

Date: 2/6/18 **Datum:**

Logged/Checked by: H.W./K.T.

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 COMPL -ETION							0			CONCRETE: 150mm.t.				
	■		■						-	FILL: Sandy clay, fine to medium grained, red and brown, traces of ironstone gravel and ash.	M			
	■		■				0.5			FILL: Silty clay, low to medium plasticity, light brown and red, traces of ironstone gravel and ash.	w≈PL			
	■			■		N = 19 9,12,7	1							
	■			■			1.5		-	Extremely Weathered sandstone: Silty CLAY, fine to medium grained, yellow and brown.	XW			
							2			END OF BOREHOLE AT 1.8m				
							2.5							
							3							
							3.5							

ENVIRONMENTAL LOGS EXPLANATORY 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.

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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:

$$C_u = \frac{D_{60}}{D_{10}} \quad \text{and} \quad C_c = \frac{(D_{30})^2}{D_{10}\ D_{60}}$$

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:

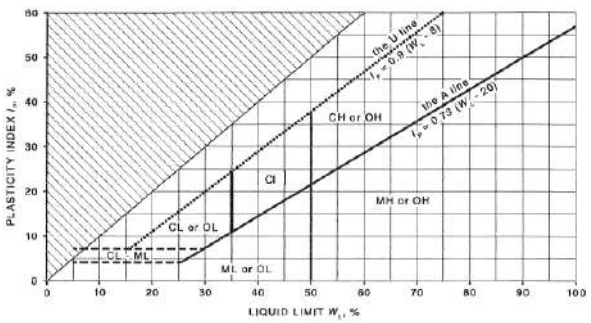
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

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.

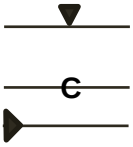
3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

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 U50 DB DS ASB ASS SAL	Sample taken over depth indicated, for environmental analysis. Undisturbed 50mm diameter tube sample taken over depth indicated. Bulk disturbed sample taken over depth indicated. Small disturbed bag sample taken over depth indicated. Soil sample taken over depth indicated, for asbestos analysis. Soil sample taken over depth indicated, for acid sulfate soil analysis. Soil sample taken over depth indicated, for salinity analysis.
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.
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.

Log Column	Symbol	Definition
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 D: Laboratory Report & COC Documents

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CERTIFICATE OF ANALYSIS 193227

Client Details

Client	Environmental Investigation Services
Attention	Katrina Taylor
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E31387K, St Ives North**
Number of Samples	27 Soil
Date samples received	04/06/2018
Date completed instructions received	04/06/2018

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	12/06/2018
Date of Issue	12/06/2018

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Authorised by Asbestos Approved Signatory: Lucy Zhu

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Lucy Zhu, Asbsestos Analyst
Priya Samarawickrama, Senior Chemist
Steven Luong, Senior Chemist

Authorised By

Jacinta Hurst, Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		193227-1	193227-3	193227-4	193227-6	193227-7
Your Reference	UNITS	BH201	BH201	BH202	BH202	BH203
Depth		0.15-0.3	1.3-1.5	0-0.2	1.3-1.5	0-0.2
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	93	93	96	119	119

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		193227-9	193227-10	193227-11	193227-13	193227-14
Your Reference	UNITS	BH203	BH204	BH204	BH205	BH205
Depth		1.7-2.0	0.05-0.2	0.6-0.9	0.05-0.3	0.5-0.8
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	107	94	102	88	84

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		193227-16	193227-17	193227-18	193227-19	193227-20
Your Reference	UNITS	BH206	BH206	BH207	BH207	BH208
Depth		0.1-0.2	0.3-0.45	0.1-0.3	0.7-0.95	0.15-0.35
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	91	113	90	97	92

vTRH(C6-C10)/BTEXN in Soil				
Our Reference		193227-25	193227-26	193227-27
Your Reference	UNITS	BH208	HWDup	TB
Depth		1.3-1.8	-	-
Date Sampled		02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018
TRH C_6 - C_9	mg/kg	<25	<25	[NA]
TRH C_6 - C_{10}	mg/kg	<25	<25	[NA]
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	[NA]
Benzene	mg/kg	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1
naphthalene	mg/kg	<1	<1	[NA]
Total +ve Xylenes	mg/kg	<1	<1	[NA]
Surrogate aaa-Trifluorotoluene	%	97	98	96

svTRH (C10-C40) in Soil						
Our Reference		193227-1	193227-3	193227-4	193227-6	193227-7
Your Reference	UNITS	BH201	BH201	BH202	BH202	BH203
Depth		0.15-0.3	1.3-1.5	0-0.2	1.3-1.5	0-0.2
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	93	93	96	94	94

svTRH (C10-C40) in Soil						
Our Reference		193227-9	193227-10	193227-11	193227-13	193227-14
Your Reference	UNITS	BH203	BH204	BH204	BH205	BH205
Depth		1.7-2.0	0.05-0.2	0.6-0.9	0.05-0.3	0.5-0.8
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	06/06/2018	07/06/2018	07/06/2018	07/06/2018
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	120	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	<100	110	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	110	<50
Surrogate o-Terphenyl	%	94	96	97	95	98

svTRH (C10-C40) in Soil						
Our Reference		193227-16	193227-17	193227-18	193227-19	193227-20
Your Reference	UNITS	BH206	BH206	BH207	BH207	BH208
Depth		0.1-0.2	0.3-0.45	0.1-0.3	0.7-0.95	0.15-0.35
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	140	<100	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	130	<100	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	130	<50	<50	<50	<50
Surrogate o-Terphenyl	%	99	97	97	96	94

svTRH (C10-C40) in Soil			
Our Reference		193227-25	193227-26
Your Reference	UNITS	BH208	HWDup
Depth		1.3-1.8	-
Date Sampled		02/06/2018	02/06/2018
Type of sample		Soil	Soil
Date extracted	-	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	08/06/2018
TRH C_{10} - C_{14}	mg/kg	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100
TRH C_{29} - C_{36}	mg/kg	100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50
TRH >C_{16} -C_{34}	mg/kg	110	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	110	<50
Surrogate o-Terphenyl	%	95	98

