

Draft Update 4

Heritage Impact Statement

SSD 6533-2014 Remediation Development Application

EPA Declaration Area 21122

Non-Indigenous Archaeology

Block 5, Barangaroo Central



Boatyard with gasworks to the south, Block 5 is in the area of the boatyard.
Patent Slip belonging to the Australian Steam Navigation Co., Frederick Garling, c.1855.

Report to

Lend Lease Millers Point

June 2014

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EXECUTIVE SUMMARY

RESULTS

- The EPA Declaration Area is contaminated and a potential risk to human health and the environment. In particular, EPA has identified the following substances as the contaminants on the “remediation site” relating to the previous use of the site as a gasworks: polycyclic aromatic hydrocarbons (PAHs); benzene, toluene, ethylbenzene and xylenes (BTEX); total petroleum hydrocarbons (TPHs); ammonia; phenol and cyanide.
- The EPA Declaration Area contains a significant archaeological resource associated with Australia’s first gasworks and nineteenth-century shipbuilding, reclamation and wharfage. The nature of the contamination makes it difficult to realise the significance of this resource in its current state.
- The remediation in Block 5 involves ex-situ remediation of the EPA Declaration Area. This will provide limited opportunity to record the potential archaeological remains within the Remediation Area. A methodology for this will need to be developed to provide for some opportunity to record substantial or significant remains.

RECOMMENDATIONS

1. An archaeological methodology (Research Design) will need to be developed in consultation with Lend Lease and which will allow for some limited recording of the remains to be removed by ex-situ remediation.
2. The detailed framework for archaeological methodology and recording will be established following some initial sampling trenches to determine the extent to which the potential archaeological remains within the site may survive and be accessible for archaeological investigation and recording. The preliminary framework for archaeological recording, defined as a result of detailed sampling trenches is as follows:
 - Where contamination is at depth and the upper layers are uncontaminated, the upper layers could potentially be archaeologically excavated, with restriction as required for OHS management of works.
 - Where the archaeology is completely covered with contamination and therefore inaccessible for normal archaeological recording methodologies, other alternative techniques may be tested to determine if recording is possible. Then it may be possible to record some major gasworks features but only if they offer a research outcome.
 - It is likely that opportunities may be extremely limited in what can be recorded. In the end there may be no ability to record remains prior to the ex-situ remediation.
3. Consultation should be undertaken with the Heritage Division in relation to this project as they may be conditioned to approve the Research Design.
4. Opportunities for monitoring the stormwater works also need to be identified.

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Appendix

Appendix 1: AECOM letter

Appendix 2: Geotechnical Sections, Coffey Geotechnical

Document Status

Name	Date	Purpose	Author	Approved
Draft 1	9/3/2011	Draft review	Mary Casey	Tony Lowe
Final	11/12/2012	Update plans, terminology, comparative sits etc.	Jenny Winnett	Mary Casey
Update 2	23/7/2013	Update terminology	Mary Casey	Mary Casey
Update 3	29/5/2014	Update terminology, study area, impacts	Mary Casey	Mary Casey
Update 4	26/6/2014	Amend maps and plans, include new stormwater	Mary Casey	Mary Casey

**Heritage Impact Statement
Remediation Development Application
Non-Indigenous Archaeology, Block 5, Barangaroo Central**

1.0 Introduction

1.1 Background

Casey & Lowe Pty Ltd have been engaged by Lend Lease Millers Point (Lend Lease) to prepare a Heritage Impact Statement report to accompany a Development Application (SSD 6533-2014) for Remediation and Land Forming Works to be submitted to the Minister for Planning pursuant to Part 4 of the *Environmental Planning and Assessment Act, 1979*. The Heritage Impact Statement has been prepared to respond to the Secretary Environmental Assessment Requirements (SEARs) issued in respect of SSD 6533-2014 Remediation Works dated June 13, 2014, specifically SEAR 11 as described below:

- *Undertake an assessment of the likely impacts of the proposal on any heritage or archaeological items and proposed mitigation and conservation measures.*

1.1.1 Barangaroo

Barangaroo is located on the northwestern edge of the Sydney Central Business District, bounded by Sydney Harbour to the west and north, the historic precinct of Millers Point (for the northern half), The Rocks and the Sydney Harbour Bridge approach to the east; and bounded to the south by a range of new development dominated by large CBD commercial tenants. The 22 ha Barangaroo site is roughly rectangular in shape and has frontage to the harbour foreshore of 1.4km (Figure 1.1). Hickson Road delineates the eastern boundary.

The NSW Government held an international urban design competition for the site in 2005 and the winning entry was used as the basis for the original Barangaroo Concept Plan which was approved in February 2007 and sets out the urban design and policy initiatives to be employed in the redevelopment of the site.

The Concept Plan (as modified) is the statutory planning approval to guide the urban renewal of Barangaroo and currently provides for the development of mixed use precinct comprising commercial, retail, residential and community development and new public open space / public domain.

1.1.2 EPA Declaration Area (#21122)

In May 2009, the NSW Environment Protection Authority (EPA) determined that a portion of land at Millers Point (part of the Barangaroo Site and an adjacent portion of Hickson Road), was contaminated in such a way as to present a significant risk of harm (SROH) to human health and the environment. As a consequence the EPA declared the area to be a remediation site (Declaration Number 21122; Area Number 3221) under the Contaminated Land Management Act 1997.

The Remediation Site Declaration 21122 indicates that the area of the declaration coincides with the known footprint of the former Millers Point gasworks facilities. This area is located on part of the Barangaroo and part of Hickson Road adjacent to the Barangaroo (Figures 1.2-1.4).

In accordance with Declaration Number 21122, the Declaration Area comprises:

- Part Lot 5 and Part Lot 3 DP 876514, Hickson Road, Millers Point, NSW 2000.
- Part of Hickson Road adjacent to:
 - 30-34 Hickson Road (Lot 11, DP1065410)

- 36 Hickson Road (Lot 5, DP873158)
- 38 Hickson Road (SP72797) Millers Point

The Barangaroo Delivery Authority has entered into a Voluntary Management Proposal (VMP) with the EPA associated with EPA Declaration Area (Approval No. 20101719). Phase 1 of this VMP involves investigative works and undertaking remedial design to determine and obtain agreement on a proposed remediation methodology. Phase 2 of the VMP (to be finalised following Phase 1) will involve the implementation of the agreed remediation works.

An independent, EPA-accredited Site Auditor has been appointed to undertake review of proposed remediation works, and prepare statutory audit statements prior to and following completion of remediation.

For the purposes of this report, the area of Remediation Site Declaration 21122 is referred to as the "Declaration Area" (Fig 1.3).

1.1.3 Definition of Site for Block 5 Remediation DA

For the purposes of the Block 5 Remediation Development Application, the **Site** includes the area of land to be remediated (**Site Remediation Area**), plus any adjacent land used for the staging and undertaking of the proposed remediation and temporary stormwater diversion works.

The **Site Remediation Area** comprises the Block 5 part of the Declaration Area (including some land adjacent to the Declaration Area on the west).

The location of the Declaration Area in the context of the surrounding area is illustrated at Figure 1.2

1.1.4 Role of Lend Lease in the Remediation of the Site

Lend Lease has been appointed by the Barangaroo Delivery Authority as the Proponent to undertake the development for Barangaroo. Lend Lease has also been contracted by the Barangaroo Delivery Authority to undertake remediation of the Declaration Area.

1.1.5 Remedial Action Plan and Methodology

The proposed remediation of the Declaration Area is detailed in the AECOM Remedial Action Plan (AECOM 2013). This Development Application for Block 5 Remediation includes the **ex-situ remediation** methodology as detailed in the AECOM RAP.

1.1.6 Summary of Proposed Works for the Block 5 Remediation DA

The works proposed as part of the Block 5 Remediation DA includes the following:

- a) Temporary diversion of existing stormwater which will comprise installing temporary infrastructure in Block 5 and Hickson Road.
- b) Installing temporary retention structures (e.g. sheet piling in bentonite slurry, secant piles) to facilitate proposed excavation, where required, including:
 - i. Temporary ground anchors or other restraint system as required into adjoining blocks and road reserve.
 - ii. Support/retain the existing Sewer Pumping Station 1129 and associated infrastructure.
- c) Installation of temporary odour structure(s) over proposed excavation area.
- d) Dewatering and water treatment in an on-site water treatment plant
- e) Excavation of contaminated soil beneath odour structures, with appropriate air emission controls/monitoring

- f) Transfer of contaminated material directly off-site for landfill disposal, including where required to a licensed off-site treatment facility for pre-treatment (e.g. for hazardous waste).
- g) Backfilling of Block 5 excavation with suitable fill (imported and/or won from site).

1.1.7 Relevant Previous Archaeological Reports

This report follows up the two previous reports written by Casey & Lowe for the European or Non-Indigenous archaeology for Blocks 4 and 5, and Hickson Road.

- Blocks 3 and 4 were addressed in detail in the:
 - *Archaeological Assessment, Barangaroo Stage 1 (Barangaroo South)* (July 2010).
 - *Archaeological Research Design & Management Strategy, Barangaroo Stage 1* (May 2010).
- Block 5 and Hickson Road were addressed in:
 - *European Archaeological Issues, SISCO in situ remediation pilot trial, Block 5 & Hickson Road, Barangaroo South* (September 2010).

A report on the Aboriginal Archaeology for this project was written by Comber Consultants.



Figure 1.1: The EPA Declaration Area is the blue outline on the plan. Barangaroo, Historical Atlas of Sydney, City of Sydney Archives

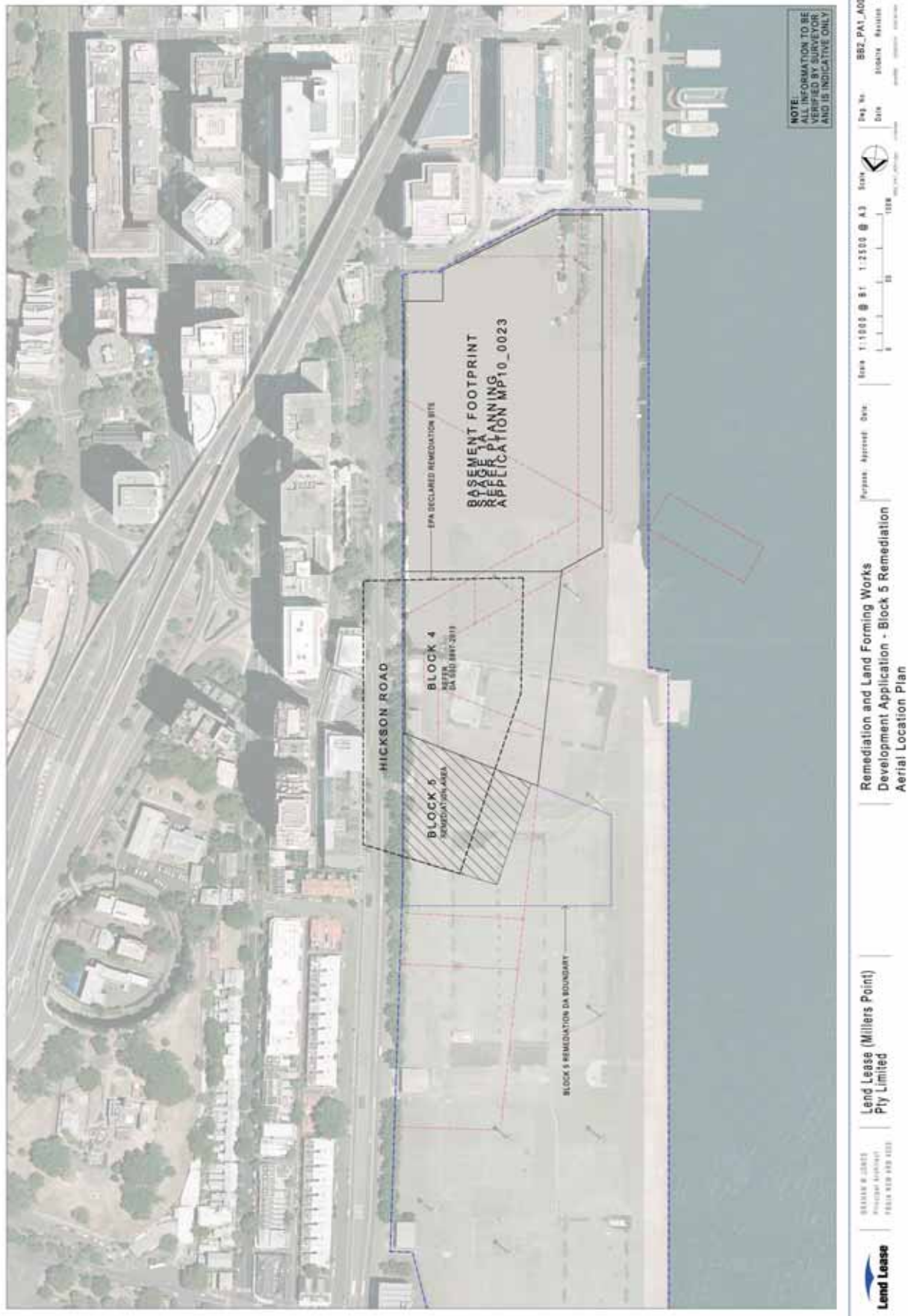


Figure 1.2: Aerial photo showing the location of Block 5 and the section of the EPA declared area (hatched) within Block 5. Arup for Lend Lease



Figure 1.5: Remediation and land forming works, Block 5 recent site survey.

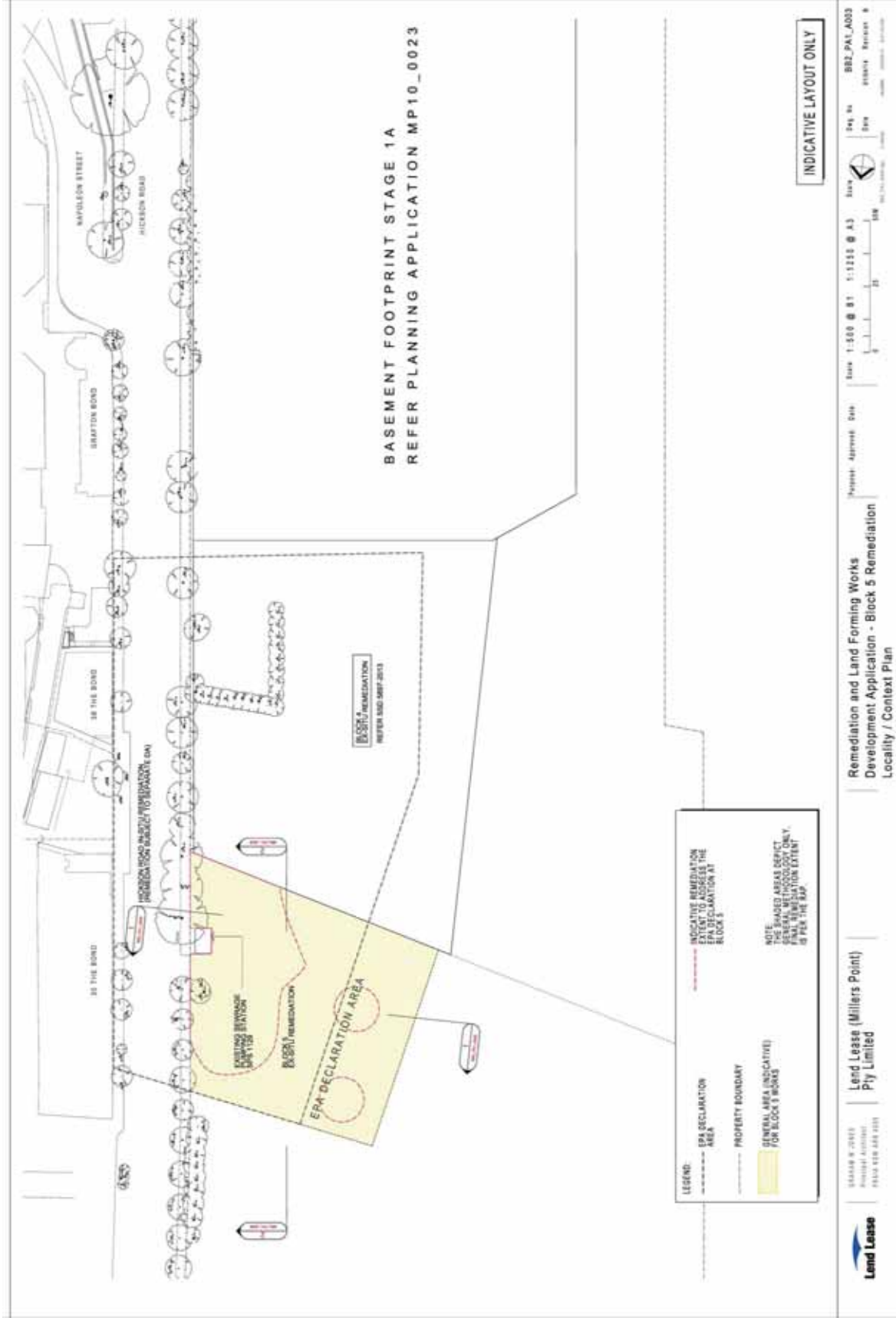


Figure 1.6: The yellow area is he extent of remediation in Block 5. The area within the red lines is the focus of the work, but surrounding areas may be impacted by battering and chasing of contamination.

1.2 Previous Archaeological and Heritage Reports

Two archaeological reports that were commissioned by the Barangaroo Development Authority from Austral Archaeology.

Barangaroo Archaeological Strategy, Final Report, 2009, by Austral Archaeology for the Barangaroo Delivery Authority

Barangaroo Archaeological Assessment & Management Plan, 2010 by Austral Archaeology for the Barangaroo Delivery Authority

For the Barangaroo Central area the following archaeological reports are the most relevant:

Non-Indigenous Archaeological Assessment, Barangaroo South, July 2010, by Casey & Lowe for Lend Lease (Millers Point) Pty Ltd.

Archaeological Research Design & Management Strategy, May 2010, by Casey & Lowe for Lend Lease (Millers Point) Pty Ltd.

Archaeological Excavation, Barangaroo South, Preliminary Results, October 2012, by Casey & Lowe for Lend Lease (Millers Point) Pty Ltd.
http://www.caseyandlowe.com.au/pdf/barangaroo/Barangaroo_South_Preliminary_Report_2012.pdf

The Casey & Lowe Assessment report dealt with the archaeological issues associated with the gasworks in Block 4 and not with any specific issues of the gasworks in Block 5. The analysis of significance for the gasworks site within Block 4 is quite relevant and identifies a number of historical impacts in addition to the major contamination of the site by the gasworks. The October 2012 report provides a report on the preliminary results of the Barangaroo South project.

1.2.1 Reports relating to the gasworks site Sydney

Archaeology & Heritage 2004 *Archaeological recording of the Annulus of 1882 gasholder and details of the 19th century gasmaking, part of former AGL Site 30-34 Hickson Road, Sydney*, for Bovis Lend Lease.

Archaeology & Heritage 2003 *Archaeological recording and excavation, former AGL Site 38 Hickson Road, Sydney, rock shelf at rear*, for Bovis Lend Lease.

Broomham, Rosemary 2007 *Land at Millers Point, ownership and usage*.

Broomham, Rosemary 1987 *First Light, 150 years of gas*, Hale & Iremonger, Marrickville, Sydney.

Godden Mackay Logan 2001 *Conservation Management Plan, 30-38 Hickson Road, Sydney*, for Delmo Pty Ltd.

Godden Mackay Logan 1999 *Archaeological Assessment, Former AGL Site, Hickson Road*, for Delmo Pty Ltd.

1.3 Statutory Constraints

1.3.1 Part 4, Environmental Planning and Assessment Act, 1979

Approval for the works is being sought from the Minister for Planning under the provisions of Part 4 of the Environmental Planning and Assessment Act, 1979. This report address the European archaeological remains while Comber Consultants has written a report assessing the issues associated with Aboriginal heritage.

Key issue 10 of the Director General's Requirements relating to European archaeology identified the following issue to be addressed by the Environmental Assessment:

- An assessment of the likely impacts of the proposal on any heritage or archaeological items and proposed mitigation and conservation measures.

1.3.2 Statutory and Non-statutory Guidelines

The management of heritage sites in NSW should conform to the requirements of the *Burra Charter* of Australia ICOMOS. Many of the following guidelines provide for best practice conservation approaches and can be used to inform all the management of the archaeological remains. There are a range of archaeological guidelines which inform the management of the place:

Archaeological Assessment Guidelines, NSW Heritage Office, Department of Urban Affairs & Planning, 1996.

Assessing Significance for Archaeological Sites and 'Relics', Heritage Branch, Department of Planning, 2009.

NSW Heritage Manual, NSW Heritage Office, Department of Urban Affairs & Planning, 1996.

Historical Archaeological Investigations: A Code of Practice, NSW Department of Planning, 2006.

Historical Archaeological Sites, Investigation and Conservation Guidelines, Department of Planning and NSW Heritage Council, 1993.

Excavation Director's Assessment Criteria, NSW Heritage Office.

ICHAM Charter, The ICOMOS Charter for the Protection and Management of Archaeological Heritage, ICOMOS International, 1990.

Recommendation on International Principles Applicable to Archaeological Excavations, UNESCO, 1956.

Heritage Interpretation Policy and Guidelines, Heritage Information Series, NSW Heritage Office, August 2005.

