



ENVIRONMENTAL INVESTIGATION SERVICES

**REPORT**

TO

**JDH ARCHITECTS**

ON

**PRELIMINARY STAGE 1/STAGE 2 CONTAMINATION  
ASSESSMENT AND PRELIMINARY SALINITY  
ASSESSMENT**

FOR

**PROPOSED ALTERATIONS AND ADDITIONS**

AT

**GREYSTANES PUBLIC SCHOOL,  
781 MERRYLANDS ROAD, GREYSTANES, NSW**

**26 JUNE 2017**

**REF: E30431KPrpt**



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

Tel: 02 9888 5000 • Fax: 9888 5004

EIS is a division of Jeffery and Katauskas Pty Ltd • ABN 17 003 550 801

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Report prepared by:



Katrina Taylor  
Environmental Scientist

Report reviewed by:



Brendan Page  
Associate | Environmental Scientist

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## **EXECUTIVE SUMMARY**

JDH Architects ('the client') commissioned Environmental Investigation Services (EIS)<sup>1</sup> to undertake a preliminary Stage 1/Stage 2 contamination assessment and preliminary salinity assessment for the proposed alterations and additions at Greystanes Public School, 781 Merrylands Road, Greystanes. 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 concurrently with the contamination/salinity assessment by JK Geotechnics<sup>2</sup>. The findings of the geotechnical investigation are to be reported under a separate cover (Ref: 30431Srpt).

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

The primary aims of the contamination assessment were to document historical land uses and assess the contamination conditions within the investigation area(s) in order to assess contamination-related risks. The assessment objectives were to:

- Provide an appraisal of the past site use(s) based on a review of historical records;
- 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 and the potential for groundwater contamination within the investigation area(s);
- Assess the risks posed by the contaminants via a Tier 1 risk assessment; and
- Assess whether the investigation area(s) is/are suitable or can be made suitable for the proposed development (from a contamination viewpoint).

The contamination assessment included a desktop site history assessment and fill/soil sampling from a total of five boreholes concurrently with the geotechnical investigation. The historical 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.

Based on the Tier 1 risk assessment, 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

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<sup>1</sup> Environmental consulting division of Jeffery & Katauskas Pty Ltd (J&K)

<sup>2</sup> Geotechnical consulting division of J&K

implementation of an unexpected finds protocol and, if required, appropriate management during the development works. An unexpected finds protocol is included in Section 9.3 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 9.3.

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## ABBREVIATIONS

Ambient Background Concentrations	ABC
Added Contaminant Limits	ACL
Asbestos Containing Material	ACM
Area of Environmental Concern	AEC
Australian Height Datum	AHD
Acid Sulfate Soil	ASS
Above-Ground Storage Tank	AST
Asbestos Quantification Assessment	AQA
Below Ground Level	BGL
Benzo(a)pyrene Toxicity Equivalent Factor	BaP TEQ
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
Data Quality Indicator	DQI
Data Quality Objective	DQO
Detailed Site Investigation	DSI
Ecological Investigation Level	EIL
Environmental Investigation Service	EIS
Ecological Screening Level	ESL
Environmental Management Plan	EMP
Excavated Natural Material	ENM
Environmental Protection Authority	EPA
Environmental Site Assessment	ESA
Ecological Screening Level	ESL
Fibre Cement Fragments	FCF
Health Investigation Level	HILs
Health Screening Level	HSLs
International Organisation of Standardisation	ISO
Lab Control Spike	LCS
Local Government Authority	LGA
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
Photo-ionisation Detector	PID
Protection of the Environment Operations	POEO
Practical Quantitation Limit	PQL
Quality Assurance	QA
Quality Control	QC
Remediation Action Plan	RAP

## ABBREVIATIONS

Relative Percentage Difference	RPD
Site Assessment Criteria	SAC
Sampling, Analysis and Quality Plan	SAQP
Source, Pathway, Receptor	SPR
Standard Penetration Test	SPT
Standard Sampling Procedure	SSP
Standing Water Level	SWL
Standard Sampling Procedure	SSP
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
Work Health and Safety	WHS
<b><i>Units</i></b>	
Litres	L
Metres BGL	mBGL
Metres	m
Millivolts	mV
Millilitres	ml
Milliequivalents	meq
micro Siemens per Centimetre	$\mu\text{S}/\text{cm}$
Micrograms per Litre	$\mu\text{g}/\text{L}$
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)<sup>3</sup> to undertake a preliminary Stage 1/Stage 2 contamination assessment and preliminary salinity assessment for the proposed alterations and additions at Greystanes Public School, 781 Merrylands Road, Greystanes. 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 concurrently with the contamination/salinity assessment by JK Geotechnics<sup>4</sup>. The findings of the geotechnical investigation are to be reported under a separate cover (Ref: 30431Srpt).

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

### **1.1 Proposed Development Details**

Based on the details provided, EIS understand that the proposed additions will include a new 2-3 storey permanent teaching building (Area A) and new single storey staff / administration building (Area B). We have generally described these proposed building footprints as Area A and Area B to differentiate between the two respectively (Area A and Area B have also been used when referring to the associated investigation areas).

We have assumed that some cut and fill earthworks may be required. The lowest finished level of the 2-3 storey building (Area A) is at reduced level (RL) 58.785 on the north-eastern side. This building may require excavation of up to 3.0m in depth at the southern end. It is also assumed that minor landscaping works will also be required.

Refurbishment of a building to the north of Area B is also proposed. This area was not investigated for this assessment.

### **1.2 Aims and Objectives**

The primary aims of the contamination assessment were to document historical land uses and assess the contamination conditions within the investigation area(s) in order to assess contamination-related risks. The assessment objectives were to:

- Provide an appraisal of the past site use(s) based on a review of historical records;

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- 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 and the potential for groundwater contamination within the investigation area(s);
- Assess the risks posed by the contaminants via a Tier 1 risk assessment; and
- Assess whether the investigation area(s) is/are suitable or can be made suitable for the proposed development (from a contamination viewpoint).

### **1.3 Scope of Work**

The assessment was undertaken generally in accordance with an EIS proposal (Ref: EP44706KP) of 6 April 2017 and written acceptance from the client of 21 April 2017. 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* and other sources;
- 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)<sup>5</sup>, and other guidelines made under or with regards to the Contaminated Land Management Act (1997)<sup>6</sup> and State Environmental Planning Policy No.55 – Remediation of Land (1998)<sup>7</sup>. A list of reference documents/guidelines is included in the appendices.

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<sup>5</sup> National Environment Protection Council (NEPC), (2013), *National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)* (referred to as NEPM 2013)

<sup>6</sup> *Contaminated Land Management Act 1997* (NSW) (referred to as CLM Act 1997)

<sup>7</sup> *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:	Greystanes Public School, 781 Merrylands Road, Greystanes, NSW
Site Owner:	Minister for Education and Training
Lot & Deposited Plan:	Lot 1 in DP76683 (Area A) Lot 1 in DP782352 (Area B)
Current Land Use:	Primary School
Proposed Land Use:	Unchanged
Local Government Authority (LGA):	Cumberland Council (formerly Holroyd City Council)
Current Zoning:	R2 – Low Density Residential
Site Area (m <sup>2</sup> approx.):	~29,700 (the Area A building is estimated to cover ~3,000m <sup>2</sup> and the Area B building area is estimated to cover ~1,300m <sup>2</sup> )
RL (AHD in m) (approx.):	58 to 65.5
Geographical Location (decimal degrees) (approx.):	Latitude: -33.828229° Longitude: 150.940843°

### **2.2 Site Location and Regional Setting**

The site is located on the northern side of Merrylands Road. The regional setting is generally characterised by low density residential dwellings, however some recreational playing field exist to the southwest of the site.

### **2.3 Topography**

The site is located within a gently undulating regional topographic setting. Part of Area A slopes steeply to the north/north-east at approximately 16° and Area B slopes gently to the north at approximately 1° to 2°.

### **2.4 Site Inspection**

A walkover inspection of the site was undertaken by EIS on 3 June 2017. The inspection was limited to accessible areas of the site and did not include an internal inspection of any buildings. The inspection

focused predominantly on the investigation areas, however a cursory walkover of the wider site was also undertaken for completeness.

At the time of the inspection the site was occupied by Greystanes Primary School and comprised various buildings, grassed and paved recreational areas. A summary of specific inspection findings are outlined in the following subsections (see also the attached Figure 2).

#### 2.4.1 Buildings, Structures and Roads

Various demountable building were located in Area A and Area B. A metal covered outdoor learning area (COLA) was also located in Area B.

#### 2.4.2 Visible or Olfactory Indicators of Contamination

Visible or olfactory indicators of contamination were not observed in the investigation areas.

#### 2.4.3 Presence of Drums/Chemicals, Waste and Fill Material

Exposed fill/imported soils and mulch were observed in the garden beds and around the demountable buildings of both Area A and Area B.

It is assumed that there is a maintenance shed/store within the site, although this was not observed during the inspection. 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.

#### 2.4.4 Drainage and Services

Surface runoff from the site was expected to flow towards the north. 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

Sensitive environments such as wetlands, ponds, creeks or extensive areas of natural vegetation were not identified on site or in the immediate surrounds.

#### 2.4.6 Landscaped Areas and Visible Signs of Plant Stress

Various trees and shrubs were located throughout the site and within the investigation areas. The vegetation appeared to be in reasonable condition based on a cursory inspection, with no obvious or extensive dieback observed. Mulch was evident at the surface in most garden beds.

## **2.5 Surrounding Land Use**

The surrounding land use in the immediate vicinity of the investigation area was residential. There were no land uses in the surrounds that were considered to be obvious sources of contamination for the investigation areas.

## **2.6 Section 149 Planning Certificate**

The s149 (2 and 5) planning certificates were reviewed for the assessment. Copies of the certificates are attached in the appendices. A summary of the relevant information is outlined below:

- The site does not comprise critical habitat under the Holroyd City Council Local Environmental Plan 2013;
- There are no applicable directions under Part 3A or Section 59(2) (provisions of the CLM Act 1997); and
- Council records do not include sufficient information about previous use of this land to determine whether the land is contaminated.

### **3 GEOLOGY AND HYDROGEOLOGY**

#### **3.1 Regional Geology**

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

#### **3.2 Acid Sulfate Soil Risk and Planning**

A review of the acid sulfate soil (ASS) risk maps prepared by Department of Land and Water Conservation (1997) indicated that the site is located in an area that is not mapped for ASS.

ASS information presented in the Lotsearch report (attached in the appendices) indicated that the site is not located within an ASS risk area and there are no other soil class risk areas within 500m of the site.

#### **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 10 registered bores within the report buffer of 2,000m. In summary:

- The nearest registered bore was located approximately 657m from the site. This was utilised for domestic purposes;
- The majority of the bores were registered for monitoring purposes; and
- The drillers log information from the closest registered bores typically identified fill and/or clay soil to depths of 1.3m to >10m, underlain by shale bedrock. Standing water levels (SWLs) in the bores ranged from 4.5mBGL to 66.0mBGL.

