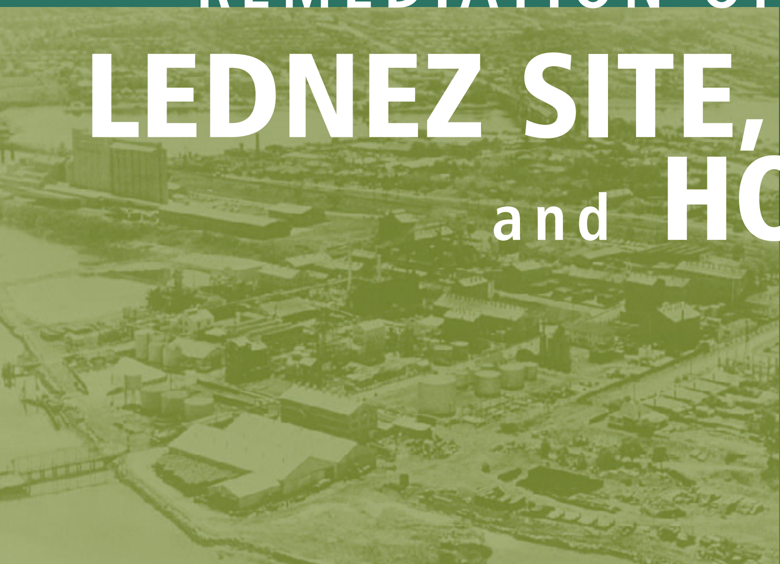
PARSONS BRINCKERHOFF

THIESS SERVICES

ENVIRONMENTAL IMPACT STATEMENT

REMEDIATION OF LEDNEZ SITE, RHODES and HOMEBUSH BAY



VOLUME 1

December 2002

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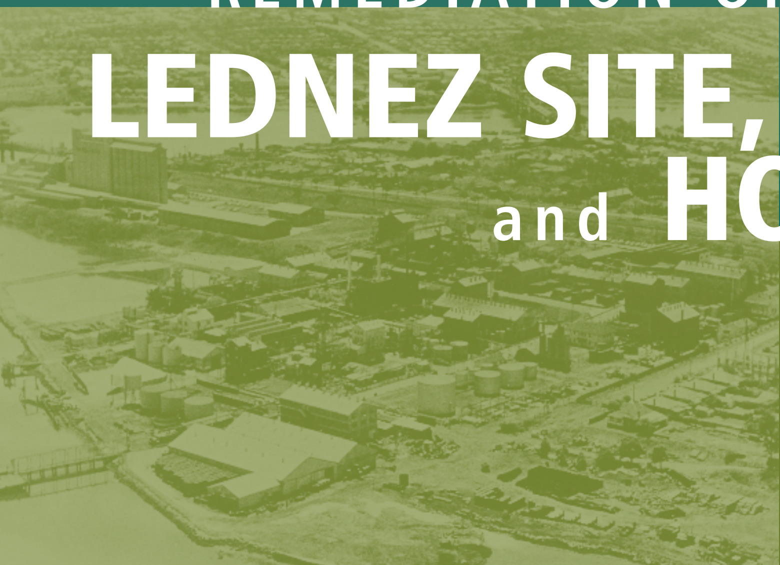

THIESS SERVICES

PARSONS BRINCKERHOFF

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VOLUME 1

December 2002

ENVIRONMENTAL PLANNING & ASSESSMENT REGULATION 2000, CLAUSE 71 DECLARATION

Submission of
Environmental Impact Statement (EIS)
Prepared under the Environmental Planning and Assessment Act 1979 Section 78A(8)

EIS PREPARED BY

name *Mark Keogh*

qualification *Bachelor of Town Planning*
University of New South Wales

company *Parsons Brinckerhoff*
PPK House
9 Blaxland Road
Rhodes NSW 2138

in respect of *Remediation of Lednez Site, Rhodes and Homebush Bay*

DEVELOPMENT APPLICATION

applicant name *Thiess Services Pty Ltd*

applicant address *43 Fourth Ave*
Blacktown NSW 2148

PROPOSED DEVELOPMENT

land to be developed *The proposed development is to be carried out on land in the EIS which is described as:*

Lot 10, DP1007931, (40 Walker Street, Rhodes) owned by the NSW Waterways Authority and described in the EIS as the Lednez site; and

A part of the bed of Homebush Bay (part residual lands comprised in Certificate of Title Volume 5018, Folio 1), described in the EIS as the portion of Homebush Bay.

These two areas are illustrated in Figure 1.2

---

assessment of environmental impact of development *An environmental impact statement is attached.*

CERTIFICATE *I certify that I have prepared the contents of this statement and to the best of my knowledge:*

- *it is in accordance with clauses 72 and 73;*
- *it contains all available information that is relevant to the environmental assessment of the development to which the statement relates; and*
- *the information contained in the statement is neither false nor misleading.*

signature

name *Mark Keogh*
Planning Executive
Parsons Brinckerhoff

date *5 December 2002*

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Part C The Proposal Description

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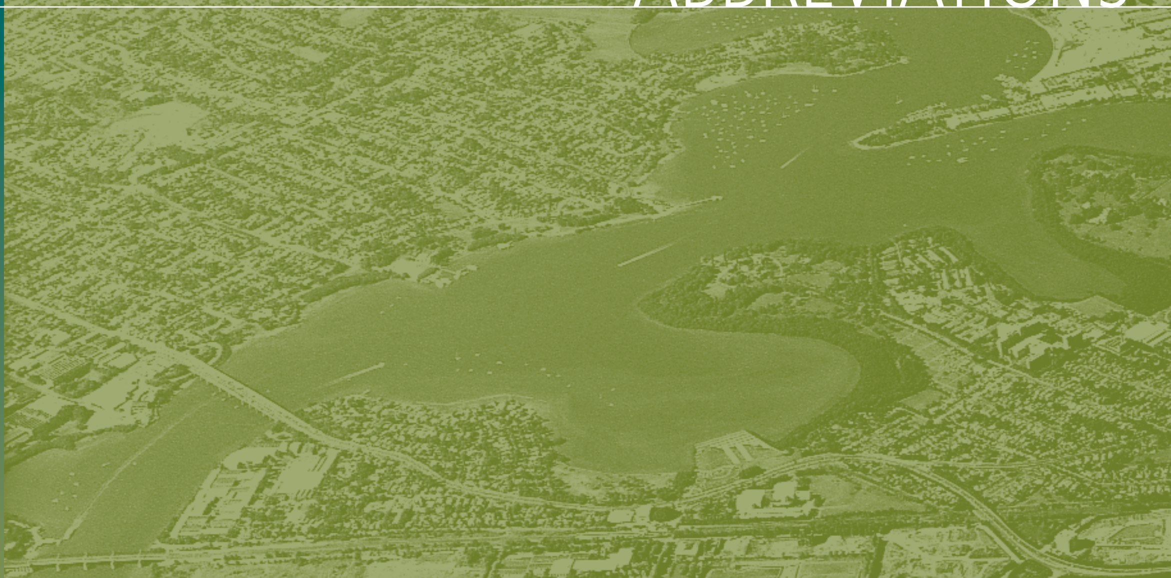
REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

ABBREVIATIONS



AMG	Australian Map Grid
ANEPM	National Environmental Protection Measure for Air Quality
ANZECC	Australian and New Zealand Environment Conservation Council
BCD	Base Catalysed Desorption
CAPCOA	California Air Pollution Control Officers Association
^{0}C	Degrees Celsius
CO	Carbon Monoxide
CO^2	Carbon Dioxide
dB(A)	Decibels
DTD	Direct Thermal Desorption
EIS	Environmental Impact Statement
EPA	New South Wales Environmental Protection Authority
ESD	Ecologically Sustainable Development
g/m^2/month	Grams Per Square Metre Per Month
g/Nm^3	Grams Per Cubic Metre Measured at Standard Temperature and Pressure
HAZAN	Hazard Analysis
HAZOP	Hazard and Operability Study
HOMBERG	Homebush Bay Environmental Reference Group
IRIS	Integrated Risk Information System
ITD	Indirect Thermal Desorption
mg/m^3	Micrograms Per Cubic Metre
NEPM	National Environmental Protection Measure

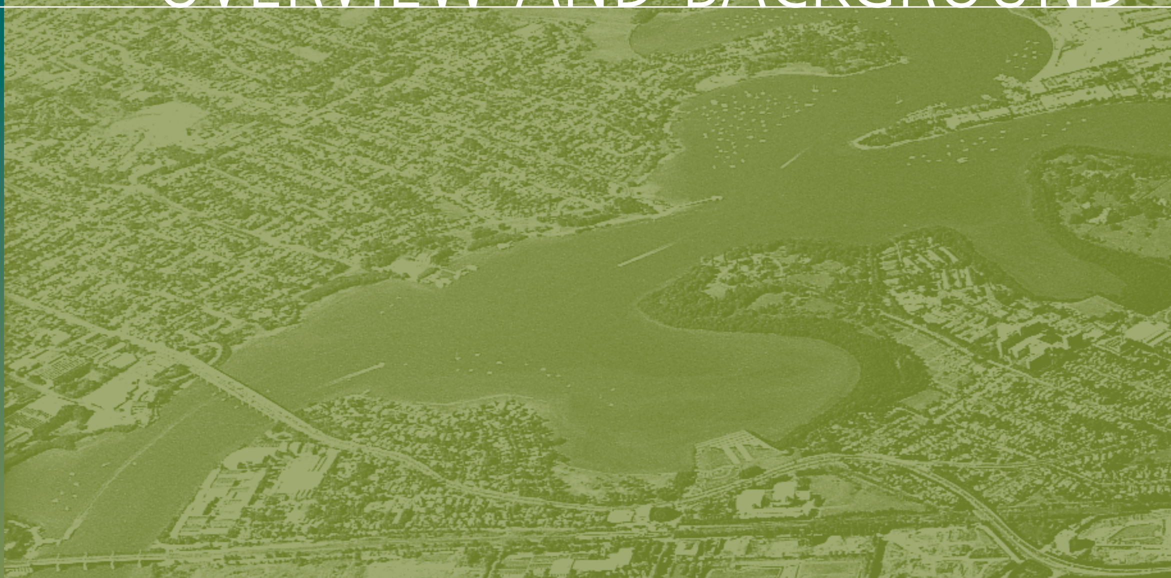
NHMRC	National Health and Medical Research Council
PAH	Polycyclic Aromatic Hydrocarbons
PB	Parsons Brinckerhoff
PM_{10}	Particulate Matter with a Diameter of Less than 10 Micrometres
$PM_{2.5}$	Particulate Matter with a Diameter of Less than 2.5 Micrometres
NERDC	National Energy Research and Demonstration Council
NTU	Normal Turbidity Units
PHA	Preliminary Hazard Assessment
pphm	Parts Per Hundred Million
ppm	Parts Per Million
PQL	Practical Quantification Units
RBL	Reference Background Level
SEPP	State Environment Planning Policy
SREP	Sydney Regional Environmental Plan
TEQ	Toxicity Equivalent
TPH	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
US EPA	United States Environment Protection Agency
WHO	World Health Organization

Part A

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

OVERVIEW AND BACKGROUND



Chapter 1

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

INTRODUCTION

Chapter 1

INTRODUCTION

1.1 Background to the Proposal

1.1.1 Lednez Site

Land located on the western-side of the Rhodes Peninsula adjacent to Homebush Bay in Sydney, New South Wales is contaminated from past industrial activities, including chemical manufacturing that commenced in the early 1930's. Investigations undertaken since 1986 have determined the extent and nature of land contamination, as well as the impact of these activities on the sediments of Homebush Bay.

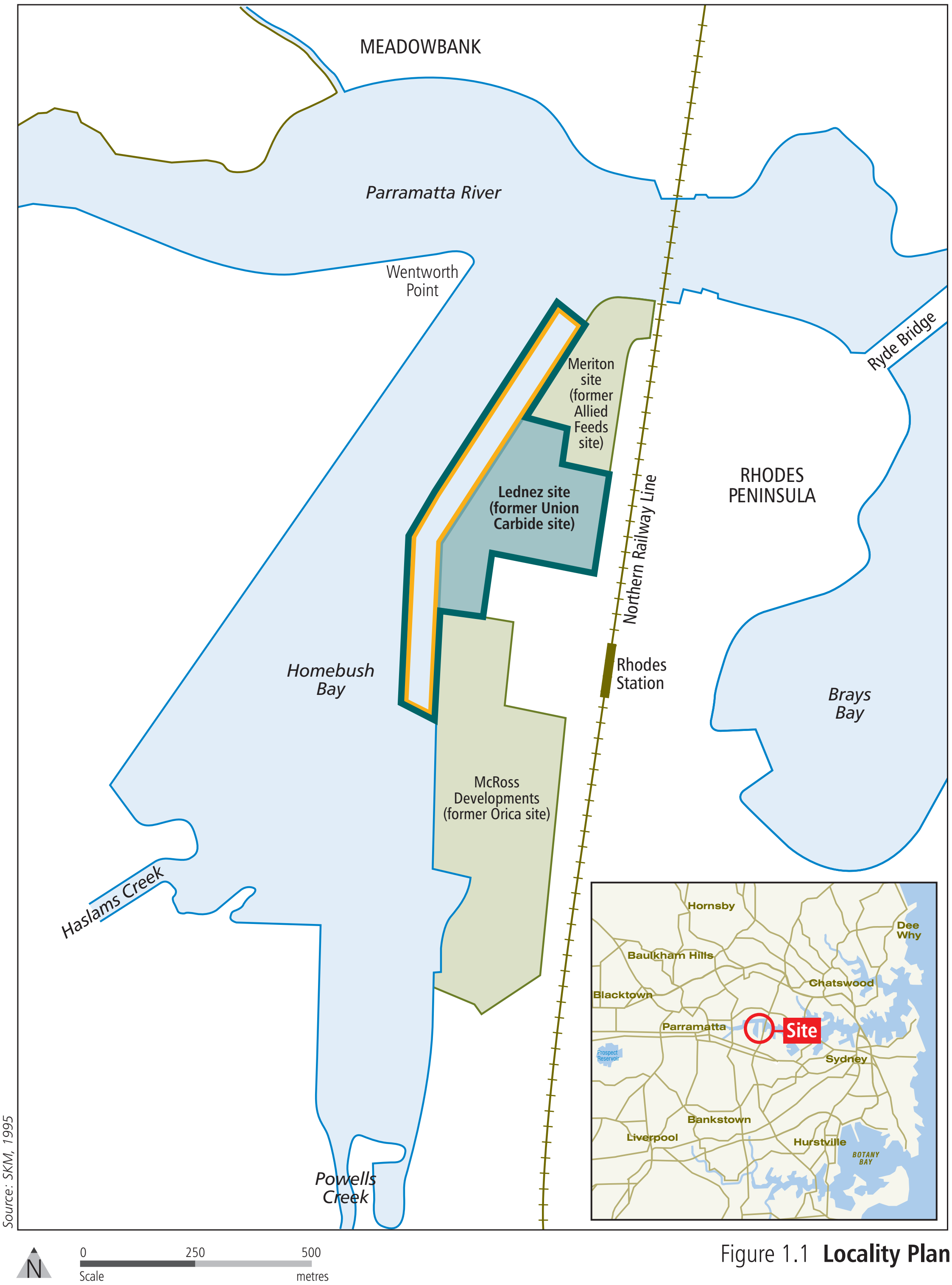
The part of the Rhodes Peninsula that is the subject of this environmental impact statement (EIS) has had a number of owners and uses over the years. It was originally owned by Timbrol until 1957 and was used for the manufacture of timber preservatives. Union Carbide then purchased the site and used it for the manufacture of chemicals, including herbicides and pesticides. The site was later transferred to Lednez Pty Ltd and is referred to as the Lednez site throughout this EIS.

The location of the Lednez site and its relationship to surrounding sites and Homebush Bay are shown in **Figure 1.1**. An aerial view of the site is shown in **Figure 1.2**.

Extensive reclamation and dredging of Homebush Bay commenced during Timbrol's occupation of the Lednez site and continued up until 1970. As a result of both chemical manufacturing and the use of contaminated fill for reclamation, soil and groundwater on the Lednez site have high concentrations of various contaminants. Typical contaminants found on the site include tar, naphthalene, other polycyclic aromatic hydrocarbons (PAHs), pyridine, tar oil, creosote oils, phenol and derivatives, bisphenol 'A', mononitrobenzene, aniline, various chlorinated phenols, chlorinated benzenes, trichloranisole, dioxins, furans, solvents and oils (JET, 2001).

In 1987, the NSW State Pollution Control Commission (now the NSW Environment Protection Authority (EPA)) served Union Carbide with a notice under the *Environmentally Hazardous Chemicals Act 1985* to remediate the Lednez site.

Between 1988 and 1993, Union Carbide undertook remediation work at the Lednez site. This work was based on a work plan agreed between Union Carbide and the State Pollution Control Commission. This remediation addressed the contamination on the eastern side of the site, however, the remainder is still contaminated and needs to be remediated.



Source: SKM, 1995

Figure 1.1 **Locality Plan**

EIS proposal boundary

Lednez site boundary

Area of Homebush Bay to be remediated

Figure 1.2 **Aerial View of the Study Area (2000)**

The clean up by Union Carbide, which cost approximately $30 million, included:

- removal and destruction by incineration of oil containing chlorinated compounds from fill in the north-western quadrant of the site
- excavation of contaminated soil and rock along the eastern and southern edges of the site
- construction of an encapsulation on the north-western quadrant of the site
- placement of a clay cap over the encapsulation and remaining filled parts of the site
- construction of a bentonite-cement cut off wall along the western boundary of the site.

1.1.2 Homebush Bay

The bed of Homebush Bay, as well as the beds of Sydney Harbour and the Parramatta River, is owned by the NSW Government. The NSW Waterways Authority (the Waterways Authority) manages these areas on behalf of the Government.

Overflow during reclamation of the Lednez and Meriton Apartments sites and the flow of stormwater and other wastewater from chemical manufacturing activities on the Lednez site into the waters of Homebush Bay have contributed to contamination of the bay. In 1989 the State Pollution Control Commission and NSW Fisheries imposed a total fishing ban in Homebush Bay. This was extended to a commercial fishing ban in Parramatta River upstream of the Gladesville Bridge in October 1990. These bans are still in force.

In 1997, the NSW Government announced that it would be committing $21 million towards the remediation of dioxin contamination in Homebush Bay.

1.1.3 Combined Remediation of Lednez Site and Homebush Bay

Between 1997 and 1999, the NSW Government investigated and considered technological options available to remediate the bay. During this time the NSW Government also decided to acquire the Lednez site in order to remediate the bay and the Lednez site as a combined project. This decision was taken because:

- there was a need to ensure that Homebush Bay would not be re-contaminated following remediation of its sediments
- newly available technology raised the possibility of safely returning the bay and Lednez site to public and residential use
- the Lednez site offered the opportunity for contaminated sediments from the bay to be processed on adjacent dry land.

These investigations and decisions were undertaken in preparation for an expression of interest/tender process to identify a suitable proponent for the remediation of the bay and Lednez site.

The expression of interest and tender processes for the combined remediation of the bay and Lednez site were initiated and completed between 1997 and 2000 by the NSW Government. The project was awarded to Thiess Services Pty Ltd (Thiess Services).

In 1999, the Waterways Authority engaged PPK Environment & Infrastructure, now known as Parsons Brinckerhoff Australia Pty Ltd (PB) to prepare this EIS. This engagement was novated to Thiess Services in 2001 to continue with the preparation of the EIS and undertake a program of community and stakeholder involvement. The study team involved in the preparation of this EIS is described in **Appendix A**.

1.1.4 Development of the Lednez Site

In 1999, the western side of the Rhodes Peninsula was rezoned by the Department of Urban Affairs and Planning (now Planning NSW) to accommodate residential development. This action was taken because the peninsula was identified in various planning documents as a key area for strategic urban development and consolidation through the remediation and subsequent sustainable land use of previous industrial sites.

The nature of the permissible development on the Lednez site is subject to a separate development application and master planning process.

1.2 Overview of the Proposal

PB has prepared this EIS for the proposal by Thiess Services to remediate the Lednez site and a portion of Homebush Bay.

This EIS is restricted to assessing impacts of the Thiess Services proposal. It does not examine impacts from the future residential development of the site.

The proposed remediation would be conducted in stages. Key activities include:

- earthworks required to excavate, stockpile and classify contaminated material from Homebush Bay and the Lednez site
- treatment of material with contaminant concentrations above site soil criteria
- beneficial reuse of material to reinstate the Lednez site to levels suitable for future residential development
- reinstatement of Homebush Bay excavations with material won from the Lednez site
- management of contaminated water.

The proposed remediation site consists of two areas referred to as Portions 1 and 2 as shown in **Figure 1.3**. These areas are defined by a remediation contract between the Waterways Authority and Thiess Services. For practical reasons, these areas have been established to maximise the effectiveness of the Waterways Authority financial contribution to the remediation.

Portion 1 comprises a section along the north-eastern foreshore of Homebush Bay, extending from the northern tip of the Rhodes Peninsula to the south along the foreshore of the northern portion of the Orica site. It also includes a narrow strip of land within the Lednez site called the “foreshore strip” in this EIS.

Portion 1 covers approximately seven hectares and includes the most contaminated parts of Homebush Bay.

The remainder of the former Lednez site is known as Portion 2 and has an area of approximately ten hectares.

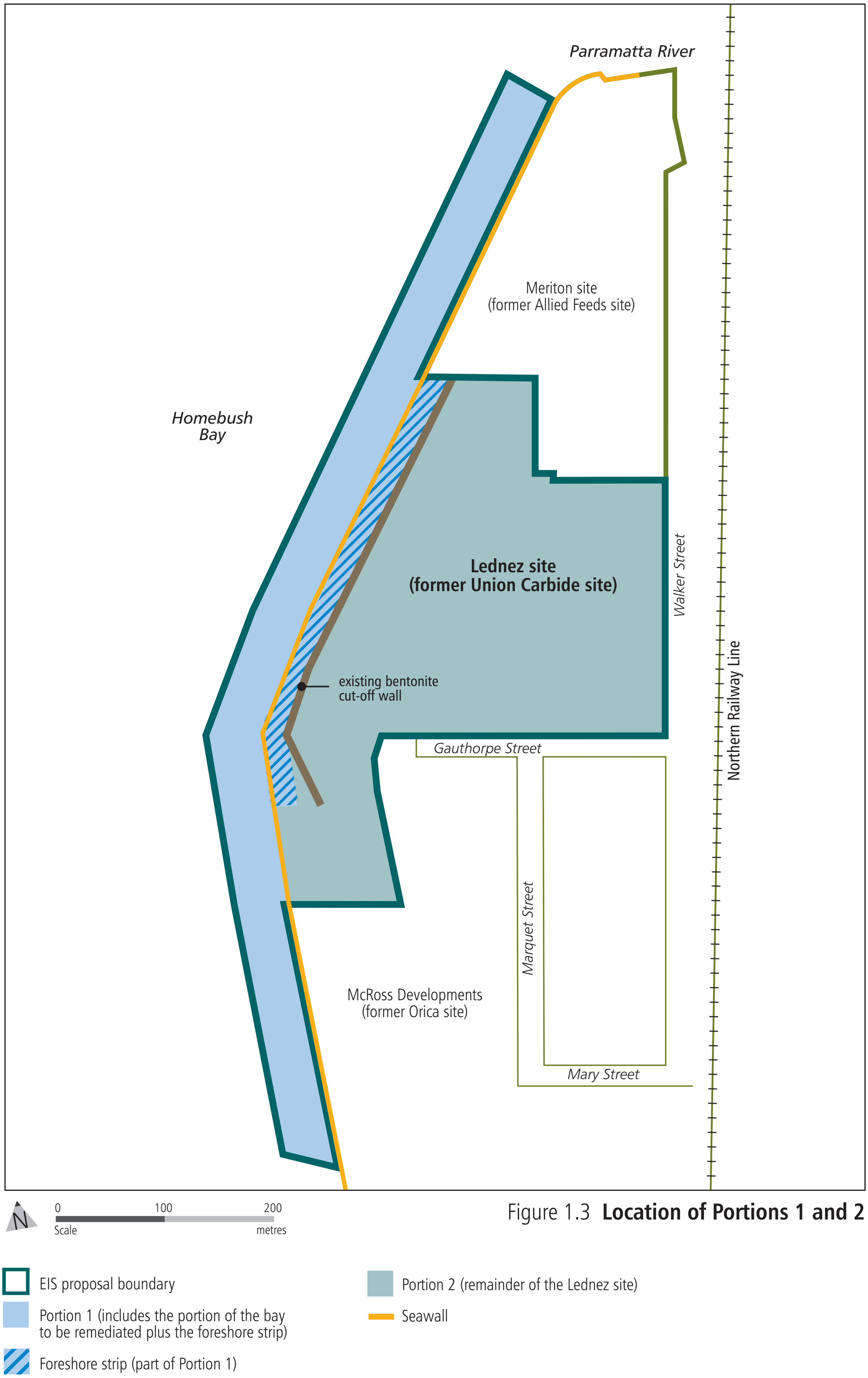


Figure 1.3 **Location of Portions 1 and 2**

1.2.1 Relationship to Other Sites on the Rhodes Peninsula

The remediation of the Lednez site and the bay area is likely to occur in tandem with the remediation of the adjacent land site to the north of the Lednez site, which is owned by Meriton Apartments. The Meriton Apartments site is subject to a separate EIS.

It is understood that the Orica land site to the south of the Lednez site has already been remediated.

1.2.2 Proposed Remediation Works

Various studies of the nature and distribution of contamination on the Lednez site and in the bay have been used to determine the occurrence of the following material types:

- material requiring treatment (Category 1)
- material not requiring treatment that is geotechnically unsuitable (that is too soft) to support building structures (Category 2)
- material not requiring treatment that could be used to support building structures (Category 3).

Treatment is proposed for material classified as Category 1 material.

Materials classified as Categories 2 or 3 are suitable for reinstatement on-site without treatment.

Category 2 materials would comprise soft material including estuarine mud and clay and is considered unsuitable from a geotechnical point of view for use in areas designated for residential development due to its limited load-bearing capacity. Accordingly, this material would be placed in open space areas and under roads, in accordance with appropriate engineering standards.

Category 3 materials would comprise soil, rock and crushed masonry that could be placed and compacted to produce a sound and stable landform. These materials would be used where structural soundness is required, for example, beneath basement areas for future residential development.

After treatment, Category 1 material may either be reclassified as Category 2 or Category 3 material subject to its geotechnical properties.

The criteria for materials suitable for reinstatement of the site are discussed in **Chapters 4** and **5**.

As discussed earlier, for practical reasons the remediation works have been divided into two separate portions established to maximise the effectiveness of the Waterways Authority financial contribution to the remediation.

The remediation of Portion 1 would involve the removal of contaminated sediments and soils from Homebush Bay and the foreshore strip respectively and the reinstatement of these excavations with material from the Lednez site that does not require treatment (for example crushed rock).

Excavation of sediment from Homebush Bay would be undertaken within the confines of up to eight coffer dams. The preferred sequence of works in the bay is to proceed from north to south. The exact timing will depend upon the progress of remediation works on the Meriton Apartments site and the Lednez site (Portion 2), with works in the bay being completed prior to or together with works on the adjacent land.

The existing seawall on the Lednez site would be demolished to facilitate removal of contaminated sediment and fill from around and beneath it. Following remediation, a new seawall would be built along the existing alignment.

A total of approximately 27,000 cubic metres of material would be excavated from Homebush Bay. An estimated 8,000 cubic metres of bay sediment would require treatment.

Portion 2 works would involve the remediation of the Lednez site, excluding the foreshore strip remediated as part of the Portion 1 works.

The remediation of the Lednez site would involve the excavation and classification of approximately 350,000 cubic metres of fill/reclaimed material. An estimated 97,000 cubic metres of material would require treatment. In addition, the works would involve the excavation and placement of approximately 280,000 cubic metres of rock needed to reinstate the site to the desired final levels. Treated material, sediment and fill/reclamation materials recovered from Portion 1 and the balance of the excavated rock material would be used to reinstate the site.

1.2.3 Proposed Treatment Technology

The technology to be used to remove dioxins and other contaminants from soils from the Lednez site and sediments from the bay is called thermal desorption. This technology has been successfully applied in over 140 projects in the United States.

Thermal desorption involves heating the soil to vaporise contaminants, which are then controlled within the thermal desorption plant, preventing their escape into the atmosphere.

Two types of thermal desorption technology exist for treating the materials present on the Lednez site and in the bay:

- direct thermal desorption (DTD)
- indirect thermal desorption (ITD).

Thiess Services proposes to apply the indirect (ITD) method of thermal desorption. This is because, unlike the direct (DTD) method of thermal desorption, ITD allows contaminated soil to be heated indirectly, preventing the formation of dioxins during the heating process.

The ITD process has been used in about 70 remediation projects in the United States to remove various organic contaminants, including dioxins, from soil and solid wastes.

Unlike incineration technologies that burn wastes or soil, ITD operates by heating the outer wall of a rotary kiln, with the heat being transmitted through to the inner wall and subsequently to the soil being treated within the kiln. The soil reaches temperatures of up to 450 degrees Celsius. The contaminated soil is not burnt.

The vaporised contaminants are then captured and condensed into a liquid condensate. It is proposed the condensate be treated using a process known as base catalysed decomposition (BCD) that converts the contaminants into non-toxic substances, such as oil and salt. The BCD process would be conducted at an off-site BCD facility in Queensland.

In the event regulatory permission for BCD treatment at an off-site facility cannot be secured, the process would be conducted at the Lednez site. This EIS considers both practices.

The EPA would need to approve the use of the proposed technologies through a project specific license. This could include separate licenses for the ITD and BCD plants. The license would impose operating conditions protective of air quality, public health and the environment.

1.3 Objectives of the Proposal

Thiess Services objectives in designing this proposal can be broadly defined as follows:

- to remediate the Lednez site to satisfy the requirements of the EPA accredited site auditor so that the site may be safely redeveloped for residential purposes
- to mitigate contaminant migration from the Lednez site and prevent adverse impacts to Homebush Bay
- with respect to Homebush Bay, remove dioxin contaminated sediment to improve human health and ecological conditions to the extent allowed by budgetary considerations, and to ensure that the bay is safe for recreational use
- to undertake the works in a safe manner protective of site workers, members of the surrounding community and the environment in general.

1.4 Proponent

Thiess Services is a subsidiary of Thiess Pty Ltd. Its operations include:

- contaminated site remediation
- recycling and resource recovery
- utilities/infrastructure maintenance and construction
- landfill ownership, development and management
- domestic and commercial waste collection services
- waste management systems
- water and wastewater treatment, operations and maintenance.

Thiess Services has extensive experience in the remediation of contaminated sites and has undertaken numerous projects in the Sydney region for a variety of government and private clients. For this remediation proposal, Thiess Services has engaged Focus Environmental (Focus) to provide design and engineering support and advice on quality management of the treatment operations, including emissions control. Focus is an American company that is internationally recognised for its expertise in using mobile thermal remediation technologies. As well as providing industry with guidance on the application of treatment technologies, Focus has also advised the US EPA in regards to the evaluation of available technologies and has had substantial input into the development of regulatory standards in the United States of America.

Thiess Services would also be partnered by a thermal technology supplier who would be responsible for the set-up, mobilisation and operation of the ITD plant to be employed on-site.

1.5 Approach to the Assessment of Environmental Impacts

1.5.1 Role of the Environmental Impact Assessment

The environmental impact assessment process is required to support a development application under Part 4 of the *Environmental Planning and Assessment Act 1979*. Specifically, because the proposed remediation works constitute designated development, an EIS is required. The EIS provides an assessment of the environmental impact of the development to which the statement relates and in particular deals with matters set out in Clauses 72 and 73 and Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* and the guidance and requirements of Planning NSW. The process of preparing the EIS includes consultation with relevant authorities, which provides the opportunity for those authorities to provide input into the assessment process. In addition, community consultation occurs and provides an opportunity for community input into the project and assessment.

The EIS is then exhibited providing the opportunity for interested people to convey their views on the proposal to the consent authority.

1.5.2 Structure of the EIS

The content of the EIS is governed by the *Environmental Planning and Assessment Act 1979* and the *Environmental Planning and Assessment Regulation 2000* and guidance documents from the relevant government agencies. In particular, an environmental impact statement must include matters referred to in guidelines issued by Planning NSW where they are in force or where there are no such guidelines in force, the matters referred to in Schedule 2 of the Regulations. The EIS must also be completed having regard to the Director-General's requirements.

It is not possible or practical to consider every environmental issue that might be relevant to the project in the same level of detail. The EIS therefore comprises a number of volumes. **Volume 1** identifies and analyses key issues and is supported by technical papers and various appendices, which deal with specific relevant issues in greater detail.

There are seven volumes in this EIS. Volume 1 contains the following eight parts:

- Part A: Overview and Background (Chapters 1, 2 and 3)
- Part B: The Need for Remediation and Consideration of Alternatives (Chapters 4 and 5)
- Part C: The Proposal Description (Chapter 6)
- Part D: Physical and Biological Impacts (Chapters 7, 8, 9, 10 and 11)
- Part E: Socio-economic Impacts (Chapters 12, 13, 14, 15 and 16)
- Part F: Cumulative Impacts (Chapter 17)
- Part G: Environmental Management and Monitoring (Chapter 18)
- Part H: Justification and Conclusions (Chapter 19).

Volumes 2–7 contain the remainder of the EIS, being the appendices and technical papers:

- Volume 2 contains Appendices A to I
- Volume 3 contains Technical Papers 1 to 3
- Volume 4 contains Technical Papers 4 and 5
- Volume 5 contains Technical Paper 6
- Volume 6 contains Technical Papers 7 and 8
- Volume 7 contains Technical Papers 9 and 10.

1.5.3 Integrating the Principles of Ecologically Sustainable Development

The principles of ecologically sustainable development are broadly designed to conserve natural resources.

Thiess Services is committed to ensuring that its works are undertaken in a manner that is consistent with the core objectives of ecologically sustainable development. Accordingly, these principles have been integrated throughout the development of the proposal and in the preparation of this EIS.

The definition of ecologically sustainable development, as set out in Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*, is based on four interrelated principles:

- the precautionary principle: if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- intergenerational equity: the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations
- conservation of biological diversity and ecological integrity: this is a fundamental consideration
- improved valuation, pricing and incentive mechanisms: environmental factors should be included in the valuation of assets and services.

An overview of the ecologically sustainable development considerations taken into account when preparing this EIS is presented in **Table 1.1**.

The issues relating to the first three of the principles of ecologically sustainable development are discussed in **Chapter 19**. The fourth principle, *improved valuation of environmental factors*, has been addressed in the assessment of the remediation options and by consulting with the community regarding their values and issues of concern. Assessment of the cumulative impact of the proposal has also assisted in addressing this principle.

Table 1.1 Integration of the Principles of Ecologically Sustainable Development in the EIS

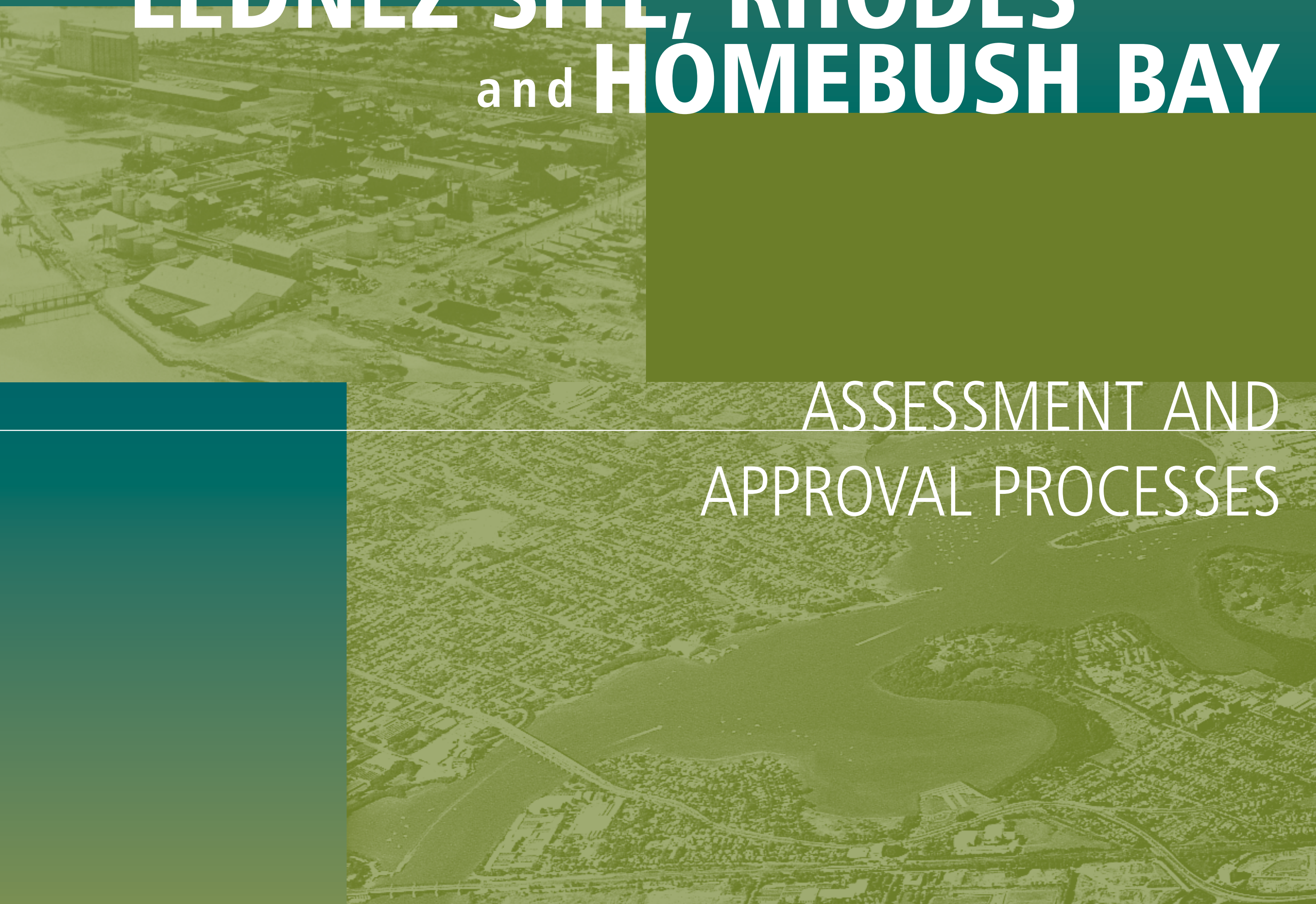
ESD principle	Method of integration
Precautionary principle	• Scope and methodologies used for environmental assessments were derived from detailed consultation with authorities, the community and other stakeholders • Potential threats of serious or irreversible damage were identified and assessed in detail as described in **Parts D** and **E** • Detailed assessment of alternatives to the proposed remediation strategy and technology were carried out as described in **Chapter 5** • Measures were identified to mitigate environmental impacts as described in **Parts D** and **E** • Monitoring and environmental management of the proposed remediation works would be undertaken as described in **Part G.**
Inter-generational equity	• A community consultation strategy was implemented as described in **Chapter 3** and **Technical Paper 1** to identify community concerns and values • Assessment of potential biophysical impacts of the proposal including identification of appropriate mitigation measures was carried out as described in **Chapters 7** to **11** • Assessment of the potential social impacts of the proposal was undertaken as described in **Chapters 12** to **16** with specific reference to community concerns and values
Inter-generational equity (cont'd)	• Health-related impacts were identified as described in **Chapter 9** • The need for the proposal and the impacts of not proceeding were considered as discussed in **Parts B** and **H** • Monitoring and management of the proposal would be undertaken as described in **Chapter 18**.
Conservational of biological diversity and ecological integrity	• Potential water quality impacts and appropriate management measures were identified as described in **Chapter 8** • The potential impacts on species and vegetation communities of local, regional and state significance along with proposed mitigation measures were identified as described in **Chapter 10** • Potential impacts on the estuarine environment and proposed management measures were identified as described in **Chapter 7**.
Improved valuation, pricing and incentive mechanisms	• Community values were identified as described in **Chapters 3** and **16** and **Technical Paper 1** • Remediation options were reviewed to determine the most appropriate approach as detailed in **Technical Paper 8** • Local and regional cumulative impact assessments were undertaken as described in **Chapter 17**

Chapter 2

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

ASSESSMENT AND APPROVAL PROCESSES



Chapter 2

ASSESSMENT AND APPROVAL PROCESSES

2.1 Introduction

The proposal comprises the remediation of land and landscaping which is development within the meaning of the *Environmental Planning and Assessment Act 1979*. The proposal is designated development, state significant development and integrated development within the meaning of that Act. The development also requires other approvals under acts administered by the EPA, the NSW Department of Land and Water Conservation and other authorities.

This EIS is required because the proposal is designated development.

2.2 Environmental Planning and Assessment Act 1979

2.2.1 Permissibility

The remediation of land is development within the meaning of Section 4 of the *Environmental Planning and Assessment Act 1979*. The permissibility of development will depend upon the applicable environmental planning instruments. Relevant environmental planning instruments are described in **Table 2.1**.

By the combined operation of *Sydney Regional Environmental Plan No. 22 – Parramatta River* (SREP 22), *Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula* (SREP 29) and *State Environmental Planning Policy No. 55 - Remediation of Land* (SEPP 55) the proposal is permissible with consent.

Sydney Regional Environmental Plan No. 22 – Parramatta River applies to the works proposed in Homebush Bay. Clause 16 of this plan requires that development consent be obtained for water-based development. Clause 28A provides:

> *"A person must not carry out development involving the remediation of land in Homebush Bay on land to which this plan applies adjoining or adjacent to the eastern boundary of Homebush Bay Area or comprising the foreshore or otherwise in the vicinity of Homebush Bay, except with the consent of the Minister."*

Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula applies to the works proposed on the Lednez site. This plan zones part of that area as "open space" and the remainder as "residential". Clause 11 provides that development for the purpose of "remediation of land" or "works ancillary to remediation of adjacent waterways", may be carried out only with development consent.

Table 2.1 Development Consent Requirement and Applicable Planning Instruments

Instrument	Date made	Last amended	Permissibility	Consent authority
SEPP 55 Remediation of Land	28/08/98	Nil	With consent	The person or authority that in accordance with a provision made by an environmental planning instrument that applies to the land, is the consent authority for the development.
SREP 29 Rhodes Peninsula	19/11/99	07/12/01	With consent	Minister for Planning
SREP 22 Parramatta River	13/07/90	01/03/02	With consent	Minister for Planning
SEPP 56 Sydney Harbour Foreshore and Tributaries	21/08/98	19/02/02	Land listed in Schedule 2 (including Lednez Site) requires master plan	Minister for Planning (who may waive the requirements for a master plan)

"Remediation of land" is defined as:

"(a) removing, dispersing, destroying, reducing, mitigating or containing the contamination of any land, or

(b) eliminating or reducing any hazard arising from the contamination of any land (including by preventing the entry of persons or animals onto the land)".

"Works ancillary to remediation of adjacent waterways" is not defined and so those words have their ordinary meaning.

Clause 5 of *Sydney Regional Environmental Plan No. 29* provides that the Minister is the consent authority for all development applications relating to land to which this plan applies.

The combined effect of the *Sydney Regional Environmental Plan No. 22* and the S*ydney Regional Environmental Plan No. 29* is that the remediation works both in the bay and on the Lednez site are permissible with the consent of the Minister.

State Environmental Planning Policy No. 56 – Sydney Harbour Foreshores and Tributaries lists the Lednez site in Schedule 2. This means that a master plan is required before any development consent for that site can be granted. However, Clause 11(2) of this plan provides that the Minister may waive that requirement for a master plan "because of the nature of the development concerned, the adequacy of other planning controls that apply to the proposed development or for other such reason as the Minister considers sufficient".

2.2.2 State Significant Development

Clause 11 of *State Environmental Planning Policy No. 55 - Remediation of Land* provides that:

> *"development that consists of the carrying out of a category 1 remediation work on land that is a remediation site is declared to be state significant development".*

A remediation site for the purposes of *State Environmental Planning Policy No. 55 - Remediation of Land* means:

"(a) land declared to be a remediation site by a declaration in force under Division 3 of Part 3 of the Contaminated Land Management Act 1997, or

(b) premises:

(i) in respect of which there is in force a notice under section 35 of the Environmentally Hazardous Chemicals Act 1985 requiring prescribed remedial action to be taken, or

(ii) that are the subject of prescribed remedial action (whether being undertaken by the EPA or by another public authority at the direction of that Authority) under section 36 of that Act".

Homebush Bay has been declared to present a significant risk of harm and to be a remediation site pursuant to Division 3 of Part 3 of the *Contaminated Land Management Act 1997*.

Category 1 remediation work includes work that is designated development or development for which another state environmental planning policy or a regional environmental plan requires development consent. *Sydney Regional Environmental Plan No. 22* and the *Sydney Regional Environmental Plan No. 29*, both of which are regional environmental plans, collectively require development consent for all of the proposed remediation work.

Accordingly:

- the proposal is category 1 remediation work, and
- the remediation work is being carried out (in part) on a remediation site.

Section 76A(8) of the E*nvironmental Planning and Assessment Act 1979* provides that:

"If:

(a) a project comprises development part of which is state significant development, all other development comprised in the project is taken to be State significant development, and

(b) but for this provision, part of state significant development would be subject to Part 5, this Part applies to the exclusion of Part 5 and the development may be carried out with development consent, and

(c) but for this provision, part of state significant development would be prohibited, the development may be carried out with development consent."

The effect of section 76A(8) is that the whole of the proposal is state significant development.

Section 76A(9) provides that the Minister for Planning is the consent authority for all state significant development.

2.2.3 Designated Development

The proposal is also designated development.

Item 15 of Schedule 3 of the *Environmental Planning and Assessment Regulation 2000* prescribes that the following development is designated development:

> *"Contaminated soil treatment works (being works for on-site or off-site treatment of contaminated soil, including incineration or storage of contaminated soil, but excluding excavation for treatment at another site):*
>
> *(a) …*
>
> *(b) …*
>
> *(c) that treat contaminated soil originating exclusively from the site on which the development is located and:*
>
> *(i) incinerate more than 1,000 cubic metres per year of contaminated soil, or*
>
> *(ii) treat otherwise than by incineration and store more than 30,000 cubic metres of contaminated soil, or*
>
> *(iii) disturb more than an aggregate area of 3 hectares of contaminated soil."*

The word "incinerate" for the purpose of this item is defined to include "*any method of burning or thermally oxidising solids, liquids or gases*". The proposal does not involve incineration, but does involve the treatment of more than 30,000 cubic metres of contaminated soil, and disturbance of more than three hectares of contaminated soil.

2.2.4 Integrated Development

The proposal is integrated development. Section 91 of the *Environmental Planning and Assessment Act 1979* defines integrated development as "*development that, in order for it to be carried out, requires development consent and one or more of [a number of other] approvals*".

The other approvals include permits under Sections 201, 205 and 219 of the *Fisheries Management Act 1994*, a permit under Part 3A of the *Rivers and Foreshores Improvement Act 1948* and a licence under sections 43(b), 48 and 55 of the Protection of the *Environment Operations Act 1997*. Thiess Services would seek those approvals from the Minister for Fisheries, the Minister for Ports, and the NSW EPA respectively. The requirement for those approvals for the proposed remediation works is discussed in **Sections 2.3** and **2.4** of this chapter.

2.3 Legislation Administered by the EPA

In NSW, the EPA administers a number of acts and legislative instruments relevant to the proposal. These include:

- the *Contaminated Land Management Act 1997*
- the *Protection of the Environment Operations Act 1997*, in particular, licensing obligations under that Act
- the *Environmentally Hazardous Chemicals Act 1985*, in particular, chemical control orders for scheduled chemical waste and dioxin contaminated waste under that Act.

2.3.1 Contaminated Land Management Act 1997

The *Contaminated Land Management Act 1997* is the primary Act under which contaminated land is regulated by the EPA.

This section deals with the following aspects of that Act:

- determination and suitability of a contaminated site for a proposed use including the generation of remediation criteria
- existing orders and regulatory instruments applicable to the remediation area
- voluntary remediation agreements.

Suitability for the Proposed Use

Clause 7(1) of *State Environmental Planning Policy No. 55 - Remediation of Land* provides that:

"a consent authority must not consent to the carrying out of any development on land unless:

(a) it has considered whether the land is contaminated, and

(b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and

(c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose."

The proposed future use of the site is residential apartments and open space. As mentioned previously, a development application will be lodged by another proponent in relation to that future use.

The *Guidelines for the NSW Site Auditor's Scheme* (EPA, 1998a) describes a decision process for assessing urban redevelopment sites that should be followed by contaminated land consultants. The guidelines prescribe soil investigation levels that are the concentration levels of particular contaminants above which further investigation and evaluation are required. Soil investigation levels are arrived at using appropriate sampling, analytical and data interpretation techniques.

However, the substances for which soil investigation levels have been prescribed do not include many of the contaminants found on the Lednez site. The guidelines make the following provision for such circumstances:

"Where soil investigation levels are not available, or assessment against soil investigation levels has been demonstrated to be inconclusive for the circumstances of a particular site, a site-specific risk assessment may have been undertaken. If so, the risk assessment should be in accordance with the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC/NHMRC, 1992) and revisions. In the case of either an abridged or detailed site-specific human health risk assessment, the auditor should check that the risk assessment satisfies all the requirements in the checklist in Appendix D. The auditor should check that all site-specific risk assessments are scientifically valid and that the recommended site-specific criteria protect public health and the environment".

The EPA has published draft new *Guidelines for the NSW Site Auditor Scheme* (EPA, 2002). In relation to risk assessments, the draft guidelines state:

> *"Where soil investigation levels are not available for particular contaminants, or assessment of contaminants against soil investigation levels at a particular site is inconclusive, a site-specific risk assessment may have been undertaken by the contaminated land consultants. If so, the risk assessment must be in accordance with the NEPM and any revisions to it. The auditor must check that any human health risk assessment satisfies all the requirements in the checklist in Appendix C. The auditor must check that all site-specific risk assessments are scientifically valid and that the recommended site-specific criteria are appropriate to protect public health and the environment."*

The "NEPM" is defined as the *National Environment Protection (Assessment of Site Contamination) Measure 1999*.

Accordingly, it is necessary and appropriate to adopt a health based risk assessment approach in determining the level of remediation required for the proposed future uses of the site. The adopted risk based approach is described in **Chapters 4** and **5**.

Existing Orders and Regulatory Instruments

Prior to the enactment of the *Contaminated Land Management Act 1997* the EPA regulated contaminated sites by way of orders under sections 35 and 36 of the *Environmentally Hazardous Chemicals Act 1985*. The transitional arrangements for the commencement of the *Contaminated Land Management Act 1997* repealed the *Environmentally Hazardous Chemicals Act 1985* in relevant respects but preserved the operation of those orders.

The Lednez site is the subject of an order requiring the maintenance of remediation of that site. The order was issued to the Marine Ministerial Holding Corporation and is Notice Number 28016.

Homebush Bay is the subject of Notice Number 21001 issued by EPA under Section 21 of the C*ontaminated Land Management Act 1997* declaring the area of Homebush Bay known in this EIS as Portion 1 (excluding the foreshore strip) to be a remediation-site. This followed the EPA finding that the site is contaminated with dioxin in such a way as to present a significant risk of harm to aquatic life near the site and to people eating fish from the bay.

Voluntary Remediation Agreement

The *Contaminated Land Management Act 1997* provides for a voluntary remediation agreement between the EPA and a proponent. Specifically, section 26(1) of this Act provides that "this section applies where one or more persons furnish the EPA with a proposal to remediate land, being land that is contaminated with a substance in such a way as to present a significant risk of harm".

Section 26(2) provides that :

> *"the EPA may agree with one or more of the parties to such a voluntary remediation proposal that the EPA will not issue a remediation order against them if remediation is carried out in accordance with the proposal and the EPA is satisfied that:*
>
> *(a) the terms of the proposal are appropriate (including any plan of remediation, provision for giving notice and terms setting out a timetable for the remediation or required progress reports on the remediation), and*
>
> *(b) the parties have taken all reasonable steps to identify and find every owner and notional owner of the land and every person responsible for contamination of the land (in such a way as to present a significant risk of harm) with the substance referred to in subsection (1); and*
>
> *(c) the parties have given the persons identified and found a reasonable opportunity to participate in the formulation and carrying out of the proposal on reasonable terms."*

Section 26(3) provides that "the EPA may agree as referred to in subsection (2) even if it is not satisfied as to the matters set out in subsection (2)(b) and (c), but only if the parties have undertaken not to recover contributions under Division 6 in respect of the remediation".

The proponent intends to seek a voluntary remediation agreement with the EPA in respect of the proposed remediation.

2.3.2 Protection of the Environment Operations Act 1997

Section 48 of the *Protection of the Environment Operations Act 1997* requires a person to obtain a licence from the EPA before carrying out any of the premises based activities described in Schedule 1 of that Act.

Schedule 1 includes the following activity:

"Contaminated soil treatment works for on-site or off-site treatment (including, in either case, incineration or storage of contaminated soil but excluding excavation for treatment at another site) that:

(1) handle more than 1,000 cubic metres per year of contaminated soil not originating from the site on which the works are located; or

(2) handle contaminated soil originating exclusively from the site on which the works are located; and

(a) incinerate more than 1,000 cubic metres per year of contaminated soil, or

(b) treat otherwise than by incineration and store more than 30,000 cubic metres of contaminated soil, or

(c) disturb more than an aggregate area of 3 hectares of contaminated soil."

Due to 2(b) and 2(c) above, the remediation works will require a licence under the *Protection of the Environment Operations Act 1997*.

2.3.3 Environmentally Hazardous Chemicals Act 1985

Under Division 5, Part 3 of the *Environmentally Hazardous Chemicals Act 1995* the EPA can make a chemical control order in relation to an environmentally hazardous chemical or a declared chemical waste.

The *Guidelines for the NSW Site Auditor's Scheme* (EPA, 1998a) state that:

"Chemical control orders set out requirements for manufacturing, keeping, using, processing, storing, selling, transporting or disposing of chemicals and declared chemical wastes. Where a site involves chemicals or chemical wastes that are subject to a chemical control order, the site auditor should be satisfied that any proposed management strategy complies with the requirements set down in the relevant chemical control order. For example, certain chemicals occurring above prescribed concentrations are prohibited from being disposed of at any landfill.

There is a program of national management plans for Schedule X wastes (ANZECC, 1994b). The program includes wastes associated with HCB (hexachlorobenzene) (ANZECC, 1996b), PCBs (polychlorinated biphenyls) (ANZECC, 1996c), and OCPs (organochlorine pesticides) (management plan proposed). The national management plans set timelines for the destruction and disposal of Schedule X wastes. The relevant authorities implement regulatory aspects of the plans. Site auditors should be aware that chemical control orders either have been or will be revised by the EPA as part of implementing the national management plans."

Chemical control orders that are relevant to the proposal are discussed below.

Dioxin Chemical Control Order

The chemical control order in relation to dioxin–contaminated waste materials dated 14 March 1986 (the Dioxin Chemical Control Order) prohibits the processing, keeping, selling, distributing or conveying of dioxin–contaminated waste materials, except in accordance with a licence issued by the EPA.

"Dioxin-contaminated waste materials" is defined as "those waste materials that, when tested using a method approved by the EPA, are found to contain more than one part in 100 million by weight of dioxin".

Scheduled Chemical Wastes Chemical Control Order

The chemical control order in relation to scheduled chemical wastes dated 14 October 1994 prohibits the manufacturing, processing, keeping, distributing, conveying, using, selling or disposing of scheduled chemical wastes, or any act related to any such act, unless it is otherwise permitted by, and carried out in accordance with the conditions of, the scheduled chemical wastes chemical control order. The scheduled chemical wastes chemical control order requires a licence for various activities.

"Scheduled chemical waste" is defined as "*any waste liquid, sludge or solid (including waste articles and containers) which contain one or more of the constituents listed in Schedule "A", where the total concentration of those constituents is more than one milligram per kilogram*".

2.4 Legislation Concerning the Marine Environment

There are a number of acts and regulations which regulate activities in the marine environment and which are relevant to the proposed remediation works. These include:

- the *Rivers and Foreshores Improvement Act 1948*
- the *Fisheries Management Act 1994*
- the *Management of Waters and Waterside Lands Regulations NSW*
- the *Heritage Act 1977*.

2.4.1 Rivers and Foreshores Improvement Act 1948

Part 3A Permit

Section 22B(1) of this Act provides that "*a person must not*:

(a) make an excavation on, in or under protected land, or

(b) remove material from protected land, or

(c) do anything which obstructs, or detrimentally affects, the flow of protected waters, or which is likely to do so,

unless the person is either authorised to do so by a permit under this Part and does so in accordance with any conditions to which the permit is subject, or is authorised to do so by the regulations".

"Protected land" is defined in section 22A as:

"(a) land that is the bank, shore or bed of protected waters, or

(b) land that is not more than 40 metres from the top of the bank or shore of protected waters (measured horizontally from the top of the bank or shore), or

(c) material at any time deposited, naturally or otherwise and whether or not in layers, on or under land referred to in paragraph (a) or (b)".

"Protected waters" is defined in section 22A as "*a river, lake into or from which a river flows, coastal lake or lagoon (including any permanent or temporary channel between a coastal lake or lagoon and the sea)*".

"River" is defined in section 2 as including "*any stream of water, whether perennial or intermittent, flowing in a natural channel, or in a natural channel artificially improved, or in an artificial channel which has changed the course of the stream of water and any affluent, confluent, branch or other stream into or from which the river flows and, in the case of a river running to the sea or into any coastal bay or inlet or into a coastal lake, includes the estuary of such river and any arm or branch of same and any part of the river influenced by tidal waters*."

Accordingly the remediation works in Homebush Bay and the works within 40 metres of the bank of Homebush Bay will require a permit under Part 3A of the *Rivers and Foreshores Improvement Act 1948*.

Navigable Waters Approval

Section 23 of the Act provides:

"Construction of works in navigable waters

In respect of any work to which this Act extends which may affect navigation upon the inland waters of the State, or in connection with the navigable waters lying within three nautical miles of the coast, such provision for navigation shall be made as may be determined by the Minister for Ports, and no work which shall prevent navigation in such waters shall be constructed without the approval of the Minister for Ports."

Homebush Bay is not within three nautical miles of the coast. The phrase "inland waters of the State" is not defined in the Act. If Homebush Bay falls within that description then the approval of the Minister for Ports would be required for the works in Homebush Bay as they would prevent navigation in that part of the Bay.

Water Management Act Approvals

Chapter 3 Part 3 of the *Water Management Act 2000* includes a number of approval provisions, which might apply to the proposed remediation works. However, while most of the provisions of the Act commenced on 1 January 2001, Chapter 3 Part 3 has not yet come into force and no date for its commencement has been publicly notified.

The requirement for a controlled activity approval, referred to in section 91 of the Act, will replace the requirement for a Part 3A permit under the *Rivers and Foreshore Improvement Act 1948*.

2.4.2 Fisheries Management Act 1994

Section 201 Permit - Dredging

Section 201 provides:

"(1) A person must not carry out dredging or reclamation work except under the authority of a permit issued by the Minister.

(2) This section does not apply to:

(a) work authorised under the Crown Lands Act 1989, or

(b) work carried out, or authorised, by a relevant public authority (other than a local government authority)."

"Dredging work" is defined in section 198A as:

"(a) any work that involves excavating water land, or

(b) any work that involves the removal of material from water land that is prescribed by the regulations as being dredging work to which this Division applies."

Accordingly a permit authorising dredging for the purposes of section 201 would be required for the remediation works in Homebush Bay.

Section 205 permit - Marine Vegetation

Section 205 provides:

"(1) This section applies to:

(a) mangroves, or

(b) seagrasses, or

(c) any other marine vegetation declared by the regulations to be marine vegetation to which this section applies,

but does not apply to protected marine vegetation under section 204A.

(2) A person must not harm any such marine vegetation in a protected area, except under the authority of a permit issued by the Minister under this Part.

"Protected area" is relevantly defined in section 204 as "*any public water land, or any area that is the subject of an aquaculture lease...*".

"Public water land" is relevantly defined in section 4 as:

"land submerged by water (whether permanently or intermittently), being:

(a) Crown land, or

(b) land vested in a public authority,

(c) land vested in trustees for public recreation or for any other public purpose, or

(d) land acquired by the Minister under Division 1 of Part 8,

but does not include land which is the subject of an aquaculture lease or land of which a person has exclusive possession under a lease under any other Act".

As the remediation works in Homebush Bay would not harm any of the types of vegetation listed in Section 205(1), a permit would not be required under Part 7 of the *Fisheries Management Act 1994*.

2.4.3 Management of Waters and Waterside Lands Regulations NSW

These regulations are in force under the *Maritime Services Act 1935*.

Approval for Structures in the Port of Sydney

Clause 65A(1) provides:

"(1) A person must not, except with the prior written consent of the Board:

(a) erect any wharf or structure in the Port of Sydney; or

(b) alter or add to any wharf or structure in that Port".

"Port of Sydney" is not defined in the regulations, the *Maritime Services Act* or any other Act. In construing the meaning of this phrase regard could be had to "Schedule 1 – Description of port boundaries" in the *Ports Corporatisation and Waterways Management Regulation 2002* made under the *Ports Corporatisation and Waterways Management Act 1995*. While that schedule does not include a description of the Port of Sydney it does include the following heading and description:

"Sydney Harbour

The waters of Sydney Harbour and of all tidal bays, rivers and their tributaries connected or leading to Sydney Harbour bounded by mean high water mark together with that part of the South Pacific Ocean below mean high water mark enclosed by the arc of a circle of radius 4 sea miles having as its centre the navigation light at Hornsby Lighthouse".

Thiess Services would seek approval under Clause 65 from the Waterways Authority to erect, and to alter or add to, structures in Homebush Bay as part of the remediation works.

Approval to Disturb the Bed of the Port of Sydney

Clause 67 provides that "*a person shall not use drags, grapplings, or other apparatus for lifting any object or material from the bed of a special port, or otherwise disturb such bed in any way, except with the written permission of the harbour master and in accordance with the conditions attaching to such permission*".

"Special port" is defined in Clause 4 as:

"(a) the Port of Sydney;

(b) the Port of Newcastle;

(c) ... (etc.)".

Thiess Services would seek approval under Clause 67 from the harbour master to disturb and lift material from the bed of Homebush Bay as part of the remediation works.