Photographic Recording of Heritage Items, Heritage Information Series, NSW Heritage Office, 2006.

1.4 Authorship

The historical chronology (Section 3.1) for this Heritage Impact Statement was taken from an earlier report by Rosemary Broomham (2007). The Broomham report formed the basis for our understanding of the development and operation of the gasworks; no additional historical research was undertaken on the gasworks for this report other than to review a range of other heritage reports on the gasworks site and to produce a chronology of events and activities at the gasworks site. We have drawn heavily on specialist reports by Verutek (2013), AECOM and Coffey (2013). Sections 1, 2, 3.2, 3.3 and 4 to 6 were written by Dr Mary Casey, Director, Casey & Lowe. Some overlays onto the historic plans were produced by Nick Pitt, Casey & Lowe while the base maps were provided by Rygate & Co. Surveyors for Lend Lease. Robert Maxwell assisted with analysis of the gasworks and wrote the chronology (Section 3.1). Lend Lease provided a glossary of terms and terminology which have been used in this report. The report was reviewed by Tony Lowe, Director, Casey & Lowe Pty Ltd. Jenny Winnett researched and wrote the Section 4.2 on the archaeological work undertaken at other gasworks. The report was updated in May 2014 Dr Mary Casey, Director, Casey & Lowe.

1.5 Acknowledgements

Warwick Bowyer, Lend Lease, commissioned and project managed this report in March 2011. He provided plans and descriptions of the proposed development, copies of geotechnical reports and other relevant information. Mark Burns, Lend Lease, also provided information on the contamination and remediation and project managed the October/December 2012 and July 2013 and May 2014 updates. A series of overlay plans by Rygate & Co, and more recently Arup, were produced for the Barangaroo project and have been used in this report. Anne Bickford, Archaeology and Heritage Pty Ltd, generously loaned copies of various archaeological and heritage reports on the gasworks. Anthony Davis, AECOM, also provided assistance.

1.6 Limitations

There were no particular constraints to producing this report. There was sufficient time and funding to complete this report to a quality standard.

1.7 Glossary

Historical Archaeology (Non-Indigenous/European)

Historical Archaeology (in NSW) is the study of the physical remains of the past, in association with historical documents, since the British occupation of NSW in 1788. As well as identifying these remains the study of this material can help elucidate the processes, historical and otherwise, which have created our present surroundings. Historical archaeology includes an examination of how the late 18th and 19th-century arrivals lived and coped with a new and alien environment, what they ate, where and how they lived, the consumer items they used and their trade relations, and how gender and cultural groups interacted. The material remains studied include:

- Archaeological Sites:
 - below ground: these contain relics which include building foundations, occupation deposits, rubbish pits, cesspits, wells, other features, and artefacts.
 - above ground: buildings, works, industrial structures and relics that are intact or ruined.
- cultural landscapes: major foreshore reclamation
- maritime sites: infrastructure and shipbuilding
- shipwrecks
- structures associated with maritime activities.

Archaeological Potential

Archaeological potential is here used and defined as a site's potential to contain archaeological relics which fall under the provisions of the *Heritage Act* 1977 (amended). This potential is identified through historical research and by judging whether current building or other activities have removed all evidence of known previous land use.

Archaeological Site

A place that contains evidence of past human activity. Below ground sites include building foundations, occupation deposits, features and artefacts. Above ground archaeological sites include buildings, works, industrial structures and relics that are intact or ruined.

Archaeological Investigation or Excavation

The manual excavation of an archaeological site. This type of excavation on historic sites usually involves the stratigraphic excavation of open areas.

Archaeological Monitoring

Archaeological monitoring is recommended for those areas where the impact of the works is not considered to mean the destruction of significant archaeological fabric. Nevertheless the disturbance of features both suspected and unsuspected is possible. In order to provide for the proper assessment and recording of these features an archaeologist should inspect the works site at intervals they consider to be adequate and to be 'at call' in case the contractor uncovers remains that should be assessed by the archaeologist.

It is not anticipated that monitoring would impact on the planned works or unduly hold up the contractors' work schedules. If recording of features is necessary it would be carried out as quickly as possible so that any time delays are minimised.

Monitoring is a regular archaeological practice used on many building and development sites.

Research Design

A set of questions which can be investigated using archaeological evidence and a methodology for addressing them. A research design is intended to ensure that archaeological investigations focus on genuine research needs. It is an important tool that ensures that when archaeological resources are destroyed by excavation, their information content can be preserved and can contribute to current and relevant knowledge.

Research Potential

The ability of archaeological evidence, through analysis and interpretation, to provide information about a site that could not be derived from any other source and which contributes to the archaeological significance of that site and its 'relics'.¹

Relic

Means any deposit, artefact, object or material evidence that:

- (a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and
 - (b) is of State or local heritage significance.
- (NSW *Heritage Act 1977*, Definitions, Part 1.4)

1.7.1 Glossary of Site & Remediation Project Specific Terms

- **Block 4 Remediation Area** – Portion of the Declaration Area situated within Barangaroo, and some adjacent area to the west.
- **Block 5 Remediation Area** – Portion of the Declaration Area located within Barangaroo Central, and some adjacent area to the west.
- **EPA** – Environment Protection Authority.
- **EPA Declaration Area** - Remediation Site Declaration 21122
- **Hickson Road Remediation Area** - Portion of the Declaration Area situated within the Hickson Road reserve,
- **Ex-situ Remediation Methodology** - Excavation of contamination and off-site disposal (with on-site pre-treatment, where required)
- **LLMP** – Lend Lease (Millers Point)
- **RAP** – Remedial Action Plan
- **Site** - area required for the purpose of the Block 5 Remediation Development Application identified as:
 - Block 5 Remediation Area
 - Any other areas of Barangaroo or Hickson Road required for staging and undertaking the remediation and stormwater diversion works.
- **Site Remediation Area** - The sum of the Blocks 4 and 5 and Hickson Road Remediation Areas.
- **VMP** – Voluntary Management Proposal.

¹ Taken from the *Assessing Significance for Historical Archaeological Sites and 'Relics'*, 2009:11.

2.0 Contamination and Remediation Proposal

2.1 Contamination

In May 2009, the NSW Environment Protection Authority (EPA) determined that part of Barangaroo was contaminated in such a way as to present a significant risk of harm (SROH) to human health and the environment. As a consequence the EPA declared part of the Barangaroo Site to be a remediation site (Declaration Number 21122; Area Number 3221) under section 9 of the Contaminated Land Management Act 1997.²

The Millers Point gasworks operated on the Declaration Area between 1840 and 1921. The Declaration Area has subsequently been used for various activities, but predominantly a commercial port facility and public road.

When the EPA declared parts of Barangaroo and Hickson Road a “Remediation Site”, it described the nature of the contamination as gasworks waste, that is, waste tar resulting from the operation of a gasworks plant.

In particular, the EPA has identified the following substances as the contaminants of concern on the Declaration Area arising from the previous use of the site as a gasworks: polycyclic aromatic hydrocarbons (PAHs); benzene, toluene, ethylbenzene and xylenes (BTEX); total petroleum hydrocarbons (TPHs); ammonia; phenol and cyanide.

2.1.1 EPA Declaration Area

The EPA has determined that the Declaration Area (an area that incorporates parts of Barangaroo South (“Block 4”), portions of Block 5 and Hickson Road that comprise the Remediation Site) is contaminated in such a way as to present a significant risk of harm to human health and the environment (Figs 1.2, 1.3). Specifically:

- Groundwater in the Declaration Area has been found to be contaminated by TPH, PAHs, BTEX, ammonia, phenol and cyanide at concentrations significantly exceeding the relevant trigger values for the protection of human health and aquatic ecosystems in the Australian and New Zealand Guideline for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000);
- These groundwater contaminants include human carcinogens and substances toxic to aquatic ecosystems;
- The contaminated groundwater is impacting the surrounding areas, including the basement of a residential building adjacent to the Site, potentially exposing humans in the building to harmful vapours; however it is currently being effectively controlled; and
- Contaminated groundwater is likely migrating from the Site to Darling Harbour and could ultimately affect aquatic ecosystems.

Contamination on Block 5 has been reported in the fill material, natural soil, bedrock and groundwater that underlie the Site and adjacent portions of Barangaroo. Block 5 (and surrounding areas) has been subject to reclamation activities that have consisted of the placement of fill material of potentially unknown origins.

² Verutek 2013

2.2 Proposed Remediation

The proposed remediation of the Block 5 Declaration Area is detailed in the AECOM Remediation Action Plan (RAP). The RAP details the remediation works required to achieve these objectives as detailed in the RAP. This will include the extent of remediation required, and the validation testing and monitoring to be undertaken to confirm completion of remediation works.

The proposed remediation strategy is ex-situ remediation across the Block 5 part of the Remediation Area. Ex-situ would involve undertaking ex-situ remediation across Block 5, EPA Declaration Area. This would require a staged bulk excavation of all areas under odour tents. It would necessitate the complete removal of all of the archaeological resource within Block 5 of the Site Remediation Area. The implementation of this strategy would involve the removal of most of the surviving archaeological remains of the gasworks, except for those to the east of Hickson Road and the nearby former gasworks building.

2.3 Scope of Works in Block 5 for Ex-situ Remediation

The scope of this current project is to remediate Block 5 to address NSW EPA Declaration 21122. These works involve: temporary stormwater diversion, installation of temporary retention structures, dewatering/water treatment, excavation of contaminated fill under odour enclosure and off-site treatment/disposal and backfilling to existing grade. The scope is:

2.3.1 Licenses/Approvals

- Obtain all licenses/approvals, including variation to existing Environment Protection License, any waste approvals, conditions of planning approval, etc.

2.3.2 Site Establishment (Stage 1) – Figure 2.2

- Install site fencing/exclusion zones and decontamination areas.
- Removal of site trees.
- Local protection/pruning of Hickson Road trees, where required for retention wall construction.
- Install general environmental controls for excavation works (e.g. bunding, sediment controls).
- Establish plant/equipment.

2.3.3 Services Diversion (Stage 1) – Figure 2.2

- Temporary diversion of existing stormwater service (Figure 2.2).
- Capping any remaining site services.

2.3.4 Perimeter Retaining Wall (Stage 1) – Figure 2.2

- Construct temporary retention wall (e.g. sheet piles in bentonite slurry/ secant piles) to facilitate excavation, on north, east and west boundaries. Final construction subject to future detailed design.
- Temporary ground anchors or associated support structures.

2.3.5 Dewatering and water treatment (Stage 2) - Figure 2.3

- Use on-site Water Treatment Plant (WTP) for managing groundwater during excavation.
- Installation of dewatering infrastructure, groundwater extraction, transfer water to WTP, treat water and discharge per EPL requirements.

2.3.6 Construct Excavation Odour Control Structures (Stage 2) - Figure 2.3

- Install temporary odour control structure(s) over proposed excavation areas. This may include installation of temporary ground structures (e.g. piles/capping beam) and/or perimeter weights as required to provide support.
- Odour control may comprise multiple structures side-by-side to achieve coverage of the remediation area, and appropriate individual span of each structure.
- Structures to be installed to ensure all odours are contained. Air exhaust system and associated emissions control, air filters/treatment and stack
- Odour control structures may include retractable doors and an air lock system at the entrance/exit to minimise odour emissions.
- Final structures to be subject to future detailed design.

2.3.7 Excavation (Stage 3) - Figure 2.4

- Excavate contaminated soil from Block 5, per the AECOM Remedial Action Plan.
 - o Indicative excavation volume ~ 39,000m³.
- Excavation of rock not proposed for remediation purposes, except limited excavation (if required) to remove tar seeps to the extent practical.
- Temporary odour control structure to be operated to manage and treat exhausted air. Include all associated maintenance & consumables.
- Water from excavation to be transferred to onsite water treatment plant for treatment and licensed discharge. Where required, highly contaminated liquid waste may be pumped by licensed liquid waste contractors (vacuum truck) and disposed offsite.
- Vehicles/plant to be decontaminated in wheel wash/cleaning area, prior to moving to other areas of site or off-site. Waste water transferred to water treatment plant.
- Conduct detailed monitoring (air, noise, water) throughout works.

2.3.8 Soil Treatment / Disposal

- Excavated contaminated material to be transported directly off-site for disposal in accordance with NSW EPA requirements and waste guidelines, following in-situ waste classification.
- Non-hazardous waste to be classified and transported off-site in covered trucks for landfill disposal.
- Hazardous classified material to be transported off-site to a licensed treatment facility for treatment, prior to landfill disposal.

2.3.9 Block 5 Area Validation

- Validate excavation per RAP – inspections and sampling/testing.

2.3.10 Backfilling and Decommissioning (Stage 4) - Figure 2.5

- Decommission excavation temporary odour control structures following excavation.
- Backfill and compact excavations with suitable fill (either imported to site, or won from site, provided it satisfies HHERA criteria for the area).
- Remove temporary sheetpiles & temporary ground anchors.

2.4 Staging of Ex-Situ Remediation

The following table and plans (Figure 2.1 to 2.5) outline the extent of works required to be undertaken in relation to the remediation.

Table 2.1: Staging times for the proposed remediation.

	Indicative Works Staging	Indicative Duration	Summary Works Block 5
Stage 1	Apr 15 – Oct 15	7 months	Temporary stormwater diversion. Install retention system
Stage 2	Nov 15 – Jan 16	2 months	Install & commission odour structures. Install Dewatering infrastructure.
Stage 3	Jan 16 – Jun 16	6 months	Excavate and dispose soil/fill. Dewatering.
Stage 4	Jul 16 – Apr 17	9 months	Backfill excavation. Decommission odour structures & dewatering infrastructure

Figure 2.1: Plan showing Block 5 study area. Arup for Lend Lease (Millers Point).

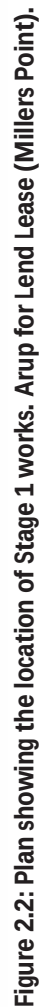
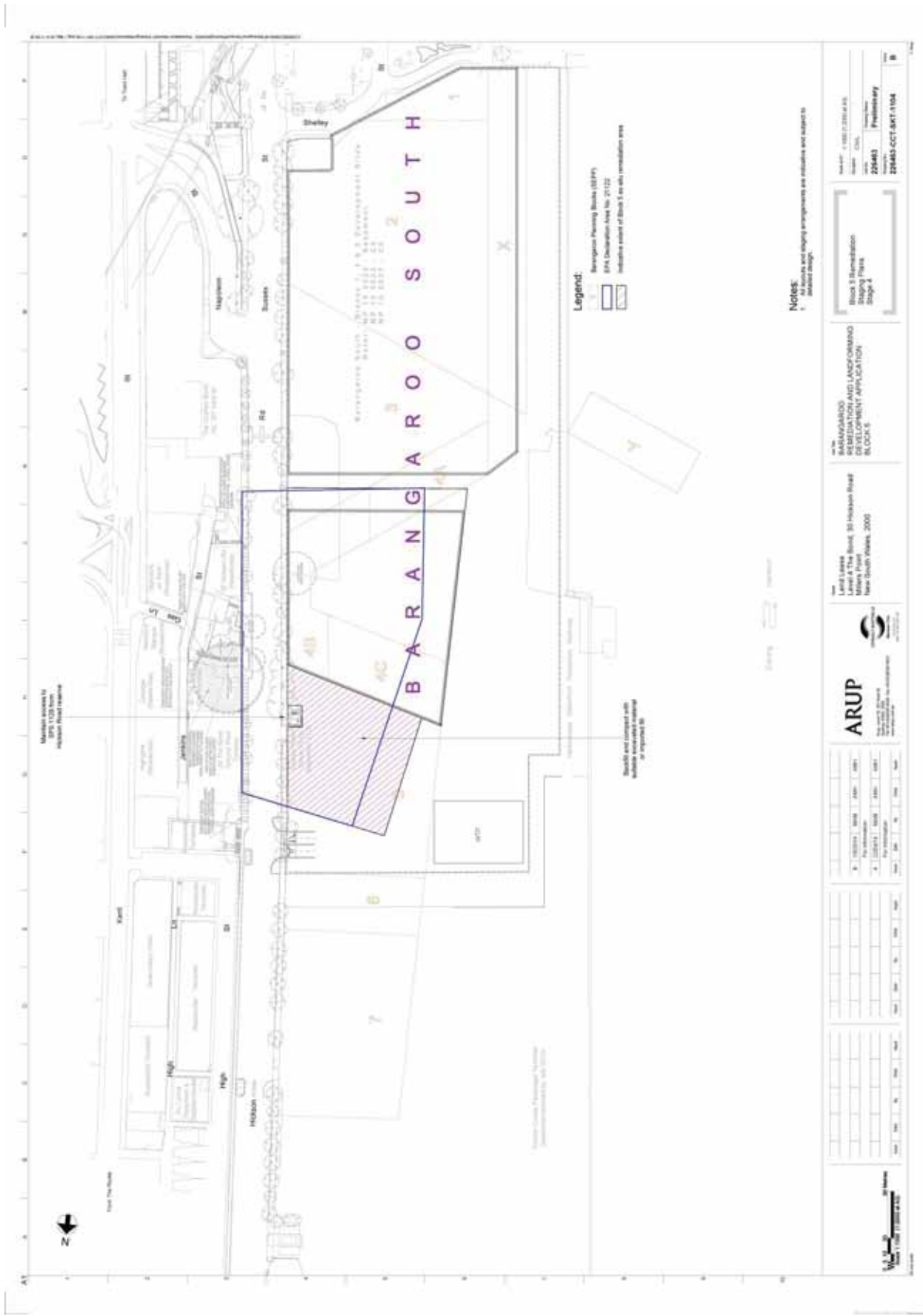


Figure 2.2: Plan showing the location of Stage 1 works. Arup for Lend Lease (Millers Point).



3.0 Historical Background & Archaeological Potential

3.1 Chronology of Development of the AGL Gasworks

The following chronology is based on the historical report by Rosemary Broomham (2007). Casey & Lowe have identified the archaeological potential associated with various events and activities. Refer to overlay maps and figures (Figures 3.1 to 3.16) for illustrations of many of the issues discussed below.

1810 (1 Nov) – John Macarthur acquires a grant of 2 acres 1 rod 10 ½ perches.

1830 – Lot is sub-divided. James Jenkins acquired allotment 11. Reclamation and a wharf extend the allotment, and a cottage is built.

1839 – Australian Gas Light Company (AGL) director Richard Jones purchases allotment I which also has reclamation beyond the shoreline. Two buildings are present on Lot I at the time of acquisition.

1839 – AGL purchases both allotments on the waterfront of Macarthur's grant, Section 67 Lots 15 & 16. A wedge of Lot 15 is sold to the neighbour on the northern side creating a rectilinear plot for the gasworks.

1842 – Subdivision plan for land on Kent St shows the original layout of the gasworks featuring a retort house, carbonising plant and two gasholders.

1857-9 – AGL add to the carbonising plant and add a third gasholder, the configuration used at the gasworks until 1868.

1859 – AGL acquires an allotment of land on Kent St.

1863 – AGL purchases land adjacent to the gasworks on the south side from Mace. It is likely that the painting on the front cover of this report shows Block 5 and 4 around this time.

1869-70 – A retort house is built, extending 180 feet (54.9m) onto the land purchased from Mace, which was needed to clean the gas produced at the gasworks. A new gasholder was constructed measuring 100 feet (30.5m) in diameter. The retort house was functional from 1869, the gasholder from 1870.

1876 – AGL acquires a second allotment on Kent St.

1880 – AGL acquires 2 acres of land to the north of the Darling Harbour gasworks. A retort house extension is built measuring 110 feet in length, and the first two gasholders are demolished to accommodate a new gasholder 152 feet (46.3m) in diameter. Ancillary plant is constructed to optimise functionality of the increased carbonisation power of the plant. A tram system is constructed, as is a hydraulic lift to convey coke to a new depot on Kent St.

1882 – The new office building is constructed on the smaller of the two allotments on Kent St. The larger allotment is turned into a coke yard for the gasworks. The gasworks would remain in this configuration until 1896.

1896 – AGL mechanises the stoking of the retorts in the retort house.

1897 – The AGL waterfront is extended by a further 40 feet (12.2m) via the purchase of a small piece of land to the north. The wharf frontage of this plot of land was incorporated into the gasworks but never built on (the area at the top of the cliff near Kent St).

1899-1900 – The Carburetted Water Gas Plant building is constructed, with the CWG plan commencing operation in 1900.

1908-1920s – Dredging of wharf frontages to the north of the gasworks for the SHT's rat-proof wall begins.

1912 – The Sydney Harbour Trust resumes the gasworks site and leases it to AGL until 1921 (Sept). AGL continues to redistribute gas until February 1918, decreasing in output from late 1917.

1918-1920s – Construction of the northern section of Hickson Rd also required considerable excavation of the gasworks site. “Most of the demolition of buildings and plant” was conducted once production ceased.

Mid-1920s – The construction of Hickson Rd through the gasworks site required the laying of six-inch thick concrete over rock, and eight-inch thick concrete over areas without rock foundation. This process may have involved excavation in some areas and fill in others. Layer of 4 inches of blue metal were laid prior to the concrete. As the road was poorly constructed it was renovated in 1925 via stamping of the concrete prior to an additional surface of tar and bitumen. The construction of jetties and cross-wharf sections of berths 5 & 6 required total dismantling of the AGL’s wharf and reclamation on the western side of Hickson Rd. This truncated a significant part of the gasworks reclamations that bore the wharf, retort houses and coal stores.