The information reviewed for this assessment indicated that the subsurface conditions at the site are likely to consist of residual soils overlying relatively shallow shale 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 north-northwest in the vicinity of the investigation areas.

#### **3.4 Receiving Water Bodies**

Surface water bodies were not identified at the site or in the immediate surrounds. The nearest surface water bodies are man-made water features on the Cumberland Country Golf Course which are located approximately 450m and 560m to the north of the site.

#### 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	<p>The wider school site appeared to include three lots across the area with the central section appearing to have exposed/disturbed soils at the ground surface. Scattered building and structures were visible across the entire wider school site, with several structure present on the western side of Area A and a structure covering the eastern half of Area B. Scattered trees were observed across the wider school site.</p> <p>The surrounding land use generally appeared to be low density residential (potentially rural lots) with scattered buildings and structures visible and cleared plots of land (potentially agricultural use).</p>
1956	<p>The photograph was of poor quality. The eastern half of the wider school site appeared to be more densely covered in medium to large trees and shrubs with fewer structures visible than in the 1943 aerial photograph. The western section of the wider school site appeared to have been cleared of most vegetation and was possibly grass covered.</p> <p>The immediate surrounds appeared to have been further delineated into agricultural lots.</p>
1961	<p>The site and the immediate surrounds generally appeared to be similar to the previous photograph.</p>
1965	<p>The site and the immediate surrounds generally appeared to be similar to the previous photograph.</p>
1970	<p>One relatively large building and one smaller building were evident in the central part of the wider school site, to the west and east of the investigation areas. The size and shape of these buildings appeared consistent with two of the existing (2017) buildings within Greystanes Public School.</p> <p>The immediate surrounds appeared to have been developed or was under development for low density residential lots.</p>
1982	<p>The main and existing school building were evident on the wider school site. The western section and north east corner appeared to have been cleared and were observed to be grass covered (potentially playing fields).</p> <p>The surrounding land use still appeared to be predominantly residential with more developed plots visible.</p>

Year	Details
1991	The site and immediate surrounds generally appeared to be similar to the previous photograph.
2004	Further alterations and additions were evident, although the site largely remained unchanged from the previous photograph.
2009	Additional buildings (demountables) were evident in the central-southern area of the wider school site along with a hardstand tennis court and basketball court.  The immediate surrounds generally appeared to be similar to the previous photograph.
2014	Additional building were observed in the south-east and a large building (school hall) was evident to the north west of the existing school buildings.  The immediate surrounds appeared similar to the previous photograph.

#### 4.2 Review of Historical Land Title Records

Historical land title record for one lot (Lot 1 in DP76683) within the site were reviewed for the assessment. The record search was undertaken by Advance Legal Searchers Pty Ltd. Copies of the title records are attached in the appendices. The title records search was limited (where possible) to the proposed investigation areas and indicate the following:

- A number of individuals were registered in the land titles as owners of the lot between 1925 and 1954. The recorded professions of the individuals included: a poultry farmer; (wife of) a poultry farmer and a dairy farmer;
- Land ownership for educational purposes commenced in 1954.

In consideration with other evidence from the historical aerial photographs, the recorded professions of the registered owners of the site, including a poultry farmer ( and including wife of) and dairy farmer, are likely to be indicative of the historical site activities during this period of time.

#### 4.3 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 (i.e. regulated sites);
- Records of notified sites under Section 60 of the CLM Act 1997 (i.e. Duty to Report Contamination); and
- Licensed activities under the Protection of the Environment Operations Act (1997)<sup>8</sup>.

<sup>8</sup> NSW Government Legislation, (1997). *Protection of the Environment Operations Act 1997*. (referred to as POEO Act 1997)

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;
- There were no records for the site or any properties in the report buffer under the Duty to Report Contamination under Section 60 of the CLM Act 1997; and
- There were no records for current or former licenced activities at the site under the POEO Act 1997. Current and former licenses were identified within the report buffer for dangerous goods production, bitumen pre-mix or hot-mix production. Various records for delicensed activities still regulated by the EPA were also identified for other properties in the report buffer. These regulated activities are considered unlikely to pose a contamination risk to the site or the investigation areas due to their distance from the site.

#### **4.4 Historical Business Directory and Additional Lotsearch Information**

Historical business directory records for the site and surrounding areas in the report buffer were included in the Lotsearch report (attached in the appendices). There were two service stations registered within 1km of the site (914m to the east and 944m to the north) in the 1970s and 1990s. Two other business, a poultry farmer and haulier, were registered within 150m of the site. Considering the nature of the businesses and / or the distance of these businesses from the site, there is considered to be a low potential for these off-site activities to impact the investigation areas. On this basis, these historical activities and premises are not considered to be potential off-site sources of contamination that warrant consideration in the context of the proposed development.

In addition to the above, EIS have reviewed additional information contained within the Lotsearch report and note that there were no significant ecological constraints at the site or in the immediate surrounds.

#### **4.5 Summary of Site History Information**

The historical information indicates that the site has been owned and potentially used for poultry and dairy farming until at least 1954, when the land ownership was transferred to government for 'public instruction' (education). It is likely that the wider school site was utilised for educational purposes from this time. There is potential for remnants of structures demolished sometime before 1954. This information is based on a weight of evidence assessment of the site history documentation and observations made by EIS.

#### **4.6 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 has relied upon the Lotsearch report and has 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. 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 9.1.

### 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
<p><u>Fill Material</u> – The site may have been filled using material from off-site areas which could be contaminated. Material from on-site may have also been used as fill, and this material has the potential to be impacted by construction and demolition waste.</p>	<p>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.</p>
<p><u>Historical agricultural use</u> – The site may have historically be used for grazing/dairy farming and/or poultry farming. These activities could have resulted in contamination via use of machinery, application of pesticides and building/demolition of various structures.</p>	<p>Heavy metals, TRH, PAHs, OCPs, OPPs and asbestos</p> <p>EIS note that OCPs only became commercially available in the 1940s. Prior to this time pesticides were predominantly heavy metal compounds.</p>
<p><u>Hazardous Building Material</u> – Hazardous building materials may be present as a result of former building and demolition activities. Demolition of former structures occurred prior to 1954 across the wider school site.</p>	<p>Asbestos and lead</p>

## 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 primary mechanisms for contamination for all sources/AEC predominantly include ‘top-down’ impacts (e.g. leaching from surficial material, demolition of above ground structures etc), spills or sub-surface release (e.g. impacts from buried material).
Affected media	Soil/soil vapour have been identified as potentially affected media.  Based on the geology and the historic and surrounding land uses, groundwater within the investigation area is unlikely to be affected by contamination. However, potential risks to groundwater should be considered further in the event that significant contamination is 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 proposed landscaped areas).
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.
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 process outlined in Schedule B2 of NEPM (2013) and the Guidelines for the NSW Site Auditor Scheme, 2nd Edition (2006)<sup>9</sup>. 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. Data is required to identify the potential for site contamination, assess the risks to the receptors, assess the need for further investigation or remediation, and make an assessment of the suitability of the site for the proposed land use.

#### **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 historical 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:

- Site information, including site observations and site history documentation;
- Soil sampling from five boreholes;
- Observations of sub-surface variables such as soil type, presence of manmade waste, photo-ionisation detector (PID) concentrations, odours and staining;
- Laboratory analysis of soils for the CoPC identified in the CSM; and

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<sup>9</sup> NSW DEC, (2006). *Guidelines for the NSW Site Auditor Scheme, 2<sup>nd</sup> ed.* (referred to as Site Auditor Guidelines 2006)

- Field and laboratory QA/QC data.

#### 6.1.4 Step 4 - Define the Study Boundary

The sampling will aim to target the investigation areas which are defined by the proposed development footprints (spatial boundary). However, it is acknowledged that samples will be positioned in accessible areas which may fall marginally outside the investigation area. The sampling was completed on 3 June 2017 (temporal boundary).

The assessment of potential risk to adjacent land users has been made based on data collected within the site.

#### 6.1.5 Step 5 - Develop and 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.

##### 6.1.5.2 Field and Laboratory QA/QC

Field QA/QC included analysis of one intra-laboratory duplicate. 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 qualitative assessment of the potential for false positives and false negatives in the analytical results is undertaken 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 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. 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 following table:

Table 6-1: Soil Sampling Plan and Methodology

Aspect	Input
Sampling Density	<p>Samples were obtained from a total of five locations for the assessment. This included three locations in Area A area and two locations in Area B (see Figure 2).</p> <p>The number of sample locations does not meet the minimum sampling density for hotspot identification to a 95% confidence level, as outlined in the NSW EPA Sampling Design Guidelines (1995). The sampling density was not adequate for asbestos quantification in accordance with the NEPM (2013) and associated guidelines.</p>
Sampling Plan	<p>The sampling locations were placed on a judgemental plan, generally positioned for coverage across the investigation areas.</p> <p>The sampling plan was considered to be appropriate to identify significant broad scale/widespread contamination impacts, however it is acknowledged that some of the locations were marginally outside the proposed development footprints.</p>

Aspect	Input
Set-out and Sampling Equipment	<p>Sampling locations were set out using a tape measure off the existing site features by JK Geotechnics personnel. The sampling locations were cleared for underground services by an external contractor prior to sampling as outlined in the sampling procedure (SSP) attached in the appendices.</p> <p>Samples were collected using a drill rig equipped with spiral flight augers, or using a hand auger (as shown on the attached borehole logs). 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.</p> <p>The surface reduced levels (RLs) shown on the borehole logs were estimated by interpolation between spot heights shown on the survey plan prepared by C.M.S Surveyors Pty Limited. The survey plan forms the basis of Figure 2 and the survey datum is AHD.</p>
Sample Collection and Field QA/QC	<p>Soil samples were obtained on 3 June 2017 in accordance with the SSP. Soil samples were collected from the fill and natural profiles based on field observations. The sampling depths are shown on the logs attached in the appendices.</p> <p>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.</p>
Field PID Screening for VOCs	<p>A portable PID 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.</p>
Decontamination and Sample Preservation	<p>Sampling personnel used disposable nitrile gloves during sampling activities. The SPT splits and hand auger were decontaminated between samples as outlined in the SSP.</p> <p>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 returned to the EIS office in Macquarie Park and refrigerated before being delivered in an insulated sample container to a NATA registered laboratory for analysis under standard chain of custody (COC) procedures.</p>

### 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	5	0
TRH/BTEX	5	0
PAHs	5	0
OCPs/OPPs	3	0
PCBs	3	0
Asbestos	5	0

The selection of fill samples was based around potential contamination indicators such as elevated PIDs or inclusions such as ash, slag or other manmade waste. Where there were no obvious contamination indicators, analysis was targeted in the shallow fill.

Samples were analysed by an appropriate, NATA Accredited laboratory (Envirolab Services Pty Ltd NSW, NATA Accreditation Number 2901) using the analytical methods detailed in Schedule B(3) of NEPM 2013. Reference should be made to the laboratory report (168694 and 168694-A) attached in the appendices for further details.