Approval to Remove Materials or Vegetation

Clause 66 provides:

"(1) A person shall not, except with the prior permission of the [Waterways Authority] and in accordance with any conditions the [Waterways Authority] may deem appropriate and attach thereto, remove from any part of a special port area any soil, sand, rock, stone, shale, slate, shingle, gravel or similar material.

(2) *A person shall not, except with the prior permission of the [Waterways Authority] and in accordance with any conditions the [Waterways Authority] may deem appropriate and attach thereto, cut, or otherwise remove or damage, any mangrove or other timber growing in any part of a special port area."*

"Special port area" is defined in Clause 4 as:

"a special port and any managed land adjoining or adjacent to such port".

"Managed land" is defined as:

"any land vested in the [Waterways Authority] or under its control or management, and includes any building or other structure erected thereon".

The Waterways Authority owns the Lednez site. Accordingly, Thiess Services would seek approval under Clause 66 from the Waterways Authority for the remediation works in both Homebush Bay and on the Lednez Site.

Under section 13TA of the *Maritime Services Act 1935*, written approval is required by the proponent from the Waterways Authority before excavation or removal of sand, soil, or other materials on land that lies within 10 metres of the high water mark.

2.4.4 Heritage Act 1977

No items have been identified on the Lednez site in the state Heritage Register and as such the proposed remediation works do not require licensing or approval under Section 58 of the *Heritage Act 1977*.

The proposed excavation of the reclaimed land would, however, destroy the remains of jetty facilities and other cultural features and deposits that are more than 50 years old. Such features and deposits are classified as "relics" under the *Heritage Act 1977*. Accordingly, an excavation permit under Section 140 of the Act is required.

2.5 Remediation Action Plans

Remediation action plans detail the proposed remediation methodology. The remediation action plans prepared for the proposal describe site procedures including material classification, treatment and placement on-site as well as the sampling and analysis programs that form part of the site validation process. Some of these details are summarised in **Chapter 6** as part of the proposal description. The remediation action plans are included in **Technical Paper 7** to meet the requirements of the Director-General for this EIS. These remediation action plans have been prepared to also meet specific requirements as determined by the EPA and the EPA accredited auditor. Copies of the Auditor's Summary Audit Reports for the remediation action plans are also included in **Technical Paper 7**.

2.5.1 Regulatory Requirement for Remediation Action Plans

Under the *Guidelines for Consultants Reporting on Contaminated Sites* (EPA, 1997a) the remediation action plans should follow detailed site investigations and:

- set remediation goals to ensure the remediated area is suitable for the proposed future uses and activities and poses no unacceptable risk to human health or the environment

- document all procedures and plans to be implemented to reduce the risks to acceptable levels for the proposed site use
- establish the environmental safeguards required to complete the remediation in an environmentally acceptable manner
- identify the necessary approvals and licences required by the regulatory authorities.

A remediation action plan should include discussion on the remediation goals, the extent of remediation required, possible remediation options and how risk can be reduced, the rationale for the any remediation technology selection, the validation testing proposed after remediation, interim site management plan (before remediation), a site management plan (during remediation, reflecting any approval and/or licensing conditions), a remediation schedule, the hours of operation, identification of licences and approvals, contact details (names and phone numbers) during remediation and a community consultation plan.

2.5.2 Review of and Sign-off on Remediation Action Plans

In addition to the various technical requirements, remediation action plans must be independently reviewed by an EPA-accredited auditor appointed under the *Contaminated Land Management Act 1997*. The audit process is described in *Guidelines for the NSW Site Auditor Scheme* (EPA, 1998a) and *Planning Guidelines SEPP 55 – Remediation of Land* (DUAP, 1998).

The EPA's Site Auditor Scheme was established in 1998. A key reason for establishing such a scheme was to "*provide greater certainty for planning authorities and the community through independent review of contaminated site assessment, remediation and validation reports.*"

The auditor assesses whether the remediation strategy is appropriate in terms of setting suitable remediation goals and methodologies for the intended use of the site. The auditor also determines whether:

- the plan adequately addresses the operational procedures to be followed in completing the works
- all regulatory requirements and guidelines are met and contingency planning for incidents and emergencies are adequate.

Upon reviewing the remediation action plans, if the auditor is not satisfied that all matters are addressed, works do not proceed until necessary amendments are made to the remediation action plan to bring it into compliance.

The auditor's role does not end once satisfactory plans have been submitted; it continues until after completion of the remediation works. For the site to be released, the auditor is required to sign off in the form of a site audit statement that all objectives stated in the plan had been met. The site audit statement confirms that validation of site remediation works was undertaken as proposed and if these deviate from the original plan, justification of what was undertaken with recommendations for further action or management as required. The site audit statement is required to be prepared with due regard for the licence conditions imposed by the EPA or planning authorities.

Issuing of a site audit statement follows the preparation of a summary site audit report by the auditor. This report documents information reviewed and substantiates the conclusions made in the site audit statement.

Statistical Validation of Remediation Action Plans

Validation of the works conducted on both the Lednez site and in Homebush Bay would be required to ensure that remediation works have been conducted in accordance with the protocols established for the proposal in the remediation action plans.

Validation requirements typically include:

- survey of excavated surface
- sampling to document chemical concentrations in exposed surfaces following excavation and prior to backfill
- validation sampling of materials to be used to backfill excavations.

Data obtained from the validation of backfill materials would be statistically analysed to ensure that the 95 percent upper confidence limit on the arithmetic mean (95 percent UCL_{AVG}) concentration for a given sample set would be below the relevant criterion for the appropriate land use. In performing the calculation of the 95 percent UCL_{AVG}, the following constraints taken from the *National Environment Protection (Assessment of Site Contamination) Measure, National Environment Protection Council, 1999*, would be considered:

- individual sample concentrations would not exceed the criteria by more than 2.5 times
- the standard deviation of the sample set would not be more than 50 percent of the criterion.

According to the *Sampling Design Guidelines* (EPA, 1995a), the 95 percent UCL_{AVG} "*implies that there is a 95 percent probability that the 'true' (but never known) arithmetic average contaminant concentration within the sampling area would not exceed the value determined by this method*". For a site to be considered successfully remediated, the typical minimum requirement is that the 95 percent UCL_{AVG} on the contaminant concentration is less than the site-specific validation criterion. A site or sampling area cannot be considered successfully remediated if the 95 percent UCL_{AVG} concentration exceeds the acceptable limit.

Full details on the validation proposed can be found in **Technical Paper 7**.

2.6 Form and Content of the EIS

Section 78A(8) of the *Environmental Planning and Assessment Regulation Act* provides that a development application must be accompanied by an environmental impact statement if the application is in respect of designated development. The EIS must be prepared by or on behalf of the applicant in the form prescribed by the regulations.

Division 4 of Part 6 of the *Environmental Planning and Assessment Regulation 2000* sets out prescribed matters in respect of an EIS. The EIS must be in a form prescribed by Clause 71. The contents of an EIS must include the matters prescribed by Clause 72.

Clause 72 provides that the contents of an EIS must include:

"(a) for development of a kind for which specific guidelines are in force under this clause, the matters referred to in those guidelines, or

(b) for any other kind of development:

(i) the matters referred to in the general guidelines in force under this clause, or

(ii) if no such guidelines are in force, the matters referred to in Schedule 2."

The Director-General may establish guidelines for the preparation of an EIS in respect of development generally or in relation to any specific kind of development.

Where Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* applies the following matters must be included in the EIS:

"• *a summary of the environmental impact statement;*

- *a statement of the objectives of the development or activity;*
- *an analysis of any feasible alternatives to the carrying out of the development or activity having regard to its objectives, including the consequences of not carrying the development or activity;*
- *an analysis of the development or activity including a description of the development, general description of the environment likely to be affected, the likely impact on the environment of the development, a description of the measures proposed to mitigate adverse effects and a list of approvals that must be obtained;*
- *a compilation of the measures referred to in item 4(d);*
- *justification for the development having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development as set out in Schedule 2."*

The applicant responsible for preparing an EIS must also consult with the Director-General and must obtain Director-General's requirements. In completing the EIS regard must be had to the Director-General's requirements relating to the form and content of the statement and its' availability for public comment. A copy of the Director-General's requirements for this proposal is contained in **Appendix B**. A table summarising where the Director-General's requirements are addressed in the EIS is provided in **Appendix C**. The requirements of integrated development authorities required under Clause 73(3) of the *Environmental Planning and Assessment Regulation 2000* are also contained in **Appendix B**.

2.7 Approval Process

Summarised, the approval process involves:

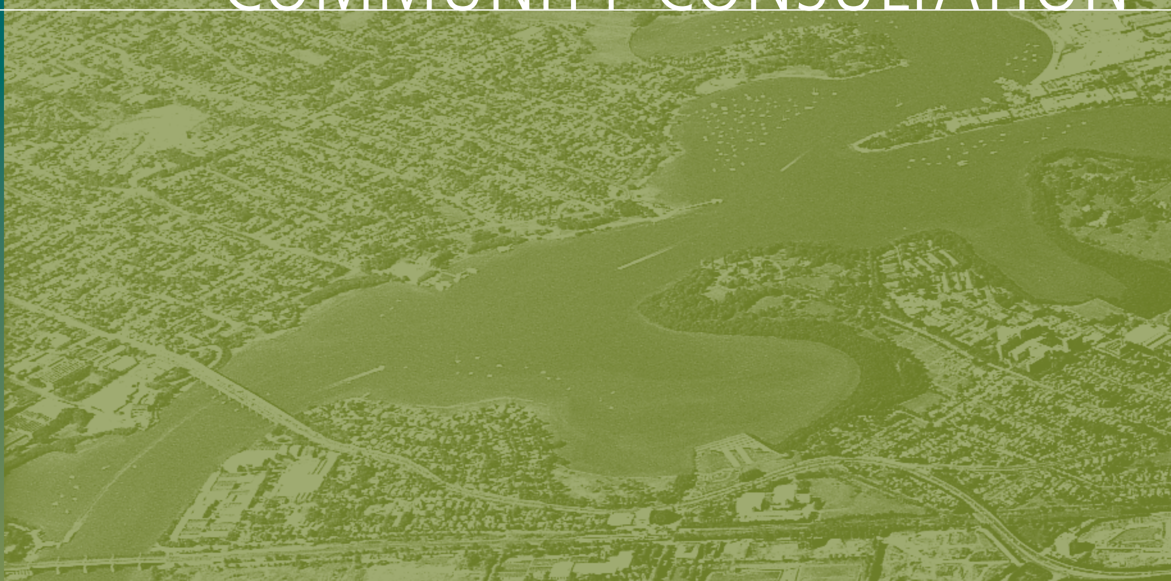
- preliminary consultation with various authorities and community
- obtain Director-General's requirements (Director-General obtains input from relevant authorities)
- prepare EIS (including consultation with community and authorities)
- make development application to Minister for Planning with the EIS attached
- the consent authority refers EIS to approval authorities
- the EIS is exhibited and public makes submissions
- the approval authorities provide comments to consent authority including general terms of any consents, licences proposed to be granted
- Planning NSW prepares an Assessment Report
- the consent authority may request additional information
- the consent authority may determine the application.

Chapter 3

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

COMMUNITY CONSULTATION



Chapter 3

COMMUNITY CONSULTATION

3.1 Consultation Before the EIS Process Began

An initial consultation process led by the Waterways Authority was carried out in the 12 months before December 2000. The objective was to canvas early issues and concerns. Consultations and briefings were held in response to invitations that were issued by interest groups. These included meetings with Ryde and Concord Councils (now Canada Bay City Council), Rhodes residents and two community groups. Briefings were also given to the Homebush Bay Environmental Reference Group (known as the HOMBERG group) and the Olympic Coordination Authority's technical environmental group. When Thiess Services was selected as the preferred contractor, PB was engaged to lead the consultation activities required for this EIS.

3.2 Senate Inquiry by the Standing Committee on State Development

In October 2001, the Legislative Council passed a resolution that the Standing Committee on State Development inquire into, and report on plans, including the *Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula*, with respect to the redevelopment and remediation of the Rhodes Peninsula.

The report produced by the Committee (Standing Committee on State Development, 2002) summarised its findings into 33 recommendations related to the proposed future remediation and redevelopment of the peninsula. These recommendations reflected the issues and concerns of stakeholders and provided a sound base on which to build the EIS consultation strategy. The recommendations have also been considered in the assessment of the proposal which is documented in this EIS.

3.3 Approach to Consultation during EIS Process

Consultation was an integral part of the preparation of the EIS. At the commencement of the environmental assessment process, a Community and Stakeholder Involvement Plan was prepared. The objectives of the plan were to:

- create stakeholder and community awareness of the need for the remediation of the Lednez site and the sediments of Homebush Bay
- understand stakeholder and community issues, values and concerns related to the project
- create stakeholder and community awareness of how potential remediation impacts could be mitigated

- incorporate stakeholder and community issues into the EIS investigations
- assist stakeholders and the community to understand the results of the EIS and to understand the next steps regarding the remediation process.

The consultation process recorded the issues and concerns of interest groups and included meetings with three Councils, 11 government agencies, four environmental groups, the Member for Drummoyne and community groups from Rhodes and Meadowbank. The issues raised have provided direct input into EIS studies.

A key component of this consultation was to establish a means by which stakeholder views, issues and concerns could be directly fed into the EIS process. A Community Liaison Group was established to fulfil this purpose. Membership of this group was defined by specific Terms of Reference and comprised local community representatives, conservation and environment groups and local and state government. This group also included two independent technical reference specialists to assist in plain English translation. The meetings were independently chaired. Further details on the activities of this group can be found in **Technical Paper 1**.

Consultation activities during the preparation of the EIS revealed that many of the concerns and issues raised by participants related to the redevelopment and end use of the site, rather than the remediation process. Participants' concerns relating to the redevelopment were noted and referred to the Planning NSW for more detailed information. The scope and limitations of the EIS were described at public consultation events and were included in the terms of reference of the Community Liaison Group.

3.4 Consultation Activities

A number of activities were devised in order to keep stakeholders well informed and involved in the EIS process. These activities included:

- identifying local stakeholders, understanding their interest in the project and determining a target area for distribution of information
- maintaining contact with relevant government agencies
- preparing and distributing information about the investigation and assessment process, the proposal and aspects of the assessment studies including:
  - developing a question and answer sheet
  - distributing an initial proposal summary and four Household Updates
  - placing advertisements in local newspapers advising of forthcoming consultation activities
  - notifying local employers
- providing for a range of opportunities for the two-way exchange of information, where study team members could provide information and answer questions. These included a Community Information Day at Rhodes Community Centre on 22 September 2001, Community Site Inspections of the Lednez site on 10 November 2001 and regular meetings of the Community Liaison Group between October 2001 and late 2002
- holding briefings with government agencies to describe the proposed remediation and seek their requirements for the project.

3.5 Issues Raised During the Consultation

A wide range of concerns was voiced about the remediation proposal. **Figure 3.1** illustrates the number of times issues were raised and demonstrates the relative level of interest in each subject. Details of all issues are provided in **Technical Paper 1**. The top five issues were:

- air quality and health. Of foremost concern to the community was the possibility of harm to workers and neighbours of the site from exposure to dioxin and other chemicals. A great deal of interest was expressed in how the soil treatment and remediation process would be conducted to minimise dust emissions
- remediation options. Many submissions were received regarding the proposed remediation treatment technology. Submissions discussed the difference between direct thermal desorption and indirect thermal desorption processes. Concerns were also raised as to whether the remediation would take place on-site
- landuse, traffic and transport. The impact of many large truck movements along local roads was a concern of the neighbouring community. Many of the submissions related to traffic after the residential redevelopment
- licensing and monitoring. Considerable concern was expressed with regard to how the community can ensure they are being told the truth about how much harm they may be exposed to. This concern is reflected in the focus on the transparency and validity of the monitoring and auditing process and the desire for the community to have access to the data
- community consultation. Initially, the largest concern from the community was that they would not be able to understand the technical details of the remediation proposal. However, as the consultation progressed, submissions on this matter decreased. The community provided feedback on the consultation activities. They requested a larger distribution area for the Household Update publications and informed PB if the updates did not reach the target distribution area.

A key issue for the consultation was the need to differentiate this EIS consultation process from the consultation process that was undertaken by Planning NSW prior to the gazettal of S*ydney Regional Environmental Plan No 29 – Rhodes Peninsula*. This was because, as mentioned earlier, the consultation revealed that most of the community participants concerns and issues related to the redevelopment and end use of the site, and the western portion of the Rhodes Peninsula, rather than the remediation process. The issues raised through community consultation prior to and during the preparation of the EIS have been compiled and addressed in this EIS.

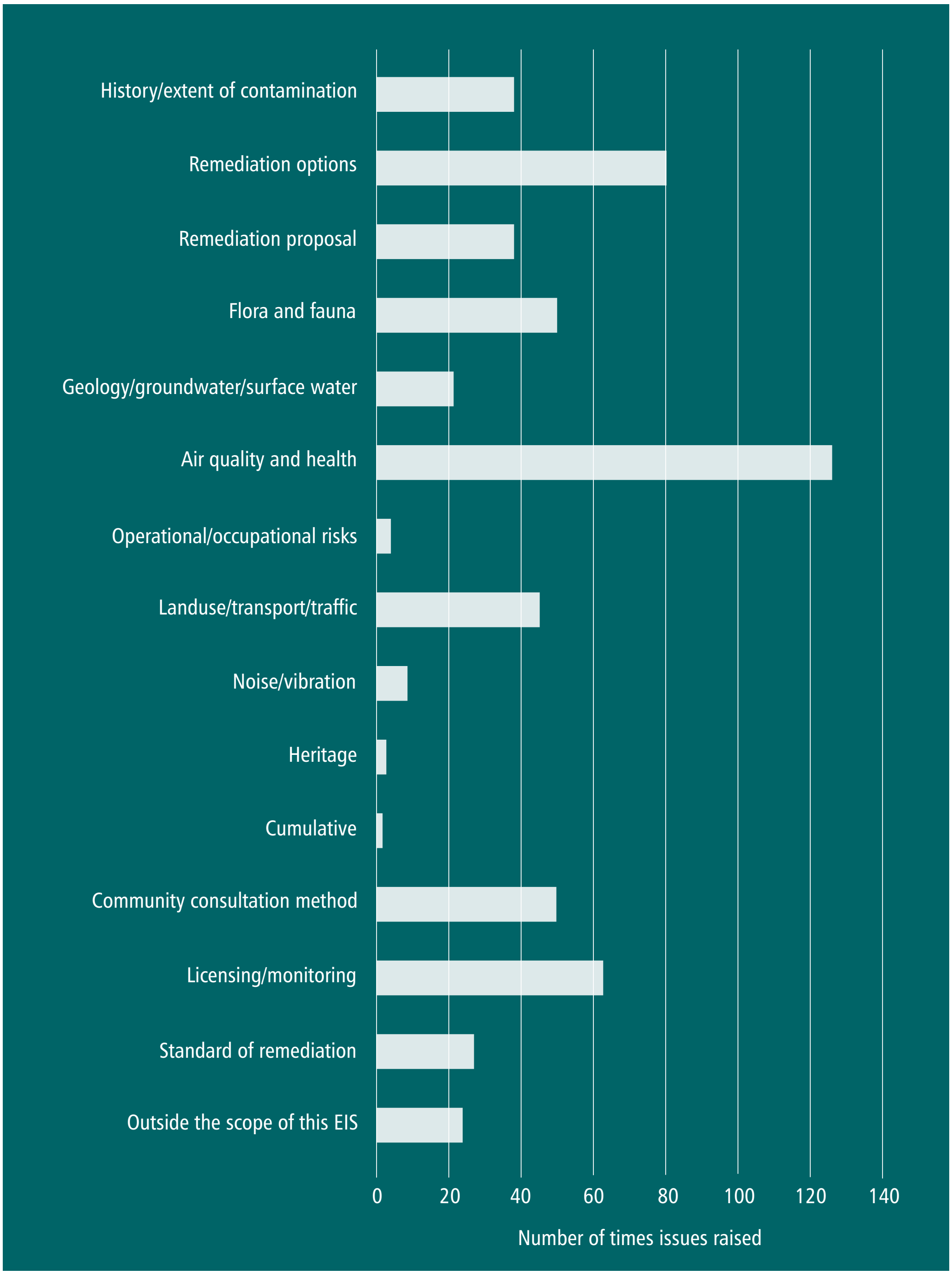


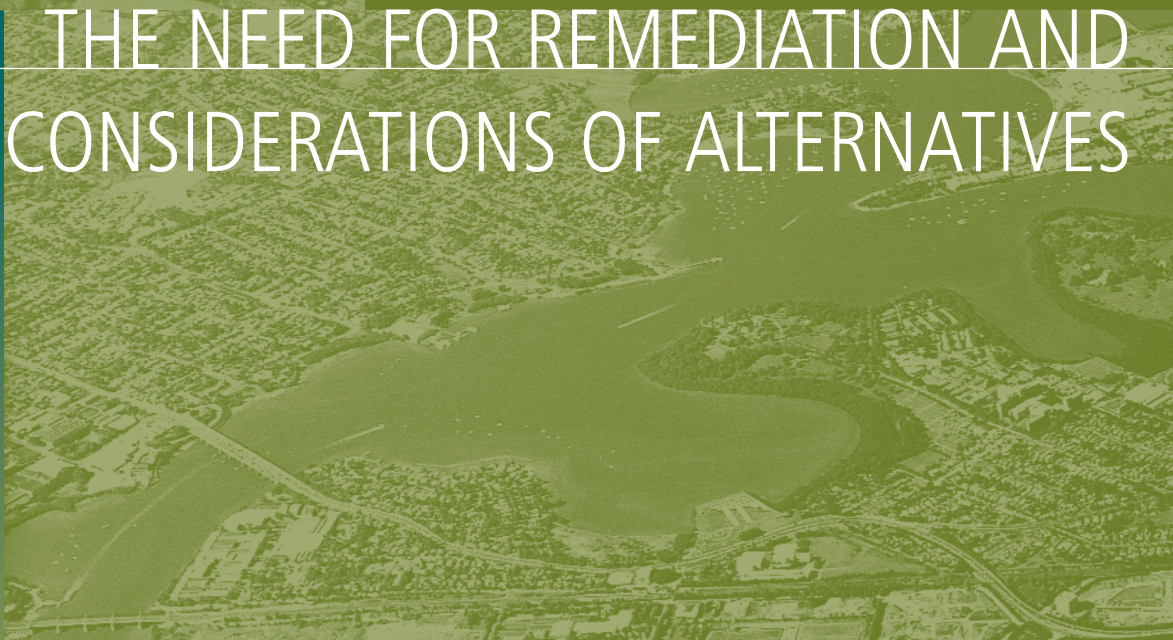
Figure 3.1 **Consultation Issues**

Part B

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

THE NEED FOR REMEDIATION AND CONSIDERATIONS OF ALTERNATIVES

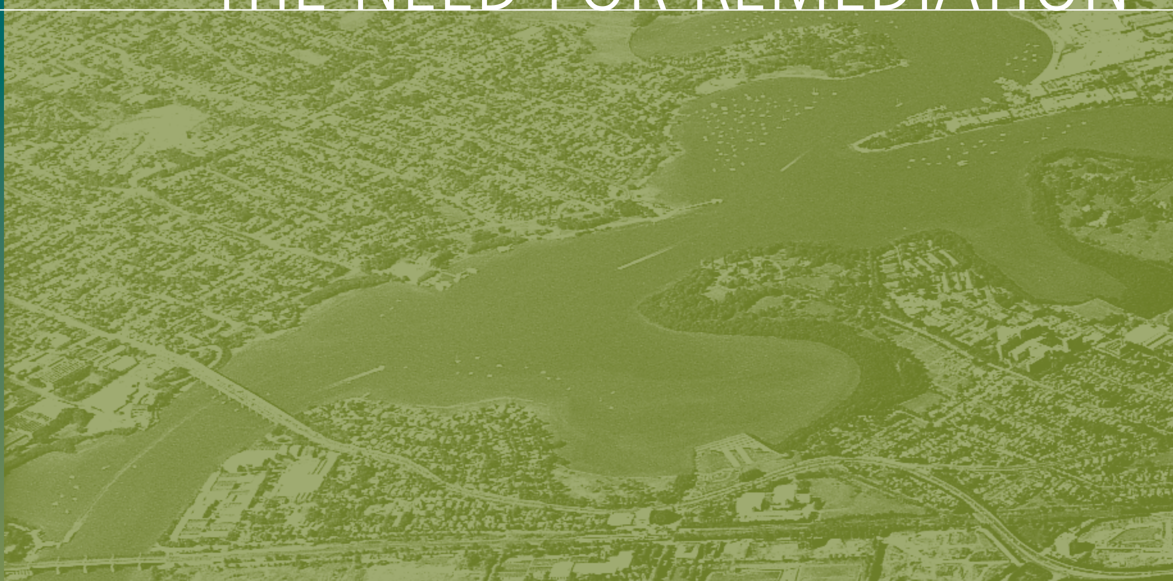


Chapter 4

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

THE NEED FOR REMEDIATION



Chapter 4 THE NEED FOR REMEDIATION

To ensure that correct remediation solutions are proposed for a contaminated site problem it is important to have a full understanding of the history of the site, to clearly define the extent and nature of the contamination that needs to be addressed and to understand the implications of not taking remediation action. It is also important to recognise the limitations and acceptable end points for the remediation strategy that is selected. A detailed history of the Lednez site is provided in **Technical Paper 2**. Full details on previous site investigations and the extent of contamination can be found in **Technical Papers 3** and **4** for Homebush Bay and the Lednez site respectively. **Technical Papers 5** and **6** examine the concept of risk assessment and appropriate site remediation criteria. **Technical Paper 7** presents the remediation action plans for both the bay and Lednez site works.

4.1 Metropolitan and Regional Planning

Over the past 20 years, there has been a substantial increase in the number of former industrial sites within 10 to 15 kilometres of the Sydney central business district, that have been converted to residential landuses. This has been in part due to the decline of traditional manufacturing (particularly in inner urban areas), the shift of employment and population further to Sydney's west, and the implementation of NSW Government policies encouraging urban consolidation. This policy is now more commonly expressed as the concept of "compact cities" with an emphasis on consolidation in locations well served by public transport.

Examples of the residential redevelopment of former industrial sites include: the AGL Gasworks at Mortlake, the BHP Wiremill at Abbotsford, and the Wellcome Pharmaceuticals factory at Cabarita. Each of these sites has been contaminated to varying degrees, requiring remediation to enable the residential landuse to proceed.

The Rhodes Peninsula was first identified as a prime example of how the concept of the compact city could be achieved in the 1995 metropolitan strategy, *Cities for a 21st Century* (Department of Planning, 1995). In this document the peninsula was described as

> *"under-utilised industrial sites adjoining the Strathfield – Hornsby railway from Rhodes to North Strathfield with scope for major residential redevelopment near the site of the Olympic games."*

4.1.1 Shaping Our Cities

Shaping Our Cities: The Planning Strategy for the Greater Metropolitan Region of Sydney, Newcastle, Central Coast and Wollongong (DUAP, 1998) is the most recent metropolitan planning strategy.

The strategy reinforces the goal of urban consolidation and identifies house construction shifting from the urban fringe to more inner areas. While outer areas still provide a greater proportion of all housing, this is declining. In addition, between 75 and 80 percent of the recent population increase in inner and middle ring suburbs of Sydney has been located within a one-kilometre radius of rail stations.

Shaping Our Cities identifies the need to create ecologically sustainable communities as a key principle in maintaining the 'liveability' of the region (the greater metropolitan region of Sydney including Wollongong and Newcastle). It also identifies as a key planning principle the protection and improvement of natural and cultural environments so as to sustain biological, water and air resources.

The strategy recognises that the total distance travelled by car in Sydney is growing much more rapidly than the increase in population. At the same time, capacity constraints of some public transport routes are being reached.

Planning strategies identified to manage the greater metropolitan region aim to achieve a high level of access without causing road congestion and poor air quality. Strategies relevant to the proposed remediation of Homebush Bay and the Lednez site include:

- increasing residential densities close to public transport to ensure that it is fully utilised while providing quick access for as many people as possible
- implementing a range of urban planning initiatives, including increasing population density in inner and middle ring suburbs, which have more jobs than resident workers, and greater access to public transport
- developing and supporting mixed use centres of all sizes and functions, concentrating trip-generating activities such as shopping, entertainment, offices and major health and education facilities
- protecting water bodies, wetlands and groundwater recharge areas and surrounding vegetation
- rehabilitating degraded natural systems.

Shaping Our Cities is complemented by the NSW Government's air quality strategy *Action for Air: The NSW Government's 25 Year Air Quality Management Plan* (EPA, 1998b) and *Action for Transport 2010 – An Integrated Transport Plan for Sydney* (Department of Transport, 1998).

4.1.2 Regional Planning

Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula provides the statutory framework for the implementation of metropolitan planning strategies relating to the Lednez site and surrounding sites. The aims of the plan are to:

- establish planning principles for development within the Rhodes Peninsula
- rezone land in the Rhodes Peninsula
- promote the orderly and ecologically sustainable use and development of land
- identify appropriate levels of retail and commercial floor space
- promote the orderly and economic use and development of land within the Rhodes Peninsula.

The extent to which the proposed remediation is consistent with the relevant planning principles set out in the plan is assessed in **Chapter 12**. It is important to note that in terms of landuse activities development of the

Rhodes Peninsula is to provide for a significant increase in residential population, open space and limited commercial and retail uses. To this end, the majority of the area west of the Northern Railway Line, including the Lednez site, is zoned for residential purposes.

4.2 History

4.2.1 The Lednez Site

In 1928, Timbrol began manufacturing timber preservatives on the Rhodes Peninsula. The Rhodes production plant was initially built on natural ground and located on the higher part of the site, adjacent to Walker Street. Over the following years, operations expanded and surrounding residential sites were purchased to accommodate this expansion. In 1957, Timbrol was acquired by Union Carbide Australia. In 1988, Union Carbide became Zendel Industries Ltd and later in 1991 was renamed Lednez Industries Ltd (Realty Researchers, 1995).

Chemical manufacture began at the Lednez site in 1928 with the production of timber preservatives by Timbrol using coal tar oil. Production of a variety of different chemical compounds continued from then until 1986 when all manufacturing activities on the site ceased.

As a result of chemical manufacturing, soil and groundwater on the Lednez site has high levels of a number of different chemical products. Typical contaminants found on the Lednez site include, tar, naphthalene, other polycyclic aromatic hydrocarbons (PAHs), pyridine, tar oil, creosote oils, phenol and derivatives, bisphenol 'A', mononitrobenzene, aniline, various chlorinated phenols, chlorinated benzenes, trichloranisole, dioxins, furans, solvents and oils (JET, 2001). **Table 4.1** provides details of the chemicals that were produced on the Lednez site between 1928 and 1983.

Table 4.1 Chemicals Manufactured on the Lednez Site

Chemical manufacture	Period of manufacture
Coal tars	1928–1936
Xanthate	1933–1986
Aniline and Mononitrobenzene	1940–1961
Synthetic Phenol	1943–1971
Chlorobenzene/Chlorophenol/DDT	1948–1983
Chlorine (Electrolytic Chlorine Plant)	1953–1976
2,4-D and 2,4,5-T Herbicides	1949–1976
Bisphenol A (DPP)	1960–1976
Phenol Formaldehyde Resins	1949–1976
Nitric Acid	Unknown
Sulphuric Acid	Unknown
Zinc Chloride	Unknown

Between 1988 and 1993, recommendations made by the USEPA (1991) for remediation works were carried out. This involved the excavation of contaminated soils to the east of the original foreshore. These materials were subsequently encapsulated in a mound on the reclaimed areas of the site. These activities resulted in the Lednez site, in its present state, being zoned as suitable for industrial activities with building restrictions imposed on the majority of the reclaimed area.

Two regulatory notices currently apply to the Lednez site. These are:

- Section 5 Notice under the *Unhealthy Building Land Act 1990*, dated 20 October 1995
- Section 28 Notice under the *Contaminated Land Management Act 1997*, dated 14 January 2000. This notice requires maintenance of remediation in accordance with guidelines set out in the notice.

Additional information regarding these notices is contained in **Technical Paper 4**.

4.2.2 The Reclamation of Homebush Bay

In the early 1800s, the land area adjacent to Homebush Bay comprised saltmarsh and wetland. Reclamation activities in this area are recorded as early as 1827 when local areas of swamp were drained.

Reclamation of Homebush Bay was undertaken on the Lednez site between 1930 and 1970. This took place in four stages. The location of reclamation areas R1 to R4 are shown in **Figure 4.1.** These activities together with other construction and dredging activities in the Homebush Bay area are summarised in **Table 4.2**.

The following are two key mechanisms by which contaminants may have entered the bay:

- the flow of stormwater and other wastewaters from the chemical factory into Homebush Bay from the Lednez site. This occurred until about 1970, when it was intercepted to comply with the *Clean Waters Act 1970*
- the leaching of contaminants from the fill materials used in the reclamation process from both the Lednez site and the adjacent Meriton site. Various materials were used in the reclamation process, though spent lime sludge was the only material that was authorised for use in the reclamation works.

In addition contamination of sediment may also be attributable to stormwater flows from surrounding creeks and the Parramatta River, which drain urban and industrial areas. Further, elevated levels of dioxin have been found surrounding the location of a former jetty. This is possibly due to spills associated with loading and unloading activities.

Two regulatory notices currently apply to Homebush Bay. These are:

- Section 21 Notice under the *Contaminated Land Management Act 1997* on 1 December 1998. This notice involved the declaration of a remediation-site with the EPA finding that "*the site is contaminated with dioxin in such a way as to present a significant risk of harm to aquatic life in the vicinity of the site*"
- Section 8 Notice (fishing closure) under the *Fisheries Management Act* dated 11 December 1998, prohibiting all methods of fishing in Homebush Bay.

Additional information regarding these notices is contained in **Technical Paper 3**.

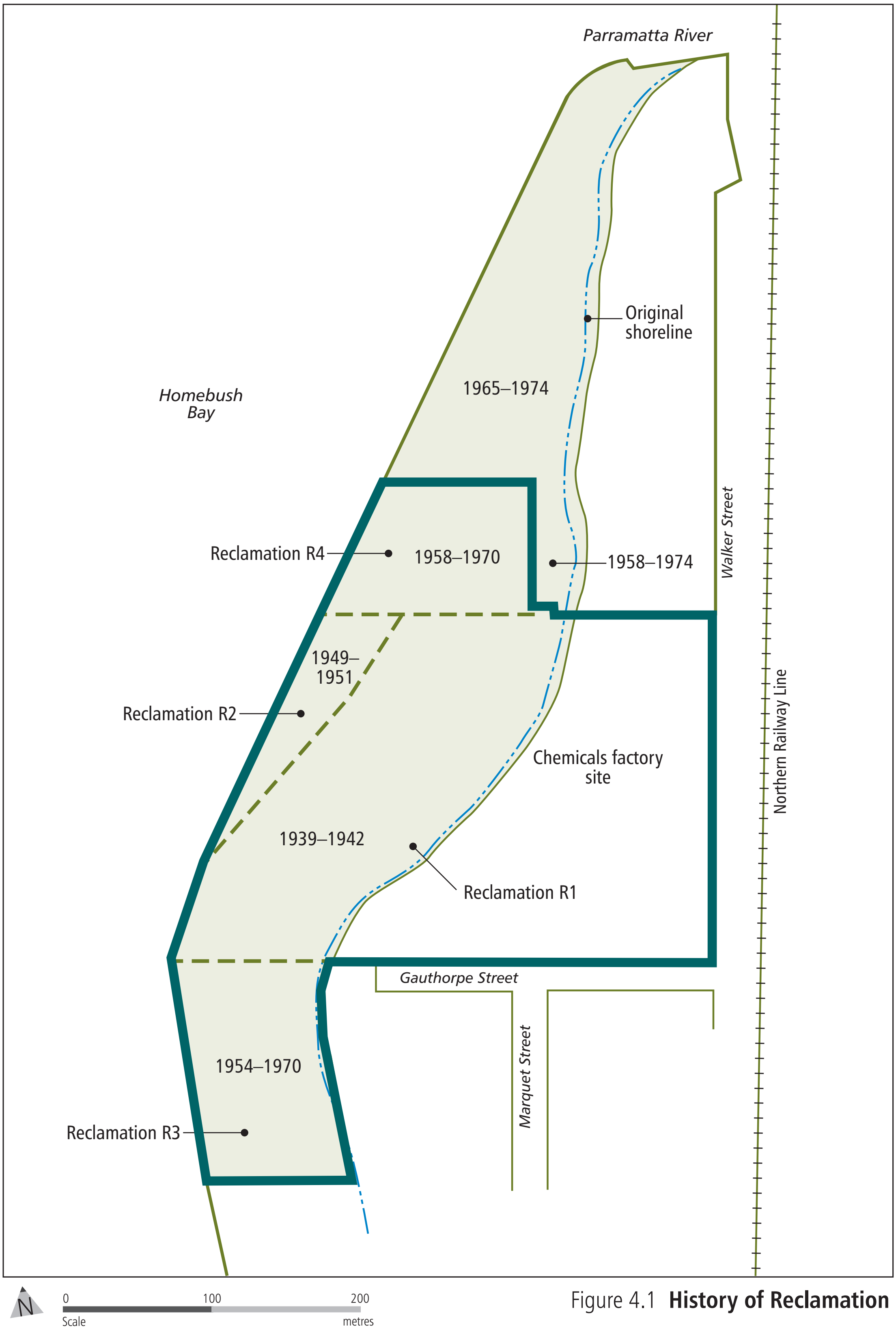


Figure 4.1 **History of Reclamation**

Table 4.2 Timeline of Reclamation and Dredging in Homebush Bay and Surrounds

Period	Reclamation activities
1891	Commencement of western shoreline seawall construction
1900–1930	Construction of a number of jetties at different sites around the bay
1930–1942	Diversion of Haslams and Powells Creeks
Early 1930s	Long jetty built across Lednez site foreshores of Homebush Bay to permit coal tar oils from Australian Gaslight Company to be unloaded from barges
1939–1942	Land reclamation begins at Lednez Site. Reclamation of area R1 undertaken. Materials included calcium carbonate (lime) and calcium sulphate (gypsum) sludge, tar and factory boiler ash. Manufacturing processes used in the 1928–1949 period would not have resulted in contamination of this fill material with chlorinated organic compounds (JET, 2001)
1948–1965	Filling of western shore of bay with dredged material (from Parramatta River and Homebush Bay). Dredging undertaken on the shoreline
1949–1951	Lednez R2 reclamation using materials including clay, sandstone, bricks, rubble, tar and lime sludge, in a similar manner to R1 (JET, 2001)
1947–1953	Reclamation on the Orica site, to the south of Lednez site
1958–1959	Construction of submarine trench for cable conduits across the bay from Rhodes to the western shoreline of Homebush Bay
1954–1970	R3 reclamation at Lednez site using factory "spent lime" sludge, which until 1960 was primarily calcium carbonate (lime) and later predominantly calcium sulphate (gypsum), intermixed with a variety of chlorinated benzene, chlorinated phenols and cresol and creosote type oils (JET, 2001). Boiler ash, rubble, clay, shale and soil were used to cover these
1958–1970	Reclamation of the northern end of the Lednez site (R4) and Meriton site using fill material sourced from the Lednez site
Late 1960s–1970s	Filling of areas around bay including; Wentworth Bay, banks of Haslam's Creek, state brickworks
1970	All reclamation activities on Lednez site completed. Dredging of Homebush Bay ceases and wastewater run-off into Homebush Bay prohibited

4.3 Need for the Remediation of Homebush Bay Sediments

Exposure to contaminated sediments can pose a risk to both human health and the environment. In order to assess the need for remediation the risks posed by the sediment must be quantified. To do this requires information regarding potential contaminants that may be present, where these are located and at what concentrations, and how these chemicals interact with the environment in terms of human and ecological exposure.

4.3.1 Summary of Sediment Investigations

Since 1985 a number of site investigations and assessments of the sediments in Homebush Bay have been undertaken. The results of these investigations provide sufficient data to allow an assessment of the risks associated with the sediments to both human health and the environment.

The following Homebush Bay sediment contamination investigations have been undertaken:

- *Johnstone Environmental Technology (JET), 1990: Remediation of Sediment Contamination in Homebush Bay (Draft). Report no. JET0106-03*. October 1990. This report identified elevated levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), dieldrin, chlordane, DDT and heavy metals
- *USEPA, 1991: Dioxin Contamination of Sediment and Marine Fauna in Homebush Bay*. Prepared by N Rubinstein and J Wicklund (USEPA) for the NSW State Pollution Control Commission. This report documented the collection and analysis for 2,3,7,8-TCDD of surface sediment from selected locations in Homebush Bay
- *Parametrix, Inc and AWT Ensight, 1996: Homebush Bay Screening-level Risk Assessment*. Prepared for the Office of Marine Safety and Port Strategy, Australia. The risk assessment involved collection of surface sediment samples from the northern half of Homebush Bay between the Lednez and Meriton sites and the western side of Homebush Bay and their analysis for heavy metals, polycyclic aromatic hydrocarbons, organochlorine compounds, monocyclic aromatic hydrocarbons, dioxins and furans
- *EVS Environment Consultants, 1998: Detailed Human Health and Ecological Risk Assessment of Homebush Bay Sediments*. Prepared for the Office of Marine Administration, Sydney, Australia. The risk assessment included a field sampling program that involved analysis of 59 composite samples from grid cells/sub cells in Homebush Bay and the Parramatta River
- *URS Australia, 2002: Homebush Bay Dioxin Remediation Project*. *Investigation of Dioxins in Homebush Bay Sediments*. Prepared for Thiess Services and Waterways Authority. Undertaken in accordance with an approved work plan provided to the EPA and EPA-accredited site auditor for comment. The investigation involved collection of sediment samples from the eastern part of Homebush Bay and reporting on the nature and extent of sedimentary dioxins and furans in these sediments.

In addition to the contaminated sediment investigations mentioned above, a number of related studies and reviews have been undertaken addressing to the sediment contamination of Homebush Bay. These include:

- *Greenpeace, 1999: A Critique of the Homebush Bay Human Health and Ecological Risk Assessment by EVS Consultants, Final, September 1999*. It was indicated that the human health and ecological risk assessment by EVS only considers the surface sediment levels of 2,3,7,8-TCDD. Greenpeace queried how the three dimensional nature of the remediation is derived.
- *Sinclair Knight Merz, 2002a: Detailed Human Health and Ecological Risk Assessment of Homebush Bay Sediments*. Prepared for the Waterways Authority. This review of the previous investigations includes observations made regarding variations between data sets and also comments on contamination in deeper sediments.
- *Sinclair Knight Merz, 2002b: Supplementary Report, Detailed Human Health and Ecological Risk Assessment of Homebush Bay Sediments*. Prepared for the Waterways Authority. A review of the May 2002 risk assessement (SKM, 2002a) identified considerable uncertainty in relation to the presently available data used to derive an estimate of the risk to human health risk from consumption of fish from Homebush Bay. Consequently, it was recommended that the fin fishing ban remain in place until data that is more conclusive can be gathered to support its' removal or modification. This supplement accounts for the uncertainty associated with present data, reflects the need for the fin fishing ban to remain and evaluates the risks posed by the sediments to ecological and human health post remediation.

4.3.2 Contaminants of Concern

Technical Paper 3 presents the location and nature of the contaminants by defining overall contaminant ranges for the contaminants of concern. A substance is classified as a contaminant of concern based upon concentration relative to the background concentration, relative toxicity and internationally recognised investigation limits.

Heavy Metals

Homebush Bay is part of the Parramatta River/Port Jackson catchment that is almost completely developed and having substantial areas devoted to industry. A significant proportion of the Parramatta River/Port Jackson estuary is contaminated with heavy metals, in particular lead, zinc and copper (Birch, 2000).

The degree of estuarine contamination by these heavy metals reflects the urbanisation and industrialisation of the catchment. For this reason stormwater discharged into the catchment is thought to be an important contributor to sediment contamination.

Other possible mechanisms for heavy metals to reach the bay sediments include industrial discharges, shipping activities, sewage overflows, illegal dumping, atmospheric deposition and leaching from reclaimed areas. Based on the history of landuses surrounding Homebush Bay these mechanisms are likely to have occurred in the past to varying degrees. Since heavy metal containing chemicals were not manufactured at the Lednez site the consideration of heavy metal leaching as a source of contamination can be eliminated.

Figure 4.2 illustrates the concentrations of copper, lead and zinc in the surficial fine (that is sized at less than 62.5 micrometres) sediment in the Port Jackson estuary in micrograms per kilogram.

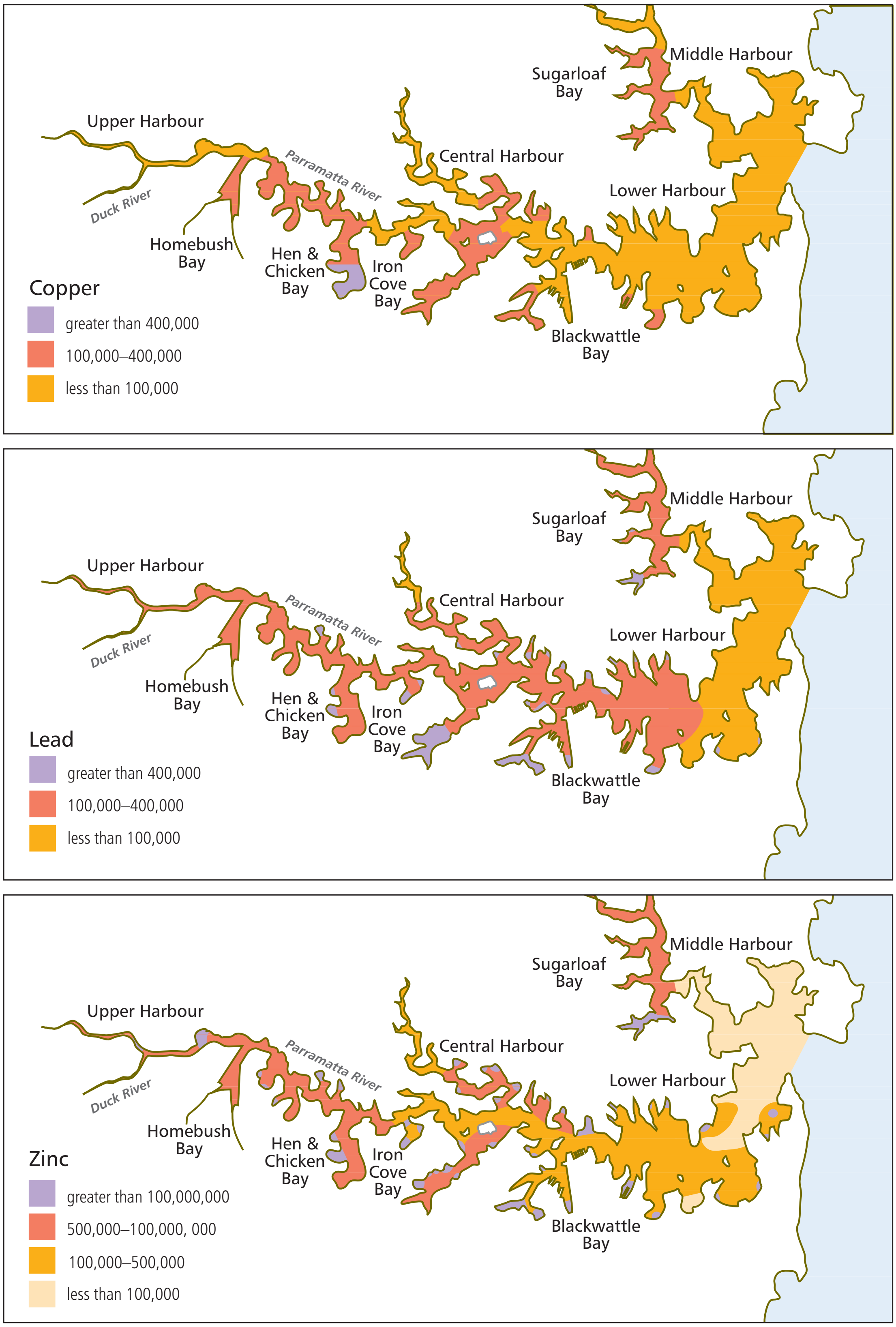
When comparing Homebush Bay to other sections of the estuary, the concentrations of copper, lead and zinc are similar, with the predominant ongoing source being catchment activities and contaminated fluvial sediments introduced to the estuary via stormwater.

Table 4.3 compares the mean concentration of heavy metals in surficial sediment from the Detailed Human Health and Ecological Risk Assessment of Homebush Bay (EVS, 1999) to that of sedimentary heavy metal concentrations in Port Jackson estuary reported by Birch (2000).

Table 4.3 Comparison of Homebush Bay and Port Jackson Sediment Concentrations of Heavy Metals

Heavy metal	EVS (1999) Homebush Bay		Birch (2000) Port Jackson Estuary	
	Range	Mean	Range	Mean
Copper	560–21,200	8,000	4,000–1,078,000	124,000
Lead	110,000–180,000	150,000	92,000–1,319,000	268,000
Zinc	290,000–530,000	405,000	18,000–2,246,000	548,000
Cadmium	630–1,900	1,100	<1,000–10,000	3,000
Chromium	47,000–150,000	90,000	17,000–1,472,000	118,000
Nickel	5,200–1,498,000	8,000	12,000–86,000	38,000
Arsenic	371–2,254	1,000	–	–

Notes:
1. EVS Environment Consultants (1999) results are based on whole sediment sample analysis (that is, not a specific sediment fraction). Sediment samples are surficial, collected from sediment surface (0.0–100 millimetres).
2. Birch (2000) results have been reproduced from Table 5 in Birch (2000).
3. All units are in micrograms per kilogram.



Source: Birch 2000

Figure 4.2 **Heavy Metal Concentrations in Surficial Fine (less than 62.5 Micrometres) Sediment in the Port Jackson Estuary**

Note: Concentrations are in micrograms per kilogram.

The concentrations of heavy metals in Homebush Bay are similar to other parts of the Port Jackson estuary and in some cases lower. This indicates that heavy metal contamination is primarily a catchment-wide issue and the presence of heavy metals in Homebush Bay is not attributable to activities carried out at the Lednez site. Accordingly, heavy metals are not considered to be a contaminant of concern for this proposal.

Organic Chemicals

Technical Paper 3 identifies that nearly all man-made organic contaminants tested for by EVS Environmental Consultants (EVS, 1998) are in detectable concentrations within the surface sediments both upstream and downstream of Homebush Bay. This indicates that there are many diffuse and localised sources of contamination within the catchment.

The EVS Environmental Consultants (EVS, 1998) investigation identified the following organic chemicals as contaminants of concern:

- chlorinated pesticides (in particular DDT, DDE and DDD)
- chlorinated benzenes (in particular 1,4-dichlorobenzene, 1,2,4,5-tetrachlorobenzene, 1,2,3,4-tetrachlorobenzene)
- polycyclic aromatic hydrocarbons (in particular naphthalene and acenaphthene)
- dioxins and furans.

That assessment was based on toxicity and the concentration of these chemicals when compared to background levels.

Toxicity is the quality or degree of being poisonous or harmful to plant, animal or human life (National Environment Protection Council, 1999).

Chlorinated pesticides are persistent in the environment and owing to their fat-soluble properties, can bio-accumulate in the fatty tissues of organisms. Some chlorinated pesticides are considered to be carcinogenic and teratogenic.

Chlorinated benzenes are also persistent in the environment. Exposure to this family of compounds may result in depression of the central nervous system and liver and kidney damage (EVS, 1998). Chlorobenzenes are neither carcinogenic nor teratogenic.

The toxicological effects of polycyclic aromatic hydrocarbons are dependent on the physicochemical properties of each individual compound. Low molecular weight polycyclic aromatic hydrocarbons, such as naphthalene, exhibit acute toxicity but are not considered to be carcinogen, where as high molecular weight polycyclic aromatic hydrocarbons are typically considered less toxic but are often carcinogenic, mutagenic and teratogenic. Of particular concern in the sediments under review is naphthalene and acenaphthene.

The key contaminants of concern to human health are dioxins and furans, particularly 2,3,7,8-tetrachlorodibenzo-p-dioxin, more commonly known as 2,3,7,8-TCDD. Most of the toxicity studies for dioxins and furans have been concerned with 2,3,7,8-TCDD. 2,3,7,8-TCDD is just one of many dioxin/furan like compounds. More limited data exists for other dioxins/furans (which are known as congeners of 2,3,7,8-TCDD). Dioxins and furans have a low solubility in water but are soluble in fat, allowing them to be transferred along the food chain by accumulating in the livers and fatty tissues of animals. These chemicals are also known to have both acute toxic effects and long-term carcinogenic effects.

For the contaminants of concern identified above, investigation data indicate that the industrial activities carried out on the Lednez site have resulted in significantly contaminated sediments along the northeastern shoreline. In this area, the average levels of chlorinated pesticides, dioxins and furans, and chlorinated benzene compounds were significantly higher than background levels. However the data showed that the average level of polycyclic aromatic hydrocarbons was typically less than the high range sediment investigation level recommended by ANZECC and ARMCANZ (2000), indicating that polycyclic aromatic hydrocarbons are unlikely to pose a significant environmental risk.

Dioxins

Whilst several contaminants attributable to previous site activities are present in Homebush Bay, the primary contaminants of concern, from a human health and ecological risk perspective, are dioxins and furans, in particular 2,3,7,8-TCDD.

For the purposes of determining the distribution of dioxin in the sediments of eastern Homebush Bay, an investigation conducted by URS for Thiess Services (URS, 2002) examined the concentration and distribution of both 2,3,7,8-TCDD and dioxins/furans in terms of toxicity equivalents. Toxic equivalence is used to express the toxicity of a mixture of dioxin-like compounds (‘congeners’). In combination with concentration data for individual congeners, toxicity equivalent factors are used to calculate toxicity equivalents that represent the aggregate toxicity of a mixture of dioxin/furan congeners as if the mixture consisted only of 2,3,7,8-TCDD (the most toxic of all the dioxin/furan congeners). The toxicity equivalence factors are considered to represent conservative estimates of the relative potency of a congener when compared to the equivalent concentration of 2,3,7,8-TCDD (United States Environmental Protection Agency, 2000). The toxicity equivalence factor system should therefore over-estimate the potency of mixtures of dioxin-like compounds.

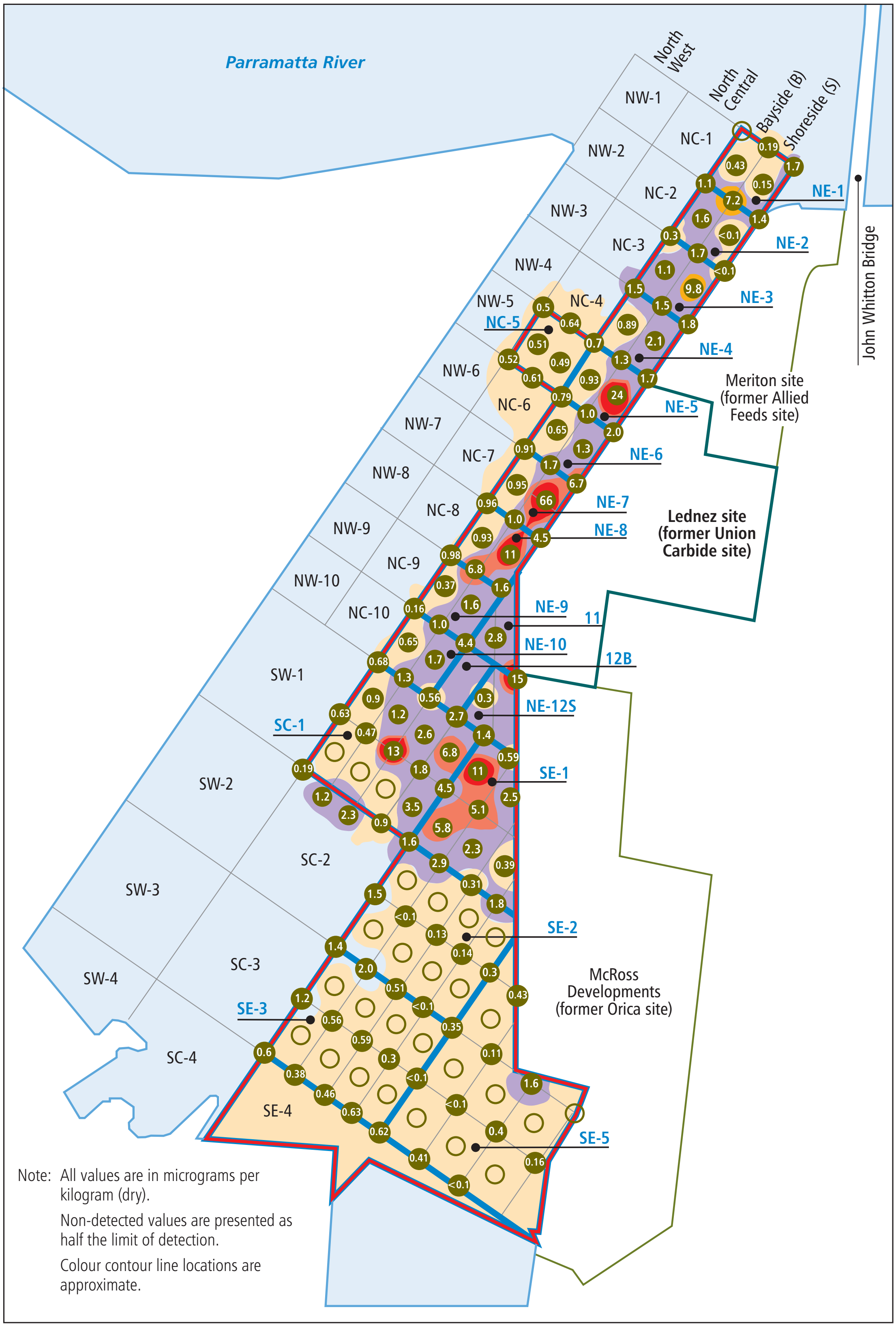
For the URS (2002) investigation, samples were collected from across the bay at three depth intervals, these being 0 to 0.1 metres (surface), 0.4 to 0.5 metres and 0.9 to 1.0 metres. The concentrations of 2,3,7,8-TCDD and the toxicity equivalent results for dioxins/furans for the three sampling depths are presented in **Figures 4.3** to **4.5**. A complete discussion on the results of the URS (2002) investigation is provided in **Technical Paper 3**.

The results obtained by URS (2002) indicate that the extent of the dioxin contamination is greatest at the surface of the sediments, with the size of the contamination footprint decreasing with depth. This is an important result since it confirms that much of the organic contamination produced by the reclamation of the industrial sites (along the north-eastern side of the bay) has migrated out over time into the sediments of Homebush Bay.

The current bay wide average for dioxin in Homebush Bay surface sediments has been estimated at approximately three micrograms per kilogram expressed as total toxic equivalency (SKM, 2002a). The surface sediments elsewhere in the Parramatta River are contaminated with dioxin-like substances, with a background concentration of 2,3,7,8-TCDD being in the order of 0.17 micrograms per kilogram. This number, when expressed in terms of total toxic equivalency, has been estimated by Sinclair Knight Merz to be 0.49 micrograms per kilogram.

Phthalates

Operations at the former Orica site involved the manufacture and storage of a range of chemicals. Chemicals of potential concern that were identified at the site included phthalate esters. It is understood that the former Orica site has been remediated to enable future residential and commercial landuses.