Late-1920s – Workshops cover the old gasworks site as shown in a 1928 plan. These workshops held carpenters, plumbers and blacksmiths, and a motor garage was situated at the north end.

1930s-40s – The Maritime Services Board painted the wharves with creosote to protect against insects. The workshops on Hickson Rd were remodelled, and post-war photographs show two-storey workshops at the northern end of the site where previously only one-story buildings had stood in the 1920s. The building at the northern boundary was also extended to Hickson Rd.

1952 – The MSB builds a 2-storey brick workshop on the southern boundary of the site. The foundations of this structure may have compromised earlier foundations or structures beneath it.

1960s – Reconstruction of the wharves that partially covered the former gasworks site occurs. The construction of parallel/longshore berths involved the demolition and removal of some old wharf structures and the construction of a new seawall approximately level with the western extent of the finger wharves. Concrete-filled caissons were sunk at the outer extent of the new wharves and then the space behind them was filled. These changes were completed by 1968, and surface modification to Wharves 5 & 6 was complete by 1974.

1984 - The MSB modifies the workshops on the site once more.

1996-2006 – The Sydney Ports Corporation leased the longshore wharves (Berth 3-8) to Patrick Stevedores NO 2 from 1996 to 2006. The area surrounding the warehouse built by AGL in the 1840s was classified as historic and retained. Developers built a commercial building to the north of that area, and a residential building to the south.

2007 – A design to convert the 22 hectares of land from Millers Point to the passenger terminal at Berth 8 into mixed commercial, residential and parkland spaces was given approval by the state government.

3.2 Nature of the Archaeological Resource in the EPA Declaration Area

3.2.1 Block 4 and Southern part of Hickson Road³

As defined in the Glossary of Terms for this project Block 4 also includes a small part of Block 3, so it is referred to as Block 4 in this report. For chronological development of the Gasworks generally see Section 3.1. Block 4 mostly consists of historic Portions 11 (part), 16 and 15 (part) and the northern part of Portion 17 (Figs 3.2, 3.5). Portions 15 and 16 were part of the original gasworks established on the site and were occupied by the gasworks from 1839. All but the southwest corner

³ This section is taken from Casey & Lowe 2010a *Archaeological Assessment, Barangaroo Stage 1 (Barangaroo South)* (July 2010).

of Portion 11 was acquired in 1863 when the gasworks started planning to expand to the south. They added to their reclaimed lands to the west and expanded their infrastructure from 1868. The newly expanded works are shown on the 1880 plan and in a painting from the 1870s. Further expansion took place in the early 1880s with further expansion to the north (Fig. 3.4). The gasworks continued to operate until 1921 when the site was transferred to the State government following resumption of many of Sydney's wharves.⁴ New wharfage was built on this site in the 1920s which involved the excavation of the western part of the gasworks to allow for a re-alignment of the wharfage to Hickson Road and other nearby wharfage.

Phases

Phase 1: Natural Landscape and foreshore

Evidence for the original foreshore landform and the environment. This type of evidence was recorded at Darling Walk, including evidence of the cockle shell beds below the tidal sands.

Phase 2: Aboriginal Occupation

Phase 3 (1788 to c.1810s): Beginnings of British Settlement

Incidental use of the study area and beginnings of permissive occupancy by later claimants. Possible use of nearby areas by early military officers and related military uses. Grant to John Macarthur.

Phase 4 (1810s-1839): Initial occupation and development

Reclamation of foreshore with probable usage but details unknown. Claimant on Portion 16 was James Jenkins and on Portion 15 was John Langdon (original portion numbers are indicated on Fig. 3.2). No clear use of Portion 11 prior to c.1845 when it was acquired by Henry Bass although there is some reclamation to the south. Most of the Declaration Area was in the harbour at this time other than the modified shoreline in Portions 15/16 and to the north in Block 5 (Fig. 3.2, AA Fig. 2.5, 1823 plan). Only the northern strip of Portion 17 is within the Declaration Area (Fig. 3.2). This strip was always outside of the gasworks footprint. Portion 17 was the original land on which Henry Bass's shipyard was established. It was initially located on the foreshore, which is close to the alignment of Hickson Road but was reclaimed and extended into the western area by 1834.

Phase 5 (1839-1869): Establishing the AGL gasworks

The original gasworks was established on the two lots and was operating by 1841. While some technical aspects of the works changed during this period there were no major alterations or land acquisitions. Northern part of portion 11 was being used as part of Henry Bass's shipyard from 1845 until it ceased to operate c.1853. The gasworks acquired the northern strip of Portion 11 in 1863. Portion 17 continued to operate as Henry Bass's shipyard until c.1853. After this date it became part of Challis & Smith wharfage and new jetties were built.

Phase 6 (1869-1882): Extending the AGL gasworks to the south

Enlarged gasworks on the land to the south. A new retort house 180 feet (54.8 m) wide across the eastern side of the larger site. Built a new gasholder 100 feet (30.5m) in diameter. Parts of Portion 11 and 17 were built over with wharfage.

Phase 7 (1882-1896): Extending the AGL gasworks to the north and Rebuilding of Grafton Wharf

Acquired 2 acres to the north in 1880 and built a retort house extension 110 feet (33.5m) long and pulled down the first two holders to make way for a much larger one that was 152 feet (46.3m) in diameter. Other investments included a tramway system and hydraulic lift to convey the coke to the new depot in Kent Street. These new works operated unchanged until 1896. Parts of Portion 11 and 17 were built over with new Grafton Wharves in early 1880s. These continued to operate until the c.1900 resumptions.

⁴ This section is based on Rosemary Broomham's *Land at Millers Point, Ownership and Usage*, June 2007.

Phase 8 (1896-1921): Extending the AGL gasworks to the west, Resumption and Lease

Mechanisation of the operation of stoking the retorts (loading the coal into them and pushing the coke out) at Darling Harbour in 1896. In 1897 the waterfront was extended by a further 40 feet (12.2m) through the purchase of a small piece of land on its northern boundary. The wharf frontage of this land was incorporated into the works. The only other significant addition to the plant at Darling Harbour in this period was a building erected in 1899 to house a carburetted water gas (CWG) plant that was installed the following year. The gasworks was resumed by the Sydney Harbour Trust in 1901 and was then leased back to AGL until September 1921. Production ceased in February 1918. Rebuilding of the southern strip of the EPA Declaration Area with twentieth-century wharfage.

3.2.2 Block 5 and Northern part of Hickson Road

This includes part of Portion 15, the southern strip and then a separate property to the north (Fig. 3.2). The research in Broomham 2007 and the chronology in Section 3.1 based on that report forms the basis for this analysis. Block 5 and the northern section of Hickson Road are discussed together as they were part of the same occupation phase and re-building events.

Phases

1788-c.1855: In Darling Harbour

There is no known occupation of this area prior to c.1855 by which time this part of Darling Harbour had been reclaimed (Fig. 3.2, 3.6). Prior to this time Block 5 had not been reclaimed and was to the west of the original foreshore (Fig. 3.6). As shown in Figures 3.2 and 3.6 the original foreshore in this area is located within the eastern half of Hickson Road. This appears to be the location of Munn's early shipyard which commenced in the 1820s, although this is only within the eastern extent of Hickson Road where the early foreshore was located at this time (Fig. 3.2). Circa 1844 Lawrence Corcoran started running Munn's yard and his foreman was John Cuthbert. In 1848 they built the brig *Wild Irish Girl*.⁵ It is probably in the early 1850s that the area was reclaimed to extend the land into Block 5 (Figs 3.6, 3.7, 3.8).

c.1855 to 1880

The land reclaimed by 1855 was used for ship building (Fig. 3.8). John Cuthbert took over an earlier shipyard in 1853 which had been operated by Lawrence Corcoran. It became a major Sydney shipyard 'specialising in schooners and other wooden-hulled vessels'.⁶ In the 1850s Cuthbert employed 150 shipsmiths, anchormen, sailmakers, carpenters and block and mastmakers. By the 1860s Cuthbert was building steamships and he could build up to 500 ton vessels.⁷ The structures indicated on the 1865 overlay were all associated with the maritime use of Block 5 (Figs 3.1, 3.2, 3.9, 3.10). The gasworks had tried to buy the shipbuilding yard of John Cuthbert in the 1870s but he refused, eventually selling it to the shipbuilders Rowntree & Co who continued to operate from Block 5 up to 1880 when they sold it to AGL.⁸ They also had a floating dock moored off shore (Fig. 3.2).

1880-1900

The acquisition of the land within Block 5 and Hickson Road added 2 acres of land for the gasworks, as well as extending the gasworks wharfage by 224 feet. Additional timber wharfage was added which extended their working area even further. Considerable expansion took place on Block 5 from 1880 with the construction of an extension to the retort house into the southern part of Block

⁵ Fitzgerald & Keating 2007:32

⁶ Fitzgerald & Keating 2007:50-51

⁷ Fitzgerald & Keating 2007:50-51

⁸ Broomham 2007:23

5 (Portion 15) (Fig. 3.2). The 'former dock site had to be cut down by 40 feet to match the existing gasworks yard and to accommodate the tank for the holder, a further 36 feet was carved out of the rock'.⁹ The extent of these works are illustrated on Figure 3.4 and relate to both Block 5 and the Hickson Road part of the site. These new works included a new retort house, the large gas holder with a diameter of 152 feet (only the cutting of which survives in the ground), purifiers and a range of structures (Fig. 3.13). The new 'telescopic holder', which was partly located within Hickson Road and beneath the Bond building, was commissioned on 29 May 1882.¹⁰

In 1896 the gasworks mechanised the operation of stoking the retorts (loading the coal into them and pushing the coke out) at Darling Harbour in 1896. In its jubilee year of 1897 it extended its waterfront by a further 40 feet through the purchase of a small piece of land on its northern boundary. The wharf frontage of this land was incorporated into the works.¹¹ Figure 1.3 shows the location of the gasworks in 1903.

1900-1921

Plague resumptions arising from rats infecting the wharves and surrounding business in Darling Harbour and nearby led to the NSW Government announcing they would rebuild the wharves. The government decided they would resume the gasworks land but it was delayed until 1912. This resumption allowed the ever expanding gasworks to remove their Darling Harbour works to their larger operations at Mortlake. Production of gas ceased in 1918 although AGL continued to occupy the site until 1921.¹²

3.2.3 Existing Impacts on Potential Archaeological Resource - Blocks 4, 5 and Hickson Road

The 1788-1839 occupation within this area typically related to early maritime trade and infrastructure and other similar activities. The area was generally built up with stages of reclamation, construction of seawalls and infilling. The occupation from 1839 by the AGL gasworks involved phases of expansion, reclamation and upgrading of technology (Figs. 3.1. to 3.4). The 1920s construction of two double-decker wharves, berths 5 and 6, required the excavation of part of the reclaimed land including wharves, coal stores and retort houses (Figs 3.4, 3.5). Therefore an important section of the gasworks was removed at this time. The mid twentieth-century construction works will have had some impacts on areas but these will generally be isolated and relate to concrete caissons and deeper services. A concrete wharf was identified in the testing stage in Block 4 but this was to the west of the dotted line and confirms that this area was heavily impacted during the 20th century.¹³ Remnant timber piling and cultural deposits formed within marine sediments under the shadow of Jetty 6. Some timber piling and cultural deposits within the marine silt could be present eastwards of the early 20th-century seawall, under 19th-century reclamation.

The following levels based on the Darling (Walk) Quarter excavation program can be used as guides for the levels at which some of the archaeological resources will be found:

- Water table was encountered at between -0.3m and 0.2m and higher after rain.
- Foreshore span with archaeological features ranged from -0.8m to 0.8m where sands met rocky outcrops (information based on Darling Walk, Area 7 and Area 6 combined).
- Mid-19th-century level after reclamation across all areas varied between RL 1.5m to 1.7m (in Darling Walk, Barkers Mill yard).

⁹ Broomham 2007:24

¹⁰ Broomham 2007:23-24

¹¹ Broomham 2007:1-2

¹² Broomham 2007:29

¹³ Casey & Lowe 2010c *Non-Indigenous Archaeological Testing, Barangaroo South*, pp. 8, Fig. 2.1. The southern

It is likely that most of the area in the west has been considerably impacted by 1950s and 1960s excavation and dredging but there is still some likelihood for piles and some cultural deposits within the shadow of Jetty 6. There is limited opportunity for archaeological evidence in this area. The eastern area is likely to contain substantial remains of Australia's first gasworks but this is part of an extensively contaminated Declaration Area. The undertaking of archaeological works in this area is likely to be highly compromised by the risk the site poses to human health and the environment.

The phasing plans (Figs 3.1 to 3.4) indicate that there was considerable rebuilding over the original part of the site. The Declaration Area includes the original gasworks area, which included the original and replacement retort buildings (to the west of the dashed line) which were probably removed in the 1920s (Figs 3.4, 3.5). The southern section of Hickson Road area contained gasworks structures built prior to 1880 (Figs 3.1, 3.2) as well as some other additional buildings after this date (Figs 3.3, 3.4).

The EPA Declaration Area has potential for impacts from wharfage rebuilding but these are most likely to be quite minor. The 1920s wharfage extended into the northern part of Portion 11 but the areas to the east should have had relatively minor impacts other than from gasworks contamination extending into this area. The making of Hickson Road through the gasworks site will have involved removal of structures, excavation of softer areas and their backfilling with compacted material as well as reduction of rock levels throughout the area.

The most recent geo-technical report on the EPA Declaration Area indicates that there are extensive fills across the site and that bedrock along Hickson Road is quite high and there are a number of services running along the road as well (Appendix 2). Typically the fills deepen out westwards from Hickson Road then step down again once out past the gasworks early and later reclamations.

3.2.4 Archaeological Potential

The EPA Declaration Area has the potential to contain:

- Some remains of pre-gasworks use of the area in Block 5 and the southern section of Block 4. In both cases this relates to later phases of timber ship building dating to the 1840s and 1870s. Block 4 and Hickson Road areas also contain evidence of the original landform although the Hickson Road area is likely to be highly modified in the northern area due to the presence of rocky cliffs along the original foreshore which were cut down during the construction of Hickson Road.
- All areas will contain stages of reclamation dating prior to and during the occupation of the site by the gasworks.
- Remains of the eastern part of the gasworks of all phases where it was not removed by the 1920s remodelling of the foreshore for wharves.
- Demolition of the gasworks is likely to have had considerable impact on the gasworks structures and technology.

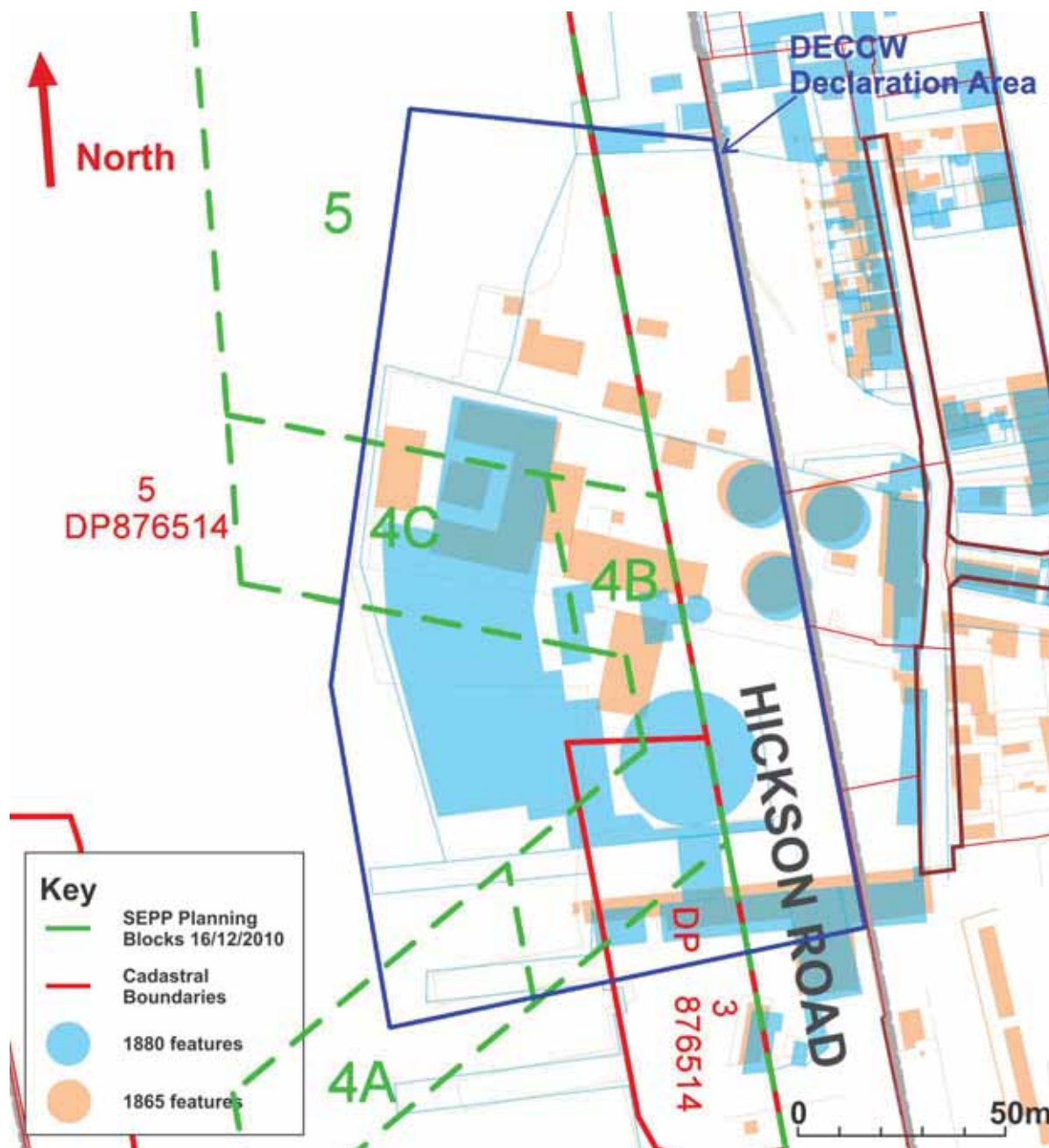


Figure 3.1: Overlay of the 1865 plan (orange), the 1880 Dove plan (blue) of the gasworks site showing how it extended out from the original portions by 1880. Block 5 area was now reclaimed as part of shipyard (by 1855). The dashed black line indicates the position of the new seawall in 1928. All parts of the gasworks to the west of this line were excavated out (destroyed) in the 1920s. It is also likely that the projecting dashed line was cut back at this time as the jetty above it was on piles. Casey & Lowe, north is at the top.

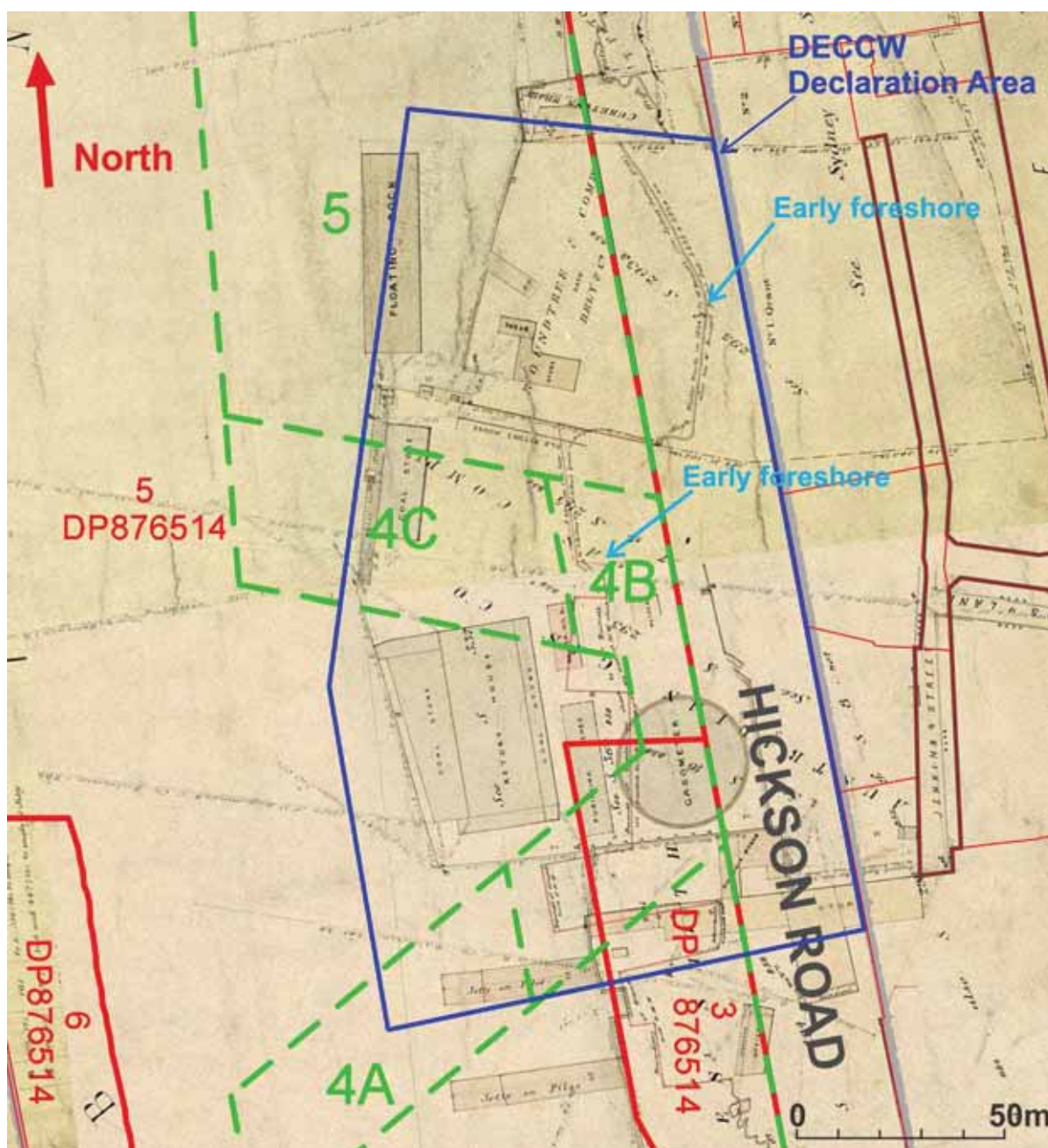


Figure 3.2: Overlay of study area onto the 1875 historic plan. Block 5 is mostly reclaimed land for the gasworks. It shows the original foreshore halfway across Hickson Road. The gasworks extends northwards into Block 5 in 1880. Green lines indicate the historic portions and are based on those on Russell's 1834 plan. Casey & Lowe based on Rygate & Co overlay, AO Map 4774, CH Wansbrough, north is at the top.