PAHs in Soil						
Our Reference		193227-1	193227-3	193227-4	193227-6	193227-7
Your Reference	UNITS	BH201	BH201	BH202	BH202	BH203
Depth		0.15-0.3	1.3-1.5	0-0.2	1.3-1.5	0-0.2
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	104	107	107	106	107

PAHs in Soil						
Our Reference		193227-9	193227-10	193227-11	193227-13	193227-14
Your Reference	UNITS	BH203	BH204	BH204	BH205	BH205
Depth		1.7-2.0	0.05-0.2	0.6-0.9	0.05-0.3	0.5-0.8
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	103	111	104	104	107

PAHs in Soil						
Our Reference		193227-16	193227-17	193227-18	193227-19	193227-20
Your Reference	UNITS	BH206	BH206	BH207	BH207	BH208
Depth		0.1-0.2	0.3-0.45	0.1-0.3	0.7-0.95	0.15-0.35
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	103	106	104	102	104

PAHs in Soil			
Our Reference		193227-25	193227-26
Your Reference	UNITS	BH208	HWDup
Depth		1.3-1.8	-
Date Sampled		02/06/2018	02/06/2018
Type of sample		Soil	Soil
Date extracted	-	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018
Naphthalene	mg/kg	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	106	104

Organochlorine Pesticides in soil						
Our Reference		193227-1	193227-4	193227-7	193227-10	193227-13
Your Reference	UNITS	BH201	BH202	BH203	BH204	BH205
Depth		0.15-0.3	0-0.2	0-0.2	0.05-0.2	0.05-0.3
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	101	92	92	92

Organochlorine Pesticides in soil					
Our Reference		193227-16	193227-18	193227-20	193227-26
Your Reference	UNITS	BH206	BH207	BH208	HWDup
Depth		0.1-0.2	0.1-0.3	0.15-0.35	-
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	07/06/2018
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	0.2	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	0.2	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	96	91	107

Organophosphorus Pesticides						
Our Reference		193227-1	193227-4	193227-7	193227-10	193227-13
Your Reference	UNITS	BH201	BH202	BH203	BH204	BH205
Depth		0.15-0.3	0-0.2	0-0.2	0.05-0.2	0.05-0.3
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	101	92	92	92

Organophosphorus Pesticides					
Our Reference		193227-16	193227-18	193227-20	193227-26
Your Reference	UNITS	BH206	BH207	BH208	HWDup
Depth		0.1-0.2	0.1-0.3	0.15-0.35	-
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	07/06/2018
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	98	96	91	107

PCBs in Soil						
Our Reference		193227-1	193227-4	193227-7	193227-10	193227-13
Your Reference	UNITS	BH201	BH202	BH203	BH204	BH205
Depth		0.15-0.3	0-0.2	0-0.2	0.05-0.2	0.05-0.3
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	98	101	92	92	92

PCBs in Soil					
Our Reference		193227-16	193227-18	193227-20	193227-26
Your Reference	UNITS	BH206	BH207	BH208	HWDup
Depth		0.1-0.2	0.1-0.3	0.15-0.35	-
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	07/06/2018
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	98	96	91	107

Acid Extractable metals in soil						
Our Reference		193227-1	193227-3	193227-4	193227-6	193227-7
Your Reference	UNITS	BH201	BH201	BH202	BH202	BH203
Depth		0.15-0.3	1.3-1.5	0-0.2	1.3-1.5	0-0.2
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Arsenic	mg/kg	8	<4	<4	6	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	11	13	11	24	12
Copper	mg/kg	35	<1	6	<1	13
Lead	mg/kg	13	15	18	14	31
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	32	<1	2	<1	9
Zinc	mg/kg	54	2	40	2	61

Acid Extractable metals in soil						
Our Reference		193227-9	193227-10	193227-11	193227-13	193227-14
Your Reference	UNITS	BH203	BH204	BH204	BH205	BH205
Depth		1.7-2.0	0.05-0.2	0.6-0.9	0.05-0.3	0.5-0.8
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Arsenic	mg/kg	8	7	<4	23	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	19	22	22	17	25
Copper	mg/kg	<1	8	<1	10	<1
Lead	mg/kg	9	36	12	25	15
Mercury	mg/kg	<0.1	0.2	<0.1	0.2	<0.1
Nickel	mg/kg	<1	2	1	3	1
Zinc	mg/kg	1	24	2	18	2

Acid Extractable metals in soil						
Our Reference		193227-16	193227-17	193227-18	193227-19	193227-20
Your Reference	UNITS	BH206	BH206	BH207	BH207	BH208
Depth		0.1-0.2	0.3-0.45	0.1-0.3	0.7-0.95	0.15-0.35
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Arsenic	mg/kg	28	4	7	<4	11
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	17	19	26	6	34
Copper	mg/kg	13	<1	<1	<1	1
Lead	mg/kg	21	13	19	19	14
Mercury	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	3	<1	1	<1	2
Zinc	mg/kg	25	2	4	<1	14