Source: URS, 2002

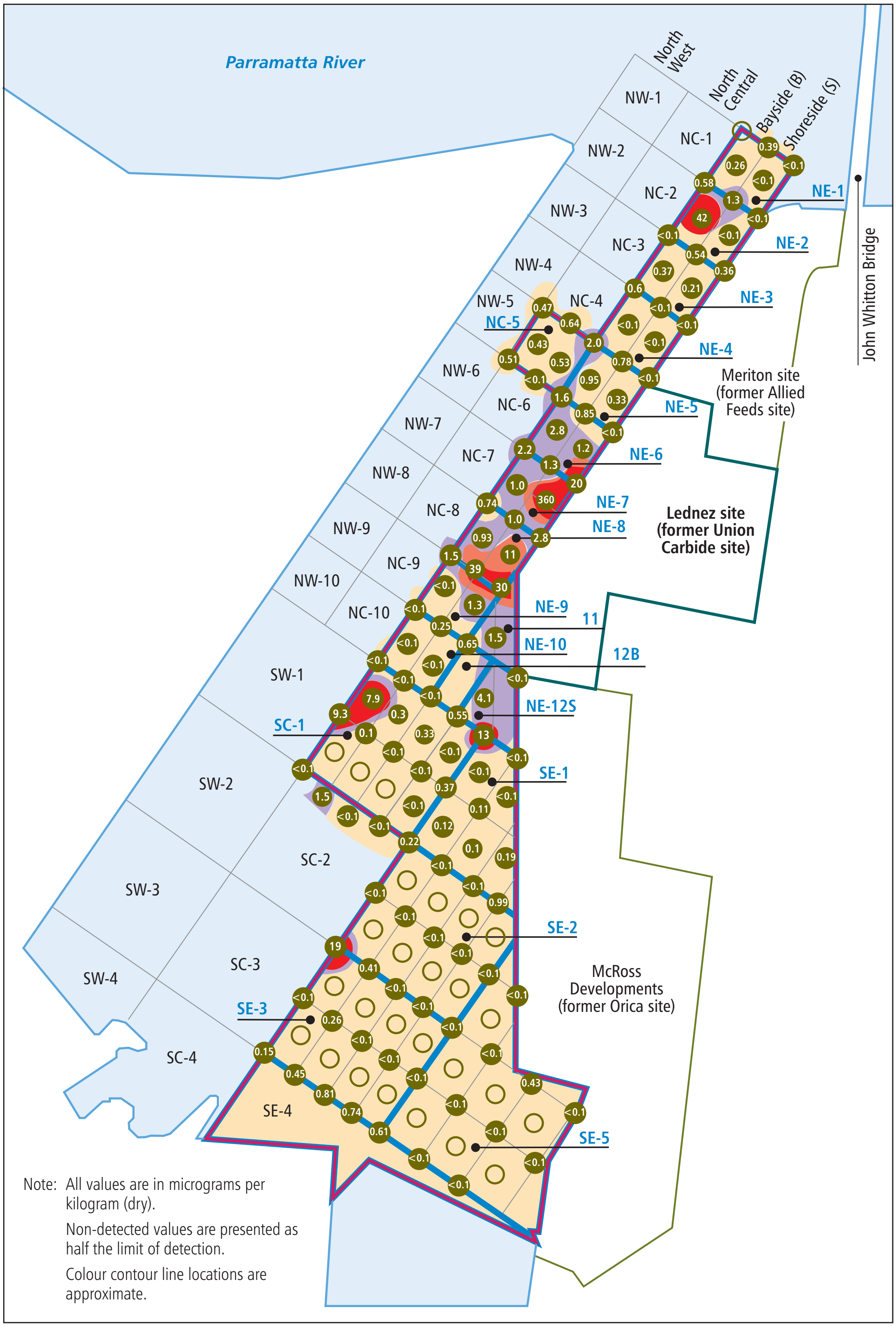
N

0 75 150
Scale metres

Figure 4.3 **2,3,7,8-TCDD in Surface Sediments 0-0.1 Metres Depth**

- 0.1 Sediment sampling location and 2,3,7,8-TCDD concentration (micrograms per kilogram)
- Samples not analysed
- NE-1 Grid cell identifier (after EVS, 1998)
- Grid cell border
- Study area

- less than 1.0 micrograms per kilogram
- less than 5.0 to greater than 1.0 micrograms per kilogram
- less than 10.0 to greater than 5.0 micrograms per kilogram
- less than 20.0 to greater than 10.0 micrograms per kilogram
- greater than 20.0 micrograms per kilogram



Source: URS, 2002

N

Scale 0 75 150 metres

Figure 4.4 **2,3,7,8-TCDD in Subsurface Sediments 0.4-0.5 Metres Depth**

- 0.1 Sediment sampling location and 2,3,7,8-TCDD concentration (micrograms per kilogram)
- Samples not analysed
- NE-1 Grid cell identifier (after EVS, 1998)
- Grid cell border
- Study area

- less than 1.0 micrograms per kilogram
- less than 5.0 to greater than 1.0 micrograms per kilogram
- less than 10.0 to greater than 5.0 micrograms per kilogram
- less than 20.0 to greater than 10.0 micrograms per kilogram
- greater than 20.0 micrograms per kilogram

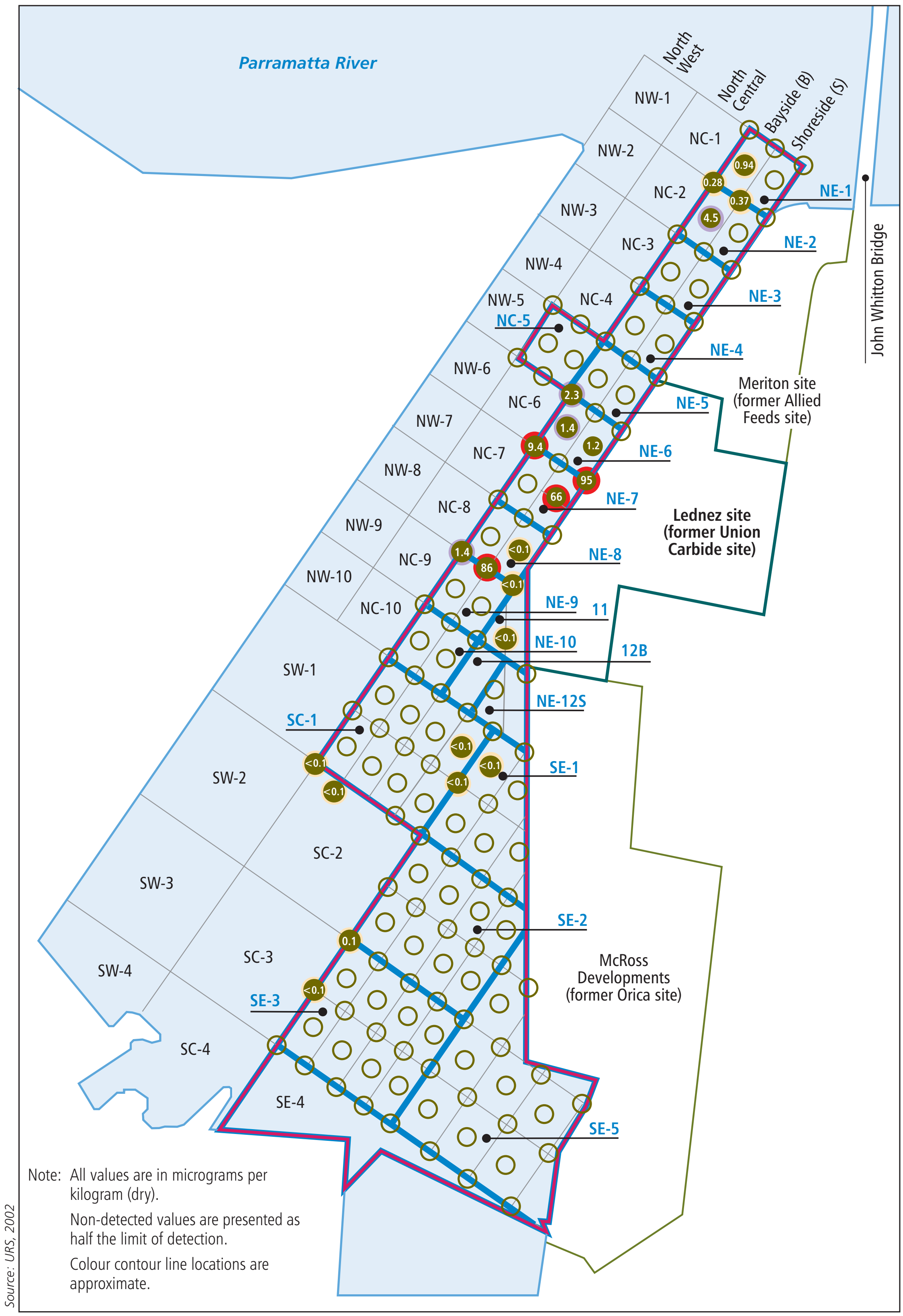


Figure 4.5 **2,3,7,8-TCDD in Subsurface Sediments 0.9-1.0 Metres Depth**

- 0.1 Sediment sampling location and 2,3,7,8-TCDD concentration (micrograms per kilogram)
- Samples not analysed
- NE-1 Grid cell identifier (after EVS, 1998)
- Grid cell border
- Study area

- less than 1.0 micrograms per kilogram
- less than 5.0 to greater than 1.0 micrograms per kilogram
- less than 10.0 to greater than 5.0 micrograms per kilogram
- less than 20.0 to greater than 10.0 micrograms per kilogram
- greater than 20.0 micrograms per kilogram

Several investigations have been conducted that report the condition of the sediments adjacent to the former Orica site, and the level of risk associated with the presence of contamination derived from the Orica site and in particular the presence of phthalate esters. Like dioxins, phthalate esters are chemicals that are generally insoluble. Unlike dioxins however, they do not bioaccumulate in the environment.

In 2001, a comprehensive human health and ecological risk assessment was undertaken by URS Australia Pty Ltd (URS, 2001) to evaluate the human health and ecological risks posed by these sediments.

The conclusions drawn from the risk assessment were:

- the risks posed by the site-related sediment contamination to human health are negligible under current and future proposed landuses in and around Homebush Bay
- there is no strong indication of adverse risk from site-related chemicals of potential concern to any of the ecological receptor groups investigated
- Homebush Bay is a net depositional environment. The ongoing deposition of relatively clean sediment over historically contaminated sediments is likely to reduce the ecological and human health risks due to burial, chemical stabilization, and isolation of contamination from the ecosystem
- burial is an ongoing and ubiquitous process, and is a practical natural attenuation process in depositional environments. Natural degradation of organic contaminants in sediment (phthalate esters and polycyclic aromatic hydrocarbons) is also likely to reduce the risk from these compounds further over time.

A risk management decision was made based on these conclusions that remedial intervention measures to manage the contamination in the sediments in the southeast of Homebush Bay are considered unwarranted (URS, 2001).

Based on these works, the chemicals of potential concern associated with historical activities of the Orica site, are considered not to be chemicals of concern for the Thiess Services proposal.

4.3.3 Risks from Contaminated Homebush Bay Sediments

The health risk assessment undertaken by Sinclair Knight Merz (SKM, 2002a, SKM, 2002b) characterises the present potential (assuming the fishing ban was not in place) risks posed by Homebush Bay without remediation works.

To assess the level of risk associated with the contaminated sediments in Homebush Bay, it is necessary to identify the various hazards to human health and the environment. Identification of these hazards requires knowledge of:

- the potential contaminants of concern that are present in the sediments (as discussed in the previous section with further detail available in **Technical Paper 3**)
- the potentially contaminated environmental media present in Homebush Bay
- the various exposure pathways (or ways in which exposure to contamination from the sediments may occur)
- the various receptors (or human population groups and animals that may be exposed to contamination originating from the sediments).

Knowledge of these factors allows the identification of exposure scenarios that are of most relevance to the assessment of health risks posed by the contaminated sediments in Homebush Bay.

There are two potentially contaminated environmental media in Homebush Bay. These comprise the sediments and the bay water.

There are four exposure pathways by which a receptor may become exposed to an increased health risk associated with contaminated environmental media (sediment and bay water):

- dermal (that is, skin) contact with contaminated sediment
- dermal contact with contaminated bay water
- ingestion of contaminated sediment
- ingestion of contaminated sediment that becomes suspended in the bay water.

These scenarios have been developed from knowledge of the impacted environmental media, the exposure pathways and potential receptors of concern.

The potential receptors of concern at Homebush Bay comprise both human and ecological receptors. Sinclair Knight Merz (2002a, b) identified four potential receptors of concern, comprising one human population group and two animal groups. These receptors are:

- adults
- birds
- benthos (aquatic plants and animals that live on or near the bottom of the seabed) in Homebush Bay.

There are also a number of sensitive human sub-populations that reflect the future residential landuse along the Rhodes Peninsula.

The exposure scenarios developed for Homebush Bay are summarised in **Table 4.4.**

Table 4.4 Exposure Scenarios

Environmental media	Exposure pathways	Exposure scenarios			
		People ingesting bay fish	People swimming in bay	Birds ingesting bay fish	Aquatic bathos
Sediments	Dermal contact		✔		✔
	Ingestion of sediments	✔	✔	✔	✔
Bay water	Dermal contact		✔		✔
	Ingestion of sediment loaded bay water		✔		✔

The scenario of people swimming in the bay includes exposure through dermal contact with the sediment and the swallowing of sediment-laden water. This includes consideration of any impacts from recreational boating in the bay, such as the disturbance of sediments and the mobilisation of contaminants and particulates. This exposure scenario also covers wading along the foreshore.

The exposure scenarios described above are specific to residents of the Homebush Bay area. These residents would also be exposed to a background level of the contaminants of concern representative of the Sydney area.

4.3.4 Ecological Risks

Dioxins and furans have the potential to bio-accumulate in the livers and fatty tissue of animals. Exposure at a low level can result in weight loss, liver damage, a weakened immune system and disruption to the endocrine system.

Risks to Benthos

The Berents (1993) investigation indicated that the abundance and diversity of the benthos in the southern and western portions of Homebush Bay appear to be generally consistent with the benthos found in estuaries in south-eastern Australia. These findings support the conclusion that the sediments in the southern and western portions of the bay have not had any measurable impact on the benthos in these areas. These findings are supported by the EVS Environmental Consultants (1999) investigation that indicated that the level of contamination present in the surface sediments in the central part of Homebush Bay has not had an adverse impact on the benthos in this area. However, the Berents (1993) investigation and the Johnstone Environmental Technology (1987) report both observed a reduction in the abundance and species richness along the north-eastern shoreline. These observations are consistent with the effect of high concentrations of organic contaminants.

Risks to Wildlife and Fish

The screening level risk assessment performed by AWT Ensight and Parametrix (1996) considered that fish-eating birds such as pelicans, herons and cormorant species, frequenting Homebush Bay had the greatest risk of any wildlife group, due to the potential for bioaccumulation and biomagnification in the aquatic food chain. In the EVS detailed risk assessment, the little black cormorant was chosen as the receptor of concern due to its abundance in Australian estuaries and its fish diet.

The assessment concluded that a potential existed for the health of birds eating contaminated fish from Homebush Bay to be adversely impacted. However it was concluded that because the wildlife component of the risk assessment was conservative, remediation of the sediments with the highest contaminant load (those along the north-eastern foreshore of Homebush Bay) should significantly alleviate risks to wildlife, including fish. This is considered to be a reasonable approach.

4.3.5 Risks to Human Health

To determine the risk posed by bay sediments to human health an assessment was made of the total exposure associated with the applicable exposure scenario. That total exposure is then compared to a published reference exposure developed by recognised sources of human toxicological data.

The principal sources of human toxicological assessment data that have been relied on in Sinclair Knight Merz (SKM, 2002a; SKM, 2002b) comprise those organisations recognised by the National Environment Protection Council, as identified in the National Environment Protection Council (1999) guidelines. These organisations include the World Health Organization, National Health and Medical Research Council, National Environmental Health Forum, United States Environmental Protection Agency, International Agency for Research on Cancer and International Programme on Chemical Safety.

In the case of dioxins the total exposure predicted is compared against the Tolerable Daily Intake. Tolerable Daily Intake is defined in the National Environment Protection Council (1999) guidelines as "*an estimate of the intake of a substance which can occur over a lifetime without appreciable health risk. It is the tolerable intake expressed as a daily amount*". The World Health Organization (1998) advises that "*the total daily intake represents a tolerable daily intake for lifetime exposure and that occasional short-term excursions above the total daily intake would have no health consequences provided that the average intake over long periods is not exceeded*".

In 1990, the World Health Organization recommended a total daily intake value for dioxin-like compounds of 10 picograms per kilogram bodyweight per day based on total toxicity equivalents. This value was used in the EVS (1998) human health risk assessment to derive remediation criteria for sediments in Homebush Bay. In 1998, the World Health Organization revised the total daily intake value to a range of one to four picograms toxicity equivalents per kilogram per day (WHO, 1998). World Health Organization advised that this range of total daily intakes overlaps typical background exposures for industrialised countries that range between one to three picograms toxicity equivalents per kilogram per day for an adult. If the dioxin-like polychlorinated biphenyls are also considered, the daily toxicity equivalents intake can be a factor of two to three times higher.

In September 2001 and August 2002, the EPA advised the Waterways Authority that NSW Health had provided advice on a provisional tolerable daily intake for polychlorinated dioxins and furans and dioxin-like polychlorinated biphenyls (EPA, 2001). In the letter, NSW Health recommended that a proposed provisional tolerable daily intake of one to four picograms toxicity equivalents per kilogram per day of dioxins and furans and dioxin-like polychlorinated biphenyls be used to assess human health risks.

Human Health Exposure Assessment

When assessing human health risk there are two key exposure components: toxicity and frequency. For example, exposure for a short period of time to a highly toxic substance may result in a similar health risk as exposure over a long period to a substance of low toxicity. Thus in order to assess the level of risk, the extent of exposure must be assessed.

The methodology used by Sinclair Knight Merz seeks to estimate the average intake of dioxin-like substances over a lifetime.

Based on the potential exposure scenarios identified in **Table 4.4** the human health exposure assessment considered that for a 70-year life span, a person lives either the first 40 years of their life, or their entire life in the Homebush Bay area. In addition it is assumed that the person:

- eats estuarine fish caught in Homebush Bay
- is breast-fed as an infant for the first year of their life with the mother consuming fish caught in Homebush Bay as a potential exposure pathway for infants is through breast milk

- undertakes recreational activities in Homebush Bay as the bay offers the potential for being used by the local residents for recreational activities such as swimming in the bay, wading along the foreshore and boating
- is exposed to background levels of dioxin. For the Sydney area, this was approximated to be a lifetime daily exposure of 1.4 picograms toxicity equivalents per kilogram body weight per day. This background exposure level includes dietary, non-dietary and historical exposure.

The combined annual exposure from the above sources is then converted into a daily average exposure, which in turn is divided by the body weight of the receptor, assumed for this analysis to be 70 kilograms. This allows for an average daily lifetime exposure to be calculated in picogram toxicity equivalents per kilogram body weight per day.

Based on the present condition of the bay and assuming that the fishing ban did not exist, the estimate made of the possible lifetime intake of dioxin-like substances from estuarine fish consumption is greater than 3 picograms total toxic equivalency per kilogram per day.

When considering all exposure pathways, the potential total dioxin exposure exceeds 5 picograms total toxic equivalency per kilogram per day, which exceeds the upper bound of the acceptable intake range recommended by the World Health Organization of one to four picograms total toxic equivalency per kilogram per day for dioxin like compounds (WHO, 1998).

4.3.6 The Implications of Not Proceeding

As discussed, the sediments in Homebush Bay are impacted by dioxins and furans, the most carcinogenic of which is 2,3,7,8-TCDD. Other contaminants are present, generally associated with dioxins/furans, including polycyclic aromatic hydrocarbons, chlorinated pesticides and chlorinated benzenes.

Unless action is taken to remediate these contaminants, and dioxins in particular, they would potentially impact on human health and ecology. Further, if the source of the problem is not managed, the contaminants may continue to disperse via tidal movements into the wider Parramatta River environment, thus spreading the problem.

If the fishing ban was removed now with the sediments in their present condition, the potential total daily dioxin exposure over a lifetime would exceed the upper bound of the acceptable intake range recommended by the World Health Organization of one to four picograms toxicity equivalent per kilogram per day for dioxin like compounds (WHO, 1998).

Relying on natural processes, such as degradation to reduce the level of contamination in the sediments would be problematic, as dioxins are widespread and persistent in the environment.

To reduce the risks posed by dioxin in sediments to levels that would aid any future removal of the fishing ban in Homebush Bay, it is necessary to reduce the concentration of dioxin present in the bay. Also, the various areas of high contaminant concentrations, which are found along the north-eastern foreshore of the bay, would need to be removed to make the foreshore, and the bay in general, safe for recreational activities. Accordingly, there is a clear need for remediation of the sediment in Homebush Bay.

The question that remains is how much remediation needs to be conducted to reduce the contaminant levels to limit exposure to a safe level. This is dealt with in **Chapter 5**.

4.4 Need for Remediation of the Lednez Site

4.4.1 Summary of Lednez Site Investigations

Prior to the 1988 to 1993 remediation of the Lednez site several site investigations were undertaken to determine the extent of contamination on the site, and to develop appropriate remediation actions. These investigations included:

- *Johnstone Environmental Technology (May 1987) Geochemical Investigations and Recommendations for Rehabilitation at the Rhodes Chemicals Factory site of Union Carbide Australia Ltd*. The land component of this investigation involved 45 backhoe test pits being dug across the factory site. Test bores using an auger were drilled to reach the underlying shale. Johnstone Environmental Technology concluded the soils of the Lednez site were polluted and recommended leaving the contaminated material on the site, confining it and covering it to avoid contact or exposure

- *Wicklund and Finnecy (June 1987) Consultants' Report Union Carbide Site Rhodes, NSW Australia*. The authors of this report were commissioned by the State Pollution Control Commission in an advisory role. They were required to review the results of the Johnstone Environmental Technology investigations and determine requirements for further investigations and advise of practical methods for rehabilitation of the site. The report found that the approach to remediation proposed by Johnstone Environmental Technology was the only practicable approach available. The recommendations made were implemented by means of the remediation works that were carried out between 1988 and 1993

- *Johnstone Environmental Technology, (August 1991), Seawall Barriers for the Control of Ground Water Egress from Union Carbide Reclaimed Land to Homebush Bay.* In 1991, Johnstone Environmental Technology carried out further studies to control groundwater egress from the site. The investigations involved the drilling of 10 boreholes in the R3 and R4 areas (see Figure 4.1), under the clay cap constructed as part of the remediation works. It found the fill behind the seawall was contaminated with chlorinated phenols, chlorinated benzenes, chlorinated anisoles, polycyclic aromatic hydrocarbons and pesticides. Results of 2,3,7,8-TCDD were not reported.

In 1999, Planning NSW rezoned the western portion of Rhodes Peninsula, to accommodate residential development. Since this rezoning, further investigations of the Lednez site have been carried out to determine remediation requirements that would make the land suitable for residential development. These investigations are summarised as follows:

- *Sinclair Knight Merz (May 1999) Lednez Site Remediation Homebush Bay – Overview of Present Contamination*. Sinclair Knight Merz were commissioned by the Department of Public Works and Services to perform a desktop study and data review to establish the scope of remediation works and identify contamination issues. It found that contamination was widespread throughout the reclamation fill material and that the available data indicated increased contamination with depth of fill material. It noted that there was no data available of material excavated during the earlier remediation works and the report made recommendations for further sampling

- *Johnstone Environmental Technology (July 1999) Contamination of the Lednez Site – A Status Report*. This report was also commissioned by the Department of Public Works and Services. Its purpose was to summarise information from old files and data gathered during initial site investigations and during previous remediation works

- *Johnstone Environmental Technology (May 2001), Homebush Bay Dioxin Remediation Project – Contamination Investigation of Former Lednez Site*. The focus of this investigation was to obtain data regarding the contamination on the Lednez site to assist in the assessment of remediation options

- *Egis Consulting (April 2002) Human Health & Ecological Risk Assessment, Former Lednez Site, Walker Street, Rhodes*. The human health and ecological risk assessment was undertaken to assist in developing suitable remediation criteria for the redevelopment of the Lednez site. The risk assessment and remediation criteria are the focus of **Technical Paper 6**.

4.4.2 Contaminants

Technical Paper 4 presents detailed information on the location and nature of the main contaminants by defining overall concentration ranges for each.

The areas and type of materials in which the highest concentrations were found across the site are summarised in **Table 4.5**. For reference, areas R1, R2, R3 and R4 can be seen on **Figure 4.1**. The foreshore strip is shown in **Figure 1.3**.

Table 4.5 Overall Contaminant Ranges

Contaminants	Range of concentrations (milligrams per kilogram)	Area/material of maximum concentration
C_6–C_9	< Detection limit–20,000	Foreshore strip/sediments
C_{10}–C_{36}	< Detection limit –169,000	Foreshore strip/sediments
Benzene	< Detection limit –>1,000	Foreshore Strip/sediments
PAH (total)	< Detection limit –8,800	R1 and R2/boiler ash
Organochlorine pesticides (total)	< Detection limit –6,570	Foreshore strip/sediments
Chlorobenzenes (total)	< Detection limit –264,000	Foreshore strip/sediments
Chlorophenols (total)	< Detection limit –960	R3/boiler ash
Phenols (total)	< Detection limit –210	R4/boiler ash
2,3,7,8-TCDD	< Detection limit –0.180	R4/spent lime

4.4.3 Risks from Contaminated Lednez Site Materials

The Lednez site, in its current form, is considered by the EPA not to be of significant risk of harm to the public or the environment.

From a human health perspective, this is because the site is vacant and the contamination that remains on the site is contained beneath a clay cap. As a result, there is limited potential for exposure by either inhalation or direct contact to occur.

From an environmental perspective, the highly degraded nature of the sediments of the bay means that the contribution from the Lednez site to bay contamination is difficult to define.

This would continue to be the case unless the bay sediments are remediated. When this happens, it is possible that the site could be considered a significant risk of harm as the bay environment would then be much cleaner and the site would be contributing to a much higher proportion of the contamination. It is therefore essential that the remediation of the bay sediments and the Lednez site occur simultaneously to achieve the best possible outcome.

In order to determine the risk associated with the Lednez site, it is first necessary to determine acceptable contaminant concentrations that are safe and protective of human health. These are determined with regard for future activities or landuses on the site and the potential for future site users to be exposed to contamination. In that context they determine the need for and extent of remediation works.

The establishment of these acceptable concentrations (criteria) is undertaken using internationally recognised acceptance criteria where they exist and through a process of risk assessment in the case of those compounds for which acceptance criteria do not exist and/or where concentrations significantly exceed existing criteria.

Establishment of these acceptable concentrations (criteria) for the land-based remediation was undertaken by a human health and ecological risk assessment. This was prepared by Egis Consulting (Egis, 2002) and is provided in **Technical Paper 6**. The risk assessment was undertaken in accordance with the requirements of the National Environmental Protection Council (NEPC, 1999) guidelines for risk assessment.

The landuses considered in the risk assessment for the Lednez site are high-density residential, commercial and open-space. Potential receptors associated with these landuses could therefore include:

- future residents at the site (adults and children)
- commercial workers
- recreational users in the case of open space (park) areas
- maintenance workers
- remediation/construction workers
- fauna.

4.4.4 Risks to Human Health

In the case of the Lednez site, there are three exposure pathways by which a receptor may become exposed to an increased health risk associated with contaminated environmental media:

- dermal (that is, skin) contact with contaminated material
- ingestion of contaminated material
- inhalation of vapours.

The scenarios directly related to the potential landuses in which receptors may become exposed to contaminated media are as follows:

- **Residents/commercial workers,** who would be shielded by buildings from skin contact with and ingestion of the soil, may be exposed to inhalation of vapours that may permeate through the buildings walls
- **Recreational users of open space areas** can be exposed to skin contact, inhalation of vapours and ingestion of contaminated soil
- **Maintenance workers** in trenches would be exposed to skin contact, inhalation of vapours and ingestion of contaminated soil.

Human Health Exposure Assessment

The risk to human health from the Lednez site is assessed by considering the toxicity of the contaminants and the exposure assessment (defined by the exposure scenarios). An "acceptable risk" is defined as an incremental lifetime risk of cancer for exposure to all carcinogenic chemicals of 10^{-5}, which translates into an increased risk of 1 in 100,000 of getting cancer from exposure to all carcinogenic chemicals over a 70-year lifetime. For contaminants for which a threshold related health effect exists, the total exposure intake over a defined period must not exceed the reference dose published by toxicological data sources recognised by the National Environment Protection Council.

The chemicals for which acceptance criteria need to be determined through a risk assessment process have been identified based on the results of previous site investigations.

The health-based soil criteria developed for each of the exposure scenarios and the limiting receptors are summarised in **Table 4.6**. The variations in the limiting receptor in each instance are a function of the exposure pathway (ingestion, dermal and inhalation) and toxicity of each chemical relative to the pathway.

The health based criteria for an individual chemical is based on a target risk of 3.5×10^{-6}, which is a level that is protective of human health when combined with other chemicals.

These criteria are intended to apply in relation to the development plan and the location of open space (parkland) areas, buildings and areas where underground services may be found.

Table 4.6 Summary of Health Based Soil Acceptance Criteria (soil criteria for distances greater than 40 metres from the bay)

Chemical	Soil acceptance criteria				
	Park, open space	High density residential	Commercial	Building with basement carpark	Maintenance work (depth of work +0.5 metres)
BTEX					
Benzene	1	1	1	-	-
Toluene	130	130	130	-	-
Ethylbenzene (odour based)		1.66	6.22	-	-
0 – 1 metres	0.2				-
1 – 5 metres	1.8				
> 5 metres	22				
Xylene (totals)		25	25	-	-
0 – 1 metres (odour based)	5.79				
1 – 5 metres (odour based)	57.9				
>5 metres (odour based)	700				
Chlorobenzene					
Chlorobenzene	150	150	540	-	-
1,3-Dichlorobenzene	13	13	52	-	-

Table 4.6 Continuation

Chemical	Soil acceptance criteria				
	Park, open space	High density residential	Commercial	Building with basement carpark	Maintenance work (depth of work +0.5 metres)
1,4-Dichlorobenzene		11.9	28.4	-	-
0 – 1 metres	11.9				
1 – 5 metres (odour based)	236				
>5 metres (odour based)	2730				
1,2-Dichlorobenzene	370	370	370	-	-
1,2,4-Trichlorobenzene	650	650	3,000	-	-
1,2,3,5- & 1,2,4,5-Tetrachlorobenzene	18	18	260	-	-
1,2,3,4-Tetrachlorobenzene		26	1,060	2,830	12
Beneath 1 metre clay layer				20,400	
0 – 1 metres	160				
1 – 5 metres	1,130				
> 5 metres	12,300				
Pentachlorobenzene	49	49	700	-	-
Hexachlorobenzene			261	697	2.9
0 – 1 metres	7.6	6.5			
1 – 5 metres	274				
> 5 metres	3,020				
Organochlorine pesticides					
Hexachlorobutadiene	11.2	11.2	21.7	-	-
a-BHC	0.32	0.32	2.1	-	-
g-BHC	1.5	1.5	10.2		-
b-BHC	1.1	1.1	7.4	-	-
Heptachlor	20	40	50	-	-
Aldrin and Dieldrin	20 (Sum)	40 (Sum)	50 (Sum)		
Chlordane	100 Sum	200	250	-	-
Endosulfan	370	370	5300	-	-
Heptachlor epoxide	0.19	0.19	0.95	-	-

Table 4.6 Continuation

Chemical	Soil acceptance criteria				
	Park, open space	**High density residential**	**Commercial**	**Building with basement carpark**	**Maintenance work (depth of work +0.5 metres)**
DDE					
DDD	400 (Sum)	800 (Sum)	1,000 (Sum)	-	-
DDT					
Endrin	18	18	260		
Methoxychlor	310	310	4,400	-	-
Phenols, Cresols and Chlorophenols					
Phenol	17,000	34,000	42,500	-	-
2-Chlorophenol (odour based)		15.6	58.2	-	-
0 – 1 metres	1.7				
1 – 5 metres	17				
> 5 metres	163				
2-Methylphenol	3,100	3,100	44,000	-	-
3-Methylphenol	3,100	3,100	44,000	-	-
4-Methylphenol	310	310	4,400	-	-
2,4-Dimethylphenol	1,200	1,200	18,000	-	-
2,4,5-Trichlorophenol	6,100	6,100	88,000	-	-
2,4,6-Trichlorophenol	154	154	770	-	-
2,3,4,6-Trichlorophenol	1,800	1,800	26,000	-	-
Bisphenol-A	3,100	3,100	44,000	-	-
Pentachlorophenol	10.5	10.5	38.5	-	-
Polycyclic Aromatic Hydrocarbons					
Naphthalene		0.32	78	208	0.88
0 – 1 metres	2.3				-
1 – 5 metres	14				-
> 5 metres	138				-
Acenaphthene	3,700	3,700	38,000	-	-
Fluorene	2,600	2,600	33,000	-	-
Anthracene	22,000	22,000	100,000	-	
Fluoranthene	1,000	2,300	30,000	-	
Pyrene	2,300	2,300	54,000	-	

Table 4.6 Continuation

Chemical	Soil acceptance criteria				
	Park, open space	**High density residential**	**Commercial**	**Building with basement carpark**	**Maintenance work (depth of work +0.5 metres)**
Chrysene					
Benzo(b)fluoranthene					
Benzo(a)pyrene					
Benzo(k)fluoranthene					
Indeno(1,2,3-cd)pyrene					
Dibenz(a,h)anthracene					
Benzo(a)anthracene					
All as Benzo(a)pyrene-TEQ		14,900	>100,000	>100,000	1,500
0 – 1 metres	1.4				
1 – 5 metres	>100,000				
> 5 metres	>100,000				
Dioxins					
TCDD (TEQ)		0.00038		0.040	
Beneath 1 metre clay layer			0.015	0.043	0.00016
0 – 1 metres	0.000085				
1 – 5 metres	0.016				
> 5 metres	0.085				
Amines					
Aniline	298	298		-	
Pyridine (odour Based)		28.9	1500	-	-
0 – 1 metres	3.15		108		-
1 – 5 metres	31.7				
> 5 metres	420				
Nitrosamines					
Mono-nitrobenzene	20	20		-	
Ketones					
Methyl Ethyl Ketone (odour Based)		2,390	110	-	-
			8,940		-
0 – 1 metres	260				
1 – 5 metres	2,600				
> 5 metres	49,200				

Table 4.6 Continuation

Chemical	Soil acceptance criteria				
	Park, open space	High density residential	Commercial	Building with basement carpark	Maintenance work (depth of work +0.5 metres)
Phthalates					
Butyl benzyl phthalate	12,000	12,000	100,000	-	
Di-n-butyl phthalate	6,100	6,100	88,000		-
Diethyl phthalate	49,000	49,000	100,000		
Polychlorinated Biphenyls	20	40	50	-	-
Phenoxy Acid Herbicides					
2,4-D	690	690	12,000	-	-
2,4,5-T	610	610	8,800	-	-
Others					
Ammonia(odour based)		229	859	-	-
0 – 1 metres	25				
1 – 5 metres	250				
> 5 metres	4,490				

Metals	Park, open space	High density residential	Commercial	Plant health
Arsenic	200	400	500	20
Cyanides (complex)	1,000	2,000	2,500	-
Beryllium	40	80	100	-
Cadmium	40	80	100	3
Chromium (III)	24%	48%	60%	400
Chromium (VI)	200	400	500	1
Copper	2,000	4,000	5,000	100
Lead	600	1,200	1,500	600
Manganese	3,000	6,000	7,500	500
Methyl Mercury	20	40	50	-
Mercury (inorganic)	30	60	75	1
Nickel	600	2,400	3,000	60
Zinc	14,000	28,000	35,000	200

Note: All units are milligrams per kilogram.
Source: Egis, 2002b

4.4.5 Ecological Risks

These chemicals are then assessed in relation to potential impact on Homebush Bay. From this in depth assessment, soil groundwater quality criteria can be characterised to provide the constraints within which the above acceptable criteria protective of human health can be applied that would result in an “acceptable” risk to both human and ecological health.

Contaminated groundwater flowing from the Lednez site has the potential to contaminate Homebush Bay and adversely affect aquatic ecosystems in the vicinity of the point of discharge into Homebush Bay. The potential for contaminant transfer via groundwater has been modelled, and the results of this modelling are discussed in **Chapter 8**. Further detail is presented in the Lednez site remediation action plan in Technical Paper 7. The chemicals that were modelled included a representation of the main chemicals of concern, those present at high concentrations and chemicals with a range of aqueous mobility. For the purpose of the assessment it can be assumed that the chemicals that were modelled are representative of all chemicals present on the Lednez site.

In order for the acceptance criteria to provide protection from impact on Homebush Bay, the nearest ecological receptor, it has been determined that materials assessed against that criteria need to be at a distance of greater than 40 metres from the seawall. The model predicted that for material with chemical concentrations at the upper limit of the acceptance criteria (protective of human health) at a distance greater than 40 metres from the sea wall, the first potential breakthrough would not occur for over 2,800 years. The model does not take into account further attenuation that would occur between the point of contamination and the point of discharge and in that regard may be considered conservative.

Based on the modelling, the soil acceptance criteria should be applied only to material at a distance of greater than 40 meters from the seawall.

Materials within 40 meters of the bay need to assessed against a set of soil criteria that insures concentrations of chemicals in groundwater exiting the site do not exceed the water criteria for protection of aquatic ecosystems, established in *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000).

The risk assessment developed an additional set of acceptance criteria specifically designed to fulfil that requirement. The criteria are presented in **Table 4.7**. They are based on the physical properties of the materials on the site that govern leachability and mobility of chemicals into and within groundwater.

Table 4.7 Soil Criteria for the Protection of Marine Aquatic Species at the Point of Groundwater Discharge (soil criteria for distances less that 40 metres from the bay)

Chemical	Criteria
Chlorinated Benzenes	
Chlorobenzene	0.8
1,4-Dichlorobenzene	2
1,2-Dichlorobenzene	4
1,2,3-Trichlorobenzene	-
1,2,4-Trichlorobenzene	8

Note: All units are milligrams per kilogram.

Table 4.7 Continuation

Chemical	Criteria
1,3,5-Trichlorobenzene	–
1,2,3,5-Tetrachlorobenzene	1
1,2,4,5-Tetrachlorobenzene	2
1,2,3,4-Tetrachlorobenzene	1
Pentachlorobenzene	8
Hexachlorobenzene	0.3
Phenols	
Phenol	1
3-Chlorophenol	0.1
4-Chlorophenoll	6
2,4-Dichlorophenol	2
3,4-Dichlorophenol -	–
2,3,5-Trichlorophenol	0.4
2,3,5,6-Tetrachlorophenol	4
Pentachlorophenol	–
Polycyclic Aromatic Hydrocarbons	
Naphthalene	5
Phenanthrene	0.6
Anthracene	0.6
Fluoranthene	9
Benzo(a)pyrene	12
Pesticides	
DDE	0.1
DDD	0.6
DDT	2
Other chemicals	
Aniline	3
Nitrobenzene	0.5
Ammonia	–
Cyanide	–
Dioxins/furans	0.003

Note: All units are in milligrams per kilograms

4.4.6 The Implications of Not Proceeding

The Lednez site has a long history of chemical manufacturing that has resulted in extensive site contamination. Remediation of the Lednez site between 1988 and 1993 has left several areas of contamination untreated and without full encapsulation.

Remediation of the site is required to facilitate the redevelopment of the site as envisaged by regional planning policies.

The remediation of the Lednez site is essential if the site is not to continue as a potential contamination source for the migration of chemicals into Homebush Bay. Due to relative concentrations of chemicals present in the bay sediments and the foreshore strip on the Lednez site, the impact of any continued leaching would be magnified in the case that the sediments of Homebush Bay are remediated, and the site is not.

Without remediation, the site would continue to require ongoing maintenance and monitoring to minimise the risks to the public and the environment from the existing contamination.

Chapter 5

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

ALTERNATIVE REMEDIATION STRATEGIES AND TECHNOLOGIES

Chapter 5 ALTERNATIVE REMEDIATION STRATEGIES AND TECHNOLOGIES

5.1 Issues to Consider During Selection of Remedial Strategies

The key considerations when selecting the appropriate remedial strategies for both Homebush Bay and the Lednez site include:

- the ability to achieve desired outcomes, in particular:
  - managing the types of contaminants that are in the bay sediments and on the Lednez site
  - reducing the ongoing risk from sources dioxin to human, aquatic and bird-life that use Homebush Bay
  - ensuring remediation of the Lednez Site
  - using technologies with a proven track record
  - using an experienced remediation team
  - using reliable technology and contractors
  - acheiving long term performance
- proposal efficiency, in particular
  - achieving the proposal objectives within the budget allocated
  - meeting regulatory approval requirements
  - utilising efficient and effective rates of remediation
  - ensuring compatibility with other technologies in the process stream
  - ensuring compatibility with site conditions
  - considering transportability of equipment of materials
- proposal safety, including:
  - environmental performance of technology
  - remediation risks
  - emissions
  - community, social and public acceptability.

5.2 Selection of a Strategy for the Long Term Management of Contaminated Sediments in Homebush Bay

In respect of the bay, five options have been considered; the do nothing option, capping and covering of the bay sediments, in-situ immobilisation, or removal by either excavation or dredging of sediments, for management by either treatment or storage on the Lednez site, or transport offsite for disposal/treatment.

5.2.1 The Do Nothing Option

Various risk assessments undertaken on the sediments of Homebush Bay have established that without remediation the sediments pose an unacceptable risk in terms of ecological and human health due to the high levels of dioxin contamination present.

If the source of the dioxin contamination is not removed, the potential for dispersion of dioxin further into the environment remains, as does the potential for the chemicals to bioaccumulate in the food chain and continue to impact on public health. If the contamination becomes more widespread in the bay due to tidal and wave action influences, the eventual removal of the sediments would become increasingly difficult. Consequently this option would not meet the project objectives.

5.2.2 Cap and Cover within Homebush Bay

This option would involve capping the sediment in the bay with concrete or some other low permeability material. This is a low cost option, however concerns exist over the potential effects on benthic animals and tidal movements. The capping material would be subject to potential damage from aquatic burrowing animals and would require ongoing monitoring to ensure the material does not deteriorate.

A variation to this theme includes reclamation of the area with the construction of a new seawall westward of its present location. Reclamation works would significantly reduce the water surface area and reduce bay access. Consequently, this option is not considered acceptable.

5.2.3 Off-site Transport, Disposal and/or Treatment

Off-site transport, disposal and/or treatment of contaminated materials would involve the excavation of large amounts of material from the site and subsequent transportation to an appropriate facility for treatment and disposal. Under current EPA policy, the off-site disposal to landfill of dioxin and other scheduled wastes is not permissible at the concentrations present in some of the bay sediments. These sediments would need to be treated prior to disposal. This option would require significant off-site transport of excavated materials, and would be likely to result in noise, dust, odour and traffic issues. Consequently, this option is likely to be unacceptable to the community.

5.2.4 In-situ Treatment or Immobilisation

This option includes in-situ immobilisation, chemical treatment or bioremediation. In-situ immobilisation or treatment in the under water environment is considered inappropriate due to practical restrictions and potential leaching risk. Bio-remediation processes are generally considered attractive, as no sediment removal is required. However these techniques have not been employed at a comparable scale for treatment of the contaminants found at Homebush Bay.

5.2.5 Removal of Sediment and Management on the Lednez Site

Whilst being the most expensive of all options available, it is assessed that this option would most fully achieve project objectives. Removal of the sediment from the bay may be achieved either by dredging or by conventional excavation within a coffer dam.

5.2.6 Preferred Long Term Remediation Strategy

As discussed in **Chapter 4**, previous work carried out by SKM, EVS and Parametrix/AWT Ensight has demonstrated that the contaminated sediments of Homebush Bay require some form of remediation action such as capping, treatment or removal in order to meet the stated proposal objectives and to reduce the level of health and ecological risk that currently exists.

As shown by the comparison in **Table 5.1** when compared with the other options, the well-managed removal of sediments from the bay with subsequent on-site management or treatment on the Lednez site is clearly the best option in terms of effectiveness in achieving the proposal objectives, and long term protection of the environment and public health, despite a significant increase. This strategy is consistent with government and community expectations, does not involve transportation to another site and provides an opportunity for material from the bay to be addressed in manner consistent with that used to address materials from the Lednez site.

In the event that undertaking the Lednez site component of the proposal as outlined in this EIS becomes financially or contractually impractical there is a contingency option whereby the contaminated sediment would be contained in purpose built cells located on the northern and southern portions of the Lednez site.

The cells would be lined with clay and high-density polyethylene membrane, and closed with a composite capping system to prevent ingress of rainwater. This option would require an ongoing monitoring programme to ensure the containment of all contaminants within the cells.

5.3 Approach to the Remediation of Homebush Bay Sediments

In order to determine the extent of remediation works required in Homebush Bay, as part of the long term preferred remediation approach, the health risk assessment undertaken by Sinclair Knight Merz (SKM, 2002a; SKM, 2002b) characterises the potential risks to human health from sediments remaining in Homebush Bay after the completion of remediation works.

The risk assessment considered the following objectives:

- to develop up-dated sediment clean-up criteria that would reduce to an acceptable level the ongoing risk from sources of dioxin to human, aquatic and bird life that use the bay
- to develop an up-dated sediment remediation objective for dioxin and dioxin-like compounds that would assist any future removal of the recreational fishing ban from Homebush Bay by NSW Fisheries
- select a socially acceptable and cost effective management strategy which mitigates threats to and provides protection for public health and the environment

Table 5.1 Options for Remediation of Homebush Bay Sediments

Option	Achieves proposal and planning objectives	Cost issues	Environmental management issues	Human health risks	Ecological health risks
Do nothing	No	Lowest cost Ongoing maintenance of sites and potential liability associated with ongoing contamination	Ongoing contamination of bay and River	Ongoing and proven risk	Ongoing and proven risk
Cap and cover within bay	In theory although stability of the bay and tidal movements may reduce effectiveness and regular monitoring would be required	Relatively low cost compared to treatment	Maintenance and monitoring of cap Community acceptance may be low Loss of bay access and surface water area	Minimised health risk due to limited exposure pathway	Reduced availability of contaminated food sources
In-situ treatment or immobilisation	Partially, not yet proven on a large scale	Uncertain cost	Monitoring of potential leakage/leaching from the stabilised material Potential acid sulphate soil conditions Effects on fish and benthic population during operation	Reduced risk as leaching potential of contaminants would be reduced	Reduced availability of contaminated food sources
Removal of sediment and management by storage on land site	Inconsistent with the environmental objectives for the peninsula	Moderate costs however there would be substantial ongoing maintenance and monitoring costs	Maintenance and monitoring of cell construction and integrity Community acceptance may be low Potential transfer of contaminants into bay waters during dredging, less risk with the coffer dam approach	Health risks associated with the removal of the sediments as part of the overall proposal if not managed appropriately	Long term risks are significantly reduced as a significant proportion of contamination would be removed
Remove sediment and management by treatment and re-use on land site	Yes	High cost – dependent on treatment technology	Potential transfer of contaminants into bay waters during dredging or coffer dam construction Effects on fish and benthic population during operation Potential acid sulphate soil conditions	Significant reduction in long-term public health risk and environmental risk from the bay.	Long term risks are significantly reduced as a substantial proportion of contamination would be removed and destroyed

- select a socially acceptable and cost effective management strategy which allows flexibility in the future use of the adjacent land
- the remediation strategy should promote the economic use and development of the land

Sinclair Knight Merz developed a number of remediation scenarios to determine the extent of remediation required to meet these objectives. These scenarios, and an assessment of the outcomes of their implementation are described in **Technical Paper 5**.

The risk assessment (SKM, 2002a; SKM 2002b) concluded that there is considerable uncertainty in relation to the presently available data used in deriving an estimate of the risks to human health from consumption of fish from Homebush Bay. As a result, regardless of the extent of remediation proposed, the fishing ban would need to remain in place until such time that dioxin concentrations in fish tissue can be reliably demonstrated to be at a safe level for human consumption. Until that happens, the fishing ban would guarantee that exposure to dioxin would be significantly lower than the World health Organization limit of four picograms toxicity equivalents per kilogram per day.

The extent of remediation proposed by Sinclair Knight Merz (SKM, 2002b) comprises the most heavily impacted portion of Homebush Bay adjacent to the Lednez, Meriton and Orica sites. It is referred to as the Preferred Remediation Scenario.

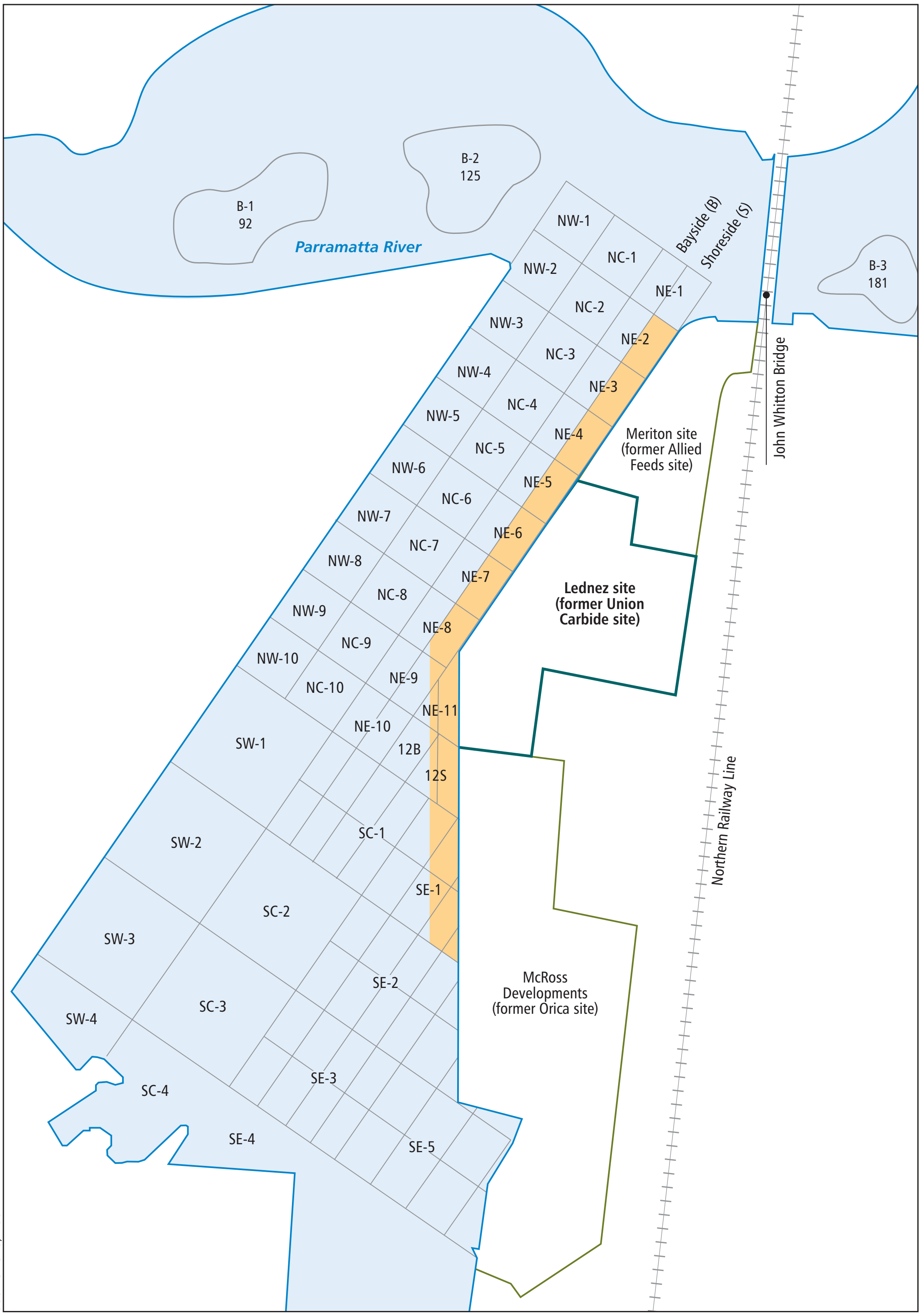
The area proposed for remediation is approximately 45 metres wide and 1160 metres long. It runs from the northern tip of the Rhodes peninsula, south along its' western foreshore, and extends in front of the northern part of the Orica site. The location of the proposed remediation area is shown in **Figure 5.1**.

Implementation of the Preferred Remediation Scenario would have the following benefits:

- it would realise the greatest rate of reduction in dioxin levels in the bay sediments per unit area
- as dioxin levels in fish decrease, so should impacts to human health by lowering the potential for daily intake though the food chain
- it would ensure that future residential users of the Lednez, Meriton and Orica sites would be protected from unsafe exposure resulting from bay based recreational activities, including those involving direct contact with sediments along the foreshore
- it would ensure the health of the ecological communities that frequent the bay by removing the most heavily contaminated sediments from the bay
- it would reduce the contaminant load available for future dispersion throughout the environment.

Increasing the remediated area of Homebush Bay further would likely reduce the dioxin levels in the estuarine fish that frequent the bay and may lead to lifetime exposures that approach the limits of the total daily intake range recommended by the World Health Organization. However, the outcome cannot be predicted with certainty. In addition, remediation beyond the area proposed would significantly exceed the NSW Government's budget for the remediation. Also, additional remediation would be addressing areas of relatively minor contamination.

In terms of the depth of remediation required, the sediment investigations conducted in Homebush Bay indicate that sediment contamination by dioxins is greatest for the surface sediments compared to the deeper sediments for the majority of Homebush Bay, as discussed in **Chapter 4**. The main exception is the area adjacent to the Lednez site where high levels of 2,3,7,8-TCDD have been found between 1 and 2 metres in depth.



Source: URS, 2001

Figure 5.1 **Extent of Homebush Bay Remediation**

NE-1 Grid cell identifier (after EVS, 1998)

Grid cell border

Area of bay to be remediated

Therefore it is considered that the remediation of the surface, and near surface sediment layers to a depth of 0.5 metres, should produce the greatest reduction in health and ecological risks posed by the dioxin-contaminated sediments in the bay, since the remediation of these sediments would result in a rapid reduction in the contaminant footprint in the bay (SKM, 2002a).

On the basis of the various sediment investigations conducted in the bay, Sinclair Knight Merz concluded that the contaminated sediments along the eastern shoreline adjacent to the Lednez site at a depth of more than 0.5 metres would not pose future risks to human health or the environment provided that:

- the benthic environment is isolated from any underlying contaminated sediment
- contaminated sediment is protected from physical disturbance that may be caused by naturally occurring or man-made activities (eg. scouring, anchor penetration)
- measures are used to reduce any flux of dissolved contaminants into the water column to an acceptable level

To meet these requirements, the top 0.5 metres of sediment would be excavated and overlain with a protective geo-textile/marker and a substrate consisting of crushed rock materials.

5.3.1 Future Management of Homebush Bay

The fishing ban must remain in place until it can be reliably demonstrated that it can be lifted.

To that end, on completion of remediation, a biological monitoring programme should be commenced to build a robust data set that can be reliably used in justifying any future removal by NSW Fisheries of the fishing ban. The data from this program would also be useful in the development of a long term environmental management plan for Homebush Bay.

The remediation strategy would also include key management measures for Homebush Bay designed to maintain the integrity of the new sediment layer and allow for the re-establishment of aquatic life. Such measures should comprise the following restrictions on activities within the bay:

- no driving of offshore piles into the restored sediment layer along the north-eastern side of the bay
- no mooring of vessels along the north eastern side of the bay
- restrictions on the location of marinas.

5.4 Alternative Methodologies for Removal of Sediments

5.4.1 Sediment Removal Methods

Removal of the sediment from the bay may be achieved either by dredging or by conventional excavation within the confines of a coffer dam.

Dredging

Dredging involves the underwater mechanical extraction and relocation of sediment. The costs, environmental impacts and timing of the work vary greatly depending on the specific dredging technique used. Dredging may result in the redistribution of the contamination, increased water turbidity, production of offensive vapours, removal of habitat, changed water flow within the bay, wastewater production and potential leaks and spills. Further, dredging would entrain large quantities of water in the sediment, thereby making subsequent processing on the Lednez site difficult.

Coffer Dam

The use of a coffer dam involves the construction of dam walls around the area from which sediments are to be removed. The coffer dam structure allows excavation and relocation of sediment to occur under close to dry conditions.

The coffer dam presents the disadvantages of potentially increased dust production, potential production of offensive vapours, changed water flow within the bay, potential leaks and spills and noise associated with coffer dam construction. However, the levels of sediment suspension and generation of contaminated water from this process would be much less than from dredging.

Preferred Option

A comparison of the two options is detailed in **Table 5.2** and discussed further in **Technical Paper 8**.

Table 5.2 Comparison of Dredging and Coffer Dam Options

Parameter	Dredging	Coffer dam
Cost	Moderate– dependent on area to be remediated	High Cost – dependent on area to be remediated
Sediment suspension	High	Low
Effect on flow and wave climate in bay	Low	Moderate
Wastewater volume requiring treatment	High	Low
Impact on benthic and marine flora and fauna	High	Moderate
Risk of bay contamination from removal of equipment	Moderate	Low
Noise impacts	Low	Low
Risk of air quality impacts	Low	Moderate

The main impacts associated with dredging relate to the degree of sediment suspension and its effect on the surrounding environment. Once suspended, fine sediment creates extensive plumes, suppression of which is problematic. The main impacts from coffer dams relate to dust emissions and tidal flows. Dust suppression techniques are commonplace and are generally successfully implemented through good environmental management planning. Minor tidal flow changes are unavoidable, however impacts on marine and benthic flora and fauna are likely to be less extreme than those associated with sediment suspension caused by dredging.

In addition, water levels in the bay are known to be shallow and below the sediment level in some areas at low tide indicating that dredging would be problematic.

On the basis of these factors and on its assessed ability to minimise sediment removal impacts, sediment excavation within a coffer dam is recommended as the preferred option to remove sediment from Homebush Bay.

5.4.2 The Application of Silt Curtains

Silt curtains would be required regardless of which method is deployed to remove the bay sediments. Two silt curtain options have been considered for containment of sediments generated as a direct result of the installation of the coffer dam and subsequent sediment excavation. These are presented in **Figure 5.2** and are:

- Option 1 – a floating curtain anchored to the bottom and separated from the coffer dam by a distance of approximately 15 metres
- Option 2 – a floating curtain anchored at the base of the coffer dam and laid over the seaward slope after completion of the coffer dam.

Detached Silt Curtain – Option 1

The first option proposed is to install and maintain the silt curtain during the construction of the coffer dams and during sediment excavation, at approximately 15 metres from the coffer dam wall. On the landward side the curtain is attached to the shoreline above high water mark and on the seaward side to a floating boom that extends the length of the coffer dam. The silt curtain would be under the continuous influence of processes in the bay, including tides, wind, waves and currents (**Figure 5.2**). In this option, a buffer zone is created between the coffer dam wall and the bay.

Depending on the mechanism for securing the silt curtain, it may not be effective in retaining all the turbid water. **Figure 5.2**, Option 1(a) shows a conceptualisation of the detached silt curtain approach and includes a floating silt curtain that extends to the seabed. Since the bottom part of the curtain is not fixed, incoming and outgoing tides may cause re-suspension at the seabed (due to the loose curtain rubbing on the sediment) allowing for turbid waters to enter the bay.

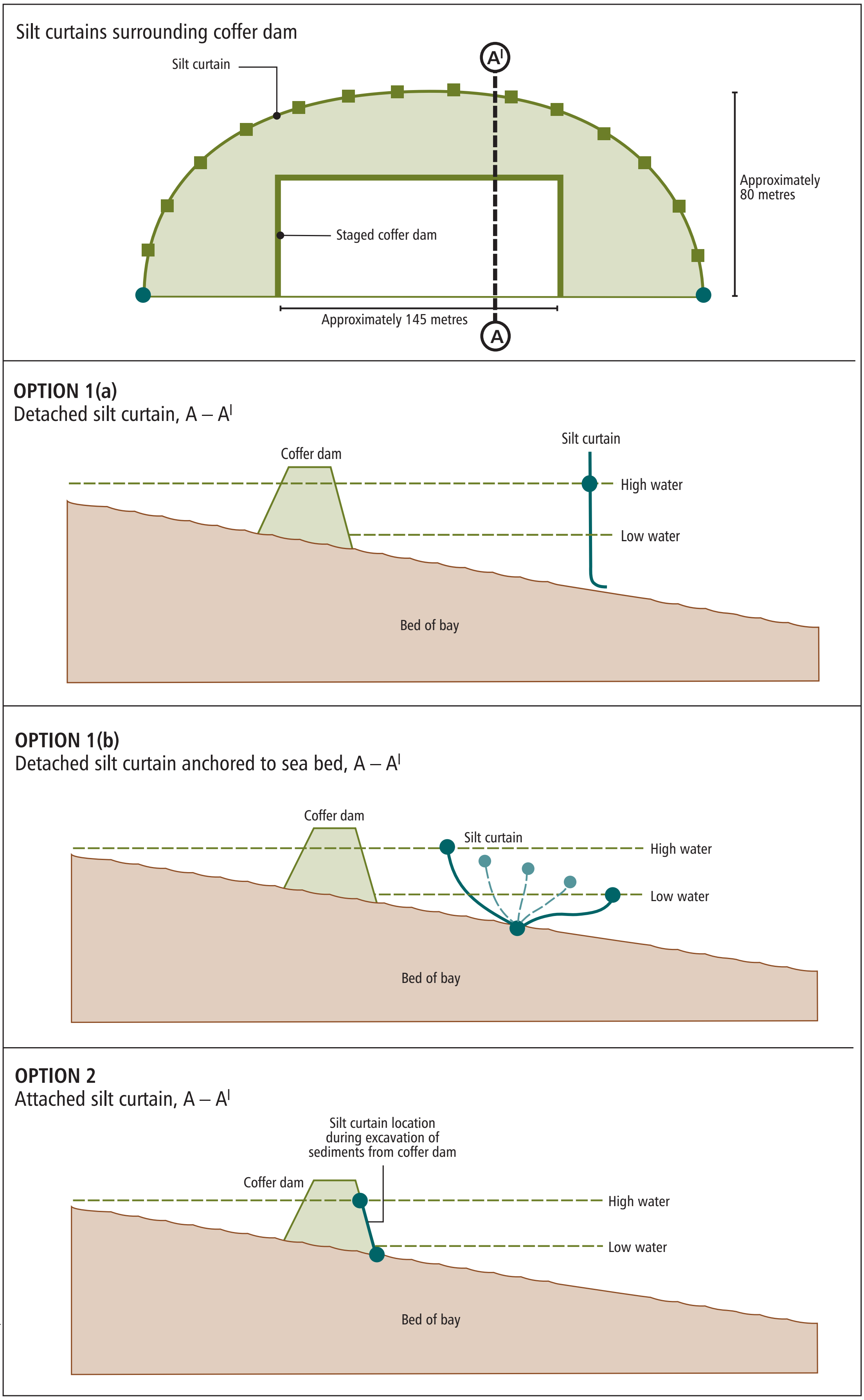
Another option for the silt curtain would be to attach it to the seabed and to allow it to move towards and away from the shore during high and low waters respectively (Figure 5.2, Option 1(b)). To accommodate the estimated water volumes the silt curtain would require the ability to move approximately 30 metres in each direction. This would require a much longer silt curtain that would be difficult to anchor and maintain.

Attached Silt Curtain – Option 2

In Option 2 it is proposed that, following coffer dam construction, the outer wall of the coffer dam would be essentially wrapped in a geotextile silt curtain material to prevent erosion of the wall and mitigate impacts associated with sedimentation of the bay (see **Figure 5.2**). The curtain would be anchored out from the coffer dam during construction, as with Option 1, but would be pulled in and attached to the coffer dam progressively as the wall is constructed. The curtain would require a floating boom for construction and the boom and curtain would be lifted from the water and laid on the wall for the duration of sediment excavation. At completion of the remediation, the curtain would be refloated and the coffer dam material removed. All water in the coffer dam cell would need to be discharged to the treatment area.

The advantage of this option is that virtually no water is enclosed between the dam and the curtain, hence averting any issues associated with such waters. Also, anchoring would require less infrastructure than the detached option and ease of access would facilitate ongoing maintenance.

There is still a risk of the silt curtain tearing for this option over the detached option due to the combined effects of tidal and wave action (for example, rubbing against the dam wall). This would, however, be mitigated through the selection of geotextile material of sufficient strength to ensure integrity is maintained and by implementation of a monitoring program during the works.



Source: MHL, 2002

Not to Scale

Figure 5.2 **Silt Curtain Design Considerations**

Preferred Option

The preferred option is Option 2 – with an attached silt curtain, as it significantly reduces the risk of turbid plumes entering the bay from coffer dam cells. It is also operationally preferable as it reduces the problems associated with tidal movement in the bay.

5.4.3 Summary of Preferred Bay Remedial Methodology

The preferred remediation methodology for the portion of Homebush Bay to be remediated is:

- to excavate behind coffer dams constructed in the bay and move contaminated materials to the Lednez site for treatment and reuse
- to protect the remainder of the bay by the use of an attached silt curtain along the coffer dams.

5.5 Selection of a Strategy to Remediate the Lednez Site

5.5.1 The Do Nothing Option

The "do nothing" option would make it necessary to implement an ongoing monitoring and site security programme to protect the public from the health risks associated with the site.

Previous remediation work on the Lednez site has left several areas of contamination untreated and without full encapsulation. As a result, without remediation large parts of the site would be unable to be used for any beneficial purpose be it residential, commercial or open space land uses.