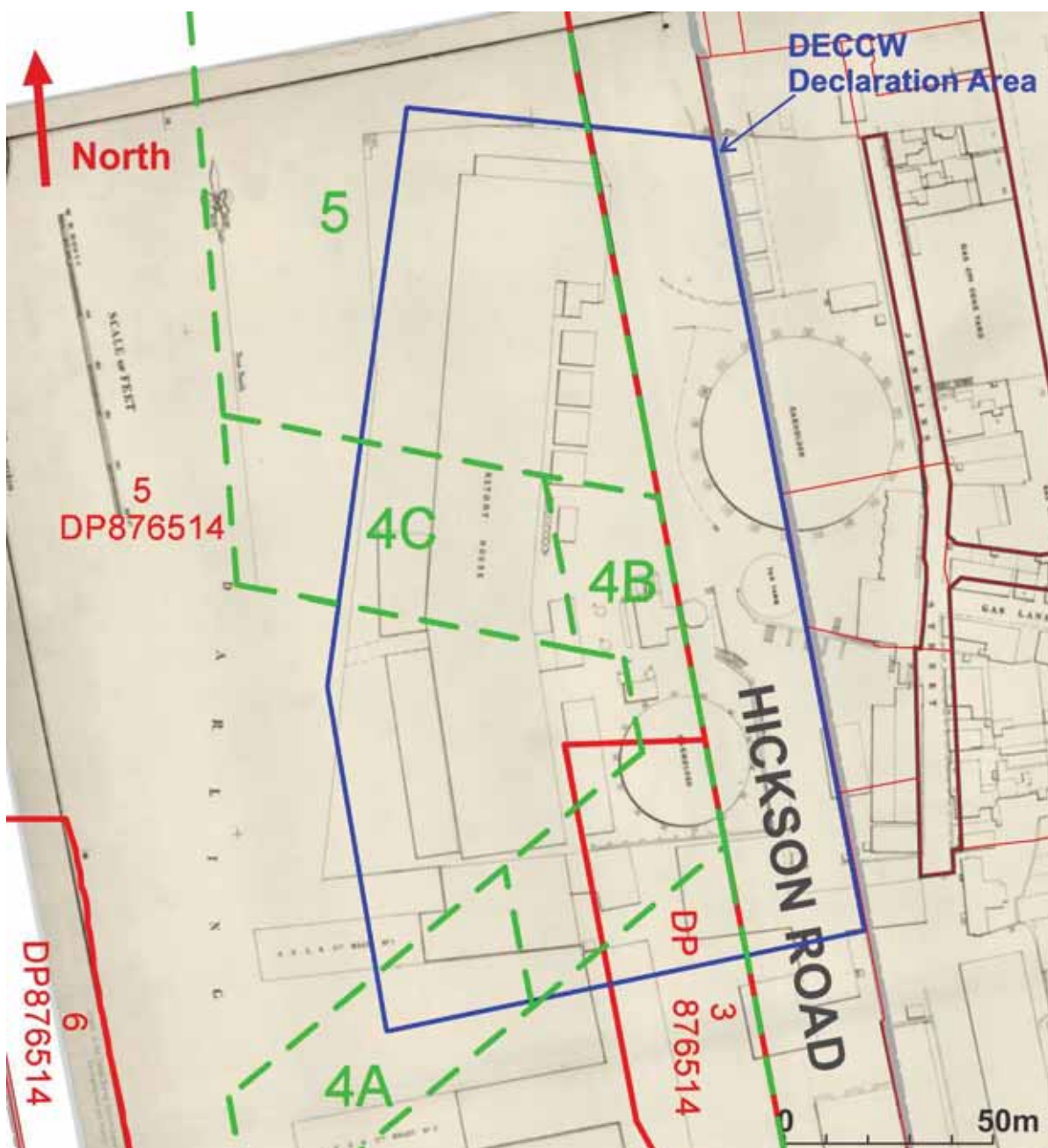


Figure 3.3: NSW Dept of Lands, Metropolitan Detail Sheets, Sydney Section 67, 1891, Z M Ser 4 811.17/1 (Mitchell Library and on line). Overlay by Rygate & Co, surveyors. Key: previous development blocks (blue), previous basement concept (purple), EPA Declaration Area (blue hatched). Rygate Surveyors for Lend Lease, north is at the top

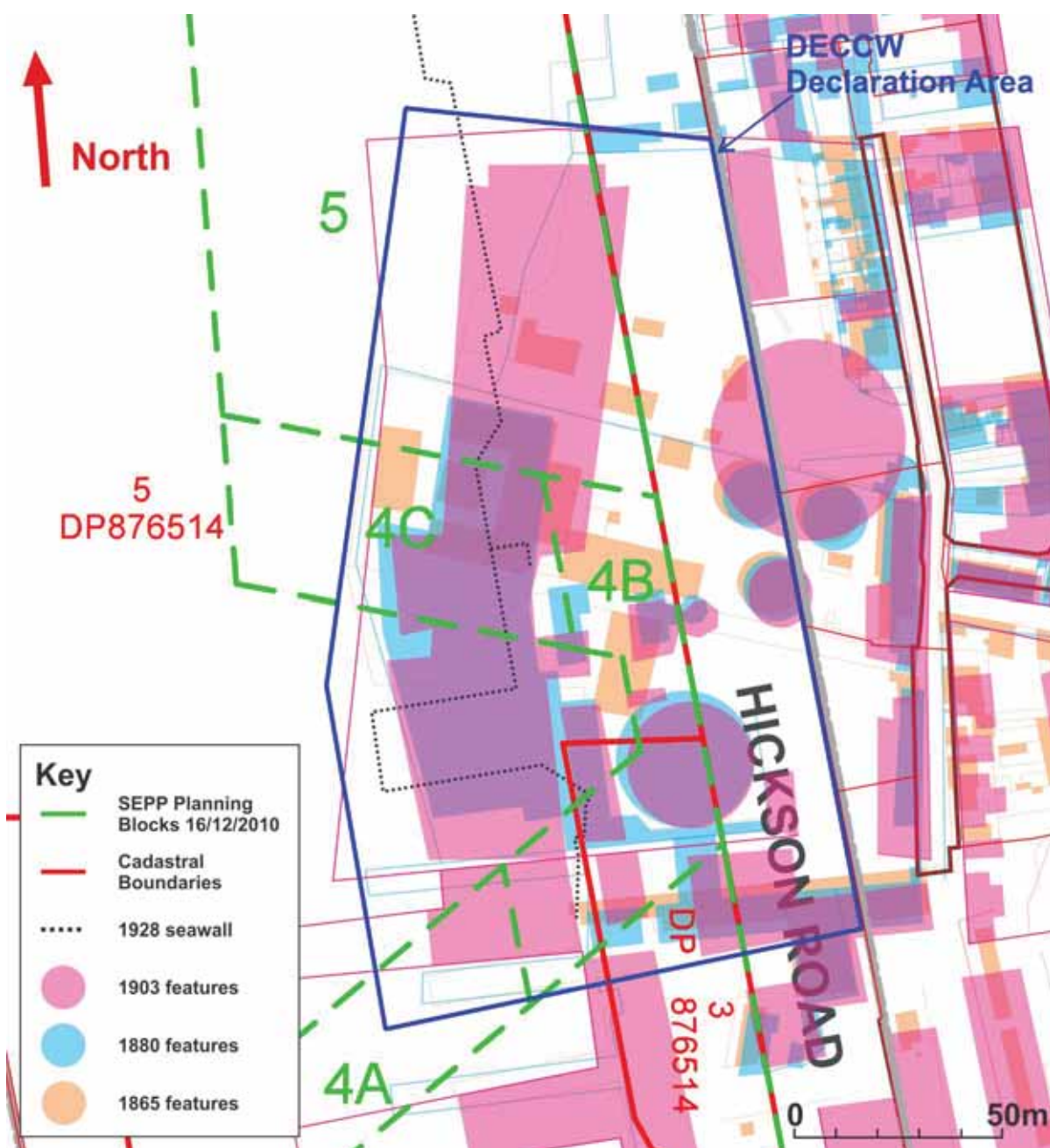


Figure 3.4: Overlay of the 1865 Trigonometrical Survey plan (orange), the 1880 Dove plan (blue) and the 1903 plan (purple) of the gasworks site showing how it extended out from the original gasworks on Portions 15 and 16 (north half Block 4) to the south and then to the north. The dotted black line indicates the position of the seawall in 1928. All parts of the gasworks to the west of this line were removed in the 1920s. It is also likely that the projecting dashed line was cut back at this time, as the jetty above it was on piles. Casey & Lowe, north is at the top

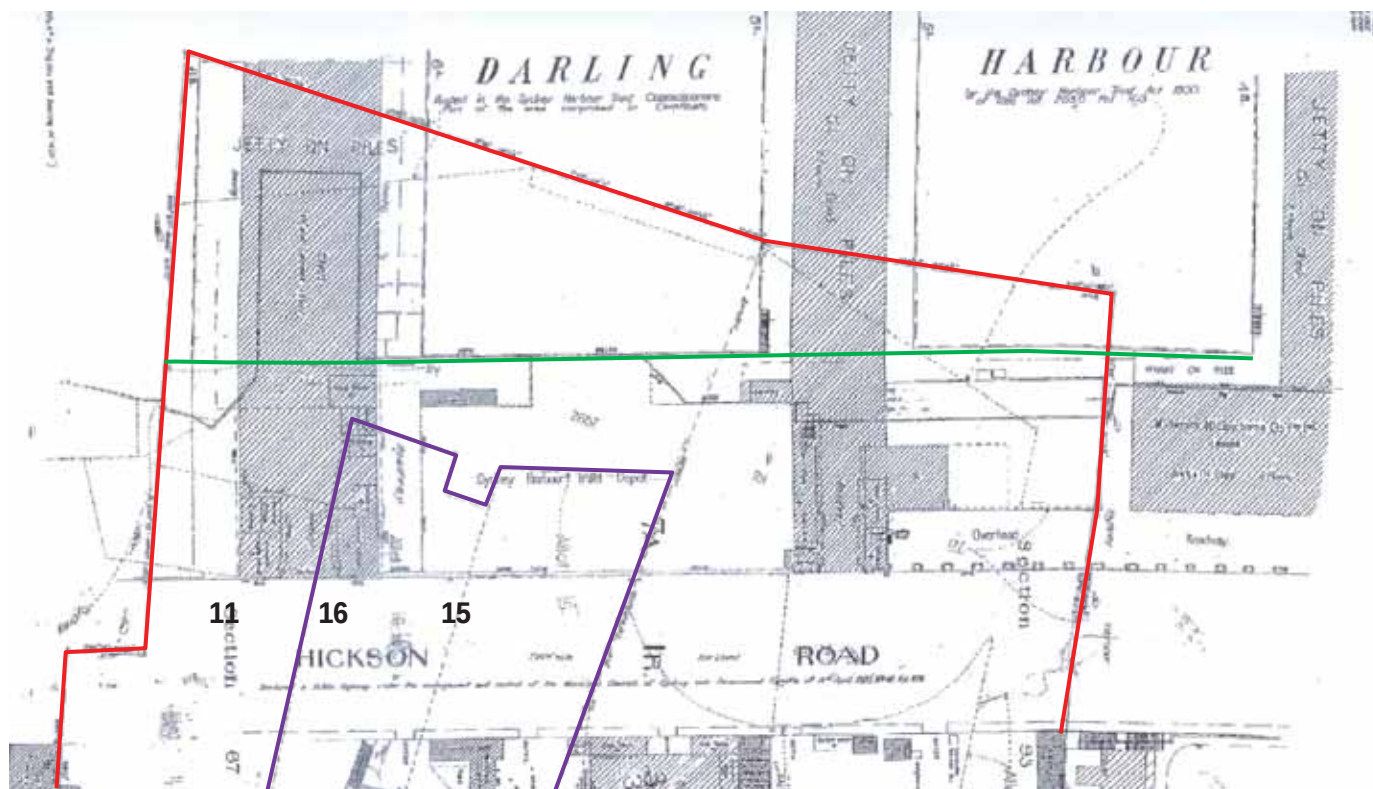


Figure 3.5: Plan showing how the western part of the gasworks was excavated for the construction of the 1920s wharfrage. Red line indicated the extent of the gasworks by 1918, the green line indicates the new 1928 seawall and the purple lines indicate that extent of Portions 15 and 16 in relation to Hickson Road in the 1830s. North is to the right.

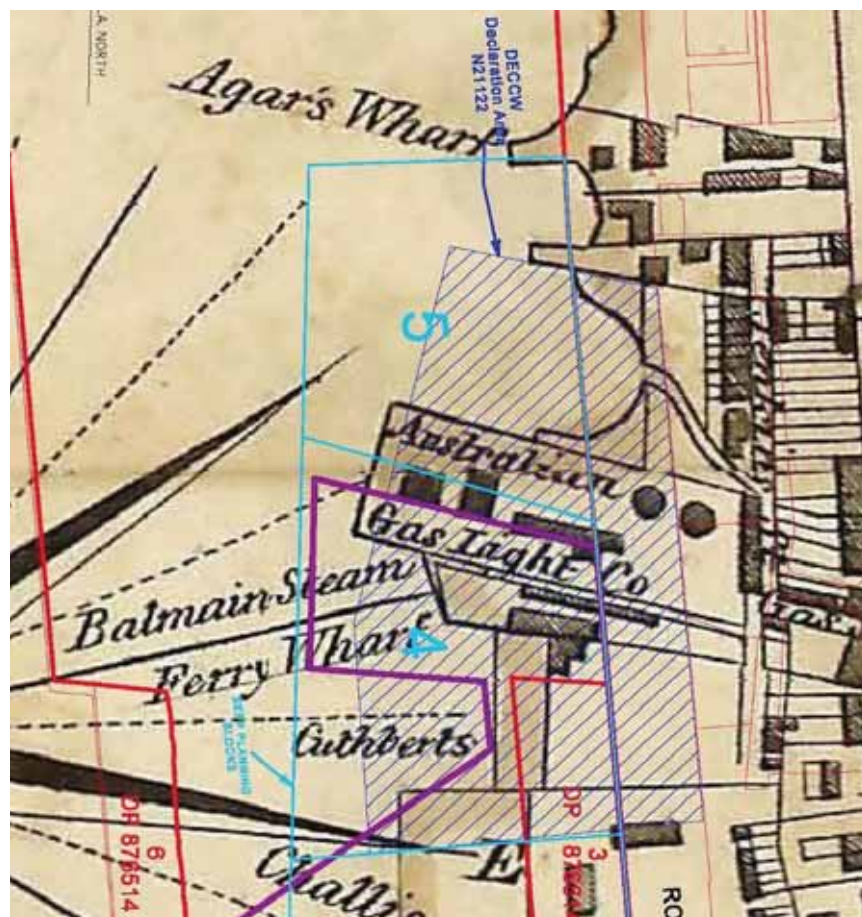


Figure 3.6: Block 5 is to the west of the foreshore in 1854, indicating it is reclaimed at a later date. Prior to the post 1850s reclamation there is no significant archaeological potential within Block 5, Key: development blocks (aqua), previous basement concept (purple), EPA Declaration Area (hatched). Woolcott & Clarke's Map of the City of Sydney, 1854, Historical Atlas of Sydney, City of Sydney Archives, with overlay by Rygate & Co, surveyors, north is at the top.

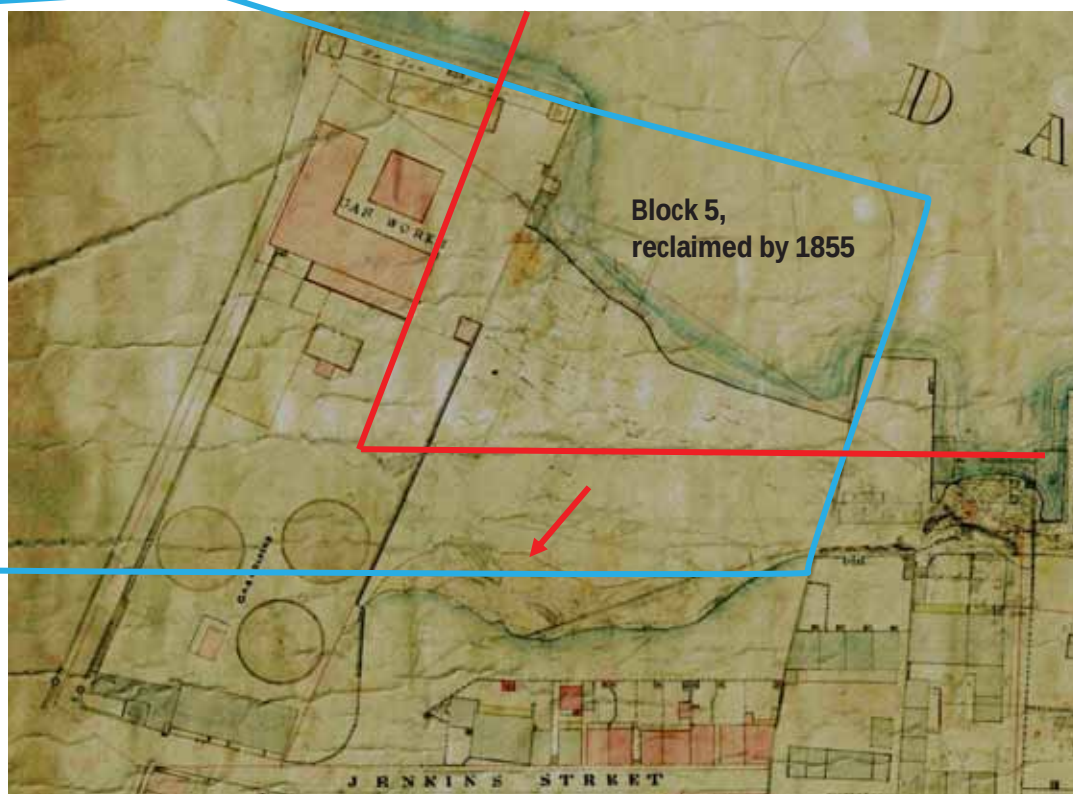


Figure 3.7: This plan shows that the early reclamation in Block 5 (red lines) was completed by 1855 with a rocky cliff to the east where Hickson Road was built in the twentieth century. Red arrow indicates the approximate line of the early foreshore. It also shows pencil drawings of structures added after 1855. Location of EPA Declaration Area is in blue. 1855 City Detail Sheet, City of Sydney, Historical Atlas of Sydney, City of Sydney Archives. North is to the right.



Figure 3.8: View of Block 5 with a gasworks building behind. Initial reclamation of Block 5 was reclaimed by 1855. The high rocky area is probably the area of the Gasworks above Hickson Road and west of modern Kent Street. *Patent Slip* belonging to the Australian Steam Navigation Co., Frederick Garling, c.1855, ML, SLNSW, DGD3



Figure 3.9: AGL gasworks and the adjacent shipyard to the north in Block 5. View of Miller's Point and Darling Harbour, c.1870 [artist unknown], ML, SLNSW, DG 392.