## **7 SITE ASSESSMENT CRITERIA (SAC)**

The SAC were derived from the NEPM 2013 and other guidelines as discussed in the following subsections. 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.

Soil data were compared to relevant Tier 1 screening criteria in accordance with NEPM (2013) as follows:

### **7.1 Human Health**

- Health Investigation Levels (HILs) for a 'residential with accessible soils' exposure scenario (HIL-A). These is the most sensitive land use criteria and are applicable for primary schools;
- Health Screening Levels (HSLs) for a 'low-high density residential' exposure scenario (HSL-A) were adopted, with the exception of the HSLs for asbestos. HSLs were calculated based on the soil type and the most conservative depth interval of 0m to 1m;
- Asbestos was considered as present/absent. Asbestos HSLs were not adopted as asbestos quantification was not undertaken; and
- Where/if 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)<sup>10</sup> were considered.

### **7.2 Environment (Ecological – terrestrial ecosystems)**

- Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) for an 'urban residential and public open space' (URPOS) exposure scenario. The criteria for benzo(a)pyrene has been increased from the value outlined 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)<sup>11</sup>; and
- ESLs were calculated based on the soil type and were derived via summing the added contaminant limit (ACL) values presented in Schedule B(1) of NEPM (2013) with the published ambient background concentration (ABC) values presented in the document titled Trace Element Concentrations in Soils from Rural and Urban Areas of Australia (1995)<sup>12</sup>. For the selection of ACLs, a pH of 6.4 was adopted based on the average pH result for the fill samples analysed for the salinity assessment. The most conservative CEC value of 5.9meq/100g was also adopted. This method is considered to be adequate for the Tier 1 screening.

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<sup>10</sup> 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*

<sup>11</sup> CRC Care, (2011). *Technical Report No. 39 - Risk-based management and guidance for benzo(a)pyrene*

<sup>12</sup> 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.

## 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 and to the JK Geotechnics report for further details.

Table 8-1: Summary of Subsurface Conditions

<b>Profile</b>	<b>Description</b>
Pavement	Asphalt pavement was encountered at the surface in BH2 and BH5. The asphalt was underlain by roadbase-type fill.
Fill	Fill was encountered beneath the asphalt in BH2 and BH5 and at the surface in the remaining boreholes. The fill typically comprised silty sand, silty sandy clay, silty clayey sand silty clay or gravelly sand and extended to a maximum depth of approximately 1.4m.  Various inclusions of ash, root and root fibres and shale gravels were encountered in the fill. Staining and obvious odours were not noted during the fieldwork. Fibre cement fragments and/or building and demolition waste were not observed in fill during sampling.
Natural Soil	Natural silty clay soil (residual) was encountered beneath the fill in all boreholes, and typically extended to depths ranging from 1.0m to 3.0m.
Bedrock	Shale bedrock was identified beneath the natural silty clay. The bedrock extended to the termination depth of the boreholes (maximum depth of 6m).
Groundwater	Groundwater was not encountered in the boreholes during augering, to a maximum depth of 6m.

### 8.3 **Field Screening**

PID soil sample headspace readings are presented in attached report tables and the COC documents attached in the appendices. All results were <0ppm equivalent isobutylene which indicates a lack of PID detectable VOCs.

Obvious staining, odours or suspected asbestos containing material (ACM) fragment were not noted in the boreholes. However, it is acknowledged that small diameter boreholes such as those drilled for

this investigation are not ideal for identifying ACM as only a small volume of soil is disturbed by the augering process.

#### 8.4 Soil Laboratory Results

The soil laboratory results are compared to the relevant SAC in the attached report tables. Contamination data are also shown on Figure 4. A summary of the results assessed against the SAC is presented below.

Table 8-2: Summary of Soil Laboratory Results

Analyte	Results Compared to SAC
Heavy Metals	<p><b><u>Human Health:</u></b> All heavy metal results were below the HIL-A criteria.</p> <p><b><u>Environment:</u></b> All heavy metal results were below the EIL-URPOS criteria.</p>
TRH	<p><b><u>Human Health:</u></b> All TRH results were below the HSL-A criteria.</p> <p><b><u>Environment:</u></b> The TRH (&gt;C<sub>16</sub>-C<sub>34</sub>) (F3) concentrations in the BH2 (0.05-0.2m) and BH5 (0.05-0.3m) samples exceeded the EIL of 300mg/kg (maximum concentration of 730mg/kg). The remaining TRH results were below the ESL-URPOS criteria.</p>
BTEX	<p><b><u>Human Health:</u></b> All BTEX results were below the laboratory PQLs and were less than the HSL-A criteria.</p> <p><b><u>Environment:</u></b> All BTEX results were below the ESL-URPOS criteria.</p>
PAHs	<p><b><u>Human Health:</u></b> All total PAH and carcinogenic PAH (reported as Benzo(a)pyrene TEQ) results were below the HIL-A criteria.</p> <p>All naphthalene results were below the HSL-A criteria.</p> <p><b><u>Environment:</u></b> All benzo(a)pyrene results were below the ESL-URPOS criterion and all naphthalene results were below the EIL-URPOS criterion.</p>
OCPs & OPPs	<p><b><u>Human Health:</u></b> All OCP and OPP results were below the laboratory PQLs and were less than the HIL-A criteria.</p>

<b>Analyte</b>	<b>Results Compared to SAC</b>
	<b><u>Environment:</u></b> All DDT results were below the EIL-URPOS criterion.
PCBs	<b><u>Human Health:</u></b> All PCB results were below the laboratory PQLs and were less than the HIL-A criterion.
Asbestos	<b><u>Human Health:</u></b> Asbestos was not detected in any of the samples analysed for the investigation.

## **9 DISCUSSION AND CONTAMINATION ASSESSMENT CONCLUSIONS**

### **9.1 Tier 1 Risk Assessment and Evaluation of SPR Linkages**

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.

In summary, the ESA identified a number of potential sources of contamination/AEC including fill, historical agricultural uses and hazardous building materials. Risks associated with the assessment findings are discussed in the following sub-sections:

#### **9.1.1 Soil**

TRH (F3) above the ESL-URPOS SAC was identified in roadbase-type fill and BH2 and BH5. As these areas are currently paved, there is considered to be no complete SPR linkage to the ecological receptors at these locations, and the environmental/ecological risks are considered to be low. The TRHs are considered likely to be associated with the roadbase fill and are unlikely to be indicative of a significant source of petroleum contamination.

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

Due to the presence of uncontrolled fill, the likelihood of asbestos being present is possible. However, the judgmental sampling undertaken did not identify any indicators for asbestos in fill (i.e. building and demolition waste), and asbestos was not identified in the five soil/fill samples submitted for analysis. Considering these lines of evidence, residual risks associated with asbestos can be addressed via the implementation of an unexpected finds protocol and, if required, appropriate management during the development works.

#### **9.1.2 Groundwater**

Considering the presence of clay soils and relatively deep groundwater (i.e. >6m deep), the risk posed by TRH to groundwater is considered to be very low. The remaining CoPC were not encountered in fill at concentrations that would be likely to impact groundwater.

## 9.2 Decision Statements

The decision statements are considered 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 historical assessment identified various potential sources of contamination/AEC, including fill, historical agricultural land use and hazardous building materials (i.e. from former demolition).

*Are any results above the SAC?*

TRH (F3) was identified at two locations above the environmental/ecological 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 (as discussed in Section 9.1). 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.

Risks associated with the roadbase-type fill at BH2 and BH5 can be mitigated provided that the roadbase remains beneath paved areas. When this material is excavated for the proposed development, it should not be re-used in unpaved areas or mixed with other soil/fill.

*Is there a requirement for remediation or further investigation?*

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 9.3.

### **9.3 Unexpected Finds Protocol**

As part of the implementation of this protocol, a suitably qualified contaminated land consultant<sup>13</sup> should be engaged to inspect the site following the initial site preparation works (i.e. following demolition of the buildings, pavements and scrape back of grass/vegetation). 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
- Any actions should be implemented and validated to demonstrate that there are no unacceptable risks to the receptors.

### **9.4 Conclusions and Recommendations**

The contamination assessment included a desktop site history assessment and fill/soil sampling from a total of five boreholes concurrently with the geotechnical investigation. The historical 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.

Based on the Tier 1 risk assessment, EIS are of the opinion that potential risks associated with contamination (i.e. the CoPC) within the investigation areas are low.

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<sup>13</sup> 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

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 9.3 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 9.3.

## **10**      **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.

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## **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.

Title: <b>SITE LOCATION PLAN</b>	
Location: GREYSTANES PUBLIC SCHOOL MERRYLANDS ROAD, GREYSTANES, NSW	
Report No: <b>E30431KP</b>	Figure No: <b>1</b>
<b>ENVIRONMENTAL INVESTIGATION SERVICES</b>	



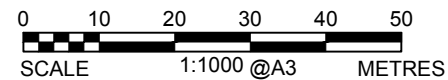
This plan should be read in conjunction with the EIS report.

PLOT DATE: 23/06/2017 10:32:51 AM DWG FILE: S:\5 EIS\SC EIS JOBS\30000\S\E30431KP GREYSTANES\CA\DE30431KP.DWG



**LEGEND**

- - - - - APPROXIMATE SITE BOUNDARY
- BH (Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)



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

Title: <b>SAMPLE LOCATION PLAN</b>	
Location: GREYSTANES PUBLIC SCHOOL MERRYLANDS ROAD, GREYSTANES, NSW	
Report No: E30431KP	Figure No: 2
<b>ENVIRONMENTAL INVESTIGATION SERVICES</b>	



## **LABORATORY SUMMARY TABLES**

**TABLE A**  
**SOIL LABORATORY RESULTS COMPARED TO HILS**  
 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 <sup>2</sup>	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P TEQ <sup>3</sup>	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	0.1	100	
Site Assessment Criteria (SAC) <sup>1</sup>	100	20	100	6000	300	40	400	7400	300	3	10	270	300	6	50	240	6	160	1	Detected/Not Detected		
Sample Reference	Sample Depth	Sample Description																				
BH1	0-0.1	Fill: silty sand	LPQL	LPQL	42	18	22	LPQL	49	84	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	No asbestos detected
BH2	0.05-0.2	Fill: gravelly sand	LPQL	LPQL	52	24	10	LPQL	47	45	0.1	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	No asbestos detected
BH3	0-0.1	Fill: silty sandy clay	LPQL	LPQL	15	22	13	LPQL	14	59	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	No asbestos detected
BH4	0.5-0.95	Fill: silty clay	LPQL	LPQL	LPQL <sup>^</sup>	54	3	LPQL	90	36	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	No asbestos detected
BH5	0.05-0.3	Fill: gravelly sand	LPQL	LPQL	12	57	22	LPQL	34	49	2.5	LPQL	NA	NA	NA	NA	NA	NA	NA	NA	NA	No asbestos detected
<b>Total Number of Samples</b>			5	5	4	5	5	5	5	5	5	5	3	3	3	3	3	3	3	3	3	5
<b>Maximum Value</b>			LPQL	LPQL	52	57	22	LPQL	90	84	2.5	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	No asbestos detected

**Explanation:**  
 1 - Site Assessment Criteria (SAC): NEPM 2013, HIL-A: 'Residential with garden/accessible soils; children's day care centers; preschools; and primary schools'  
 2 - The 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.  
 3 - B(a)P TEQ - Benzo(a)pyrene Toxicity Equivalence Quotient has been calculated based on 8 carcinogenic PAHs and their Toxic Equivalence Factors (TEFs) outlined in NEPM 2013  
<sup>^</sup> - Additional analysis for Cr VI was undertaken as reported in Envirolab report 168694-A. The Cr VI result has been reported for this sample.

