



Rhodes East Priority Investigation Area

RobertsDay

Contamination and Acid Sulphate Soils Report

FINAL

15 December 2016



Rhodes East Priority Investigation Area

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Executive Summary

Jacobs was engaged by RobertsDay to undertake a Contamination and Acid Sulfate Soils (ASS) assessment as part of a project to examine a potential rezoning of the Rhodes East Priority Investigation Area (hereafter referred to as the Investigation Area). RobertsDay are undertaking the project for the Department of Planning and Environment (DP&E) and the City of Canada Bay Council (Council).

State Environmental Planning Policy no. 55 – Remediation of Land (SEPP 55) and Council's Contaminated Land Policy require the planning authority to consider contamination issues in zoning and rezoning proposals. The planning authority must be satisfied that the land is suitable, or can be made suitable, for the proposed land uses. Where remediation is required to make the land suitable for the proposed uses, the planning authority must be satisfied that sufficient controls are in place to ensure remediation is undertaken.

In relation to ASS, risk maps are included in the Canada Bay Local Environmental Plan (LEP). Dependant of the risk identified in areas covered by the maps and the works proposed, an ASS management plan may be required to manage the potential risks associated with the soils during certain construction activities.

The objectives the Contamination and ASS assessment were:

- To identify and document the potential for contamination, based on a review of historical activities in the Investigation Area as well as previous investigation reports;
- To comment on the suitability of the land for the proposed land uses including the potential for the land to be made suitable through remediation and any areas not suitable for development;
- To review existing information on ASS risks in order to identify areas which are not suitable for development and other likely mitigation measures; and,
- Where information gaps are identified, to recommend additional investigations or other mitigation measures to be incorporated in to the LEP and / or Development Control Plan (DCP).

The review focussed on the area currently zoned industrial (IN1) within the Investigation Area. This area is hereafter referred to as "the site". However a high level assessment of contamination issues was also performed across the remainder of the Investigation Area.

Jacobs has undertaken a review of historical aerial photographs, historical land titles, historical Universal Business Directory (UBD) listings, historical information supplied by Council and public registers maintained by the NSW EPA. Based on the information reviewed, Jacobs identified the following Areas of Environmental Interest (AEI) in relation to contamination in the Investigation Area:

AEI 1: Reclaimed land north of Leeds Street prior to 1928

AEI 2: Sawmill and timber activities in the current industrial area from approximately 1912 to 1972

AEI 3: Historical power station at Uhrs Point from 1914 to sometime between 1961 and 1972

AEI 4: Reclaimed land in the northern portion of 1 – 3 Leeds Street between 1961 and 1972

AEI 5: Industrial activities in the current industrial area after approximately 1972

AEI 6: Industrial activities at 14 Cavell Avenue

AEI 7: Land contamination from asbestos containing materials.

The historical saw mill activities across the current industrial area (AEI 2) may have included the use of timber treatments such as creosote or CCA (Copper, Chromium and Arsenic) and the reclamation of the northern portion of 1 – 3 Leeds Street (AEI 4) may have involved the use of waste material. Reclamation of the former Allied Feed Mills site on the western side of the railway was ongoing at approximately the same period when reclamation activities were being undertaken on the site and involved the use of dioxin contaminated waste from

the Timbrol / Union Carbide site also on the western side of the railway. These AEI were considered to present a high risk with the potential to impact on the viability of the rezoning proposal and therefore a preliminary soil and groundwater investigation was carried out for the site.

The objective of the soil and groundwater investigation was to identify contamination issues that may have a material impact on the rezoning investigation. Material impacts were considered to be contamination issues that could preclude certain uses of the land, significantly extend the timeframe for development or potentially compromise the economic viability of the proposed land use. The purpose of the investigation was not to identify all contamination that may be present across the Rhodes East Investigation Area. Additional investigations and risk assessment will be required as part of each future development application in accordance with SEPP 55 and Council's Contaminated Land Policy.

The investigation involved soil sampling at 16 locations and groundwater sampling at eight locations across the site. Sampling locations were limited to external areas (i.e. accessible areas around existing building footprints) in order to minimise disturbance to site occupants. The sampling locations were selected to target the identified high risk AEIs and provide spatial distribution across the site (limited by access to accessible areas around existing footprints).

Soil and groundwater samples were analysed for potential contaminants of concern and the analysis results were compared against Site Assessment Criteria (SAC) developed from NSW EPA endorsed guidance. The SAC for soil were based on residential land use. The SAC for groundwater were based on the Australia and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Research Management Council of Australia and New Zealand (ARMCANZ), Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) (ANZECC Guidelines). Groundwater investigation levels for marine water and for slightly to moderately disturbed systems were adopted for this investigation.

The soil and groundwater investigation identified concentrations of dioxins, heavy metals, Total Recoverable Hydrocarbons (TRH) and Benzo(a)pyrene in fill samples which exceeded the adopted SAC at two locations (BH06 and BH07), both located in the northern portion of the properties at 1 – 3 Leeds St (i.e. the area reclaimed between 1961 and 1972). Concentrations of dissolved metals (Copper, Lead, Nickel and Zinc) in groundwater were also identified to exceed the SAC at certain locations.

While further investigation, risk assessment and potentially remediation (including management measures to reduce risks) are recommended to be required as part of any future development application process for a change in use of each property, the contaminant concentrations in soil and groundwater identified during this investigation are not considered to present a significant constraint to the future use of the land, have a significant impact on the overall timeframe for redevelopment or have a significant impact on the economic viability of the proposed redevelopment.

In terms of SEPP 55, based on the investigations performed by Jacobs and provided further investigation and assessment is required through the development application process, it is considered likely that the area currently zoned IN1 can be made suitable for residential and public open space use.

There are no specific requirements relating to contamination or remediation in the Canada Bay Local Environmental Plan 2013. However Council's Development Control Plan, Section 3.4, sets out requirements for development proponents to undertake an initial evaluation of land for the potential for contamination. If contamination is, or may be present, an investigation is required. The DCP also references the Council Contaminated Land Policy which provides more details on the contaminated land assessment process for the determination of development applications.

No changes to the current DCP controls and measures in the Council Contaminated Land Policy are considered necessary.

It is noted that in addition to the land currently zoned IN1, further evaluation of potential contamination at the property at 14 Cavell Avenue is recommended with any future development application that proposes a change to a more sensitive land use at this property.

The ASS maps within the LEP identifies that all land within the Investigation Area is either Class 2 or 5. The LEP sets out requirements for an ASS management plan for certain types of work. These requirements are also referenced in the Council DCP.

No changes to the LEP or DCP controls in relation to ASS are considered necessary.

While there is the potential for ASS management requirements to add cost to development activities within the Investigation Area, particularly within the Class 2 area, these requirements are considered unlikely to restrict development.

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Important note about your report

The sole purpose of this report is to present the findings of a Contamination and Acid Sulfate Soils Assessment undertaken by Jacobs for RobertsDay ('the Client') in connection with the Rhodes East Priority Investigation Area.

This report was produced in accordance with and is limited to the scope of services set out in the contract between Jacobs and the Client.

All reports and conclusions that deal with sub-surface conditions are based on interpretation and judgement and as a result have uncertainty attached to them. You should be aware that this report contains interpretations and conclusions which are uncertain, due to the nature of the study. No study can investigate every risk, and even a rigorous assessment and/or sampling programme may not detect all problem areas within a site.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context. This report has been prepared on behalf of, and for the exclusive use of, the Client, and is subject to and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

Jacobs was engaged by RobertsDay to undertake a Contamination and Acid Sulfate Soils (ASS) assessment as part of a project to examine a potential rezoning of the Rhodes East Priority Investigation Area. RobertsDay are undertaking the project for the Department of Planning and Environment (DP&E) and the City of Canada Bay Council (Council).

The Rhodes East Priority Investigation Area covers the land bounded by the Parramatta River, Mary Street and the Northern Rail Line (see **Figure 1**). This is hereafter referred to as the "Investigation Area".

This report outlines the objectives, scope of work, findings and recommendations from the assessment.

1.1 Background

The Rhodes peninsula has a long history of industrial development and the land in the northern part of the Investigation Area continues to be zoned for industrial use.

State Environmental Planning Policy no. 55 – Remediation of Land (SEPP 55) requires Council to consider contamination issues in zoning and rezoning proposals. Council's Contaminated Land Policy (April, 2008) states that "Council will not include land in a zone that would permit a change of use of the land from the existing use unless:

- Council has considered whether the land is contaminated;
- If the land is contaminated, Council is satisfied that the land is suitable in it's contaminated state (or will be suitable after remediation) for all the purposes for which land in the zone concerned is permitted to be used; and,
- If the land requires remediation to be made suitable for any purpose for which the land in that zone is permitted to be used, Council is satisfied that the land will be so remediated before the land is used for that purpose. (eg. satisfied by provisions in Local Environmental Plan or Development Control Plan that contamination issues will be addressed at Development Application stage)."

Leeds Street, Rhodes is defined as a Strategic Foreshore site under the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (SREP). Clause 41 of this plan prohibits development consent to be issued for development on a strategic foreshore site unless there is a master plan for the site and the consent authority has taken the master plan into consideration. Clause 46 of the SREP states that the master plan is to include a proposal for remediation of the site as appropriate.

The Canada Bay Local Environmental Plan 2013 (LEP) identifies areas of risk for ASS across the Investigation Area and provides measures to ensure that development does not disturb, expose or drain ASS and cause environmental damage.

The City of Canada Bay Development Control Plan 2013 (DCP) includes procedures for applicants for developments on known or potentially contaminated land or within potential ASS risk areas.

1.2 Objectives

The objectives of the contamination and ASS assessment were:

- To identify and document the potential for contamination, based on a review of historical activities in the Investigation Area as well as previous investigation reports;
- To comment on the suitability of the land for the proposed land uses including the potential for the land to be made suitable through remediation and any areas not suitable for development;
- To review existing information on ASS risks in order to identify areas which are not suitable for development and other likely mitigation measures; and,

- Where information gaps are identified, to recommend additional investigations or other mitigation measures to be incorporated in to the LEP and / or DCP.

1.3 Scope of work

Our scope of work for the assessment was detailed in the proposal from RobertsDay to DP&E and Council dated 13 November, 2015 as well as our supplementary proposal for a soil and groundwater investigation dated 15 April, 2016.