Figure 3.10: View to northwest from area of gasworks across Cuthbert's shipyard, 1873. The northern edge of the stone seawall of the gasworks wharf is in the foreground. Holterman Collection, SPF, ML, SLNSW

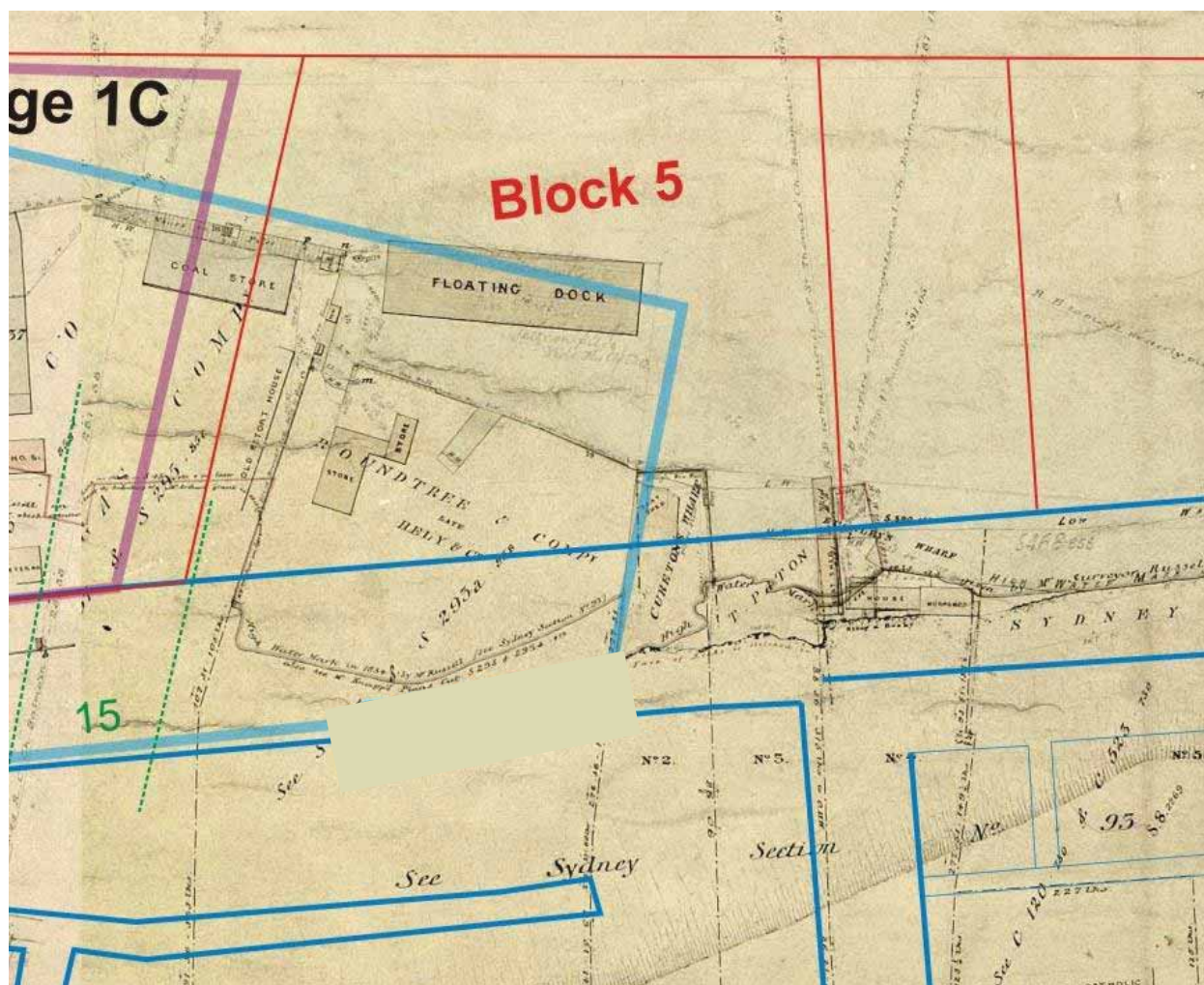


Figure 3.11: Detail of the Block 5 and the northern extent of the EPA Declaration Area (blue) which includes the Roundtree (Rowntree) shipyard. Beyond the EPA Declaration Area to the north are smaller wharves and slips: Cureton's wharf, T. Paton, and Buckley's wharf. Detail from overlay on EPA Declaration Area and SEPP development blocks onto the 1875 historic plan, AO Map 4774, CH Wansbrough, north is to the right

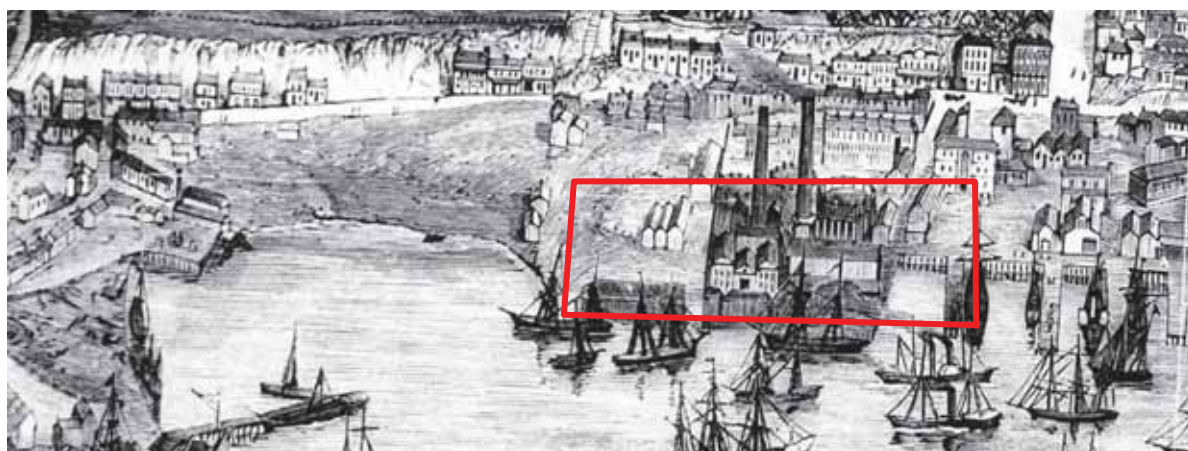


Figure 3.12: Approximate location of the EPA Declaration Area on a detail from an 1879 *Illustrated Sydney News*. The gasworks sketch shows the additions made between 1868 and 1872. Block 5 has yet to be acquired by the gasworks. Taken from Broomham 2007:22, ML SLNSW



Figure 3.13: Gasworks from the north showing the new retort house (1880) and stack on the southern side of the old carbonising plant with the Rowntree shipyard in middleground. Dates prior to the purchase of the northern block by the gasworks in 1880, probably c.1880. SPF, ML SLNSW

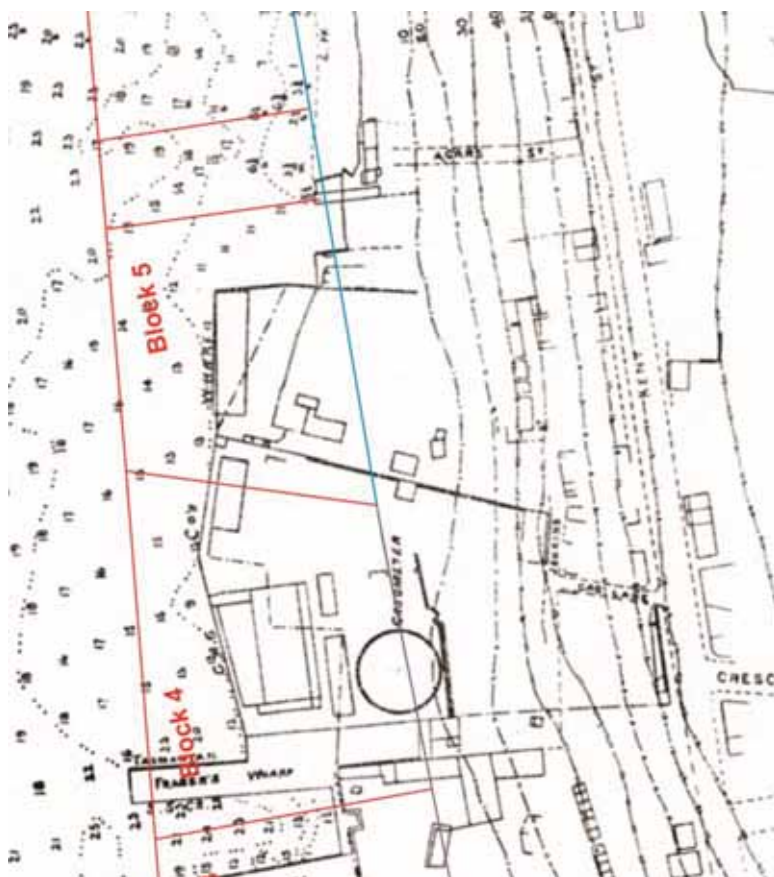


Figure 3.14: 1887 plan showing the extent of reclamation which now extended to the west. *Plan of Darling Harbour showing existing wharfage.* SR NSW.



Figure 3.15: View to the southeast showing the large gasholder on Block 4 and the southern part of Hickson Road. The rocky face to the north of the gasholder was cut back when Hickson Road was built in the early twentieth century. View of the reconstruction of Darling Harbour from Millers Point showing Dalgetys Wharf No.1 partly completed, 1/1/1909, State Records 9856_ao17_AO17000007.



Figure 3.16: AGL site during demolition, c. 1922, shows the northern side of the five-storey sandstone office and store with the balcony on the western side and the brick building in front of it. The telescopic holder in the middle ground was being dismantled. The cutting for the holder, excavated deep into the bedrock, was recorded during the construction works for the Bond in 2002 (Archaeology & Heritage 2004). AGL Archives, from Broomham 2007:43

3.3 Gasworks Archaeology and Heritage

In 1999 Godden Mackay Logan assessed the archaeological potential of the eastern side of the AGL gasworks site for Delmo Pty Ltd. They assessed that the eastern part of the site had been heavily impacted by quarrying for the 1882 annulus for the gasholder. This annulus was photographically recorded by Anne Bickford in 2002. The Annulus was 152 feet in diameter (46.3m) and destroyed most of the earlier archaeological resource in the eastern part of the site.¹⁴ The main item recorded by Bickford in 2002 (2004 report) was the cutting for the annulus circle into bedrock. Bickford was limited to recording the remains by photos 'because the toxic by-products of gasmaking by burning coal, the site was highly contaminated and no closer record by measuring or plan drawing could be made of the annulus'.¹⁵

It is noted that while the archaeological resources have been removed to the east of Hickson Road under 30 Hickson Road, some should still survive within Hickson Road. Also a number of gasworks buildings survive at 34-36 Hickson Road and 2-4 Jenkins Street (Figs 3.17, 3.18, 3.19).



Figure 3.17: Former gasworks building at 34 Hickson Road.



Figure 3.18: Former gasworks building at 36 Hickson Road.

¹⁴ Archaeology & Heritage 2004:12; GML 1999:29, 39.

¹⁵ Bickford, Archaeology and Heritage 2004:3.



Figure 3.19: Former gasworks building, Jenkins Street above the Hickson Road buildings.



Figure 3.20: Tar contamination apparently uncovered during construction works in September 2002. Mark Burns, Lend Lease (Millers Point)



Figure 3.21: View of the the eastern part of the annulus, cut into bedrock, found beneath the bond during works in 2002. Bedrocks is quite high in this area. Mark Burns, Lend Lease.

4.0 Contamination & Heritage Significance of the Gasworks

4.1 Contamination and its impact on Heritage Significance

The impact of the known contamination in the EPA Declaration Area is a real issue for understanding and assessing the heritage significance of this archaeological resource. As stated above a major part of the contamination within the Site Remediation Area is tar, a major bi-product of gasmaking from coal. As Fig. 3.20 shows this is likely to be all over the site, covering remains of structures, infilling voids and making it extremely difficult to undertake typical archaeological recording process which involve manual cleaning, recording by drawing and photography all within hazmat suits in a confined space. As acknowledged in the GML 1999 and Bickford, Archaeology & Heritage 2004 reports the nature of the contamination will greatly affect an archaeologist's ability to record these remains and therefore other non-typical approaches need to be considered. In addition Casey & Lowe consider that the contamination of the remains also affects significance.¹⁶

4.2 Other Gasworks Sites

As part of the assessment of the SISCO project Casey & Lowe reviewed other gasworks projects and the associated contamination issues. The levels of contamination in former gasworks sites can create limitations on archaeological work. Contaminations can particularly limit investigation involving hand excavation and other tasks requiring close contact with soil. Some actions, such as kneeling and recording, which requires close examination of soil and structures and measurements, are difficult to replicate through mechanical processes.

Disused gasworks are often sources of contamination as, on their closure, very few were brought to an acceptable level of environmental cleanliness and many were abandoned with process wastes often left *in situ*.¹⁷ The most severe contamination at gaswork sites can take the form of coal tar, mixed long-chain aromatic and aliphatic hydrocarbons, a by-product of coal carbonisation, and 'Blue Billy', a by-product of lime purification contaminated with cyanides, amongst other contaminants.¹⁸ The following table outlines a UK-based assessment of gasworks contamination and potential structures of archaeological significance.¹⁹

Potential land contamination	Potential structures of archaeological significance	
Coal tars	Benzole plant	Lime shed
Heavy metals	Coal handling plant	Lime washers
Phenols	Coal store	Liquor tank
Sulphates	Coke handling plant	Napthelene plant
Cyanide Ammonium (Ammoniacal liquor)	Coke ovens	Oxide shed
Hydrocarbons	Coke store	Purifier
Chlorinated solvents	Condenser	Purifier house
Poly Chlorinated Biphenyls (PCBS) (If electricity generation on Site)	Cyanogen plant	Refuse lime heap
	Electro-detarrers	Retort house
	Fuel storage tanks	Rotary washer
	Gas drying plant	Tar pit
	Gasholder	Tower purifier
	Gasholder house	Tower scrubber
	Gasworks	

Table 1: Potential historic features and land contamination issues associated with a gasworks.

¹⁶ Casey & Lowe July 2010

¹⁷ City Plan Heritage, *Macdonaldtown Gasworks Archaeological Test Excavation Report for Railcorp*. August 2010; 20.

¹⁸ City Plan Heritage, August 2010; 20.

¹⁹ English Heritage, *Guidance on Assessing the Risk Posed by Land Contamination and its Remediation on Archaeological Resource Management*. Environment Agency, June 2005; 20.

Gasworks sites often require remediation to bring them up to modern environmentally acceptable standards of cleanliness, and allow for the changing use of previously industrial sites. However, remediation, generally involving the wholesale removal or treatment of contaminated fills, can severely impact on potentially significant archaeological structures and *in situ* remains. Therefore remediation of historic industrial sites often incorporates archaeological investigation to assess impacts. In order to protect staff working in close contact with serious contaminants archaeologists working on these types of sites are often required to wear a high level of protective equipment, such as impermeable suits, gloves, half or full face respirators and footwear.

Australian examples where archaeological investigation has taken place are relatively limited. In 1989 Don Godden & Associates carried out survey and recording of standing remains at the Mortlake gasworks but the report did not deal with buried archaeological remains.²⁰

4.2.1 The Former Macdonaldtown Gasworks, Erskineville

The former Macdonaldtown Gasworks in Erskineville has been the subject to two assessments. The first by Banksia Heritage + Archaeology (2004), and the second by Heritage Concepts (2006). A program of archaeological investigation by test trenching was also undertaken by City Plan Heritage in March 2010.²¹ The archaeological testing program was designed with the planned remediation in mind, to determine whether the removal of contaminated fills would impact on buried archaeological features or standing structures. The Macdonaldtown gasworks were in operation up until the 1950s, when the majority of buildings were demolished, with the exception of a standing gasholder which was used for gas storage into the 1970s and is currently the only standing gasholder in NSW.²²

Prior to archaeological testing RailCorp had identified the presence of coal by-products, including tar, coke and ash in the central area of the site, where processing occurred. Contaminated fills containing coke, ash and demolition waste were also identified. This contamination was declared by the NSW Environmental Protection Agency to pose a significant Risk of Harm to human health and/or the environment, as defined by the *Contaminated Land Management Act 1997* (CLM Act).²³ It was determined that the decontamination and remediation works would affect the archaeological remains and therefore a programme of test excavations was planned in order to assess and identify any archaeological remains.²⁴

The test trenching carried out by City Plan Heritage commenced in March 2010 and involved the excavation of five test trenches. This work was carried out by machine excavation and hand cleaning of exposed features. The trenches were located to determine the extent and condition of remains of the Purifying Shed (Trench 1 and Trench 2), the Retort House (Trench 3) and the Compressor and Tea Rooms joining the Retort House at the northeast corner (Trench 4).²⁵ Trench 5 was intended to confirm a building referred to as the Superintendent's Residence but this was not possible as the footprint of the building was located under the current driveway and gravel wash bay.²⁶ The contamination levels required the work to be carried out in protective suits and respirator masks. Stockpiles were covered in plastic to prevent the spread of contaminated dust

²⁰ Don Godden & Associates, *Mortlake Gasworks, Conservation Plans, Miscellaneous Structures*. Report for the Australian Gas Light Company. March 1989.

²¹ City Plan Heritage, August 2010.

²² City Plan Heritage, August 2010; 1.

²³ City Plan Heritage, *Former Macdonaldtown Gasworks Heritage Interpretation Plan For Railcorp*, updated February 2011:3.

²⁴ City Plan Heritage, *Former Macdonaldtown Gasworks Archaeological Research Design*, Report to Railcorp, March 2010:6.

²⁵ City Plan Heritage, August 2010; 15.

²⁶ City Plan Heritage, August 2010; 15.

and odours. Contaminated groundwater in the trenches also affected hand excavation and limited recording.²⁷

4.2.2 Former gasworks at Little Manly Point, Manly

Archaeological monitoring was undertaken by Edward Higginbotham & Associates in 1989 at the site of the former gasworks site at Little Manly Point in Manly. The preliminary report outlining the recommendations for the management of the site was completed in 1989. The report recommended that archaeological investigation be undertaken prior to disturbance of archaeological features. It also stated that it was envisaged that any archaeological work could be carried out at the same time as the decontamination process, and that the extent of the archaeological investigation would be limited by this process. In this situation it was therefore recommended that the excavator operator, under the supervision of the archaeologist who had been given advice by the de-contamination contractor, would carry out both archaeological investigation and decontamination.²⁸

During decontamination in 1990 deposits containing high levels of harmful chemicals were removed. An archaeologist was able to observe and record parts of various heritage items during the process. It was recommended throughout the decontamination process that the core areas of gas manufacturing be conserved, although this recommendation was modified by the need to decontaminate the site.²⁹ The site of the gasworks at Little Manly Point is therefore an example of an archaeological program that has been modified to suit the needs of the decontamination process.

4.2.3 Nowra Gasworks

In 2002 a heritage assessment of the site of the former Nowra gasworks site was undertaken by Edward Higginbotham & Associates.³⁰ This report noted that there was likely to be contamination of the site from by-products of gas manufacture, which may have a major impact on the management and conservation of the site.³¹ It was recommended that prior to any additional works being carried out that Shoalhaven City Council assess the levels of contamination at the site and, based on the impact of the contamination on the site, an assessment of heritage significance prepared.³² The report recommended that the most appropriate action should redevelopment occur was to include some archaeological investigation of footings and other remains.³³ It is noted that the level of contamination would need to be taken into consideration should redevelopment occur, and that this would likely change the appropriateness of the recommendations.³⁴

4.2.4 The gasworks site on the former HMAS Platypus naval base

This former HMAS Platypus site was established in 1876 as a gasworks which was in operation for 50 years.³⁵ In 1942 the Commonwealth government resumed part of the gasworks for the Royal Australian Navy's to perform torpedo maintenance during WWII and the majority of the gasworks

²⁷ City Plan Heritage, August 2010; 15.

²⁸ Edward Higginbotham & Associates *Gasworks Site, Little Manly Point, Manly NSW, Report on Archaeological Watching Brief*. Report for Department of Planning NSW, 1990: 1.

²⁹ Edward Higginbotham & Associates 1990:12

³⁰ Edward Higginbotham & Associates *Statement of Heritage Impact for Nowra Gasworks, Lamonds Lane, Nowra NSW*. Report for Shoalhaven City Council, November 2002.

³¹ Edward Higginbotham & Associates November 2002:82.

³² Edward Higginbotham & Associates November 2002:86.

³³ Edward Higginbotham & Associates November 2002:90.

³⁴ Edward Higginbotham & Associates November 2002:93.

³⁵ Accessed via The Harbour Trust Website: <http://www.harbourtrust.gov.au/visit-our-sites/hmas-platypus/history/> on 25/09/2012.

buildings were demolished (those extant today date mainly to the 1940s).³⁶ HMAS Platypus was commissioned in 1967. In 1999 the government relocated its submarine base and in 2005 the site was taken over by the Harbour Trust.

The Conservation Management Plan (CMP)³⁷ prepared for the site lists potential subsurface remains. These include an 1860s two-roomed timber cottage and farm buildings that pre-dated the gasworks, structures from 1876 that represent the early phase of the gasworks use, including a building house brick retorts, a boiler house, coke plant, coal stores and an additional retort house. Potential remains dating to the late 19th century, still associated with the gasworks, may include three purifiers, washers and scrubbers, a blacksmiths shop, store, Governor Room, Test Rooms, a third gasholder and an office.³⁸ In the 1920s two additional sets of purifiers and a booster house were constructed but these were outside the project study area. Up to four tanks and associated tar pits were excavated into bedrock. These were associated with the gasworks and containing contamination in the form of coal tar products. In addition, during the Royal Australian Navy's use of the site at least four underground tanks were established. These tanks include a sullage tank, a petrol tank, a diesel tank and a lubricating oil tank.³⁹ It is likely that underground piping from the gasworks survives, and the CMP noted that Godden Mackay Heritage Consultants had previously stated that the archaeology of gasworks usually provides a range of examples of piping.⁴⁰

The HMAS Platypus site is currently undergoing a second phase of remediation which will involve assessment of the archaeological potential of the gasworks in the northern portion of the site, and how this will be managed during remediation.⁴¹ It has been noted that the damage to any subsurface remains from the gasworks era should be minimised and allowances made for an archaeologist to view any remains.⁴² The CMP, however, notes that subsurface investigations undertaken on other former gasworks sites has established that remnant subsurface features have provided little information that is of research value, that the technology and practises of gasworks have been well documented and that the archaeological material is generally out of context and difficult to relate to the various processes which are known to have been undertaken on the site.⁴³ For these reasons the CMP considered the site to have limited significance, and concluded excavation work would not be expected to expose material evidence of the operation of the gasworks that is significant or unavailable elsewhere.⁴⁴

The Following examples are from the UK and the USA, and demonstrate that the methods for dealing with contaminated gasworks sites are largely universal.