Acid Extractable metals in soil				
Our Reference		193227-25	193227-26	193227-28
Your Reference	UNITS	BH208	HWDup	BH201 - [TRIPLICATE]
Depth		1.3-1.8	-	0.15-0.3
Date Sampled		02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil
Date prepared	-	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018
Arsenic	mg/kg	<4	8	14
Cadmium	mg/kg	<0.4	<0.4	<0.4
Chromium	mg/kg	10	31	11
Copper	mg/kg	1	2	32
Lead	mg/kg	7	19	14
Mercury	mg/kg	<0.1	<0.1	<0.1
Nickel	mg/kg	2	2	28
Zinc	mg/kg	6	5	59

Moisture						
Our Reference		193227-1	193227-3	193227-4	193227-6	193227-7
Your Reference	UNITS	BH201	BH201	BH202	BH202	BH203
Depth		0.15-0.3	1.3-1.5	0-0.2	1.3-1.5	0-0.2
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
Moisture	%	10	13	11	11	15

Moisture						
Our Reference		193227-9	193227-10	193227-11	193227-13	193227-14
Your Reference	UNITS	BH203	BH204	BH204	BH205	BH205
Depth		1.7-2.0	0.05-0.2	0.6-0.9	0.05-0.3	0.5-0.8
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
Moisture	%	12	15	14	12	16

Moisture						
Our Reference		193227-16	193227-17	193227-18	193227-19	193227-20
Your Reference	UNITS	BH206	BH206	BH207	BH207	BH208
Depth		0.1-0.2	0.3-0.45	0.1-0.3	0.7-0.95	0.15-0.35
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018	07/06/2018
Moisture	%	9.0	9.8	24	12	13

Moisture			
Our Reference		193227-25	193227-26
Your Reference	UNITS	BH208	HWDup
Depth		1.3-1.8	-
Date Sampled		02/06/2018	02/06/2018
Type of sample		Soil	Soil
Date prepared	-	06/06/2018	06/06/2018
Date analysed	-	07/06/2018	07/06/2018
Moisture	%	10	23

Asbestos ID - soils						
Our Reference		193227-1	193227-4	193227-7	193227-10	193227-13
Your Reference	UNITS	BH201	BH202	BH203	BH204	BH205
Depth		0.15-0.3	0-0.2	0-0.2	0.05-0.2	0.05-0.3
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Sample mass tested	g	Approx. 20g	Approx. 20g	Approx. 25g	Approx. 30g	Approx. 20g
Sample Description	-	Brown coarse-grained soil & rocks	Brown fine-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils				
Our Reference		193227-16	193227-18	193227-20
Your Reference	UNITS	BH206	BH207	BH208
Depth		0.1-0.2	0.1-0.3	0.15-0.35
Date Sampled		02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil
Date analysed	-	06/06/2018	06/06/2018	06/06/2018
Sample mass tested	g	Approx. 25g	Approx. 25g	Approx. 15g
Sample Description	-	Brown fine-grained soil & rocks	Beige coarse-grained soil & rocks	Brown clayey soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected

Misc Inorg - Soil					
Our Reference		193227-13	193227-20	193227-23	193227-24
Your Reference	UNITS	BH205	BH208	BH205	BH208
Depth		0.05-0.3	0.15-0.35	1.5-2.0	0.7-0.95
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018
Date analysed	-	07/06/2018	07/06/2018	07/06/2018	07/06/2018
pH 1:5 soil:water	pH Units	5.7	6.6	4.7	5.7
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	53	100	25	41
Resistivity in soil*	ohm m	190	92	400	230

Texture and Salinity*					
Our Reference		193227-13	193227-20	193227-23	193227-24
Your Reference	UNITS	BH205	BH208	BH205	BH208
Depth		0.05-0.3	0.15-0.35	1.5-2.0	0.7-0.95
Date Sampled		02/06/2018	02/06/2018	02/06/2018	02/06/2018
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018	06/06/2018	06/06/2018
Electrical Conductivity 1:5 soil:water	µS/cm	51	110	25	44
Texture Value	-	9.0	7.0	8.0	7.0
Texture		CLAY LOAM	MEDIUM CLAY	LIGHT MEDIUM CLAY	MEDIUM CLAY
ECe	dS/m	<2	<2	<2	<2
Class		NON SALINE	NON SALINE	NON SALINE	NON SALINE

CEC			
Our Reference		193227-13	193227-20
Your Reference	UNITS	BH205	BH208
Depth		0.05-0.3	0.15-0.35
Date Sampled		02/06/2018	02/06/2018
Type of sample		Soil	Soil
Date prepared	-	06/06/2018	06/06/2018
Date analysed	-	06/06/2018	06/06/2018
Exchangeable Ca	meq/100g	2.6	5.4
Exchangeable K	meq/100g	<0.1	<0.1
Exchangeable Mg	meq/100g	0.64	0.84
Exchangeable Na	meq/100g	<0.1	0.15
Cation Exchange Capacity	meq/100g	3.4	6.4

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
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.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.
INORG-123	Determined using a "Texture by Feel" method.
Metals-009	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-003	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-003	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. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.