This scope initially included the following items:

- Review of Council's Contaminated Land Policy, LEP and DCP as well as information supplied by Council such as section 149 certificates, historical development applications, contamination investigation and remediation reports,
- Interview with Council staff responsible for contamination and ASS,
- Review of historical aerial photographs (approximately one photo per decade from 1930 to present),
- Review of historical title search findings within the current industrial zoned land. This included the strata plans on four of the properties within this area,
- Review of Universal Business Directories (UBD) from 1950, 1970 and 1991,
- Review of NSW EPA Contaminated Land Public Record, List of Contaminated Sites Notified to the EPA and Protection of Environmental Operations (POEO) Public Register for Licensed Premises,
- Review of topographical and geological maps and the Department of Primary Industries (DPI) register of water bores,
- Review of the current Canada Bay LEP, DCP and any other relevant reports supplied by Council in relation to ASS risk in the area,
- Site visit in order to review current activities in the industrial area and collect additional information on the site setting.

The review focussed on the area currently zoned industrial (IN1) within the Investigation Area. This area is hereafter referred to as "the site". However a high level assessment of contamination issues was also performed across the remainder of the Investigation Area. Furthermore, the potential for contamination of surface water and sediments in the Parramatta River, where it abuts the industrial zoned land in the Investigation Area, was also considered.

Based on the findings of the initial work, Jacobs was engaged to undertake a soil and groundwater investigation within the area currently zoned industrial (IN1). The scope of work for this investigation included the following items:

- Advancement of boreholes using a direct push drill rig at 16 locations and the collection of soil samples at these locations,
- Installation of groundwater wells in nine (9) of the boreholes and collection of groundwater samples,
- Laboratory analysis of selected soil and groundwater samples for potential contaminants of concern,
- Assessment of the soil and groundwater data against NSW EPA endorsed risk screening criteria.

2. Environmental setting

2.1 Topography and hydrology

There is a high point with an approximate elevation of 20 m Australian Height Datum (AHD) around the central western part of the Investigation Area. The ground then slopes down to the Parramatta River. There is a rock cutting around the properties at the eastern end of Leeds Street on the southern side of the street. A topographical contour map of the Investigation Area is provided as **Figure 1**.

Surface water across the Investigation Area would generally flow to the Council drainage network before discharging to Parramatta River at numerous discharge points. Besides Parramatta River, there are no other natural surface water bodies within or adjoining the Investigation Area.

2.2 Geology and hydrogeology

The “Sydney Soil Landscape Series Sheet 9130” map produced by the Soil Conservation Service of NSW indicates that soils within the Investigation Area are within the Blacktown soil landscape grouping. The landscape in this grouping is characterised as gently undulating rises to steep low hills on Wianamatta Group shales and Hawkesbury sandstone. Soils are characterised as shallow to moderately deep (<100cm) Red and Brown Podzolic Soils on crests, upper slopes and well drained areas; deep (150-300cm) Yellow Podzolic Soils and Soloths on lower slopes and in areas of poor drainage.

The “Sydney Geological Series Sheet 9130, 1:100,000 scale” map produced by the Geological Survey of NSW indicates that geology in the Investigation Area consists of Wianamatta Group Hawkesbury Sandstone (Rh) which is overlain by Ashfield Shale (Rwa) in the more elevated areas away from the Parramatta River.

Actual groundwater flow direction and depth to groundwater was not detailed in the available information reviewed. Regional groundwater flow is likely to generally follow topography and flow towards the Parramatta River. In relation to the area currently zoned IN1, regional groundwater flow is likely to flow from south to north. Sub-surface structures may influence localised flow patterns. Perched groundwater beneath the site is likely to exist within fill materials (where present) and weathered residual soils above the regolith.

A review of the DPI register of water bores determined that there were no registered bores in the Investigation Area. The nearest registered bores to the Investigation Area were:

- A cluster of bores registered as monitoring wells located in Anderson Park, close to the ferry wharf on the opposite side of Parramatta River, approximately 300 meters north east of the Investigation Area boundary.
- Several registered bores at Wentworth Point, approximately 750 meters west of the Investigation Area boundary. These are noted to be monitoring wells.
- A registered bore to the west of the intersection of Oulton Ave and Homebush Bay Drive approximately 800 meters south west of the boundary of the Investigation Area. This is noted as a test irrigation well, installed to a depth of 180 meters below ground level.

Sydney Water supplies potable water throughout the Investigation Area. None of the information reviewed by Jacobs indicates that there is any beneficial use of groundwater in the Investigation Area.

3. Current land use

Current land use zoning for the Investigation Area according to the Canada Bay Local Environmental Plan 2013 (LEP) is presented on **Figure 2**.

The area zoned General Industrial IN1 is predominantly used for commercial and light industrial activities including offices, warehousing and logistics. One café was also observed within the area zoned IN1.

Searches of Google Maps and Yellow Pages indicated the following potential contaminating activities currently being undertaken within the Investigation Area:

- a) One vehicle service workshop: MRT Performance, located on the corner of Averill Street and Concord Road
- b) No dry cleaning activities
- c) No petrol stations.

The property at 14 Cavell Ave (Lot 50, DP747036) is located in the area currently zoned Low Density Residential (R2). The property is currently used by a company trading as Roman Autotek Australia Pty Ltd. Based on the company's website, this appears to be an automotive products business. This property is further discussed in Section 4.

According to their website, Derivan Pty Ltd operates a paint production facility at Unit 4/23 Leeds St, Rhodes. The website indicates that the facility was commissioned in 2009.

Jacobs performed a search of the POEO Act Public Register. Only one site within the Investigation Area was listed in the register.

Davies, Campbell & De Lambert Pty. Limited (trading as Davies Campbell De Lambert Pathology) held an Environment Protection License (License 6049) for a site at 2 Leeds Street, Rhodes. The license was to permit a scheduled waste activity and permitted the generation and storage of up to 100 tonnes per year of clinical and related wastes (R100).

The first annual return for this license was submitted for 1999 and the last return was submitted in 2007. The license is no longer in force.

4. Historical activities

Jacobs has undertaken a review of information on historical activities in the Investigation Area in order to identify activities that may have resulted in soil and groundwater impacts. The information reviewed from each source and our findings from this review are presented below.

4.1 Council's website

Council's website includes various pages on the history of Rhodes. The information indicates that industrial development of the Rhodes peninsula commenced with the establishment of the NSW State Sawmill in the early 1900s. This was located to the north of Leeds Street within the Investigation Area.

Aerial photos from 1928 supplied by Council and from the State Library are presented below (Photos 1 and 2). The sawmill site in the north of the Investigation Area and the John Darling & Son flour mill on the northern end of the western side of the Rhodes Peninsula can be seen. The flour mill is discussed further below. It is noted that the northern portion of the sawmill site appears to have already been reclaimed from Parramatta River at this point.



Photo 1: Rhodes Peninsula in 1928 (photo taken towards the south west) (City of Canada Bay Council Image Library)

Information from the NSW Government Gazette dated 28 October, 1914 and 19 September, 1922 obtained by GBA Heritage indicates that there was a State Power Station at Uhr's Point which received the major portion of sawmill waste and also had facilities for use of coal. The station appears to have been developed in 1914. A stack can be seen in Photos 2 and 3 which may have been associated with this power station. The power station appears to have been located on the land currently known as Lots 19 and 20 DP239579 (4 and 2 Leeds St).



Photo 2: Rhodes Peninsula in 1928 (photo taken towards the east) (sourced from State Library by GBA Heritage). Stack possibly associated with the State Power Station is shown in red circle.

The NSW State Sawmill site was later purchased by H. McKenzie, timber merchants and joiners who continued on the site until 1969. A photo of the H.McKenzie site is provided below.



Photo 3: H.McKenzie Limited Timber Merchants circa 1969 (sourced from State Library by GBA Heritage). Stack possibly associated with the State Power Station is shown in red circle.

The Tulloch's Phoenix Iron Works relocated from Pyrmont to an area between the Northern Rail Line and Concord Road, to the south east of the train station (just south of the Investigation Area). The Iron Works closed in 1974 and the land was redeveloped for the Rhodes Corporate Park.

The John Darling & Son flour mill was established in 1919 at the northern end of the Rhodes Peninsula on the western side of the railway. This was taken over by Allied Feed Mills Pty Ltd in 1963.

Further south of the Allied Feed Mills site, also on the western side of the railway, Timbrol Limited, a timber preservative manufacturer, was established in 1928. According to the report on the “Redevelopment and Remediation of the Rhodes Peninsula” prepared by the Standing Committee on State Development dated June, 2002, Timbrol used waste coal tar oils from the Australian Gas Light (GL) gasworks at Mortlake to produce timber preservatives and other products. In 1949, Timbrol commenced the production of various chlorinated herbicides which resulted in by-products containing dioxins, furans, organochlorines, phenols and several metals.

In 1957 Timbrol merged with Union Carbide and became a major producer of chemicals, such as pesticides and herbicides, as well as extruded polyethylene film.

G. & C. Hoskins established a pipeworks on the western side of the railway, south of Mary Street in 1911. CSR Chemicals Ltd purchased the site from Hoskins in 1943 and produced acetic anhydride and cellulose acetate developed in response to war needs.

Lewis Berger & Sons (Australia) Pty Ltd was a major industry which began production in Alfred Street Rhodes in 1917 on the western side of the railway.

Rider & Bell Pty Ltd commenced operations at 14 Cavell Ave in 1920 (within the area currently zoned R2 Low Density Residential in the Investigation Area). The Universal Business Directory from 1950 (See Section 4.4) also listed this business at 83 Blaxland Rd, the property adjacent to 14 Cavell Ave. The company produced metal products such as automotive components, fishing and gardening equipment and brass firemen’s helmets.

Most of the industry located outside of the Investigation Area closed operations from the 1980s. Large scale remediation of the areas on the western side of the railway and to the south of the Investigation Area was performed from the 1980s to 2000s in order to enable commercial and residential development. This included the remediation of dioxin contaminated waste that was used to reclaim land from Homebush Bay as well as the partial remediation of dioxin contaminated sediments in Homebush Bay.

4.2 Historical aerial photographs

Jacobs obtained historical aerial photographs of the Investigation Area from Land & Property Information. The photos obtained were from 1930, 1943, 1955, 1961, 1972, 1982, 1991, 2000 and 2009. The photos are presented in Figures 3 to 12. Comments from our review of the photos are provided in Table 1 below. Comments on ownership for specific properties is based on information from the historical titles search discussed further in Section 4.3.