4.2.5 The Ansell Gasworks Warwick, UK⁴⁵

The excavations at the Ansell Gasworks in Warwick were required prior to the redevelopment of the site. The excavation was hampered by potential contamination within the soil, contaminants included arsenic, lead, benzene and 2,4 dimethylphenol.⁴⁶ Decontamination suits and respirators

³⁶ Stedinger Associates in Clive Lucas Stapleton and Partners, HMAS Platypus Conservation Management Plan, March 2008.

³⁷ Clive Lucas Stapleton and Partners, March 2008:54.

³⁸ Clive Lucas Stapleton and Partners, March 2008:53

³⁹ Clive Lucas Stapleton and Partners, March 2008:54.

⁴⁰ Clive Lucas Stapleton and Partners, HMAS Platypus Conservation Management Plan, March 2008

⁴¹ Sydney Harbour Federation Trust, *Site Management Plan, Stage 2 Works, Platypus Remediation Project*, June 2011; 56

⁴² Sydney Harbour Federation Trust, June 2011:56

⁴³ Sydney Harbour Federation Trust, June 2011:21

⁴⁴ Sydney Harbour Federation Trust, June 2011: 21

⁴⁵ Cambrian Archaeological Projects Ltd, *Ansell Road Gasworks, Saltisford, Warwick, Archaeological Excavation and Watching Brief*. CAP Report No. 325, August 2004, December 2005 to March 2005.

⁴⁶ Cambrian Archaeological Projects Ltd, August 2004, December 2005 to March 2005; 4.

were therefore required to be worn at all times. Excavation remained at a relatively shallow level owing to the recent date of the archaeological deposits of interest.⁴⁷

The watching brief was carried out to the north of a building constructed in 1822 during excavation of 70m² of land. It was hoped that the brief would be able to establish whether archaeological structures or features survived within the works area. In this area the high levels of contaminants within the soil meant that contact with the archaeology was to be avoided as a Health and Safety issue.⁴⁸ The archaeologists were required to wear vapour masks and disposable clothing. In addition gas detectors were fitted to the machines during excavation of identified hot-spots. The overall results of the excavation were hampered by Health and Safety restrictions, as well as issues such as the presence of large amounts of tarmac and rubble on site.⁴⁹

This contamination meant that none of the surfaces could be cleaned by hand and scale plan drawing could not be undertaken. Recording using high-resolution digital photography was the only recording that could take place. Scales could not always be included in these photographs.⁵⁰ The overall results of the watching brief were severely restricted by Health and Safety concerns relating to high levels of soil contamination and waterlogging. It was concluded that it was unlikely that any significant record could be made as no dating evidence could be examined and therefore it was difficult to interpret building and demolition sequences.⁵¹

4.2.6 The Santa Barbara Manufactured-Gas Plant (in operation from 1872), USA⁵².

The remediation of this significant American gasworks site required archaeological investigation to record potentially significant features buried by contaminated soil. Prior to this work commencing the highly contaminated nature of the soils and groundwater in the site initial safety recommendations required that field crew 'avoid contact with potentially contaminated substances...and whenever possible avoid kneeling, leaning or sitting on the contaminated surfaces'.⁵³ Processes put in place to facilitate archaeological work included the use of mechanised equipment to remove contaminated fill, the continuous misting to suppress dust, wet screening by hand to clean artefacts of contaminated soil (undertaken by archaeologists wearing rubber boots, waterproof suits, Nitril interior and exterior gloves, and level-C Tyvek suits), the special handling of excavated soil and screen water, the use of specialised PPE: hard hats, ear plugs, eye protection, level-C Tyvek suits, leather boots; daily decontamination of crew members and the implementation of special exclusion zones. In addition all field personnel were required to undertake 40 hours of training in Hazardous Waste Operations and be fit tested and trained in the use of half face/full face respirators.⁵⁴

⁴⁷ Cambrian Archaeological Projects Ltd, August 2004, December 2005 to March 2005; 4.

⁴⁸ Cambrian Archaeological Projects Ltd, August 2004, December 2005 to March 2005; 5.

⁴⁹ Cambrian Archaeological Projects Ltd, August 2004, December 2005 to March 2005; 15

⁵⁰ Cambrian Archaeological Projects Ltd, August 2004, December 2005 to March 2005; 6.

⁵¹ Cambrian Archaeological Projects Ltd, August 2004, December 2005 to March 2005; 15.

⁵² Stratton, et al, Hazardous Site Archaeology: A Case Study of a Manufactured-Gas Plant. In *Current Research in Historical California Archaeology* Vol. 14, 2000; 21-24

⁵³ Stratton, et al, 2000; 22

⁵⁴ Stratton, et al, 2000; 23

4.3 Discussion of Heritage Significance

This discussion of heritage significance is based on the one written for the Archaeological Assessment of Barangaroo South which specifically addressed the gasworks site and issues of contamination as well as the remains of timber boat yards in Blocks 3 and 4. It is extracted and updated for this report. Considerable information relating to the other parts of Barangaroo South has been retained in this discussion as it is important for understanding the significance of this site.

4.3.1 Main Heritage Criterion

Criterion (a): Historic Significance - (evolution)

an item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area);

The Barangaroo South development area as a whole illustrates the evolution of a section of Sydney's history and archaeology from the 1810s into the early 20th century. The non-indigenous occupation of this part of Darling Harbour evolved through a range of stages: Prosper de Mestre's and later Francois Girard's wharf and goods store (c.1824-1830s), Henry Bass' shipyard (c.1819-1850s) and the later shipyard associated with Cuthbert and Rowntree in Block 5 (1840s-c.1880), which was part of the early and later shipbuilding in Darling Harbour, the AGL gasworks and earlier uses. These early developments were typical of the maritime and industrial development of early Sydney and Darling Harbour. They all involved early reclamation to expand the land into the harbour for more secure wharfage and to increase the size of their land. The central part of the study area remained unreclaimed foreshore until the 1840s when it was acquired by the adjoining land holders and became wharfage.

From the 1840s the area was dominated by various phases of wharfage including the extensive Grafton Wharf which was rebuilt in the 1880s to provide for larger ships with the wharf and ground levels raised by about 0.6m. Part of the substantial Grafton Bond store still survives to the east of the study area.

Between the 1860s and 1900 the gasworks expanded to accommodate the increasing demand for gas for lighting in expanding suburban Sydney. It is noted that a number of standing buildings from the gasworks survive on Hickson Road and Jenkins Street. Barangaroo Stage 1 is part of the area resumed by the State government with the onset of the Bubonic plague. This area included the Rocks, Millers Point, Darling Harbour and parts of Pyrmont.

While there were a number of jetties within Barangaroo South they were typically rebuilt and demolished through time. The surviving archaeological resource associated with these jetties is likely to consist of pile stumps on the floor of the harbour and artefacts that may have collected within the shadow of the jetties during their operation. Such remains have been found during preliminary excavation of Barangaroo South, Trench C4.



Criterion (b): Associative Significance – (association)

an item has strong or special association with the life or works of a person, or group of persons, or importance in NSW's cultural or natural history (or the cultural or natural history of the local area);

The potential archaeological remains within the study area are associated with a number of significant persons and industrial manufactories: the AGL gasworks, Francois Girard who was successful early French immigrant, and Henry Bass, John Cuthbert and Rowntree, all three were nineteenth-century ship builders.

Criterion (c): Aesthetic Significance - (scenic qualities / creative accomplishments)

an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the cultural or natural history of the local area);

The gasworks in Blocks 4, 5 and Hickson Road was the first in NSW as well as the first in Australia. While there are impacts from later phases some archaeology associated with the original gasworks - the first manufacturing of gas in Australia - may survive. The archaeological resource associated with the EPA Remediation Area currently provides very limited opportunity to expose some of the surviving archaeology and record it. The site was substantially modified during its c.78 years of operation. It is noted however that this site is highly contaminated and an EPA-declared area which will limit the ability to recover archaeological information.



Criterion (d): Social Significance - (contemporary community esteem)

an item has a strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the cultural or natural history of the local area);

While no community consultation has been undertaken for the archaeology considerable public consultation has been undertaken for the site and its proposed redevelopment. The maritime and industrial archaeology and heritage of NSW have strong community interest and support. These places not only represent the success of the entrepreneur and owner but also of the many workers whose skills and labour supported the achievements of these industrial places. The industrial heritage of Darling Harbour occupies a special position in the industrial heritage of NSW as it was the place where so many 'firsts' happened. The Barangaroo South area is important in its own right as well as representative of the wider maritime infrastructure and industry of Darling Harbour, the remnants of which disappeared 20 years ago when they were demolished for the Darling Harbour Redevelopment. The current community esteem for the AGL gasworks and Bass' shipyard may be higher than some of the lesser known sites. The Open Day for the Barker's Mill during the Cross City Tunnel works in 2003 saw 300 people visit the site with relatively limited publicity. There were also articles in the newspapers at that time. The historical report on Barker's mill and the archaeological work of the Cross City Tunnel is lodged on the Casey & Lowe webpage and is a popular link.

Criterion (e): Technical/Research Significance - (archaeological, educational, research potential and scientific values)

an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);

Barangaroo South contains a layering of maritime and early industrial sites within an intensively modified maritime/urban landscape which was extensively used between 1820s and 1920s. Parts of the area were quickly occupied and used while other portions were on the edge of the foreshore and had little use until wharfage was established after 1834 but by the 1840s. It is part of the area resumed by the State government with the onset of the Bubonic plague so health hazards could be removed and wharfage facilities upgraded. The recording, analysis and interpretation of the potential archaeological remains within the study area has substantial ability to yield information on a range of maritime and industrial activities which were essential to the development of NSW from the 1810s and 1830s up to 1900.

The nature of the post-1788 archaeological resource will include a range of modifications from extensive manipulation of the landform in the process of reclamation by construction of phases of seawalls, major infilling of land and construction of yard areas for stores, boatyard or the gasworks. All of this eventually became subsumed into the extensive wharfage, and then later into the Grafton Wharves which took over most of Blocks 2 and 3. Extensive wharfage buildings were constructed and are visible in a number of the photos and plans - remains of these will survive. State government resumption will have seen another stage of alteration and modification prior to the main demolition phase in the 1950s and 1960s.

All of these activities and events will have left a range of archaeological evidence surviving within the eastern 40m of the site. Archaeological testing and excavation generally supports the focus of this work on the 40m zone, although it is noted that the gasworks area extends out beyond the 40m zone and this needs to be considered if archaeological works are undertaken in Block 5.

This type of technological and chronological layering is not typical of Sydney sites which often have one or two phases of occupation. It has been found on at least three other sites along the harbour foreshore where the process of reclamation has built up the landform, such as Darling Walk, KENS site and Towns Place. Barangaroo South has considerable wharfage and stores which have not been found at most of these other sites (except Towns Place), but it has much less industrial archaeology than found at Darling Walk which included parts of Barker's Mill, small foundries, boiler room of the PN Russell carriage works, elements of the PN Russell foundry as well as associated workers' housing. Nor does it have such an early and extensive jetty as Barker's 1830s jetty. Aspects of the archaeological resource still survive at the Darling Walk site.

Block 3

This block includes Portions 17 (part), 18 and 19 (Fig. 3.2, 3.4). The archaeological remains in Portions 18 and 19 have a similar history to Portion 5 with the foreshore only being reclaimed post-1834. Then there was a stage of reclamation and building and rebuilding of wharves. Portion 19 had limited reclamation and then a later jetty.

Portion 17 was the main part of Henry Bass' shipyard, he appears to have reclaimed the foreshore by 1834 and continued to operate his shipyard there until the 1850s and also amalgamated Portion 18 into the shipyard and was probably responsible for the reclamation of this section of the foreshore. This appears to have involved two phases of reclamation for Portion 17 and one for 18 with the construction of a seawall. After c.1853 the shipyard became wharfage with jetties attached to the seawall between 1850 and 1865. The whole area becomes part of the Grafton wharf with a similar sequence of jetties and stores to Block 2. Considerable archaeological evidence of the various phases of occupation should survive, notably the seawall and two phases of reclamation, buried wharfage, evidence of the northern embayment and various buildings and Henry Bass' shipyard activity and later activities. It is noted that there is considerable contamination in Block 3.

EPA Declaration Area: Blocks 4, 5 and Hickson Road

The EPA Declaration Area had the potential to contain the highly contaminated remains of Australia's first gasworks established on the site by 1839 and which expanded to the south, west and north during the 1860s and 1880s. There were a number of phases of expansion which typically allowed for AGL to supply considerably more gas to the expanding suburbs of Sydney. The northern and southern parts of the Declaration Area have the potential to contain contaminated remains of 1830s to c.1880 shipyards. The construction of the 1920s wharfage involved the removal of the western section of the gasworks. The eastern part of the original gasworks should survive in Block 4 and some in the southern section of Block 5 although these are likely to have been heavily modified by later works. It appears that most of the retort house archaeology was

removed in the 1920s. The likely archaeological evidence of the gasworks that may survive within Block 4 and Hickson Road is the later 1870s gasholder which will have removed earlier evidence, the purifying shed, boiler house, meter building and possibly part of the earlier retort house. Block 5 and the northern part of Hickson Road should contain remains of the 1840s to 1880s Cuthbert and later Rowntree shipyards as well as the 1882 gasholder annulus and retort house.

Intactness or Integrity

The new Significance guidelines, as with earlier archaeological guidelines, identify integrity as a key issue in assessing a site's archaeological research potential (p11). The definition of research potential in the new guidelines is 'the ability of archaeological evidence, through analysis and interpretation, to provide information about a site that could not be derived from any other source'.⁵⁵ Therefore if the nature of the archaeological resource is covered in tar and other contaminants which makes it unsafe for humans to come into contact unless wearing a suit and respirator, the ability of the resource to be analysed is greatly reduced (Appendix 1).



Criterion (f): Rarity

an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);

Evidence of nineteenth-century Darling Harbour wharfage and industrial complexes is relatively rare in the context of NSW but also in the context of what survives within Darling Harbour. This area was excluded from the Zoning Plan for the City of Sydney and Pyrmont and Ultimo because it was managed by the Darling Harbour Authority when these plans were produced. Therefore there is no means of having certainty about the potential archaeological resource within the general locality.

The later nineteenth-century wharfage was replicated around the foreshores of Darling Harbour, Walsh Bay, Pyrmont and Darling Island. There are extant twentieth-century wharves in a number of these areas which have been retained and modernised and are now intensively used as part of the life of Sydney. The archaeological remains of late nineteenth-century wharves/jetties can be found under reclamation, in the vicinity of and within the footprint of surviving early twentieth-century wharves in Darling Harbour and Walsh Bay. The archaeological evidence associated with the later nineteenth century would be replicated within these areas. This is a diminishing resource and as stated in the Research Questions in the Archaeological Assessment for Barangaroo South there is likely to be a large difference in quality of construction between these late nineteenth and early twentieth-century structures. It is likely that this was less so with the mid nineteenth-century privately-owned jetties and wharves which were more individual and ad hoc and were closely related to the contemporary reclamations. The pre-1850s reclamation has also been found at Darling Walk, some of which still survives within that precinct, at the KENS Site and Paddy's Market Site and possibly to the north of Barangaroo Stage 1. It is also likely that other areas of substantial reclamation may survive beneath the 1980s Darling Harbour redevelopment.

While the gasworks in Blocks 4, 5 and Hickson Road was the earliest in NSW and Australia there were a series of impacts by extensive redevelopment in the 1880s and 1920s. The surviving archaeological resource is likely to date more to the post-1860s changes. Generally this is considered to be a rare resource but one highly compromised by the health risk associated with the contamination linked to the operation of the gasworks.

⁵⁵ Heritage Branch 2009:11

Henry Bass' shipyard (c.1819-c.1853) is rare in terms of surviving archaeological resources but again the northern part in Block 4 is within the Remediation Site Area and there is likely to be some further contamination of Block 3 where the archaeological remains of the early core of Bass' yard may survive. The later yards in Block 5 operated by John Cuthbert and then Rowntree & Co date to the c.1840s to c.1880.



Criterion (g): Representativeness

an item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places of cultural or natural environments (or the cultural or natural history of the local area).

The archaeological remains of late nineteenth-century wharves/jetties can be found under the reclamation, in the vicinity of and within the footprint of surviving early twentieth-century wharves in Darling Harbour and Walsh Bay. This is a diminishing resource and as stated in the Archaeological Assessment Research Questions (Casey & Lowe 2010a) there is likely to be a large difference in quality of construction between these late nineteenth and early twentieth-century structures. The earlier types of sites, such as the Grafton wharf and the earlier jetties while representative of the mid nineteenth-century may offer us opportunities which are unlikely to be repeated on other sites as each class or group can further and extend our knowledge of these types of sites and the differences between them.



Intactness

Intactness refers to the physical condition of an item. It is particularly relevant to archaeological sites in the sense of 'undisturbed' sites or areas which may be expected to yield well-provenanced archaeological deposits, amenable to investigation and interpretation. An archaeological site or other heritage place may also need to retain sufficient integrity that it is able to convey its significance to people in the present. This could derive from factors unrelated to 'research potential' such as location, setting, design, materials, workmanship, association.⁵⁶

This is keenly relevant to the EPA Declaration Area where the contamination arising from the gasworks site, much of it thought to be associated with black tar which has oozed across, through and down the site, will make it difficult to undertake investigation and recording. There has been little debate in archaeological circles in Australia how contamination will impact on the significance of an archaeological resource or resources. It is the opinion of this consultant that if an archaeological resource cannot be recorded by detailed archaeological excavation and recording, the typical strategies for investigating a site, then is its integrity any less different to it having been excavated or substantially disturbed? This is also discussed in Archaeological Research Potential (Criterion E) above.



4.3.2 Research Potential

Research potential is the most relevant criterion for assessing archaeological sites. However, assessing research potential for archaeological sites can be difficult as the nature or extent of features is sometimes unknown, therefore judgements must be formed on the basis of expected or potential attributes. One benefit of a detailed

⁵⁶ Heritage Branch, Department of Planning 2009:9

*archaeological assessment is that the element of judgement can be made more rigorous by historical or other research.*⁵⁷

Assessment of Research Potential

Once the archaeological potential of a site has been determined, research themes and likely research questions identified, as addressed through archaeological investigation and analysis, the following inclusion guidelines should be applied:

Does the site:

- (a) contribute knowledge which no other resource can?*
- (b) contribute knowledge which no other site can?*
- (c) is the knowledge relevant to general questions about human history or other substantive problems relating to Australian History, or does it contribute to other major research questions?*⁵⁸

If the answer to these questions is yes then the site will have archaeological research potential.

Does the site:

- (a) contribute knowledge which no other resource can?*

Written historical documents present the official and semi-official picture about the alienation and division of land, who was buying and selling, and how the land was being used. The descriptions of working class, commercial and industrial areas are documents that bear the imprint of androcentric Anglo-Saxon interpretation of 19th-century life. This material presents a partial image of the occupants who lived and worked in the area. The archaeological material will supply evidence provided by the occupants of the site regarding the conditions in which they lived, worked, and procreated. Material culture provides an avenue into the daily life of groups of people and industries.

Some of the potential archaeological remains identified within the study area can provide knowledge that is available from no other resources. The excavation and study of material culture provides access to deposits, structures, and relics that contains knowledge on a scale that is found in no other resources.

The ability of a site to produce knowledge that no other resource can is dependent upon the Research Questions posed and the methodology employed to investigate the archaeological resource. The main areas of research that this site can contribute to are the remaking of the harbour foreshore, the development of maritime infrastructure for 19th-century Sydney and early shipbuilding. In addition the gasworks archaeology should contain mid to later 19th-century technology.

- (b) contribute knowledge which no other site can?*

The archaeological resource at this site, through its association with a range of chronological and occupation phases, including industrial and maritime, presents a rare opportunity to examine the process of urbanisation as represented by the reclamation and rebuilding of maritime infrastructure within the framework of needing to meet contemporary requirements for more land, more wharfage, and more space. This site is considered to be a mixture of rare and representative remains and as a whole can contribute knowledge that no other site can.

⁵⁷ NSW Heritage Office 1996:26.

⁵⁸ Bickford, A. & S. Sullivan 1984:23.

(c) is the knowledge relevant to general questions about human history or other substantive problems relating to Australian History, or does it contribute to other major research questions

As outlined in the above section on technical/research significance the archaeological recording, analysis and interpretation of this site can contribute to substantive research questions in Australian history.

4.4 Statement of Heritage Significance

The EPA Declaration Area at Barangaroo has the potential to contain a range of archaeological remains dating from the 1830s to the 1920s. There remains include early and later maritime infrastructure and substantial reclamation of the foreshore, mid to later nineteenth-century shipbuilding as well as the remains of Australia's first gasworks site. The EPA Declaration Area is highly contaminated by the nature of the gasworks activities which affects the significance of the site. The level of significance of the site as outlined below in its current state is therefore of Local significance.