Consequently, this option does not meet the desired outcomes, to improve the environment and ensure that the Lednez site is remediated to facilitate redevelopment as envisaged by *Sydney Regional Environmental Plan No 29 - Rhodes Peninsula.*

5.5.2 Cap and Contain On-site

The cap and contain option would involve removing material from the current capped locations, as well as excavating material from the remaining strip of un-remediated land that lies along the seawall. On-site engineered containment cells would need to be constructed to store this material appropriately. These cells would require full lining (top, side and bottom), with installation of permanent monitoring.

The following assessment is made for the cap and contain option:

- cap and contain is considered a low cost feasible option, however the size and nature of the final containment area would limit the redevelopment of the site and potentially restrict future landuse options
- ongoing monitoring of air quality, groundwater quality and cap integrity would be required to ensure that the containment area does not have any residual impact on human health and the environment
- highly contaminated material may still require some treatment (for example, treatment of oily sludges) before placement into any containment cell or disposal/treatment off-site
- this option is not perceived as a long term solution by many stakeholders.

Consequently, this option does not meet the desired outcomes, to ensure that the Lednez site is remediated to facilitate redevelopment as envisaged by *Sydney Regional Environmental Plan No 29 - Rhodes Peninsula.*

5.5.3 Off-site Transport, Disposal and/or Treatment

Off-site transport, disposal and/or treatment of contaminated materials would involve the excavation of large amounts of material from the site and subsequent transportation to an appropriate facility for treatment and/or disposal. Under current EPA policy, the off-site disposal to landfill of dioxin and other scheduled wastes is not permissible at the concentrations present on-site. Therefore, a substantial proportion of the material would need to be treated before disposal.

This option would require significant offsite transport and would be likely to result in increased noise, dust, odour and traffic issues. Consequently this option is likely to be unacceptable to the community.

5.5.4 In-situ Treatment

In-situ remediation involves the remediation of contaminated soils without removal from their current location. In-situ treatment is advantageous as excavation works are not required. Various in-situ remediation methods include:

- bioremediation (soils and groundwater)
- pump and treat (groundwater)
- vitrification (soils, sludges, etc.)
- vapour phase extraction (soils, groundwater)
- reactive barriers (groundwater)
- solidification/stabilisation (soils).

Due to the varied and heterogenous subsurface conditions (for example, lime sludges, rubble, marine sediments), it is likely that any in-situ treatment or immobilisation would be complex and require institutional controls.

The following assessment is made for in-situ remediation:

- future development may require the excavation of selected areas for foundations, basements and infrastructure. Furthermore the subsurface material must be geotechnically sound to ensure structural stability for future structures. Consequently, excavated material may need to be further treated to allow off-site disposal
- in-situ treatment (destruction) of dioxins and other persistent chlorinated chemicals (as distinct from capping and containment or ex-situ treatment) is not well documented.

Consequently, this option does not meet the desired outcomes, to ensure that the Lednez site is remediated to facilitate redevelopment as envisaged by *Sydney Regional Environmental Plan No 29 - Rhodes Peninsula.*

5.5.5 On-site, Ex-situ Treatment

On-site treatment of contaminated materials would involve the excavation of large amounts of material from the site followed by treatment. This approach would require staged excavation and treatment operations, with treated material being beneficially reapplied to the site.

Assessment of on-site, ex-situ treatment indicates that:

- on-site treatment removes the risks associated with off site transport of large quantities of contaminated material
- impacts including noise, dust, odour, truck movements etc., would need to be assessed
- assessment of environmental impacts and engineering feasibility would be required for any treatment plant selected
- on-site treatment is significantly more expensive than containment options
- on-site, ex-situ treatment technologies have been successfully applied more extensively than in-situ processes
- optimisation trials would be required to assess the viability of the methods on the materials identified on the Lednez site.

Provided that due consideration is given to the engineering aspects of this option, it would meet the desired outcomes, and ensures that the Lednez site is remediated to facilitate redevelopment as envisaged by *Sydney Regional Environmental Plan No 29 - Rhodes Peninsula.*

5.5.6 Preferred Remediation Option for Lednez Site

In summary the "do nothing" approach is not considered appropriate, as it does not achieve the project objectives. The other remediation options considered are assessed below:

- cap and contain would involve the creation of engineered cells to contain all of the contaminated material. This option does not vary in monitoring requirements from the existing situation at the Lednez site. The cells would require institutional controls and the public perception may be that this is a low cost option which if not engineered adequately may allow continued leaching to the bay and would adversely impact on the land available for redevelopment
- on-site, ex-situ remediation presents technical and environmental difficulties but this is the preferred approach of the National Health and Medical Research Council. Any on-site remediation would be more expensive and time consuming than non-treatment options, however it has the advantage of dealing with the contamination in a way which removes future concern. Treatment also allows residential development of the site to be a feasible option. At present ex-situ treatment techniques are much more extensively documented and tried than in-situ remediation methods
- in-situ remediation has many of the same advantages as on-site, ex-situ remediation in that the contamination is removed to an acceptable level, from public and ecological risk perspectives, allowing site development. However, options for in-situ remediation are currently not considered commercially or technically proven
- off-site remediation would essentially move the problem to another area and involve the transport of large quantities of material through residential suburbs to alternative landfill or specialised treatment sites.

It is concluded that, ex-situ, on-site treatment of contaminated material represents the most appropriate remediation option.

The alternatives within that option then relate to the determination of the extent of remediation required and the selection of the most appropriate treatment technology.

5.6 Approach to Remediation of the Lednez Site

The remediation proposal for the Lednez site (discussed in detail in **Chapter 6**) involves the staged excavation of all fill materials to the natural materials beneath, the replacement of the excavated material with material that meets soil acceptance criteria and treatment of material that does not meet the soil acceptance criteria. This approach would ensure that the site could be used for the designated activities of high-density residential and open-space land use. The application of the acceptance criteria are summarised below and discussed in detail in **Technical Papers 6** and **7**.

The soil acceptance criteria would be applied in relation to the development plan and the location of buildings, open space areas and areas where underground services would be placed. **Table 4.6** and **Table 4.7** (see **Chapter 4**) detail the soil acceptance criteria to be applied for protection of human health and the environment.

The potential for odour would also be considered, particularly for sensitive landuses such as residential. Odour-based soil acceptance criteria developed in the risk assessment (Egis, 2002) for each of the post-remediation landuse scenarios are shown in **Table 4.6** and have the objective of ensuring that odours would not be experienced by persons at the site after the remediation had been completed.

The application of soil acceptance criteria varies depending on the proposed landuse types.

In the residential and commercial areas, the top one metre layer of compacted soil would meet the lower of the upper residential and commercial soil acceptance criteria and the appropriate odour criteria. The lower soil layer would meet the soil acceptance criteria based on the exposure to chemicals volatilising through the one metre surface layer, into the indoor air space.

The soil in the open spaces would form three layers. The top one metre layer must satisfy the lower of the upper open space soil acceptance criteria and the odour criteria. Below one metre depth the soil must satisfy the lower of the "lower" open space soil acceptance criteria and the odour criteria. Below five metres depth the soil must satisfy the deep open space soil acceptance criteria and the odour criteria.

As discussed previously, groundwater modelling has predicted that for material meeting the human health based acceptance criteria placed at a distance greater than 40 metres from the sea wall, the first potential breakthrough of chemicals into the bay would not occur for over 2,800 years. The model does not take into account further attenuation that would occur between the point of contamination and the point of discharge and in that regard is considered conservative. Based on the conservative nature of the model and the predicted timescale it is considered that the proposed approach prevents impact to the bay, unless preferential flow pathways are present that allow more rapid transport in groundwater.

Based on the modelling, the soil acceptance criteria are considered to be at a level that would prevent contamination of the bay by groundwater. To provide additional protection to the bay the following measures would be incorporated into the remediation strategy within 40 metres of the seawall:

- a high permeability zone of coarse crushed rock/aggregate constructed immediately behind the seawall to provide a tidal flushing zone
- a barrier of clean compacted clay with low permeability constructed on the landward side of the high permeability zone.

Materials within 40 metres of the seawall would meet the soil acceptance criteria designed to protect the bay ecosystem (see **Table 4.7**).

5.7 Evaluation of Soil/Sediment Treatment Technologies

5.7.1 Assessment and Selection of Suitable Technology Types

The nature of the contaminated material needs to be identified and characterised before any technology analysis can be made. The distribution of the contaminants within the sediments of Homebush Bay and on the Lednez site is detailed in **Technical Paper 3** and **Technical Paper 4**. More detailed discussion on the contaminants of concern and remediation criteria is provided in **Technical Paper 5** and **Technical Paper 6**.

The assessment of suitable treatment technologies for the project considers the following primary factors:

- contaminants addressed
- implementation status of technology (laboratory/bench trial, pilot scale, full scale demonstration or full scale commercialised)
- achievement of the objectives of the proposal
- track record in similar projects
- regulatory approval (in Australia and overseas)
- public acceptability/opinion
- safety
- cost.

Secondary factors considered include:

- quantity of soil/sediment
- materials handling
- rates of remediation (for example, treatment rates)
- reliability
- long term performance
- remediation risks (for example, spills, air emissions, equipment malfunctions, equipment sensitivity, ability to handle variable feeds)
- emissions (solid, liquid, gas)
- availability of equipment.

5.7.2 Comparison of Treatment Technologies

One of the most significant factors in selecting treatment technologies for remediation is ensuring that the process selected addresses the contaminants of concern. The prime contaminants to be treated are dioxins, however there are other contaminants (refer **Chapter 4**) that are also of concern. **Table 5.3** outlines the different treatment technologies reviewed and their applicability to treatment of significant contaminants. **Table 5.4** presents a comparison of various other factors considered in the analysis of the different technology options. For more information on the review of remediation and technology options refer to **Technical Paper 8**. For more information regarding the selected technology refer to **Technical Paper 9**.

In selecting an appropriate treatment technology for contamination in Homebush Bay and the adjacent Lednez site, an overview of current and best available technologies was undertaken. This assessment established that thermal desorption is, at present, the only treatment technology option which meets the objectives of the proposal.

5.7.3 Thermal Desorption Technologies

Thermal desorption technologies are generally classified as either indirect or direct. Direct thermal desorption separates contaminants from the soil matrix by directly exposing the soil to hot combustion gas. Following desorption, gas phase contaminants require treatment, which typically involves a secondary combustion step at greater than 1,000 degrees Celsius.

Volatilisation of contaminants by indirect heating in a low oxygen atmosphere is the primary process involved in indirect thermal desorption. Formation of dioxins and furans are avoided in the indirect method due to low oxygen levels and the absence of combustion gases.

Substantial consideration has been given to the selection of the technology. Factors that have been included in the evaluation are the absence and/or treatability of process residuals, degree to which the technology is proven, emission levels, time required for processing and cost.

Table 5.5 provides a comparison of significant aspects of indirect and direct thermal desorption processes. As well as considering the technical and cost performance of the available thermal treatment technologies, community opinion has also been considered. The clear preference of local community groups and that of peak environmental groups is for indirect thermal desorption over direct thermal desorption.

Direct and indirect thermal desorption are both internationally proven and effective technologies for the treatment of organic contaminants. Whilst both methodologies are technically suitable, the preferred option for the treatment of contaminated materials for this proposal is indirect thermal desorption.

The desorbed contaminants would then be destroyed using a technology known as a base catalysed decomposition (BCD). In this process contaminants are destroyed in a controlled manner by essentially reversing the chemical reaction by which they where created in the first place.

Table 5.3 Contaminants Addressed by Treatment Technologies

Technology	Contaminants				
	Dioxin furans	Organochlorine pesticides and herbicides	Chlorinated organic compounds (chlorobenzenes, chlorophenols, solvents)	Petroleum Hydrocarbons (TPH, BTEX, PAHs, Phenols)	Heavy metals
Bioremediation	Problematic (not viable at the levels present on the Lednez site)******	Problematic (not viable at the levels present on the Lednez site)******	Problematic (not viable at the levels present on the Lednez site)******	Yes	–
Dechlorination					
BCD (base catalysed Dechlorination)	Yes	Yes	Yes	Not applicable	Not applicable
Gasification	–	Yes	Yes	–	Yes***
Incineration	Yes	Yes	Yes	Yes	Not applicable
Molten media process					
Molten metal	Yes	Yes	Yes	Yes	Yes***
Molten salt	Yes	Yes	Yes	Yes	Yes***
Molten slag	–	–	–	Yes	Yes*****
Plasma arc (requires ITD for soils)					
PACT (Plasma Arc Centrifugal Treatment)	Yes	Yes	Yes	Yes	Yes**
PLASCON (In Flight Plasma Arc System)	Yes	Yes	Yes	Yes	Yes

Notes:
- – limited information
- (1) indirect thermal desorption units are typically paired with another technology following desorption, to destroy contaminants of concern – this assessment is based on use of appropriate follow on treatment
- (2) direct thermal desorption units typically include an oxidation chamber/s (after burner/s) operating in excess of 1000ºC which oxidises desorbed contaminants in the vapour stream.
- * low boiling point metals such as mercury can be separated/removed
- ** leachable metals in solids are vitrified into a non leachable mass
- *** slag and or ash containing oxidised metals
- **** contaminants are immobilised/stabilised in a non leachable mass not removed/destroyed
- ***** inorganics move into the slag layer while iron and most heavy transition metals dissolve into the molten metal
- ****** information provided by Thiess Services

Table 5.3 Continuation

Technology	Contaminants				
	Dioxin furans	**Organochlorine pesticides and herbicides**	**Chlorinated organic compounds (chlorobenzenes, chlorophenols, solvents)**	**Petroleum Hydrocarbons (TPH, BTEX, PAHs, Phenols)**	**Heavy metals**
Solvated electron process	Yes	Yes	Yes	Yes	–
Stabilisation/ solidification	Yes	Yes****	Yes****	Yes****	Yes****
Supercritical water oxidation	Yes	Yes	Yes	Yes	–
Thermal Desorption					
Indirect thermal desorption (1)	Yes	Yes	Yes	Yes	No*
Direct thermal desorption (2)	Yes	Yes	Yes	Yes	No*
Vitrification					
GeoMelt process	Yes	Yes	Yes	Yes	Yes (the heavy metals end up in the slag)******

Notes:
- – limited information
- (1) indirect thermal desorption units are typically paired with another technology following desorption, to destroy contaminants of concern – this assessment is based on use of appropriate follow on treatment
- (2) direct thermal desorption units typically include an oxidation chamber/s (after burner/s) operating in excess of 1000°C which oxidises desorbed contaminants in the vapour stream.
- * low boiling point metals such as mercury can be separated/removed
- ** leachable metals in solids are vitrified into a non leachable mass
- *** slag and or ash containing oxidised metals
- **** contaminants are immobilised/stabilised in a non leachable mass not removed/destroyed
- ***** inorganics move into the slag layer while iron and most heavy transition metals dissolve into the molten metal
- ****** information provided by Thiess Services

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Table 5.4 Summary of Treatment Technologies for Soils

Treatment technology	Suitable for dioxin treatment	Implementation status	Australian experience	Mass destruction efficiency**	Indicative costs $A/tonne soil****	Comments/limitation
Bioremediation	Problematic (not viable at the levels present on the Lednez Site)***	Laboratory	No	–	–	Micro-organisms for dioxin treatment have been identified however there is insufficient information available at present on effectiveness
Base catalysed Dechlorination (BCD)	Yes	Commercial	Yes	99.9999%	5,000***	Requires pre-treatment for soil
Gasification (fluidised bed)	Not tried	Commercial	No	–	–	
Incineration	Yes	Commercial	Yes*	91–99.9999%	200–1,000***	
Molten media						
Molten metal	Yes	Bench	No	99.999–99.9999%	370	Plus capital costs
Molten sag	–	Bench	No	–	–	
Molten salt	–	Commercial	No	–	1,200–2,000	Cost for 1,000 kilograms per hour
Plasma arc	–	Commercial	Yes	>99.99%	1,500-2,000	Volatile metals and products of incomplete combustion may be generated. Requires pre-treatment for soils.
Solvated electron	–	Bench	No	–	300–400	Polychlorinated Biphenyls contaminated soils
Stabilisation/ solidification	–	Commercial	Yes	–	–	
Supercritical water oxidation	Yes	Research	No	99.9999%	200–250	Information costs (United States)
Thermal desorption	Yes	Commercial	Yes	98–99.9%	100-1000	
Vitrification	Yes	Commercial	Yes	99.9999%	–	

Notes:
- * Not known to be used for contaminant destruction
- _ unknown
- ** Costner et al (1998)
- *** information provided by Thiess Services
- **** CMPS&F (1997)

Table 5.5 Comparison of Thermal Desorption Alternatives

Parameter	Direct/destructive	Indirect/recovery
Common design types	Rotary kiln	Rotary kiln and thermal screw
Maximum soil temperature (degrees Celsius)	800	500
Contaminant concentration	Less than 2 to 4 percent	Less than 40 percent
Contaminant fate	Destroyed onsite in afterburner	Captured on-site. Separate destruction step required
Heat transfer	Direct – efficient	Indirect – inefficient
Processing rate (tonnes per hour)	30 to 50	5 to 20
Cost per tonne for greater than 50,000 tonnes (dollars)	100	200
Potential emission rate		
Difficult organics	Low	Very low
Dioxins	Low	Very low
Particulates	Very low	Very low
Carbon monoxide	Very low	Very low
Total hydrocarbons	Very low	Very low
Process residuals for off-site disposal or additional treatment.	None	High
Cost	Moderate	Moderate to high

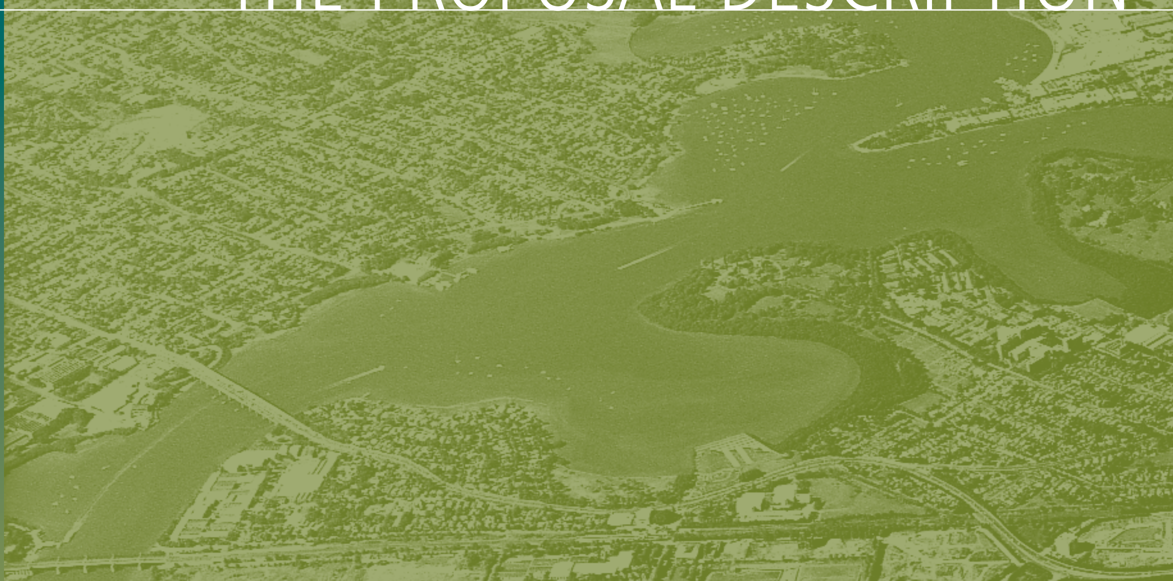
1. Troxler, 2001
2. Thiess Services

Part C

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

THE PROPOSAL DESCRIPTION

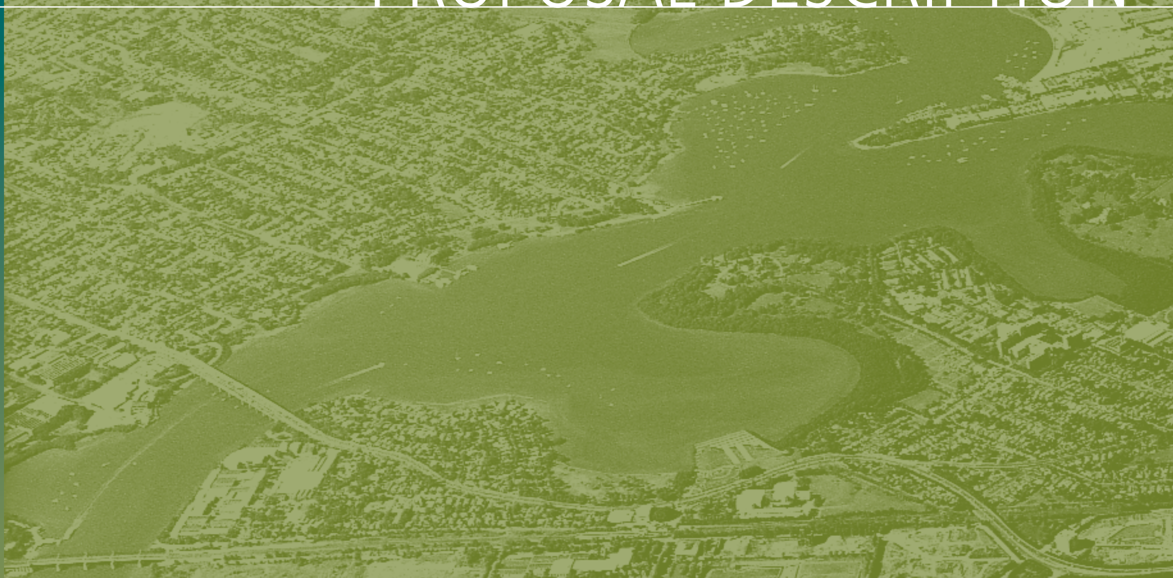


Chapter 6

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

PROPOSAL DESCRIPTION



Chapter 6 PROPOSAL DESCRIPTION

This chapter describes the works required for the remediation of Homebush Bay and the adjacent Lednez site. It provides details on the activities associated with the bay and Lednez site remediation and the environmental protection measures built into the proposal to minimise potential impacts to the surrounding environment. This proposal is the basis on which environmental impacts have been assessed, in accordance with the requirements of Part 4 of the *Environmental Planning and Assessment Act, 1979*. Alternatives to the proposal are addressed in **Chapter 5** and have been assessed in a literature review presented in **Technical Paper 8**.

Detailed validation procedures proposed for both the land and the bay are described in the remediation action plans presented in **Technical Paper 7**.

6.1 Proposal Overview

The proposed remediation would be conducted in stages. Key activities include:

- earthworks required to excavate, stockpile and classify contaminated material from Homebush Bay and the Lednez site
- treatment of material with contaminant concentrations above site soil criteria
- beneficial reuse of material to reinstate the former Lednez site to levels suitable for future residential development.

Information regarding material characteristics and contaminant concentrations has been used to categorise the excavated material into the following broad categories:

- Category 1: contaminated treatment material
- Category 2: geotechnically limited regrade
- Category 3: general application regrade.

Treatment is proposed for material classified as Category 1 material. A large proportion of Category 1 materials would comprise spent lime sludges and sediments. Materials classified as Categories 2 or 3 are suitable for reinstatement on-site without treatment. Category 2 material would comprise soft material including sediments, spent lime sludges and clay and is considered unsuitable from a geotechnical point of view for use in areas designated for residential development due to its limited load-bearing capacity. Accordingly, this material would be placed in open space areas and under roads, in accordance with appropriate engineering standards. Category 3 materials would comprise soil, rock and crushed masonry that could be placed and compacted to produce a sound and stable landform. These materials would be used where structural soundness is required, for example, beneath basement areas for future residential development.

6.2 Proposal Staging

The works would be staged to enable progressive completion and handover of remediated areas. In total there would be four remediation stages, and four progressive land releases following EPA-accredited auditor sign off. The indicative land release schedule is outlined in **Section 6.4**.

Stage 1 is directly related to Portion 1 and would encompass all of the works required to complete the bay and foreshore strip remediation. Stages 2 to 4 would involve the land remediation works and are collectively referred to as Portion 2.

It is expected that the remediation works would take up to five years to complete with Stages 1 to 4 scheduled as shown in **Table 6.1**. The timing presented is indicative and is dependent on the requirement for the EPA-accredited site auditor to sign off of each particular stage.

Table 6.1 Remediation Schedule

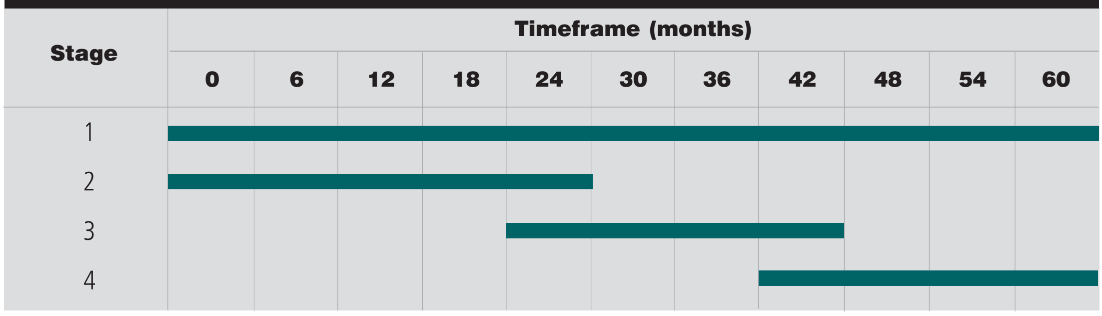


Table 6.2 summarises the key work components and the indicative timing of each stage. **Figures 6.1, 6.2, 6.3** and **6.4** illustrate Stages 1 to 4 respectively.

Table 6.2 Key Work Components and Timing

Portion	Stage	Approximate timing	Key work components
1	1	0 to 60 months	Site establishment including the relocation of local services currently traversing the site and the establishment of utility services. Staged coffer dam construction and dewatering. Excavation of coffer dam construction material from the Lednez site. Construction of haul road within coffer dam adjacent to the seawall between the Meriton site and Homebush Bay. Lednez seawall removal. Excavation, dewatering and reinstatement of area known as Portion 1. Stockpiling and classification of excavated marine sediments on Lednez site. Establishment and operation of water treatment plant and associated water management measures. Reinstatement of new seawall and removal of coffer dam. Progressive installation and maintenance of environmental controls.

Table 6.2 Continuation

Portion	Stage	Approximate timing	Key work components
2	2	0 to 24 months	Demolition of derelict buildings on the site. Ongoing operation of water treatment plant and associated water management measures. Ongoing installation and maintenance of environmental controls. Excavation, stockpiling and classification of Stage 2 materials. Reclassification of treated material. Validation of excavations and reinstatement with suitable material. Establishment and operation of pre-treatment building. Thermal treatment plant establishment, commissioning and operation.
2	3	24 to 42 months	Ongoing operation of water treatment plant and associated water management measures. Ongoing installation and maintenance of environmental controls. Excavation, stockpiling and classification of Stage 3 materials. Thermal treatment plant operation. Pre-treatment building operation. Reclassification of treated material. Validation of excavations and reinstatement of Stage 3 with suitable material.
2	4	42 to 60 months	Ongoing operation of water treatment plant and associated water management measures. Ongoing progressive installation and maintenance of environmental controls. Excavation, stockpiling and classification of Stage 4 materials. Thermal treatment plant operation. Pre-treatment building operation. Reclassification of treated material. Validation of excavations and reinstatement of land with suitable material. Decommissioning and validation of thermal and water treatment plant footprint.

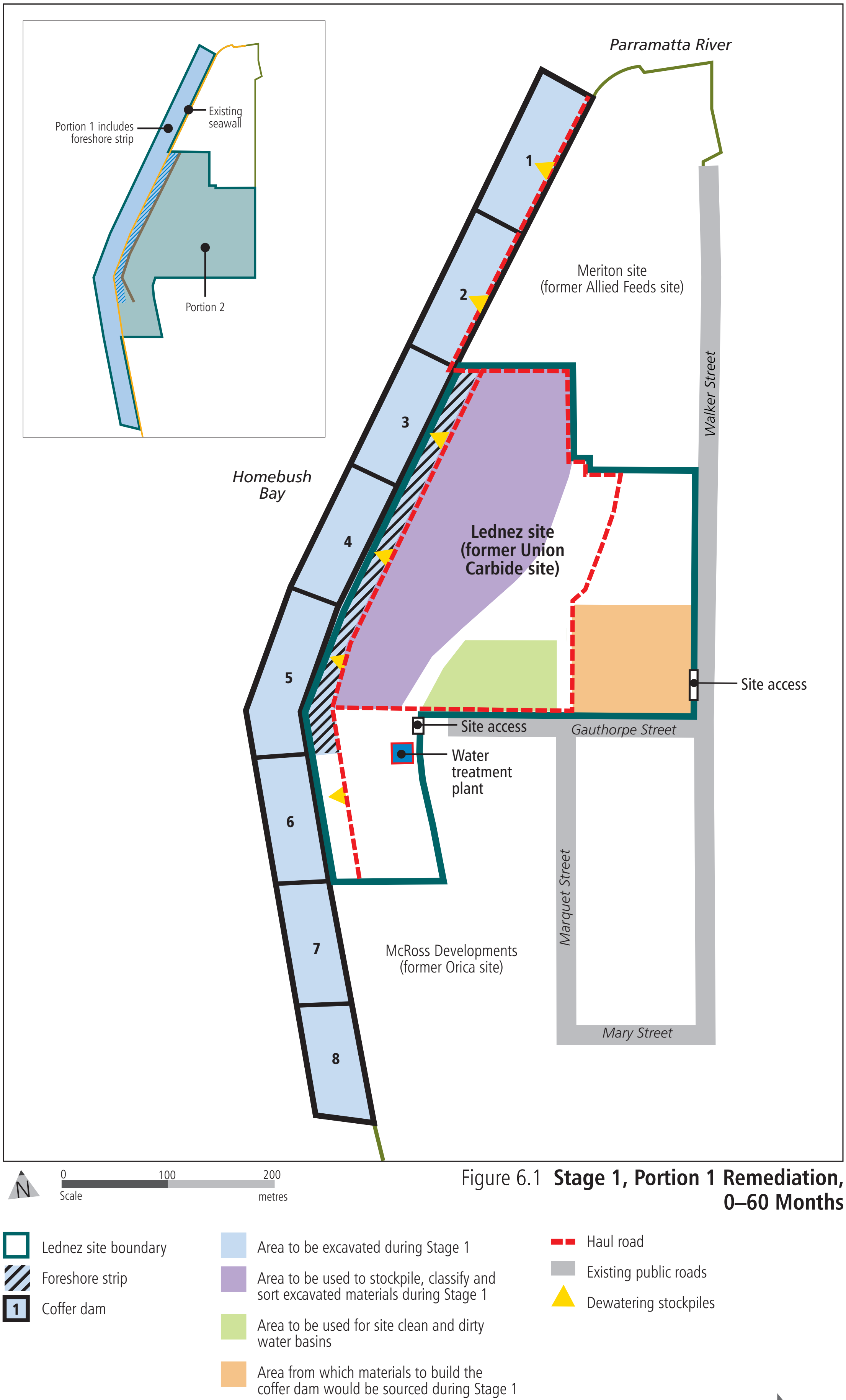


Figure 6.1 **Stage 1, Portion 1 Remediation, 0–60 Months**

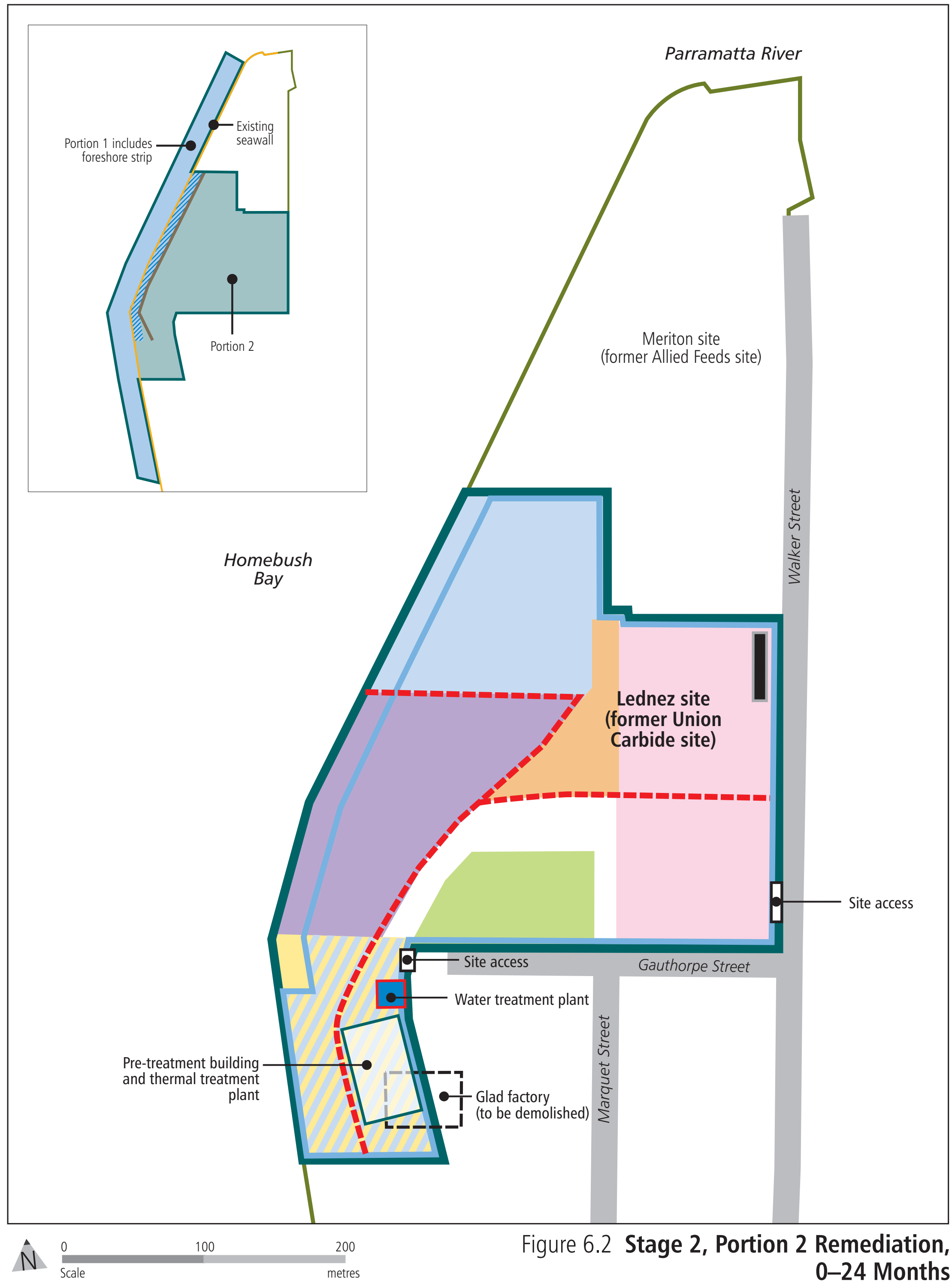


Figure 6.2 **Stage 2, Portion 2 Remediation, 0–24 Months**

- Lednez site boundary
- Portion 2 boundary
- Existing building to be demolished
- Area which may be used to stockpile regrade material
- Area to be excavated during Stage 2
- Area to be used to stockpile, classify and sort excavated materials during Stage 2
- Areas to be used for site clean and dirty water basins
- Area from which regrade materials would be sourced during Stage 2. This is also known as the regrade borrow pit
- Early in Stage 2, this area would be excavated to remove material from beneath the footprint of the pre-treatment building and the thermal treatment plant
- Area to be used to stockpile materials prior to treatment
- Haul road
- Existing roads

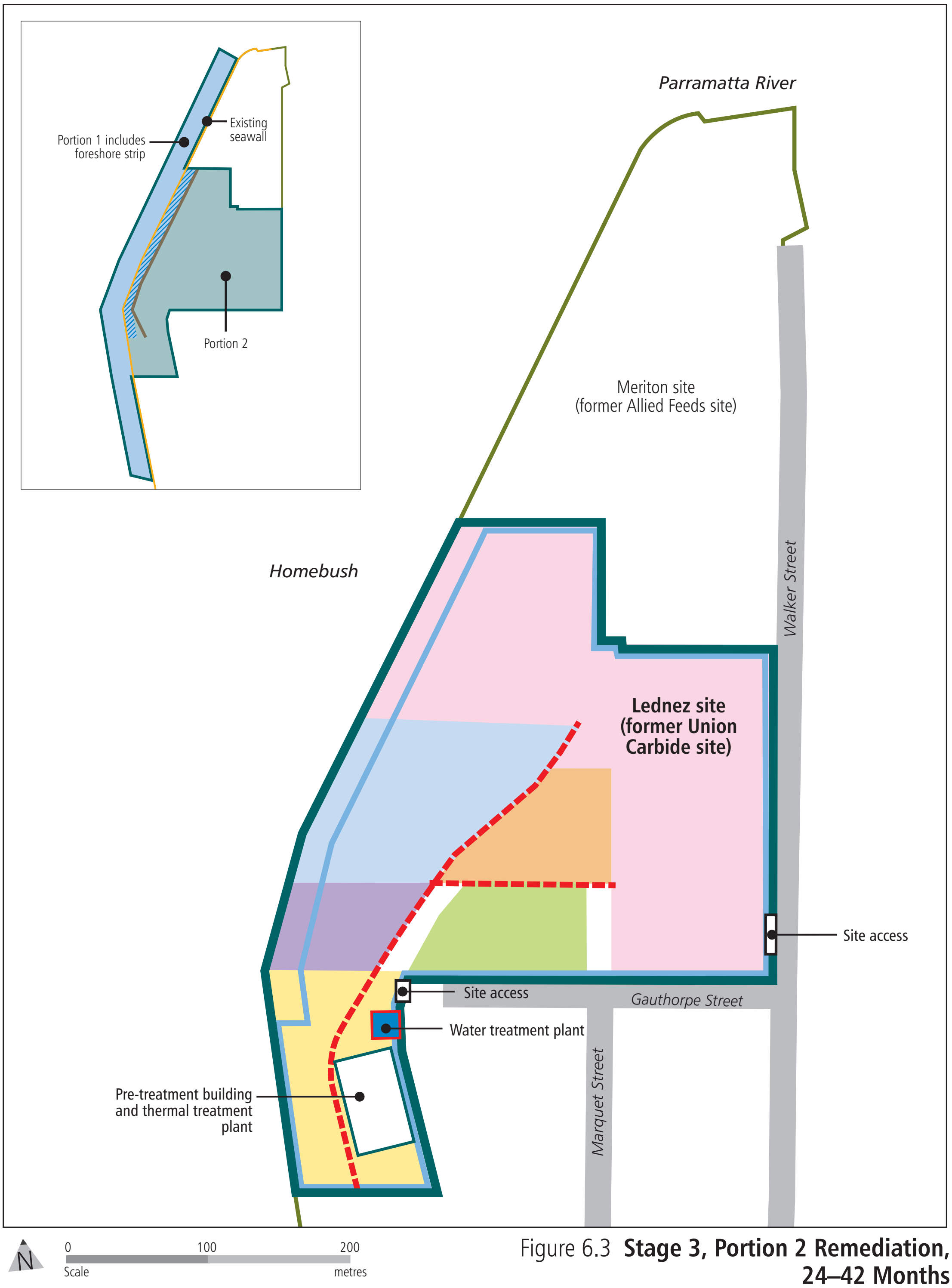


Figure 6.3 **Stage 3, Portion 2 Remediation, 24–42 Months**

- Lednez site boundary
- Portion 2 boundary
- Area which may be used to stockpile regrade material
- Area to be excavated during Stage 3
- Area to be used to stockpile, classify and sort excavated materials during Stage 3
- Areas to be used for site clean and dirty water basins
- Area from which regrade materials would be sourced during Stage 3. This is also known as the regrade borrow pit
- Area to be used to stockpile materials prior to treatment
- Haul road
- Existing roads

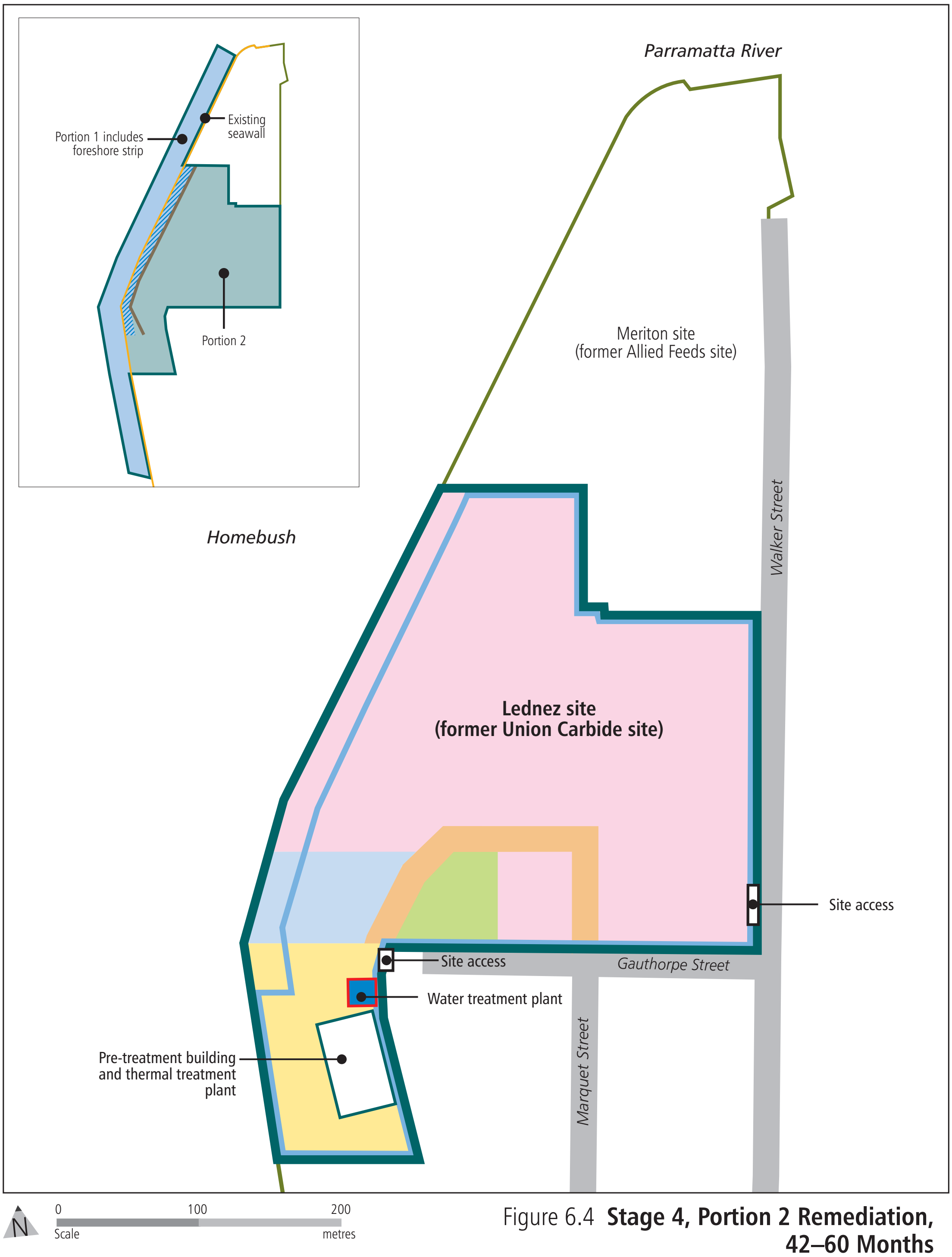
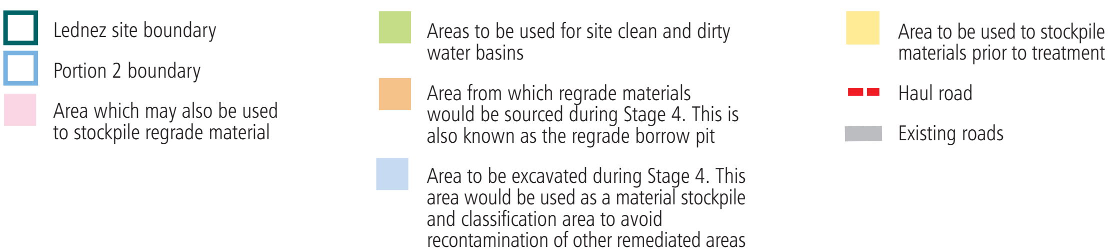


Figure 6.4 **Stage 4, Portion 2 Remediation, 42–60 Months**



6.3 Bay Remediation (Portion 1 Works)

6.3.1 Site Establishment

Most of the site establishment activities would be undertaken at the beginning of Stage 1. However, some would be ongoing and undertaken concurrently with other works during Stages 2 to 4. The following site establishment works would be undertaken in Stage 1:

- establish site entry, security fencing and staff amenities
- connect electricity and water supply
- construct internal roadways
- establish erosion and sedimentation control measures including water diversion drains, sediment fences and sprinkler systems
- construct and install water retention basins and water treatment plant
- relocate existing services.

6.3.2 Coffer Dam Construction and Dewatering

To isolate the sediments to be excavated from Homebush Bay and to facilitate a "dry" excavation process, up to eight coffer dams would be constructed in stages along the foreshore to enclose the area to be remediated (see **Figures 6.5** and **6.6**). The coffer dams would be constructed from low-permeability Category 3 materials taken from the Lednez site. This material would be selected to have low permeability to limit the flow of water from the bay into the dam. This material would have sufficient structural capacity to ensure that the dam can support plant and equipment.

Each coffer dam would enclose an area of approximately 150 metres by 60 metres. This would enable the removal of sediment to a distance of approximately 45 metres off-shore from the current seawall location. Subject to the timing of the remediation works on the adjacent Meriton site, the first two coffer dams would be constructed to the north of the boundary between the Lednez and Meriton sites. Coffer dams three to six would be constructed next and would be followed by the construction of coffer dams seven and eight to the south of the boundary between the Lednez and Orica sites. Ultimately, the construction schedule of the coffer dams would need to be scheduled in a way that best suits the remediation and redevelopment of all three sites.

The detailed construction sequence of each dam would be such that during construction of a coffer dam, the end wall of the proceeding coffer dam would be enclosed within its' confines, allowing the removal of sediments from beneath the end walls.

Each coffer dam would be approximately 3.5 metres high, with a width of approximately five metres at the top and 11 metres at the base. The coffer dams numbered one, two, seven and eight would be configured slightly differently to those numbered three to six. This would accommodate the installation of a haul road on the bay side of both the Meriton and Orica seawalls. The two coffer dam cross-section configurations are given in **Figures 6.7** and **6.8**. These show a typical section of a coffer dam, the area to be excavated and the environmental controls to be deployed.

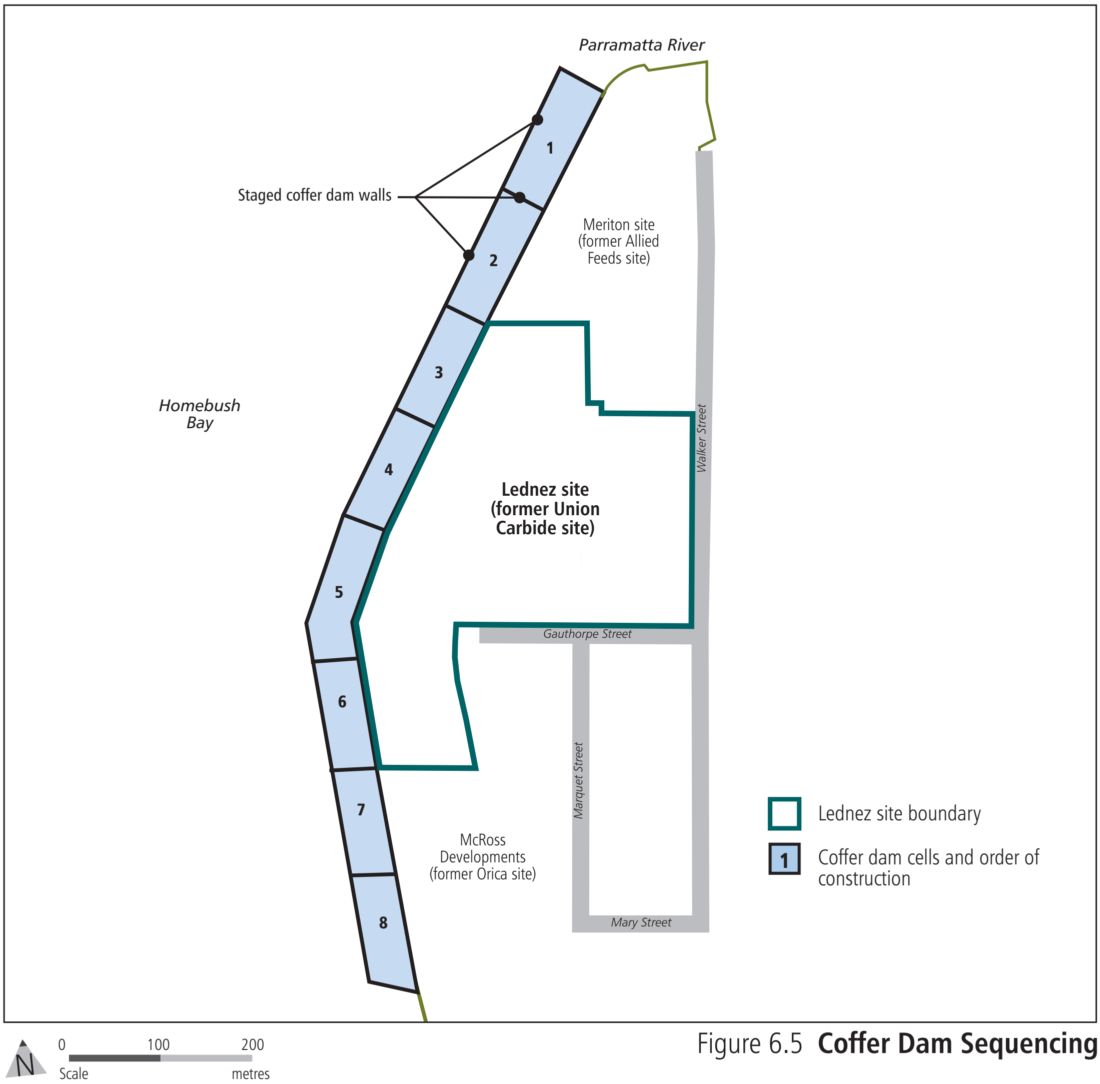
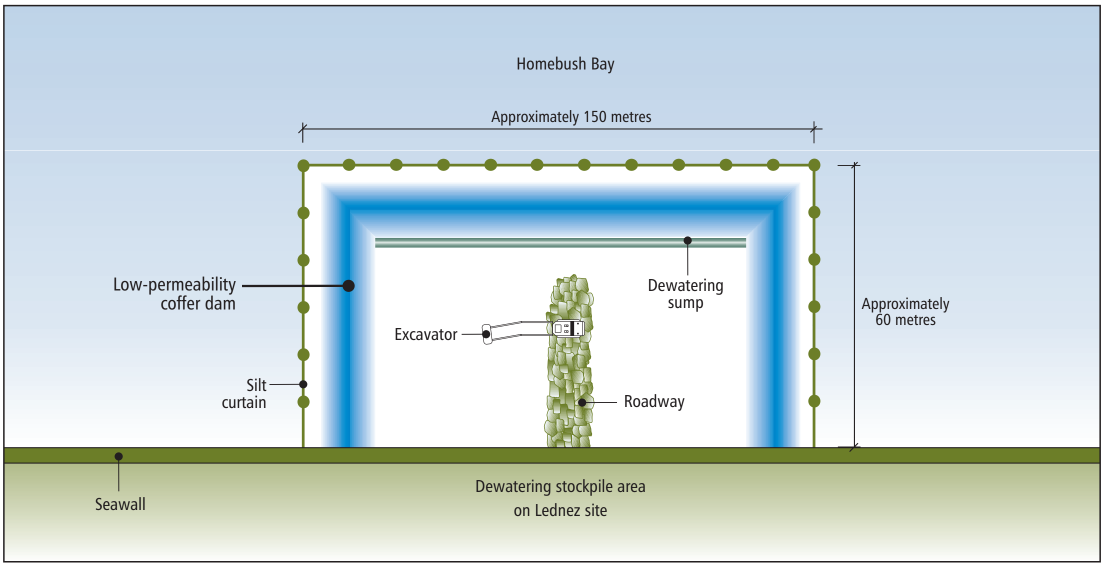


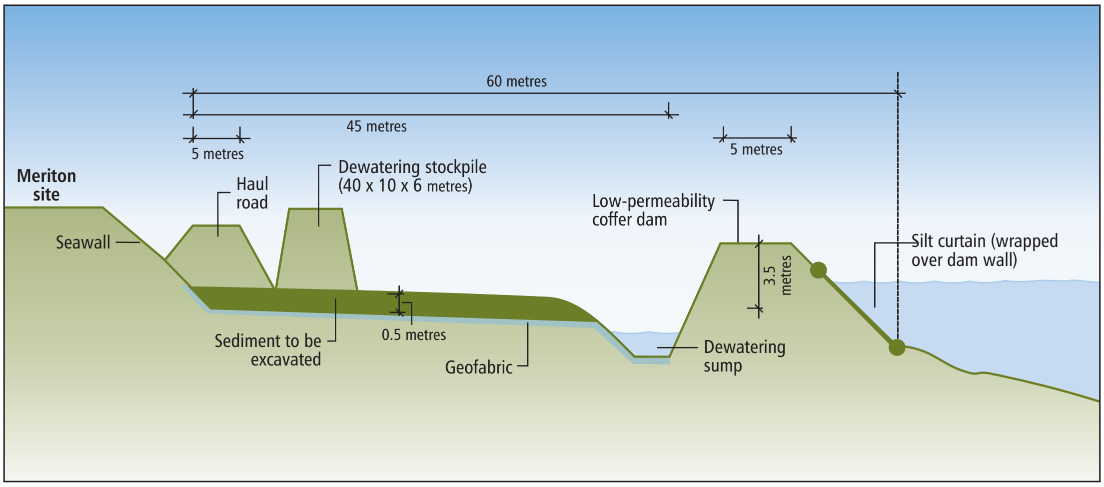
Figure 6.5 **Coffer Dam Sequencing**



Not to scale

Figure 6.6 **Typical Coffer Dam Layout**

Note: All measurements are approximate.

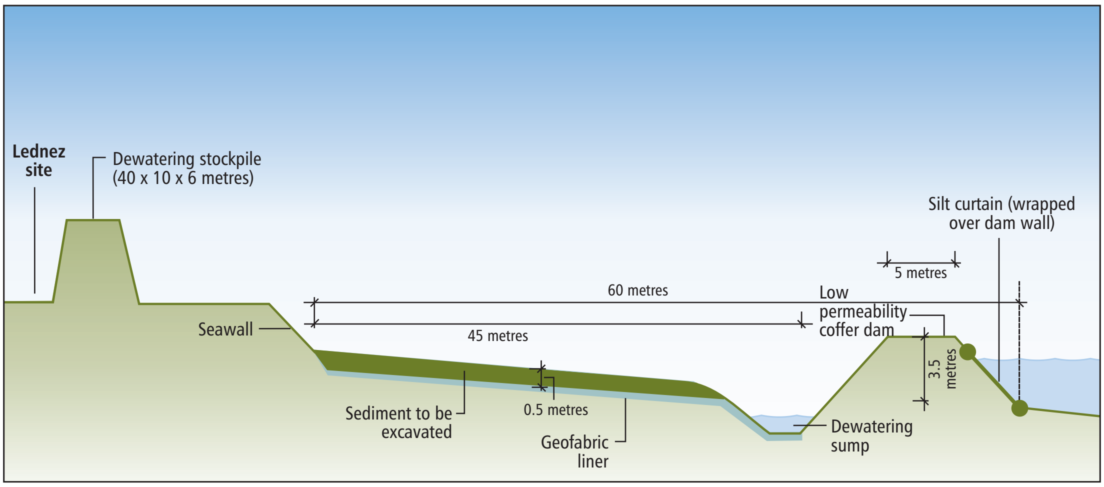


Not to scale

Figure 6.7 **Typical Coffer Dam Cross-section for Dams 1, 2, 7 and 8**

Notes: Haul road to be located next to the seawall in the bay. Excavated material to be stockpiled in the coffer dam cell for dewatering.

All measurements are approximate.



Not to scale

Figure 6.8 **Typical Coffer Dam Cross-section for Dam 3 to 6**

Notes: Silt curtain anchored to the bottom of coffer dam during its construction. After the coffer dam has been constructed, the curtain would be wrapped over it.

All measurements are approximate.

Coffer dams would be constructed by end-tipping soil from dump trucks and spreading it by bulldozer. Each coffer dam would be closed at low tide to minimise the volume of water trapped in the dam. The area enclosed by each coffer dam would then be dewatered to facilitate the excavation of sediment in a dry and isolated environment.

During the construction of the coffer dam wall, a silt curtain would be anchored to the bottom of the coffer dam on the bay side and held at the surface by a floating boom (see **Figure 5.1**). After completion of the coffer dam structure, the silt curtain would be wrapped over the bay side of the dam to minimise scouring. Further detailed discussion on the coffer dam wall is provided in **Technical Paper 8**.

The dewatering of each coffer dam would be undertaken to reduce the amount of water held in the sediments during excavation. This would initially involve pumping the less turbid, standing water trapped in the coffer dam into the area between the coffer dam wall and the silt curtain. The remaining water would be pumped into purpose-built water retention basins on the Lednez site. Once contained on-site, this water would be managed in accordance with site-specific water management protocols as described in **Section 6.6**.

Ongoing dewatering of the coffer dams would be undertaken as required from sumps located at low points along the coffer dam (see **Figures 6.7** and **6.8**).

6.3.3 Bay Excavation

It is unlikely that the exposed marine sediments would be able to support conventional earthmoving equipment after the coffer dams have been dewatered. Access for excavation equipment would be achieved by forming temporary roadways made of Category 3 material sourced from the Lednez site. Materials from the demolition of the existing seawall may also be suitable for use.

The access roadways would be constructed perpendicular to the seawall and extend to within approximately 15 metres of the coffer dam wall (see **Figure 6.6**). These roadways would allow long reach excavators to remove the exposed sediment enclosed by the coffer dam.

The roadways would be constructed using bulldozers to spread material tipped by articulated dump trucks.

Sediments would be excavated to a depth of 0.5 metres to a distance of 45 metres from the seawall using a 25 tonne long reach excavator. Excavated sediments in dams one, two, seven and eight would initially be stockpiled within the coffer dams adjacent to the existing shoreline to promote drainage of free water. Material excavated in dams three to six would be stockpiled for dewatering in the foreshore strip depicted in **Figure 6.1**. Excavated sediments and roadways no longer required would then be transferred to the Lednez site by articulated dump trucks and stockpiled for the purpose of classification.

6.3.4 Seawall Removal and Reinstatement

This proposal includes the removal of the seawall along the foreshore of the Lednez site. The removal of the seawall at the front of the Meriton and Orica sites is outside the scope of this proposal. As a result, sediments in front of these sites would be removed to the base of the seawall. Considering the depth of excavation is limited to 0.5 metres, stability of the seawall adjacent to the excavation is not considered to be an issue.

The present seawall in front of the Lednez site would be demolished to allow for contaminated sediments and fill located beneath and behind it and sediment enclosed within the coffer dams to be removed simultaneously. Demolition of the wall would be undertaken using a hydraulic excavator with a hammer attachment if required.

As the remediation works are completed, the seawall would be reconstructed in its current location to maintain the boundary alignment of the Lednez site. These works would occur progressively within the confines of a coffer dam.

The new seawall would use a "keystone" block design, which comprises a series of precast blocks stacked slightly offset from vertical. As shown on **Figure 6.9**, the blocks would be retained horizontally by the use of geosynthetic reinforcing straps buried in the reinstated fill on the landward side of the wall.

Where the bay works do not coincide with the adjacent Portion 2 works (that is where the bay works progress in advance of work on the land) then the seawall reconstruction would include a composite cut-off to prevent the re-contamination of the bay from seepage from the Lednez site. **Figure 6.10** depicts the cut-off design proposed. Key elements include:

- a compacted clay wall of minimum three metres thickness and permeability of less than one billionth (10^{-9}) of a metre per second
- a two millimetre thick high density polyethylene geo-membrane
- a bentonite powder base seal.

The cut-off wall would be keyed into the natural underlying alluvial clays. These materials are of low permeability.

6.3.5 Excavation Restoration and Coffer Dam Removal

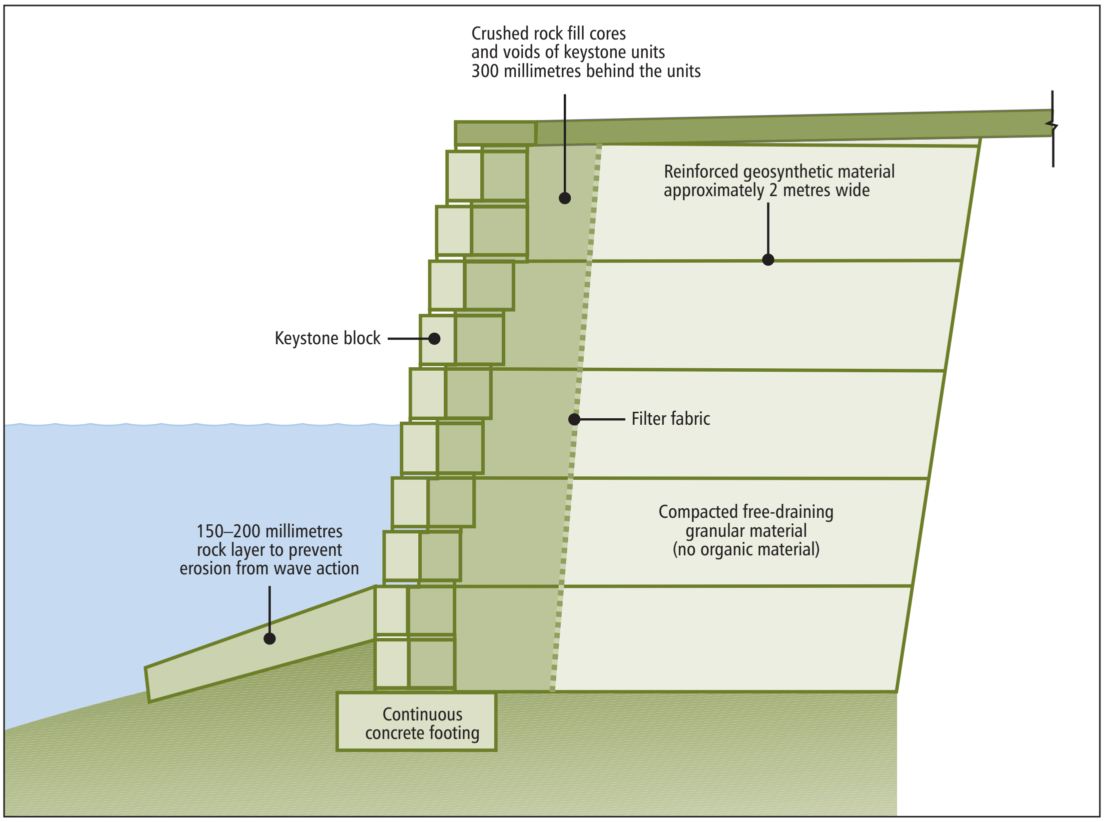
Progressively, as the final sediment excavation levels are reached in each coffer dam, the excavations would be reinstated to pre-remediation levels. Once the excavation surface has been surveyed and sampled a geo-fabric would be laid down. The subsequent backfill materials would be primarily sourced from the coffer dam wall materials. Ultimately all reinstatement materials would be sourced from the Lednez site and would be subject to testing to confirm that the materials meet the reinstatement material criteria prior to use.