Concentration above the SAC VALUE

**Abbreviations:**  
 PAHs: Polycyclic Aromatic Hydrocarbons  
 B(a)P: Benzo(a)pyrene  
 PQL: Practical Quantitation Limit  
 LPQL: Less than PQL  
 OPP: Organophosphorus Pesticides  
 OCP: Organochlorine Pesticides  
 PCBs: Polychlorinated Biphenyls  
 UCL: Upper Level Confidence Limit on Mean Value  
 HILs: Health Investigation Levels  
 NA: Not Analysed  
 NC: Not Calculated  
 NSL: No Set Limit  
 SAC: Site Assessment Criteria  
 NEPM: National Environmental Protection Measure

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

					C <sub>6</sub> -C <sub>10</sub> (F1)	>C <sub>10</sub> -C <sub>16</sub> (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID <sup>2</sup>
PQL - Envirolab Services					25	50	0.2	0.5	1	3	1	
HSL Land Use Category <sup>1</sup>					<b>RESIDENTIAL WITH ACCESSIBLE SOIL</b>							
Sample Reference	Sample Depth	Sample Description	Depth Category	Soil Category								
BH1	0-0.1	Fill: silty sand	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
BH2	0.05-0.2	Fill: gravelly sand	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
BH3	0-0.1	Fill: silty sandy clay	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
BH4	0.5-0.95	Fill: silty clay	0m to < 1m	Clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
BH5	0.05-0.3	Fill: gravelly sand	0m to < 1m	Sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0
<b>Total Number of Samples</b>					5	5	5	5	5	5	5	5
<b>Maximum Value</b>					LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL

**Explanation:**

- 1 - Site Assessment Criteria (SAC): NEPM 2013
- 2 - Field PID values obtained during the investigation

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

**Abbreviations:**

- UCL: Upper Level Confidence Limit on Mean Value
- HSLs: Health Screening Levels
- NA: Not Analysed
- NC: Not Calculated
- NL: Not Limiting
- SAC: Site Assessment Criteria
- PQL: Practical Quantitation Limit
- LPQL: Less than PQL
- NEPM: National Environmental Protection Measure

SITE ASSESSMENT CRITERIA

					C <sub>6</sub> -C <sub>10</sub> (F1)	>C <sub>10</sub> -C <sub>16</sub> (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
PQL - Envirolab Services					25	50	0.2	0.5	1	3	1
HSL Land Use Category <sup>1</sup>					<b>RESIDENTIAL WITH ACCESSIBLE SOIL</b>						
Sample Reference	Sample Depth	Sample Description	Depth Category	Soil Category							
BH1	0-0.1	Fill: silty sand	0m to < 1m	Sand	45	110	0.5	160	55	40	3
BH2	0.05-0.2	Fill: gravelly sand	0m to < 1m	Sand	45	110	0.5	160	55	40	3
BH3	0-0.1	Fill: silty sandy clay	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
BH4	0.5-0.95	Fill: silty clay	0m to < 1m	Clay	50	280	0.7	480	NL	110	5
BH5	0.05-0.3	Fill: gravelly sand	0m to < 1m	Sand	45	110	0.5	160	55	40	3



**TABLE D**  
**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 = BH1 (0.0-0.1) Dup Ref = DUPJDC1  Envirolab Report: 168694	Arsenic	4	LPQL	LPQL	NC	NC
	Cadmium	0.4	LPQL	LPQL	NC	NC
	Chromium	1	42	38	40.0	10
	Copper	1	18	17	17.5	6
	Lead	1	22	21	21.5	5
	Mercury	0.1	LPQL	LPQL	NC	NC
	Nickel	1	49	44	46.5	11
	Zinc	1	84	90	87.0	7

**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

**Abbreviations:**

PQL: Practical Quantitation Limit

LPQL: Less than PQL

NA: Not Analysed

NC: Not Calculated

OCP: Organochlorine Pesticides

OPP: Organophosphorus Pesticides

PCBs: Polychlorinated Biphenyls

TRH: Total Recoverable Hydrocarbons

# **Appendix A: EIS Preliminary Salinity Assessment Report**



**ENVIRONMENTAL INVESTIGATION SERVICES**

**REPORT**

TO

**JDH ARCHITECTS**

ON

**PRELIMINARY SALINITY ASSESSMENT**

FOR

**PROPOSED ALTERATIONS AND ADDITIONS**

AT

**GREYSTANES PUBLIC SCHOOL,  
781 MERRYLANDS ROAD, GREYSTANES, NSW**

**26 JUNE 2017**

**REF: E30431KPrpt-SAL**



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

Tel: 02 9888 5000 • Fax: 9888 5004

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Report prepared by:



Katrina Taylor  
Environmental Scientist

Report reviewed by:



Brendan Page  
Associate Environmental Scientist

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#### LABORATORY SUMMARY TABLES:

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Table B (Appendix A):	Summary of Resistivity Calculation on Soil EC Results
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Table E (Appendix A):	Summary of Soil Laboratory Results – CEC & ESP

#### APPENDICES:

Appendix A1:	Background on Salinity
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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
<b><i>Units</i></b>	
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)<sup>1</sup> to undertake a preliminary salinity assessment for the proposed alterations and additions at Greystanes Public School, 781 Merrylands Road, Greystanes. This report forms Appendix A of the EIS report E30431KPrpt (dated 26 June 2017, 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**

Based on the details provided, EIS understand that the proposed additions will include a new 2-3 storey permanent teaching building (Area A) and new single storey staff / administration building (Area B). We have generally described these proposed building footprints as Area A and Area B to differentiate between the two respectively (Area A and Area B have also been used when referring to the associated investigation areas).

We have assumed that some cut and fill earthworks may be required. The lowest finished level of the 2-3 storey building (Area A) is at reduced level (RL) 58.785 on the north-eastern side. This building may require excavation of up to 3.0m in depth at the southern end. It is also assumed that minor landscaping works will also be required.

Refurbishment of a building to the north of Area B is also proposed. This area was not investigated for this assessment.

### **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; and
- Assess the soil salinity conditions via implementation of a preliminary sampling and analysis program.

---

<sup>1</sup> Environmental consulting division of Jeffery & Katauskas Pty Ltd (J&K)

### 1.3 Scope of Work

The scope of work included the following:

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

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

<b>Guidelines/Regulations/Documents</b>
Site Investigations for Urban Salinity (2002) <sup>2</sup>
Salinity Code of Practice (2004) <sup>3</sup>
Managing Urban Stormwater – Soil and Construction (4 <sup>th</sup> ed.) (2004) <sup>4</sup>
Salinity Potential in Western Sydney Map (2002) <sup>5</sup>
Piling – Design and Installation AS2159-2009 (2009) <sup>6</sup>
T56: Guide to Residential Slabs and Footings in Saline Environments (2005) <sup>7</sup>

<sup>2</sup> Department of Land and Water Conservation (DLWC), (2002). *Site Investigations for Urban Salinity*, (referred to as DLWC 2002)

<sup>3</sup> 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)

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

<sup>5</sup> DIPNR, (2002). *1:100,000 Map – Salinity Potential in Western Sydney*, (referred to as Salinity Potential Map)

<sup>6</sup> Standards Australia, (2009). *Piling – Design and Installation, AS2159-2009* (referred to as AS2159-2009)

<sup>7</sup> Cement, Concrete and Aggregates Australia (CCA), (2005). *T56: Guide to Residential Slabs and Footings in Saline Environments* (referred to as CCA 2005)

## **2 SITE DESCRIPTION**

The site is located on the northern side of Merrylands Road. The regional setting is generally characterised by low density residential dwellings, however some recreational playing field exist to the southwest of the site. The site is located within a gently undulating regional topographic setting. Part of Area A slopes steeply to the north/north-east at approximately 16° and Area B slopes gently to the north at approximately 1° to 2°.

A walkover inspection of the site was undertaken by EIS on 3 June 2017. 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 wider site was also undertaken for completeness.

At the time of the inspection the site was occupied by Greystanes Primary School and comprised various buildings, grassed and paved recreational areas. 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 site underlain by Bringelly Shale of the Wianamatta Group, which typically consists of shale, carbonaceous claystone, claystone, laminite, fine to medium grained lithic sandstone, rare coal and tuff. Soil landscape mapping indicates that the site is located within the Blacktown soil landscape. Blacktown soils are characterised by moderate erodibility with some higher local occurrences, low dispersivity and localised areas of moderate salinity.

#### **3.2 Salinity Hazard Map**

The site is located within the area of Western Sydney included in the Salinity Potential Map. Based upon interpretation from the geological formations and soil groups presented on the map, the site is located in a region of moderate salinity potential. The moderate classification is attributed to scattered areas of scalding and indicator vegetation, in areas where concentrations have not been mapped. Saline areas may occur in this zone, which have not been identified or may occur if risk factors change adversely.

#### **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 10 registered bores within the report buffer of 2,000m. In summary:

- The nearest registered bore was located approximately 657m from the site. This was utilised for domestic purposes;
- The majority of the bores were registered for monitoring purposes; and
- The drillers log information from the closest registered bores typically identified fill and/or clay soil to depths of 1.3m to >10m, underlain by shale bedrock. Standing water levels (SWLs) in the bores ranged from 4.5mBGL to 66.0mBGL.

The information reviewed for this assessment, and the findings of the contamination assessment as documented in the main report, indicated that the subsurface conditions at the site are likely to consist of residual soils overlying relatively shallow shale bedrock. Groundwater is unlikely to be encountered during shallow excavation works for the proposed development.

## **4 SAMPLING AND ANALYSIS PLAN**

### **4.1 Soil Sampling Rationale**

The investigation included soil sampling from three locations (BH1, BH3 and BH4). 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 depth was nominated at the commencement of the project when details of the proposed development and proposed depths of excavation were not available.