Method ID	Methodology Summary
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-016	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.
Org-016	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. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	193227-4
Date extracted	-			06/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
Date analysed	-			07/06/2018	1	07/06/2018	07/06/2018		07/06/2018	07/06/2018
TRH C_6 - C_9	mg/kg	25	Org-016	<25	1	<25	<25	0	106	102
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	1	<25	<25	0	106	102
Benzene	mg/kg	0.2	Org-016	<0.2	1	<0.2	<0.2	0	92	89
Toluene	mg/kg	0.5	Org-016	<0.5	1	<0.5	<0.5	0	106	103
Ethylbenzene	mg/kg	1	Org-016	<1	1	<1	<1	0	112	107
m+p-xylene	mg/kg	2	Org-016	<2	1	<2	<2	0	111	106
o-Xylene	mg/kg	1	Org-016	<1	1	<1	<1	0	114	113
naphthalene	mg/kg	1	Org-014	<1	1	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	118	1	93	102	9	128	124

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	25	06/06/2018	06/06/2018		[NT]	[NT]
Date analysed	-			[NT]	25	07/06/2018	07/06/2018		[NT]	[NT]
TRH C_6 - C_9	mg/kg	25	Org-016	[NT]	25	<25	<25	0	[NT]	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-016	[NT]	25	<25	<25	0	[NT]	[NT]
Benzene	mg/kg	0.2	Org-016	[NT]	25	<0.2	<0.2	0	[NT]	[NT]
Toluene	mg/kg	0.5	Org-016	[NT]	25	<0.5	<0.5	0	[NT]	[NT]
Ethylbenzene	mg/kg	1	Org-016	[NT]	25	<1	<1	0	[NT]	[NT]
m+p-xylene	mg/kg	2	Org-016	[NT]	25	<2	<2	0	[NT]	[NT]
o-Xylene	mg/kg	1	Org-016	[NT]	25	<1	<1	0	[NT]	[NT]
naphthalene	mg/kg	1	Org-014	[NT]	25	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	[NT]	25	97	97	0	[NT]	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	193227-4
Date extracted	-			07/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
Date analysed	-			08/06/2018	1	07/06/2018	07/06/2018		07/06/2018	07/06/2018
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	1	<50	<50	0	124	126
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	1	<100	<100	0	112	121
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	1	<100	<100	0	108	130
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	<50	1	<50	<50	0	124	126
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	<100	1	<100	<100	0	112	121
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	<100	1	<100	<100	0	108	130
Surrogate o-Terphenyl	%		Org-003	104	1	93	94	1	118	96

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	25	06/06/2018	06/06/2018		[NT]	[NT]
Date analysed	-			[NT]	25	07/06/2018	07/06/2018		[NT]	[NT]
TRH C_{10} - C_{14}	mg/kg	50	Org-003	[NT]	25	<50	<50	0	[NT]	[NT]
TRH C_{15} - C_{28}	mg/kg	100	Org-003	[NT]	25	<100	<100	0	[NT]	[NT]
TRH C_{29} - C_{36}	mg/kg	100	Org-003	[NT]	25	100	130	26	[NT]	[NT]
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	[NT]	25	<50	<50	0	[NT]	[NT]
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	[NT]	25	110	130	17	[NT]	[NT]
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	[NT]	25	<100	<100	0	[NT]	[NT]
Surrogate o-Terphenyl	%		Org-003	[NT]	25	95	97	2	[NT]	[NT]

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	193227-4
Date extracted	-			06/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
Date analysed	-			07/06/2018	1	07/06/2018	07/06/2018		07/06/2018	07/06/2018
Naphthalene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	106	94
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	101	106
Phenanthrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	113	104
Anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	119	109
Pyrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	119	108
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	109	106
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	1	<0.05	<0.05	0	113	105
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	105	1	104	103	1	100	99

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date extracted	-			[NT]	25	06/06/2018	06/06/2018		[NT]	[NT]
Date analysed	-			[NT]	25	07/06/2018	07/06/2018		[NT]	[NT]
Naphthalene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Phenanthrene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Anthracene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Pyrene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	[NT]	25	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	[NT]	25	<0.05	<0.05	0	[NT]	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	[NT]	25	106	106	0	[NT]	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	193227-4
Date extracted	-			06/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
Date analysed	-			07/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
HCB	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	85	84
gamma-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	81	79
Heptachlor	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	87	84
delta-BHC	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	87	89
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	84	84
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	90	90
Dieldrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	97	96
Endrin	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	83	82
pp-DDD	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	87	86
Endosulfan II	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	99	101
Methoxychlor	mg/kg	0.1	Org-005	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	107	1	98	96	2	114	118

QUALITY CONTROL: Organophosphorus Pesticides						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	193227-4
Date extracted	-			06/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
Date analysed	-			07/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	86	95
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	90	87
Dimethoate	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	82	83
Fenitrothion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	84	103
Malathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	111	117
Parathion	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	87	102
Ronnel	mg/kg	0.1	Org-008	<0.1	1	<0.1	<0.1	0	93	92
Surrogate TCMX	%		Org-008	107	1	98	96	2	99	97

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	193227-4
Date extracted	-			06/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
Date analysed	-			07/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	104	108
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	107	1	98	96	2	99	97

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	193227-4
Date prepared	-			06/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
Date analysed	-			06/06/2018	1	06/06/2018	06/06/2018		06/06/2018	06/06/2018
Arsenic	mg/kg	4	Metals-020	<4	1	8	18	77	108	98
Cadmium	mg/kg	0.4	Metals-020	<0.4	1	<0.4	<0.4	0	104	98
Chromium	mg/kg	1	Metals-020	<1	1	11	10	10	107	106
Copper	mg/kg	1	Metals-020	<1	1	35	34	3	107	108
Lead	mg/kg	1	Metals-020	<1	1	13	83	146	103	98
Mercury	mg/kg	0.1	Metals-021	<0.1	1	<0.1	<0.1	0	102	73
Nickel	mg/kg	1	Metals-020	<1	1	32	28	13	99	95
Zinc	mg/kg	1	Metals-020	<1	1	54	59	9	102	91