4.5 Level of Heritage Significance

New criteria have recently been developed to identify whether the archaeological resource is of Local or State significance.⁵⁹ In terms of this site the assessment of levels of significance the following criteria were seen as the most relevant:

- *Archaeological Research Potential (current NSW Heritage Criterion E).*
- *Aesthetic or technical significance (NSW Heritage Criterion C).*
- *Ability to demonstrate the past through archaeological remains (NSW Heritage Criteria A, C, F & G).*

The new significance guidelines were designed to assess significance in light of the amendments to the definition of relics needing to be of either local or State significance. The new guidelines identified a series of questions that could be asked to address this issue, most of which have already been addressed within the discussion of significance:

- **To which contexts (historical, archaeological and research-based) is it anticipated that the site will yield important information?**

The site generally is considered to have a moderate to high ability to yield archaeological information but this can also be relevant to both historical and research-based contexts.

- **Is the site likely to contain the mixed remains of several occupations and eras, or is it expected that the site has the remains of a single occupation or a short time-period?**

As has been demonstrated the site as a whole should contain archaeological evidence from a number of distinct phases of occupation but few of them offer archaeological information at a small scale. Analysis of reclamation and wharfage can only be addressed on a large scale unlike an individual house which can address research questions on a smaller scale.

⁵⁹ Heritage Branch, Dept of Planning 2009.

▪ **Is the site rare or representative in terms of the extent, nature, integrity and preservation of the deposits (if known)?**

The above analysis illustrates that the surrounding harbour areas, notably Walsh Bay and Pyrmont as well as Darling Harbour, all experienced similar development during much of the nineteenth century but the absence of a zoning plan does not help us understand the extent to which such remains survive. We know some contemporary remains survive outside the development areas of Darling Walk and within its associated Public Domain.⁶⁰ The excavation at the KENS site removed all the archaeological resource within that site. It is unclear if archaeological deposits would survive to the south of Barangaroo South as some of the new development certainly involved excavation of basements but possibly not all areas.

Generally the archaeological remains are considered to have a moderate to high level of integrity except for the isolated impacts from the extant 1960s wharf and the extensive contamination issues present in Blocks 4 and 5 and Hickson Road. The contamination in Block 4 will severely reduce the ability of archaeologists to record this site. The extent of contamination in Block 3 is to be further refined and it is likely that archaeological recording will be constrained in some form or other. The issue of contamination undermines the rarity of the archaeological resource of the gasworks as determined by Godden Mackay Logan in 1999 when they assessed that the contamination at the site would inhibit how it could be recorded, other than photographically and even if such remains should be kept. High levels of contamination are typically seen as a health threat and need to be removed so the material can be decontaminated. This of course removes the archaeological resource in the process but the key issue here is that the research potential of the resource is highly compromised and therefore is it only of Local significance as its full research potential cannot be realised through normal archaeological means.

Other parts of the site, notably southern part of Block 2 (Portion 20), should have a high level of integrity and considerable archaeological resource which should address a whole range of research questions. This area will be able to be investigated archaeologically and is relatively rare as the reclamation dates prior to 1834.

▪ **Is this type of site already well-documented in the historical record?**

Other than the later nineteenth-century wharfage the site is not particularly well documented in the historical record. Reclamation fills were recorded at the KENS site and at Darling Walk as well as at Pyrmont and Jones Bay wharves and Paddy's Market site and have now been recorded at Barangaroo South during testing and preliminary archaeological works (2010 and ongoing). Early 20th-century wharves have been recorded at both Pyrmont and Jones Bay wharves. While the original elements of the gasworks site are not represented on other potential gasworks sites, the 1860s and 1880s remains may be found on other sites, although they are all likely to be in the same contaminated condition.

▪ **Has this site type already been previously investigated with results available?**

Yes, this type of site has previously been investigated at the KENS site, Darling Walk, Towns Place and potentially other sites for which reports are not available. But what is quite clear for Casey & Lowe's work at Darling Walk and Barangaroo South is that there can be quite a different range of evidence found at these sites which makes them worthwhile to investigate if site conditions permit.

▪ **Is the excavation of this site likely to enhance or duplicate the data set?**

Yes, the excavation of this site has some different characteristics to the other excavations in Darling Harbour in that there is little likelihood of residential remains and that the archaeological record is

⁶⁰ Casey & Lowe have undertaken extensive recording of remains at the Darling Walk site:
<http://www.caseyandlowe.com.au/sitedw.htm>

dominated by Australia's first gasworks and mid-nineteenth-century shipbuilding which has been little investigated within Darling Harbour and NSW generally.

Another set of questions were developed in relation to Criterion (c) – technical or aesthetic significance:

▪ **Does the site/is the site likely to have aesthetic value?**

All archaeological sites can have incidental aesthetic values, notably in relation to the process of ruination but this cannot be determined until a site is excavated. We consider this to be an incidental part of any site, meaning there is no intentionally involved in such an aesthetic outcome. Clearly the gasworks remains would have technological significance but our ability to realise this is highly compromised due to the contamination.

▪ **Does the site/is the site likely to embody a distinctive architectural or engineering style or pattern/layout?**

Not especially. What is clear in relation to the gasworks is that there were at least two main phases of rebuilding with numerous additions to the works as the site was expanded. There are a number of standing buildings in Hickson Road and Jenkins Street that were built as part of the gasworks.

▪ **Does the site demonstrate a technology which is the first or last of its kind?**

It is possible that the EPA Declaration Area may contain some remains from the earliest gasworks but there are certainly impacts on the earlier technology by the 1880s expansion and the 1920s demolition of the western area for wharfage.

Archaeological remains of Local Significance within the EPA Declaration Area

- The 19th-century wharfage and reclamation where we can relate it to the foreshore and reclamation phases.
- Nineteenth-century timber shipbuilding.
- The reduced ability to record the remains of the gasworks due to contamination, the extensive rebuilding which will have removed early phases of technology and the excavation of the western part of the EPA Declaration Area means that it potentially does not reach the State significance threshold.

5.0 Impacts on Archaeological Relics by Ex-situ Remediation & Other Impacts

5.1 Ex-Situ Remediation

The 'ex-situ methodology' involves the managed excavation of Block 5, EPA Declaration Area (Figure 1.6). Figure 1.6 shows the extent of the proposed remediation. This generally concurs with our assessment of the extent to which gasworks archaeology may survive subsequent to the 1920s wharfage (Figure 3.4). This methodology will result in the removal of the surviving archaeological remains of the original sections of the gasworks not removed by later modifications or the twentieth-century wharfage excavation, as well as all surviving later phases of the gasworks use of the Remediation Site. In addition it will remove the remains of the Cuthbert and later Rowntree shipbuilding yard, predating the northern gasworks, as well as the remains of wharfage and reclamation associated with the development and expansion of the gasworks.

The nature of the contamination requires quite a defined methodology for the removal of the material which involves odour tents covering part of the area, restricted access to areas at any one time due to need to maintain road access along Hickson Road, access to people only in hazmat suits, and working in this area is defined as a confined space. Therefore this limits the nature of potential recording able to be undertaken, in addition to the issues associated with the remains and technology being covered with gooey tar material which is hazardous to human health.

5.2 Other Impacts

Aside from the remediation impacts the proposed works also include the diversion of existing stormwater drainage infrastructure within the Hickson Road reserve and subject-site, involving decommissioning existing pipes, and construction of a new pipe network. There are two options identified for the stormwater which are discussed below. Depending on the final option archaeological monitoring may be needed.

Option 1

This option involves the excavation of a trench partially within an existing trench but wider (Figure 5.1). The new trench will be 800mm to 1m wide while the existing trench is probably 600mm wide. The new trench will be 1.2m deep.

The proposed impacts of this trench are relatively minor as they are in the location of an existing service trench. The trench to the north of the Declaration Area is within an area of Darling Harbour which was not reclaimed until the 1960/70s (Figure 3.1, Figure 3.4). The area of the stormwater trench is not considered likely to contain relics.

Option 2

This option involves the excavation of a new stormwater line following the remediation of the eastern part of the Block 5 Declaration Area following its remediation and then into Hickson Road. This temporary stormwater trench is within the Hickson Road section of the EPA Declaration Area (Figure 5.2). There is some archaeological potential in this area but it is an area of contamination. The Option 2 trench would be approximately 600mm to 800mm wide and 1m to 1.5m deep.

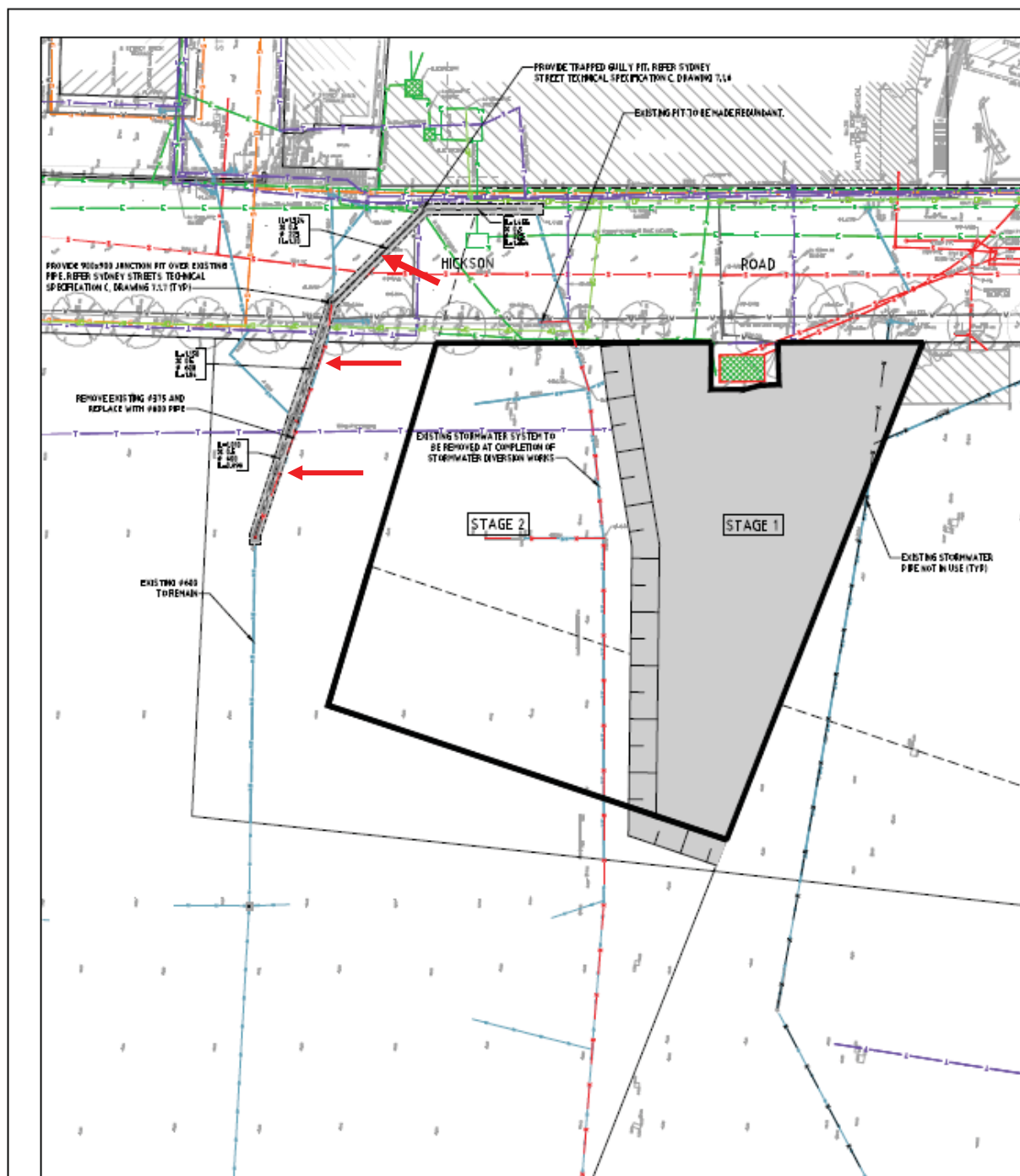


Figure 5.1: Plan of the Option 1 stormwater services diversion. Red arrow indicates excavation of a trench in Block 5 to the north of the remediation area. Cardno plan

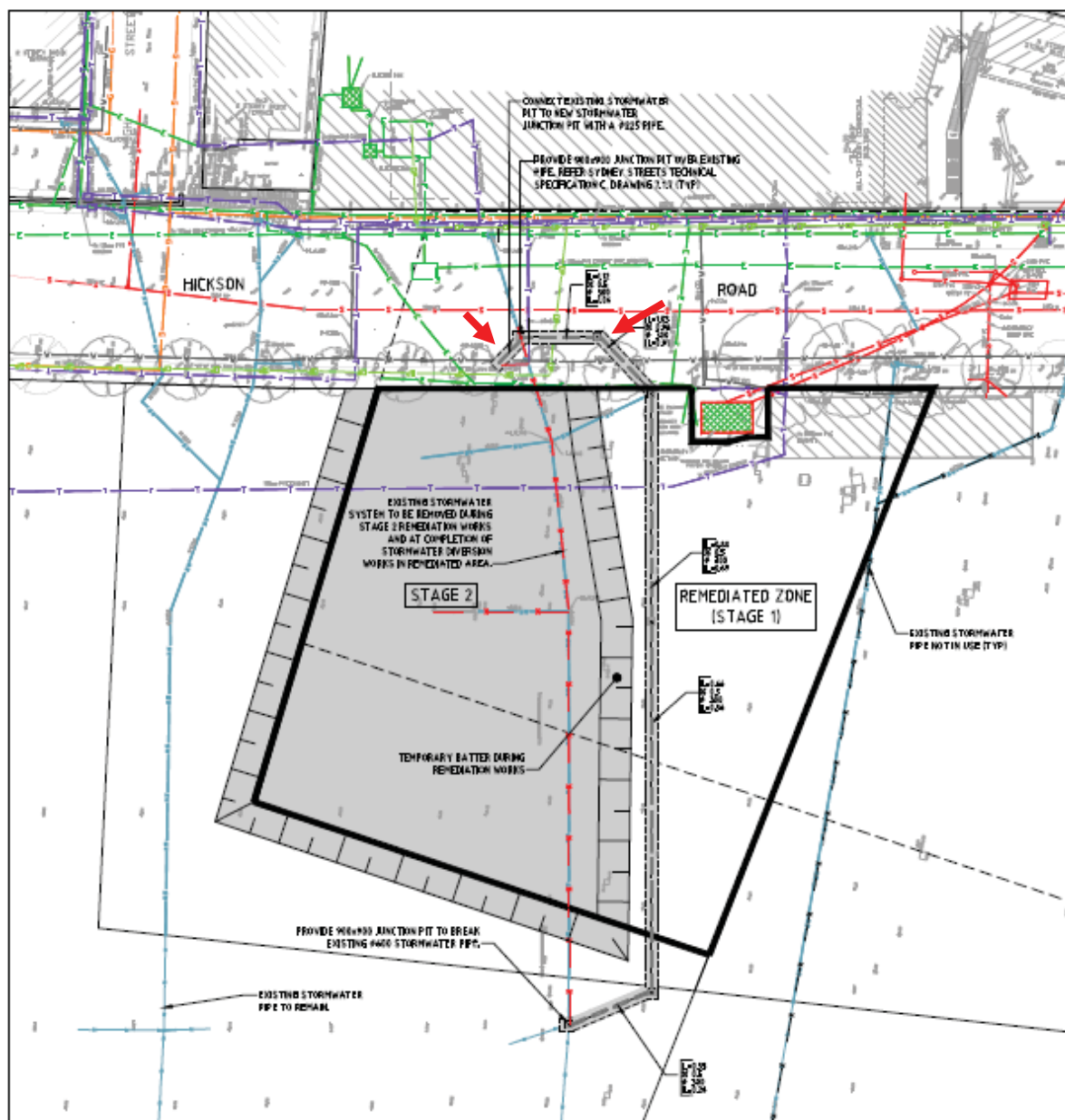


Figure 5.2: Stormwater Option 2. The impact associated with the stormwater is in Hickson Road. The main diversion is within the Stage 1 area following the remediation of this area which therefore has no impact on archaeology. The thick black line defines the remediation area within Block 5. Cardno plan

6.0 Results and Recommendations

6.1 Results

- The EPA Declaration Area is contaminated and a potential risk to human health and the environment. In particular, EPA has identified the following substances as the contaminants on the “remediation site” relating to the previous use of the site as a gasworks: polycyclic aromatic hydrocarbons (PAHs); benzene, toluene, ethylbenzene and xylenes (BTEX); total petroleum hydrocarbons (TPHs); ammonia; phenol and cyanide.
- The EPA Declaration Area contains a significant archaeological resource associated with Australia’s first gasworks and nineteenth-century shipbuilding, reclamation and wharfage. The nature of the contamination makes it difficult to realise the significance of this resource in its current state.
- The remediation in Block 5 involves ex-situ remediation of the EPA Declaration Area. This will provide limited opportunity to record the potential archaeological remains within the Remediation Area. A methodology for this will need to be developed to provide for some opportunity to record substantial or significant remains.

6.2 Recommendations

1. An archaeological methodology (Research Design) will need to be developed in consultation with Lend Lease and which will allow for some limited recording of the remains to be removed by ex-situ remediation.
2. The detailed framework for archaeological methodology and recording will be established following some initial sampling trenches to determine the extent to which the potential archaeological remains within the site may survive and be accessible for archaeological investigation and recording. The preliminary framework for archaeological recording, defined as a result of detailed sampling trenches is as follows:
 - Where contamination is at depth and the upper layers are uncontaminated, the upper layers could potentially be archaeologically excavated, with restriction as required for OHS management of works.
 - Where the archaeology is completely covered with contamination and therefore inaccessible for normal archaeological recording methodologies, other alternative techniques may be tested to determine if recording is possible. Then it may be possible to record some major gasworks features but only if they offer a research outcome.
 - It is likely that opportunities may be extremely limited in what can be recorded. In the end there may be no ability to record remains prior to the ex-situ remediation.
3. Consultation should be undertaken with the Heritage Division in relation to this project as they may be conditioned to approve the Research Design.
4. Opportunities for monitoring the stormwater works also need to be identified.

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Appendix 1: AECOM Letter re archaeology and contamination

18 May 2010

Mr Warwick Bowyer

Lend Lease (Millers Point) Pty Ltd
30 The Bond
30 Hickson Road
Millers Point
NSW 2000

Dear Warwick,

Barangaroo Stage 1- Archaeological Assessment : Environmental conditions encountered during Data Gap Investigations within VMP and PDA Remediation Works Area and Other Remediation Works (South) Area

AECOM Australia Pty Ltd (AECOM) has been engaged by Lend Lease (Millers Point) Pty Ltd (LL) to undertake Data Gap Investigations (DGIs) and remediation design works for the Stage 1 Barangaroo project in accordance with the Professional Services Agreement (PSA) between the parties dated 20 November 2009.

LL has requested that AECOM provide information regarding encountered Site conditions within the Voluntary Management Proposal (VMP) and Project Delivery Agreement (PDA) Remediation Works Area and Other Remediation Works (South) Area (refer attached figure) for provision to the LL appointed archaeologists (Casey and Lowe) in order that they can:

- Determine a preferred, and where appropriate, approach to the undertaking of preliminary test pit exploratory works, subsequent archaeological excavation, recovery and recording of potential archaeological deposits (both of a European and Indigenous nature) during the proposed ex-situ remediation works, noting that the remediation area is likely to be contaminated; and
- Document the preferred approach in the Archaeological Assessment and Research Design reports associated with Barangaroo Stage 1.

Relevant information relating to the above considerations is provided in the following sections.

1.0 VMP and PDA Remediation Works Area

In May 2009, the NSW Environment Protection Authority (EPA) determined that the land encompassed by the former Millers Point gasworks was contaminated in such a way as to present a **significant risk of harm (SROH) to human health and the environment**. As a consequence the EPA declared the Site to be a remediation site (Declaration Number 21122; Area Number 3221) under section 9 of the Contaminated Land Management Act 1997.

The land to which the declaration applies is described as:

- Part Lot 5 and Part Lot 3 in Deposited Plan (DP) 876514, Hickson Road, Millers Point.
- The part of Hickson Road adjacent to:
 - 30-34 Hickson Road being Lot 11, DP 1065410;
 - 36 Hickson Road being Lot 5, DP 873158 and Lot 12, DP 1065410; and
 - 38 Hickson Road being SP72797, Millers Point in the City of Sydney Local Government Area.

1.1 Nature of contamination

The EPA declaration notes that the VMP and PDA Remediation Works Area is contaminated with gasworks waste and particularly waste tar resulting from the historical use of the land as a gasworks plant. The chemical composition of gasworks waste includes the following contaminants of potential concern (CoPC):

- polycyclic aromatic hydrocarbons (PAHs);
- benzene;
- toluene, ethylbenzene and xylenes (BTEX);

- total petroleum hydrocarbons (TPHs);
- ammonia;
- phenol; and
- cyanide.

Groundwater has been found to be contaminated by TPHs, PAHs, BTEX, ammonia, phenol and cyanide at concentrations exceeding the relevant trigger values for the protection of human health and aquatic ecosystems in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000).