Trial plots using different replacement substratum would be established using material sourced from the Lednez site. The trial of different substratum plots to replace the excavated sediments forms the first part of an ongoing research project to be conducted by the Centre for Research on Ecological Impacts on Coastal Cities. The research project has been designed to examine how different substratum materials impact on the diversity and rate of re-colonisation of benthic organisms. This study has been developed in consultation with NSW Fisheries and the Waterways Authority. These trial plots would utilise a portion of the coffer dams area along the front of the Lednez site.

After reinstatement of sediments is complete, the remaining portions of the coffer dam would be removed. Coffer dam materials would be progressively reused in the construction of subsequent dams or taken onto the Lednez site for use in accordance with the site criteria.

6.3.6 Classification and Treatment of Excavated Sediment

Excavated sediments would be transferred to the Lednez site by articulated dump trucks and stockpiled for the purpose of classification. For coffer dams one, two, seven and eight, it is anticipated that the sediments would be transported along a haul road constructed in front of the Meriton and Orica sites and then on to the Lednez site for stockpiling before being classified. Once sediment has been stockpiled and classified as either Category 1, 2 or 3, it would be incorporated into the Portion 2 remediation works as discussed in **Section 6.4**.



Not to scale

Figure 6.9 **Detailed Design of New Seawall**

All measurements are approximate.

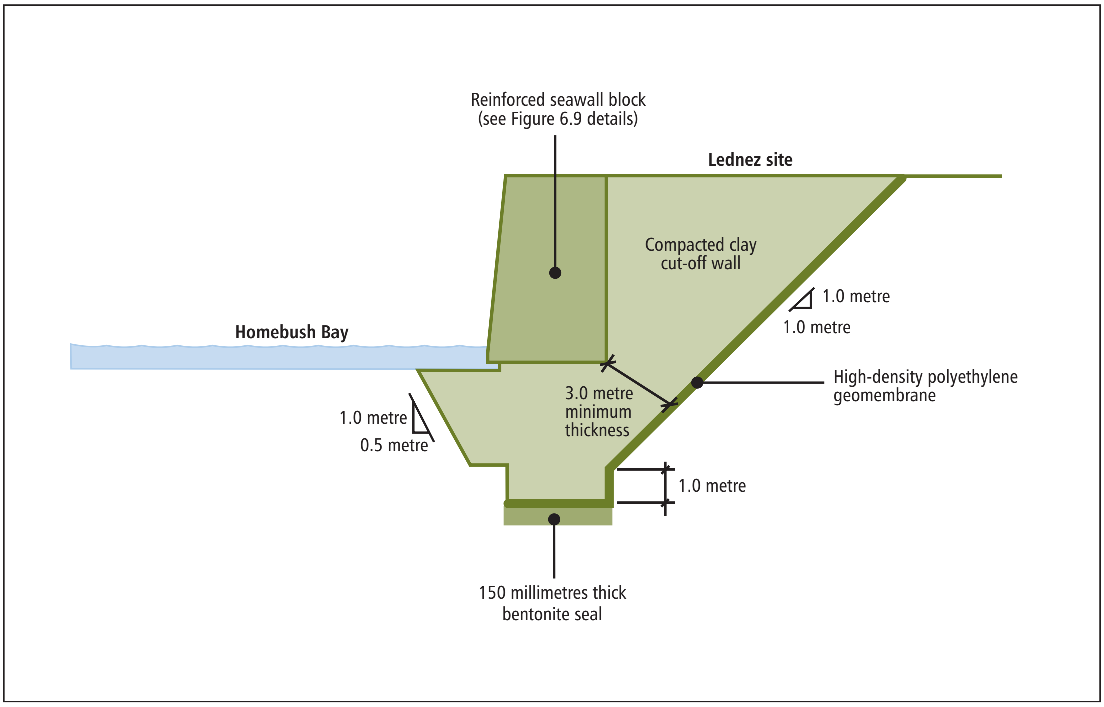


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Figure 6.10 **Detailed Design of Compacted Clay Cut-off Wall with Bentonite Seal**

All measurements are approximate.

6.3.7 Excavation of Contaminated Foreshore Strip

Whilst it is part of the Stage 1 works, the excavation of the 15 metre strip of contaminated foreshore that runs along the seawall would be managed in the same manner as that applied to the remainder of the Lednez site (see **Figure 1.3**). Further detail on the approach for this strip is provided in **Section 6.4** in the discussion of excavation and stockpiling of Portion 2 materials.

6.4 Lednez Site Remediation (Portion 2 Works)

The excavation and treatment of contaminated soil from the Lednez site would be undertaken in Stages 2 to 4. These stages have been arranged so that the works would generally proceed from north to south.

There are two advantages to this approach:

- it would allow for site works to be managed so that the contaminated and uncontaminated areas are kept distinctly separate. The uncontaminated areas are shown in **Figures 6.2** to **6.4** as pink. This assists in the application of environmental and occupational health and safety controls whose requirements vary between contaminated and remediated areas
- it would allow for land to be released for development as it is certified suitable by the Auditor while maintaining a buffer between future development works and ongoing remediation works. This buffer area is also used to store regrade materials (shown as pink on **Figures 6.2** to **6.4**).

Figures 6.2 to **6.4** illustrate Stages 2 to 4 respectively for the key work components listed in **Table 6.2**. The key work components to be undertaken as part of the Portion 2 works are described below.

6.4.1 Demolition of Existing Structures on the Site

A licensed demolition subcontractor would be commissioned to undertake the site demolition works and to remove asbestos material contained in structures on the site. The works associated with demolition would include removal of:

- the masonry facade of the former Lednez offices including the existing two- and three-storey building facing Walker Street
- the partial demolition of the former Glad factory which encroaches on southern reclamation areas.

It is anticipated that most of the material resulting from the demolition would be uncontaminated and suitable for recycling and use on-site. Any materials containing asbestos would be transported to and disposed of at a landfill licensed to receive asbestos.

6.4.2 Excavation and Stockpiling of Category 1, 2 and 3 Materials

The process for excavating, handling and processing material that is excavated from the Lednez site is outlined in the materials flow diagram in **Figure 6.11**. The sediments excavated from the bay are also included in this process as these would be managed in the same manner as the Lednez soils once they are moved onto the Lednez site.

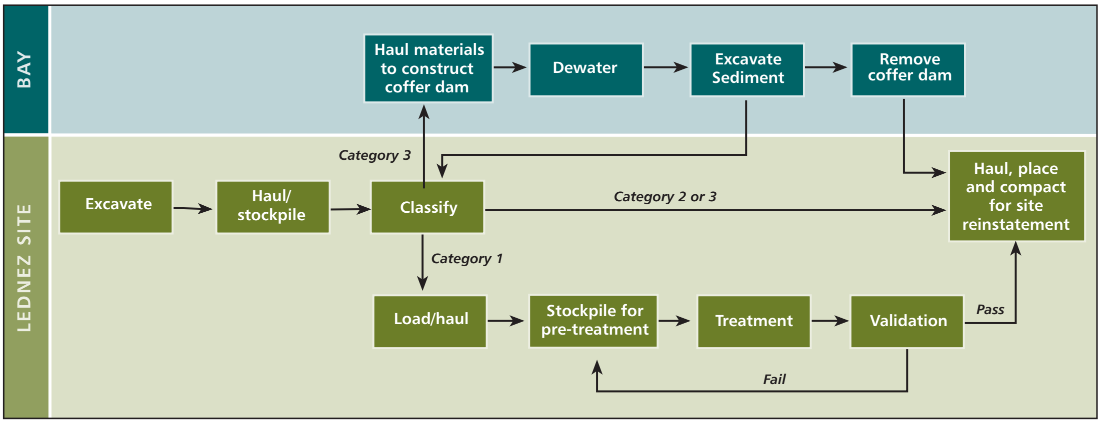

Figure 6.11 **Materials Flow Diagram**

Before excavation activities began, a pre-excavation assessment would allow the implementation of the following site management practices:

- application of appropriately sized equipment to each work area
- excavation of material according to current and predicted weather conditions
- consolidation of like material for either treatment or site restoration.

Excavations would extend vertically to underlying natural materials and where required into the natural materials as required to meet the soil acceptance criteria.

A total of approximately 630,000 cubic metres of rock and reclamation material would be excavated as part of the remediation works, with up to approximately 2,100 cubic metres of material being excavated daily. **Table 6.3** provides an upper estimate of the volume of material to be excavated daily within each category.

Table 6.3 Daily Material Excavation

Category	Description	Volume per day (cubic metres)
1	Contaminated treatment material	300
2	Geotechnically limited regrade (GLR)	800
3	General application regrade (GAR)	1,000
	Total	**2,100**

Throughout the excavation period there would be disturbance to a variety of material categories. Each of these materials would have the following specific critical handling issues associated with them:

- contamination levels
- moisture content
- particle size
- odour generating potential
- secondary handling requirements.

Materials would be excavated and stockpiled to enable classification. Category 2 materials would be used as backfill to reinstate excavations in open space areas and at depth under roadways. Category 3 materials would be used to reinstate areas designated for residential development. Category 1 materials would be treated by thermal desorption and then reclassified as either Category 2 or 3 material and dealt with accordingly. Equipment to be used to excavate and haul materials would include tracked excavators, articulated dump trucks, a range of bulldozers to rip rock and maintain stockpiles, graders for haul road maintenance and water carts for dust control.

Wet fill and reclamation material that is excavated would be temporarily stockpiled next to the excavation area on the up-gradient side. A temporary diversion drain and bunding would be located on the down-gradient side of the stockpiled material. This stockpiling arrangement would allow fluids to drain out of the stockpiled material and back into the excavation.

Category 1 excavated fill requiring treatment would be transported from the excavation area to an outdoor pre-treatment stockpile area next to the enclosed pre-treatment building. These materials would be stockpiled in high-density polyethylene-lined containment areas with perimeter bunds and high-density polyethylene covers (see **Figure 6.12**).

Most of the materials likely to require treatment have been identified in previous characterisation investigations. Further information on these investigations is presented in **Technical Paper 4**.

The pre-treatment stockpiling area would have stockpiling capacity for four stockpiles. The likely dimensions of these stockpiles would be approximately 100 metres by 60 metres wide by six metres high.

After treatment, materials would be stockpiled for reinstatement on-site. A water cart would be used to dampen the treated material stockpiles to avoid generation of dust. Surface water control measures would consist of silt fencing and diversion drains.

6.4.3 Excavation at Lednez Site Boundaries

Due to the nature of some of the materials present at the Lednez site boundaries, there may be a need to prevent cross-boundary migration of contaminants into previously remediated areas, and to provide structural support.

To this end, it is proposed to install a vertical steel sheet pile wall along those boundaries as shown in **Figure 6.13** before commencing excavation. The piles would be driven from the surface and keyed into the underlying natural clays and bedrock. As excavation progresses, soil anchors would be installed to maintain stability. During backfilling activities, a three metre wide wall of low permeability clay would be placed along the subject boundaries prior to removal of the sheet pile wall. This would prevent cross boundary contamination following the Lednez remediation works. The sheet pile would be removed at completion of backfilling activities.

6.4.4 Establishment and Operation of Pre-treatment Building

Pre-treatment of Category 1 material would be conducted inside an enclosed building to accomplish the following objectives:

- minimise fugitive dust and odour emissions
- minimise noise emissions
- prevent rainfall from contacting contaminated material
- limit visual impacts resulting from pre-treatment operations.

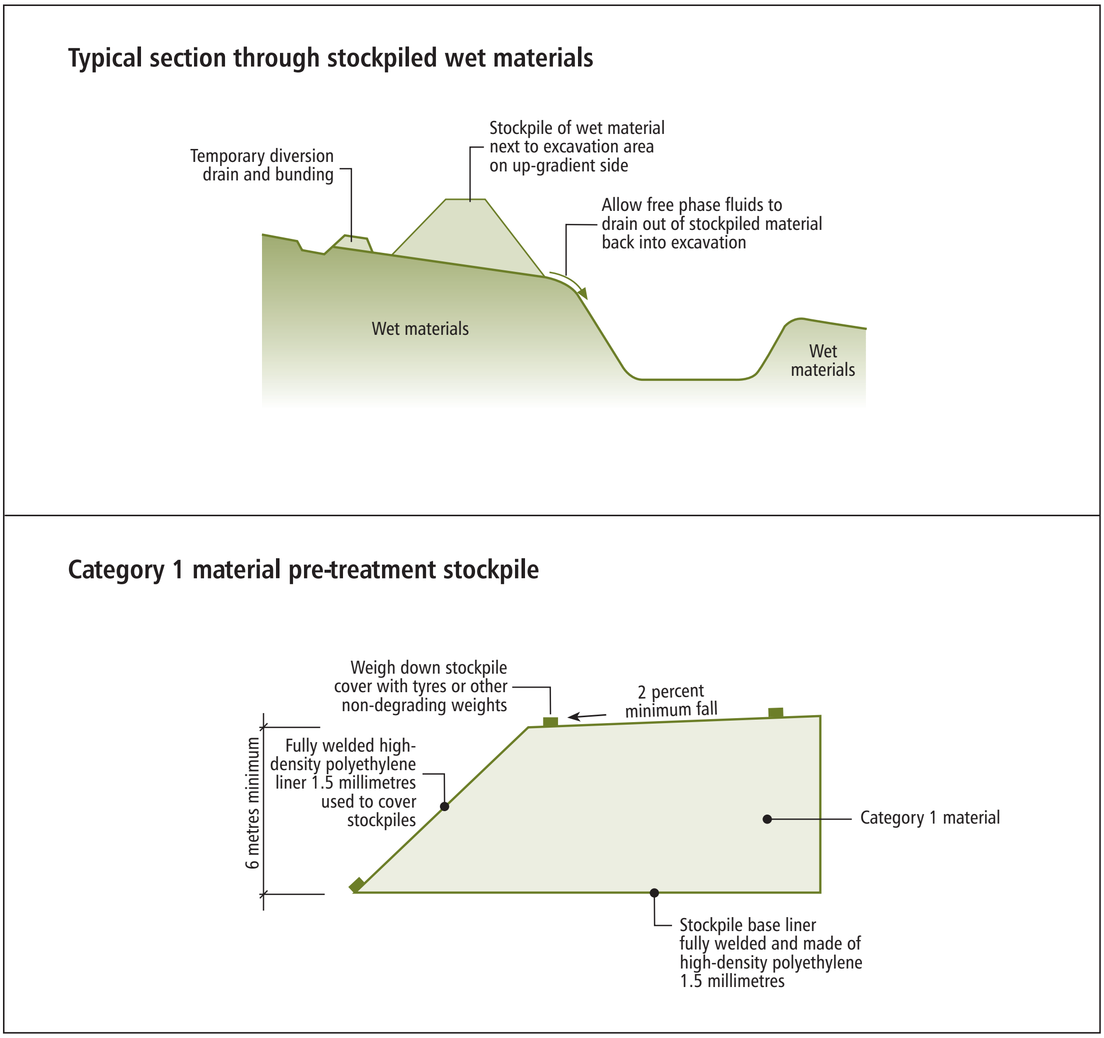

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Figure 6.12 **Stockpile Management**

The pre-treatment building would be used to unload, sort, pre-treat, store and feed contaminated soil to the thermal treatment plant. Soil pre-treatment operations that would be conducted inside the building include screening, dewatering, drying, blending, storing and loading the feed hopper of the thermal treatment plant. **Figure 6.14** shows the typical layout of the pre-treatment building, the thermal treatment plant and the post-treatment storage area.

The pre-treatment building would be constructed of a steel frame with metal sheeting. The building would be approximately 70 metres long, 40 metres wide, 10 metres high at the walls and 12 metres high at the centre line. It would include doors, lights, electrical and other ancillary facilities that are required for safe and efficient operation. All walls and building entrances would be constructed to prevent rainfall entering the building.

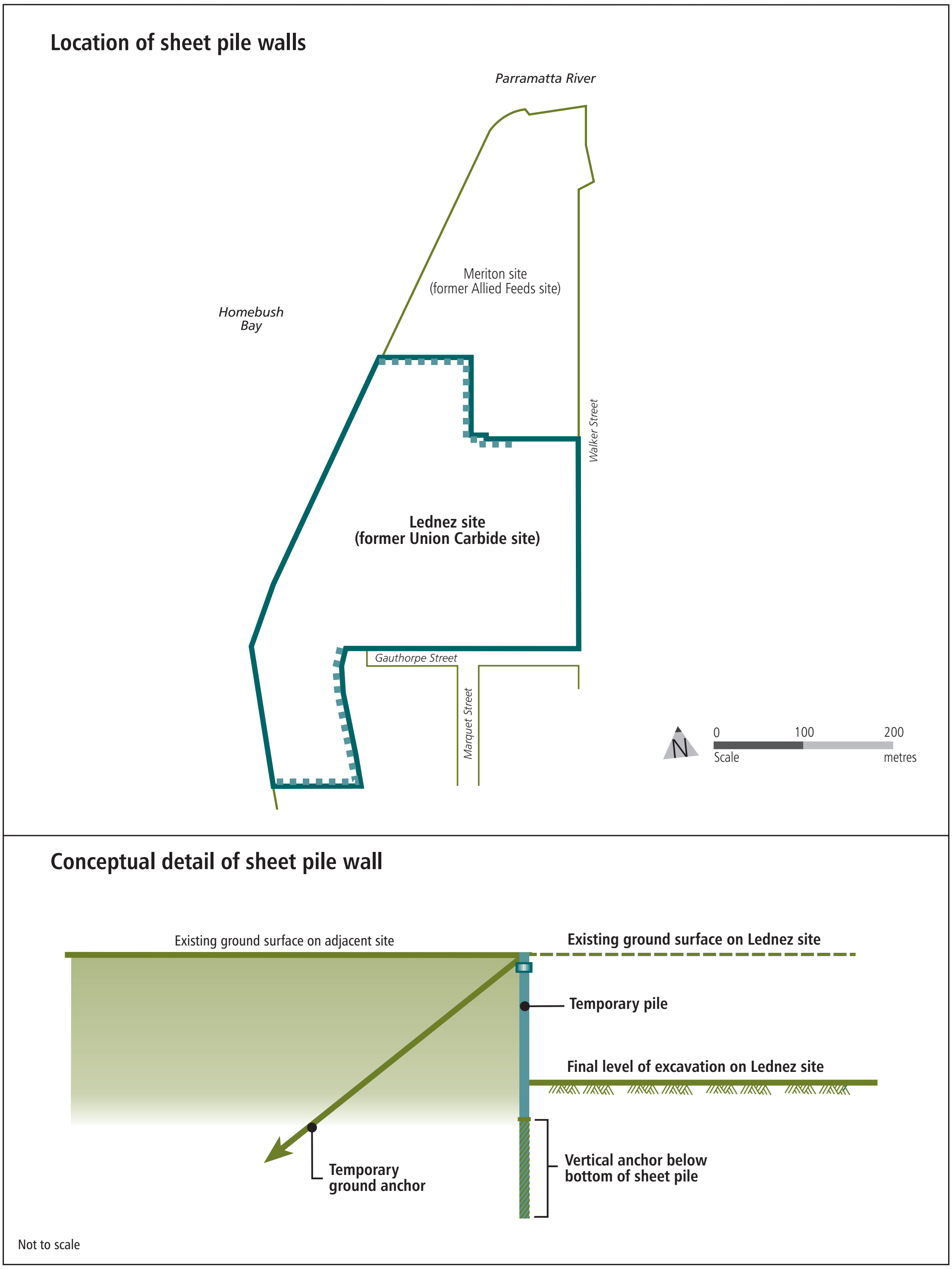


Figure 6.13 **Location and Detail of Sheet Pile Wall**

▪▪ Sheet pile wall

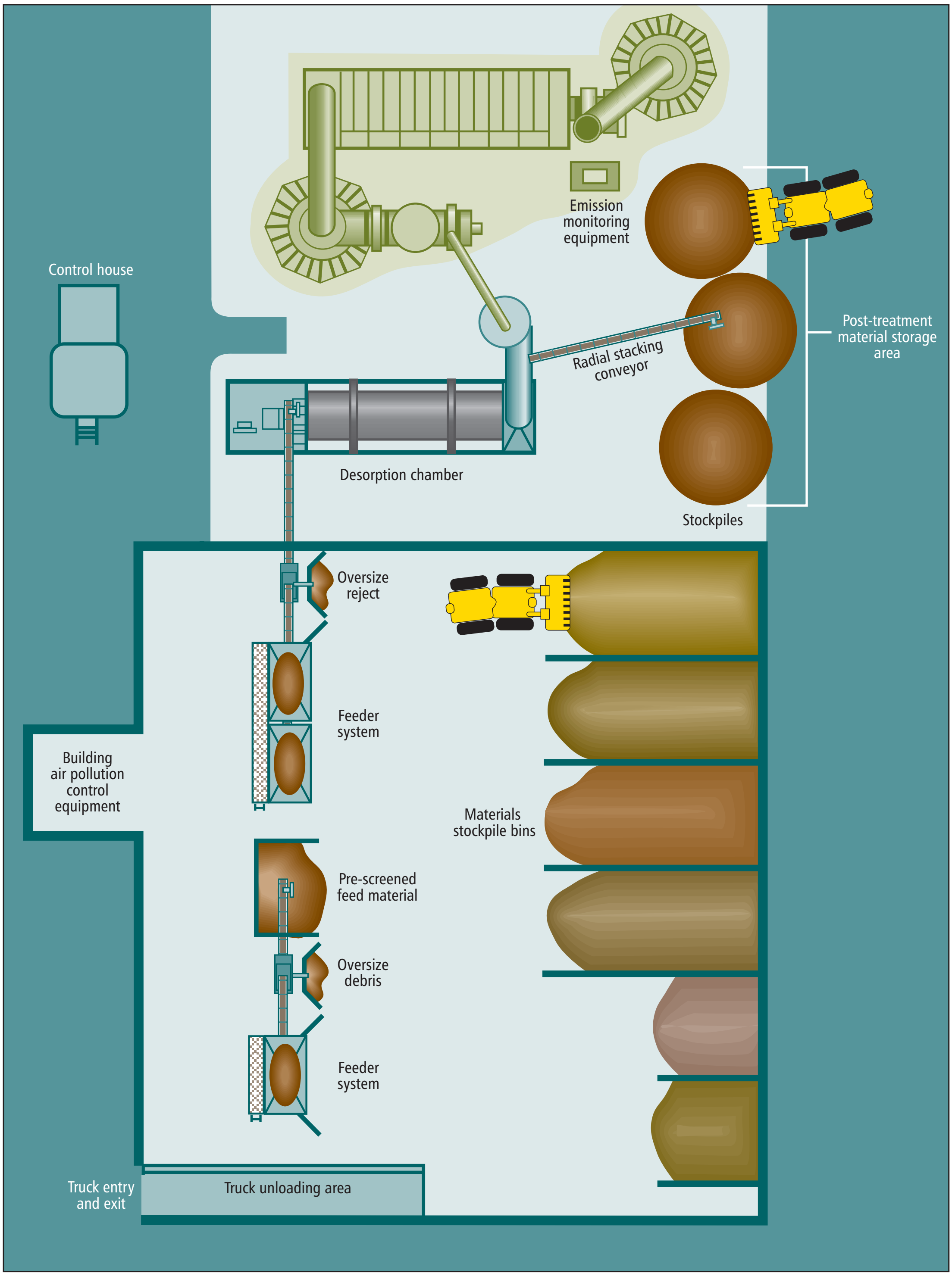


Figure 6.14 **Schematic Layout Plan of Pre-treatment Building and Thermal Treatment Plant**

Building walls

Vapour/liquid and air pollution control system

Capacity

The pre-treatment building would be constructed to contain a seven-day working inventory of feed soil (approximately 2,100 cubic metres). This inventory volume is designed to provide adequate storage capacity to feed the thermal treatment plant during periods when weather conditions interfere with normal excavation activities.

Unprocessed soil would be stored in bins. Approximately four to six bins would be used to segregate untreated materials with different physical and/or chemical characteristics.

Water Containment

Any water that is generated from the pre-treatment operations would be managed to prevent the water from contacting subsurface soils. The floor of the building would be constructed with an impermeable material (concrete or equivalent) that would prevent migration of contaminated liquids. The floor would be constructed with a number of sumps and drains to collect liquids. All liquids would be directed to the water treatment plant.

Building Entrances

The building would be equipped with two personnel entrances and one truck entrance. The truck entrance would include an airlock comprised of a small structure attached to the pre-treatment building. The airlock would be equipped with two doors. When a truck enters the building, the inner door would be closed and the outer door would open to allow the truck to enter the airlock. The outer door would then close, the inner door would open and the truck would enter the pre-treatment building. The procedure would be reversed when a truck exits the building.

Ventilation and Control of Fugitive Emissions

The pre-treatment building would be designed to control potential fugitive emissions of dust and organic vapours. This would be accomplished by the design, installation and operation of a building ventilation system.

The ventilation system would consist of a series of louvred openings along each side of the building, a ductwork system, induced draft fan, particulate control device, activated carbon adsorption system and stack. The ventilation system would be designed with sufficient capacity to provide a safe working environment within the building.

The purpose of the louvres is to allow fresh air to enter the building. The louvred openings would be sized to provide sufficient air exchange to prevent unacceptable concentrations of organic vapours or carbon monoxide from accumulating in the building. Each louvre would be provided with a mechanical system so that it could be manually opened and closed.

The ductwork system would consist of a central header that would be suspended along the centreline of the roof of the building. There would be hoods located along the length of the header.

The air exhausted from the building would first pass through a particulate control device such as a baghouse or pleated paper filter system to remove fugitive dust. The particulate control system would include an air pulsing system to remove particulates from the filter media. Dust removed would be collected in enclosed drums or hoppers. When the dust collection container is taken offline, the dust would be returned to the pre-treatment building for blending with the feed soil.

After the exhaust gas exits the particulate filter, it would pass through an activated carbon adsorption system. The activated carbon system would be equipped with a number of monitoring ports. A monitoring protocol would be implemented for the various ports along the activated carbon adsorption system. This protocol would form the basis for deciding when activated carbon beds need to be replaced.

Safety Equipment

The pre-treatment building would be equipped with fire extinguishers, first aid supplies, safety showers, eyewash stations and any other necessary safety equipment. Details regarding health and safety equipment would be provided in the site occupational health and safety plan.

Plant Within the Pre-Treatment Building

A rubber-tyred loader would be used to transfer material from the covered stockpiles in the pre-treatment area to the pre-treatment building. The transfer of material from the covered stockpiles to the building would commence once the treatment building had been established on-site in Stage 2.

Within the pre-treatment building a loader would be used to load a vibrating “powerscreen” used to remove oversized debris unsuitable to be fed into the thermal treatment plant. Also, a rubber-tyred loader would be used to move materials, undertake blending of materials and addition of lime if required and load the feed hopper of the thermal treatment plant.

6.4.5 Thermal Treatment Plant

Thermal treatment plant commissioning would include the following:

- establishment of electricity, natural gas and water supply for the plant
- construction of internal roadways
- establishment of the pre-treatment stockpiling area associated with the pre-treatment building
- construction of the pre-treatment building
- establishment, testing and commissioning of the thermal treatment plant
- establishment of a post-treatment stockpile area.

Material from the pre-treatment building would be treated using an indirect thermal desorption plant. Most of the plant would be located outdoors and next to the pre-treatment building (see **Figure 6.14**). All materials would be fed into the indirect thermal desorption plant from within the building to ensure that contaminated dusts and odours are contained. Treated materials would then be stockpiled in the post-treatment storage area outside the building.

The indirect thermal desorption plant would operate 24 hours a day, seven days a week. One day per week would be scheduled to enable regular maintenance to occur. The average rate of treatment through the thermal desorption plant would be approximately 15 tonnes per hour with a maximum rate of 30 tonnes per hour.

The indirect thermal desorption plant would have a footprint of approximately 25 by 30 metres. It would be established within a bunded and lined area with its own internal surface water drainage control measures. Electrical power to the thermal desorption plant would be provided by a diesel-powered generator or from the electrical grid. Mains natural gas would be used to fire the heating burners of the plant.

A schematic process flow diagram for the thermal desorption plant is shown in **Figure 6.15**.

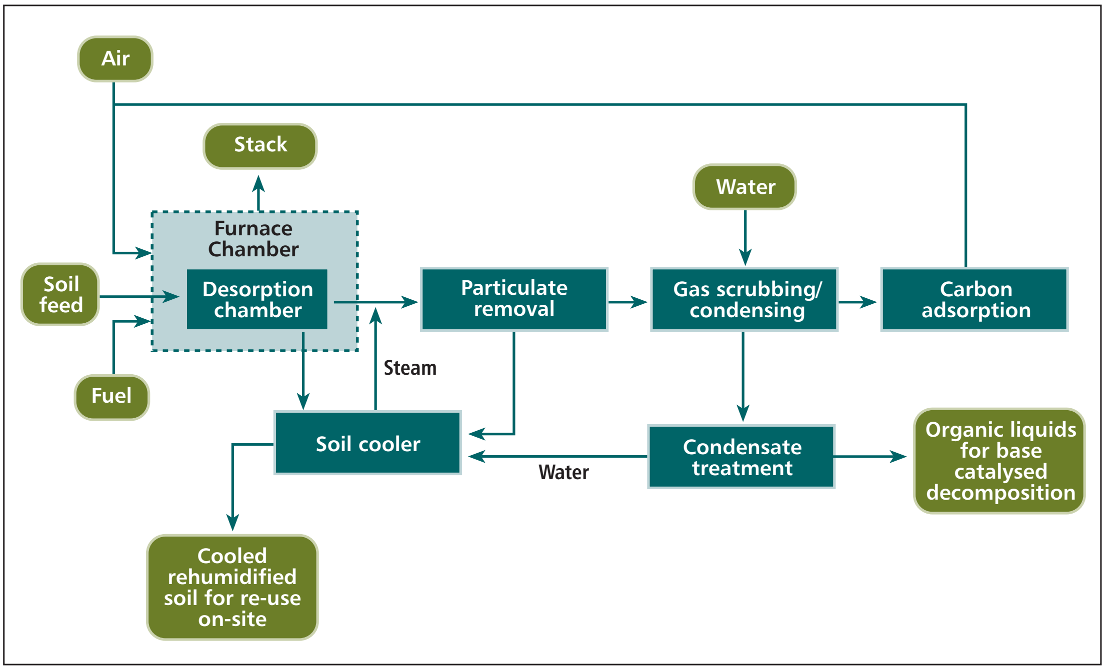


Figure 6.15 **Process Flow Diagram of Indirect Thermal Desorption System**

Indirect Thermal Desorption Process

A typical indirect thermal desorption plant comprises the following process sub-systems:

- the materials feed system
- an indirect desorption chamber to remove contaminants from feed soil
- a gas treatment system comprised of a baghouse and vapour treatment system to filter contaminants from the vapour stream
- a treated materials handling system
- a liquids treatment/separation system to collect and treat contaminants from the gas treatment liquid stream.

Material Feed System

Soil is loaded using a front-end loader into a self-contained hydraulic feed hopper fitted with screens. The soil is passed through a grizzly screen, then into a hopper and up a feed conveyor which includes a weigh scale. The conveyor drops soil into another hopper mounted on a pugmill that feeds the desorption chamber. A soil seal is maintained in the feed pugmill to ensure that only minimum ambient air enters the system. The feed rate is monitored and controlled from the control room.

Desorption Chamber

From the feed pugmill, contaminated materials are fed through a sealed end plate into the desorption chamber. Once in the chamber, the soil is heated by radiant heat from the steel walls of the chamber to the temperatures required for effective desorption of contaminants from the soil. The atmosphere in the chamber is maintained in an oxygen deficient state.

Gas Treatment System

The gas stream containing volatilised contaminants, vaporised water, and entrained particulate, exits the desorption chamber and enters a baghouse or cyclone. This equipment is capable of filtering high temperature gases to remove particulate from the gas stream. Maintaining a high temperature prevents condensation and allows clean particulate to be removed from the volatilised waste stream. The clean particulate falls into the soil discharge breach where it is combined with clean material exiting the plant.

The gases, which are now filtered, and essentially free of particulate, enter the quench unit. This unit is designed to condense and collect the majority of contaminants in the liquid phase. Gases are quenched and sub-cooled to below vaporisation temperatures. By sub-cooling the gas stream, volatilised contaminants and steam contained in the gas stream are changed (condensed) to the liquid phase.

This liquid, known as the condensate, accumulates in the quench sump, and is drawn off by gravity, as required. The liquid that is drawn off from the quench is sent to the liquid treatment system.

Gases leaving the quench contain only residual amounts of contaminants. The remaining air pollution control devices are designed to separate the residual contaminants from the gas stream. Gases leave the quench and enter the condenser. Any moisture collected from the condenser is routed back to the liquid treatment system.

Upon exiting the condenser, the gases are routed through a series of filters designed to reduce moisture content. Any mist or droplets collected as a result are routed to the liquid treatment system. Filters are removed and replaced, as required.

The associated liquid treatment system processes all liquids generated, in the quench and condensers of the gas treatment system, into a condensate with a low moisture content. This condensate is then containerised for treatment by the base catalysed decomposition (BCD) process.

Process gases exit the filters and pass through a high efficiency particulate air filter that is designed to further polish the gas stream and remove any entrained particulate remaining.

An induced draft fan moves the gas stream through vapour phase activated carbon filters for further removal of any residual contaminants. The vapour phase carbon beds consist of two or more vessels arranged to provide continuous filtering through lead and lag vessels. Upon exiting the vapour phase carbon vessels, the gases are routed back to the thermal desorption plant furnace for combustion.

Treated Soil Handling System

The thermal desorption plant treated soil handling system consists of several components to cool, dampen and stockpile the remediated soils without generating dust.

As treated soil exits the desorption chamber, it is indirectly cooled by heat exchange with air in a soil discharge structure that is fully enclosed and sealed to prevent fugitive emissions.

After cooling, the treated soil enters a discharge pugmill. The discharge pugmill mixes and dampen the soil. Water sprays in conjunction with the mixing action of the pugmill allow for thorough dampening of the soil.

The final component of the treated soil handling system is the radial stacking conveyor. This component transports the soil from the discharge pugmill to the post treatment storage area for verification testing. The storage area would be equipped with a series of bins, each with a capacity of approximately 500 tonnes.

6.4.6 Treatment of Condensate from Indirect Thermal Desorption

Treatment of the condensate from the indirect thermal desorption process would be conducted by BCD Technologies (BCDT), utilising the BCD plant at their Narangba facility in Queensland. As a contingency, any condensates encountered that may not be amenable to treatment by the BCD process would be treated using the plasma arc process operated by BCDT at the same facility.

The containerised condensate would be transported to Queensland by road at the rate of one semi-trailer each month. Transport would be by a licensed transporter recognised by the NSW and Queensland EPA's.

BCDT presently operates the Narangba facility on a permanent basis under a license issued by the Queensland EPA. That license may need to be amended to allow treatment of materials from the Homebush Bay remediation project at the facility. If required, an amendment of the license would be sought from Queensland EPA once condensate is produced by the indirect thermal desorption plant, allowing it's characteristics to be accurately reported.

If an amendment permitting BCD treatment of Homebush Bay indirect thermal desorption condensate at the Narangba facility was not secured, treatment would be conducted by BCDT at the Lednez site. BCDT would use a purpose built plant housed within the pre-treatment building or in an adjacent dedicated building of similar construction and characteristics.

BCD is a thermo-chemical process that destroys chlorinated compounds such as dioxins by a process that is essentially the reverse of the process that creates them. Treatment involves heating the condensate from the indirect thermal desorption process in an oil mixture in the presence of sodium hydroxide, and a hydrogen donor.

The condensate, containing concentrated contaminants from the indirect thermal desorption process, is mixed with oil and then fed into a 1200 litre batch reactor for base catalysed decomposition. The reactor operates at atmospheric pressure with the contents under an inert gas (argon or nitrogen) blanket. Within the reactor the oil mixture is dosed with a caustic solution (typically sodium hydroxide) and a hydrogen donor (usually an unsaturated hydrocarbon). The temperature of the reactor is increased to 330 degrees Celsius. This results in the chlorinated contaminants reacting with the caustic solution and the hydrogen donor to produce simple hydrocarbons, sodium chloride (salt) and water.

As the temperature of the oil mixture increases in the reaction vessel some of the contaminants and water vaporise. This gas stream is passed through a reflux condenser to condense the volatilised organics and the water. The organics are separated from the water and recycled back into the reactor, and the water is distilled before disposal. The non-condensable gas stream is discharged intermittently from the condenser through an activated carbon filter that polishes the stream, allowing only inert gases to be emitted from the system.

The processed oil flows through a heat exchanger to cool the processed stream and heat the next batch of contaminated oil. The salt settles out of the cooled mixture and then undergoes additional treatment in an indirect thermal desorber before being disposed of to landfill or by any other suitable means approved by the regulatory authorities. The processed oil can now be recycled back through the process.

The outputs from the process are benign and consist of salt, treated water and spent carbon from the polishing filter. The salt is disposed of to landfill as discussed above, the water to sewer and the spent carbon is treated in the desorption chamber.

The risks associated with the process are primarily those that would be expected from a small-scale chemical dosing facility. The risks are minimised due to there being only one moving part (the mixing mechanism in the reaction vessel) and the whole process occurs under a blanket of inert gas (such as argon) to minimise the risk of fire. The entire process would be located on a bunded hardstand area to minimise risk of contamination through spillage. In addition, the base catalysed decomposition unit is equipped with a sophisticated process control system to limit the potential for any environmental or, health or safety impacts.

6.4.7 Reclassification and Post-treatment Storage

A post-treatment material storage area would be located adjacent to the thermal treatment plant (see **Figure 6.14**). Treated material outputs from the indirect thermal desorption plant would be transferred to the storage area via a radial conveyor (stacker). Treated materials would then undergo validation sampling and reclassification. This would determine whether the process has been effective and whether or not the materials are ready for reinstatement on-site.

Materials that have been treated to an acceptable level would be transported to suitable areas for reinstatement and undergo compaction as part of the backfilling process. Materials that require further treatment would be transported back to the pre-treatment building and would be reprocessed through the thermal treatment plant.

The post-treatment area would have the capacity to store approximately 3,500 cubic metres of material. Stockpiled material would be kept moist using a sprinkler system to prevent the generation of dust.

Equipment to be used to remove treated material from the post-treatment area would consist of a rubber-tyred loader or excavator and articulated dump trucks.

6.4.8 Final Landform

After stockpiled material has been deemed to meet the site soil acceptance criteria, it would be hauled to its backfill location, spread and compacted. Equipment to be used for the relocation of stockpiled material would consist of rubber-tyred loaders or excavators for loading, articulated dump trucks, bulldozers and compactors. A typical production rate for an operation of this type is 120 cubic metres per hour. Finished surfaces would be grassed by turfing to minimise ongoing dust generation.

The basement levels for the proposed development would be incorporated into the final landforms of the remediated site. **Figure 6.16** depicts the indicative proposed finished surface levels and basement locations.

6.4.9 Indicative Land Release Schedule

As the Lednez site is remediated and turfed, land would be progressively released for development. The first release occurs during the early months of Stage 3 of the remediation proposal. The indicative schedule for release is presented in **Table 6.4**.

It is envisaged that once land is released for development, construction of residential premises would commence. Each construction stage would last for approximately 18 months, after which time, sale of the development and possibly residential occupation, could be expected.

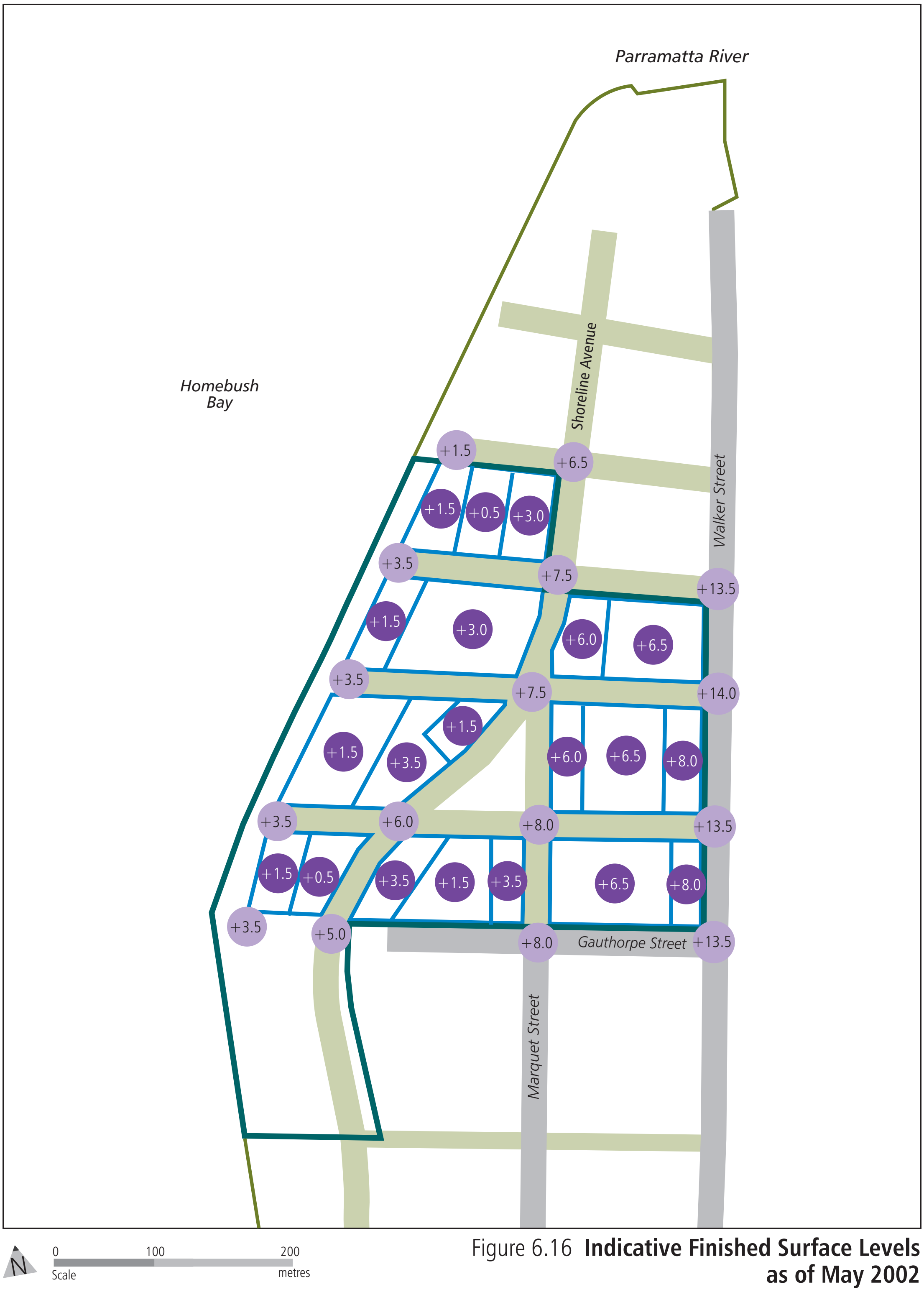


Figure 6.16 **Indicative Finished Surface Levels as of May 2002**

Note: All units are in metres Australian Height Datum.

- Lednez site boundary
- Basement excavations
- Proposed level of basement
- Proposed road levels
- Proposed roads as per development control plan
- Existing roads

Table 6.4 Indicative Land Release Schedule

Stage	Timeframe (months)														
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
Remediation															
1	■	■	■	■	■	■	■	■	■	■					
2	■	■	■	■											
3				■	■	■	■								
4							■	■	■	■					
Release of Remediated Land for Development and Construction															
1											■	■	■		
2					■	■	■								
3								■	■	■					
4											■	■	■		
Release of Residential Premises for Sale															
1														■	
2								■							
3											■				
4														■	

Areas in which construction would be occurring would be separated from the remediation activities by a buffer zone (shown on **Figure 6.17**). Activities in the buffer zone would be limited to the stockpiling of Category 3 materials. Environmental controls such as boundary sprinkler systems, application of turf, and erosion control systems would be applied to these areas in the same manner as for the rest of the site.

Prior to the release of land, each area would be validated and the remediation completed to the satisfaction of the EPA accredited-Auditor. This would be documented by the Auditor signing off on the status of the site and certifying that it is suitable for the proposed landuse. If the remediation has not been completed to the Auditor's satisfaction, further remediation and validation works would need to be undertaken.

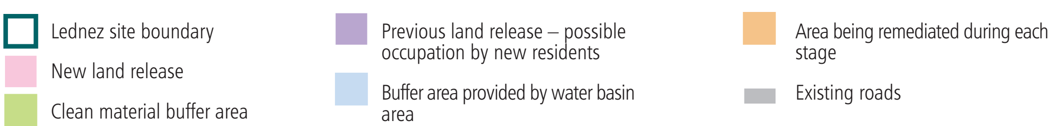
6.5 Environmental Controls

6.5.1 Portion 1 Works

The coffer dam walls would provide the primary environmental control measure for the Portion 1 works restricting dispersion of sediments during excavation in the bay.

The secondary environmental control measure associated with the remediation of Homebush Bay is a silt curtain anchored to the bottom of the seawall which extends around the perimeter of each coffer dam as it is constructed (see **Figure 6.6**). This arrangement would allow the curtain to move with the change in tides, while anchoring at the bottom of the coffer dam would prevent sediment from escaping under the curtain.

Figure 6.17 **Proposed Land Release Schedule**



Once construction of each dam has finished, the curtain would be wrapped over the top of the dam as shown on **Figures 6.7** and **6.8**. This approach would:

- eliminate disturbances caused by the curtain coming into contact with bottom sediments as it bunches up at low tide
- reduce the likelihood of the curtain tearing due to tidal movement
- reduce the potential erosion of the wall
- minimise the potential impacts associated with sedimentation of the bay.

Chapter 7 contains more information on the application of silt curtains as an environmental control measure.

In order to minimise the impacts on the marine environment through fish kills, turbidity and sedimentation, the coffer dams would be sealed only at low tide.

Excavated marine sediments would be stockpiled within the Lednez site. The coffer dams would be dewatered as necessary. A collection drain would be located within each coffer dam with clear water being released in the area between the coffer dam and silt curtain. High-turbidity water would be stored and treated on the Lednez site before being discharged.

6.5.2 Portion 2 Works

Environmental controls applied to the Lednez site would be established within and surrounding each active remediation area.

Surrounding a remediation area would be a boundary sprinkler system for the control of dust and odour. The sprinkler system would dispense a solution of water and odour suppressant as needed during the remediation works. Internal sprinkler lines that could be moved to provide coverage of the active excavation area would supplement the boundary sprinkler system. In addition, water carts would be used to suppress dust. **Figure 6.18** illustrates the application of boundary and internal sprinklers and water carts for dust suppression. Additional environmental controls to manage dust would consist of surface treatment of the stockpiles including spray grass seeding, mulch cover, non-odorous soil cover and plastic sheeting as appropriate.

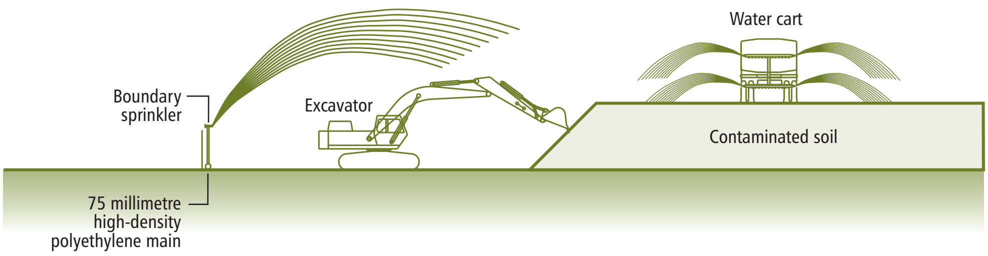


Figure 6.18 **Dust Suppression Methods**

A truck wash would be established at any entrance and exit points to prevent contamination of remediated areas. A combination of automated and mechanical methods would be used. **Figure 6.19** shows the details of the remediation stage truck wash and the site truck wheel wash proposed.

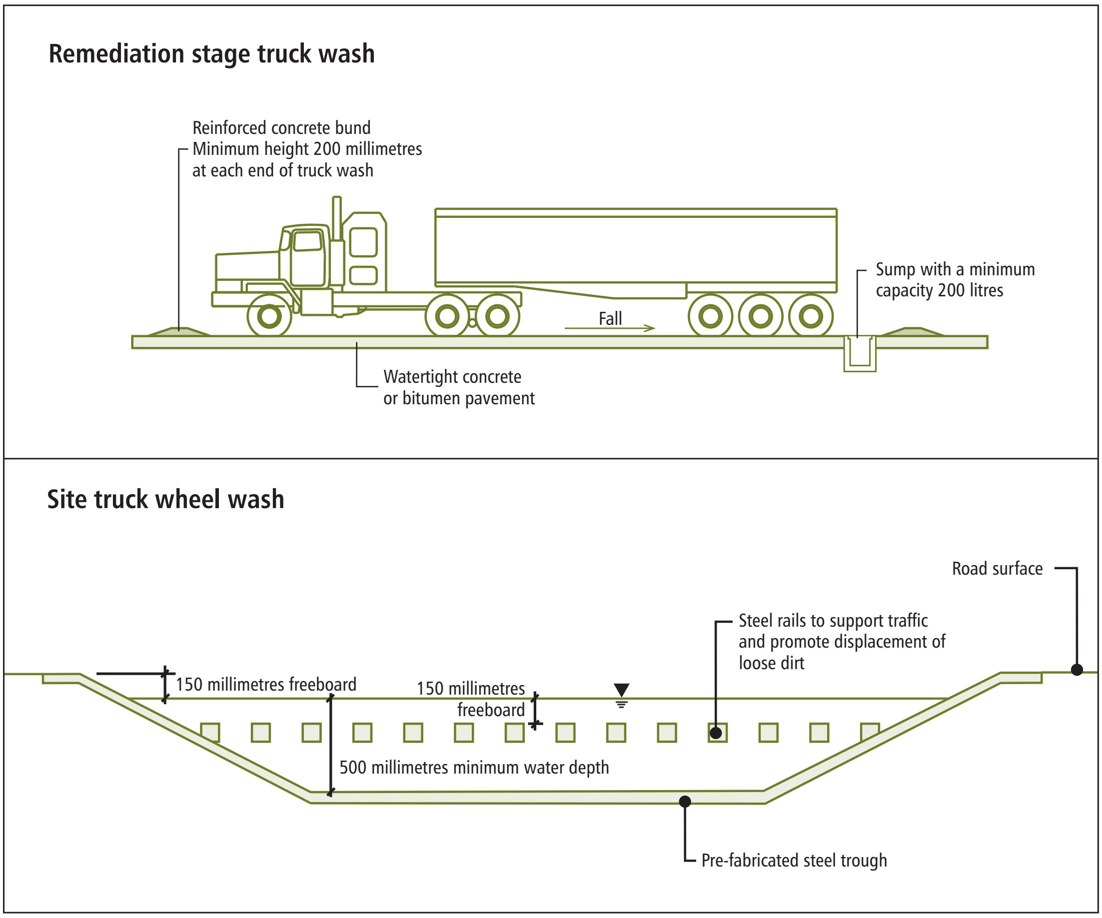


Figure 6.19 **Truck Wash Details**

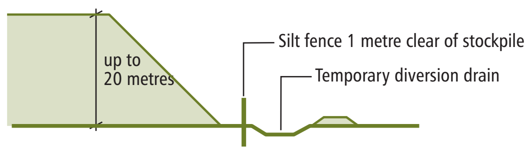
Internal haulage roads would be constructed of compacted granular materials. These would be routinely maintained with dust suppression undertaken via a water cart.

As described earlier, a ventilation system at the pre-treatment building would create an environment of negative pressure that would minimise the escape of contaminated dust and gases from the enclosure. An air filtering system consisting of particulate and activated carbon filters would also be established at the enclosure to filter air drawn from within the building.

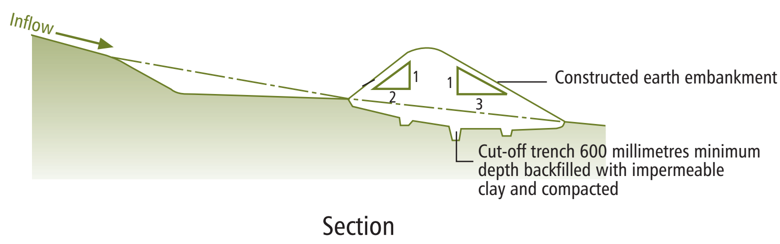
Stockpiles of Category 2 and 3 materials would be periodically dampened via sprinklers to minimise dust. Areas that have been reinstated would be turfed. Where stockpiles are inactive for more than 30 days, spray mulch would be applied to minimise dust and surface erosion.

Diversion drains would be located at up-gradient locations to prevent clean surface water run-off from entering the remediation area where dirty water would be contained. The clean water would be diverted to a clean water storage basin (see **Figure 6.20**), and after appropriate testing, would be used on-site or diverted into the bay through hay bale filters. Construction details regarding silt fences, hay bale filters, catch drains, sediment basins and hay bale check dams are provided in **Figure 6.21**.

Typical surface water controls around uncovered stockpile areas



Clean water basin



Contaminated water basin

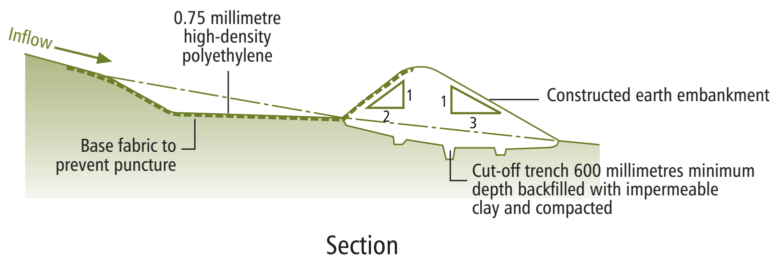


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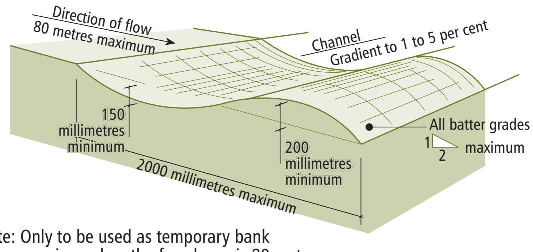
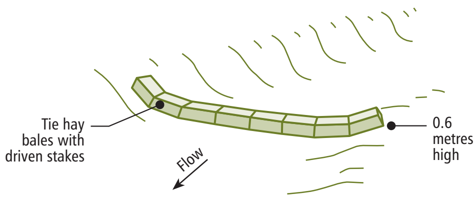
Figure 6.20 **Environmental Control Details (Sheet 1)**

Catch drains

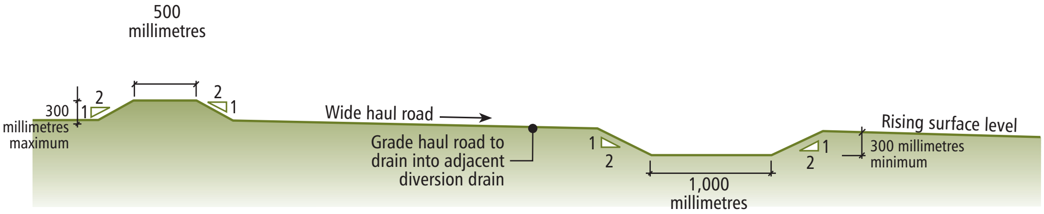


Note: Only to be used as temporary bank where maximum length of upslopes is 80 metres

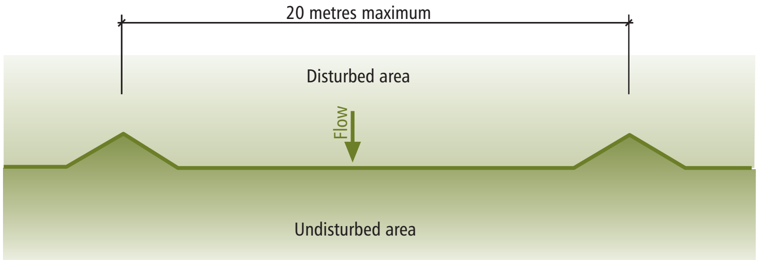
Typical isometric of straw bale check dam



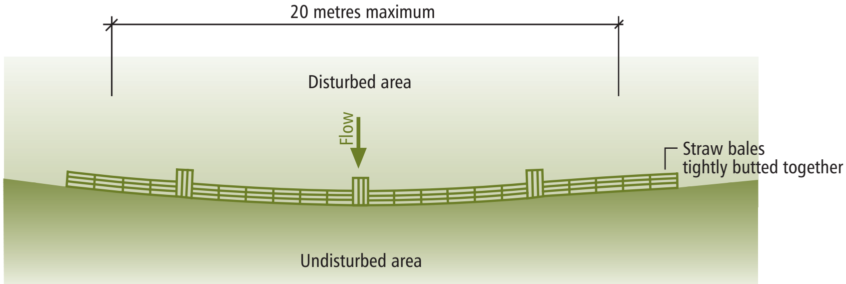
Typical detail haul road and diversion drain



Plan on sediment fence



Plan on straw bale filter



Elevation on straw bale filter

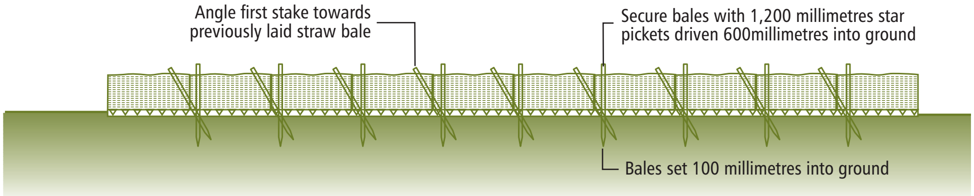


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Figure 6.21 **Environmental Control Details (Sheet 2)**

Dirty water catch drains would direct water to a temporary sump within the remediation phase. This dirty water would then be transferred to a dirty water storage basin associated with the water treatment plant on-site.

All treatment plants would be established within bunded and lined areas, with internal surface water drainage controls.

All machinery operating on-site would be well maintained and would operate in compliance with all relevant noise and air emission regulations.

Figure 6.22 shows the general location of the boundary sprinkler misting system, internal sprinklers (portable), catch drains, silt fence and hay bales for all stages. Implementation and location of these controls would depend on the stage of works.

6.5.3 Site Disestablishment

Disestablishment of the site would include the following:

- disconnection of electricity, natural gas and water supply
- removal of internal roadways
- removal of environmental controls no longer required
- removal of water management basins
- removal of the pre-treatment building and treatment plants.

The decommissioning and removal of the treatment plant area would not occur until the completion of all excavation works, material treatment and validation.

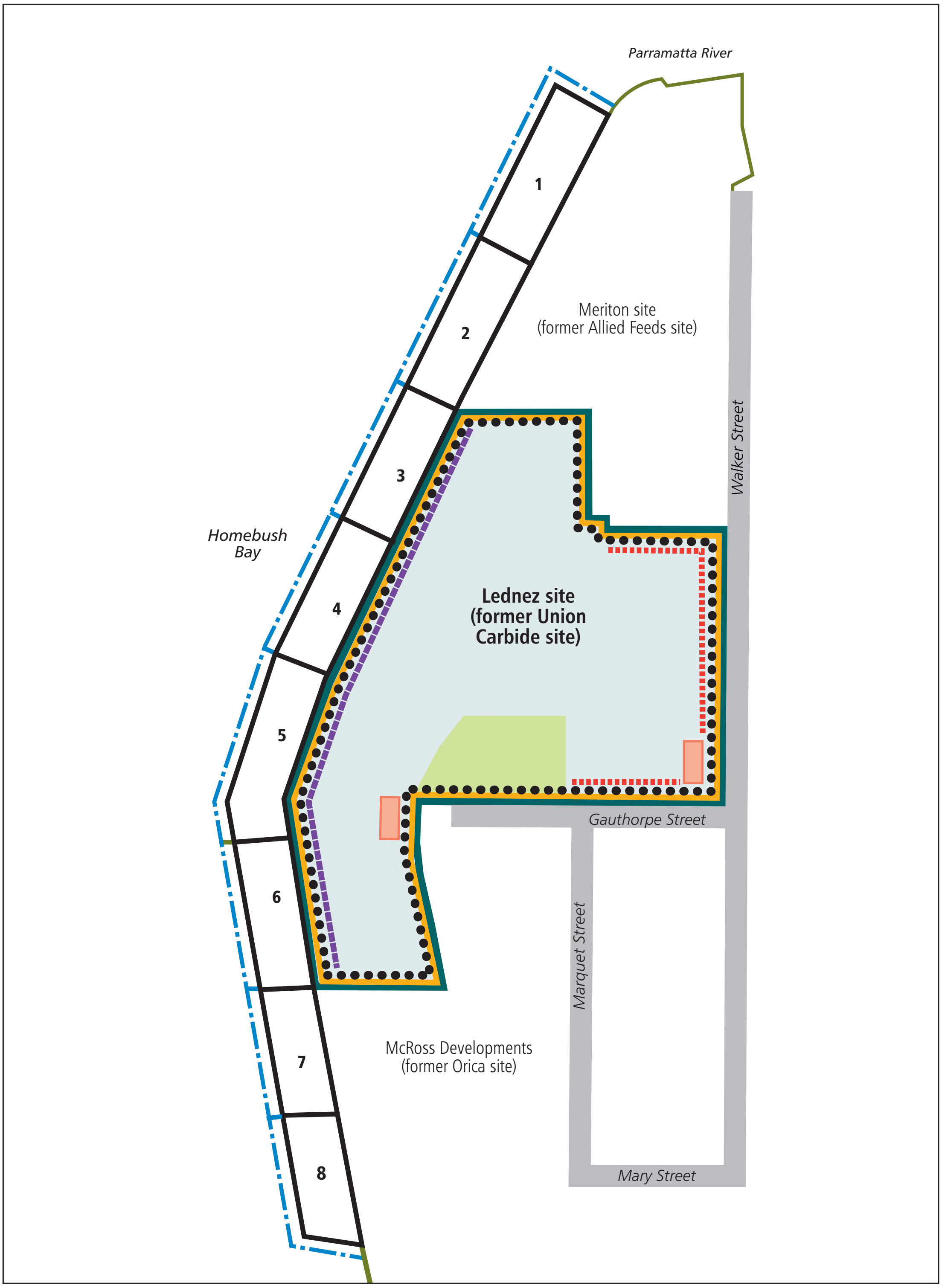
6.6 Water Management and Treatment

6.6.1 Water Management Protocols

The objectives of the water management protocols are to minimise the volume of contaminated water that needs to be recovered and treated and to undertake the management program in the most effective manner possible while complying with all regulatory requirements. These objectives would be achieved by managing contaminated water using a hierarchy of methods.