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	25	06/06/2018	06/06/2018		[NT]	[NT]
Date analysed	-			[NT]	25	06/06/2018	06/06/2018		[NT]	[NT]
Arsenic	mg/kg	4	Metals-020	[NT]	25	<4	4	0	[NT]	[NT]
Cadmium	mg/kg	0.4	Metals-020	[NT]	25	<0.4	<0.4	0	[NT]	[NT]
Chromium	mg/kg	1	Metals-020	[NT]	25	10	12	18	[NT]	[NT]
Copper	mg/kg	1	Metals-020	[NT]	25	1	3	100	[NT]	[NT]
Lead	mg/kg	1	Metals-020	[NT]	25	7	7	0	[NT]	[NT]
Mercury	mg/kg	0.1	Metals-021	[NT]	25	<0.1	<0.1	0	[NT]	[NT]
Nickel	mg/kg	1	Metals-020	[NT]	25	2	3	40	[NT]	[NT]
Zinc	mg/kg	1	Metals-020	[NT]	25	6	6	0	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date prepared	-			07/06/2018	[NT]	[NT]	[NT]	[NT]	07/06/2018	[NT]
Date analysed	-			07/06/2018	[NT]	[NT]	[NT]	[NT]	07/06/2018	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	96	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	99	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

QUALITY CONTROL: Texture and Salinity*					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date prepared	-			07/06/2018	[NT]	[NT]	[NT]	[NT]	07/06/2018	[NT]
Date analysed	-			07/06/2018	[NT]	[NT]	[NT]	[NT]	07/06/2018	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	96	[NT]

QUALITY CONTROL: CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	[NT]
Date prepared	-			06/06/2018	13	06/06/2018	06/06/2018		06/06/2018	[NT]
Date analysed	-			06/06/2018	13	06/06/2018	06/06/2018		06/06/2018	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-009	<0.1	13	2.6	2.5	4	106	[NT]
Exchangeable K	meq/100g	0.1	Metals-009	<0.1	13	<0.1	<0.1	0	114	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-009	<0.1	13	0.64	0.63	2	106	[NT]
Exchangeable Na	meq/100g	0.1	Metals-009	<0.1	13	<0.1	<0.1	0	102	[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.

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: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-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.

Report Comments

Asbestos: Excessive sample volumes were provided for asbestos analysis.
A portion of the supplied samples were sub-sampled according to Envirolab procedures.
We cannot guarantee that these sub-samples are indicative of the entire sample.
Envirolab recommends supplying 40-50g (50mL) of sample in its own container as per AS4964-2004.
Note: Samples 193227-1, 4, 7, 10, 13, 16, 18 & 20 were sub-sampled from bags provided by the client.

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 193227-1 for Pb. Therefore a triplicate result has been issued as laboratory sample number 193227-28.

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 193227-25 for Cr, Pb. and Zn. Therefore a triplicate result has been issued as laboratory sample number 193227-29.

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SAMPLE RECEIPT ADVICE

Client Details

Client	Environmental Investigation Services
Attention	Katrina Taylor

Sample Login Details

Your reference	E31387K, St Ives North
Envirolab Reference	193227
Date Sample Received	04/06/2018
Date Instructions Received	04/06/2018
Date Results Expected to be Reported	12/06/2018

Sample Condition

Samples received in appropriate condition for analysis	YES
No. of Samples Provided	27 Soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	4.4
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:

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	vTRH(C6-C10)/BTEXN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticidesin soil	Organophosphorus Pesticides	PCBsin Soil	Acid Extractable metalsin soil	Asbestos ID - soils	Misc Inorg - Soil	Texture and Salinity*	CEC	On Hold
BH201-0.15-0.3	✓	✓	✓	✓	✓	✓	✓	✓				
BH201-0.5-0.95												✓
BH201-1.3-1.5	✓	✓	✓				✓					
BH202-0-0.2	✓	✓	✓	✓	✓	✓	✓	✓				
BH202-0.6-0.95												✓
BH202-1.3-1.5	✓	✓	✓				✓					
BH203-0-0.2	✓	✓	✓	✓	✓	✓	✓	✓				
BH203-0.6-0.95												✓
BH203-1.7-2.0	✓	✓	✓				✓					
BH204-0.05-0.2	✓	✓	✓	✓	✓	✓	✓	✓				
BH204-0.6-0.9	✓	✓	✓				✓					
BH204-1.7-2.0												✓
BH205-0.05-0.3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
BH205-0.5-0.8	✓	✓	✓				✓					
BH205-1.8-2.0												✓
BH206-0.1-0.2	✓	✓	✓	✓	✓	✓	✓	✓				
BH206-0.3-0.45	✓	✓	✓				✓					
BH207-0.1-0.3	✓	✓	✓	✓	✓	✓	✓	✓				
BH207-0.7-0.95	✓	✓	✓				✓					
BH208-0.15-0.35	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
BH208-0.5-0.7												✓
BH205-1.0-1.4												✓
BH205-1.5-2.0									✓	✓		
BH208-0.7-0.95									✓	✓		
BH208-1.3-1.8	✓	✓	✓				✓					
HWDup	✓	✓	✓	✓	✓	✓	✓					
TB	✓											

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.