Table 1 : Comments following review of historical aerial photographs

| Year | Comments on area currently zoned IN1 | Comments on surrounding areas |
|------|--|---|
| 1930 | Based on the historical title search the land was owned by the NSW Minister for Public Works except for the land in the western area of IN1 (property 1 on Figure 1) which was owned by A&E Ellis. The photo quality is poor. However it indicates areas of timber storage across the northern part of the IN1 area. It is assumed that this was the NSW State Sawmill apart from the land owned by A&E Ellis which, based on the UBD for 1950 (Section 4.4 below) was also a timber business. There are several buildings in the area and a large open space. There are wharf structures protruding into the Parramatta River in the north east corner of the area. The shoreline along the northern part appears to have been modified through land reclamation. The stack that is suspected to have been associated with the power station at Uhr's Point appears to be present (area now indicated as properties 14 and 15 on Figure 3). | The remainder of the Investigation Area appears to be low density residential with some open space. The railway line is visible. The John Darling & Son Flour Mill is visible at the northern end of the peninsula on the western side of the railway. |
| 1943 | No significant change apparent in the photo. At this time, ownership of the land occupied by the NSW State Sawmill had been transferred to H. McKenzie Limited (continued timber storage activities). The land on the western part of IN1 continued to be owned by A&E Ellis. | Concord Road and the Ryde Bridge across the Parramatta River had been constructed. Some further residential development in the Investigation Area. The Timbrol Limited site is apparent on the western side of the railway, south of the John Darling & Son site. Reclaiming of the land in Homebush Bay is also apparent. This is understood to have occurred through the construction of a sea wall and then infilling of the ponds. A pond is apparent in the photo. |
| 1955 | Buildings in the western part of the area had been demolished and there appear to be cranes in this area. This land was still owned by A&E Ellis. Further modification of the Parramatta River foreshore was ongoing. Storage of timber ongoing. | The John Darling & Sons site had expanded southwards and reclamation works on the Timbrol site appears to be complete. Some further low density residential development apparent in former open space within the Investigation Area. |
| 1961 | The area appears to continue to have been used for timber storage. Some additional buildings had been constructed in the area owned by H.McKenzie Limited. Land in the south-east corner of the area (property 16 in Figure 3) which appeared to be previously undeveloped now appears to have several buildings. This land was still owned by H.McKenzie Limited. Properties 2 and 3 in Figure 3 had been transferred from A&E Ellis to other companies and may now have other uses. | Reclamation of land in Homebush Bay for the John Darling & Sons site appears to be ongoing. A sea wall had been constructed and ponds are present. |

| Year | Comments on area currently zoned IN1 | Comments on surrounding areas |
|------|--|---|
| 1972 | <p>The H.McKenzie Limited operations had closed in 1969. An extension to Leeds Street, east of Cavell Avenue had been constructed and the properties to the north, south and east of this extension appear to have been redeveloped. Properties 4, 10 and 12 on Figure 3 appear to have been substantially vacant in the 1972 photo. Works along the Parramatta River foreshore had been undertaken and some reclamation of land in the north east portion of the industrial area had been performed. A new building appears to be under construction on the area of Property 13 in Figure 3.</p> <p>The area where the suspected Uhr's Point power station was located (properties 14 and 15 on Figure 3) had been redeveloped.</p> | <p>The John Darling & Sons sites was taken over by Allied Feed Mills in 1963 and the 1972 photo indicates that partial filling of the ponds at this site appears to have been undertaken.</p> |
| 1982 | <p>Redevelopment of the former A&E Ellis site (Property 1 on Figure 3) appears to have been undertaken with large buildings now present. Large buildings are also now present on the land noted as Property 4 on Figure 3. Properties 10 and 12 on Figure 3 appear to still be vacant. The building at Property 13 on Figure 3 appears to have been completed.</p> | <p>Reclamation work at the Allied Feed Mills site appears to have been completed.</p> |
| 1991 | <p>New industrial/commercial scale buildings on the previous open space at Properties 10 and 12 on Figure 3 appear to have been completed.</p> | <p>The Union Carbide site (formerly Timbrol) on the western side of the railway had been demolished and earthworks appear to be underway. Duplication of the Ryde Bridge and upgrades to Concord Road had been completed.</p> |
| 2000 | <p>The photo indicates that at least new roofs were installed on the buildings at the properties labelled 21, 22 and 23 on Figure 3. Properties 21 and 22 were owned by Aldridge Traffic Systems Pty Ltd at the time and Property 23 was owned by Aldridge Group Pty Limited.</p> | <p>The Allied Feed Mills site on the western side of the railway had been demolished and land appears vacant.</p> |
| 2009 | <p>The roofs on several buildings appear to have been replaced. Changes to the buildings on the Property 13 on Figure 3 appear to have been made.</p> | <p>Substantial redevelopment of the western side of the railway ongoing.</p> |

4.3 Historical property titles

Jacobs engaged Advanced Legal Searches Pty Ltd to perform historical title searches for all properties located within the area currently zoned IN1. The reports from the searches are provided in **Appendix B**.

Jacobs has reviewed the reports and provides the following comments:

- The historical titles for several of the properties indicate land along the north of the IN1 area was reclaimed from Parramatta River. The approximate historical shoreline is shown on Figure 4. The reclaimed land was owned by the Maritime Services Board and leased to the adjacent land owners until approximately 1972 when the reclaimed area became part of the adjacent property lots.

- The land in the western part of the area currently zoned IN1 (Properties 1, 2 and 3 in Figure 3) appears to have been owned by private persons until 1913, when it was acquired by A&E Ellis Pty Ltd. A&E Ellis owned the land noted as Property 1 until 1972 and the land noted as Properties 2 and 3 until 1933. Jacobs was not able to obtain information on A&E Ellis activities but the historical aerial photos indicate storage of timber on the site and the UBD for 1950 (see Section 4.4) indicates an association with the Millars' Timber & Trading Co. Ltd.
- The remaining land in IN1 (ie. Properties 4 – 24 on Figure 3) was also owned by private persons until it was acquired by the NSW Minister for Public Works in 1912. While not confirmed, Jacobs assumes that the land was acquired by the NSW Minister for Public Works to establish the NSW State Sawmill. This land was sold to H. McKenzie Ltd in 1924. Information on Council's website indicates that H. McKenzie Ltd was a timber merchants and joiners business. The UBD for 1950 (see Section 4.4) indicates that H. McKenzie Ltd may also have been associated with the business Millars' Timber & Trading Co. Ltd.
- From approximately 1969 – 1972, the land zoned IN1 was sold to various parties, many of which appear to be property development companies and light industrial businesses. The land owned by H. McKenzie Ltd was sold to Newcastle Guarantee Corporation in 1969.

4.4 Historical business directories

Jacobs engaged Lotsearch Pty Ltd (Lotsearch) to conduct a search of businesses in the UBD for 1950, 1970 and 1991. The business to business directory search was limited to the area zoned IN1 plus a 150m buffer while the search of dry cleaners, motor garages and service stations was limited to within the area zoned IN1 plus a 1km buffer.

The Lotsearch report is provided in **Appendix C**.

Findings from the Jacobs review of the Lotsearch report are summarised as follows:

- The 1950 UBD records include the company Rider and Bell at 83 Blaxland Road, Rhodes. The company is listed under the business activities of "Engineers" and "Metal Presses and Stampers". As noted in Section 4.1, Rider and Bell also operated at the adjacent property at 14 Cavell Ave (Lot 50, DP747036).
- The 1950 UBD records include H. McKenzie Ltd at Averill Street, Rhodes and A7E Ellis Pty Ltd at Uhres Point, Rhodes. This was discussed in Section 4.3.
- One dry cleaner and no motor garages or service stations were identified in the 1950 UBD. The dry cleaner was located at 29 Bank Street, Meadowbank, approximately 800 meters north of the Investigation Area.
- A&E Ellis Pty Ltd and Rider and Bell were also listed in the UBD for 1970.
- No dry cleaners, motor garages or service stations were identified within the Investigation Area in the 1970 UBD.
- The 1991 UBD included a number of registered businesses within the area zoned IN1. While the businesses have been listed under various Business Activities, the specific activities performed by each entity at the site in Rhodes have not been determined.
- No motor garages or service stations were identified within the Investigation Area in the 1991 UBD. Dry cleaner information was not available for this year.

4.5 Council property cards

Council provided a number of property cards for properties located within the area zoned IN1. These cards provide information on historical inspections of the properties conducted by Council Officers. Most of the annotations related to inspections performed in the 1970s and 1980s.

The cards indicate that the activities in the area zoned IN1 consisted primarily of warehousing and distribution as well as other light industrial activities. Specific manufacturing activities identified on the cards are summarised as follows:

- The card for 11 Averill Street (Property 25 on Figure 3) indicates a historical development application for the construction of a factory for the compounding, mixing, packaging and handling of liquid cleaning products (DA 47/70).
- The card for 17 Leeds Street (Property 7 on Figure 3) indicates a historical development application for Lithographic Printing and Book-binding (DA 78/71).
- The card for 27 Leeds Street (Property 1 on Figure 3) indicates a historical development application at Units 4 and 5 for the manufacture and warehousing of central heating equipment (DA 31/74). This card also indicates a historical development application at Units 1 and 2 for manufacture and warehousing of power distribution and control equipment and heavy duty magnetic shoe brakes (DA 109/73).

5. NSW EPA contaminated land registers

Jacobs conducted a search of the following NSW EPA public registers:

- List of NSW contaminated sites notified to the EPA. Sites within 1km of the Investigation Area are presented in **Table 2**.
- Contaminated Land Management Record of Notices. Sites within 1km of the Investigation Area where notices have been issued are listed in **Table 3**.