### **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 report (Ref: 168694) attached in the appendices of the main report 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

<b>Analyte</b>	<b>Fill Samples</b>	<b>Natural Soil Samples</b>
pH	4	2
Electrical Conductivity (EC)	4	2
Resistivity	4	2
Texture (used to determine EC extract – ECe)	4	2
Cation Exchange Capacity (CEC)	1	1
Sulphate	4	2
Chloride	4	2

## 5 SITE ASSESSMENT CRITERIA (SAC)

### 5.1 Soil Salinity and Plant Growth

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

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

Table 5-1: Plant Response to Soil Salinity

ECe (dS/m)	Salinity Class	Plant Response <sup>1</sup>
<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<sup>8</sup>) presented below:

<sup>8</sup> 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<sup>9</sup>) developed a set of ratings for effective CEC and the most abundant cations. These are summarised in the following table (values are in meq/100g):

<sup>9</sup> Metson, A.J, (1961). *Methods of Chemical Analysis for Soil Survey Samples* (referred to as Metson 1961)

Table 5-3: CEC Rating

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

**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<sup>10</sup>). 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<sup>11</sup>) 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 future information:

<sup>10</sup> Eckert, D.J, (1987) .*Soil Test Interpretation: Basic Cation Saturation Ratios and Sufficiency Levels* (referred to as Eckert 1987)

<sup>11</sup> Charman, P.E.V and Murphy, B.W (eds), (2000).*Soils: Their Management and Properties*, (referred to as Charman and Murphy 2000)

Table 5-4: Minimum Concrete Grade for Slabs and Footings in Saline Soils

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

**Note:**

1 - Concrete Grade for Salinity Class has been adopted from CCAA 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 <sub>4</sub> )		pH	Chlorides in Groundwater (ppm)	Soil Conditions A <sup>1</sup>	Soil Conditions B <sup>2</sup>
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 <sup>1</sup>	Soil Conditions B <sup>2</sup>
	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 of the main report for further details.

Table 6-1: Summary of Subsurface Conditions

Profile	Description
Pavement	Asphalt pavement was encountered at the surface in BH2 and BH5. The asphalt was underlain by roadbase-type fill.
Fill	Fill was encountered beneath the asphalt in BH2 and BH5 and at the surface in the remaining boreholes. The fill typically comprised silty sand, silty sandy clay, silty clayey sand silty clay or gravelly sand and extended to a maximum depth of approximately 1.4m.  Various inclusions of ash, root and root fibres and shale gravels were encountered in the fill. Staining and obvious odours were not noted during the fieldwork. Fibre cement fragments and/or building and demolition waste were not observed in fill during sampling.
Natural Soil	Natural silty clay soil (residual) was encountered beneath the fill in all boreholes, and typically extended to depths ranging from 1.0m to 3.0m.
Bedrock	Shale bedrock was identified beneath the natural silty clay. The bedrock extended to the termination depth of the boreholes (maximum depth of 6m).
Groundwater	Groundwater was not encountered in the boreholes during augering, to a maximum depth of 6m.

### 6.2 Laboratory Results

A summary of the results is presented below.

Table 6-2: Summary of Laboratory Results

Analyte	Results
EC & E <sub>ce</sub>	The EC results ranged from 49µS/cm to 580µS/cm.  The E <sub>ce</sub> results ranged from less than the laboratory practical quantitation limit (PQL) (i.e. <2 dS/m) to 4dS/m.
Resistivity	The resistivity values for the soil samples ranged from 1,700ohm.cm to 20,000ohm.cm.
pH	The results of the analysis ranged from 5.1 to 7.1.

Analyte	Results
CEC	The results of the analysis ranged from: <ul style="list-style-type: none"> <li>• CEC – 5.9meq/100g to 13meq/100g;</li> <li>• Exchangeable Na – 0.16meq/100g to 0.76meq/100g;</li> <li>• Exchangeable K – 0.1meq/100g to 0.6meq/100g;</li> <li>• Exchangeable Ca – 0.7meq/100g to 8.1meq/100g; and</li> <li>• Exchangeable Mg – 4.0meq/100g to 4.3meq/100g.</li> </ul>
Sulphate	The sulphate results ranged from 10mg/kg to 390mg/kg.
Chloride	The chloride results ranged from less than the PQL to 380mg/kg.

**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

<b>Parameter</b>	<b>Notes</b>
Soil Salinity and Plant Growth	The ECe results generally ranged from less than the PQL (i.e. <2) to 4. The majority of the samples were classed as non-saline (it is noted that the laboratory also reported the results as non-saline when the ECe was equal to 2). Soil samples BH3 (1.8-2.0) and BH1 (0.5-1.0) were classed as slightly saline and moderately saline respectively.
Soil pH and Plant Growth	The soil pH results ranged from 5.1 to 7.1 and are classed as strongly acidic to neutral (optimal plant growth).  The acidic conditions generally increased with depth. Any proposed excavations will likely 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 5.9meq/100g to 13meq/100g and were in the very low to moderate range.
Ratio of Calcium to Magnesium	The results indicate that the soils are calcium deficient. The CEC of the soil is generally very low to moderate. Lime and gypsum can be used to stabilise the soil which will improve soil structure for both engineering and fertility purposes.
ESP%	The ESP% values of the samples ranged from 1.2% to 12.9%. The sodicity rating threshold for non-sodic soils is <5% and for sodic soils is an ESP value of between 5% and 15%. Sodic soils should be expected within the sub-soils.
Concrete Slabs and Footings in Saline Soils (CCAA 2005)	The proposed earthworks are anticipated to expose soils generally classed as non-saline to moderately saline. The CCAA 2005 recommended concrete grade for slabs and footings in moderately saline soils is N25.  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 sub-surface soils are non-aggressive to mildly aggressive towards buried concrete.

Parameter	Notes
Exposure Classification for Steel Piles/Foundations (AS2159-2009)	The soil pH and chloride results indicate that the soils are non-aggressive towards buried steel. The soil resistivity results indicated that the soils are non-aggressive to moderately 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) to a maximum depth of 2m. However, slightly to moderately saline soils and mildly to moderately aggressive soil conditions are present. EIS recommend that the structural engineer review the exposure classification and salinity results within this report and factor these into the design accordingly.

As the preliminary investigation included sampling to a maximum depth of 2m, and the proposed development includes bulk excavation to a depth of approximately 3m, additional sampling and analysis is recommended to assess the deeper soils that will be exposed by the bulk excavation. A salinity management plan is recommended to document these requirements and provide a basis for managing the salinity/aggressivity conditions at the site.

## **9**      **LIMITATIONS**

Salinity is a natural phenomenon and can change over time based on site conditions and climatic variations. Changes to existing drainage patterns can also impact the salinity at the site. The results outlined in this report are a snapshot 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.

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## **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 A (Appendix A)**  
**SUMMARY OF SOIL LABORATORY RESULTS - EC and ECe**

Borehole Number	Sample Depth (m)	Sample Description	EC ( $\mu\text{S/cm}$ )	ECe (dS/m)	Salinity Class <sup>1</sup>
<b>Sample Depth Range - 0.1m to 2.0m</b>					
BH1	0-0.1	Fill: silty sand	70	<2	Non-Saline
BH1	0.5-1	Silty clay	580	4	Moderately Saline
BH3	0.8-1.0	Fill: silty sandy clay	66	<2	Non-Saline
BH3	1.8-2	Silty clay	290	2	Slightly Saline
BH4	0-0.1	Fill: silty clayey sand	78	<2	Non-Saline
BH4	0.8-1	Fill: silty clay	49	<2	Non-Saline
<b>Total Number of Samples</b>			6	2	-
<b>Minimum Value</b>			49	2	-
<b>Maximum Value</b>			580	4	-

**Explanation**

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

**ECe Values (dS/m)**

<2  
 2 to 4  
 4 to 8  
 8 to 16  
 >16

**Salinity Class**

Non-Saline
Slightly Saline
Moderately Saline
Very Saline
Highly Saline

**Abbreviations**

EC - Electrical Conductivity  
 ECe - Extract Electrical Conductivity



**TABLE B (Appendix A)**  
**SUMMARY OF RESISTIVITY CALCULATION ON SOIL EC RESULTS**

Borehole Number	Sample Depth (m)	Sample Description	EC (µS/cm)	Resistivity <sup>1</sup> (ohm.cm)	Classification <sup>2</sup> Condition B
<b>Sample Depth Range - 0.1m to 2.0m</b>					
BH1	0-0.1	Fill: silty sand	70	14,286	Non-Aggressive
BH1	0.5-1	Silty clay	580	1,724	Moderately Aggressive
BH3	0.8-1.0	Fill: silty sandy clay	66	15,152	Non-Aggressive
BH3	1.8-2	Silty clay	290	3,448	Mildly Aggressive
BH4	0-0.1	Fill: silty clayey sand	78	12,821	Non-Aggressive
BH4	0.8-1	Fill: silty clay	49	20,408	Non-Aggressive
<b>Total Number of Samples</b>			6	6	-
<b>Minimum Value</b>			49	1,724	-
<b>Maximum Value</b>			580	20,408	-

**Explanation**

1 - Resistivity values have been calculated by the laboratory as ohm.m. EIS have multiplied this results by 100 to convert the resist to ohm.cm.

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.m)**

>5,000  
 2,000 - 5,000  
 1,000 - 2,000  
 <1,000

**Classification for Steel Piles**

Non-Aggressive
Non-Aggressive
Mildly Aggressive
Moderately Aggressive

**Abbreviations**

EC - Electrical Conductivity



**TABLE C (Appendix A)**  
**SUMMARY OF SOIL LABORATORY RESULTS - pH**

Borehole Number	Sample Depth (m)	Sample Description	pH	Classification for Concrete Piles <sup>1</sup> Soil Condition B <sup>2</sup>	Classification for Steel Piles <sup>1</sup> Soil Condition B <sup>2</sup>
<b>Sample Depth Range - 0.1m to 2.0m</b>					
BH1	0-0.1	Fill: silty sand	6.5	Non-Aggressive	Non-Aggressive
BH1	0.5-1	Silty clay	5.1	Mildly Aggressive	Non-Aggressive
BH3	0.8-1.0	Fill: silty sandy clay	7.1	Non-Aggressive	Non-Aggressive
BH3	1.8-2	Silty clay	5.8	Non-Aggressive	Non-Aggressive
BH4	0-0.1	Fill: silty clayey sand	6.3	Non-Aggressive	Non-Aggressive
BH4	0.8-1	Fill: silty clay	6.9	Non-Aggressive	Non-Aggressive
<b>Total Number of Samples</b>			6	-	-
<b>Minimum Value</b>			5.1	-	-
<b>Maximum Value</b>			7.1	-	-
<b>Explanation</b>					
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.					
<b>pH Value</b>	<b>Classification for Concrete Piles</b>		<b>pH Value</b>	<b>Classification for Steel Piles</b>	
>5.5	Non-Aggressive		>5	Non-Aggressive	
4.5 - 5.5	Mildly Aggressive		4.0 - 5.0	Non-Aggressive	
4 - 4.5	Moderately Aggressive		3.0 - 4.0	Mildly Aggressive	
<4	Severely Aggressive		<3	Moderately Aggressive	