The management of contaminated water at the site would require the supply and operation of a range of plant and equipment including:

- surface and groundwater control measures
- water storage facilities
- pipelines to move contaminated water across the site
- treatment facilities
- disposal facilities.



Not to Scale

Figure 6.22 **Schematic Showing Environmental Controls**

- Lednez site boundary
- 1 Coffer dam walls
- Clean and dirty water basin area
- Truck wash
- Boundary sprinkler
- Catch drain
- Internal sprinkler (moved as required)
- Silt fence of hay bales
- Silt curtain

Water at the site would be classified into one of four types:

- clean water – water that is not contaminated water, for example, rainfall that has not been in contact with contaminated materials
- contaminated water – water that requires recovery, treatment, recycling and disposal to enable the works to proceed
- grey water – recycled water which is suitable for irrigation and dust suppression. Grey water must comply with criteria specified by the *Draft Environmental Guidelines for Industry, The Utilisation of Treated Effluent by Irrigation* (EPA, 1995b)
- sewer quality water – water that has been either treated or not treated and meets the Trade Waste Criteria for discharge to sewer as given in the Trade Waste Licence to be established with Sydney Water.

Figure 6.23 presents a logic diagram for water management on the site.

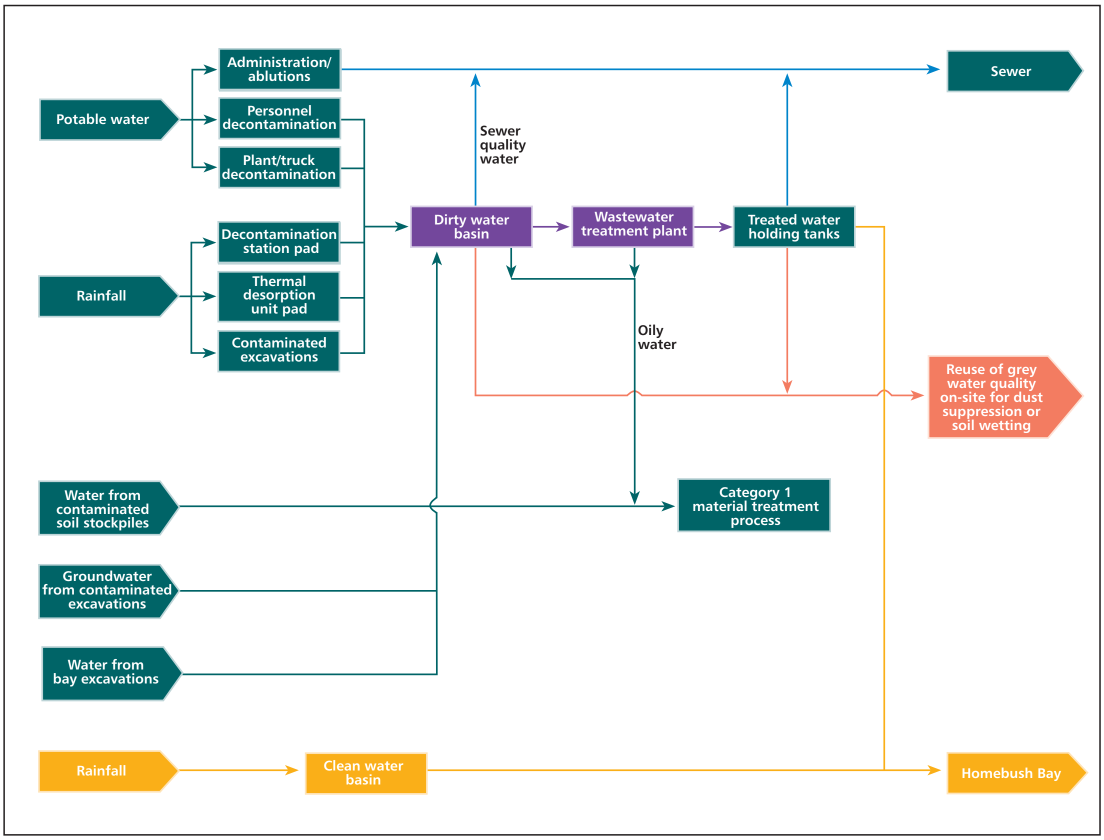


Figure 6.23 **Logic Diagram for Water Management**

In order to minimise the volumes of contaminated water generated on-site, water would be managed using an approach involving a hierarchy of methods. The hierarchy of methods in order of highest preference are:

- prevent surface water or bay water from mixing with contaminated materials or contaminated water. This is the most preferred approach to managing contaminated water at the site and aims to minimise the volume of contaminated water encountered during the works wherever possible. To achieve this goal, it is proposed that surface water flows be directed away from excavations, depressions or pits. This would involve the construction of bunds, diversion drains and other drainage works. In addition, the lined and covered Category 1 stockpiles and the pre-treatment enclosure would control incident rainfall on the most highly contaminated materials
- no treatment or removal of contaminated water from an area where the water would naturally degrade and attenuate without impact on the environment over a period acceptable to the programming requirements of the project. To achieve this goal, it would be necessary to ensure that any contaminated water left in excavations does not present a human or ecological health risk and would not lead to re-contamination of clean backfill materials. In addition, contaminated water would not be allowed to be discharged or flow into other areas of the site containing clean water. Tarry or oily sludges and other highly contaminated fluids would be removed without delay from excavations, particularly on the foreshore strip
- remove contaminated water from an area where it is mildly contaminated and use it for irrigation or dust suppression. To achieve this goal, it would be necessary to ensure that contaminated water is managed to maximise the volume of grey water and minimise the volume of water that requires treatment. All contaminated water that complies with the grey water criteria would be recycled on-site. To this end, it is proposed to recycle grey water by a combination of the following methods:

  – spray-irrigation over areas of the site that have not been remediated to enhance evaporation

  – use of grey water for dust control during earthworks activities

  – use of grey water for other site operations including truck washing

- remove contaminated water from an area where it is contaminated mainly by suspended sediment or organic compounds with a short half-life. This approach would involve pumping the contaminated water to a sedimentation basin and allowing the water to settle and aerate within the basin over a period of several days.

  A number of lined and unlined sediment basins would be constructed for use during the proposed remediation works (see **Figure 6.20**). The sedimentation basins would be constructed to ensure that sufficient capacity is available at all times to store water that is contaminated by suspended solids or organic compounds with a short half-life.

- remove contaminated water from an area and discharge to sewer without any prior treatment. It is proposed to construct the following plant for the purpose of discharging water to sewer:

  – 100 kilolitres storage tank

  – in-line pump of 5 litres per second capacity

  – magnetic flow meter

  – rising main to sewer.

The contaminated water that is to be discharged to sewer without treatment would be first pumped to a water storage tank before being discharged. Contaminated water would only be discharged to sewer in accordance with the requirements of the Trade Waste Licence conditions specified by Sydney Water. There would be a requirement for regular testing of all water before its discharge.

- remove contaminated water from an area and treat in an on-site water treatment plant. Because of its high cost, this is the least preferred approach to managing contaminated water.

A preliminary quantitative water balance for the proposed remediation process is provided in **Table 6.5**. This shows the anticipated sources and use of water on-site and provides an indication of likely volumes that may need to be managed.

Water Treatment Plant

An on-site water treatment plant would be operated for the duration of the proposal to process contaminated water streams that cannot be managed by the alternative means discussed earlier.

The proposed water treatment plant involves the following processes:

- physical separation of light and heavy oils and oily sediments using hydrocyclones
- removing and coalescing emulsions on an ultra filtration membrane
- adsorption of the dissolved contaminants on granular activated carbon.

A preliminary process flow diagram for the water treatment plant is given in **Figure 6.24**.

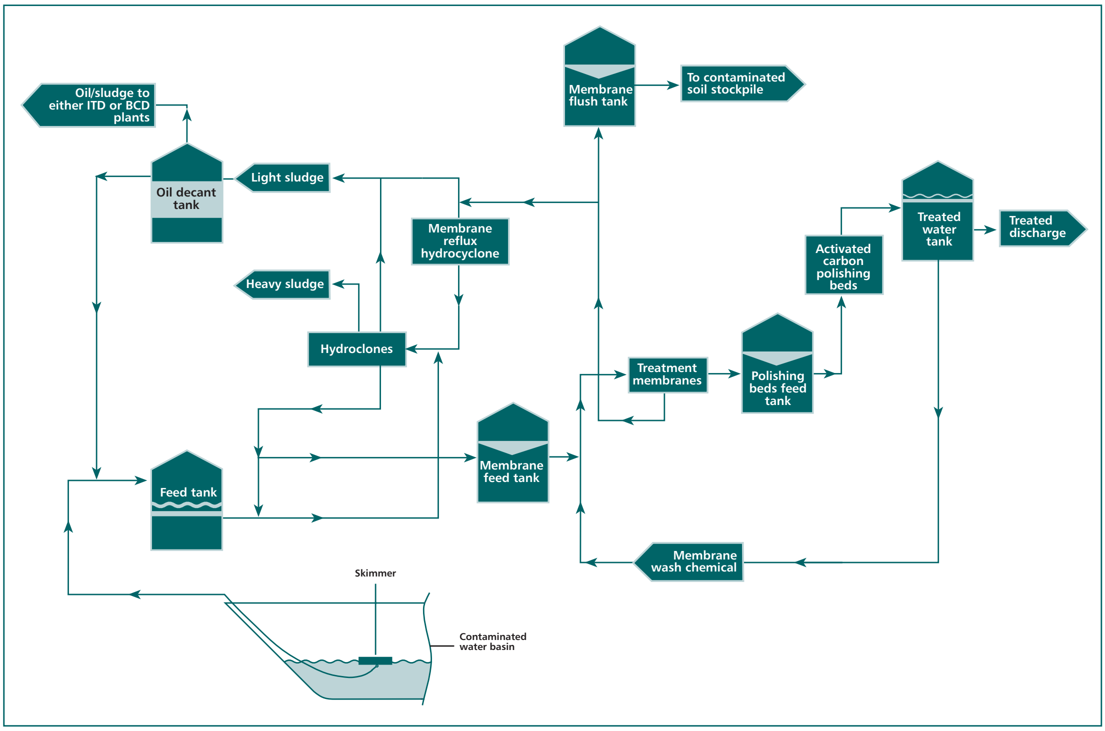


Figure 6.24 **Preliminary Process Flow Diagram – Water Treatment Plant**

Table 6.5 Water Balance

Water source	Use or origin	Assumptions or unknown	Volume assumption and calculation	Estimated volumes	Clean	Sewer	Treatment
Potable water from mains	Administration or ablution	Assume 25 personnel using 12 litres per flush, eight litres per hand wash, twice daily	1,000 litres per day	1.0 kilolitres per day		1.0 kilolitres per day	
	Personnel decontamination	Assume 15 personnel on dirty work, allow four decontaminations per day. Eight litres for hand wash, 15 litres per bootwash[1]	1,380 litres per day	1.4 kilolitres per day			1.4 kilolitres per day
	Mobile plant decontamination	Assume designated plant for dirty work, plant to remain in dirty area. Allow three excavators, four dumpers, two auxiliary plant and three site vehicles. Allow plant to be cleaned once per week for service. Allow high pressure washer for cleaning with 220 litres per plant[2]	220 x 12 x 4.33 week equals 11,400 per month, allow another 1,000 litres for miscellaneous use	0.6 kilolitres per day			0.6 kilolitres per day
Rainfall	Contaminated excavation	Assume run-off from disturbed areas of excavation. Assume 120 banked cubic metres per hour using 1,000 square metres of disturbed ground[3]	Run-off for one in 10-year event for disturbed area with assumed intensity of 60 millimetres per hour, infiltration coefficient of 0.4 and a five-minute period to discharge. Assume storm event of one hour	2.0 kilolitres per day			2.0 kilolitres per day
	Drain off decontamination pad	10 metres by 5 metres	Same as above with infiltration coefficient of 0.9	0.5 kilolitres per day			0.5 kilolitres per day
	Drain off thermal pad	Area of 50 by 50 metres	Same as above with infiltration coefficient of 0.9	10 kilolitres per day			10 kilolitres per day

Table 6.5 Continuation

Water source	Use or origin	Assumptions or unknown	Volume assumption and calculation	Estimated volumes	Clean	Sewer	Treatment
	Off undisturbed site	Assume run-off from undisturbed site clean used for dust suppression with excess discharged to bay. Assume all site area undisturbed[4]	Run-off for one-in-10-year event for disturbed area. Assumes intensity of 60 millimetres per hour, an infiltration coefficient of 0.6 and a one-hour period to discharge. Assume storm event of one hour	5,100 kilolitres per day	5,100 kilolitres per day		
	Drain of stockpile	Assume one-week storage of contaminated material at 120 banked cubic metres per hour, 1,080 banked cubic metres per day for 5.5 days equals approximately 6,000 banked cubic metres or 7,800 stockpiled cubic metres. Assume area of stockpile and pad is approximately 80 by 80 metres[5]	Run-off for one-in-10-year event for disturbed area. Assumes intensity of 60 millimetres per hour, infiltration coefficient of 0.4 and a five-minute period to discharge. Assumes storm event of one hour	12.1 kilolitres per day			2.1 kilolitres per day
Excavation water	Treatment	Based on Investigation data worst case standing watertable over Lednez site in reclaimed areas is at a relative level of one metre. This represents a volume of contaminated material estimated at approximately 60,000 banked cubic metres. Assume 15 per cent moisture content and that all groundwater in this area is to be treated[6]	1. 9,000 kilolitres for total volume of groundwater, assume all requiring treatment 2. Groundwater produced per day based on 60 banked cubic metres per hour Assume 120 banked cubic metres per hour at 15 per cent equals18 kilolitres per day. Volume of basin for 300 days of excavation as 5 megalitres	18 kilolitres per day			18 kilolitres per day

Table 6.5 Continuation

Water source	Use or origin	Assumptions or unknown	Volume assumption and calculation	Estimated volumes	Clean	Sewer	Treatment
Residual bay water		Coffer dams extend 145 by 65 metres for entire length of site. Waters within coffer dam pumped to bay inside silt curtain					
Sediment remediation	Moisture in sediments	Review of unconsolidated moisture content of sediments suggests a figure of 50 per cent Assume all sediments along seawall at depth of 0.5 metres to be excavated for treatment (worst case)	Volume of sediments to be excavated 22,500 at 50 per cent moisture content equates to 113,000 kilolitres Assume excavation at 30 banked cubic metres per hour therefore 270 banked cubic metres per day at 50 per cent moisture equals 135 kilolitres per day. Assume 50 per cent of moisture drained and pumped at excavation, therefore 67 kilolitres per day	67.0 kilolitres per day			67.0 kilolitres per day
	Moisture of sediment stockpile	50 per cent of moisture content of sediments drained at excavation, as calculated above. Balance drains in stockpile, assume 10 per cent of revised moisture content free drain in stockpile	135 kilolitres at 50 per cent at 10 per cent equals 6.75 kilolitres per day	6.8 kilolitres per day			6.8 kilolitres per day
Estimated total volumes in kilolitres per day					**5,100**	**1**	**118.3**

Notes:
1. Direct to decontaminated water storage then to water treatment plant.
2. Direct to decontaminated water storage then to water treatment plant.
3. Pumped from excavation sump to contaminated storage basin.
4. Pumped/drained to clean storage basin. Assume one 16,000 litre water cart operating on-site, filling 10 times per day equals 160,000 litres per day.
5. Collect in pad sump and pump to contaminated storage basin.
6. Construct two 4 ML facilities with base fabric to prevent puncture. One for direct discharge to sewer and standpipe for dust suppression operations.

The water treatment process has been designed to minimise the generation of residuals such as precipitated sludges caused by the addition of flocculating/coagulating chemicals. Such contaminated sludges are difficult to handle, with potentially limited treatment success if routed back to the thermal desorber. The process has also been designed to accommodate wide fluctuations in contaminant load as the site remediation progresses.

Reuse of water from the water treatment process would be subject to trials to confirm the quality of effluent obtained after each unit process and the appropriate disposal pathway. Water quality from the intermediate unit processes may be suitable for use on-site, for example, for dust suppression and soil wetting. The quality of the water for reuse would be measured and used subject to compliance with criteria specified by the *Draft Environmental Guidelines for Industry, The Utilisation of Treated Effluent by Irrigation* (EPA, 1995b).

The overall process is designed to meet a trade waste discharge standard as determined by the Sydney Water Trade Waste Policy and Management Plan. A Trade Waste Licence Agreement would be negotiated with Sydney Water at the commencement of the project. Any measurements of flow and quality for discharge to sewer would be carried out in accordance with the licence agreement.

6.7 Waste Management

Waste management protocols would be employed to manage wastes through the hierarchy of avoid, reuse, recycle and disposal. **Table 6.6** provides a summary of the waste streams expected on-site and the management protocols that would be adopted for each waste type.

Table 6.6 Waste Management Protocols

Waste stream	Management protocol
Solid wastes (excluding contaminated fill)	
Food scraps and waste generated from the site office	Collection and disposal by licensed contractor.
Paper and cardboard waste	Collection for recycling by licensed contractor.
Asbestos waste	All asbestos waste would be disposed off-site at a waste depot licensed to receive this material. A licensed contractor would be employed to remove such materials.
Demolition materials (excluding asbestos)	Masonry recycled on-site. Timber recycled off-site
Solid chemicals	Spent solids classified as hazardous would be recycled in the treatment process as appropriate. Otherwise, collection and disposal would be by licensed contractor.
Liquid wastes	
Wastewater	The site would be managed as per the hierarchy discussed in Section 6.6 to minimise the volumes of contaminated waters. It would be classified as clean, contaminated, grey or suitable for disposal in the sewer and used as appropriate.
Liquid chemicals	Spent liquids classified as hazardous would be recycled in the treatment process as appropriate. Otherwise, collection and disposal would be by licensed contractor.

6.8 Mobile Plant

Table 6.7 summarises the mobile plant requirements anticipated for the project.

Table 6.7 Plant Associated with the Proposal

Activity	Plant and equipment	Duration
Construction of coffer dams	Long reach excavator (20–30T) Bulldozer (D6 or equivalent) Grader	60 months (intermittent use, 10 hours per day, six days per week, daylight hours)
Dewatering	150 millimetre dewatering pumps	60 months (intermittent use, 10 hours per day, six days per week, daylight hours)
Demolition	Excavators with hammer and shear attachments Articulated dump trucks Concrete crusher (200T per hour capacity)	Early Stage Two
Excavation of Category 1, 2 and 3 materials	Excavators (20–65T) Articulated dump trucks (20–45T) Bulldozers with ripper (Cat D11/D10 or equivalent) Bulldozers for stockpile maintenance (Cat D6/D7/D8 or equivalent) Grader and water cart	Five years (10 hours per day, six days per week, daylight hours)
Relocation of stockpiled material following classification	Wheeled loader (Cat 950/966 or equivalent) Articulated dump trucks (20-45T)	Five years (10 hours per day, six days per week, daylight hours)
Restoration of excavations	Compactor (Cat 826 or equivalent) Bulldozer (Cat D7 or equivalent) Grader (140G or equivalent) Water cart	Five years (10 hours per day, six days per week, daylight hours)
Internal haulage/traffic road maintenance	Grader (140G or equivalent) Same as above	Five years (10 hours per day, six days per week, daylight hours)
General purpose maintenance work	Backhoe	Five years (10 hours per day, six days per week, daylight hours
Site vehicles	6 cars/utilities	Seven days /five years
Personal vehicles	20 cars	Seven days /five years

Table 6.7 Continuation

Activity	Plant and equipment	Duration
Establishment of thermal treatment plant and water treatment plant	50T and 100 T cranes 5 –10 semi trailers	Two months (10 hours per day, six days per week, daylight hours)
Transfer of highly contaminated soil from covered stockpiles to pre-treatment enclosure	Wheeled loaders (2m^3 bucket)	Two years (10 hours per day, six days per week)
Material handling in pre-treatment enclosure, screening operation and thermal treatment plant feed	Wheeled loaders (Cat 928/966 or equivalent) Powerscreen (Finlay 930HS)	Two years (24 hours per day, six days per week)
Thermal treatment plant	Rotary kiln	Two years (24 hours per day, six days per week)
Material handling in the post-treatment storage area	Excavator (20–65T) Articulated dump truck (25-45T)	Two years (2.5 hours per day, six days per week)

6.9 Hours of Operation

All operations that involve excavation or hauling material outside the pre-treatment building would occur between the hours of 7.00 am and 5.00 pm, Monday to Saturday.

The only operations that would occur outside these hours are those within the pre-treatment building (hauling and blending of stockpiled materials and feeding this material to the thermal treatment plant) and the thermal treatment process itself, which would occur 24 hours a day, seven days per week.

6.10 Workforce

The remediation works are likely to create employment opportunities for approximately 50 people for the first two years and approximately 30 people for the following three years. The estimated number of employment opportunities per stage, specified in terms of skilled, semi-skilled and unskilled employees, is given in **Table 6.8**.

Table 6.8 Employment Numbers and Breakdown

Stage	Estimated number of employment opportunities
1 and 2	10 skilled 15 semi-skilled 25 unskilled
3	5 skilled 10 semi-skilled 15 unskilled
4	5 skilled 10 semi-skilled 15 unskilled

Over the entire project, the remediation activities would be carried out by local contractors and employees where possible. The required equipment and material would also be supplied locally where possible. Possible direct and indirect local employment would be for activities such as:

- demolition contractors
- revegetation contractors
- fencing contractors
- earthmoving contractors
- security
- supply of materials.

6.11 Materials Handling

The materials handling procedures have been designed to provide cradle-to-grave control and management of all materials throughout all phases of the project. These controls are required due to the nature of the work and the need to ensure that the remediated site is suitable for the proposed landuses with a high level of confidence. Implementation of these procedures is a critical requirement for all work undertaken and would significantly impact on many of the operations to be undertaken.

Materials handling during site works would comprise:

- the “cradle-to-grave” tracking of all materials
- the use of special handling procedures to excavate, stockpile, process, treat and backfill soils and fill
- where cost-effective, the screening and removal of clean, oversize material from materials won during the earthworks program.

A computerised system to track all materials handled on-site in order to verify the correct movement and handling of the materials would be implemented. The tracking system would apply to all materials at the site, imported to the site and removed from the site.

Materials at the site would be processed, handled, moved and stored in a manner designed to minimise environmental impacts. The material handling requirements for trucks transporting materials at the site are as follows:

- trucks would carry only one material type at any time
- trucks carrying contaminated materials would proceed directly to the designated stockpiles
- all loads of dry materials transported within the site would either be securely covered by a tarpaulin or be kept damp by the use of water sprays
- no truck carrying contaminated materials would be permitted to drive over areas of the site that have been remediated, validated or where clean materials have been placed
- the movement and handling of asbestos wastes would be conducted in accordance with the relevant legislation.

Stockpile locations would vary depending on the activity being undertaken. Stockpiles would be located in accordance with the following requirements:

- stockpiles would only be placed at approved locations
- stockpiles would be strategically located while facilitating material handling requirements
- only clean materials would be stockpiled in remediated areas of the site
- contaminated materials would only be stockpiled in unremediated areas of the site at locations which do not pose any risk of environmental impairment of the stockpile area or surrounding areas.

Stockpiles would only be constructed in areas of the site that have been located and prepared in accordance with the requirements of the remediation action plan. Detailed information on material handling is provided in the remediation action plans (see **Technical Paper 7**).

6.11.1 Validation

As discussed in **Section 6.1**, information regarding material characteristics and contaminant concentrations would be used to categorise the material as either Category 1, contaminated treatment material; Category 2, geotechnically unsuitable regrade; or Category 3, geotechnically suitable regrade. Validation sampling and analysis is required to confirm the status of each of these types of materials before determining the correct management option. This has been discussed above as material classification.

Validation is the process by which confirmation is obtained that the remediation objectives of the proposal have been met. Validation is generally undertaken as part of a formal plan that is included in the remediation action plan. The validation plan stipulates the number of samples required to confirm that the remediation was effective as well as details such as the type of analysis that is required, the detection limits for the analysis, the methods to be used in the analysis and data and sample quality control procedures. The site validation requirements are detailed in the remediation action plans provided in **Technical Paper 7** and are summarised below for both the Lednez site and the area of bay sediments to be excavated.

Validation of Excavations

Validation of excavations on the Lednez site would require collection of samples from the base of the excavations using 15 metre grid in residential areas and a 20 metre grid in open space areas where future activities would likely be less intrusive. Samples would be collected from a depth interval of 0 to 100 millimetres. If the excavation extends into rock, samples of rock would be collected and analysed. Validation samples would be collected at a rate of one sample per 25 lineal metres for each layer of material (fill, clay) along the walls requiring validation. It is estimated that a maximum of two to three samples per 25 lineal metres would be taken in many areas.

The excavation of bay sediments would be limited to a depth of 0.5 metres. This would be validated by survey to ensure that this depth has been achieved.

Validation of Backfill Material

All materials used to backfill excavations would be validated beforehand. Validation sampling would be conducted at a rate of one sample per 1,000 cubic metres.

Material that has been classified as requiring thermal treatment before reinstatement would require validation sampling after passing through the thermal treatment plant. These samples would be collected at the rate of one sample per eight hours of operation.

Thermal Treatment Plant Area and Associated Stockpiling Areas

It is estimated that the treatment and stockpiling area would encompass approximately 30,000 square metres. Based on the EPA's 1995 *Sampling Design Guidelines*, the number of sampling points for a site of this size using a 20 metre grid is 48. Considering the operations and the environmental management measures planned, this grid size is considered appropriate for most of the area.

The exception to the 20 metre grid is the area where wastewater treatment and liquids handling would be undertaken which represents a potential for point source contamination. The area where the handling of liquids is proposed is estimated to be approximately 300 square metres. In this area validation samples would be collected from a tighter grid of 10 metres.

Validation of Previously Remediated Areas

It is proposed that areas validated at the conclusion of the 1988 to 1993 remediation program be subject to confirmatory sampling by collection of validation samples from a 40 by 40 metre square grid.

Those areas would be segregated (fenced and signed where practical) as clean areas and would be used only for support (administration, ablutions) activities and to provide access from support areas to other areas on the site. Any equipment and vehicles travelling on these areas from other areas on the site would be decontaminated in accordance with the environmental management plan.

6.12 Contingency Works

The following contingency works have been developed in case the proposal as outlined in this EIS becomes financially or contractually impractical. The conditions under which the contingency works would be employed include:

- where work on Portion 2 has ceased for more than 24 months
- where bay remediation (Portion 1 works) are not completed within six years of commencement
- any of the "conditions precedent" to the Remediation Deed between Waterways Authority and Thiess Services are unable to be satisfied. These are requirements in the deed that must be satisfied in order for the proposal contracts to be valid. Such conditions include obtaining all relevant approvals on terms acceptable to the parties.

If the contingency works need to be implemented, the objectives would be to:

- remediate Homebush Bay
- prevent recontamination of the bay from seepage from the Lednez site

Figure 6.25 shows the proposed contingency works. The main elements of the contingency works in the bay are:

- construction of coffer dams in a number of stages to enable excavation of sediments under dry conditions
- excavation of contaminated sediments adjacent to the Lednez, Meriton and Orica sites as shown on **Figure 6.25** (refer **Chapter 4** and **Technical Paper 7**) to a depth of 0.5 metres
- progressive reinstatement of the sediment excavations using Category 3 materials won from the Lednez site
- containment of the excavated sediment in purpose-built containment cells to be located on the northern and southern portions of the Lednez site as an extension of the clay-capped mound that currently exists on-site.

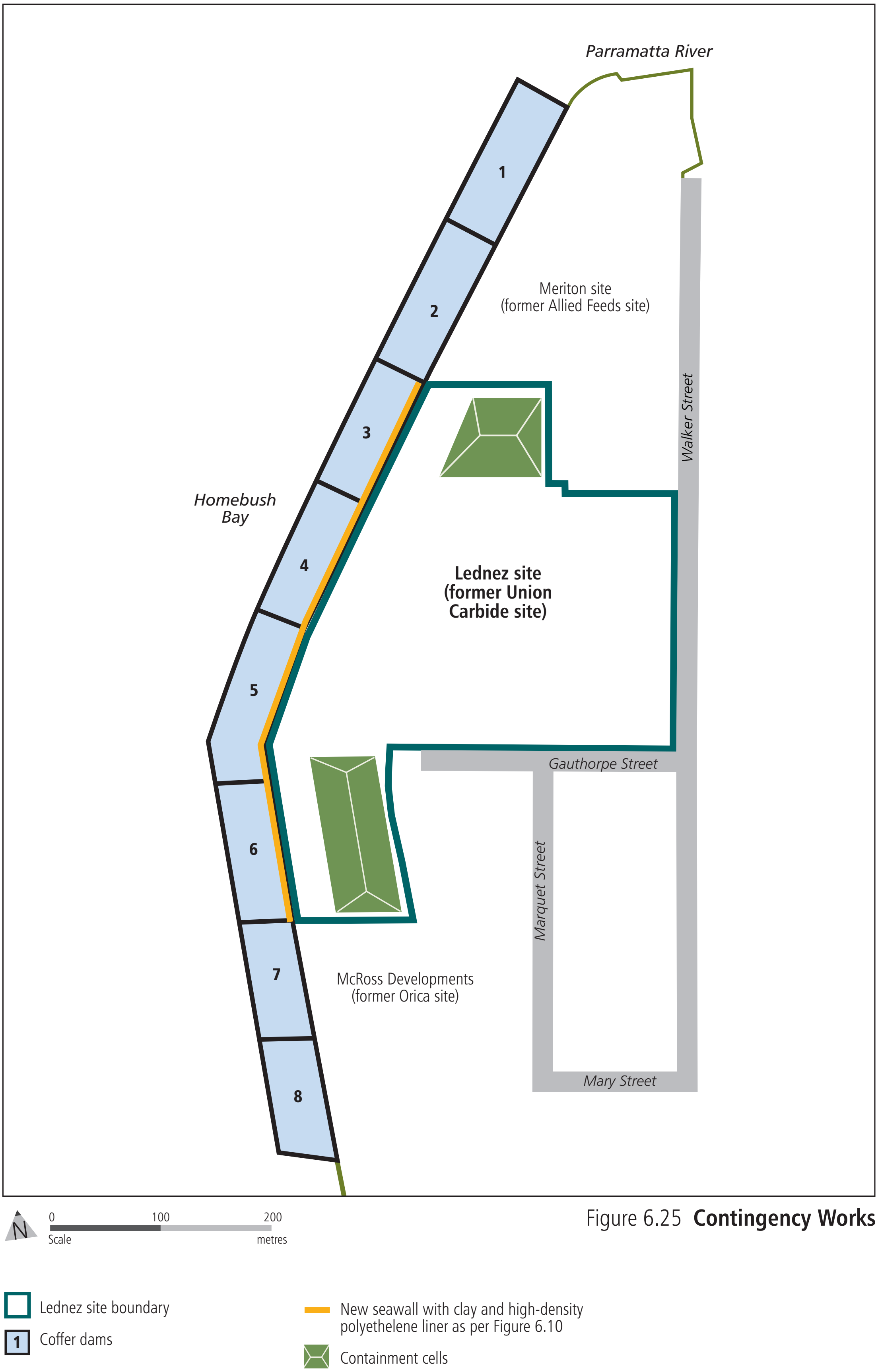
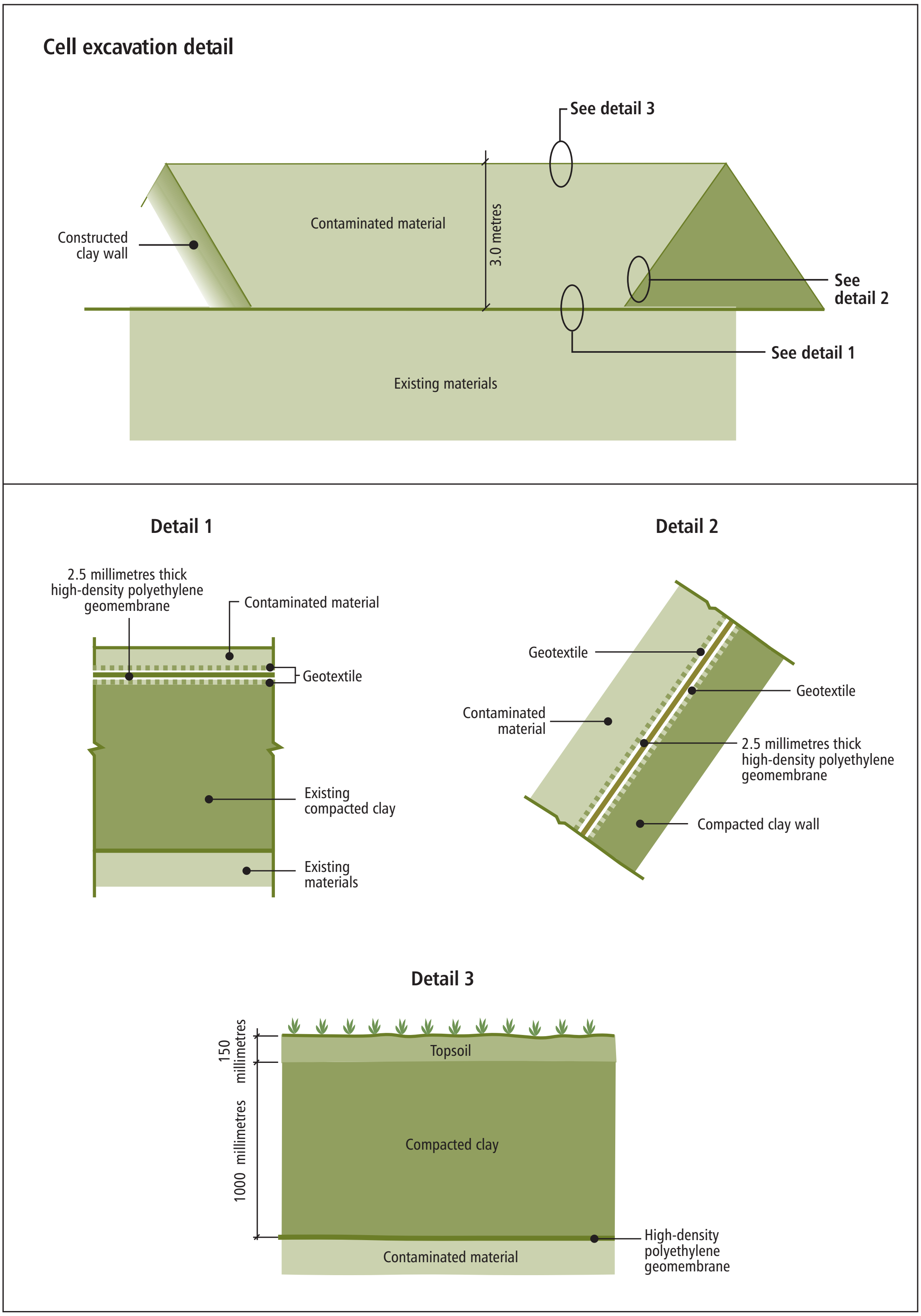


Figure 6.25 **Contingency Works**

The main elements of the land component of the contingency works are:

- demolition of the seawall and excavation of the contaminated foreshore strip
- reinstatement of the foreshore strip with Category 3 material excavated from the site
- construction of a new seawall and a compacted clay wall with a bentonite seal and a high-density polyethylene membrane as shown in **Figure 6.10** (in front of the Lednez site)
- construction of composite lined containment cells as repositories for contaminated sediment and soil excavated from the bay and foreshore strip. The cells would be constructed over the existing clay cap (see **Figure 6.26**). The cells would be lined with clay and high-density polyethylene membrane and closed with a composite capping system to prevent rainwater infiltration.



Not to scale

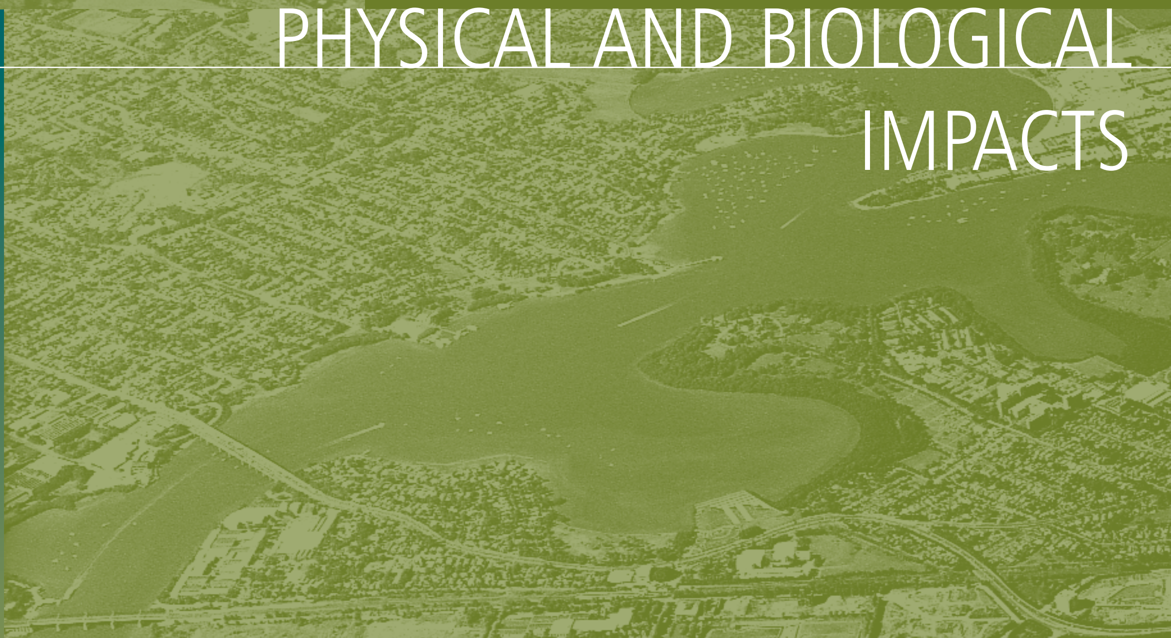
Figure 6.26 **Cell Cross-section of Contingency Works**

Note: All measurements are approximate.

Part D

REMEDIATION OF LEDNEZ SITE, RHODES and HOMEBUSH BAY

PHYSICAL AND BIOLOGICAL IMPACTS



Chapter 7

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

ESTUARINE ENVIRONMENT

Chapter 7

ESTUARINE ENVIRONMENT

7.1 Hydrology of Homebush Bay

7.1.1 Existing Environment

In considering the design of sediment remediation activities and the impact these activities would have on Homebush Bay, there are several aspects that need to be addressed. These include understanding existing water movements in the bay, determining whether the establishment of a fixed structure such as the coffer dams would modify the water flows and what the possible dispersion effects would be where sediments are disturbed as a result of the coffer dam placement.

The quality of the water in Homebush Bay is determined by exchange with the Parramatta River, inputs from the adjacent catchment via Powells and Haslams Creeks and local sediment re-suspension. The following processes typically dominate the flushing of small estuarine bays like Homebush Bay:

- tidal exchange
- wind-induced mixing and flushing
- freshwater inputs and gravitational exchange.

Tidal currents cause a periodic flow into and out of the bay and coupled with the induced turbulent mixing this process effectively replaces bay water with adjacent main body estuarine water from the Parramatta River.

The action of the wind blowing across the water surface results in turbulent mixing near the surface. Surface waves created from this wind induce currents at the seabed, which are important for re-suspending bed material into the water column.

Freshwater inputs from Powells and Haslams Creeks contribute to the gravitational, or density-driven, circulation.

7.1.2 Potential Impacts and Mitigation Measures

Tidal currents and wind-induced flows would especially affect the silt curtain surrounding the coffer dams. In addition, wind-induced surface waves would lead to forces on the structures and the run-up of breaking waves may lead to wave overtopping.

Increased turbidity can decrease light for photosynthesis, interfere with fish respiration and feeding, cause discolouration of normally clear surface waters, reduce oxygen levels and release adsorbed toxic metals or organic compounds into the water column. Sediment re-suspension can lead to increased dispersion of contaminants as contaminants adsorbed to sediment particles are dissolved in the water column or spread beyond the contamination zone.

The design and operation of the proposed staged coffer dams for remediation need to consider the following implications:

- increased suspension of sediment within the water column due to construction activities
- seepage of contaminated water through the coffer dam walls
- a changed flow and wave climate in the bay due to the presence of coffer dam structures
- removal of habitat
- biodegradation and bioaccumulation.

Silt curtains would be installed around the coffer dam before construction to minimise the impacts of turbid plumes during construction and ongoing remediation works. Each coffer dam would be sealed as close to low tide as possible to minimise the volume of water trapped within the dam.

Suitably sized rock armour on the seaward face of the coffer dam would withstand wave forces and prevent any adverse wave field effects.

Dewatering pumps would be used to maintain the water level inside the coffer dam below the water level in the bay to prevent contamination seepage.

In general, the impacts of the coffer dams on the bay waters would be negligible due to their containment within the geotextile silt curtains. In the unlikely event of a failure of a silt curtain, the rapid flushing water exchange between the bay and the Parramatta River would disperse any suspended particulates in a matter of days.

Monitoring of Bay Waters

Baseline water sampling has been undertaken for the proposal (see **Section 8.3**). The results of this sampling, combined with further tailored sampling, would provide the basis for procedures that would test for appropriate parameters and contaminants of concern before, during and after remediation. A key parameter would be turbidity (or suspended solids) as this would determine the effectiveness of control measures such as the coffer dam and silt curtains.

Monitoring is required to determine whether contaminant levels exceed the specified licence limits. A contingency remediation plan would be established for events that exceed licence conditions, with additional monitoring to determine the impact of any such event.

Proposed monitoring for the proposal is summarised in **Table 7.1.** For more detail on the hydraulics of Homebush Bay, refer to **Technical Paper 8**.

Table 7.1 Proposed Homebush Bay Water Quality Monitoring

Phase	Type of monitoring
Pre-activity monitoring	Establish "background turbidity" in Homebush Bay and Brays Bay
Initial dam construction phase	Track plumes in event of disturbance
	Turbidity compliance monitoring around silt curtain perimeter
	Curtain integrity checks
Remediation phase	Turbidity compliance monitoring around silt curtain perimeter
	Curtain integrity checks
	Event tracking using turbidity
Decommissioning of dam	Track plumes in event of disturbance
	Turbidity compliance monitoring
	Curtain integrity checks

Before Stage 1 (Portion 1) activities commence, monitoring activities would include:

- establishing time series data for turbidity. This would be undertaken one month before the start of activity. Data loggers would be placed at three sites to record surface and bottom water quality. These loggers would be set to record every 15 minutes
- undertaking turbidity spatial surveys to determine spatial variability under different conditions. These conditions would include wind events at flood tide and conditions during a dry period and wet weather event. Rapid sampling would be undertaken using high-resolution water quality/turbidity probes at approximately 20 sites.

Initial construction-phase monitoring would focus on the area near the activities, with background sites established in other parts of Homebush Bay and in Brays Bay. In addition, a rapid sampling technique using a high-resolution turbidity sensor would be kept on standby in the event turbid water is generated by the activities.

This approach would also be adopted for the remaining remediation and decommissioning phases.

7.2 Estuarine Ecology

In 1989, NSW Fisheries imposed a total fishing ban in Homebush Bay as a result of elevated dioxin concentrations detected in fish and prawn tissue samples. This was followed, in 1990, by a commercial fishing ban in Parramatta River west of the Gladesville Bridge. In 1998, the ban on fishing in Homebush Bay was extended to prohibit all methods of fishing in the whole of the waters of Homebush Bay, together with its creeks and tributaries, upstream (south) to its source from a line drawn between Rhodes Point and Wentworth Point.

In December 1998, the EPA declared the bed of Homebush Bay to be contaminated with dioxin in such a way as to present a significant risk of harm to aquatic life in the vicinity of the site and to humans consuming aquatic biota from the bay.

The following section of this EIS details the existing environment of Homebush Bay with respect to mangroves and saltmarshes, benthic communities and fish communities. For information on the condition of the environment of Homebush Bay and its sediments, see **Technical Paper 3.** For more detailed information on the estuarine sampling methodology and results relating to the studies referred to below, see **Technical Paper 10**.

7.2.1 Existing Environment

Mangroves and Saltmarsh

Only two species of mangroves grow in the intertidal zones of estuaries of the Sydney area: the grey mangrove (*Avicennia marina*) and the river mangrove (*Aegiceras corniculatum*). The closest stands of mangroves to the Lednez site are located approximately 600 metres to the north of the site on the northern shoreline of the Parramatta River (equates to approximately 300 metres from the closest point of the bay remediation works) and approximately 410 metres to the south of the proposed remediation area along the eastern foreshore of Homebush Bay as shown in **Figure 7.1**.

A study into mangrove health conducted by Burchett and Pulkownik in 1995 discovered that the whole area of Newington Wetlands is showing signs of stress, with dieback and loss of canopy in the mangrove community. Only about 15 per cent of the existing mangroves appear healthy.

The same study by Burchett and Pulkownik in 1995 indicates that the main saltmarsh species in the Homebush Bay area include *Sarcocornia quinqueflora, Suaeda australis, Triglochin striata, Sporobolus virginicus, Juncus actus* (exotic) and *Juncus kraussi*. Narrow-leaf Wilsonia (*Wilsonia backhousei*) is listed as a Vulnerable species on Schedule 2 of the *Threatened Species Conservation Act 1995* and is the only plant species in the Homebush area listed under the Act. This plant often occurs as pure or nearly pure stands. The Homebush Bay area contains the largest remaining stands in the Sydney Region, located in the northern areas of the Newington Nature Reserve, over one kilometre from the proposed remediation.

The closest area of saltmarsh to the Lednez site is located at the southern end of Homebush Bay approximately 410 metres from the proposed remediation area (see **Figure 7.1**).

The value of these wetland ecosystems has been recognised and these are included on the register of the National Estate. Migratory wading birds, which are known to frequent these wetlands are also protected by international agreements with China under the China–Australia Migratory Bird Agreement, with Japan under the Japan–Australia Migratory Bird Agreement, and by the Ramsar Convention on Wetlands of International Importance, as Waterfowl Habitat.

Benthos

The benthic environment is defined by the bay floor and includes organisms living on the bay floor and in bay sediment. Benthic organisms play an important role in the ecological health of estuaries and are an important component of the local food chain.

The Centre for Research on Ecological Impacts of Coastal Cities undertook baseline benthic sampling (EICC, 2002) for this EIS. Thirty-seven different groups of animals or "taxa" representing seven phyla were found in the samples collected off Rhodes Peninsula. The numerically dominant groups were, in order of importance, spionid, nephtyid and ophelid worms, amphipods, the bivalve *Theora* species, fish larvae, sabellid worms and the bivalve Tellina species. This report is reproduced in **Technical Paper 10.**

Figure 7.1 **Mangroves and Saltmarsh Distribution**

Fish and Mobile Invertebrates

Assemblages of fish associated with mudflats in Homebush Bay have been found to be diverse and similar to those in Brays Bay and Majors Bay. Furthermore, Homebush Bay supports large numbers of commercially important species, including sea mullet, yellowfin bream, flat-tail mullet, crabs and prawns (The Ecology Lab, 1994). Gobies are particularly abundant in the mudflat habitats. In general, the composition of fish assemblages in the mudflat habitats is similar to that in the adjacent mangroves.

Sampling for fish and macroinvertebrates, including beam trawl and gill net sampling, was undertaken by The Ecology Lab on two occasions in Homebush Bay and at two reference locations. A total of 2,161 fish were collected by beam trawling in the three locations with 11 fish taxa identified during the study. From the proposed Homebush Bay remediation area, six and eight taxa were collected during Times 1 and 2, respectively. At Brays Bay, seven and eight taxa were sampled during Times 1 and 2 while nine taxa were collected during each time of sampling in Majors Bay. A total of 241 fish and crustaceans was sampled by gill nets in the three locations with 10 taxa identified comprising nine species of fish and one species of crustacean. In terms of locations, five taxa were identified during each time of sampling from the proposed remediation area. At the reference locations, four taxa were identified in Time 1 and five taxa occurred during Time 2 in Brays Bay while seven taxa were identified during each time of sampling in Majors Bay.

No threatened species of fish were collected or observed as part of the present field studies, nor have they been recorded in earlier detailed fish surveys of Homebush Bay. Although unlikely, the green sawfish, scheduled as endangered under the *Fisheries Management Act 1994*, may occur in the area. Accordingly, an eight-part test was prepared (refer The Ecology Lab, 2002 contained within **Technical Paper 10**). This test concluded that it is highly unlikely that the species would be impacted by the proposal and therefore no species impact statement is required.

7.2.2 Potential Impacts and Mitigation Measures

Mangroves and Salt Marsh

There would be no direct impact on either mangroves or saltmarshes from the proposal, since the nearest plants are approximately 410 metres away from direct excavation activities on the Lednez site, and approximately 300 metres away from any of the bay works.

Indirect impacts on mangrove communities from either the land or bay activities could include:

- smothering and reduction of exposed roots or “pneumatophore” surface area as a result of increased sedimentation
- deposition of dust on the leaves and trunks of mangrove or saltmarsh plants.

The results of estuarine dispersion studies and air dispersion modelling show that neither mangroves nor saltmarshes would be impacted via indirect mechanisms such as these. The shallow depth (approximately one metre) of the eastern sections of the bay and the use of mitigation measures, such as the silt curtains, would mean that the distribution of sediments in the vicinity of the plants would be at concentrations similar to those expected under regular wet and dry conditions. The dust modelling discussed in detail in **Chapter 9** shows that the maximum levels expected would not impact on either the mangrove or saltmarsh communities.

As there are not direct or indirect impacts, no further assessments is required.

Benthos

Remediation involves the excavation and removal of the top 0.5 metres of sediment and its replacement with crushed sandstone or shale. This would result in the removal and death of all organisms occupying the upper part of the seabed in the proposed remediation area and cause a substantial increase in the size of particles in the substratum. Any organisms in the lower levels of sediment are likely to be subject to considerable physical disturbance in addition to a change in the upper layers of their habitat. This would have a major impact on their ability to maintain the structure of their burrows. Deeper-living animals would probably be unable to cope with this change in conditions and would therefore die. As the organisms that would be lost from the proposed remediation area are widely distributed and abundant elsewhere in the bay, this activity is unlikely to have a significant impact on their numbers or long-term survival.

The remediated area is likely to be colonised by a different suite of animals from those there now, increasing the biodiversity within Homebush Bay. The effect, however, may only be transient, because the bay is undergoing long-term accretion of sediment.

The excavated area would be filled with clean material following sediment removal to re-establish the existing sediment levels. The overlying backfill materials that would become the new surficial sediments would be sourced from the Lednez site.

Approximately three months after sediment replacement, samples would be taken to determine species and abundance of animals that have colonised the new substrata. Further sampling would be undertaken after periods of approximately 12 and 24 months to ascertain how the fauna has developed over time. The faunal assemblages that develop would also be compared with those in similar sized, undisturbed control areas adjacent to the remediated area.

Fish and Mobile Invertebrates

Given the mobility of the species sampled, significant long-term effects on large fishes and invertebrates are not likely as it would be expected that these species would re-enter the remediated areas once the excavated sediments had been replaced and the coffer dams removed. In the short-term, two issues need to be considered. Firstly, displacement of some species would occur during the construction phase of the project but similar habitats are located nearby in Homebush Bay and within bays located upstream and downstream of the proposed works. Secondly, it is possible that the use of coffer dams to isolate the area of remediation from the rest of Homebush Bay would trap fish within this area, where they would die.

To minimise potential impacts, it is proposed that the coffer dam would be built as eight individual structures. It is unlikely that more than two coffer dams would exist at any time. Construction of each coffer dam would be undertaken as the preceding dam was close to decommissioning, thereby minimising the area of impact at any one time and increasing the likelihood of mobile fish and invertebrate survival. Each coffer dam cell would be closed at low tide to minimise the quantity of water to be removed from the enclosure. Efforts would be made to herd, catch and release larger fish and macroinvertebrates to ensure their survival.

Remediation works on the Lednez site would involve major earthworks and the stripping of vegetation cover from the surface. There is therefore the potential for pollution of the bay by water-borne sediment due to land degradation and construction activities.

On-site management measures to control these effects would include:

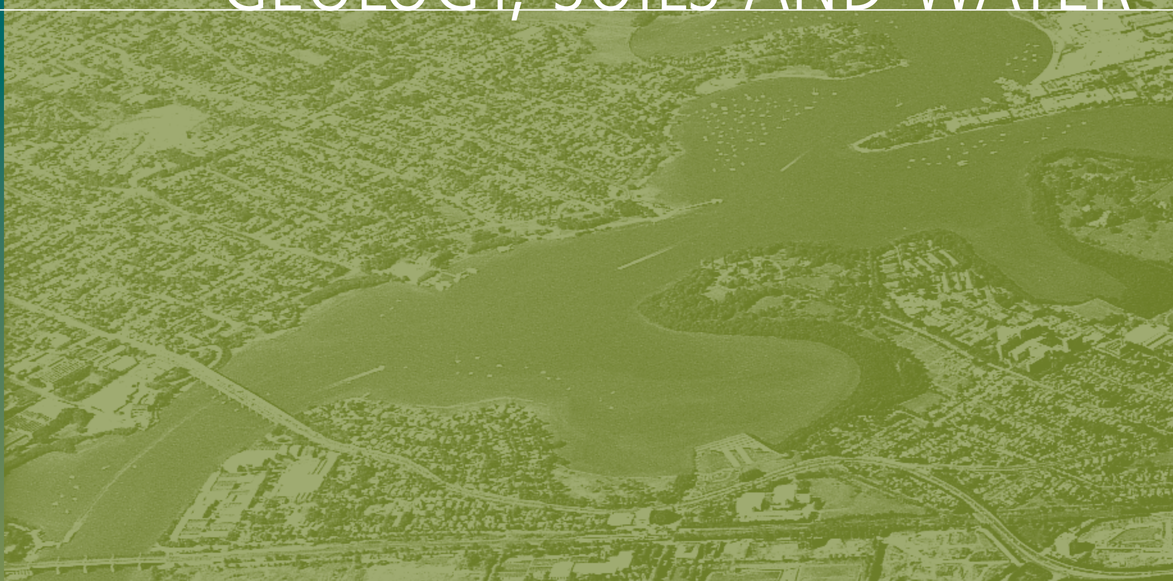
- staging development activities to minimise land disturbance
- restricting vehicle access to designated and stabilised entry and exit points
- providing sediment ponds, sediment fences, catch drains, check dams, straw bale filters and other structures to collect and treat “dirty” run-off from disturbed areas
- diverting “clean” run-off from upstream areas around disturbed construction areas
- monitoring control measures and in particular discharges from sediment basins
- temporarily stabilising stockpiles and disturbed areas not associated with the ongoing remediation operations
- stabilising and vegetating areas immediately after completion of the works
- providing vegetated buffer strips to isolate undisturbed, stable and rehabilitated areas from disturbed areas.

Considering that the physical impacts of the proposed works would be localised, bay-wide monitoring of fish and mobile invertebrates is not proposed.

Chapter 8

REMEDIATION OF LEDNEZ SITE, RHODES and HOMEBUSH BAY

GEOLOGY, SOILS AND WATER



Chapter 8

GEOLOGY, SOILS AND WATER

8.1 Geology

The geological profile underlying the Lednez site has been interpreted based on published geology maps and bore logs from the various contamination investigations, bore logs from investigation of the neighbouring Meriton site (JET, 1993) and from three cored boreholes drilled to depths of around 30 metres in 2000 by URS for Thiess Services.

The basement geology of Homebush Bay comprises Triassic age strata consisting of the lower part of the Ashfield Shale (Wianamatta Group), underlain by Hawkesbury Sandstone. A transitional unit known as the Mittagong Formation occurs between the Ashfield Shale and Hawkesbury Sandstone. The lithology of these strata is as follows:

- Ashfield Shale – dark grey to black sideritic claystone to siltstone, with thin siltstone and sandstone laminae
- Mittagong Formation – fine- to medium-grained quartz sandstone with interbedded siltstone and laminite
- Hawkesbury Sandstone – medium- to coarse-grained quartz sandstone with minor shale and laminite horizons.

The upper few metres of the Ashfield Shale comprise mottled grey/brown residual clays resulting from weathering processes. Data from site investigation boreholes indicates that this residual clay is approximately one to two metres in thickness. The upper one to two metres of shale below the residual clay is highly fractured.

Estuarine deposits of marine mud are present above the residual clay in much of the area reclaimed from Homebush Bay. These consist of dark-grey or black clays, often containing shell fragments and have a thickness of up to 3.5 metres.

The 1:25,000 Acid Sulphate Soil Risk Map, Parramatta Sheet prepared by the NSW Department of Land and Water Conservation indicates that there is a high probability of acid sulphate soil occurring within one metre of the ground surface.

The detailed geology of the Lednez site is presented as three interpretive cross-sections drawn perpendicular to the Homebush Bay shoreline. The lines of section are shown on **Figure 8.1** and the cross sections are provided in **Figures 8.2** to **8.4**.