Table 2 : Contaminated sites notified to the NSW EPA within 1km of the Investigation Area

| Suburb/City | Site description and address | Activity that caused contamination | EPA site management class |
|-----------------|--|------------------------------------|---|
| RHODES | Former UCAL site (multiple) Walker STREET | Chemical Industry | Contamination being managed via the planning process (EP&A Act) |
| RHODES | Former Glad factory site 10-16 Marquet STREET | Chemical Industry | Regulation under CLM Act not required |
| RHODES | Homebush Bay sediments adjoining former Berger Paint factory Oulton AVENUE | Chemical Industry | Contamination currently regulated under CLM Act |
| RHODES | Former Allied Feeds site Walker STREET | Other Industry | Contamination being managed via the planning process (EP&A Act) |
| RHODES | Homebush Bay Sediments adjoining the former UCAL and Allied Feeds sites | Chemical Industry | Contamination currently regulated under CLM Act |
| CONCORD WEST | Caltex Service Station 369-375 Concord ROAD | Service Station | Under assessment |
| WENTWORTH POINT | RMS Eastern Precinct 3-7 Burroway ROAD | Other Petroleum | Regulation under CLM Act not required |

Table 3 : Sites within 1km of the Investigation Area listed in the Contaminated Land Management Record of Notices

| Suburb | Address | Site Name | Notices related to this site |
|---------|--------------------------|---|------------------------------|
| CONCORD | Nullawarra AVENUE | Concord RSL Club | 2 current |
| CONCORD | Nullawarra AVENUE | Majors Bay Reserve | 1 current and 1 former |
| RHODES | Walker STREET | Former Allied Feeds site | 7 former |
| RHODES | (multiple) Walker STREET | Former UCAL site | 13 current and 41 former |
| RHODES | Oulton AVENUE | Homebush Bay sediments adjoining former Berger Paint factory | 1 current and 10 former |
| RHODES | | Homebush Bay Sediments adjoining the former UCAL and Allied Feeds sites | 1 current and 4 former |
| RHODES | Mary STREET | Rhodes Waterside | 2 former |

The sites listed in Tables 2 and 3 are all located outside the Investigation Area and are considered unlikely to have impacted on soil, soil vapour or groundwater conditions within the Investigation Area.

6. Previous contamination investigations

Council conducted a search for previous contamination investigations within the area currently zoned IN1. This search identified the “Stage 1 Contamination Assessment for 27 Leeds Street, Rhodes” prepared by Molino Stewart Pty Ltd (Molino Stewart) for BH Australia Leeds 1 Pty Ltd dated January, 2010. BH Australia Pty Ltd is the current owner of the property and the Stage 1 Contamination Assessment was undertaken to support and application for rezoning of the property for residential use.

The Stage 1 Contamination Assessment included a review of historical aerial photographs, a review of historical titles for the property, WorkCover dangerous good license search and a site inspection. The assessment also included a review of a “Drilling and Contamination Investigation – 27 Leeds St, Rhodes” prepared by Johnstone Environmental Technology (JET) in 1993. This report was not available for review by Jacobs.

At the time of the Stage 1 Contamination Assessment, the property at 27 Leeds Street was leased by Angus & Coote for warehousing and distribution of jewellery products. Historical activities at the site were reported to include:

- A&E Ellis, operation of a saw-mill from 1912 to 1972;
- Cutler –Hammer Australia Pty Ltd (Units 1 & 2 from 1974 to approximately 1994 and Unit 3 from 1974 to approximately 1985), manufacture of transformers and other electrical equipment which involved the use of a large funnel and boiler which have since been removed from the site;
- Rayson Industries Pty Ltd (Units 4 & 5 from 1974 to approximately 1984), supplier of heating and cooling products, unknown if manufacturing occurred;
- Adfoam Industries Pty Ltd (Unit 1 from 1989 to approximately 2000), warehousing and light manufacture of polyethylene foam inserts; and,
- Angus & Coote Pty Ltd (Units 3-5 from 1985 to present, Unit 2 from approximately 1994 to present and Unit 1 from approximately 2000 to present), warehousing and distribution of jewellery products.

No chemicals or waste products were observed by Molino Stewart during the site inspection and no dangerous goods records were identified. The report stated that no Underground Storage Tanks (USTs) were known to exist at the site at present and in the past.

The Molino Stewart report notes that the land in the northern portion of the site was reclaimed from Parramatta River. The period when the reclamation work was carried out was not obtained but it was noted to have occurred prior to 1930, before reclamation work on the Allied Feed Mills and Union Carbide sites on the western side of the Rhodes Peninsula which used chemical waste for fill material.

The JET investigation in 1993 was reported by Molino Stewart to have involved drilling of boreholes at seven locations in the reclaimed land area. Fill material was typically stony clay, however in some locations there were bands of brick and sandstone rubble. No contamination odours were noted and no indications of volatile contamination were identified through field screening of soil samples using a Photo-ionisation Detector. Therefore JET concluded that there was no evidence of contaminated fill material being used at the site and no indications of the historical saw mill activities were noted within the area investigated. No laboratory analysis of samples was undertaken by JET.

Molino Stewart reported that the roof of the site building contained asbestos cement that had been recently inspected and deemed to be in good condition.

Molino Stewart concluded that historical activities at the site may have had the potential to cause contamination. These activities included the manufacture of electrical equipment (potential for Polychlorinated Biphenyls (PCBs)), manufacture of heating and cooling equipment and reclamation of the land using fill material of unknown source and quality. The need for further investigations of contamination at the site was acknowledged as part of the development assessment process.

7. Preliminary conceptual site model

7.1 Potential sources of contamination

Jacobs has identified seven Areas of Environmental Interest (AEI) within the Investigation Area based on the information reviewed and these are presented in **Table 4**. An assessment of relative risk is also presented for each AEI. This assessment is based on the potential risk for significant remediation measures to be required.

Table 4 : Identified Areas of Environmental Interest, potential contaminants of concern and qualitative risk level

| Area of Environmental Interest | Potential contaminants of concern | Risk level |
|---|---|------------|
| <p>AEI 1: Reclaimed land north of Leeds Street prior to 1928</p> <p>The northern portion of properties north of Leeds Street was reclaimed from the Parramatta River. No information on the period that this reclamation occurred, the source of the material used and the quality of this material has been obtained by Jacobs.</p> <p>It is noted that the reclamation appears to have occurred prior to 1928. Some of the historical reclamation activities at the former Timbrol / Union Carbide site in Homebush Bay, on the western side of the Rhodes Peninsula, involved the use of waste containing dioxins and other contaminants resulting in challenging and costly remediation works. The processes at the Timbrol site which generated these wastes did not start until 1949. Therefore the risk for dioxin contaminated waste to have been used to reclaim land in the main northern part of the Investigation Area is considered low. However there is the potential for other contaminants to be present in this fill material.</p> | Heavy metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAH), monocyclic aromatic hydrocarbons (BTEX) | Low |
| <p>AEI 2: Sawmill and timber activities in the current industrial area from approximately 1912 to 1972</p> <p>The area currently zoned IN1 was used for a sawmill and timber activities from approximately 1912 to 1972. Details of the activities performed in this period have not been obtained. There is a risk that chemical timber treatments were used.</p> | Creosote, copper, chromium, arsenic, phenols, dioxins | High |
| <p>AEI 3: Historical power station at Uhrs Point from 1914 to sometime between 1961 and 1972</p> <p>Information from the NSW Government Gazette indicates that there was a State Power Station at Uhr's Point from 1914 to sometime between 1961 and 1972. Based on the stack observed in historical photos, the station appears to have been located on land currently referred to as Lots 19 and 20 DP239579 (4 and 2 Leeds St). There is a risk for the presence of soil contamination in the area. However it is noted that these properties are currently at a significantly lower grade than the adjacent Concord Road and there is a rock cutting between these properties and the Concord Road corridor and therefore it is possible that contaminated soil from the power station, if any, may have been removed during the redevelopment of this area.</p> | Heavy metals, petroleum hydrocarbons, PAH | Moderate |

| Area of Environmental Interest | Potential contaminants of concern | Risk level |
|---|---|-----------------|
| <p>AEI 4: Reclaimed land in the northern portion of 1 – 3 Leeds Street between 1961 and 1972</p> <p>Additional land reclamation was undertaken in the north east corner of the land at 1 – 3 Leeds Street (Properties 12 and 13 on Figure 3) sometime between 1961 and 1972. The source of the material used for this reclamation is not known.</p> <p>Reclamation of land at the Allied Feed Mills site was also ongoing at this time. The reclamation work at the Allied Feed Mills site was undertaken by Union Carbide using fill material consisting mainly of a combination of spent lime and boiler ash, as well as imported fill and marine mud dredged from Homebush Bay. The lime fill contained high concentrations of chlorinated compounds including dioxins. It is possible that this material was also used to reclaim the north eastern portion of the Investigation Area.</p> | <p>Dioxins, heavy metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAH), monocyclic aromatic hydrocarbons (BTEX), polychlorinated biphenyls (PCB)</p> | <p>High</p> |
| <p>AEI 5: Industrial activities in the current industrial area after approximately 1972</p> <p>A broad range of light industrial activities have been undertaken in the current industrial area after the sawmill operations closed in approximately 1972. Detailed information on these activities has not been undertaken but there is the potential for soil and groundwater impacts to have occurred associated with the operation of these facilities.</p> | <p>Heavy metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAH), monocyclic aromatic hydrocarbons (BTEX), other volatile organic compounds (VOC), polychlorinated biphenyls (PCB)</p> | <p>Moderate</p> |
| <p>AEI 6: Industrial activities at 14 Cavell Avenue</p> <p>The property at 14 Cavell Avenue (Lot 50, DP747036) is located in the area currently zoned Low Density Residential (R2). However the property is currently used by a company trading as Roman Autotek Australia Pty Ltd. Based on the company's website, this appears to be an automotive products business. Historical information indicates that the property was previously used by Rider and Bell, an engineering workshop. The historical aerial photographs reviewed for this report indicate the current buildings on this property were constructed prior to 1961. There is the potential for the activities at the site to have impacted soil and groundwater.</p> | <p>Heavy metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAH), monocyclic aromatic hydrocarbons (BTEX), other volatile organic compounds (VOC), polychlorinated biphenyls (PCB)</p> | <p>Low</p> |
| <p>AEI 7: Land contamination from asbestos containing materials</p> <p>Asbestos containing materials were widely used in building construction in Australia from approximately the 1930s to the mid 1980s. Historical demolition practices may have resulted in waste material containing asbestos impacting soil.</p> | <p>Asbestos fragments and friable asbestos</p> | <p>Low</p> |

7.2 Potential receptors and exposure pathways

Potential receptors and exposure pathways for the identified Areas of Environmental Interest are summarised in **Table 5**.