**TABLE D (Appendix A)**  
**SUMMARY OF SOIL LABORATORY RESULTS - SULPHATE & CHLORIDE**

Borehole Number	Sample Depth (m)	Sample Description	Sulphate (mg/kg)	Chloride (mg/kg)	Classification for Concrete Piles <sup>1</sup> SO4 - Soil Condition B <sup>2</sup>	Classification for Steel Piles <sup>1</sup> Cl - Soil Condition B <sup>2</sup>
<b>Sample Depth Range - 0.1m to 2.0m</b>						
BH1	0-0.1	Fill: silty sand	10	20	Non-Aggressive	Non-Aggressive
BH1	0.5-1	Silty clay	390	380	Non-Aggressive	Non-Aggressive
BH3	0.8-1.0	Fill: silty sandy clay	20	<10	Non-Aggressive	Non-Aggressive
BH3	1.8-2	Silty clay	270	130	Non-Aggressive	Non-Aggressive
BH4	0-0.1	Fill: silty clayey sand	20	10	Non-Aggressive	Non-Aggressive
BH4	0.8-1	Fill: silty clay	30	10	Non-Aggressive	Non-Aggressive
<b>Total Number of Samples</b>			6	5	-	-
<b>Minimum Value</b>			10	10	-	-
<b>Maximum Value</b>			390	380	-	-

**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.

<u>Sulphate (SO4) Values</u>	<u>Classification for Concrete Piles</u>	<u>Chloride (Cl) Values</u>	<u>Classification for Steel Piles</u>
<5,000	Non-Aggressive	<5,000	Non-Aggressive
5,000 - 10,000	Mildly Aggressive	5,000 - 20,000	Non-Aggressive
10,000 - 20,000	Moderately Aggressive	20,000 - 50,000	Mildly Aggressive
>20,000	Severely Aggressive	>50,000	Moderately Aggressive



**TABLE E (Appendix A)**  
**SUMMARY OF SOIL LABORATORY RESULTS - CEC & ESP**

Borehole Number	Sample Depth (m)	Sample Description	Total CEC	Ca	K	Mg	Na	ESP <sup>1</sup> %
BH1	0.5-1	Silty clay	5.9	0.7	0.1	4.3	0.76	12.9
BH4	0-0.1	Fill: silty clayey sand	13	8.1	0.6	4	0.16	1.2
<b>Total Number of Samples</b>			2	2	2	2	2	2
<b>Minimum Value</b>			5.9	0.7	0.1	4.0	0.16	1.23
<b>Maximum Value</b>			13.0	8.1	0.6	4.3	0.76	12.88

**Explanation**

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

**ESP Value**

< 5%  
 5% to 15%  
 > 15%

**Sodicity Rating**

Non-Sodic
Sodic
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 A1: 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 and Site History Information**

## **Lotsearch Report**

# Lotsearch



## **Environmental Risk and Planning Report**

**Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145**

**Report Buffer: 1000m**

**Report Date: 01 May 2017 18:31:11**

**Disclaimer:**

The purpose of this report is to provide an overview of some of the site history, environmental risk and planning information available, affecting an individual address or geographical area in which the property is located. It is not a substitute for an on-site inspection or review of other available reports and records. It is not intended to be, and should not be taken to be, a rating or assessment of the desirability or market value of the property or its features. You should obtain independent advice before you make any decision based on the information within the report. The detailed terms applicable to use of this report are set out at the end of this report.

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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	No. Features Onsite	No. Features within 100m	No. Features within Buffer
Cadastre Boundaries	Land and Property Information	01/05/2017	01/05/2017	Daily	-	-	-
Topographic Data	Land and Property Information	10/04/2015	01/04/2015	As required	-	-	-
List of NSW contaminated sites notified to EPA	Environment Protection Authority	20/04/2017	05/04/2017	Monthly	0	0	0
Contaminated Land: Records of Notice	Environment Protection Authority	08/04/2017	08/04/2017	Monthly	0	0	0
Former Gasworks	Environment Protection Authority	08/04/2017	16/01/2017	Monthly	0	0	0
National Waste Management Site Database	Geoscience Australia	07/03/2017	15/11/2012	Quarterly	0	0	0
EPA PFAS Investigation Program	Environment Protection Authority	19/04/2017	19/04/2017	Monthly	0	0	0
Licensed Activities under the POEO Act 1997	Environment Protection Authority	07/04/2017	07/04/2017	Monthly	0	0	1
Delicensed POEO Activities still Regulated by the EPA	Environment Protection Authority	07/04/2017	07/04/2017	Monthly	0	0	0
Former POEO Licensed Activities now revoked or surrendered	Environment Protection Authority	07/04/2017	07/04/2017	Monthly	0	0	7
UPSS Environmentally Sensitive Zones	Department of Environment, Climate Change and Water (NSW)	14/04/2015	12/01/2010	As required	0	0	0
UBD Business to Business Directory 1991	Hardie Grant			Not required	0	0	0
UBD Business Directory 1991 Motor Garages/Service Stations	Hardie Grant			Not required	0	0	1
UBD Business Directory 1970	Hardie Grant			Not required	0	0	0
UBD Business Directory 1970 Drycleaners & Motor Garages/Service Stations	Hardie Grant			Not required	0	0	1
UBD Business Directory 1950	Hardie Grant			Not required	0	1	2
UBD Business Directory 1950 Drycleaners & Motor Garages/Service Stations	Hardie Grant			Not required	0	0	0
Points of Interest	Land and Property Information	01/02/2017	01/02/2017	Annually	1	2	36
Tanks (Areas)	Land and Property Information	01/02/2017	01/02/2017	Annually	0	0	0
Tanks (Points)	Land and Property Information	01/02/2017	01/02/2017	Annually	0	0	1
Major Easements	Land and Property Information	01/02/2017	01/02/2017	As required	0	0	1
State Forest	Land and Property Information	01/02/2017	29/06/2016	As required	0	0	0
NSW National Parks and Wildlife Service Reserves	NSW Office of Environment and Heritage	01/02/2017	31/12/2016	Annually	0	0	0
Hydrogeology Map of Australia	Commonwealth of Australia (Geoscience Australia)	08/10/2014	17/03/2000	As required	1	1	1
Groundwater Boreholes	NSW Department of Primary Industries - Office of Water / Water Administration Ministerial Corporation; Commonwealth of Australia (Bureau of Meteorology) 2015	21/03/2016	01/12/2015	Annually	0	0	10
Geological Units 1:100,000	NSW Department of Industry, Resources & Energy	20/08/2014		None planned	1	-	1
Geological Structures 1:100,000	NSW Department of Industry, Resources & Energy	20/08/2014		None planned	0	-	0
Naturally Occurring Asbestos Potential	NSW Department of Industry, Resources & Energy	04/12/2015	24/09/2015	Unknown	0	0	0
Soil Landscapes	NSW Office of Environment and Heritage	12/08/2014		None planned	1	-	2
Standard Local Environmental Plan Acid Sulfate Soils	NSW Planning and Environment	07/10/2016	07/10/2016	As required	0	-	-
Dryland Salinity Assessment	National Land and Water Resources Audit	18/07/2014	12/05/2013	None planned	0	0	0
Mining Subsidence Districts	Land and Property Information	31/08/2016	31/08/2016	As required	0	0	0



Dataset Name	Custodian	Supply Date	Currency Date	Update Frequency	No. Features Onsite	No. Features within 100m	No. Features within Buffer
SEPP 14 - Coastal Wetlands	NSW Planning and Environment	17/12/2015	24/10/2008	Annually	0	0	0
SEPP 26 - Littoral Rainforest	NSW Planning and Environment	17/12/2015	05/02/1988	Annually	0	0	0
SEPP 71 - Coastal Protection	NSW Planning and Environment	17/12/2015	01/08/2003	Annually	0	0	0
SEPP Major Developments 2005	NSW Planning and Environment	09/03/2013	25/05/2005	Under Review	0	0	0
SEPP Strategic Land Use Areas	NSW Planning and Environment	06/07/2016	28/01/2014	Annually	0	0	0
Local Environmental Plan - Land Zoning	NSW Planning and Environment	21/04/2017	13/04/2017	Quarterly	1	3	32
Local Environmental Plan - Minimum Subdivision Lot Size	NSW Planning and Environment	21/04/2017	13/04/2017	Quarterly	1	-	-
Local Environmental Plan - Height of Building	NSW Planning and Environment	20/04/2017	13/04/2017	Quarterly	1	-	-
Local Environmental Plan - Floor Space Ratio	NSW Planning and Environment	20/04/2017	07/04/2017	Quarterly	1	-	-
Local Environmental Plan - Land Application	NSW Planning and Environment	20/04/2017	03/03/2017	Quarterly	1	-	-
Local Environmental Plan - Land Reservation Acquisition	NSW Planning and Environment	20/04/2017	13/04/2017	Quarterly	0	-	-
State Heritage Items	NSW Office of Environment and Heritage	20/04/2017	30/09/2016	Quarterly	0	0	1
Local Heritage Items	NSW Planning and Environment	20/04/2017	13/04/2017	Monthly	0	0	6
Bush Fire Prone Land	NSW Rural Fire Service	28/03/2017	17/02/2017	Quarterly	0	0	0
Native Vegetation of the Sydney Metropolitan Area	NSW Office of Environment and Heritage	01/03/2017	16/12/2016	As required	2	2	4
RAMSAR Wetlands	Commonwealth of Australia Department of the Environment	08/10/2014	24/06/2011	As required	0	0	0
ATLAS of NSW Wildlife	NSW Office of Environment and Heritage	01/05/2017	01/05/2017	Daily	-	-	-

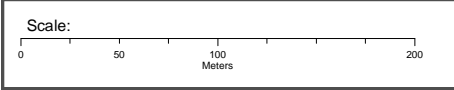
# Aerial Imagery 2015

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145



**Legend**

-  Site Boundary
-  Buffer 150m



Data Sources: Aerial Imagery © 2017 Google Inc, used with permission. Google and the Google logo are registered trademarks of Google Inc.