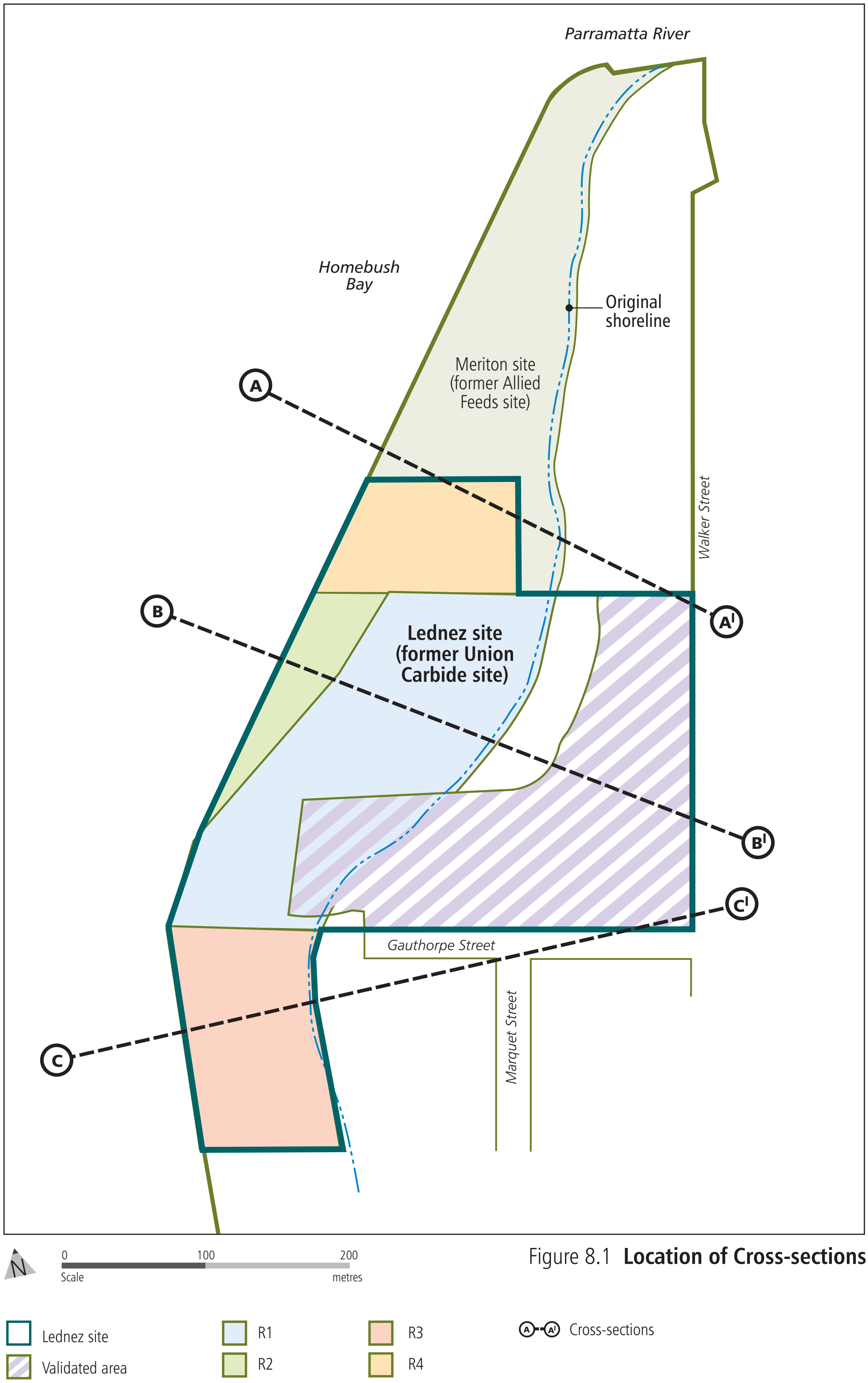


Figure 8.1 **Location of Cross-sections**

SECTION A–A^I (Northern Cross-section)

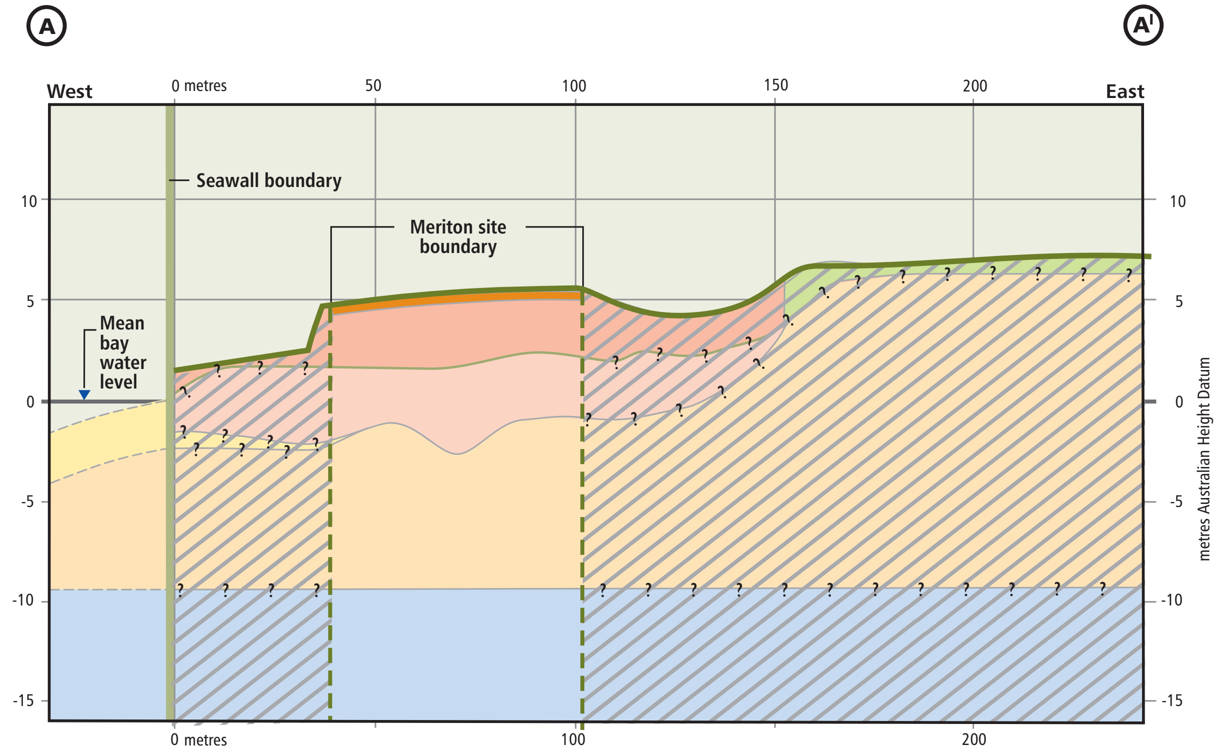


Figure 8.2 **Generalised Cross Section of Reclamation Area R4**

- Mixed fill – encapsulated (clayey fill material, shale, sandstone, rubble, and compacted concrete rubble)
- Boiler ash and spent lime
- Marine mud
- Residual clay
- Shale
- Sandstone
- Clay cap
- ? Indicates exact geology is unknown as it is outside boundary of the Lednez site
- Existing surface
- Previous surfaces

SECTION B–B

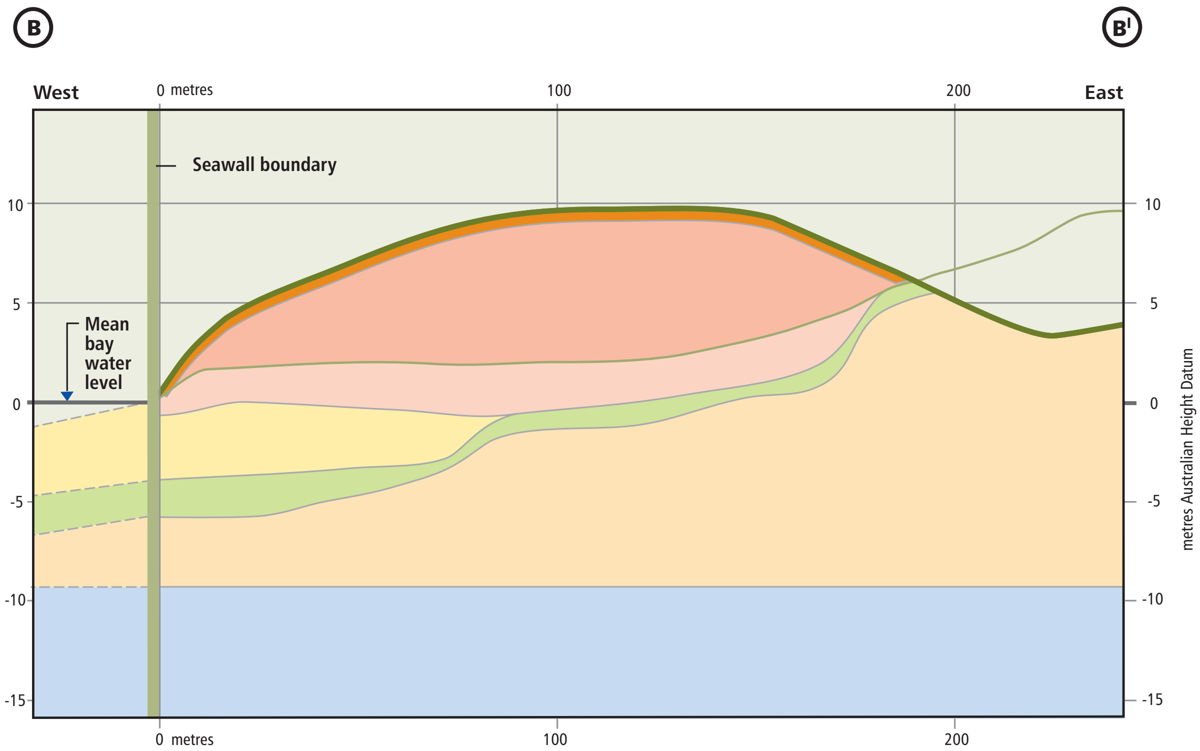


Figure 8.3 **Generalised Cross Section of Reclamation Area R1 and R2**

- Mixed fill – encapsulated (clayey fill material, shale, sandstone, rubble, and compacted concrete rubble)
- Mixed fill, boiler ash and spent lime
- Marine mud
- Residual clay
- Shale
- Sandstone
- Clay cap
- Existing surface
- Previous surfaces

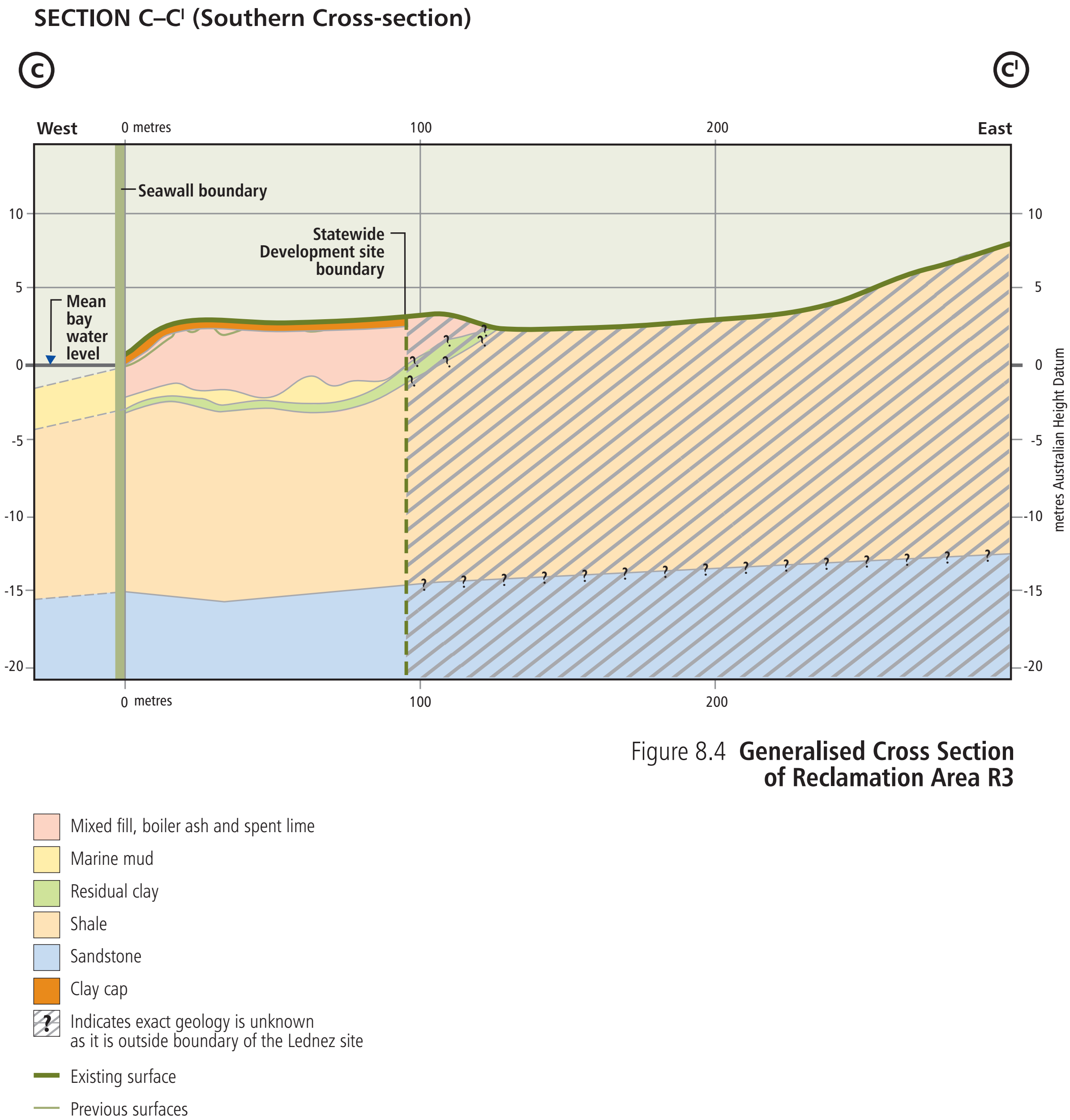


Figure 8.4 **Generalised Cross Section of Reclamation Area R3**

8.1.1 Mitigation of Potential Impact by Acid Sulphate Soils

It is highly probable that acid sulphate soils would be encountered by the works proposed. Consequently, for the purpose of this remediation proposal, all sediments excavated from the bay and reclaimed areas on the site would be assumed to be potential acid sulphate generating material. Accordingly, the analytical suite for classification samples obtained for those materials would include oxidisable sulphur.

Post-analysis, the results would then be interpreted in accordance with:

- *Environmental Guidelines for Assessing and Managing Acid Sulphate Soils,* EPA, 1995d
- *Acid Sulphate Soils Management Advisory Committee Draft Acid Sulphate Soils Planning Guidelines*, Department of Urban Affairs and Planning, 1997.

Excavated materials classified as acid sulphate soils would be treated by adding an appropriate quantity of lime as determined by the analytical results before placement of these materials on-site. The addition and mixing of lime would be by conventional mechanical methods such as spreading and turning using hydraulic excavators.

Where temporary stockpiling of untreated acid sulphate soils was required, the following additional management procedures would be followed:

- regular monitoring of the pH of the stockpiles
- collection and management of any waters that drain from the stockpiles
- regular watering of stockpiles
- maintain a stock of lime on-site to be available to immediately balance pH where acid conditions occur
- storage of untreated material on-site for periods exceeding two weeks would be limited. Where stockpiling exceeded two weeks, the material would be regularly spray-irrigated and the pH would be monitored daily. If a pH of less than six were detected, the materials would be immediately treated with lime.

8.2 Groundwater

8.2.1 Regional Hydrogeological Setting

The Lednez site lies on the western side of the Rhodes Peninsula. Ashfield Shale followed by Mittagong Formation and Hawkesbury Sandstone underlies the peninsula. A weathered profile of residual clay overlies the Ashfield Shale and marine muds overlie the residual clay in the reclaimed area.

Regional groundwater systems occur in the Hawkesbury Sandstone and the Ashfield Shale strata. The Ashfield Shale is a fracture flow aquifer, with groundwater occurring and being transmitted predominantly through the fracture system. This comprises both bedding plane partings and sub-vertical cracks/fractures. Permeability is generally low, but can be moderate in highly fractured strata. In the Sydney Basin permeabilities are generally in the range of 0.0001 to 0.05 metres per day.

Because of the low permeability of the rock mass, the Ashfield Shale generally behaves as a semi-confined aquifer system.

Groundwater in the Ashfield Shale is generally brackish to saline, reflecting the marine origin and low permeability of the formation. Groundwater recharge in the shale occurs from local rainfall, with discharge to the Parramatta River estuary.

The Hawkesbury Sandstone is also a fracture flow aquifer, although the rock mass is of higher permeability than that of the Ashfield Shale and is likely to make a slightly greater contribution to groundwater flow. Permeability is moderate, ranging from 0.001 to 0.1 metres per day.

The Hawkesbury Sandstone behaves as a confined aquifer system where overlain by the shale and a semi-confined system where it is exposed at the surface.

Groundwater quality in the Hawkesbury Sandstone is generally fresh in outcrop areas, but tends to be brackish to saline where the sandstone is confined by shale. Groundwater recharge in the Hawkesbury Sandstone occurs by regional inflow, leakage from the overlying shale and limited rainfall recharge. Groundwater discharge is probably to the Parramatta River estuary.

8.2.2 Local Hydrogeological Setting

A perched groundwater system can be present in the weathered profile and fill overlying the Ashfield Shale, where a reasonable thickness is present. Groundwater is likely to be ephemeral at higher sites.

Groundwater quality is generally fresh to brackish reflecting rainfall recharge and shale bedrock conditions.

8.2.3 Groundwater Levels and Flow

Fractured Rock Aquifers

Groundwater flow is controlled by the estuary tidal water level on both sides of the peninsula. Rainfall recharge results in the creation of a recharge mound along the axis of the peninsula, with groundwater flowing in generally easterly and westerly directions from either side of the axis to Homebush Bay or Brays Bay/Parramatta River. There may be a more regional component of flow in the Hawkesbury Sandstone from the south.

Hydrogeology of the Site

Detailed hydrogeology of the Lednez site has been established during drilling and installation of piezometers during the various contamination investigations. These investigations concentrated on shallow hydrogeology, principally within the fill material.

The shallow hydrogeology of the site is controlled by two main factors: the presence of a bentonite wall close to the bay and the presence and nature of the fill material. The bentonite wall runs parallel to the seawall, at a distance of 15 to 20 metres inland. No remediation of the area between the seawall and the existing bentonite wall has taken place. The bentonite wall is expected to have a very low hydraulic conductivity (0.00001 to 0.0001 metres per day) and groundwater flow rates through the wall would be very low.

The fill material present on the Lednez site is highly variable and includes spent lime sludge, boiler ash, clay and sandstone. In general, hydraulic conductivities are expected to be low, but localised areas or layers of moderately conductive material may be present.

Perched groundwater is present within the fill material. Levels on the seaward side of the existing bentonite wall show a tidal influence (JET, 2001). Perched groundwater levels in the encapsulation mound range from 0.47 metres Australian Height Datum south-west of the stormwater basin to 2.25 metres Australian Height Datum on the eastern side of the encapsulation mound (April 2001 levels – JET 2001). Levels fluctuate with rainfall conditions by 0.5 to 1 metre, but do not show a long-term trend. Groundwater flow in the consolidation mound appears to be towards the areas excavated as part of the previous remediation works.

Groundwater Quality

Groundwater in the natural fractured rock aquifers is likely to be saline. Accordingly, it is not likely to be used on-site or in the future as a water source.

The existing quality of the perched groundwater in the encapsulation mound and the foreshore strip to the west of the bentonite wall reflects the presence of contaminants in the fill material and soils. Regular sampling and analysis of groundwater and foreshore seep water (low tide seepages at the bed of the bay immediately adjacent the seawall) has taken place at approximately six-monthly intervals from March 1999, with analysis for a range of organic contaminants, including total petroleum hydrocarbons (TPHs), polycyclic aromatic hydrocarbons (PAHs), chlorinated phenols, chlorinated benzenes, DDT-related pesticides and dioxins. The results from the April 2001 sampling program are summarised in **Table 8.1**.

Table 8.1 Summary of Groundwater Quality Results, April 2001

Chemical	Units	Groundwater (five sites)	Seepage water (two sites)	Assessment criteria
TPH	µg/L	nd to 6003	nd	–
Naphthalene	µg/L	nd to 180	nd	70[1]
Benzo(a)pyrene	µg/L	nd	nd	0.2[2]
Total PAHs	µg/L	nd to 180	nd	3[2]
2,3-dichlorophenol	µg/L	nd to 160	nd	31[1]
Chlorobenzene	µg/L	0.81 to 960	nd to 0.22	55[1]
Hexachlorobenzene	µg/L	nd to 0.65	nd	0.1[1]
1,2,3,4-tetrachlorobenzene	µg/L	nd to 580	nd to 0.13	4[1]
DDT	µg/L	nd to 1.5	nd to 0.19	0.01[1]
TCDD (TEQ)	pg/L	4 to 157	nd to 30	10[3]

Notes:
1. ANZECC, 2000
2. Modified NEPM (after Egis, 2002)
3. Canadian Marine Water Quality (after EGIS, 2002b)
4. nd – not detected in sample
5. µg/L is micrograms per litre
6 pg/L is picograms per litre

Criteria for the assessment of groundwater quality with respect to potential impacts on the bay have been developed by Egis (2002b) based mainly on the ANZECC (2000) and NEPM (1999) guidelines. The results of the April 2001 sampling round indicate that concentrations of contaminants in groundwater and seepage presently exceed relevant criteria at a number of locations.

8.2.4 Potential Impacts on Groundwater and Mitigation Measures

The proposed remediation scheme for the Lednez site includes excavation of contaminated fill and natural material from the site, including both the un-remediated area to the west of the bentonite wall and the encapsulation mound. Category 2 and Category 3 material would be replaced in the excavated areas to provide the new landform for development. The proposal also includes excavation of natural material from the regrade borrow beneath Shoreline Avenue.

The risks posed to groundwater beneath the site by the proposed remediation scheme are as follows:

- mobilisation of contaminants resulting from disturbance during excavation and removal of contaminated material (dissolution and release of colloidal material into suspension)
- release of contamination to shallow groundwater during stockpiling or treatment of contaminated soil
- discharge of contaminated water to the ground
- long-term migration of chemicals from reinstatement material (Category 2 and/or Category 3).

During excavation, some of the perched groundwater would also be removed. Depressed perched groundwater levels could be expected to occur at this time. The impacts to the deeper fractured rock aquifers are expected to be minimal except in the area of the regrade borrow. In this area the risk to regional groundwater is limited to the long-term migration of chemicals from reinstatement materials.

Mobilisation During Excavation

Excavation of contaminated material has the potential to mobilise contamination by allowing greater contact between free-phase contaminants and water and by agitation bringing colloidal particles (onto which hydrophobic contaminants are adsorbed) into suspension. These mechanisms are particularly important where excavation takes place below the water table.

The hydrophobic nature of most of the contaminants of concern limits the potential for such impacts. In addition, colloidal transport is only significant in large-diameter fracture flow systems. Such conditions are not present within the anticipated zone of contaminated material excavation.

Excavation of potentially contaminated material is expected to extend to minus two metres Australian Height Datum. Perched groundwater is present in the encapsulation mound and in fill and natural strata (mostly marine mud and residual clays) in the area to the west of the bentonite wall and contaminated groundwater is likely to be encountered during excavation in both these areas.

The proposal includes excavation of materials from the regrade borrow in the shale/sandstone. Groundwater is likely to be encountered during this excavation, both from seepage from the overlying fill material and within the shale itself. The shale groundwater is expected to be free from contamination and brackish to saline.

If in certain areas permeabilities are higher than anticipated, it may be necessary to dewater during excavation to improve the characteristics of the excavated material. Consequently, pumped groundwater must be tested to establish contaminant concentrations and treatment may be necessary, particularly during excavation of the highly contaminated areas.

Release During Surface Activities

Surface activities during the remediation program could allow release of contamination to the groundwater system. Stockpiling of contaminated soils (particularly free-draining, saturated material such as bay sediments and material excavated from below the water table) and storage of contaminated water in basins or dams are of particular concern.

Potentially contaminated soils would be stored over potentially contaminated material, or otherwise on hard standing areas or sealed surfaces, with drainage contained and directed to the dirty water system.

Any basins to be used for storage of potentially contaminated water would be provided with a low-permeability liner such as compacted clay or a flexible high-density polyethylene membrane.

Discharge of Contaminated Water

All potentially contaminated water would be contained in the dirty water system and tested to determine the appropriate treatment and disposal option.

Long-term Chemical Migration

Long-term migration through the groundwater system from residual chemicals in the reinstatement material would occur through dissolution. Migration would be expected to be extremely slow through the material reinstatement strata because of the low solubility of most of the chemicals present and the low permeability and high clay content of the strata. In the area of the deeper regrade borrow excavation, chemical migration would depend on fracture flow in the shale/sandstone strata. Attenuation mechanisms such as hydrophobic sorption, biological degradation, hydrolysis, other sorption reactions and volatilisation would act to reduce concentrations of chemicals and are likely to prevent contamination of bay waters.

The potential for migration of chemicals in all groundwater systems has been assessed using a comprehensive groundwater and contaminant transport model. This model is described in detail in **Technical Paper 7** and **Section 8.2.5**.

8.2.5 Contaminant Transport Modelling

The groundwater model has been developed as a two-dimensional representation based on a cross-section through the Lednez site, perpendicular to the shoreline. This allows prediction of flow conditions and contaminant transport down the flow path from contaminant sources.

The conceptual model is relatively straightforward, consisting of a layered aquifer system to represent the Hawkesbury Sandstone, Ashfield Shale and the overlying residual clay, marine mud and reinstatement materials, including those placed in the regrade borrow excavation beneath Shoreline Avenue. The model extends from the bay shoreline to 350 metres inland, with a fixed head boundary to represent the bay water level and another at the top of the ridgeline to represent the estimated groundwater level along the axis of the peninsula. Rainfall recharge is represented based on the final landform and surface. The base of the model is a no-flow boundary set at an arbitrary depth of minus 30 metres Australian Height Datum.

The contaminant transport model is a transient simulation of contaminant behaviour within the steady-state hydraulic model. The model used is MT3DMS, a multi-species model capable of simulating a range of contaminant transport and reaction processes. Transport was modelled using advective flow with longitudinal dispersion and dilution. The only reaction process simulated was hydrophobic sorption of the organic contaminant on organic carbon in the substrate. Other potentially attenuative processes, particularly biological degradation, hydrolysis, other sorption reactions and volatilisation, have not been simulated because of the difficulties in simulating these processes accurately. These processes would be important in the removal of organic contaminants and their omission means that the model results would be highly conservative, with substantial over-estimation of contaminant concentrations likely.

The model simulates the behaviour in groundwater of seven chemicals: phenol; naphthalene; dioxin; chlorobenzene; 1,2,3,4-tetrachlobenzene; hexachlorobenzene; and benzo(a)pyrene. These were selected to ensure representation of the main chemicals of concern, those present on the site at relatively high concentrations and a range of aqueous mobilities.

Reinstatement materials containing residual concentrations of chemicals have been simulated using constant concentration boundaries. Material has been divided into three categories for solid phase concentration of chemicals: material to be placed at depths of less than five metres, material to be placed at depths greater than five metres and geotechnically limited regrade material to be placed in the regrade borrow. Initial aqueous concentrations were calculated from the chemical species and soil characteristics and the appropriate soil acceptance criteria developed by Egis (2002a), or the 95 percentile observed contaminant concentrations where no criterion is available.

The output from the contaminant transport model indicates that:

- migration of chemicals is almost solely horizontal down the hydraulic gradient, except to/from the regrade borrow excavation
- steep upward hydraulic gradients in and around the regrade borrow excavation result in predominately upward migration into the shallow fill material rather than lateral migration through the shale and sandstone
- extent of migration of most chemicals is limited to 15 to 20 metres from the up-gradient contaminant source.

Breakthrough of naphthalene, chlorobenzene and phenol is predicted at the seawall in a timeframe ranging from over one million days (2,800 years) for phenol, to around 30 million days (over 80,000 years) for naphthalene. Maximum concentrations occur after considerably longer periods (seven million days for phenol) and are similar to the initial release concentrations of around 37 milligrams per litre for phenol, 18 milligrams per litre for chlorobenzene and 11 milligrams per litre for naphthalene.

Given the extremely long travel times predicted and the highly conservative approach taken to modelling, it is highly unlikely that detectable chemical concentrations would reach the bay from reinstatement materials. However, confirmatory testing of various soil parameters would be carried out during remediation to confirm the assumptions used in the model.

Details of the contaminant model study are provided in the remediation action plan for the Lednez site in **Technical Paper 7**.

Confirmatory Testing and Precautionary Measures

Testing would be required during the remediation process to confirm that the model assumptions are realistic. This would include the following:

- testing of contamination concentrations in reinstatement material and natural materials
- testing of the organic carbon content of reinstatement material and natural strata
- confirmation of final hydraulic conductivity of reinstatement material.

Should the organic carbon content of the reinstatement material be found to be substantially lower than anticipated, adjustment by the addition of charcoal or a similar carbon substrate is proposed. Similarly, should the hydraulic conductivity of the reinstatement materials be higher than expected, addition of clay and/or increased compaction may be required.

In addition to the above it is proposed that the following measures be incorporated into the proposal to further minimise the risk of contaminant migration to Homebush Bay:

- a high-permeability zone (coarse-crushed rock/aggregate or similar with hydraulic conductivity greater than 10 metres per day) immediately behind the seawall to enhance a tidal flushing. This material would meet the soil acceptance criteria as setout in **Table 4.7**
- a compacted-clay, low-permeability (0.001 to 0.01 metres per day or 0.00000001 to 0.0000001 metres per second) barrier at least three metres wide (measured perpendicular to the shoreline) on the landward side of the high permeability zone and extending to the full depth of the reinstatement materials.

The groundwater model predicts steady-state final groundwater levels close to the proposed building basement levels in places. Accordingly, design of basements would need to consider any features that penetrate the groundwater table and could act as preferential pathways for groundwater flow. Such features typically include service trenches and related structures. Where basement levels or services are close to the final groundwater level, tanking may be necessary.

Requirements for Groundwater Monitoring

Monitoring of groundwater conditions during and after remediation may be required to demonstrate that the groundwater system is behaving as predicted. The decision as to whether a monitoring program is needed would be made once validation data is available on actual residual concentrations of chemicals in the reinstatement material and parameters such as organic carbon content and hydraulic conductivity. Given the extremely long timescales predicted and the conservatism inherent in the model, groundwater monitoring is not proposed unless final conditions are worse than anticipated in terms of the key parameters of residual concentrations, organic carbon content and hydraulic conductivity.

8.3 Surface Water

8.3.1 Site Hydrology and Drainage Patterns

Previous remediation work on the Lednez site has resulted in the current landform. As shown in **Figure 8.5**, significant features include:

- an L-shaped basin considerably lower than its immediate surrounds at a level of less than one metre Australian Height Datum is located in the central portion of the site and drains to an outlet structure at the south-west end
- a mound rising to a level higher than nine metres Australian Height Datum located to the north of the L-shaped basin.

As part of the earlier remediation work, the Lednez site surface was rehabilitated and stabilised. Poor vegetation cover currently exists over much of the Lednez site, except for the lower south-west portion of the L-shaped basin, which is frequently under water. The area acts as a sediment basin, ensuring that surface water sediments are trapped before water is discharged into Homebush Bay.

Natural drainage from the Lednez site and immediate surrounds is generally from Walker Street in the east, which is located along a ridgeline, to Homebush Bay in the west (see **Figure 8.5**). Ground levels at Walker Street are of the order of 14 metres Australian Height Datum falling over a distance of approximately 320 metres to about three metres Australian Height Datum at the seawall.

About 5.8 hectares of the Lednez site, extending back up to Walker Street, drains into the L-shaped basin. Discharge from the basin is via an outlet structure into the bay. The remainder of the site drains directly to the bay.

Walker Street runs parallel to the railway line and is located approximately 25 metres to the west of the line. The strip of land between the street and the railway falls westwards to the street. Due to the longitudinal gradient of the street, which crests at the Lednez site, any run-off from this area is directed north and south along the street away from the Lednez site. Run-off from this area would have no impact on the site.

The land to the east of the railway line falls towards the east. Run-off from this area has no impact on the Lednez site.

8.3.2 Surface Water Quality

In 1997, AGC Woodward-Clyde undertook an environmental investigation in relation to the former Orica site to assess the potential environmental impacts of remediation of that site.

That project included limited monitoring of surface water quality at Homebush Bay to determine whether the quality of the discharge from the Orica site complied with EPA pollution control limits. Monitoring was conducted from December 1994 to 1997.

Results showed that concentrations of oil and grease (between less than two milligrams per litre and five milligrams per litre) and non-filterable residue (between less than two milligrams per litre and 17 milligrams per litre) were below the EPA licence limits of 10 milligrams per litre for oil and grease and 50 milligrams per litre for non-filterable residue.

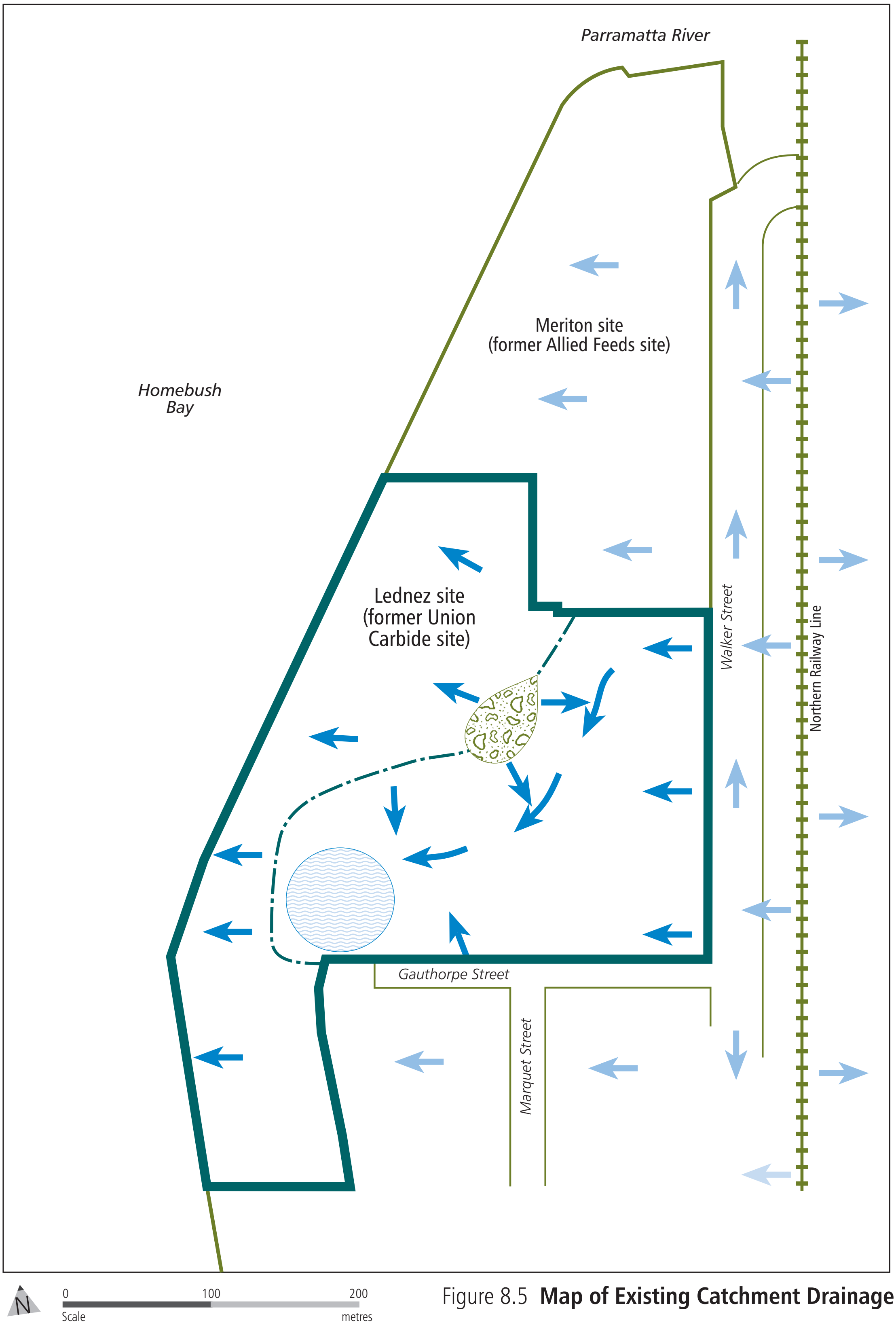


Figure 8.5 **Map of Existing Catchment Drainage**

- Lednez site boundary
- Existing mound at greater than nine metres above Australian Height Datum
- Existing low spot used as sediment basin at less than one metre above Australian Height Datum
- Clean water off-site
- Dirty water on-site
- Ridge line which acts to divide surface water flow

Water Quality Sampling, 2002

As part of this EIS, a surface water study was undertaken by PB for the purpose of providing a snapshot of water quality conditions at Homebush Bay. The study took place during February and March 2002 and included both wet weather and dry weather sampling events with analysis for a range of nutrients, metals and organic compounds, including dioxins.

Surface water sampling during wet weather conditions was undertaken on 8 February 2002. Due to breakage of sampling bottles during transit, all three sites were re-sampled for dioxin analysis on 13 March 2002. Dry weather sampling was undertaken on 27 March 2002. On both occasions, surface water samples were collected from three locations along the shore of the Lednez site, to provide an indication of bay water quality variability. Sampling locations are shown in **Figure 8.6**. The results of field tests and laboratory analysis are presented in **Table 8.2**, **Table 8.3** and **Table 8.4**.

As can be seen from **Tables 8.2**, **8.3** and **8.4**, with a few notable exceptions the sample analyses are generally consistent with the values set out in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000), although comparative guidelines were not available for all analytes. Those values that exceeded the trigger value limits are considered consistent with past industrial activity carried out at the site.

The following summarises the Homebush Bay water quality results:

- total nitrogen and phosphorus exceeded the adopted water quality criteria in all samples
- endrin exceeded the adopted water quality criterion for sample WQ2W (wet weather)
- lead and zinc exceeded the adopted water quality criterion for all samples
- copper exceeded the adopted criterion for all wet weather samples and for WQ2D (dry weather)
- mercury exceeded the adopted water quality criteria for all dry weather samples
- dioxin and furan results are elevated and exceed the only available guideline value (Canadian Water Quality Guidelines, CCME, 1999, 2001) for all samples, with particularly high results for WQ2 under both wet and dry conditions.

In summary, water quality in Homebush Bay adjacent to the Lednez site is generally fair, but poor in terms of dioxin concentrations. The water is also elevated in terms of nutrients, metals and some organic compounds. Overall, the results of wet weather sampling indicate slightly lower chemical concentrations than those from dry weather sampling.

Water quality results for sampling point WQ2 show markedly higher concentration of most contaminants than at other locations under both wet and dry conditions.

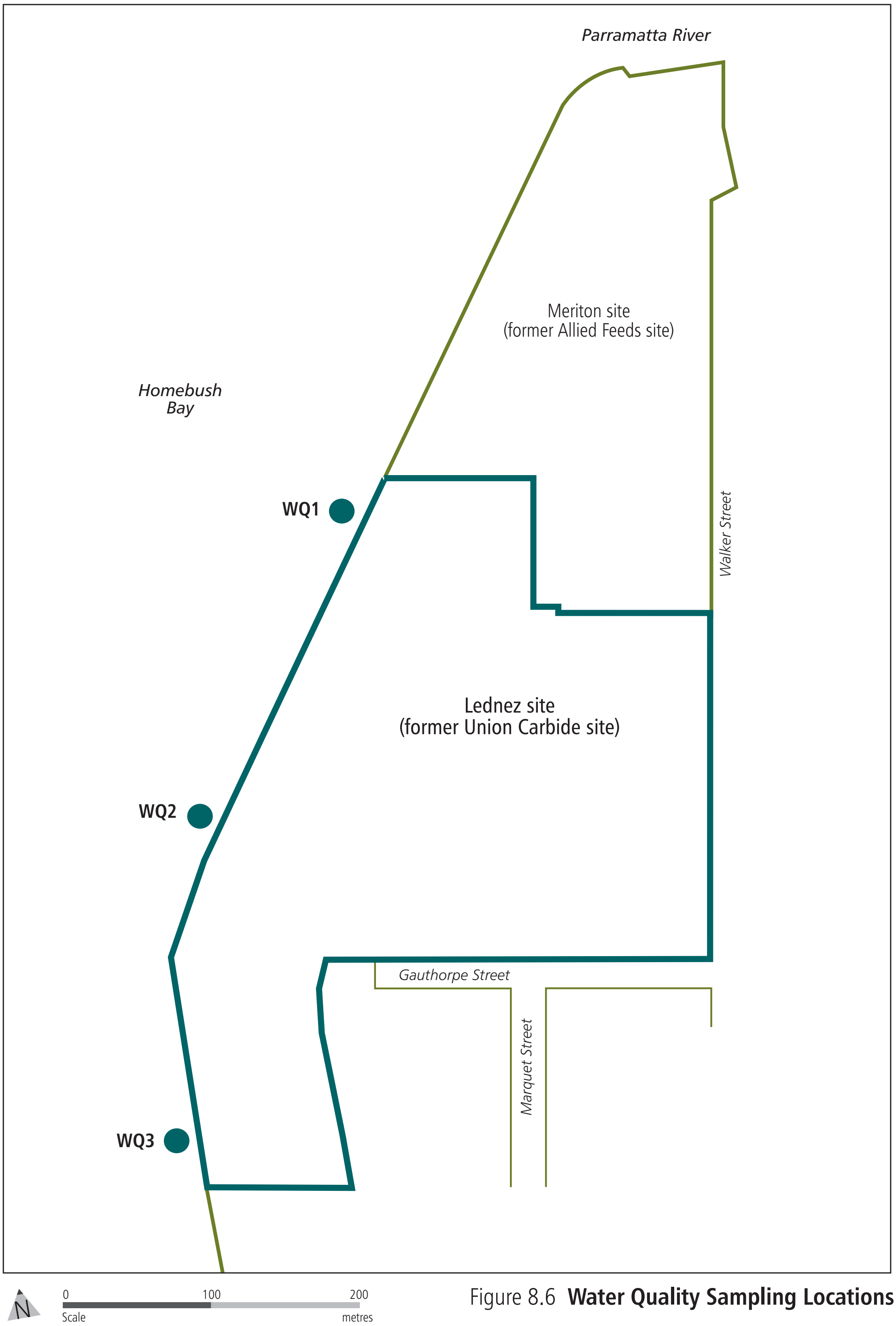


Figure 8.6 **Water Quality Sampling Locations**

Lednez site boundary

Water sampling locations

WQ3 Sample reference number

Table 8.2 Wet Weather Results

Analyte	Units	PQL	Samples from Homebush Bay			ANZECC 2000 Water quality criteria
			WQ1	WQ2	WQ3	
Turbidity	NTU	0.1	23	68	26	NA
Suspended solids	mg/l	1	18	130	21	NA
Total nitrogen	mg/l	0.1	2	2	2	0.3[1]
Nitrate as N	mg/l	0.01	0.83	0.73	0.79	0.015[1]
Nitrite as N	mg/l	0.01	0.06	0.06	0.06	NA
TKN	mg/l	0.1	1.2	1.2	1.2	NA
Total phosphorus	mg/l	0.01	0.16	0.28	0.17	0.03[1]
Ammonia as Nitrogen	mg/l	0.1	0.31	0.35	0.34	0.91[2]
TPH	µg/L	20	ND	ND	ND	NA
Benzene	µg/L	0.5	1.2	ND	ND	500
Toluene	µg/L	1	ND	ND	ND	NA
Ethylbenzene	µg/L	1	ND	ND	ND	NA
Xylenes	µg/L	2	ND	ND	ND	NA
Naphthalene	µg/L	0.1	ND	ND	ND	50[2]
Total PAHs	µg/L	0.1	ND	ND	ND	NA
Dieldrin	µg/L	0.01	0.02	0.02	ND	NA
Endrin	µg/L	0.01	ND	0.02	ND	0.004[2]
DDE	µg/L	0.01	ND	0.03	ND	NA
DDD	µg/L	0.01	0.12	0.44	ND	NA
DDT	µg/L	0.01	0.02	0.05	ND	NA
Phenol	µg/L	5	ND	ND	ND	400[2]
2-Chlorophenol	µg/L	5	ND	ND	ND	NA
Other phenolic compounds	µg/L	5	ND	ND	ND	NA
HCB	µg/L	0.01	ND	ND	ND	NA
Other OC/OP pesticides	µg/L	10	ND	ND	ND	NA
Lead	µg/L	20	9	24	12	4.4[2]
Zinc	µg/L	10	70	80	40	15[2]
Nickel	µg/L	5	8	7	6	7[2]
Cadmium	µg/L	0.5	ND	ND	ND	0.7[2]
Copper	µg/L	5	12	16	9	1.3[2]

Table 8.2 Continuation

Analyte	Units	PQL	Samples from Homebush Bay			ANZECC 2000 Water quality criteria
			WQ1	WQ2	WQ3	
Arsenic	µg/L	2	7	7	7	NA
Mercury	µg/L	0.05	0.07	0	0	0.1[2]
Chlorobenzene	µg/L	1	3	ND	ND	NA
Other chlorobenzene compounds	µg/L	1	0	ND	ND	NA

Notes: 1. ANZECC, 2000. Default Trigger Values – Environmental Stressors, Estuaries
2. ANZECC, 2000. Default Trigger Values – Toxicants, Marine Waters
3. µg/L is micrograms per litre
4. mg/L is milligrams per litre
5. NTU –nominal turbidity units
Shaded values exceed the adopted criteria
PQL Practical quantification limit; ND: not detected; NA: none available

Table 8.3 Dry Weather Results

Analyte	Units	PQL	Samples from Homebush Bay			ANZECC 2000 Water Quality Criteria
			WQ1	WQ2	WQ3	
Turbidity	NTU	0.1	80	180	130	NA
Suspended solids	mg/l	1	340	750	570	NA
Total nitrogen	mg/l	0.1	1.2	5.2	1.2	0.3[1]
Nitrate as N	mg/l	0.01	0.01	0.01	0.01	0.015[1]
Nitrite as N	mg/l	0.01	ND	ND	ND	NA
TKN	mg/l	0.1	1.2	5.2	1.2	NA
Total Phosphorus	mg/l	0.01	0.39	4	0.71	0.03[1]
Ammonia as N	mg/l	0.1	0.15	0.53	0.1	0.91[2]
TPH	µg/L	20	40	ND	ND	NA
Benzene	µg/L	0.5	27	ND	ND	500[2]
Toluene	µg/L	1	ND	ND	ND	NA
Ethylbenzene	µg/L	1	ND	ND	ND	NA
Xylenes	µg/L	2	ND	ND	ND	NA
Naphthalene	µg/L	0.1	2.4	0.4	ND	50[2]
Total PAHs	µg/L	0.1	5.2	14	3.2	NA
Dieldrin	µg/L	0.01	* <0.1	* <0.1	* <0.1	NA
Endrin	µg/L	0.01	* <0.1	* <0.1	* <0.1	0.004[2]
DDE	µg/L	0.01	0.24	0.74	*<0.1	NA
DDD	µg/L	0.01	5.6	8.6	0.22	NA

Table 8.3 Continuation

Analyte	Units	PQL	Samples from Homebush Bay			ANZECC 2000 Water quality criteria
			WQ1	WQ2	WQ3	
DDT	µg/L	0.01	1.2	0.49	*<0.1	NA
Phenol	µg/L	5	ND	ND	ND	400[2]
2-Chlorophenol	µg/L	5	ND	ND	ND	NA
Other phenolic compounds	µg/L	5	ND	ND	ND	NA
HCB	µg/L	10	470	620	*<0.1	NA
Other OC/OP pesticides	µg/L	10	ND	ND	ND	NA
Lead	µg/L	20	101	299	164	4.4[2]
Zinc	µg/L	10	150	580	270	15[2]
Nickel	µg/L	5	*<100	*<100	*<100	7[2]
Cadmium	µg/L	0.5	*<100	*<100	*<100	0.7[2]
Copper	µg/L	5	*<100	128	*<100	1.3[2]
Arsenic	µg/L	2	*<100	*<100	*<100	NA
Mercury	µg/L	0.05	0.26	0.48	0.26	0.1[2]
Chlorobenzene	µg/L	1	50	2	ND	NA
Other chlorobenzene compounds	µg/L	1	76	2	ND	NA

Notes:
1. ANZECC, 2000. Default Trigger Values – Environmental Stressors, Estuaries
2. ANZECC, 2000. Default Trigger Values – Toxicants, Marine Waters
3. µg/L is micrograms per litre
4. mg/L is milligrams per litre
5. NTU –nominal turbidity units

Shaded values exceed the adopted criteria

PQL Practical Quantification Limit; ND: not detected; NA: none available

* PQL raised due to matrix interference

Table 8.4 Dioxin Results

Analyte	Units	Wet weather results			Dry weather results			Water quality criteria
		WQ1	WQ2	WQ3	WQ1	WQ2	WQ3	
2378 TCDF	pg/L	7.9	130	14	44	8.0	5.2	NA
Total TCDF	pg/L	660	5,200	560	1,200	140	180	NA
2,3,7,8-TCDD	pg/L	320	6,100	330	1,200	220	140	NA
Total TCDD	pg/L	1,300	10,000	940	2,200	530	290	NA
Total PeCDF	pg/L	760	5,500	1200	2,700	420	180	NA
Total PeCDD	pg/L	780	6,500	1000	2,200	410	230	NA
Total HxCDF	pg/L	1,300	15,000	2400	4,800	880	590	NA
Total HxCDD	pg/L	1,900	40,000	2500	11,000	2,500	1,700	NA
Total HpCDF	pg/L	3,400	53,000	5000	13,000	2,600	1,900	NA
Total HpCDD	pg/L	17,000	360,000	22000	110,000	25,000	18,000	NA
OCDF	pg/L	5,600	60,000	7800	17,000	3,500	2,300	NA
OCDD	pg/L	130,000	2,000,000	160000	670,000	170,000	120,000	NA
Total dioxins and furans	pg/L	163,000	2,560,000	203,000	834,000	206,000	145,000	NA
Total toxic equivalence	pg/L	690	12,100	815	3,080	652	445	101

Notes:
1. Canadian Water Quality Guidelines
2. NA – no available
3. pg/L is picograms per litre. The ANZECC 2000 guidelines do not provide a guideline value for dioxins. The only guideline value available is 0.01 nanograms per litre (or 10 picograms per litre) of 2,3,7,8-TCDD toxicity equivalents from the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME, 1999, 2001).

8.3.3 Potential Impacts on Surface Water and Mitigation Measures

Impacts on the water quality of Homebush Bay could occur during the remediation process as a result of uncontrolled surface water flows leading to transport of sediment and contamination from the site. Stormwater management measures would be required as part of the remediation proposal to protect the water quality of the catchment, Homebush Bay and surrounds. These measures which are outlined below, would form part of the overall water management plan. They would take into account the existing site constraints and the staging and construction requirements of the proposed remediation works.

The key surface water management strategy would be to isolate the contaminated water resulting from the remediation works from the "clean" and "dirty" surface water. This would be necessary because different treatment measures are required for the two water streams. "Clean" water in this context refers to run-off from upstream catchments as well as areas within the site that are unaffected by the remediation works. "Dirty" water refers to run-off from areas within the site that would be disturbed by remediation activities.

The basic intention of the surface water management plan would be to divert clean waters around and away from disturbed areas, whilst controlling dirty water using the structural measures outlined in **Chapter 6**. Dirty water would be collected in diversion drains and directed to sediment basins for settling out of the sediment. Where necessary, water would be treated before its discharge into Homebush Bay.

The remediation works would involve excavation and treatment of contaminated material and excavation of uncontaminated material. Various areas across the site would be used to stockpile material for classification and for storage, pending further treatment or placement on-site. The contaminated water would be processed through an on-site water treatment plant, details of which are described in **Chapter 6**.

The clean and dirty surface water would be handled in accordance with the guidance document *Managing Urban Stormwater: Soils and Construction* also known as the "Blue Book", published by NSW Department of Housing in 1998.

Water Quality Monitoring

Monitoring of water quality would be required for water discharged to the bay. The discharge of waters from the remediation site into the bay would require licensing from the EPA in accordance with the *Protection of the Environment Operations Act 1997*. Discharge criteria would be established in consultation with the EPA in accordance with that Act and the ANZECC 2000 water quality guidelines where necessary.

Erosion and Sediment Control Plan

The erosion and sediment control plan would focus on the minimisation of erosion and prevention of sediment movement off-site during the remediation works. The various control measures to be used on-site would include:

- staging remediation activities to minimise land disturbance
- restricting vehicle access to designated and stabilised entry and exit points
- providing sediment basins, sediment fences, catch drains, check dams, straw bale filters and other structures to collect and treat dirty run-off from disturbed areas
- diverting clean run-off from upstream areas around disturbed construction areas
- monitoring control measures and in particular discharges from sediment basins to ensure compliance with regulatory requirements, including the licence conditions for the site
- temporarily stabilising stockpiles and disturbed areas not associated with the ongoing remediation operations
- stabilising and vegetating areas immediately following completion of the works
- providing vegetated buffer strips to isolate undisturbed, stable and rehabilitated areas from disturbed areas.

Site conditions would change daily throughout the remediation works and the erosion and sediment control plan and control measure implementation would therefore need to respond to the particular site constraints prevailing at the time. Further details on the erosion and sediment control plan are given in the remediation action plan for the Lednez site provided in **Technical Paper 7**.

8.4 Flooding

8.4.1 Existing Flood Levels

The significant water body in relation to the site is Homebush Bay. Both Haslams Creek and Powells Creek drain into the southern end of Homebush Bay, which then drains into the Parramatta River.

The Parramatta River is the major influence on flooding in the bay. A previous study, *Powells Creek and Saleyards Creek Flood Study*, by Webb McKeown & Associates (October, 1998), quotes a one per cent annual exceedance probability design flood level of 1.40 metres Australian Height Datum in the bay (that is, there is a one per cent chance of a water level exceeding 1.4 metres Australian Height Datum occurring in any given year). This is equivalent to a 100 year Average Recurrence Interval. The same study quotes a design flood level of 3.21 metres Australian Height Datum for an extreme flood scenario, which is similar to a probable maximum flood event.

As the Lednez site is above the floodplain of the Parramatta River, it is not likely to be affected by a one in one hundred year flood event but would be affected by an extreme flood scenario of 3.21 metres. Local storm events may cause minor inundation of low-lying areas where drainage is inadequate.

The establishment of the coffer dams within the bay would be the only activity proposed which has the potential to affect flooding patterns in the catchment. However, any impact would be limited because only a small area of the bay (and the total Parramatta River catchment) would be occupied by the coffer dams at any one time.

8.4.2 Potential Impacts and Mitigation Measures

In the bay, coffer dams with crest levels set at 3.5 metres Australian Height Datum would be constructed around the area to be remediated. Adequate freeboard would be available to the one per cent annual exceedance probability flood level of 1.40 metres Australian Height Datum and a reduced freeboard of 0.29 metres would be available to the extreme flood level.

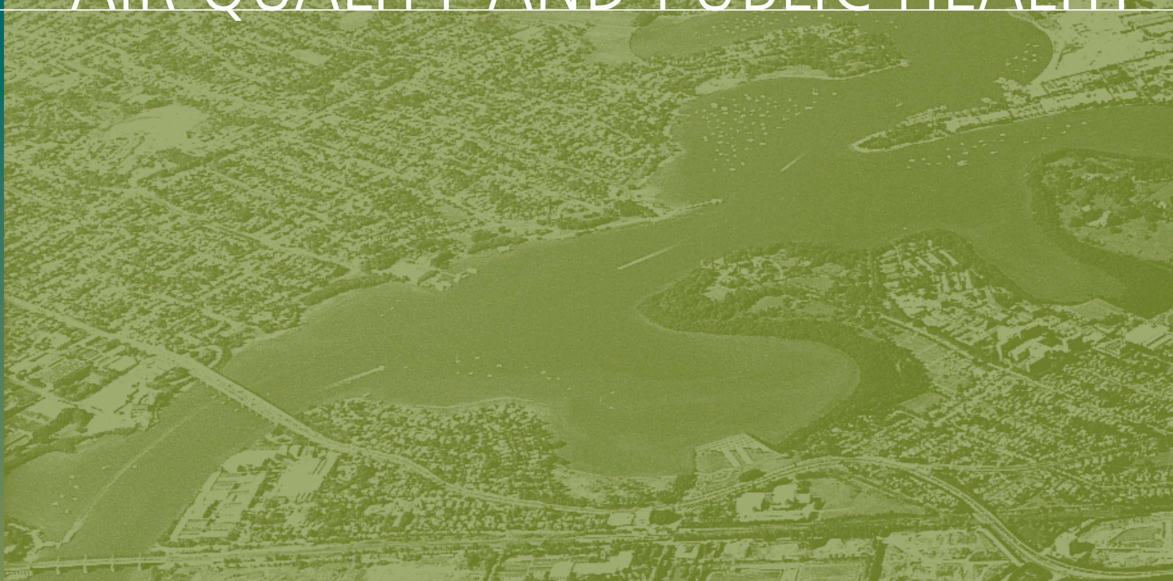
Remediation work on the land would move progressively southwards through the site in stages. The frontage onto Homebush Bay would be modified during these stages from an existing level of approximately two metres Australian Height Datum to the final landform level of 3.5 metres Australian Height Datum (refer **Figure 6.16**). A freeboard of more than two metres would therefore be maintained in relation to the one per cent annual exceedance probability flood level. A freeboard of 0.3 metres would be available in relation to the extreme flood level.

Chapter 9

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

AIR QUALITY AND PUBLIC HEALTH



Chapter 9

AIR QUALITY AND PUBLIC HEALTH

9.1 Introduction

Consideration of public health effects is an essential consideration in the assessment of any remediation activity. In the *National Framework for Environmental and Health Impact Assessment* (1993), the National Health and Medical Research Council asserts that:

> *"Healthy environments and healthy populations are interdependent. Ensuring that environmental degradation would not occur and that public health would not be adversely affected by planning decisions requires more than simply preventing or countering the problem of environmental pollution; it also involves the active maintenance and where appropriate promotion of health through improved social amenities and living and working environments."*

The proposal aims to ensure the long-term environmental health of Homebush Bay and the Lednez site by treating contaminants of concern identified in site studies. This is intended to remove the public health risks currently associated with dioxin and other associated chemicals in the area. In undertaking the remediation proposal, consideration of the associated short-term and long-term public health risks is essential. This requires assessment of possible health risks arising from remediation activities, including impacts on air quality and the impacts of any changes on the health of the surrounding population.

9.2 Regional Health Issues

The historical landuses and remediation of the western side of the Rhodes Peninsula and other nearby industrial sites have resulted in an enhanced community awareness of potential public health impacts associated with such proposals. While it is clear that Thiess Services is responsible for impacts directly associated with the proposal, it is not Thiess Services' role to take responsibility for existing regional issues.

The NSW Department of Health plays an important role in regional public health issues through provision of data relating to public health and epidemiology and through its involvement in the consultation and assessment process.

The responsibilities of the Department of Health include:

- provide specific advice to other government agencies in relation to the protection of human health and to comment on planning tools such as this EIS
- try to address community concerns about health. These usually fall into the categories of the health impacts of the proposal and the health impact of what has gone before.

The Department of Health has been an active participant at the Thiess Services/PB Community Liaison Group meetings and has welcomed the contributions made on these issues by group members.

The Department of Health has formed the Rhodes Community Health Liaison Group. The first meeting of the Rhodes Community Health Liaison Group was held on 21 March 2002. Sixteen people representing Rhodes, Meadowbank and Mariners' Cove residents, Greenpeace, Friends of the Earth and representatives of the Department of Health attended the meeting. The independent facilitator from the Thiess Services/PB Community Liaison Group, Mr John Kent, chaired the meeting.

The Department of Health provided information on health studies and the usefulness of data obtained from these studies to the Rhodes Peninsula situation.

The remainder of this chapter deals with the specific air quality and health impacts from the proposed remediation.

9.3 Proposal-specific Receptors

9.3.1 On-site Receptors

During remediation, site access would be tightly controlled. An occupational health and safety plan would be developed to protect the health of employees and visitors to the site. Compliance with the health and safety plan would be mandatory for all personnel including subcontractors and visitors to the site. An outline of the health and safety plan is provided in **Technical Paper 7**.

Workers Exposed to Toxic Contaminants

Some workers on-site would be in positions where exposure to toxic contaminants may occur. Workers in such circumstances would be provided with appropriate protective clothing and would receive appropriate health and safety procedures training.

Other Workers

Site personnel would also include office employees situated on-site. The site would be managed so that these office employees would not need protective clothing. Similarly, any visitors to the site would not be expected to wear protective clothing unless entering restricted areas such as excavation areas or the thermal treatment plant area.

9.3.2 Off-site Receptors

The main pathway for off-site exposure to contamination is through dust and particulate emissions. Potential off-site receptors include workers in the nearby Rhodes and Homebush industrial areas and residents. Residents have been identified as being a population group of interest for risk assessment purposes.

9.4 Air Quality Assessment

In 2002, Holmes Air Sciences undertook an assessment to determine impacts of the proposal on air quality. This report is contained in **Appendix D**. The following sections outline the results of this report and include details on meteorology, relevant air quality criteria and goals, existing air quality and predicted air quality impacts from the proposal for three emission categories:

- dust – including impacts from fugitive dust emissions from activities such as excavation and stockpiling
- process emissions – emissions from the thermal treatment plant which would include a range of organic materials
- odour – from anthropogenic and natural chemicals released during the excavation of the land and the bay.

9.4.1 Meteorology

Wind Data

In order to have a good understanding of the way dust and odour would behave if emitted from the site, it is essential to have information that describes the meteorology around the site. There are various sources available from which this can be obtained. This data has been assessed for suitability for use in the air dispersion model in terms of the amount of data available and the nature of the data recorded.

The most recent suitable data is that collected by the EPA at Lidcombe. This has been used for the dispersion modelling.

Annual and seasonal wind roses collected from this source are shown in **Figure 9.1**. On an annual basis winds are predominantly from the north–north-west, south and south-east. This pattern is present in spring and autumn, while in summer the south-easterlies predominate and in winter the westerlies are most common.

Temperature, Humidity and Rainfall

Data collected from the Parramatta Meteorological Station shows that the annual maximum and minimum temperatures experienced are 23.1 degrees Celsius and 10.9 degrees Celsius respectively (Bureau of Meteorology, 2001). On average, January is the hottest month with an average maximum temperature of 28.1 degrees Celsius. July is the coldest month, with an average minimum temperature of 4.5 degrees Celsius.

The annual average humidity reading at 9.00 am is 69 percent and at 3.00 pm it is 51 percent. May and June are the months with the highest humidity, with a 9.00 am average of 79 percent, while October has the lowest humidity, with a 3.00 pm average of 45 percent.

Rainfall data collected over 100 years shows that March is the wettest month, with an average rainfall of 99 millimetres over 10 days. The annual average rainfall is 921.3 millimetres, with an average of 106 rain days per year.

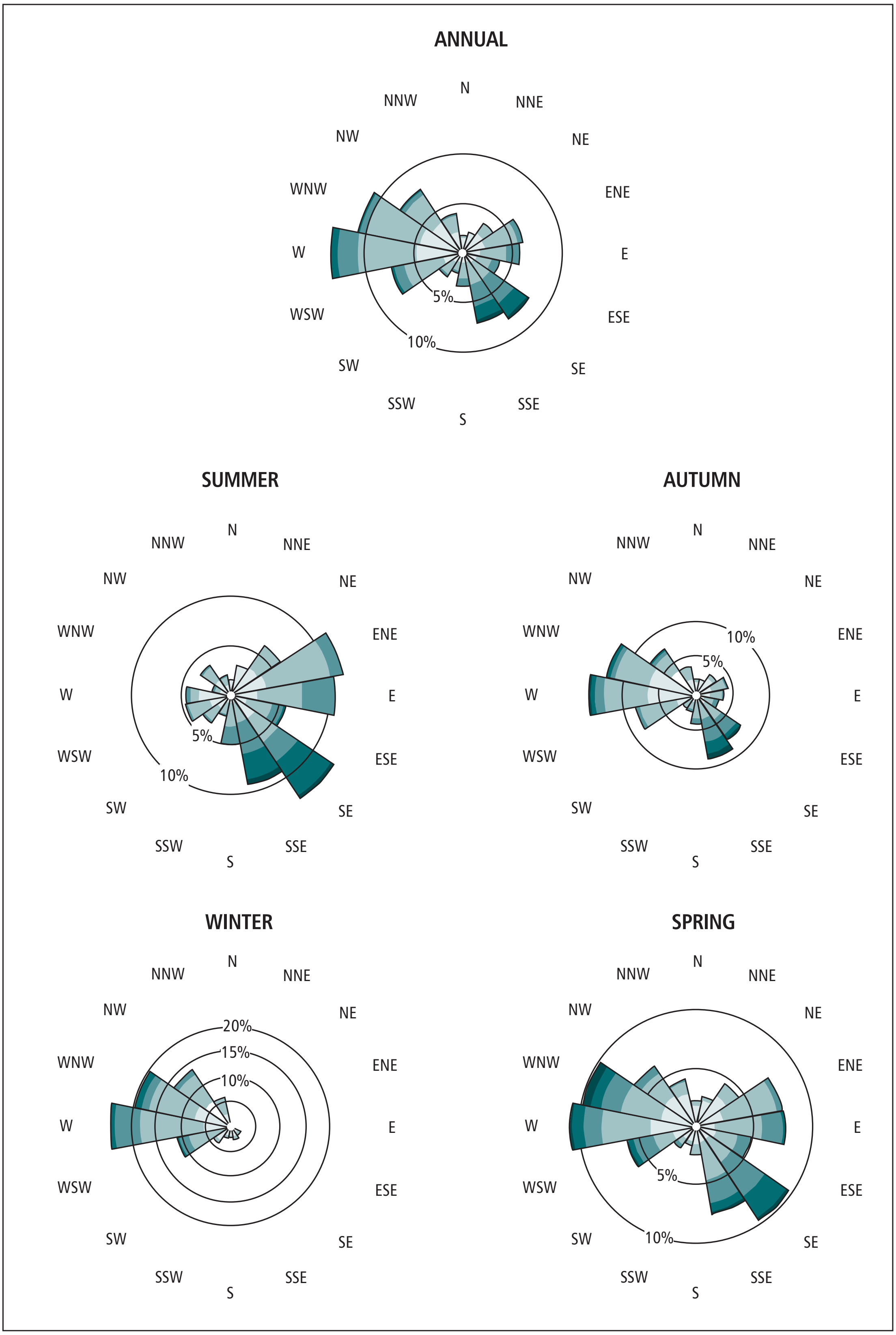


Figure 9.1 **Annual and Seasonal Wind Roses, Lidcombe, 1999 to 2000 (EPA)**

- greater than 7.5 metres per second
- 6.0 to 7.5 metres per second
- 4.5 to 6.0 metres per second
- 3.0 to 4.5 metres per second
- 1.5 to 3.0 metres per second
- 0.5 to 1.5 metres per second

9.4.2 Air Quality Criteria and Goals

Dust

The difference between nuisance and toxic dust requires distinction. Nuisance dust is non-toxic dust that reaches levels considered unacceptable by air quality standards. Toxic dust emissions that impact the health of both on-site workers and the surrounding community would not be acceptable and therefore would not be permitted to occur.