Table 5 : Potential receptors and exposure pathways

| Potential receptors | Potential exposure pathways |
|--|--|
| Current site users (commercial / industrial) – Adult employees | Indoor and outdoor inhalation of vapours (volatile contaminants only) Indoor and outdoor inhalation of dust particles Dermal contact with dust particles Incidental ingestion of dust particles |
| Current off-site receptors (residential) – children and adults | Outdoor inhalation of dust particles |
| On-site terrestrial ecology receptors (vegetation and soil invertebrates) | Direct exposure to soil and groundwater contamination |
| Parramatta River (aquatic ecology and recreational users) | Erosion of contaminated soils and transport to the river Groundwater migration to the river |
| Future on-site receptors (potential for residential and recreational open space) – children and adults | Incidental ingestion of soil Indoor and outdoor inhalation of vapours (volatile contaminants only) Indoor and outdoor inhalation of dust particles Dermal contact with dust particles Incidental ingestion of dust particles |

We note that in assessing the potential exposure pathways, we have assumed the following:

- Off-site receptors are hydrogeologically upgradient of the area currently zoned IN1 and therefore not potentially at risk from groundwater contamination (if present) from this area.
- There is no current licensed or likely beneficial use of groundwater at the site and this is unlikely to occur in the future.

8. Soil and groundwater investigation

8.1 Introduction

The absence of soil and groundwater quality data across the area currently zoned IN1 and the potential presence of dioxins from the historical sawmill and timber activities (AEI 2) as well as the reclamation of land in the northern portion of 1 – 3 Leeds Street (AEI 4) were considered to present a significant risk to the rezoning proposal. Therefore a soil and groundwater investigation was undertaken across the area.

The objective of the investigation was to identify contamination issues that may have a material impact on the rezoning investigation. This could include contamination issues that may preclude the use of the land for certain uses, impact on the overall timeframe for redevelopment or impact on the economic viability of the proposed redevelopment.

The purpose of the investigation was not to identify all contamination that may be present across the Rhodes East Investigation Area. Additional investigations and risk assessment will be required as part of each future development application in accordance with SEPP 55 and Council's Contaminated Land Policy.

8.2 Methodology

A sampling plan was developed based on the Data Quality Objectives (DQO) outlined in **Appendix D**. No sampling was conducted in the southern part of the current industrial area (properties fronting Averill Street and Cavell Ave). These properties are at a significantly higher grade than the remainder of the area and historical aerial photographs indicate that the area was not utilised for the former saw mill activities. This area is also not likely to be associated with the identified land reclamation activities.

The sampling locations selected were all in outdoor areas and were selected to provide general spatial coverage of the area and enable an assessment of groundwater quality in areas estimated to be up-gradient and down-gradient of the AEI. Several sampling locations were positioned in the area of reclaimed land at 1 Leeds St and 3-5 Leeds St.

The sampling locations are presented on **Figure 13** in **Appendix A**. The sampling locations have also been overlain on the historical aerial photograph of 1961 (**Figure 14, Appendix A**) in order to show the locations in relation to historical activities and the former Parramatta River shoreline.

8.2.1 Soil sampling

Soil sampling was undertaken at sixteen boreholes (BH01 to BH16) using a direct push tube drill rig. Where refusal was encountered with the push tube, a solid flight auger was used to advance boreholes. Boreholes were terminated at approximately 2 m into natural soil, once bedrock was encountered or drill method refusal, whichever was shallower. The maximum depth of drilling during the investigation was 8m below ground level (bgl).

Soil samples were collected from the disposable push tube liners at approximately 0.5m intervals until termination of the boreholes or at other discrete locations such as changes in the soil profile or where there was evidence of potential contamination (odorous or discoloured soils, waste or fill). Samples were transferred to laboratory supplied sample jars with Teflon lined lids by Jacobs field staff using disposable nitrile gloves. Soil samples for asbestos analysis were collected in zip lock bags.

Field screening of the soil samples for volatile organic compounds (VOC) was undertaken using a Photo-ionisation Detector (PID).

All soil samples for the soil investigation were placed in jars provided by the primary laboratory Eurofins MGT (Eurofins). All sample jars were fitted with Teflon lined lids. Zip lock bags were used to for asbestos analysis. The jars and zip lock bags were completely filled with soil, labelled with the date, unique sampling point identification and sampler information.

The soil jars and zip lock bags once filled with sample and sealed, were immediately placed in an esky/cool box in which a cooling medium had been added to keep the samples below a temperature of approximately 4 °C. At the end of the sampling program the samples in the cool box were transported to the laboratory. Custody seals were placed on the esky / cool box for delivery to the laboratory.

8.2.2 Groundwater sampling

Nine groundwater monitoring wells (MW01, MW03, MW04, MW07, MW09 and MW12 to MW15) were installed to assess groundwater quality in the investigation area. The groundwater investigation comprised:

- Construction of groundwater wells using new, Class 18, 50 mm UPVC with machine slotted screen sections, filter pack (sand), bentonite seal and grout/bentonite to the surface. The wells were completed flush with the ground level with a gatic cover.
- Survey of the groundwater wells to site datum to allow for the estimation of groundwater flow gradients.
- Measuring of water levels within all wells to assess depth to groundwater.
- Development, purging and sampling of the wells.

Groundwater was not encountered during drilling works at location MW15. However a groundwater well was installed in the borehole in order to confirm whether groundwater was present. After allowing at least 24 hours following well installation, MW15 was found to be dry and no sampling of groundwater was carried out from this well.

The remaining wells were developed using a submersible pump. The wells were then allowed to stabilise for approximately 48 hours before being purged and sampled using a Micropurge pump. The pump had flow control to minimise drawdown and new dedicated, disposable bonded polyethylene tubing and bladders were used for the collection of each sample. Care was taken to minimise the potential for volatile losses during sampling.

The electrodes of a calibrated water quality meter were used to measure pH, redox potential (Eh), electrical conductivity, dissolved oxygen (mg/L and % saturation) and temperature in water purged from the wells. Samples were collected following stabilisation of these water quality parameters (generally $\pm 10\%$).

Laboratory supplied sample containers were used to contain the groundwater samples. Sample containers were filled in order of volatility, with samples for the most volatile substances collected first. Care was taken to minimise disturbance of the sample to avoid aeration by minimising the distance between the outlet tubing and the container and tilting the container so that discharge flowed gently down the inner walls. Samples for dissolved heavy metals in groundwater were field filtered using 0.45 micron single use stericups.

Once filled, the caps were checked to ensure that they were secure (and that there were no air bubbles/head space within the glass vials and bottles) then placed within an esky / cool box in which a cooling medium had been added to keep the samples below a temperature of approximately 4°C. Custody seals were placed on the esky / cool box for delivery to the laboratory.

8.2.3 Decontamination procedures

Soil samples were collected as grab samples from disposable push tube liners using new disposable nitrile gloves, changed between sample locations. When refusal was encountered with the push tubes, a solid flight auger on the drill rig was used to advance boreholes. The solid flight auger was scrubbed with a steel brush and rinsed with potable water between borehole locations. No soil samples were collected from the solid flight augers.

For the groundwater sampling, the submersible pump, bladder casing and Micropurge pump were decontaminated between groundwater well locations by washing with deionised water mixed with Decon 90 and then rinsed with deionised water. Dedicated, single use sample tubing and bladders were used to purge and to sample all wells. All samples were collected using new disposable nitrile gloves, changed between sample locations.

8.2.4 Reinstatement and waste management

Drill cuttings from the soil sampling boreholes were reinstated to the boreholes in the order they were excavated and the asphalt surface was reinstated. Waste drill cuttings from the boreholes where groundwater wells were installed as well as waste groundwater from the development and purging of the wells was placed in containers and disposed off-site by a licensed waste contractor. Jacobs prepared waste classification reports in accordance with the NSW EPA Waste Classification Guidelines (2014) to enable appropriate disposal of the waste.

8.3 Laboratory analysis

Soil samples were selected for analysis based generally on providing vertical and lateral coverage of the site, PID results and visual observations. The samples selected were generally from the fill material or upper layer of the underlying natural soil. Samples for asbestos analysis were generally selected from the upper fill material where waste building materials were observed in a number of locations.

Soil samples were analysed for the following potential contaminants of concern:

- 18 samples (16 primary + 2 QA/QC) for heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), Total Recoverable Hydrocarbons (TRH), monocyclic aromatic hydrocarbons (BTEXN), polycyclic aromatic hydrocarbons (PAH), Polychlorinated Biphenyls (PCBs) and speciated Phenols.
- 16 samples for asbestos (presence/absence)
- 13 samples for Dioxins and Furans
- Two samples for pH, cation exchange capacity (CEC) and % clay
- Two trip spike/trip blank for BTEX.

Groundwater samples were analysed for the following potential contaminants of concern:

- 10 samples (8 primary + 2 QA/QC) and 1 rinsate blank for dissolved heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), TRH, BTEXN, speciated Phenols and VOC.
- One trip spike/trip blank for BTEX.

Jacobs commissioned Eurofins MGT (Eurofins) as the primary laboratory and Envirolab Services (Envirolab) as the secondary laboratory. Eurofins and Envirolab are accredited by the National Association of Testing Authorities (NATA) for the testing undertaken.

Where appropriate, the samples were analysed in accordance with NEPC *National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended 2013* (NEPC, 2013) guidelines using methods based on US Environment Protection Agency (US EPA) and American Public Health Association (APHA) approved analytical methods.

8.4 Quality assurance and quality control evaluation

Quality assurance and quality control measures were implemented as part of the investigation in accordance with the DQO outlined in **Appendix D**. Jacobs has undertaken an assessment of the results of the quality control samples as well as the lab quality reporting. This assessment is presented in **Appendix E**.

The assessment concluded that the laboratory data are of acceptable quality and are considered useable in making conclusions and recommendations regarding the site.

8.5 Site assessment criteria

Jacobs compared the analytical test results against a set of soil and groundwater human health and ecological risk screening levels, referred to in this report as Site Assessment Criteria (SAC). The SAC have been set at levels that provide confidence that contaminant concentrations below the SAC will not adversely affect human health or terrestrial/aquatic ecosystems. It is noted that exceedance of the SAC does not necessarily indicate a need for remediation. The SAC indicate concentrations of contaminants above which further assessment and investigation may be required.

The SAC developed for the investigation were adopted from the National Environment Protection (Assessment of Site Contamination) Measure 1999 (as revised 2013) - *Schedule B1 Guideline on Investigation levels for Soil and Groundwater* (NEPC, 2013). The specific criteria adopted are described in **Appendix F**.

NEPC (2013) does not include investigation levels for dioxins in soil. Therefore Jacobs has derived a site specific investigation level based on the framework outlined in Schedule B4 of NEPC (2013). The derivation of the site specific investigation level for dioxins in soil is presented in **Appendix G**.