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: E31387K Date Results Required: STANDARD Page: 1/2	ENVIRONMENTAL INVESTIGATION SERVICES REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: ktaylor@jkgroup.net.au

Location: St Ives North

Sampler: HW

Sample Preserved in Esky on Ice

Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	PID	Sample Description	Combo 6a	Combo 3	BTEX	CEC	Aggressivity suite*	ECe	Combo 6						
2/6/18	1	BH201	0.15-0.30	G,A	0.1	F:Gravsand	X												
	2	BH201	0.5-0.95	G,A	0	F:Sandyclay													
	3	BH201	1.3-1.5	G	0	Sandstone		X											
	4	BH202	0-0.2	G,A	0.2	F:SiltySand	X												
	5	BH202	0.6-0.95	G,A	0	F:Sandyclay													
	6	BH202	1.3-1.5	G	0	Sandstone		X											
	7	BH203	0-0.2	G,A	0	F:SiltySand	X												
	8	BH203	0.6-0.95	G,A	0	F:Siltyclay													
	9	BH203	1.7-2.0	G	0	Sandstone		X											
	10	BH204	0.05-0.2	G,A	0	F:Siltysand	X												
	11	BH204	0.6-0.9	G	0	Siltyclay		X											
	12	BH204	1.7-2.0	G	0	siltyclay													
	13	BH205	0.05-0.3	G,A	0	F:Sandyclay	X												
	14	BH205	0.5-0.8	G,A	0	Sandyclay		X											
	15	BH205	1.8-2.0	G	0	Siltyclay													
	16	BH206	0.1-0.2	G,A	0	F:sandyclay	X												
	17	BH206	0.3-0.45 & 0.5-0.9	G,A	0	Sandyclay		X											
	18	BH207	0.1-0.3	G,A	0	F:Siltyclay	X												
	19	BH207	0.7-0.95	G	0	siltyclay		X											
	20	BH208	0.15-0.35	G,A	0	F:Sandyclay	X												
	21	BH208	0.5-0.7	G,A	0	F:Siltyclay													
	13	BH205	0.05-0.3	P	—	F:Sandyclay				X	X	X							
	22	BH205	1.0-1.4	P	—	F:Siltysand													
	23	BH205	1.5-2.0	P	—	siltyclay					X	X							
↓	20	BH208	0.15-0.4	P	—	F:Sandyclay				X	X	X							

Remarks (comments/detection limits required):

* - Aggressivity Suite (sulfate, chloride, pH, EC and resistivity)

Sample Containers:
G - 250mg Glass Jar
A - Ziplock Asbestos Bag
P - Plastic Bag

Relinquished By:	Date:	Time:	Received By:	Date:
			JE	4/6/18

Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 193227

Date Received: 4/6/18

Time Received: 12:00

Received by: JE

Temp: Cool / Ambient 4.7°C

Cooling: Ice / Gel

Security: Intact / Broken / None

193227

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: E31387K Date Results Required: STANDARD Page: 2/2	ENVIRONMENTAL INVESTIGATION SERVICES REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: ktaylor@ikgroup.net.au

Location:	St Ives North	Sample Preserved in Esky on Ice
Sampler:	HW	Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	PID	Sample Description	Combo 6a	Combo 3	BTEX	CEC	Aggressivity suite*	ECe	Combo 6					
2/6/18	24	BH208	0.7-0.9	P	–	silty clay					X	X						
	25	BH208	1.3-1.8	G,P	–	Sandstone		X										
	26	HAPDUP	–	G	–	Soil							X					
	27	TB	–	G	–	Soil			X									

Remarks (comments/detection limits required):	Sample Containers:
* - Aggressivity Suite (sulfate, chloride, pH, EC and resistivity)	G - 250mg Glass Jar A - Ziplock Asbestos Bag P - Plastic Bag

Relinquished By:	Date:	Time:	Received By:	Date:
			JE	4/6/18

Appendix E: Report Explanatory Notes

STANDARD SAMPLING PROCEDURE

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

Soil Sampling

- 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 EIS 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[17].
- 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 where it is safe to do so. 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.

Decontamination Procedures for Soil Sampling Equipment

- 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.

[17] 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.

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.
- Measure 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:
  - Stericup single-use filters (for heavy metals samples);
  - 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/Temperature meters;
  - Plastic drums used for transportation of purged water;
  - Esky and ice;
  - Nitrile gloves;
  - Distilled water (for cleaning);
  - Electronic dip meter;
  - Low flow peristaltic pump and associated tubing; and
  - Groundwater sampling forms.

- 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 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, BTEX vials or plastic bottles.
- All samples are preserved in accordance with water sampling requirements specified by the laboratory and placed in an insulated container with ice. Groundwater samples are preserved by immediate storage in an insulated sample container with ice.
- At the end of each water sampling complete a chain of custody form for samples being sent to the laboratory.

Decontamination Procedures for Groundwater Sampling Equipment

- 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

QA/QC DEFINITIONS

The QA/QC terms used in this report are defined below. The definitions are in accordance with US EPA publication SW-846, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (1994)[18] methods and those described in *Environmental Sampling and Analysis, A Practical Guide,* (1991)[19].

Practical Quantitation Limit (PQL), Limit of Reporting (LOR) & Estimated Quantitation Limit (EQL)

These terms all refer to the concentration above which results can be expressed with a minimum 95% confidence level. The laboratory reporting limits are generally set at ten times the standard deviation for the Method Detection Limit for each specific analyte. For the purposes of this report the LOR, PQL, and EQL are considered to be equivalent.

When assessing laboratory data it should be borne in mind that values at or near the PQL have two important limitations: *"The uncertainty of the measurement value can approach, and even equal, the reported value. Secondly, confirmation of the analytes reported is virtually impossible unless identification uses highly selective methods. These issues diminish when reliably measurable amounts of analytes are present. Accordingly, legal and regulatory actions should be limited to data at or above the reliable detection limit*" (Keith, 1991).

Precision

The degree to which data generated from repeated measurements differ from one another due to random errors. Precision is measured using the standard deviation or Relative Percent Difference (RPD).