1.2 Data Gap Investigation

AECOM is currently completing a DGI within the VMP and PDA Remediation Works Area, which has considered information obtained during previous investigations. As a result, the nature, distribution and concentrations of contamination within this area are well documented.

The DGI has identified concentrations of CoPC including lead, TPH (C6-C9 and C10-C36), BTEX compounds, PAHs (including benzo(a)pyrene) and sulfate within soil and fill materials variably exceeding the adopted Site Investigation Criteria. Concentrations of some semi-volatile organic compounds (SVOCs) exceeding the laboratory limit of reporting (LOR) were also reported. The reported results are generally consistent with the findings of previous investigations with respect to the identified CoPC.

Dissolved-phase concentrations of contaminants were variably reported above the Site investigation criteria (e.g. lead, cadmium, chromium, cobalt, copper, mercury nickel, zinc, benzene, naphthalene and phenol) in groundwater.

Reported soil vapour results indicated some gasworks-derived impacts in locations closest to the former gasworks area and low concentrations of toluene, chloroform and tetrachloroethene (below soil vapour guidelines) in some locations. The reported results were below the Site investigation criteria with the exception of naphthalene which reported soil vapour concentrations exceeding the ambient air screening criteria (3.7 $\mu\text{g}/\text{m}^3$) in eight locations and the adopted soil vapour screening criteria (37 $\mu\text{g}/\text{m}^3$) in five locations.

The highest concentrations of soil, soil vapour and groundwater contamination were identified in the immediate vicinity of the former gasworks infrastructure.

1.3 General description of Encountered Conditions

Fill and Soil

Encountered stratigraphic conditions were variable across the VMP and PDA Area, but generally comprised fill material overlying natural weathered sandstone with clay components. Sandstone bedrock was generally present underlying natural weathered bedrock materials or in some instances directly underneath fill materials. Observations of odours, staining and sheen were generally more common in the overlying fill materials, although they were also noted within a number of locations within the natural soil and bedrock present on the Site.

Fill materials were generally shallower in the eastern portion of the Site closest to Hickson Road and deeper in the western portion of the Site. The thickness of fill material generally increased from east to west across the Site.

Observations during the test pitting works identified the presence of unconsolidated, highly variable fill materials, which generally comprised unconsolidated gravels, sand, bricks, sandstone, timber, slag and steel. Visual signs of contamination including black staining, tar and surface sheen (where groundwater was present) were noted in several test pits, predominantly located in the footprint of the former Retort House and Purifying Beds within Block 4.

Natural soils encountered across the Site comprised silty sands, gravelly sands, clays, weathered sandstone and sand with components of clay.

Tar was generally (but not exclusively) encountered within fill materials and was characterised by a strong naphthalene odour, black colour and a viscous consistency. Where hydrocarbon impact was detected in groundwater a surface sheen and odour were also identified. Tar mixed with groundwater was identified in the tar tank, located underlying Hickson Road. The material within the tar tank was black, odorous and unspeadable.

Groundwater

Groundwater was encountered within the fill materials and underlying natural material. Groundwater was encountered at depths ranging from 1.38 to 2.92 m below ground surface (bgs) and is subject to tidal fluctuation. Water level monitoring within selected wells over a three day period confirmed that groundwater at the Site is tidally influenced, with the influence extending as far east (inland) as Hickson Road, although the degree of fluctuation is much less on the eastern portion of the Site towards Hickson Road.

Free phase tar was reported in several wells located within the footprint of the former gasworks site. Tar was observed within wells installed at varied depths throughout the profile, indicating dense non aqueous phase liquid (DNAPL) is present at the Site within the fill materials, natural sediments and bedrock.

1.4 OH&S Considerations

The nature of the contamination within the VMP and PDA Remediation Works Area is likely to prohibit the type of detailed excavation and recording practices associated with conventional archaeological excavations. It would also likely prohibit the specific requirements for the investigation of Indigenous archaeology, which AECOM understands may involve hand excavation, machine excavation and wet sieving of natural sands to collect artefacts, within the DECCW declared area.

AECOM understands it is proposed that a limited program of archaeological photographic recording/mapping is being considered within the VMP and PDA Remediation Works Area associated with Stage 1, and that the timing of these works is such that they will be undertaken in parallel with the proposed remedial works. The proposed archaeological works are associated with the former gasworks that once occupied the site.

Based on the nature and concentrations of reported contamination, AECOM notes that specific Occupational Health and Safety (OH&S) considerations will apply to the remediation works being undertaken. The remediation of gasworks waste is complex and requires appropriate consideration and management of chemical and other hazards. Remediation activities will only be undertaken following the completion of a rigorous OH&S plan incorporating a risk assessment and development of detailed management protocols for the proposed works.

AECOM notes that remediation works will likely be undertaken within an exclusion zone that will require additional protective measures to be taken. These measures may include the use of specialist equipment including respirators, air monitors and coveralls and will require adherence to appropriate decontamination practises.

The remediation works will entail the use of heavy machinery which will present a potential risk to the safety of Site workers. As such, the number of workers within the exclusion at any one time will be kept to a minimum to reduce the potential for health and safety incidents

The preferred approach to risk management would be to minimise the number of archaeological practitioners accessing the remediation area and for the archaeological works within this area to be restricted to photographic recording and associated mapping only, which is considered more appropriate given the nature of the hazardous environment expected during the remedial works within the Stage 1 VMP and PDA Remediation Works Area. Following the completion of appropriate inductions and subject to careful planning and management, limited archaeological works such as photographic recording and limited mapping in parallel with remedial works might be appropriate. Such works will need to be undertaken under the direct supervision of a specialist remediation contractor, and on the proviso that the archaeological practitioners are adequately trained and strictly conform to the appropriate health and safety management systems and practices implemented by the specialist remedial contractor. Only authorised personnel and equipment will be allowed into the exclusion zones and other areas associated with the remediation works.

2.0 Other Remediation Works (South) Area

The Other Remediation Works (South) Area (ORWS Area) is located to the south and west of the VMP and PDA Remediation Works Area and is outside the footprint of the former gasworks area. Consequently, concentrations of CoPC, although still present, were generally reported at concentrations below that identified within the VMP and PDA Area.

Encountered soil and fill conditions were generally similar to the VMP and PDA Area, although no evidence of liquid tar was identified.

AECOM considers that as reported concentrations of CoPC are not as high as the VMP and PDA Area, the ORWS Area will not require the same level of OH&S management. As such, a reduced level of personal protective equipment (PPE) than is considered necessary for the VMP and PDA Remediation Works Area may be adequate for works in this area. This will be subject to verification of the actual conditions encountered during archaeological excavation works.

APPENDIX 2: Geo-technical plans and sections of EPA Declaration Area

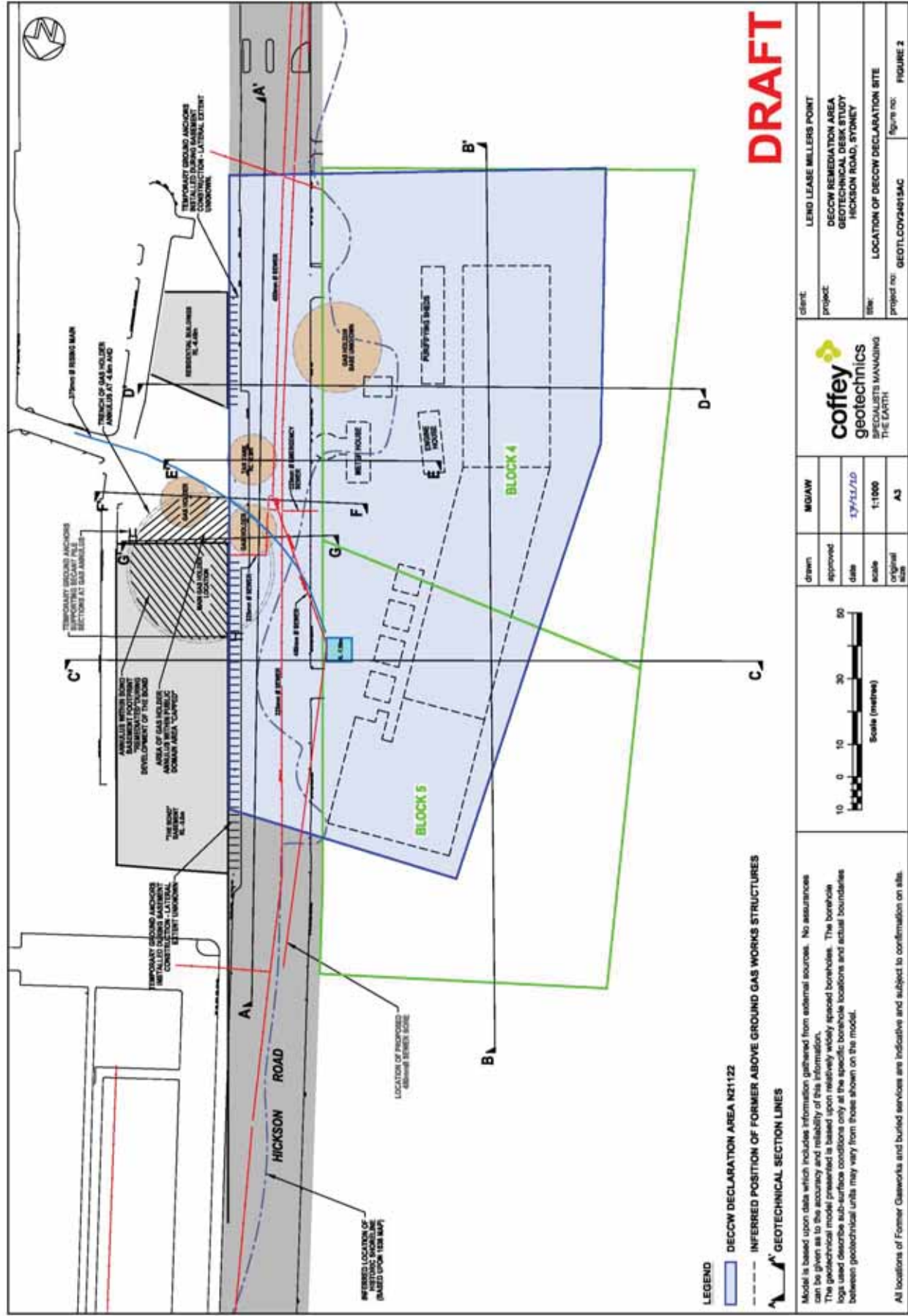


Figure 1: Plan showing the EPA Declaration Area with section lines for geotechnical plans to follow. Coffey Geotechnics

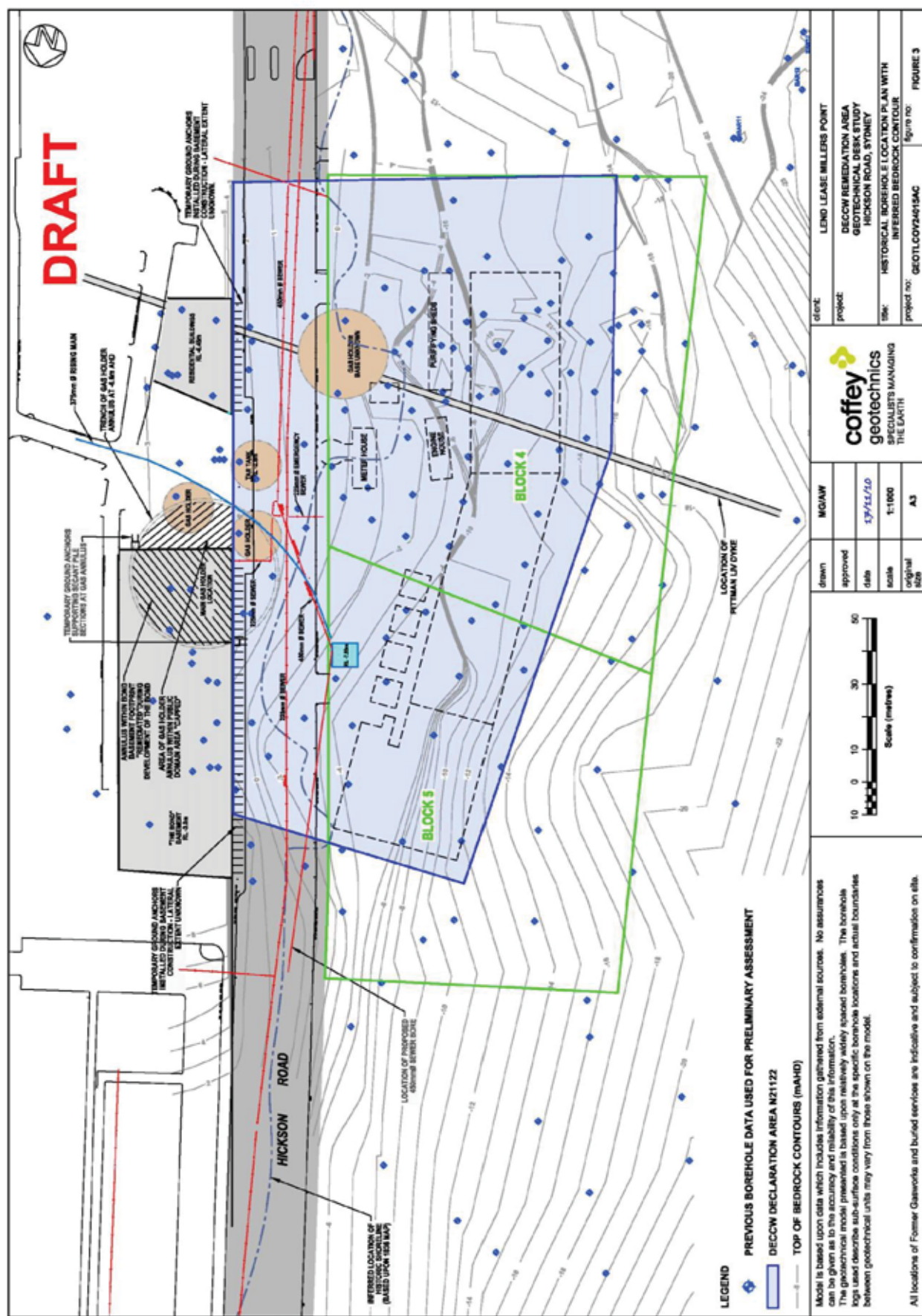


Figure 2: Plan of the various boreholes used to produce the geotechnical sections. Coffey geotechnics

SECTION A-A'

0 50 100 150 200 250

38 HICKSON ROAD "THE BOND"

LOCATION OF DECOMMISSIONED PUMPING STATION

POSITION OF 230mm Ø CONCRETE ENCASED SEWER (L. 2.7m AHD)

LOCATION OF GAS HOLDER ANNULUS (APPROX. 1.5m WIDE)

INFERRED POSITION OF 375mm Ø RISING MAIN (L. -1.5m AHD)

TANK LOCATION

SANDSTONE

TEMPORARY RETAINING WALL INCLUDING TEMPORARY GROUND ANCHORS

INFERRED LOCATION OF RENEWABLE DYKE

UNIT 4200

DECOW DECLARATION AREA

A

UNIT 1 (FIII)
UNIT 2A (Holocene Estuarine Sediments)
UNIT 2B (Pleistocene Alluvium)
UNIT 4A/4B (Class V & Class IV Sandstone)
UNIT 4C/4D (Class III better sandstone)

INFERRED POSITION OF GEOTECHNICAL UNITS
PREVIOUS INVESTIGATION BOREHOLES

NOTE: ALL LOCATIONS OF BURIED STRUCTURES AND SERVICES ARE INFERRED FROM INFORMATION PROVIDED BY LLMP. ALL POSITIONS ARE INDICATIVE AND ARE TO BE CONFIRMED ON SITE.

 coffey geotechnics SOILS AND FOUNDATIONS CONSULTING ENGINEERING THE LANTIN	client	LEUNG LEASE MILLERS POINT		
	project	DECON REMEDIATION AREA GEOTECHNICAL DESK STUDY HICKSON ROAD, SYDNEY		
	title	CROSS SECTION A-A'		
	project no.	GEO/TL/COV24015AC		
figure no.				
FIGURE 4				

Figure 3: Section A-A runs north-south along the eastern side of Hickson Road and suggests fill is quite shallow above bedrock. It also indicates the probable location of the tar tank. The description of the Hickson Road construction works in Broomham 2007 (pp. 39-45) suggests that there are likely to be few archaeological remains in Hickson Road associated with the gaswork's archaeology. Coffey geotechnics

[illegible]

LEGEND

	INFILLED BELOW GROUND GASWORKS STRUCTURE
	UNIT 1 (Fill)
	UNIT 2A (Holocene Estuarine Sediments)
	UNIT 2B (Pleistocene Alluvium)
	UNIT 4A/4B (Class V & Class IV Sandstone)
	UNIT 4C/4D (Class III better sandstone)
	INFERRED POSITION OF GEOTECHNICAL UNITS
	PREVIOUS INVESTIGATION BOREHOLES

[illegible]

Figure 4: Section B-B runs north-south through the western part of Blocks 4 and 5. It basically shows the extent of fills, typically between 8 to 10m in depth above alluvium. This accords with our understanding that this area was with reclaimed in the nineteenth century or as part of the 1960s container wharf. Coffey geotechnics

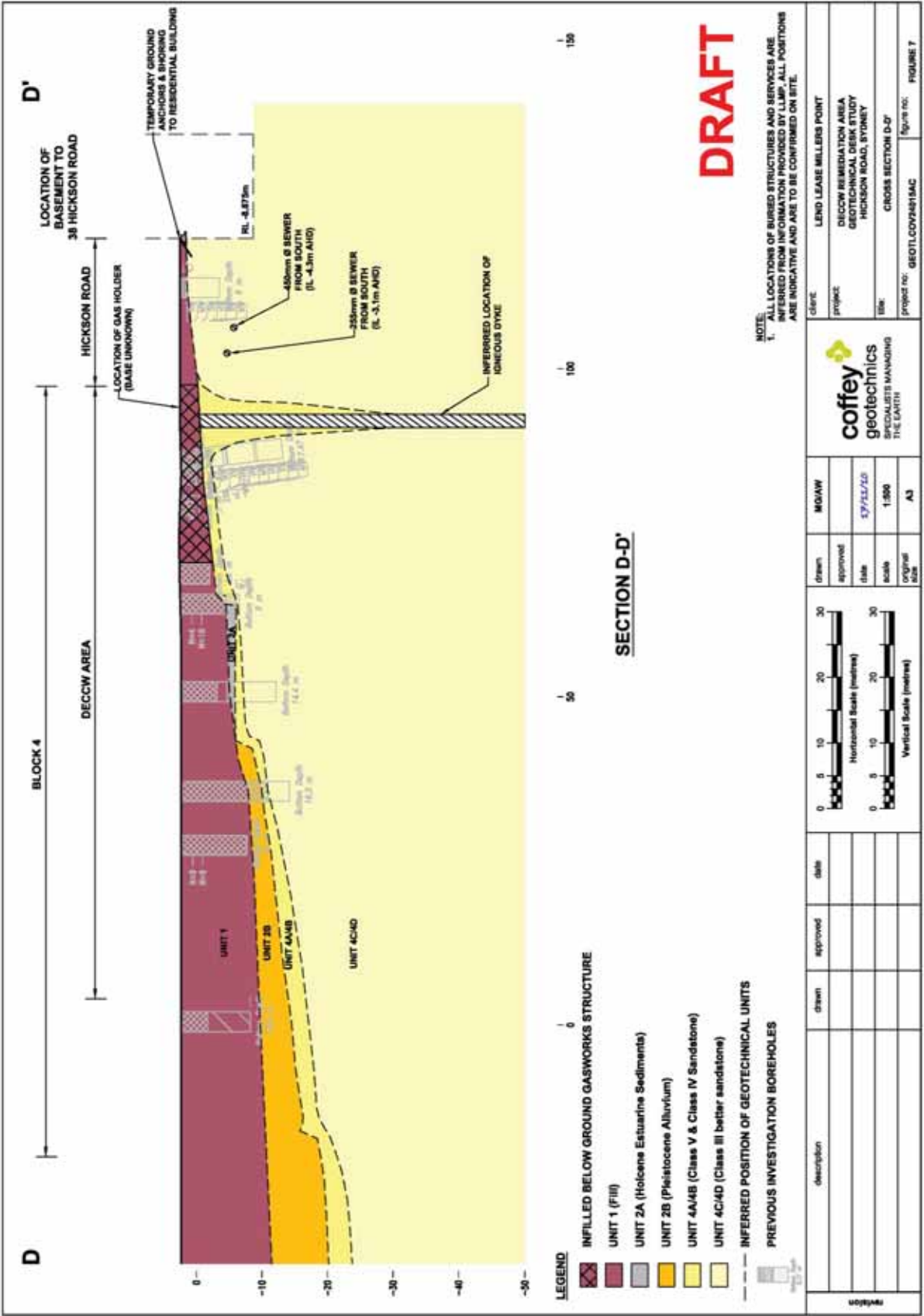


Figure 6: Section D-D' runs east-west through Hickson Road and Block 4, within Portion 16, just within the original gasworks land, though this is quite close to the line of Hickson Road. It runs through the northern edge of the first large gasholder. The Holocene Estuarine sediments probably indicate the location of the mudflats following the initial reclamation of Portion 16 (compare Figure 3.5) before this land was further reclaimed. Coffey geotechnics