In addition to the SAC adopted for the assessment of human health and ecological risks, Jacobs has also assessed aesthetics factors. Aesthetics relates to the presence of observable odours, discoloration and erroneous wastes materials in soil which could possibly indicate contamination. Such olfactory evidence can point to how receptors can be impacted by vapours on and migrating from the site. Odour thresholds for organic substances can be exceeded in off-site settings (through groundwater transmission of hydrocarbons) and whilst may not represent a direct health risk, could possibly prompt civil action. Aesthetics was continually assessed during the investigation and reported on the borehole logs (where present).

8.6 Results

8.6.1 Site stratigraphy

The generalised site stratigraphy can be summarised from the surface to depth as follows:

- 1) Fill material varying in depth from approximately 1 meter in the southern portion of the site (BH11 and BH15) to approximately 4 meters in the areas close to the Parramatta River. The depth of fill was logged to approximately 5.8 meters below ground level (bgl) at BH12 in the central portion of the site. Fill material was observed to consist of silty clay or sand soils with some areas of gravel and crushed rock. Building material waste such as bricks, timber was observed in fill material in some locations.
- 2) Residual silty clay and clay soil with a thickness varying from not present in BH11 in the south eastern portion of the site to approximately 1 – 1.5 meters in the central portion and greater than 5 meters in north eastern portion of the site near Parramatta River. Shells were observed in the soil at several locations adjacent to Parramatta River.
- 3) Sandstone was encountered at depths ranging from 1 meter bgl in the south eastern portion of the site (BH11) to 6 to 7 meters bgl in the central and northern portions of the site. There was some variation in the boreholes adjacent to Parramatta River, potentially due to the reclamation of land in this area.

Borehole logs are presented in **Appendix H**.

8.6.2 Aesthetics

The fill material was observed to contain waste building materials (bricks, timber, bitumen and gravels) at several locations. It is considered unlikely that this would present a significant aesthetics issue.

No staining, discoloration or odours indicative of contamination were observed in any of the material generated during the investigation with the exception of a hydrocarbon odour observed at BH12. The odour was encountered when soil sampling at a depth of 5.3 to 5.5 meters bgl. Staining was also observed in the soil and a PID response of 119 parts per million (ppm) was recorded. A soil sample at this location was selected for laboratory analysis for TRH compounds and BTEXN.

8.6.3 Soil analytical results

Tables presenting the soil analytical results in comparison to the adopted SAC are presented in **Table A** in **Appendix I**. The full analysis reports from the laboratory are presented in **Appendix J**.

All analytical results for soil were below the SAC with the following exceptions:

- 1) Dioxin concentrations (expressed as sum of PCDD/F and PCB Toxic Equivalents (TEQ) WHO 2005) exceeded the Health Investigation Level (HIL) in three samples (Sample IDs: BH06_0.4-0.6, BH06_3.0-3.2 and BH07_3.6-3.8). The HIL for dioxins in soil derived by Jacobs was 120 ng/kg. Concentrations of dioxins in the two samples from BH06 were 143 ng/kg and the concentration in the soil sample from BH07 was 183 ng/kg. Dioxin concentrations in the remaining soil samples analysed ranged from 6 ng/kg to 66 ng/kg.
- 2) The reported concentration of Copper in sample ID BH07_3.6-3.8 was 78 mg/kg. The adopted (Ecological Investigation Level) EIL for Copper was 65 mg/kg. The maximum concentration of Copper in the remaining soil samples analysed was 32 mg/kg.
- 3) The reported concentration of Mercury in sample ID BH07_3.6-3.8 was 1.2 mg/kg. The adopted EIL for Mercury was 1 mg/kg. The maximum concentration of Mercury in the remaining soil samples analysed was 0.14 mg/kg.
- 4) The reported concentration of Nickel in sample ID BH06_0.4-0.6 was 35 mg/kg. This is equivalent to the EIL. The maximum concentration of Nickel in the remaining soil samples analysed was 12 mg/kg.
- 5) The reported concentration of Zinc in sample ID BH06_0.4-0.6 was 140 mg/kg and in sample ID BH07_3.6-3.8 was 460 mg/kg. The adopted EIL for Zinc was 75 mg/kg. The maximum concentration of Zinc in the remaining soil samples analysed was 88 mg/kg.
- 6) The reported concentration of Benzo(a)pyrene in sample ID BH06_0.4-0.6 was 8.6 mg/kg and in sample ID BH07_3.6-3.8 was 2 mg/kg. The adopted Ecological Screening Level (ESL) for Benzo(a)pyrene was 0.7 mg/kg. The concentrations of Benzo(a)pyrene in the remaining soil samples were below the laboratory limit of reporting.
- 7) The reported concentration of TRH (C16-C34) in sample ID BH06_0.4-0.6 was 1,100 mg/kg and in sample ID BH07_3.6-3.8 was 990 mg/kg. The adopted ESL for this parameter was 300 mg/kg. TRH concentrations were below the laboratory limits of reporting in all other soil samples except for sample ID: BH01_1.7-1.9 where the reported concentration of TRH (C16-C34) was 120 mg/kg.

No asbestos was identified in the soil samples submitted for analysis.

8.6.4 Groundwater conditions

Groundwater was generally encountered in the fill / soil layer at approximately 3 meters bgl in the boreholes located adjacent to Parramatta River and between 2.5 and 5 meters bgl in the central portion of the site. Groundwater was not encountered in the boreholes in the southern portion of the site (BH11 and BH15). A groundwater well was installed at BH15 to confirm whether groundwater was present in the fill / soil layer. The well was subsequently observed to be dry.

The depth to groundwater was measured prior to purging and sampling each groundwater well using an interface probe. No indications of light non-aqueous phase liquid were observed (to the limit of measurement of the interface probe).

The measured groundwater levels and surveyed positions are provided on the borehole logs provided in **Appendix H**. Groundwater elevations are presented in **Table 6** on the following page. The elevations indicate a general gradient towards Parramatta River.

8.6.5 Groundwater analytical results

Groundwater analytical results are provided in **Table B** in **Appendix I**. Laboratory certificates of analysis are presented in **Appendix J**.

The general water quality parameters measured at the respective groundwater well locations are presented in Table 6 below.

Table 6 : Groundwater gauging and intrinsic water quality parameters

| Well ID | Sample date | Top of casing (mAHD) | Depth to water (mAHD) | Conductivity ($\mu\text{S}/\text{cm}$) | Redox Potential (mV) | pH | Dissolved Oxygen | | Temp ($^{\circ}\text{C}$) |
|---------|-------------|-------------------------|--------------------------|---|-------------------------|------|------------------|--------|-----------------------------|
| | | | | | | | mg/L | (%Sat) | |
| MW01 | 24/8/16 | 2.747 | 0.835 | 15,748 | 100.5 | 5.16 | 0.72 | 8.2 | 18.3 |
| MW03 | 24/8/16 | 2.3 | 0.75 | 34,239 | 7.1 | 7.94 | 4.51 | 54.4 | 16.4 |
| MW04 | 24/8/16 | 3.391 | 0.101 | 34,441 | 76.0 | 6.80 | 4.36 | 52.3 | 16.5 |
| MW07 | 25/8/16 | 2.21 | 0.736 | 28,383 | 84.9 | 5.96 | 0.22 | 2.5 | 18.5 |
| MW09 | 25/8/16 | 3.313 | 0.876 | 23,692 | 72.9 | 7.14 | 4.14 | 47.7 | 17.1 |
| MW12 | 25/8/16 | 3.892 | 0.653 | 37,838 | 128.0 | 5.53 | 1.60 | 20.3 | 18.8 |
| MW13 | 24/8/16 | 3.29 | 1.218 | 212.3 | 22.5 | 6.39 | 5.66 | 59.8 | 17.1 |
| MW14 | 25/8/16 | 3.486 | 1.688 | 145.9 | 72.7 | 6.30 | 1.05 | 11.2 | 17.5 |
| MW15* | 25/8/16 | 5.443 | Dry | - | - | - | - | - | - |

* Monitoring well dry. Groundwater not detected.

It is noted that the conductivity results exceed 10,000 $\mu\text{S}/\text{cm}$ in the wells located adjacent to Parramatta River and wells MW09 and MW12. This indicates that the groundwater at these locations is influenced by the Parramatta River.

In relation to the reported concentrations of dissolved heavy metals in the groundwater samples, the following exceedances of the SAC are noted:

- 1) Dissolved Copper concentrations exceeded the Groundwater Investigation Level (GIL) for protection of aquatic ecosystems of 1.3 $\mu\text{g}/\text{L}$ in five of the eight samples analysed. The maximum concentration was 100 $\mu\text{g}/\text{L}$ in the sample from MW01. The remaining samples had concentrations between 2 and 16 $\mu\text{g}/\text{L}$.
- 2) Dissolved Lead concentrations exceeded the GIL for protection of aquatic ecosystems of 4.4 $\mu\text{g}/\text{L}$ in two of the eight samples analysed. The sample from MW01 had a reported Lead concentration of 9 $\mu\text{g}/\text{L}$ and the sample from MW03 had a concentration of 5 $\mu\text{g}/\text{L}$.
- 3) Dissolved Nickel concentrations exceeded the GIL for protection of aquatic ecosystems of 7 $\mu\text{g}/\text{L}$ in the samples from MW01 (66 $\mu\text{g}/\text{L}$), MW03 (10 $\mu\text{g}/\text{L}$), MW04 (10 $\mu\text{g}/\text{L}$), MW07 (11 $\mu\text{g}/\text{L}$), MW12 (74 $\mu\text{g}/\text{L}$) and MW14 (55 $\mu\text{g}/\text{L}$).
- 4) Dissolved Zinc concentrations exceeded the GIL for protection of aquatic ecosystems of 15 $\mu\text{g}/\text{L}$ in five of the eight groundwater samples analysed. The reported concentrations of Zinc in these five samples ranged from 24 to 280 $\mu\text{g}/\text{L}$.

Speciated Phenols, TRH and BTEXN concentrations were below the laboratory limits of reporting in all samples analysed.

All VOC compounds were below the laboratory reporting limits in all samples analysed with the exception of Acetone. Concentrations of Acetone above the laboratory reporting limits were identified in five of the eight groundwater samples analysed with concentrations ranging from 5 – 47 $\mu\text{g}/\text{L}$.