Coordinate System:  
GDA 1994 MGA Zone 56

Date: 28 April, 2017

# Contaminated Land & Waste Management Facilities

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145

## List of NSW contaminated sites notified to EPA

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

Map Id	Site	Address	Suburb	Activity	EPA site management class	Status	Dist	Direction	LC
N/A	No records in buffer								

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

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

NSW EPA Contaminated Land List Data Source: Environment Protection Authority  
 © State of New South Wales through the Environment Protection Authority

# Contaminated Land & Waste Management Facilities

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145

## Contaminated Land: Records of Notice

Record of Notices within the report buffer:

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

Contaminated Land Records of Notice Data Source: Environment Protection Authority  
© State of New South Wales through the Environment Protection Authority  
Terms of use and disclaimer for Contaminated Land: Record of Notices, please visit  
<http://www.epa.nsw.gov.au/clm/clmdisclaimer.htm>

## Former Gasworks

Former Gasworks within the report buffer:

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

Former Gasworks Data Source: Environment Protection Authority  
© State of New South Wales through the Environment Protection Authority

## National Waste Management Site Database

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

Site Id	Owner	Name	Address	Suburb	Postcode	Landfill	Reprocess	Transfer	Distance	Direction	LC
N/A	No records in buffer										

Waste Management Facilities Data Source: Australian Government Geoscience Australia  
Creative Commons 3.0 © Commonwealth of Australia <http://creativecommons.org/licenses/by/3.0/au/deed.en>

## EPA PFAS Investigation Program

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145

## EPA PFAS Investigation Program

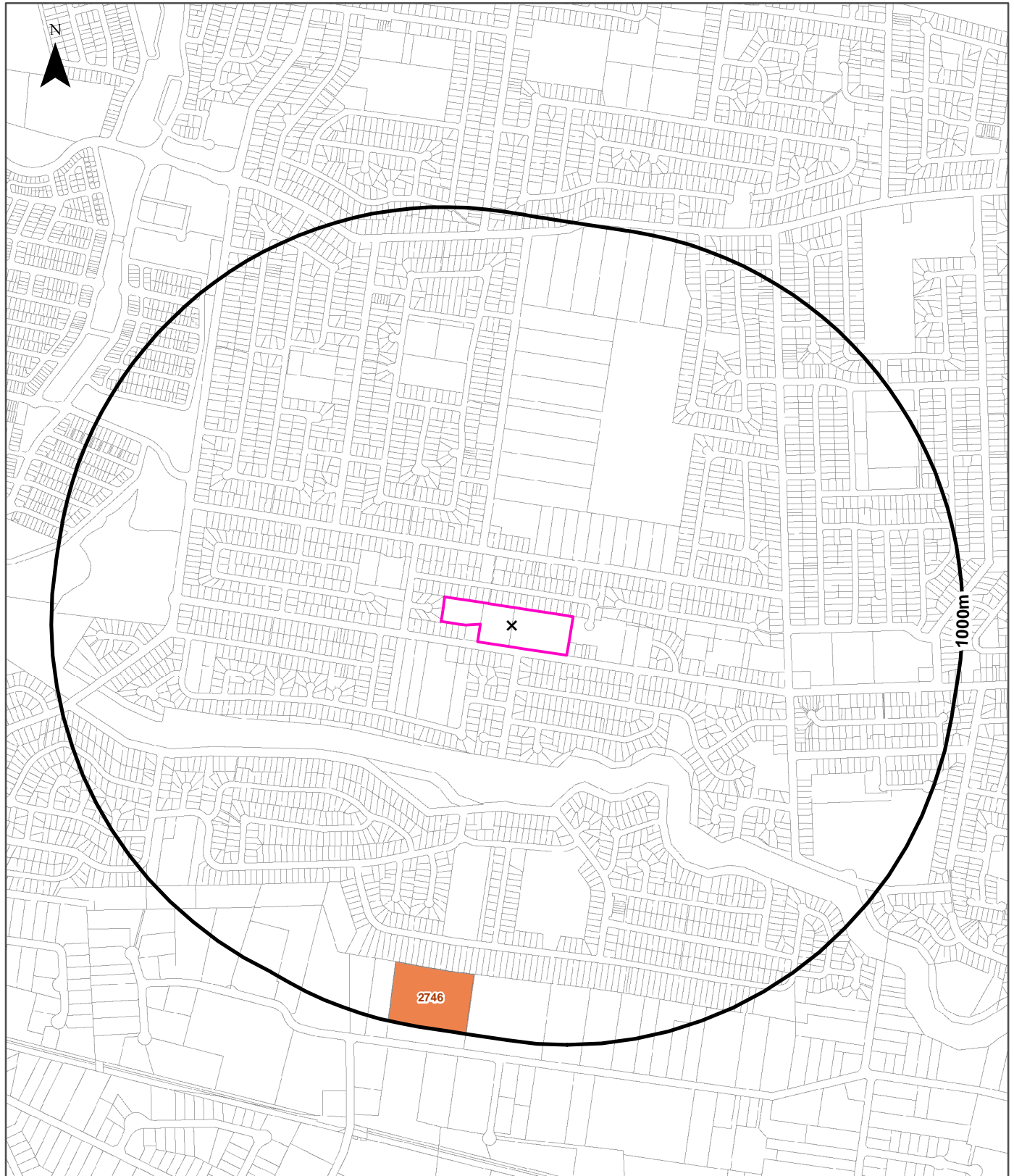
Sites that are part of the EPA PFAS investigation program, within 2km:

Id	Site	Address	Loc Conf	Distance	Direction
N/A	No records in buffer				

EPA PFAS Investigation Program: Environment Protection Authority  
© State of New South Wales through the Environment Protection Authority

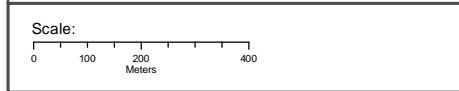
# Current EPA Licensed Activities

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145



**Legend**

- X Site Centre
- Site Boundary
- Report Buffer
- Property Boundary
- Current Licensed Activities under POEO Act
- Current Licences related to Other Activities incl. Application of Herbicides to Waterways
- Current Licences related to Irrigated Agriculture



Data Sources: Property Boundaries & Topographic Data:  
© Land and Property Information (a division of the  
Department of Finance and Services) 2017

Coordinate System:  
GDA 1994 MGA Zone 56

Date: 01May 2017

## EPA Activities

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145

### Licensed Activities under the POEO Act 1997

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

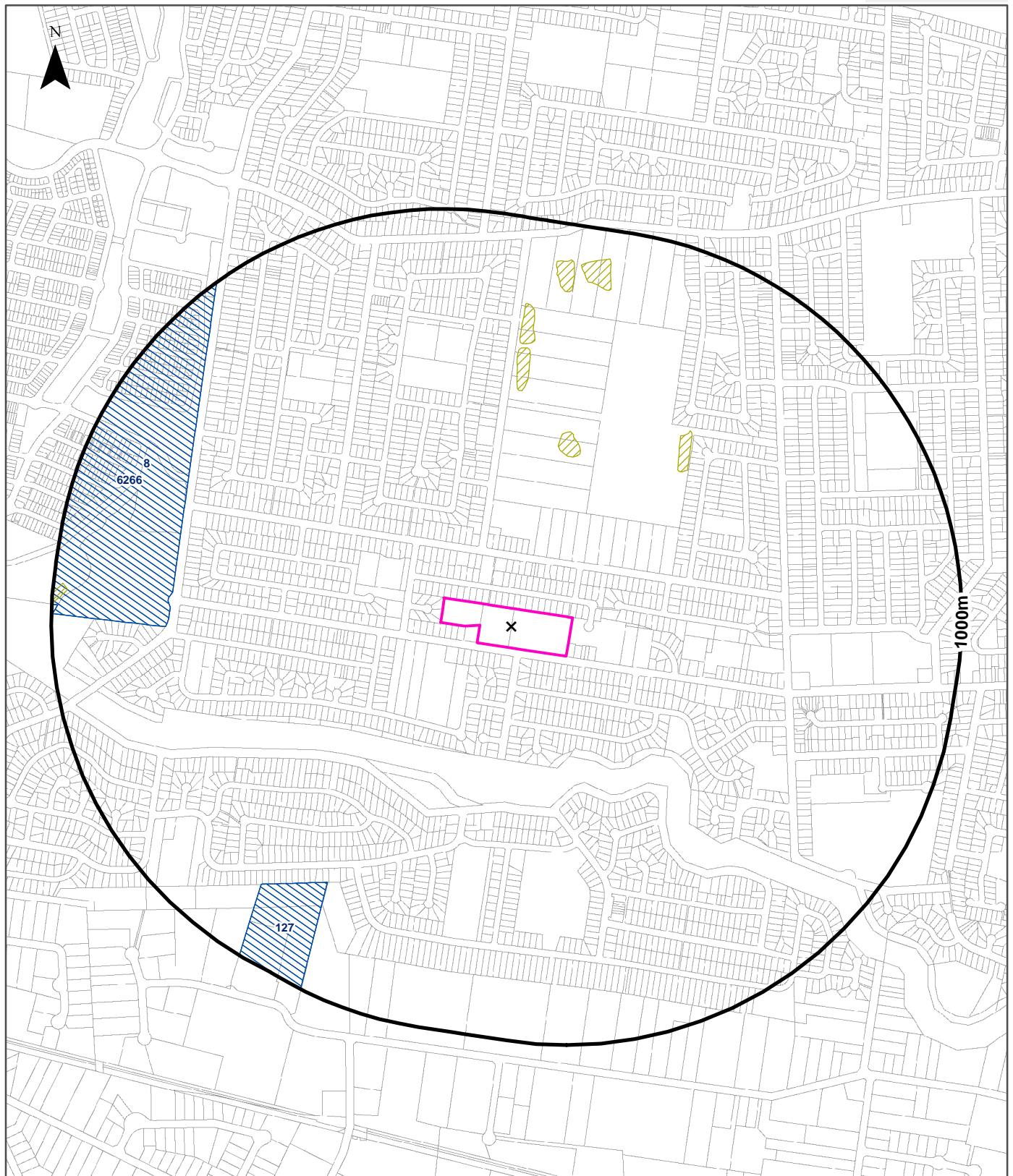
EPL	Organisation	Name	Address	Suburb	Activity	Loc Conf	Distance	Direction
2746	JALCO AUSTRALIA PTY. LIMITED	JALCO HOUSEHOLD AND FABRIC CARE	277-303 WOODPARK ROAD	SMITHFIELD	Dangerous goods production	1	844m	South

POEO Licence Data Source: Environment Protection Authority

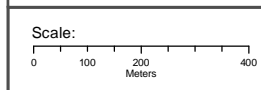
© State of New South Wales through the Environment Protection Authority

# Delicensed & Former Licensed EPA Activities

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145



Legend	
X Site Centre	Delicensed Activities still Regulated by EPA
Site Boundary	Former Licensed/Regulated Activities (revoked or surrendered)
Report Buffer	Surrendered Licences related to Other Activities on Waterways incl. Application of Herbicides
Property Boundary	



Data Sources: Property Boundaries & Topographic Data:  
© Land and Property Information (a division of the  
Department of Finance and Services) 2017

Coordinate System:  
GDA 1994 MGA Zone 56

Date: 01May 2017

## EPA Activities

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145

### Delicensed Activities still regulated by the EPA

Delicensed activities still regulated by the EPA, within the report 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  
© State of New South Wales through the Environment Protection Authority