Accuracy

Accuracy is a measure of the agreement between an experimental result and the true value of the parameter being measured (i.e. the proximity of an averaged result to the true value, where all random errors have been statistically removed). The assessment of accuracy for an analysis can be achieved through the analysis of known reference materials or assessed by the analysis of surrogates, field blanks, trip spikes and matrix spikes. Accuracy is typically reported as percent recovery.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is primarily dependent upon the design and implementation of the sampling program. Representativeness of the data is partially ensured by the avoidance of contamination, adherence to sample handing and analysis protocols and use of proper chain-of-custody and documentation procedures.

Completeness

Completeness is a measure of the number of valid measurements in a data set compared to the total number of measurements made and overall performance against DQIs. The following information is assessed for completeness:

- Chain-of-custody forms;
- Sample receipt form;
- All sample results reported;

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[18] US EPA, (1994). *SW-846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* (US EPA SW-846)

[19] Keith., H, (1991). *Environmental Sampling and Analysis, A Practical Guide.*

- All blank data reported;
- All laboratory duplicate and RPDs calculated;
- All surrogate spike data reported;
- All matrix spike and lab control spike (LCS) data reported and RPDs calculated;
- Spike recovery acceptable limits reported; and
- NATA stamp on reports.

Comparability

Comparability is the evaluation of the similarity of conditions (e.g. sample depth, sample homogeneity) under which separate sets of data are produced. Data comparability checks include a bias assessment that may arise from the following sources:

- Collection and analysis of samples by different personnel; Use of different techniques;
- Collection and analysis by the same personnel using the same methods but at different times; and
- Spatial and temporal changes (due to environmental dynamics).

Blanks

The purpose of laboratory and field blanks is to check for artefacts and interferences that may arise during sampling, transport and analysis.

Matrix Spikes

Samples are spiked with laboratory grade standards to detect interactive effects between the sample matrix and the analytes being measured. Matrix Spikes are reported as a percent recovery and are prepared for 1 in every 20 samples. Sample batches that contain less than 20 samples may be reported with a Matrix Spike from another batch. The percent recovery is calculated using the formula below. Acceptable recovery limits are 70% to 130%.

$$\frac{\text{(Spike Sample Result – Sample Result) x 100}}{\text{Concentration of Spike Added}}$$

Surrogate Spikes

Samples are spiked with a known concentration of compounds that are chemically related to the analyte being investigated but unlikely to be detected in the environment. The purpose of the Surrogate Spikes is to check the accuracy of the analytical technique. Surrogate Spikes are reported as percent recovery.

Duplicates

Laboratory duplicates measure precision, expressed as Relative Percent Difference. Duplicates are prepared from a single field sample and analysed as two separate extraction procedures in the laboratory. The RPD is calculated using the formula where D1 is the sample concentration and D2 is the duplicate sample concentration:

$$\frac{(D1 - D2) \times 100}{\{(D1 + D2)/2\}}$$

SCREENING CRITERIA DEFINITIONS

The following definitions have been adopted based on Schedule B(1) of NEPM (2013) and are relevant to Tier 1 screening criteria adopted for contamination assessments.

Health investigation levels (HILs) have been developed for a broad range of metals and organic substances. The HILs are applicable for assessing human health risk via all relevant pathways of exposure. The HILs are generic to all soil types and apply generally to a depth of 3 m below the surface for residential use. Site-specific conditions should determine the depth to which HILs apply for other land uses.

Health screening levels (HSLs) have been developed for selected petroleum compounds and fractions and are applicable to assessing human health risk via the inhalation and direct contact pathways. The HSLs depend on specific soil physicochemical properties, land use scenarios, and the characteristics of building structures. They apply to different soil types, and depths below surface to >4 m. HSLs have also been developed for asbestos and apply to the top 3m of soil.

Ecological investigation levels (EILs) have been developed for selected metals and organic substances and are applicable for assessing risk to terrestrial ecosystems. EILs depend on specific soil physicochemical properties and land use scenarios and generally apply to the top 2 m of soil.

Ecological screening levels (ESLs) have been developed for selected petroleum hydrocarbon compounds and total petroleum/recoverable hydrocarbon (TPH/TRH) fractions and are applicable for assessing risk to terrestrial ecosystems. ESLs broadly apply to coarse- and fine-grained soils and various land uses. They are generally applicable to the top 2 m of soil.

Groundwater investigation levels (GILs) are the concentrations of a contaminant in groundwater above which further investigation (point of extraction) or a response (point of use) is required. GILs are based on Australian water quality guidelines and drinking water guidelines and are applicable for assessing human health risk and ecological risk from direct contact (including consumption) with groundwater.

Management Limits for Petroleum hydrocarbons are applicable to petroleum hydrocarbon compounds only. They are applicable as screening levels following evaluation of human health and ecological risks and risks to groundwater resources. They are relevant for operating sites where significant sub-surface leakage of petroleum compounds has occurred and when decommissioning industrial and commercial sites.

Interim soil vapour health investigation levels (interim HILs) have been developed for selected volatile organic chlorinated compounds (VOCCs) and are applicable to assessing human health risk by the inhalational pathway. They have interim status pending further scientific work on volatile gas modelling from the sub-surface to building interiors for chlorinated compounds.

Appendix F: Data (QA/QC) Evaluation

DATA (QA/QC) EVALUATION

INTRODUCTION

This Data (QA/QC) Evaluation forms part of the validation process for the DQOs documented in Section 6.1 of this report. Checks were made to assess the data in terms of precision, accuracy, representativeness, comparability and completeness. These 'PARCC' parameters are referred to collectively as DQIs and are defined in the Report Explanatory Notes attached in the report appendices.

Field and Laboratory Considerations

The quality of the analytical data produced for this project has been considered in relation to the following:

- Sample collection, storage, transport and analysis;
- Laboratory PQLs;
- Field QA/QC results; and
- Laboratory QA/QC results.