8.7 Discussion

8.7.1 Dioxins in soil

Dioxin concentrations in soil exceeded the derived HIL at two locations, BH06 and BH07. These boreholes are located in the northern portion of the properties at 1 – 3 Leeds Street where reclamation of land from the Parramatta River was identified to have occurred at some time between 1961 and 1972 (noted as AEI 4 in Section 7).

Dioxins are persistent contaminants that are widespread in the environment. An investigation of dioxins in soil in Australia was undertaken for the National Dioxins Program (Department of Environment and Heritage, 2004). The study reported that dioxins were identified in most of the 166 soil samples analysed with concentrations ranging from 0.05 ng/kg (TEQ) to 23 ng/kg (TEQ).

Significant remediation of dioxin contamination was carried out as part of the clean-up of Homebush Bay and development of the former Lednez and Allied Feeds sites on the western side of the Rhodes peninsula where waste material from the Lednez operations was used as fill material. According to the Health Risk Assessment for the former Allied Feeds site (GHD, 2005), the maximum concentration of dioxins in soil was 92.3 $\mu\text{g}/\text{kg}$ (92,300 ng/kg). The Environmental Impact Statement (EIS) for the Remediation of the Lednez Site and Homebush Bay (PB, 2002) noted that the maximum dioxin concentration in soil at the Lednez site was 0.18 mg/kg (180,000 ng/kg) and in Homebush Bay sediments was 360 $\mu\text{g}/\text{kg}$ (360,000 ng/kg). The EIS also noted that background concentrations of dioxins in the Parramatta River were in the order of 0.17 $\mu\text{g}/\text{kg}$ (170 ng/kg). All values are expressed in 2,3,7,8-TCDD TEQ.

The dioxin concentrations identified at BH06 and BH07 are higher than the reported dioxin concentrations in fill samples collected at other locations during the investigation, indicating that the concentrations at BH06 and BH07 are unlikely to be indicative of general background concentrations. However the concentrations detected at these locations are several orders of magnitude below the maximum concentrations reported for the former Lednez and Allied Feeds sites and Homebush Bay.

While it is possible that waste material from the Lednez operations was used as fill material to reclaim the area around BH06 and BH07, a more likely hypothesis would be that sediment with concentrations of dioxin was dredged from the Parramatta River as part of the reclamation process.

The reported dioxin concentrations at BH06 and BH07 exceeded the HIL of 120 ng/kg derived by Jacobs. The primary exposure pathways driving this HIL are the incidental ingestion of soil and inhalation of dust by young children. These pathways are not relevant for the current commercial / industrial use of the land. While Jacobs has not derived HILs for commercial / industrial receptors, the Health Risk Assessment for the former Allied Feeds site (GHD, 2005) derived a series of HILs for dioxins in soil. The lowest HIL derived in the Allied Feeds risk assessment was 89 ng/kg for recreational users in open space surficial soils. The next lowest HIL: derived was 570 ng/kg for ground maintenance workers in open space surficial soils.

The reported dioxin concentrations in the soil samples from BH06 and BH07 were well below 570 ng/kg and therefore the identified concentrations are not considered to present a significant risk to human health under the current use of the land (with respect of the GHD 2005 derived HIL).

In relation to future uses of the land, the identified dioxin concentrations in soil from BH06 and BH07 indicate a potential risk to human health if the land is used for residential purposes (or other sensitive uses such as childcare or schools) and there is the potential for direct access to the impacted soil.

Further investigation and risk assessment would be needed to confirm the extent of contamination and need for remediation actions. Potential remediation actions to reduce the risk would likely be limited to measures to ensure that the impacted soil is not accessible (eg. maintenance of a layer of clean material above the impacted soil or construction of buildings/roadways above contaminated materials and implementation of an appropriate management plan) or excavation and off-site disposal of the impacted soil.

It is noted that the identified dioxin concentrations are well below the level above which the Chemical Control Order in relation to Dioxin-contaminated waste materials under the Environmentally Hazardous Chemicals Act 1985 would apply. This order prohibits the disposal of dioxin-contaminated waste materials. The order also prohibits the processing, keeping, selling, distributing or conveying of dioxin contaminated waste materials, except in accordance with a licence issued by the Commission (EPA). The order defines dioxin contaminated waste as "waste materials that, when tested using a method approved by the Commission, are found to contain more than 1 part in 100 million by weight (i.e. 10-8 w/w) of dioxin." This is equivalent to 10,000 ng/kg.

Therefore, should excavation and off-site disposal of the dioxin impacted soil be required in the future, this would not trigger the Chemical Control Order requirements based on the current reported concentrations and the classification of the waste material would be classified according to its other chemicals/ or attributes according to the NSW EPA Waste Classification Guidelines (2014).

8.7.2 Other contaminants in soil

Concentrations of Nickel and Zinc exceeded the adopted EILs in a sample from the fill material at BH06 and concentrations of Copper, Mercury and Zinc exceeded the EILs in a sample of the fill material from BH07. Concentrations of Benzo(a)pyrene and TRH in both of these samples also exceeded the adopted Ecological Screening Levels.

As noted in Appendix F, the EILs and ESLs are for the protection of terrestrial ecology and typically apply for the top 2 metres of soil at the finished surface/ground level which corresponds to the root zone and habitation zone of many species.

Further investigation will be required to determine the extent of the impacted fill material and the need for remediation (if any) under the proposed design of the future land use. However, based on the data obtained during the Jacobs investigation, the exceedance of the EILs and ESLs is not considered to present a significant constraint to rezoning of the area. Should further assessment during the development approval process determine a remediation requirement then it is likely that this would be limited to excavation and off-site disposal of soil or fill material in the top 2 meters of soil in open space or vegetated areas.

8.7.3 Heavy metals in groundwater

Concentrations of Copper, Lead, Nickel and Zinc in groundwater exceed the Groundwater Investigation Level based on the ANZECC water quality guidelines for marine water for slightly to moderately disturbed ecosystems. These guidelines would normally apply to receiving water bodies rather than in groundwater. The actual risk to aquatic ecology in the Parramatta River from dissolved heavy metals in groundwater discharging from the site would need to be assessed through additional groundwater and surface water monitoring.

It is noted that groundwater in the monitoring wells close to Parramatta River and at well locations MW09 and MW12 appears to be influenced by the Parramatta River and therefore the reported concentrations of dissolved metals in these wells could be influenced by water quality in the river. Heavy metals in the fill material across the site could also be a source of the elevated concentrations reported in groundwater.

In terms of the rezoning proposal, increasing the extent of open space in the area could create increased groundwater recharge and increase groundwater (and contaminant) flow to the river. However the excavation of basements and removal of impacted fill material is likely to have a more significant, positive impact on groundwater quality beneath the investigation area.

8.7.4 Acetone in groundwater

Concentrations of Acetone above the laboratory reporting limits were identified in five of the eight groundwater samples analysed with concentrations ranging from 5 – 47 µg/L. There are no Groundwater Investigation Levels for Acetone in NEPC (2013). It is noted that the US EPA Regional Screening Level for Acetone in tap water (May 2016) is 14,000 µg/L. Therefore the reported Acetone concentrations at the site are not considered to present a significant risk.

9. Acid sulfate soils

ASS maps provided in the LEP indicate that the majority of the Investigation Area is Class 5 for ASS. However the area north of Leeds Street has Class 2 ASS.

Under clause 6.1 of the LEP development consent is required in Class 2 areas for works below the natural ground surface and works by which the watertable is likely to be lowered. For Class 5 areas, development consent is required for works within 500 meters of adjacent Class 1, 2, 3 or 4 land that is below 5 meters AHD and by which the water table is likely to be lowered below 1 meter AHD on adjacent Class 1, 2, 3 or 4 land.

Where development consent is required under clause 6.1, the proponent must submit to the consent authority, an ASS Management Plan prepared for the proposed works in accordance with the ASS Manual (published by the NSW Acid Sulfate Soils Management Advisory Committee, August 1988). However an ASS Management Plan is not required where a preliminary assessment of the proposed works prepared in accordance with the ASS Manual indicates that an ASS management plan is not required for the works and this is confirmed by the consent authority.

Furthermore, clause 6.1 of the LEP states that development consent is not required under this clause for certain works undertaken by a public authority or for works that involve the disturbance of less than 1 tonne of soil or works that are not likely to lower the water table.

Council conducted a search of records relating to ASS assessments within the Investigation Area. This search identified documentation for a development application in 2010 pertaining to the development of the Ikea Warehouse located at 1-3 Leeds Street, Rhodes. The documentation included an ASS Management Plan prepared by Environmental Investigation Services dated January, 2010.

Environmental Investigation Services conducted an investigation of the property involving soil sampling from five boreholes and suspension Peroxide Oxidation-Combined Acidity and Sulfate (sPOCAS) analysis of seven samples.

Environmental Investigation Services concluded that the risk for generation of acid sulfate conditions following disturbance of the natural soils at the site is considered to be high and an ASS management plan was considered necessary for the proposed works.

The ASS management plan developed for the works primarily included:

- Addition of lime to exposed Potential Acid Sulfate Soils (PASS) at the base of footings as soon as possible after exposure;
- Storage testing and treatment of water extracted during dewatering of construction works; and,
- Segregation and lime treatment of excavated PASS.

10. Conclusions and recommendations

10.1 Soil and groundwater contamination

The objective of the soil and groundwater investigation was to identify contamination issues that may have a material impact on the rezoning investigation. Material impacts were considered to be contamination issues that could preclude certain uses of the land, significantly extend the timeframe for development or potentially compromise the economic viability of the proposed land use. The purpose of the investigation was not to identify all contamination that may be present across the Rhodes East Investigation Area.

The soil and groundwater investigation identified concentrations of dioxins, heavy metals, TRH and Benzo(a)pyrene in fill samples which exceeded the adopted SAC at two locations (BH06 and BH07), both located in the northern portion of the properties at 1 – 3 Leeds St (i.e. the area reclaimed between 1961 and 1972). Concentrations of dissolved metals (Copper, Lead, Nickel and Zinc) in groundwater were also identified to exceed the SAC at certain locations.

While further investigation, risk assessment and potentially remediation (including management measures to reduce risks) are recommended to be required as part of any future development application process for a change in use of each property, the contaminant concentrations in soil and groundwater identified during this investigation are not considered to present a significant constraint to the future use of the land, have a significant impact on the overall timeframe for redevelopment or have a significant impact on the economic viability of the proposed redevelopment.