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

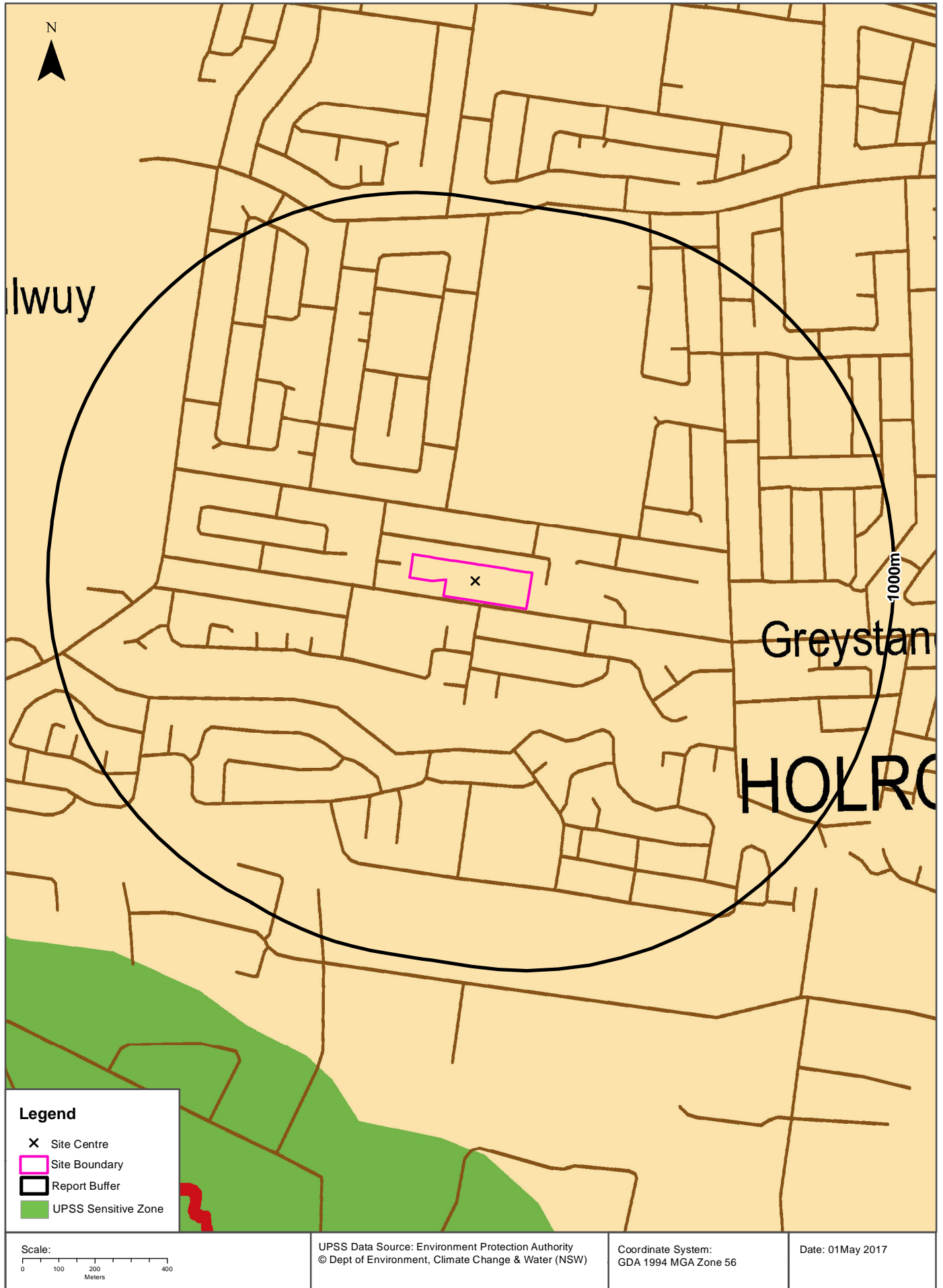
Former Licensed activities under the Protection of the Environment Operations Act 1997, now revoked or surrendered, within the report buffer:

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	7	408m	-
4838	Robert Orchard	Various Waterways throughout New South Wales - SYDNEY NSW 2000	Surrendered		Other Activities / Non Scheduled Activity - Application of Herbicides	7	408m	-
6630	SYDNEY WEED & PEST MANAGEMENT PTY LTD	WATERWAYS THROUGHOUT NSW - PROSPECT, NSW, 2148	Surrendered		Other Activities / Non Scheduled Activity - Application of Herbicides	7	408m	-
6266	BORAL RECYCLING PTY LIMITED	GREYSTANES ROAD, SOUTH WENTWORTHVILLE , NSW 2145	Surrendered	10/01/2001	Waste Storage, Transfer, Separating or Processing; Crushing, grinding or separating	1	693m	North West
8	BITUPAVE LTD	GREYSTANES ROAD, GREYSTANES, NSW 2145	Surrendered	02/03/2000	Bitumen pre-mix or hot-mix production	1	693m	North West
127	WYETH AUSTRALIA PTY LIMITED	323-329 WOODPARK ROAD, SMITHFIELD, NSW 2164	Surrendered	09/02/2000	Hazardous, Industrial or Group A Waste Generation or Storage	1	726m	South West
127	WYETH AUSTRALIA PTY LIMITED	323-329 WOODPARK ROAD, SMITHFIELD, NSW 2164	Surrendered	09/02/2000	Pharmaceutical and veterinary products production	1	726m	South West

Former Licensed Activities Data Source: Environment Protection Authority  
© State of New South Wales through the Environment Protection Authority

# UPSS Sensitive Zones

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145



## Historical Business Directories

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145

### 1991 Business to Business Directory Records

Records from the 1991 UBD Business to Business Directory within 150m of the site:

Business Activity	Organisation	Address	Ref No.	Location Confidence	Distance	Direction
N/A	No records in buffer					

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

### 1991 Business Directory Motor Garages & Service Stations

Motor Garages & Service Stations from the 1991 UBD Business Directory within 1km of the site:

Business Activity	Organisation	Address	Ref No.	Location Confidence	Distance	Direction
Motor Garages & Service Stations	Shell Greystones Self Service	661 Merrylands Rd., Greystanes	53855	Premise Match	914m	East

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

## Historical Business Directories

**Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145**

### 1970 Business Directory Records

Records from the 1970 UBD Business Directory within 150m of the site:

Business Activity	Organisation & Premise	Ref No.	Location Confidence	Distance	Direction
N/A	No records in buffer				

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

### 1970 Business Directory Drycleaners & Service Stations

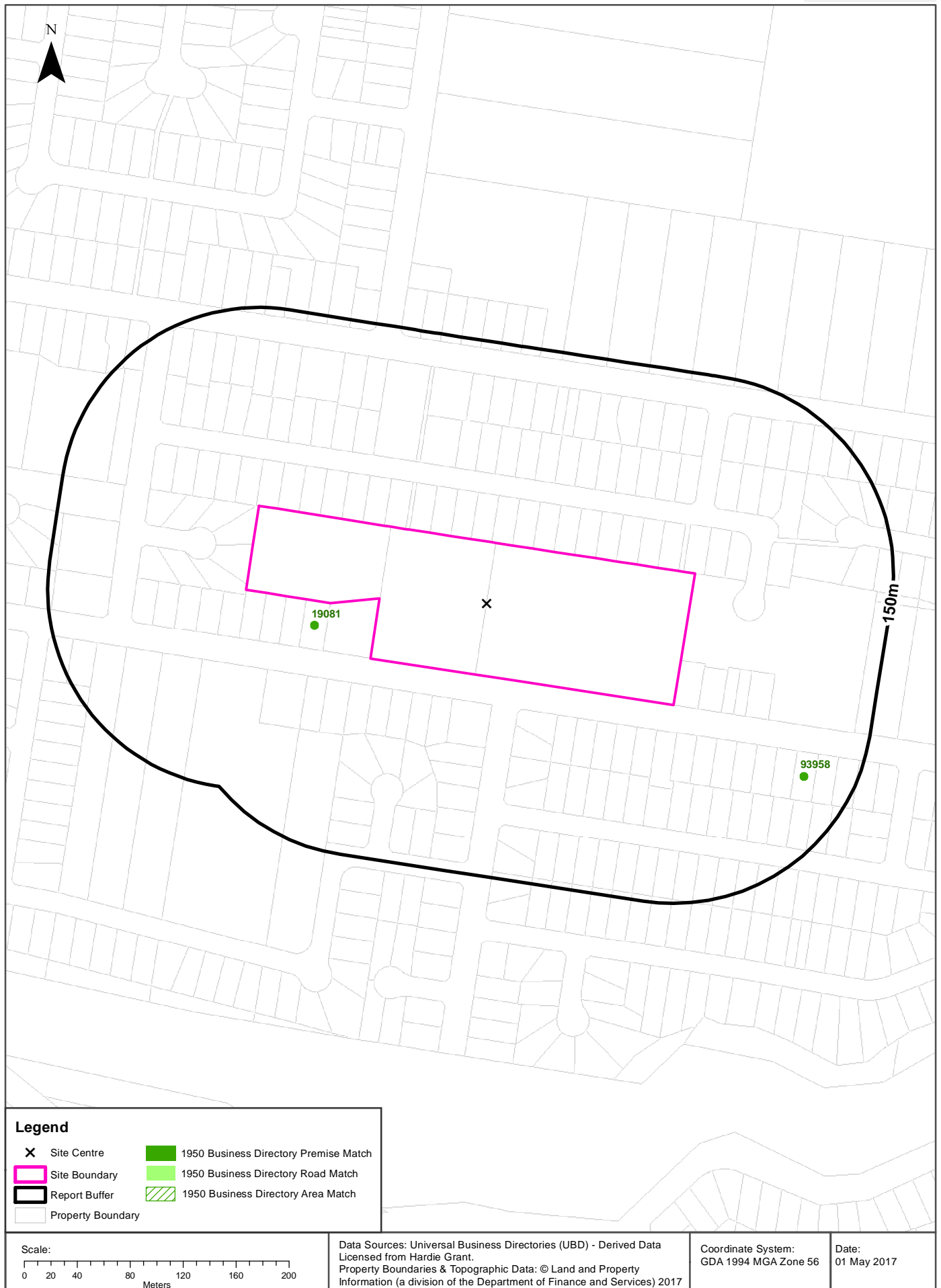
Drycleaners, Motor Garages & Service Stations from the 1970 UBD Business Directory within 1km of the site:

Business Activity	Organisation & Premise	Ref No.	Location Confidence	Distance	Direction
MOTOR GARAGES & ENGINEERS (M6S6)	Charles St. Service Station,250 Prospect Rd.PROSPECT	337563	Road Match	944m	North

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

# 1950 Historical Business Directory Records

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145



## Historical Business Directories

**Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145**

### 1950 Business Directory Records

Records from the 1950 UBD Business Directory within 150m of the site:

Business Activity	Organisation & Premise	Ref No.	Location Confidence	Distance	Direction
CARRIERS & CARTAGE CONTRACTORS	Hyslop, J. R., 789 Merrylands Rd., Greystanes	19081	Premise Match	16m	West
POULTRY FARMERS	Crabbe, H. L., 764 Merrylands Rd., Wentworthville	93958	Premise Match	110m	South East

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

### 1950 Business Directory Drycleaners & Service Stations

Drycleaners, Motor Garages & Service Stations from the 1950 UBD Business Directory within 1km of the site:

Activity	Organisation & Premise	Ref No.	Location Confidence	Distance	Direction
N/A	No records in buffer				


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

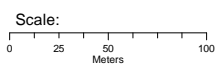
# Aerial Imagery 2014

Greystanes Public School, 781 Merrylands Road, Greystanes, NSW 2145



### Legend

-  Site Boundary
-  Buffer 150m



Data Sources: Historical Aerials: © Land and Property Information (a division of the Department of Finance and Services)

Coordinate System: GDA 1994 MGA Zone 56

Date: 01 May 2017

© Land and Property Information 2015