Field QA/QC Samples and Analysis

A summary of the field QA/QC samples collected and analysed for this assessment is provided in the following table:

Sample Type	Sample Identification	Frequency (of Sample Type)	Analysis Performed
Intra-laboratory duplicate (soil)	HWDup (primary sample BH207 0.1-0.2m)	Approximately 6% of primary samples	Heavy metals, TRH/BTEX, PAHs, OCPs, OPPs and PCBs
Trip blank (soil)	TB (2 June 2018)	One for the assessment to demonstrate adequacy of storage and transport methods	BTEX

The results for the field QA/QC samples are detailed in the laboratory summary tables (Table E to Table F inclusive) attached to the assessment report and are discussed in the subsequent sections of this Data (QA/QC) Evaluation report.

Data Assessment Criteria

EIS adopted the following criteria for assessing the field and laboratory QA/QC analytical results:

Field Duplicates

Acceptable targets for precision of field duplicates in this report will be less than 50% RPD for concentrations greater than 10 times the PQL, less than 75% RPD for concentrations between five and 10 times the PQL and less than 100% RPD for concentrations that are less than five times the

PQL. RPD failures will be considered qualitatively on a case-by-case basis taking into account factors such as the sample type, collection methods and the specific analyte where the RPD exceedance was reported.

Field Blanks

Acceptable targets for field blank samples in this report will be less than the PQL for organic analytes. Metals will be considered on a case-by-case basis with regards to typical background concentrations in soils and published drinking water guidelines for waters.

Laboratory QA/QC

The suitability of the laboratory data is assessed against the laboratory QA/QC criteria which is outlined in the laboratory reports. These criteria were developed and implemented in accordance with the laboratory's NATA accreditation and align with the acceptable limits for QA/QC samples as outlined in NEPM (2013) and other relevant guidelines.

A summary of the acceptable limits adopted by the primary laboratory (Envirolab) is provided below:

RPDs

- Results that are <5 times the PQL, any RPD is acceptable; and
- Results >5 times the PQL, RPDs between 0-50% are acceptable.

Laboratory Control Samples (LCS) and Matrix Spikes

- 70-130% recovery acceptable for metals and inorganics;
- 60-140% recovery acceptable for organics; and
- 10-140% recovery acceptable for VOCs.

Surrogate Spikes

- 60-140% recovery acceptable for general organics; and
- 10-140% recovery acceptable for VOCs.

Method Blanks

- All results less than PQL.

DATA EVALUATION

Sample Collection, Storage, Transport and Analysis

Samples were collected by trained field staff in accordance with the EIS SSP. The SSP was developed to be consistent with relevant guidelines, including NEPM (2013) and other guidelines made under the CLM Act 1997.

Appropriate sample preservation, handling and storage procedures were adopted. Laboratory analysis was undertaken within specified holding times in accordance with Schedule B(3) of NEPM (2013) and the laboratory NATA accredited methodologies.

Review of the project data also indicated that:

- COC documentation was adequately maintained;
- Sample receipt advice documentation was provided for all sample batches;
- All analytical results were reported; and
- Consistent units were used to report the analysis results.

Laboratory PQLs

Appropriate PQLs were adopted for the analysis and all PQLs were below the SAC.

Field QA/QC Sample Results

Field Duplicates

The results indicated that field precision was acceptable. An RPD non-conformances was reported for copper. As both the primary and duplicate sample results were less than the SAC, the exceedances are not considered to have had an adverse impact on the data set as a whole.

Field Blanks

During the investigation, one soil trip blank was placed in the esky during sampling and transported back to the laboratory. The results were all less than the PQLs, therefore cross contamination between samples that may have significance for data validity did not occur.

Laboratory QA/QC

The analytical methods implemented by the laboratory were performed in accordance with their NATA accreditation and were consistent with Schedule B(3) of NEPM (2013). The frequency of data reported for the laboratory QA/QC (i.e. duplicates, spikes, blanks, LCS) was considered to be acceptable for the purpose of this assessment.

A review of the laboratory QA/QC data identified the following minor non-conformances:

- Acid extractable metals in soil were exceeded for several metals in two samples and therefore triplicate results were issued for these samples.

DATA QUALITY SUMMARY

EIS are of the opinion that the data are adequately precise, accurate, representative, comparable and complete to serve as a basis for interpretation to achieve the investigation objectives.

Appendix G: Guidelines and Reference Documents

CRC Care, (2011). Technical Report No. 10 – Health screening levels for hydrocarbons in soil and groundwater Part 1: Technical development document

CRC Care, (2017). Technical Report No. 39 – Risk-based management and guidance for benzo(a)pyrene

Contaminated Land Management Act 1997 (NSW)

Department of Land and Water Conservation, (1997). 1:25,000 Acid Sulfate Soil Risk Map (Series 9130N3, Ed 2)

Managing Land Contamination, Planning Guidelines SEPP55 – Remediation of Land (1998)

NSW EPA, (1995). Contaminated Sites Sampling Design Guidelines

NSW EPA, (2014). Waste Classification Guidelines - Part 1: Classifying Waste

NSW EPA, (2015). Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997

NSW EPA, (2017). Guidelines for the NSW Site Auditor Scheme, 3rd Edition

National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)

Olszowy, H., Torr, P., and Imray, P., (1995). Trace Element Concentrations in Soils from Rural and Urban Areas of Australia. Contaminated Sites Monograph Series No. 4. Department of Human Services and Health, Environment Protection Agency, and South Australian Health Commission

Protection of the Environment Operations Act 1997 (NSW)

State Environmental Planning Policy No.55 – Remediation of Land 1998 (NSW)