In terms of SEPP 55, based on the investigations performed by Jacobs and provided further investigation and assessment is required through the development application process, it is considered likely that the area currently zoned IN1 can be made suitable for residential and public open space use.

There are no specific requirements relating to contamination or remediation in the Canada Bay Local Environmental Plan 2013. However Council's Development Control Plan, Section 3.4, sets out requirements for development proponents to undertake an initial evaluation of land for the potential for contamination. If contamination is, or may be present, an investigation is required. The DCP also references the Council Contaminated Land Policy which provides more details on the contaminated land assessment process for the determination of development applications.

No changes to the current DCP controls and measures in the Council Contaminated Land Policy are considered necessary.

It is noted that in addition to the land currently zoned IN1, further evaluation of potential contamination at the property at 14 Cavell Avenue is recommended with any future development application that proposes a change to a more sensitive land use at this property.

10.2 Parramatta River water and sediment quality

Jacobs has not obtained specific data on water or sediment quality in the parts of Parramatta River adjoining the Investigation Area. Water quality in the parts adjoining the industrial area is unlikely to meet the water quality objectives for Primary Contact Recreation (eg. swimming) endorsed by the NSW EPA, particularly after rain events. Sediments are also likely to be impacted by dioxins, other contaminants associated with historical industrial land use adjacent to the Parramatta River and contaminants from the urban catchments discharging to the Parramatta River in the vicinity of the Investigation Area. The current guidance from the NSW DPI on recreational fishing will be likely need to stay in place.

If works in the Parramatta River are required in order to upgrade the foreshore then additional assessment of potential impact to sediments and water quality as well as the management of sediments disturbed through these works may be required.

10.3 Acid sulfate soils

The ASS maps within the LEP identifies that all land within the Investigation Area is either Class 2 or 5. The LEP sets out requirements for an ASS management plan for certain types of work. These requirements are also referenced in the Council DCP.

No changes to the LEP or DCP controls in relation to ASS are considered necessary.

While there is the potential for ASS management requirements to add cost to development activities within the Investigation Area, particularly within the Class 2 area, these requirements are considered unlikely to restrict development.

Appendix A. Figures

List of figures

Figure 1: Topographical Map

Figure 2: Zoning Map

Figure 3: Current Property Map

Figure 4: Aerial Photograph from 1930

Figure 5: Aerial Photograph from 1943

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Figure 7: Aerial Photograph from 1961

Figure 8: Aerial Photograph from 1972

Figure 9: Aerial Photograph from 1982

Figure 10: Aerial Photograph from 1991

Figure 11: Aerial Photograph from 2000

Figure 12: Aerial Photograph from 2009

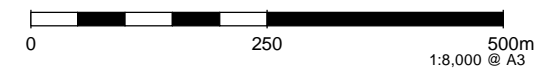
Figure 13: Soil and groundwater investigation sampling plan

Figure 14: Soil and groundwater sampling locations overlain on 1961 photo



Legend

- Wharfs
- Bus corridors
- Railway
- Study Area
- 5m contours

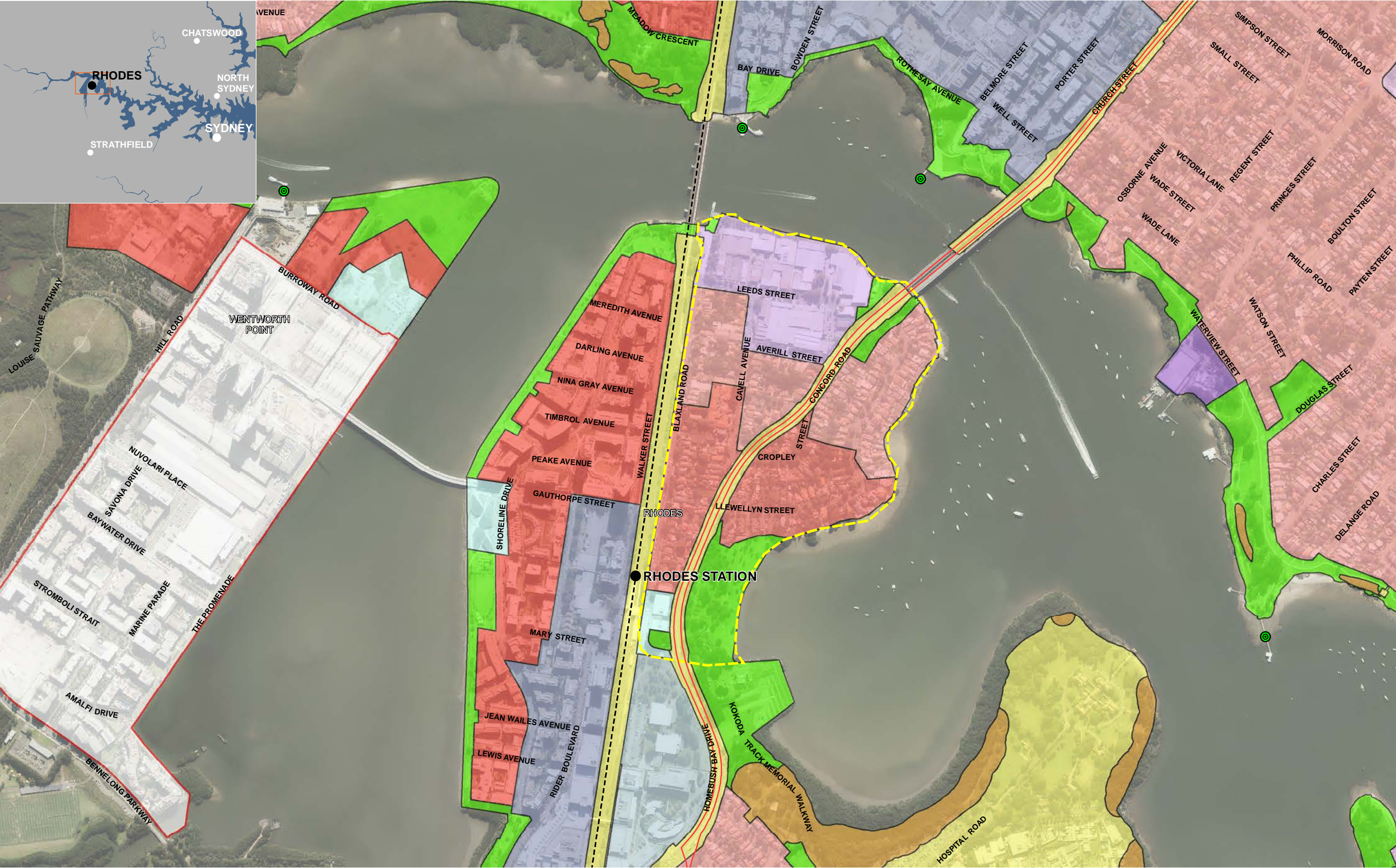


Data sources

Jacobs 2015
Ausimage 2016
LPI 2015

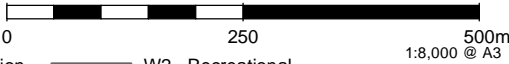
RHODES EAST

Figure 1 | Topographical map



Legend

- | | | | | | | | |
|--------------------------------------|---|--|---|---|---|--|---|
| <p>--- Railway</p> <p>Study Area</p> | <p>Zone</p> <p>B1 Neighbourhood Centre</p> <p>B4 Mixed Use</p> | <p>B7 Business Park</p> <p>E2 Environmental Conservation</p> | <p>IN1 General Industrial</p> <p>IN4 Working Waterfront</p> | <p>R1 General Residential</p> <p>R2 Low Density Residential</p> | <p>R3 Medium Density Residential</p> <p>R4 High Density Residential</p> | <p>RE1 Public Recreation</p> <p>SP2 Infrastructure</p> | <p>W2 Recreational Waterways</p> <p>DM Deferred matters</p> |
|--------------------------------------|---|--|---|---|---|--|---|



Data sources

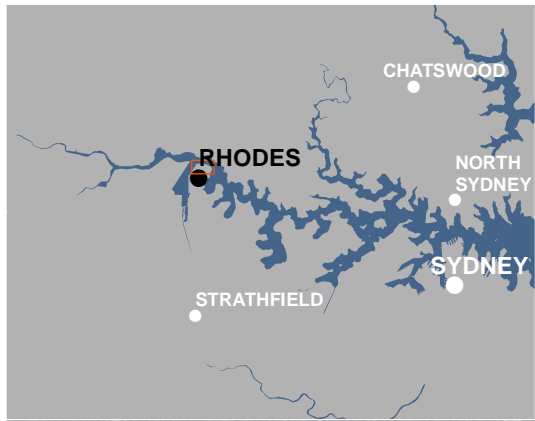
Jacobs 2015
Ausimage 2016
LPI 2015

RHODES EAST

Figure 2 | Zoning map



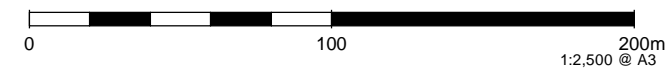
Figure 3 | Current property map



Legend

- Study Area
- Area currently zoned General Industrial IN1

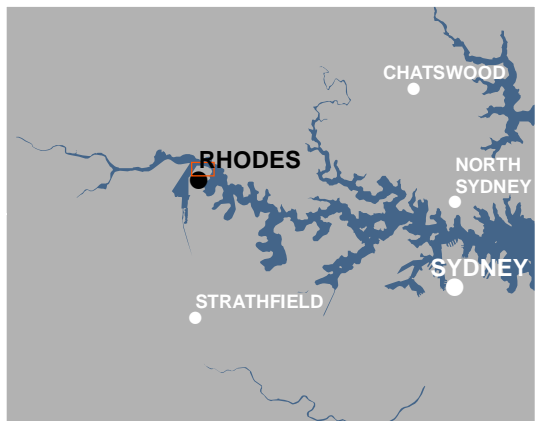
Approximate historical line showing the boundary of land before reclamation



Data sources
 Jacobs 2015
 LPI 1930 (Imagery)
 Canadabay Council LEP (2013)

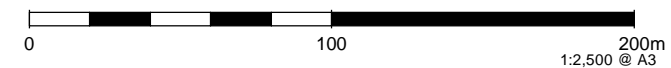
Figure 4 | Aerial photograph from 1930

RHODES EAST



Legend

- Study Area
- Area currently zoned General Industrial IN1



Data sources

Jacobs 2015
Ausimage 1943
Canadabay Council LEP (2013)

Figure 5 | Aerial photograph from 1943

RHODES EAST