Nuisance goals have been considered for inert dust during the excavation period. Although small amounts of nuisance dust may be unavoidable, emissions would be minimised to ensure they do not reach levels that breach EPA licence conditions.

There are a number of activities that are potential sources of nuisance dust during the proposed remediation. These include:

- coffer dam construction
- on-site excavation
- stockpiles
- on-site transport of material for treatment
- reinstatement of the site to the required contour levels.

Table 9.1 shows the maximum acceptable increase in dust deposition over the existing levels in the area of the proposed remediation and the maximum total level allowable as determined by the EPA in its recent publication on air quality goals and assessment procedures (EPA, 2001b).

Table 9.1 EPA Criteria for Dust Fallout

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2g/m^2/month	4g/m^2/month

Note: g/m^2/month grams per square metre per month of total insoluble solids.

Process Emissions

Process emissions are those that are exhausted from the thermal treatment plant. Typically they have a different composition and impact to nuisance dust emissions. Typical emissions include:

- nitrogen oxides
- sulphur oxides
- carbon monoxide
- particulate matter less than 10 microns (known as PM_{10}).

The EPA has formulated air quality goals for nitrogen dioxide, carbon monoxide and particulate matter (PM_{10}). **Table 9.2** lists the EPA air quality goals, including historical goals and newly adopted goals. The historical goals developed by the National Health and Medical Research Council of Australia and the US Environmental Protection Agency are included to show the increasing stringency of the EPA goals. Also included are goals for air toxics and odorous compounds. These goals are drawn from the Victorian EPA and have now been adopted by the EPA (EPA, 2001b). They are based on the toxic and odorous properties of the compound. The more stringent of the two is adopted as the goal. Also included are goals drawn from the World Health Organization and Integrated Risk Information System with associated unit risk factors.

Table 9.2 Relevant Air Quality Goals

Criteria pollutant	Objective/standard	Averaging period	Agency
Nitrogen dioxide	16 pphm or 320 $\mu g/m^3$	1 hour maximum	NHMRC (historical goals)
	5 pphm or 103 $\mu g/m^3$	Annual mean	US EPA (historical goals)
	12 pphm or 245 $\mu g/m^3$	**1 hour maximum**	**NEPM, EPA**
	11 pphm or 200 $\mu g/m^3$	1 hour maximum	WHO, NSW EPA long term reporting goal
	3 pphm or 60 $\mu g/m^3$	**Annual mean**	**NEPM, EPA**
Carbon monoxide	**25 ppm or 31 mg/m^3**	**1 hour maximum**	**WHO**
	9 ppm or 10 mg/m^3	**8 hour maximum**	**NHMRC, NEPM**
Particulate matter <10 mm diameter (PM_{10})	50 $\mu g/m^3$	Annual mean	US Environment Protection Agency
	30 $\mu g/m^3$	**Annual mean**	**EPA**
	150 $\mu g/m^3$	24 hour maximum	US Environment Protection Agency
	50 $\mu g/m^3$	**24 hour maximum**	**NEPM, EPA**
Total suspended particulate matter (TSP)	**90 $\mu g/m^3$**	**Annual mean**	**NHMRC**
Sulphur dioxide	25 pphm or 700 $\mu g/m^3$	10 minute maximum	NHMRC
	20 pphm or 570 $\mu g/m^3$	**1 hour maximum**	**ANEPM**
	8 pphm or 225 $\mu g/m^3$	**1 day**	**ANEPM**
	2 pphm or 60 $\mu g/m^3$	**Annual mean**	**NHMRC and ANEPM**
Other compounds			
PAH	**Risk factor of 0.087 for lifetime exposure to 1 $\mu g/m^3$**		**WHO**
Dioxins and furans	**0.00000003 mg/m^3**	**1 hour**	**VEPA**
Chlorine	**0.1 mg/m^3**	**3 minute**	**EPA**
HCl	**0.2 mg/m^3**	**3 minute**	**EPA**

Table 9.2 Continuation

Criteria pollutant	Objective/standard	Averaging period	Agency
Hydrogen Sulphide	**0.00014 mg/m^3**	**3 minute**	**EPA**
Benzene	**16 μg/m^3**	**Annual average**	**UK**
Chlorobenzene	**0.2 mg/m^3**	**3 minute**	**EPA**
Dichlorobenzene	**10 mg/m^3**	**3 minute**	**EPA**
Ethylbenzene	**14.5 mg/m^3**	**3 minute**	**EPA**
Nitrobenzene	**0.0047 mg/m^3**	**3 minute**	**EPA**
Phenol	**0.036 mg/m^3**	**3 minute**	**EPA**
Pentachlorophenol	**0.036 mg/m^3**	**3 minute**	**EPA**
Toluene	**63.3 mg/m^3**	**3 minute**	**EPA**
Xylene	**0.35 mg/m^3**	**3 minute**	**EPA**
Heavy metals			
Cadmium	**Risk factor of 1.8E-3 for lifetime exposure to 1 μg/m^3**		**IRIS**
Chromium (VI)	**Risk factor of 1.4E-1 for lifetime exposure to 1 μg/m^3**		**CAPCOA**
Copper	**100 μg/m^3**	**Annual average**	**WHO**
Lead	**1.5 μg/m^3**	**90 day average**	**NHMRC**
	0.5 μg/m^3	**Annual average**	**NEPM**
Mercury	**1.09 μg/m^3**	**Annual average**	**WHO**

Notes: Goals in bold are those applicable to the Thiess Services proposal

PM_{10} is a subset of TSP

ppm	parts per million
pphm	parts per hundred million
μg/m^3	micrograms per cubic metre
mg/m^3	milligrams per cubic metre
NHMRC	National Health and Medical Research Council of Australia
WHO	World Health Organization
EPA	NSW EPA
VIC EPA	Victorian EPA
NEPM	National Environment Protection Measure
ANEPM	Air National Environment Protection Measure
IRIS	Integrated Risk Information System
CAPCOA	California Air Pollution Control Officers Association

Odour

Odour impacts may arise from volatile anthropogenic chemicals at the Lednez site and in the sediments of Homebush Bay. Odour impacts may also arise from naturally occurring organic chemicals present in sediments in the bay, including reduced sulphide compounds such as hydrogen sulphide produced by anaerobic bacteria.

The EPA has adopted criteria recognising that the risk of odour annoying an individual increases with the size of the community affected. For this reason the smaller the affected community the less stringent the criteria for odour. These criteria are summarised in **Table 9.3**.

Table 9.3 Odour Performance Criteria for the Assessment of Odour (EPA, 2001b)

Population of affected community	Odour performance criteria (nose response odour certainty units at the 99th percentile, odour unit per cubic metre)
Single residence (≤ 2)	7
10–30	6
30–125	5
125–500	4
500–2,000	3
Urban (>2,000)	2

9.4.3 Existing Air Quality

The most representative historical data available are from the EPA monitoring station at Lidcombe as it also includes corresponding meteorology, thus allowing consideration of meteorological conditions as the data is applied to the site. In addition for this EIS, a dust-monitoring network was established in the vicinity of the site to collect site-specific background data.

EPA Monitoring Data

Monitoring data for nitrogen dioxide and PM_{10} collected in 1999 and 2000 has been taken from the Lidcombe site (**Table 9.4**).

In summary, air quality with respect to nitrogen dioxide and PM_{10} complies with EPA goals at the Lidcombe site. No data are available for total suspended particulates, which have an annual goal of 90 micrograms per cubic metre. However, PM_{10} levels are on average approximately 40 percent of total suspended particulate levels. Therefore, an annual average total suspended particulate level of about 40 micrograms per cubic metre can be inferred, compared to the goal of 90 micrograms per cubic metre.

Table 9.4 Nitrogen Dioxide and PM_{10} Data for EPA Lidcombe Site

Period	NO_2 (pphm) 1 hour goal 12 pphm			PM_{10} (µg/m^3) 24 hour goal 50 (µg/m^3)			$PM_{2.5}$ (µg/m^3) No goal	
	Monthly average	One hour maximum	No. of hours above goal	Monthly average	One hour maximum	No. of days above goal	Monthly average	One hour maximum
Jan-99	1.8	3.7	0	12	45	0	8	29
Feb-99	1.7	2.9	0	12	57	0	8	33
Mar-99	2.8	4	0	18	76	0	11	40
Apr-99	2.6	4.4	0	15	47	0	10	43
May-99	3.7	7.3	0	19	73	0	13	42
Jun-99	3.1	4.1	0	15	96	0	10	56
Jul-99	3.1	4.4	0	19	77	0	12	40
Aug-99	3.4	4.9	0	19	210	0	11	41
Sep-99	3.3	5.6	0	19	83	0	12	51
Oct-99	3	5.3	0	17	53	0	10	24
Nov-99	2.5	4.4	0	16	57	0	7	25
Dec-99	2.1	3.7	0	16	58	0	8	39
Annual-99	2.8	7.3	0	16.4	210	0	10	56
Jan-00	1.8	3.9	0	18	93	0	8	36
Feb-00	2.2	4.4	0	23	126	0	10	42
Mar-00	2.4	4.9	0	18	101	0	10	35
Apr-00	2.8	5.2	0	17	60	0	10	27
May-00	2.7	5	0	18	90	0	11	49
Jun-00	2.6	3.9	0	16	50	0	11	35
Jul-00	2.9	4.9	0	16	104	0	12	52
Aug-00	3.1	5.6	0	11	50	0	10	48
Sep-00	3.3	5.6	0	18	94	0	12	62
Oct-00	2.9	7	0	16	216	1	10	208
Nov-00	2.3	3.8	0	14	42	0	9	26
Dec-00	2.3	4.1	0	22	83	0	10	31
Annual-00	2.6	7	0	17.3	216	1	10	208

pphm parts per hundred million (µg/m^3 = one part per hundred million x 20.5)

µg/m^3 micrograms per cubic metre

Site Specific Data

In 2001/2002, a dust-monitoring network was established to determine background dust levels. The locations of the monitors are shown in **Figure 9.2** and comprised the following:

- six dust deposition gauges for measuring dust fallout on a monthly basis. These have been established around the Lednez site, at the Rhodes Community Centre, at a residence in Meadow Crescent and at the Bicentennial Park bird sanctuary
- one high-volume sampler measuring PM_{10} on a six-day cycle. This is located at Rhodes Community Centre
- two DustTrak monitors for continuous measurement of PM_{10}. These are located at the Community Centre and at the residence in Meadow Crescent
- one measurement of dioxin was recorded over a two-week period at the Rhodes Community Centre.

Data recorded at these monitoring stations provides information on existing dust levels in the area surrounding the Lednez site. These locations were selected to provide an indication of background ambient air quality at the boundaries of the site and the receptors most likely to be affected. The information collected by the six dust gauges located around the site perimeter would provide a useful comparison with nuisance dust deposition monitoring undertaken during the remediation works. The locations slightly further removed from the site were nominated, based on existing and past meteorological conditions, to collect background data to be used in monitoring the dispersion of any emissions from the thermal treatment plant.

Table 9.5 lists the monitor type, identification number, location and pollutant measured. Monitoring commenced in February 2002. Earlier DustTrak data is available from the Rhodes Community Centre from December 2001.

Table 9.5 Summary of Dust Monitoring Network

Monitor type	Monitor ID	Location	Pollutant measured
High-volume air sampler	HVAS	Rhodes Community Centre	PM_{10} six day cycle
DustTrak	DT1	Rhodes Community Centre	PM_{10} continuous
DustTrak	DT2	Meadow Crescent residence	PM_{10} continuous
Deposition gauge	DG1	Site gate	Monthly deposition
Deposition gauge	DG2	Site perimeter	Monthly deposition
Deposition gauge	DG3	Site perimeter	Monthly deposition
Deposition gauge	DG4	Rhodes Community Centre	Monthly deposition
Deposition gauge	DG5	Bird Sanctuary	Monthly deposition
Deposition gauge	DG6	Meadow Crescent residence	Monthly deposition
Dioxin sampler	DS	Rhodes Community Centre	One off sample over a two week period

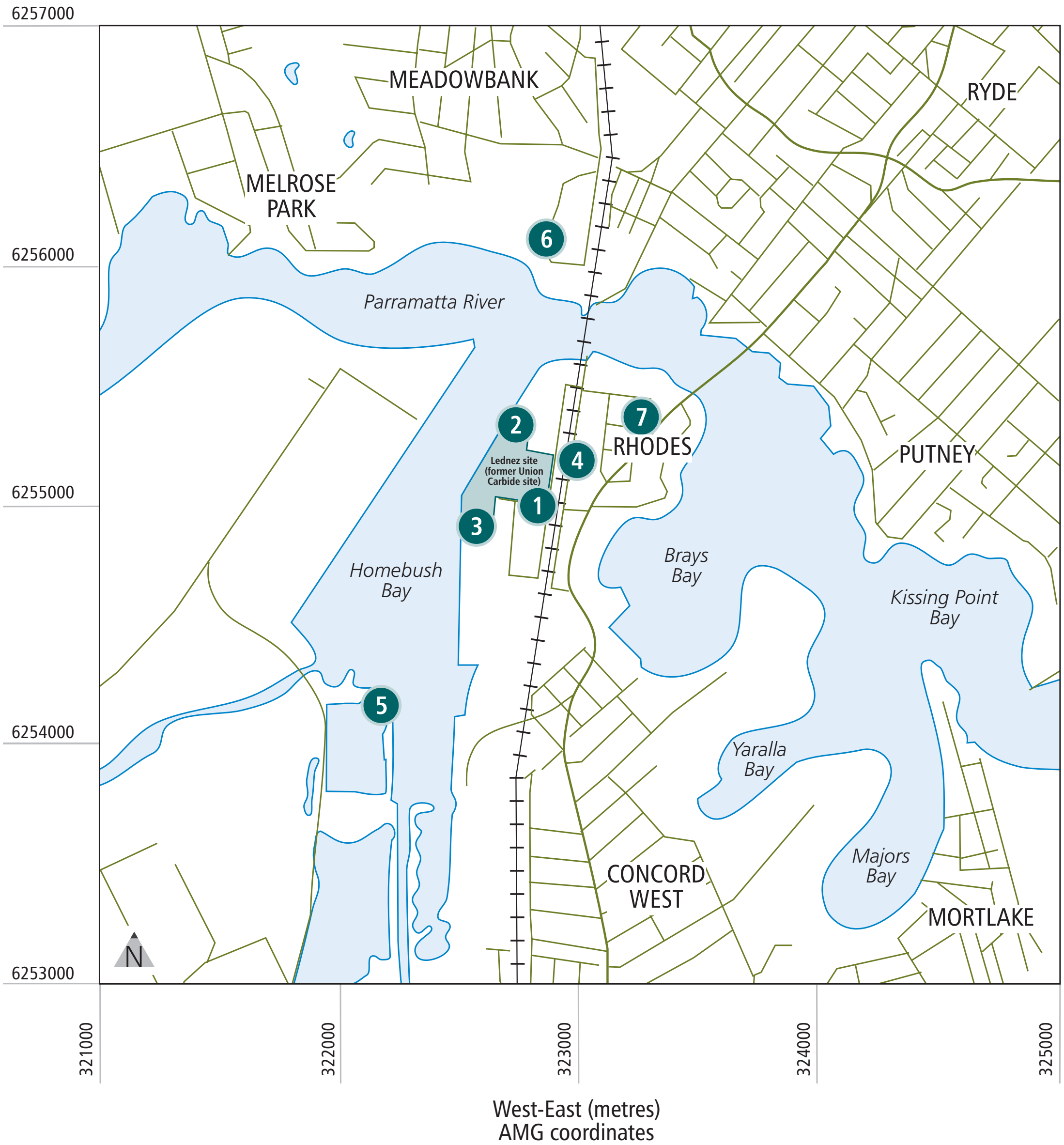


Figure 9.2 **Location of Background Air Monitoring Devices for Impact Assessment**

Location

1. One depositional dust gauge
2. One depositional dust gauge
3. One depositional dust gauge
4. One depositional dust gauge
   One high-volume air sampler
   One DustTrak monitor
   Dioxin sampling
5. One depositional dust gauge
6. One depositional dust gauge
   One DustTrak monitor
7. On-site meteorological station

Concentrations of Particulate Matter (Dust in Air)

Data from the DustTrak at Rhodes Community Centre, with the December and January data included, shows that the bushfires that were prevalent from Christmas Day 2001 to the second week of January 2002 had a significant impact on the air quality in the area. The 24-hour average values for PM_{10} exceeded 500 micrograms per cubic metre on occasions compared to the goal of 50 micrograms per cubic metre. Short-term peaks were as high as 3,200 micrograms per cubic metre. When this data is removed to provide a more accurate record of background dust levels, the maximum 24 hour running average recorded was approximately 40 micrograms per cubic metre.

The maximum PM_{10} concentration measured using the high-volume air sampler was 34 micrograms per cubic metre on 20 March 2002.

A DustTrak monitor was also used at the Meadow Crescent residential site. The available data shows that the 24-hour running average has not exceeded 50 micrograms per cubic metre, with a maximum of 42 micrograms per cubic metre recorded on 19 March 2002. There are, however, short-term fluctuations in the data as are seen in the Rhodes Community Centre data and in the EPA data discussed above.

Deposition of Dust

Dust deposition is recorded on a monthly basis and as such there were five readings available for each of the six sites at the time of this report. **Table 9.6** summarises the data for these five months and shows that on all occasions the recorded levels were well below the guideline of four grams per square metre per month with the average value at each site being below one gram per square metre per month.

Table 9.6 Summary of Dust Deposition Data, February to June 2002

	Total insoluble solids – g/m^2/month					
Dust gauge	**February 2002**	**March 2002**	**April 2002**	**May 2002**	**June 2002**	**Average**
DG1	0.9	0.8	1.1	0.2	0.5	0.7
DG2	0.5	2.0	0.6	0.3	0.6	0.8
DG3	1.1	0.7	0.5	0.5	0.6	0.7
DG4	0.8	1.1	0.2	NDA	1.3	0.9
DG5	0.6	1.0	0.9	0.7	0.6	0.8
DG6	0.3	0.8	1.0	1.4	0.6	0.8

g/m^2/month grams per square metre per month.
NDA No data available (gauge vandalised)

Dioxin

In addition to dust measurements, a single measurement of dioxin collected using US EPA method TO-9A (US EPA, 1999) was recorded over a two-week period at the Rhodes Community Centre. The average dioxin level measured over that period was 0.24 femtograms per cubic metre expressed as total toxic equivalents (one femtogram which is equal to 1×10^{-15} gram). The Victorian EPA goal for dioxins is 30 picograms per cubic metre for a one-hour average (one picogram equals 1×10^{-12}gram). The measured level was therefore less than 100,000th of the one-hour goal. Although the measured level was an average over a two-week period, it is extremely unlikely that there would have been a fluctuation above the one-hour goal in this time. As can be seen from the DustTrak data, short-term fluctuation may be of the order of 10 to 20 times the longer-term average.

The level at the Rhodes Community Centre was lower than measurements of ambient dioxin concentrations undertaken at Silverwater in 1994, which showed three-day average levels of 74.9, 61.3 and 134 femtograms per cubic metre respectively at the Janson, Telecom and George Lewis sites (EPA, 1998a).

Odour

No existing odour data is available for the Lednez site or within two kilometres of the site. There are no major point sources of odour, with the possible exception being odour impacts that may arise from the construction works currently being undertaken on the Orica site. Odours are generally typical for an urban environment close to an estuary. Odours are considered as part of risk assessment studies conducted by Egis (Egis, 2002a) and are discussed in more detail later in this chapter.

9.4.4 Air Quality Impacts

Potential impacts from the proposal on the surrounding area have been assessed using AUSPLUME Version 5.4. The model was run separately for dust emissions from proposed excavation and site work activities and process emissions from the proposed thermal treatment plant. The model was also used to predict odour impacts from anthropogenic chemicals. AUSPLUME is widely used throughout Australia and is regarded as a state-of-the-art model. It is the model recommended in the EPA's *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2001b).

For the stack emissions, the model has been used to predict concentrations of emissions at a set of receptors arranged at 50 metres spacing for a five by five kilometre grid around the plant. For the dust modelling, the receptor grid was set closer to the source (3 kilometres x 3 kilometres) as impacts would be close to the site. Information on local terrain has been obtained from topographic maps of the area.

Dust Emissions

Determining model inputs for dust-generating activities involved developing an emissions inventory. This comprised an analysis of on-site activities using dust emission factors developed by the US Environment Protection Agency and from the National Energy Research and Demonstration Council (NERDC). The annual dust emissions were estimated (see **Table 9.7**) for Stages 2 and 3 (as described in **Chapter 6**), when dust emissions are likely to be at their maximum. These estimations were used as input for dispersion modelling.

Table 9.7 Estimate of Dust Emissions on an Annual Basis

Activity	Emissions (kilograms per year)	
	Stage 2	Stage 3
Vehicles moving on unpaved areas	38,245	30,451
Wind erosion from exposed areas	2,943	2,943
Loading from and dumping to stockpiles	1,158	1,158
Excavation	327	327
Total	**42,673**	**34,878**

These emission estimates were run through the AUSPLUME model to predict dust concentrations and deposition levels for each grid receptor near the Lednez site. Dispersion modelling was undertaken for Stages 2 and 3 of the proposed remediation, as they have the greatest potential for air quality impacts. Only the results of Stage 2 modelling are presented, as the results for Stage 3 were equal to or less than Stage 2. Dust deposition has been averaged over a year and expressed as monthly deposition rates. Results are presented in **Figures 9.3** to **9.7** and discussed with reference to the individual goals.

Figure 9.3 presents the maximum 24-hour average increase in PM_{10} concentrations due to the proposed excavation operations at the site during Stage 2. Predicted off-site impacts at the boundary of the site are above 40 micrograms per cubic metre but the maximum off-site impact at the nearest sensitive receptors, including houses and the Rhodes railway station, is predicted to be below 30 micrograms per cubic metre. This would be below the goal of 50 micrograms per cubic metre.

The predicted annual average increase in PM_{10} due to the excavation operations is shown in **Figure 9.4**. Maximum increases off-site are in the order of six micrograms per cubic metre, again below the annual goal of 30 micrograms per cubic metre.

The predicted annual average increase in total suspended particulate concentrations is shown in **Figure 9.5**. This is approximately double the increase in PM_{10}, with maximum off-site levels at residential areas of approximately 12 micrograms per cubic metre. The annual goal for total suspended particulate is 90 micrograms per cubic metre.

Figure 9.6 presents the predicted annual average dust deposition rate. The increase at any sensitive receptors due to the remediation works would be less than one gram per square metre per month compared to the goal of two grams per square metre per month. When these increases are added to the estimated annual dust emissions expected in **Table 9.7**, the guideline goal for maximum total deposited dust of four grams per square metre per month would not be exceeded.

Figure 9.7 shows the predicted annual average concentration for particulate matter less than 2.5 microns (known as $PM_{2.5}$). There is as yet no goal in Australia for this parameter. Predicted levels are significantly lower than the annual average PM_{10} levels shown in **Figure 9.4**, with maximum levels close to three micrograms per cubic metre. This is because the mass of $PM_{2.5}$ in excavation dust is low.

As discussed above, predicted dust levels are generally low, largely because the excavated material has high moisture content. Haul road dust dominates the impacts. Provided the stockpiles and haul roads are maintained in a watered and/or controlled condition, it is unlikely that there would be significant off-site impacts of inert dust. It should be noted that no account has been taken in the modelling of the shielding effect of trees along Walker Street. If maintained, the presence of these trees would help to further reduce any residual dust impacts.

Table 9.8 summarises dust impacts at the most affected sensitive receptor (for example, those located at or near the community centre on Blaxland Road). This receptor is shown as receptor four on **Figure 9.8**.

Also considered was the potential for dust impacts within the site or close to the site at locations that may be developed for residential purposes during the life of the remediation project. The Holmes Air Sciences report in **Appendix D** summarises the top 100 24-hour PM_{10} predictions at nine of the closest special receptors (see **Figure 9.8**), which are close to or within the site for Stages 2 and 3.

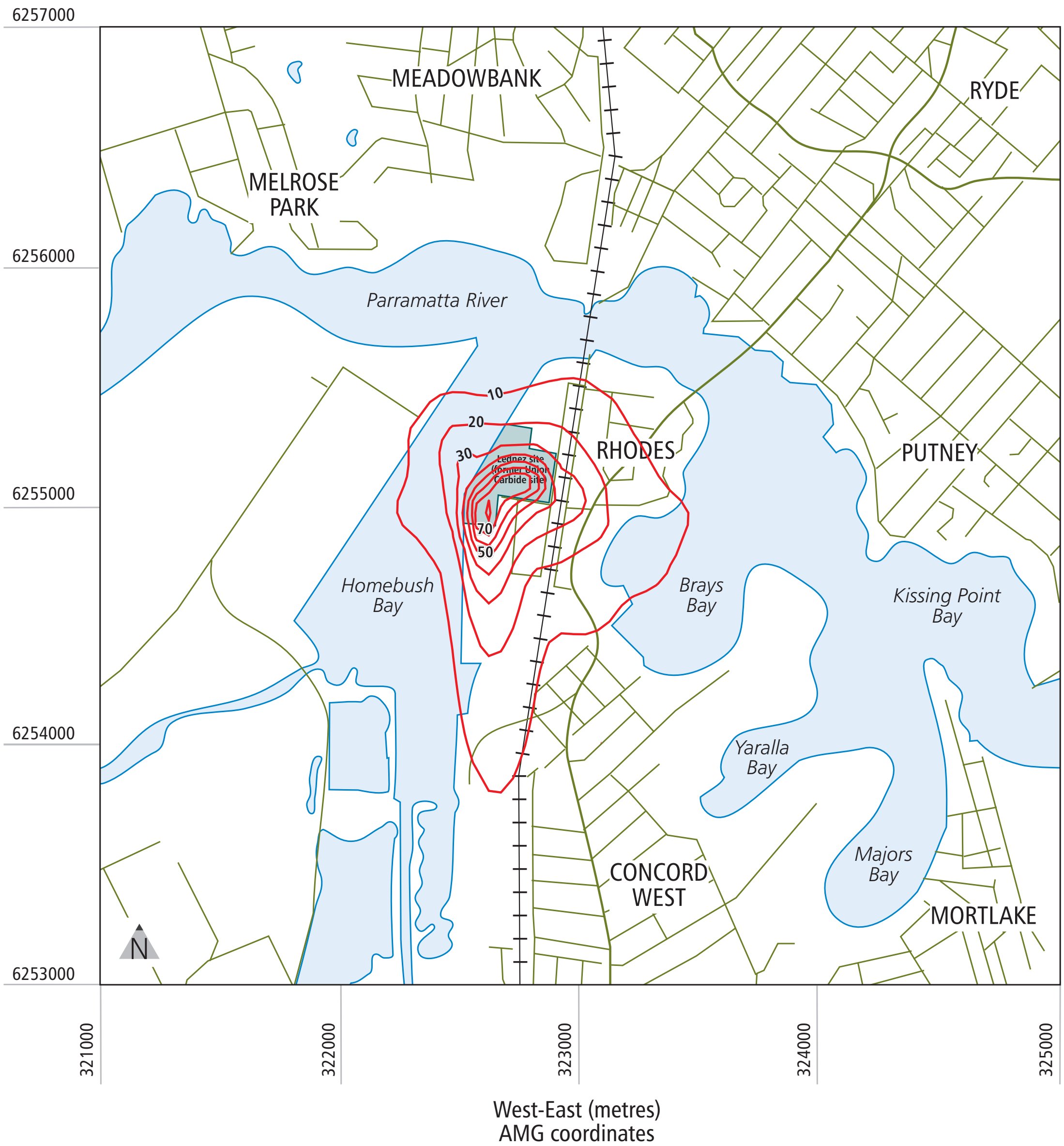


Figure 9.3 **Stage 2 – Predicted Maximum 24-hour Average Particulate Matter less than 10 Microns Concentration at Ground Level due to Excavation Activities**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 50 micrograms per cubic metre.
3. Contours shown do not include emission controls.
4. Colour contour line locations are approximate.

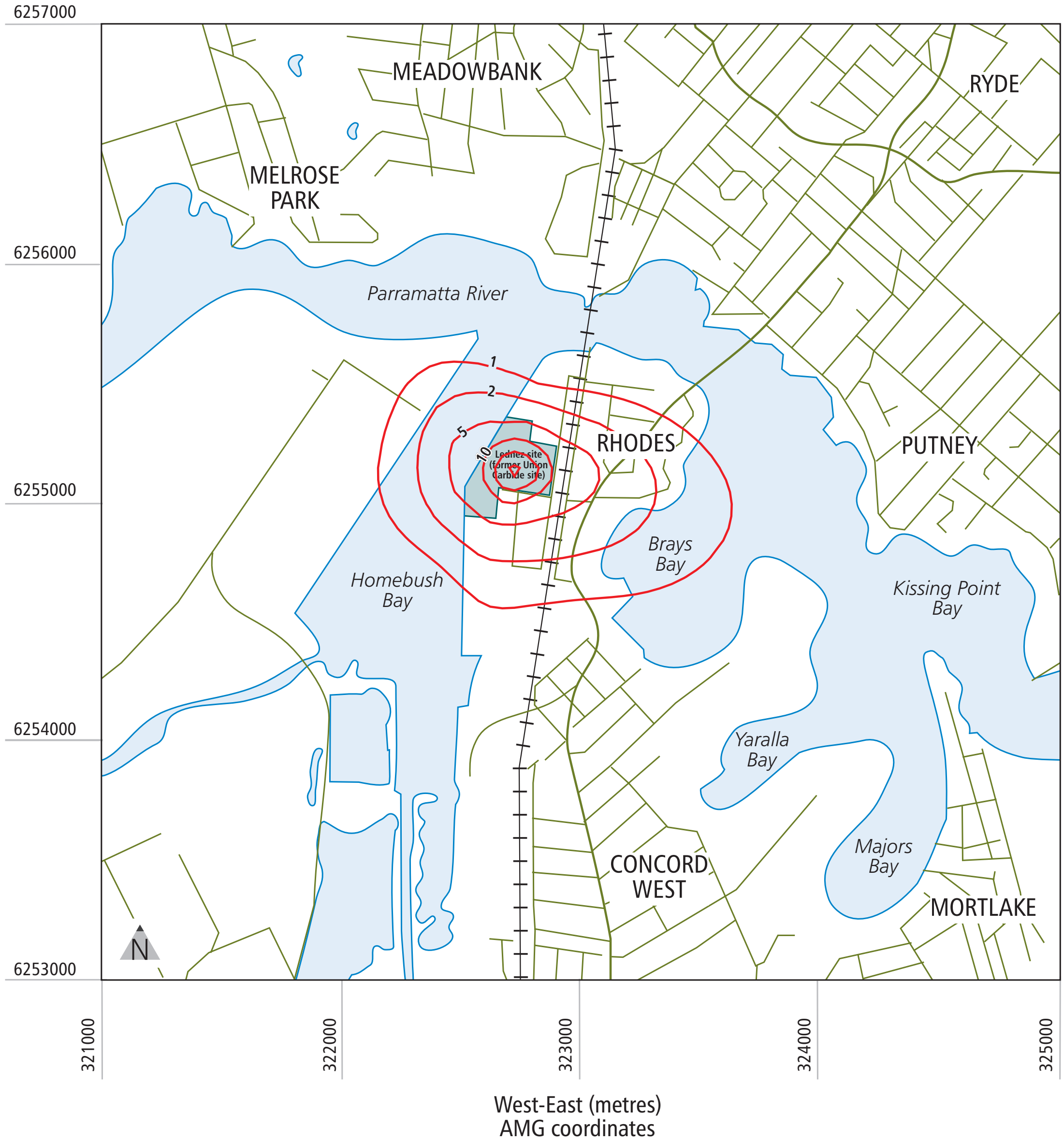


Figure 9.4 **Stage 2 – Predicted Annual Average Particulate Matter less than 10 Microns Concentration at Ground Level due to Excavation Activities**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 30 micrograms per cubic metre.
3. Contours shown do not include emission controls.
4. Colour contour line locations are approximate.

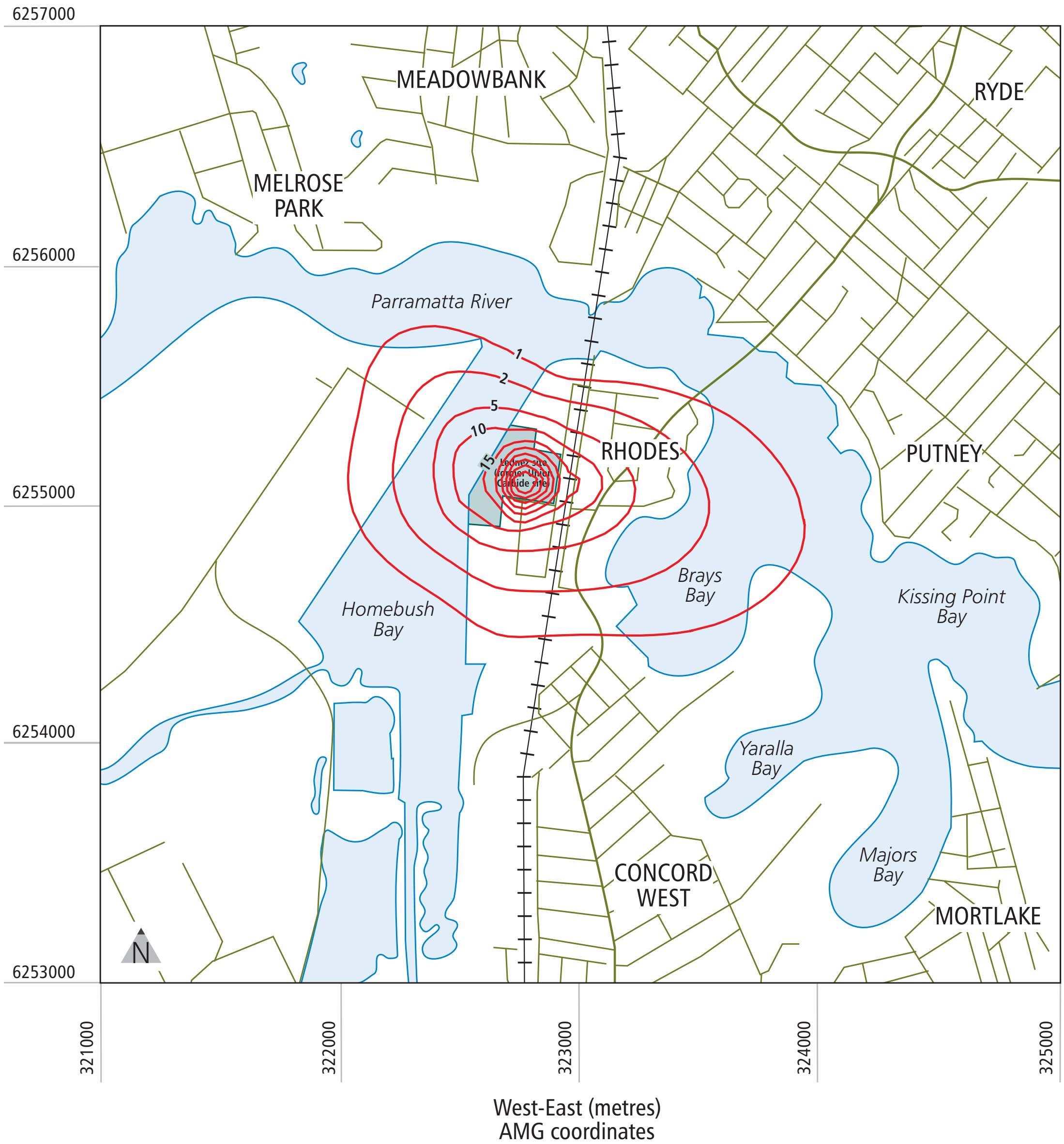


Figure 9.5 **Stage 2 – Predicted Annual Average Total Suspended Particulate Concentrations at Ground Level due to Excavation Activities**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 90 micrograms per cubic metre.
3. Contours shown do not include emission controls.
4. Colour contour line locations are approximate.

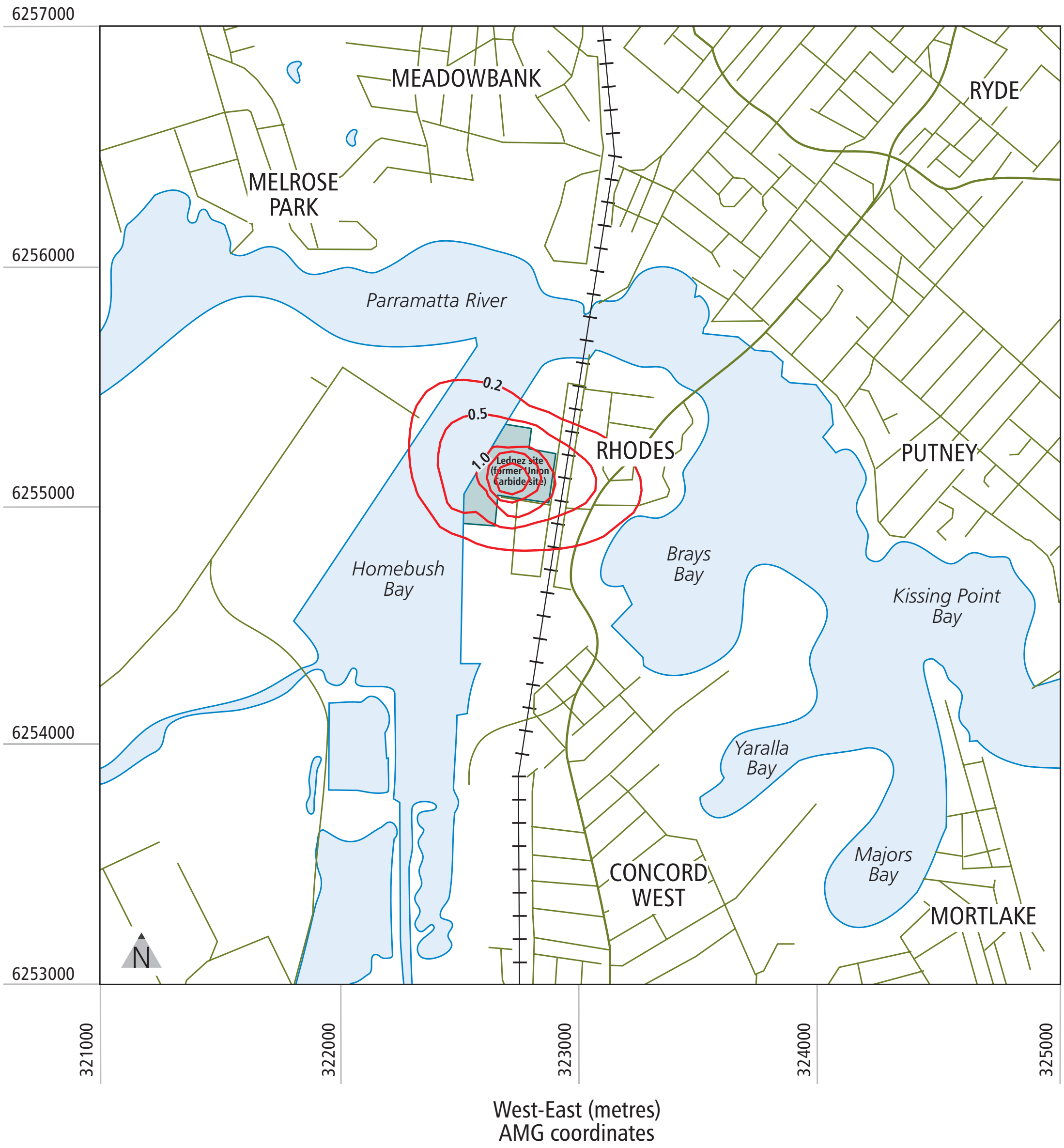


Figure 9.6 **Stage 2 – Predicted Annual Average Dust Deposition due to Excavation Activities**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 2 grams per square metres per month.
3. Contours shown do not include emission controls.
4. Colour contour line locations are approximate.

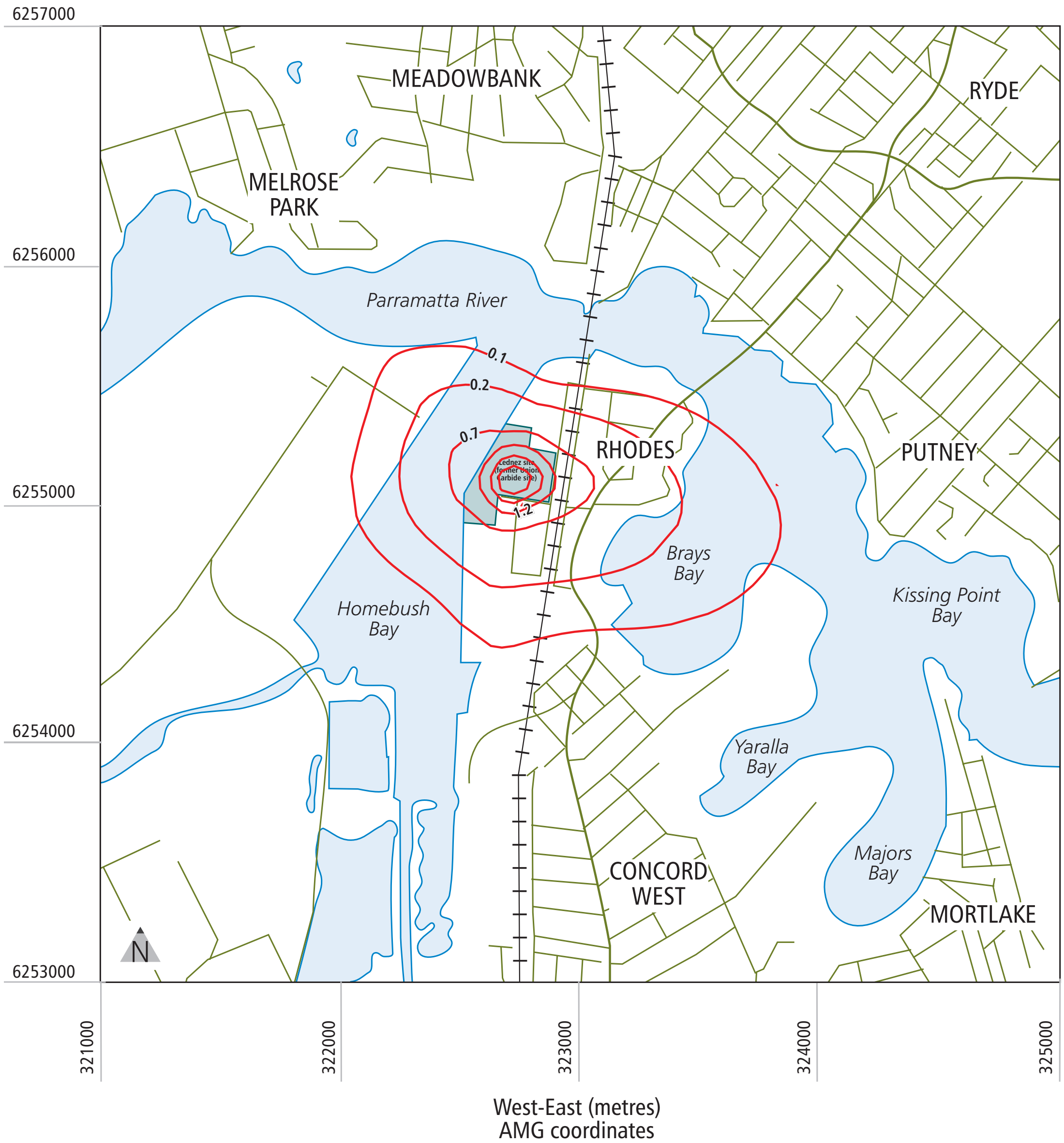


Figure 9.7 **Stage 2 – Predicted Annual Average Particulate Matter less than 2.5 Microns Concentration at Ground Level due to Excavation Activities**

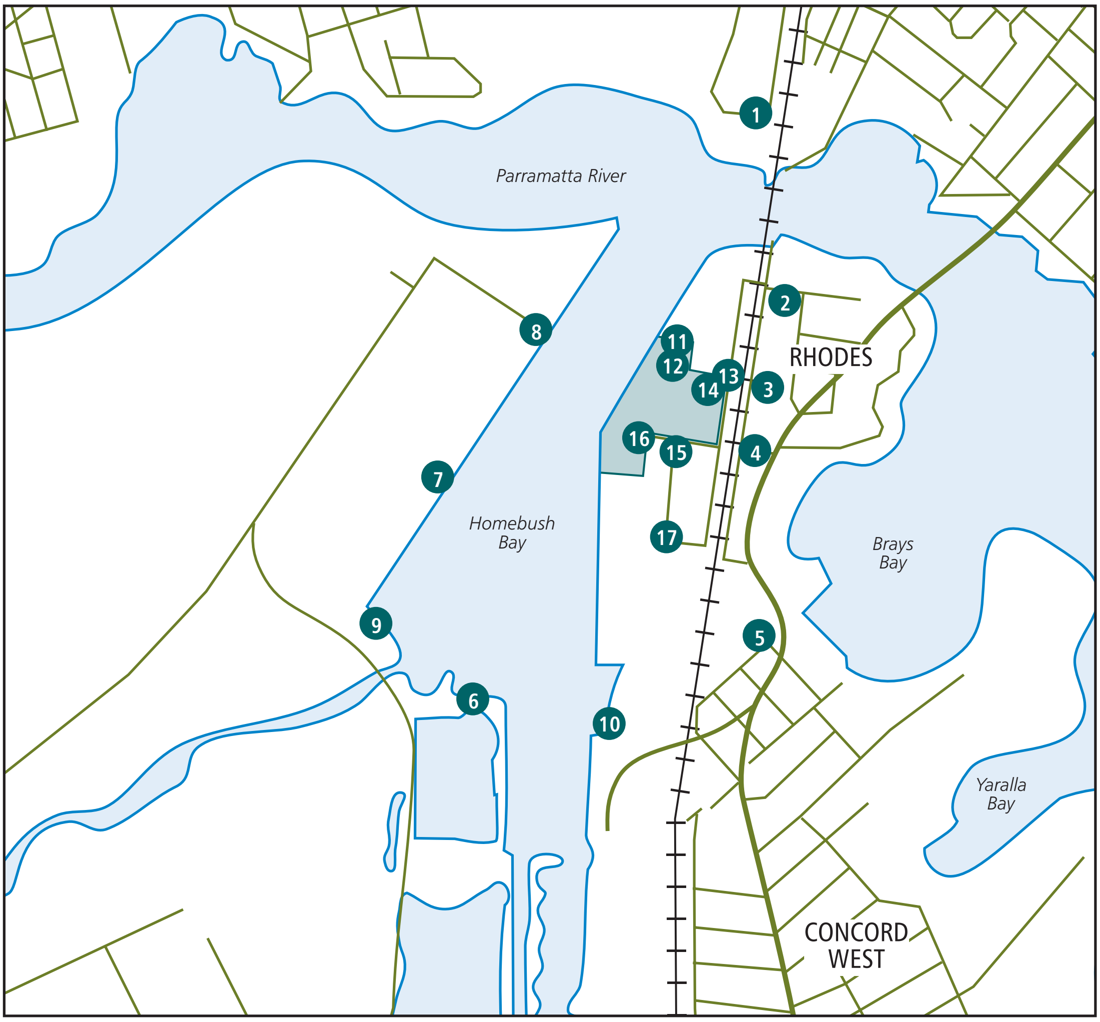
Notes:
1. All units are in micrograms per cubic metre.
2. There is no applicable air quality goal for this figure.
3. Contours shown do not include emission controls.
4. Colour contour line locations are approximate.

Table 9.8 Predicted Increase in Dust Levels at Most Affected Sensitive Residential Receptors

Parameter	**Goal**	**Background**	**Stage 2**	**Stage 3**
Maximum 24-hour PM_{10}	50 $\mu g/m^3$	Not relevant	37 $\mu g/m^3$	24$\mu g/m^3$
Annual average PM_{10}	30 $\mu g/m^3$	17 $\mu g/m^3$	6 $\mu g/m^3$	4 $\mu g/m^3$
Annual average TSP	90 $\mu g/m^3$	40 $\mu g/m^3$ (inferred)	12 $\mu g/m^3$	8 $\mu g/m^3$
Annual average $PM_{2.5}$	No goal	10$\mu g/m^3$	0.8 $\mu g/m^3$	0.6 $\mu g/m^3$
Dust deposition	4 g/m^2/month	Approximately 2 g/m^2/month	0.5 g/m^2/month	0.4 g/m^2/month

g/m^2/month grams per square metre per month

$\mu g/m^3$ grams per cubic metre



N Not to scale

Figure 9.8 **Locations of Special Receptors for Analysis of Potential Off-site Impacts**

1 Special receptor

The location which is most affected is the Statewide Developments site at receptors 15 and 16, at the south-eastern end of the Lednez site. At these points exceedances of the 24-hour PM_{10} goal are predicted during Stage 2 and to a lesser extent during Stage 3. Notionally this is not an issue whilst this area remains an unused, unoccupied industrial site. If this changes over the duration of the proposal to a point where residential occupancy is possible, additional dust suppression measures may be required. Certainly continuous ambient dust measurements would be required at this location.

Process Emissions

Predicted emissions from the indirect thermal treatment plant proposed at the Lednez site are summarised in **Table 9.9**. Average emission rates for the process as well as the conditions under which the emissions occur that are relevant to dispersion modelling are presented.

Table 9.9 Indirect Thermal Treatment Plant Stack Emission Characteristics

Emissions	Concentration g/Nm³	Emissions rate (g/s)
Criteria and other pollutants		
NO_x	0.07	0.21
CO	0.003	0.012
PM_{10}	0.054	0.162
SO_2	0.0024	0.007
HCl	0.14	0.42
Chlorine	-	-
Organic materials		
PAHs	1.74×10^{-7}	4.36×10^{-7}
Dioxins/furans (TEQ)	2.43×10^{-13}	7.27×10^{-13}
Benzene	3.39×10^{-6}	1.01×10^{-5}
Chlorobenzene	4.89×10^{-6}	1.46×10^{-5}
Dichlorobenzene	6.39×10^{-6}	1.95×10^{-5}
Phenol	1.74×10^{-7}	5.2×10^{-7}
Metals		
Mercury	-	-
Lead	-	-
Cadmium	-	-
Total chromium	-	-
Nickel	-	-

Notes:
- m — Metres
- m/s — Metres per second
- °C — Degrees Celsius
- g/s — Grams per second
- g/Nm³: — Grams per normalised cubic metre (referenced to zero degrees Celsius and 101.3 kilopascals)
- \- — not measured
- AMG — Australian Map Grid
- TEQ — Toxicity equivalents
- 1 gram — 1,000,000,000 nanograms

Assumptions:
- Stack/vent height (m): 20
- Internal diameter of stack at tip (m): 1.16
- Exhaust temperature (°C): 760
- Exit velocity (m/s): 10.7
- Location (AMG): 322610, 625506
- Building dimension: Height: 11 metres. Width: 40 metres.
- Ground elevation (m): 5

Process emission model runs were undertaken using the emissions data above and the meteorological data described in **Section 9.1**. The predicted maximum ground-level concentrations due to indirect thermal treatment plant emissions are shown in **Table 9.10**. Plots showing the distribution of the maximum one-hour and annual average nitrogen oxides, one-hour and eight-hour average carbon monoxide and 24-hour and annual average PM_{10} concentrations due to the plant can be found in **Figures 9.9** to **9.14**. The predicted maximum one-hour, eight-hour and 24-hour average ground-level concentration plots do not represent the dispersion pattern at any particular instant in time, but show the highest predicted levels that occurred under the modelled conditions at each receptor location for each averaging period. These do not include existing background levels.

Table 9.10 Predicted Maximum Ground Level Concentration due to Indirect Thermal Desorption Stack Emissions at all Locations (including on-site locations)

Compound	Concentration (µg/m³)	Averaging period	Objective/ standard (µg/m³) risk factor	Risk level
Carbon monoxide	1.8	1-hour max	31,000	NA**
	0.94	8-hour max	10,000	
Nitrogen dioxide*	31.4	1-hour max	245	NA**
	1.9	Annual peak	60	
Particulates (PM_{10})	8.74	24-hour max	50	NA**
	1.41	Annual peak	30 (allows 5 exceedances per year)	
SO_2	1.05	1-hour max	570	NA**
	0.4	24-hour max	225	
	0.06	Annual	60	
Dioxins and furans	1.09×10^{-10}	1-hour	3.0×10^{-5}	NA**
	6.46×10^{-12}	Annual		
Hydrogen chloride	60.8	3-minute	200	NA**
Benzo(a)pyrene	3.79×10^{-6}	Annual	Risk factor: 8.7×10^{-2} per µg/m³	Risk 3.3×10^{-7}
Benzene	8.89×10^{-5}	Annual	16	NA**
Chlorobenzene	0.002	3-minute	200	NA**
Dichlorobenzene	0.003	3-minute	10,000	NA**
Phenol	7.53×10^{-5}	3-minute	36	NA**

* assuming 100% of the NO_x is NO_2
** Not applicable – risk is not the criterion used for assessment in this instance
µg/m³ micrograms per cubic metre
PM_{10} Particulate matter less than ten microns

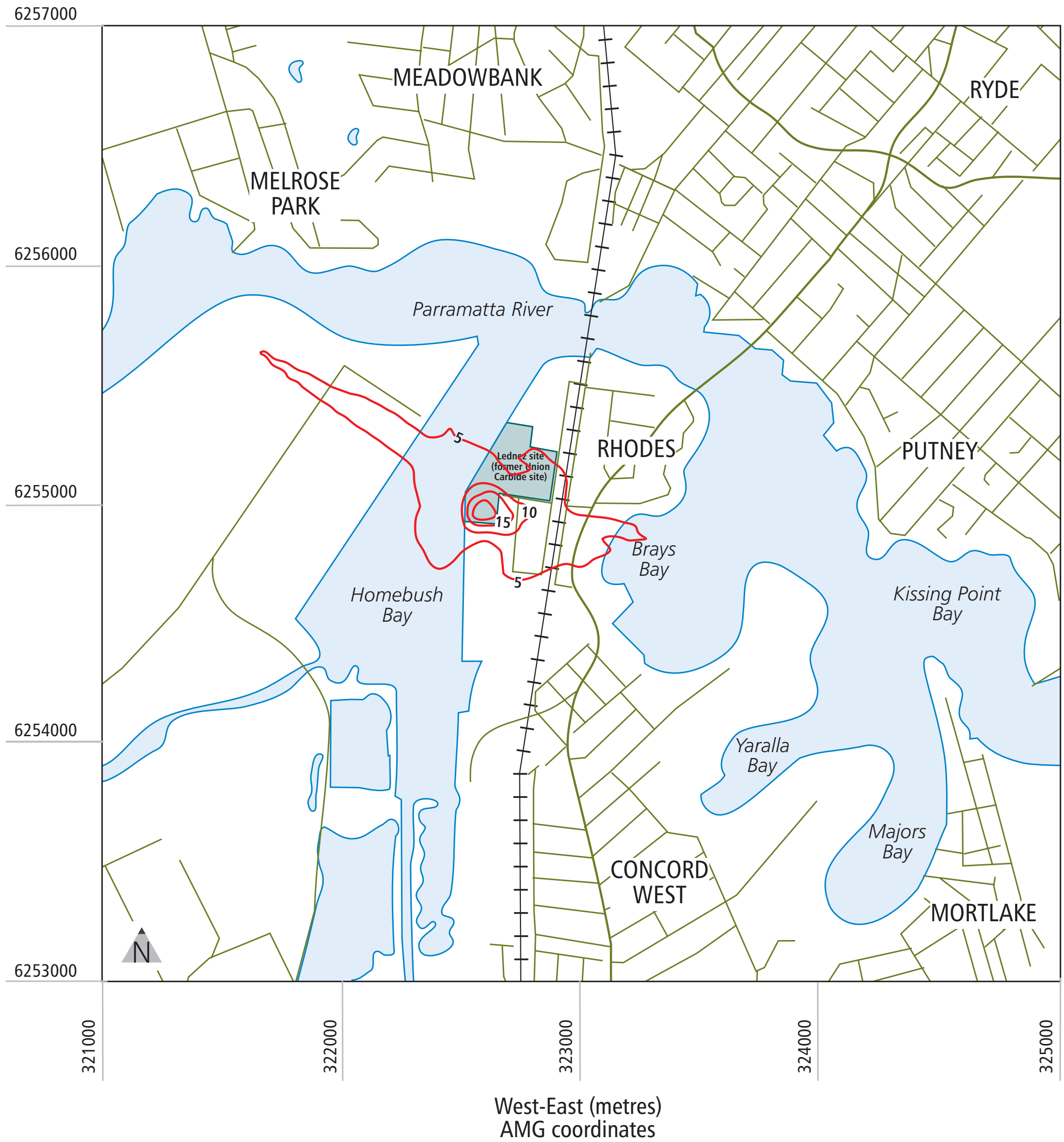


Figure 9.9 **Predicted Maximum 1-hour Average Nitrogen Oxides Concentration at Ground Level due to Thermal Treatment Plant Emissions**

Notes: 1. All units are in micrograms per cubic metre.

2. Air quality goal for this figure is 245 micrograms per cubic metre.

3. Colour contour line locations are approximate.

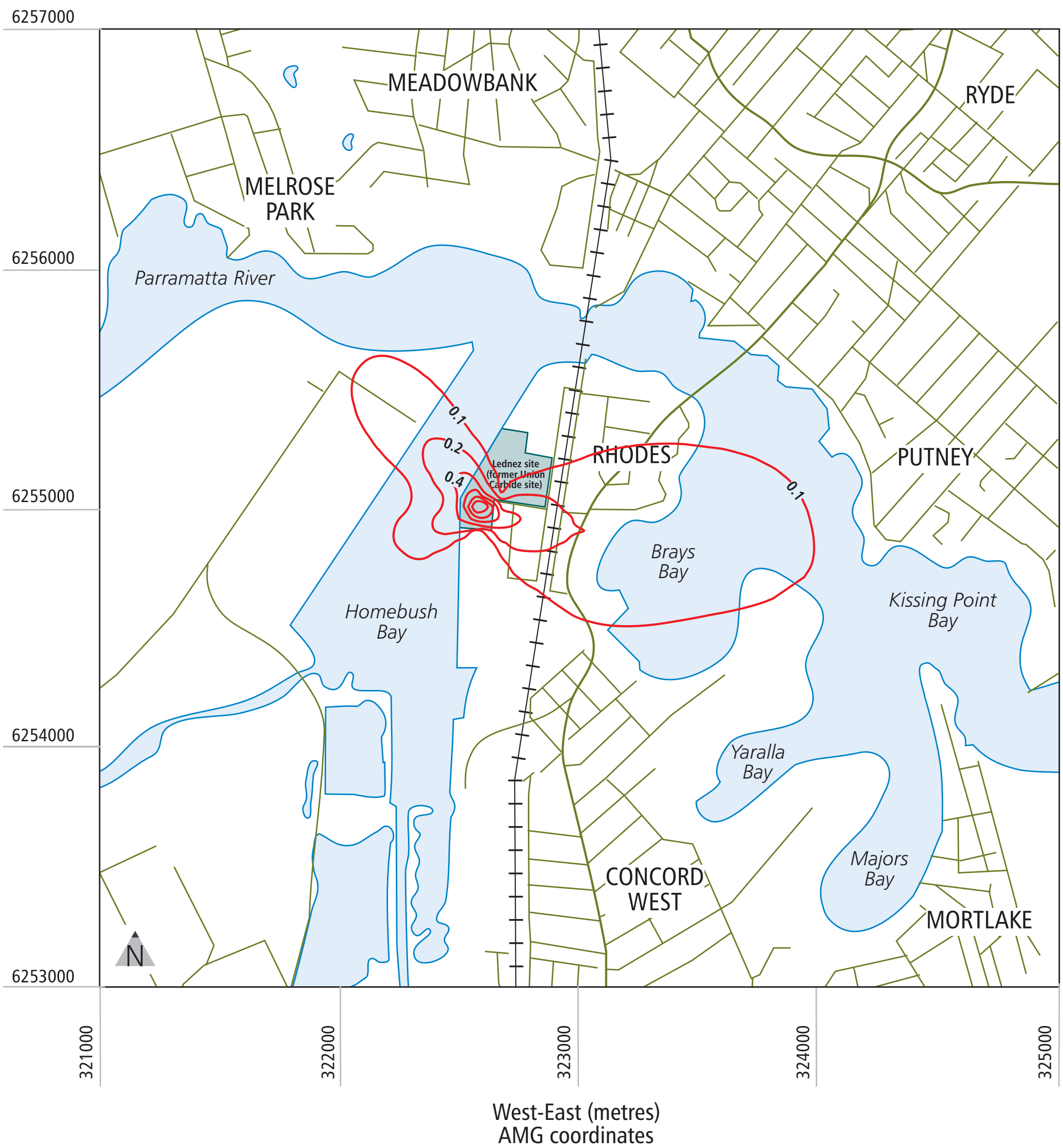


Figure 9.10 **Predicted Annual Average Nitrogen Oxides Concentration at Ground Level due to Thermal Treatment Plant Emissions**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 103 micrograms per cubic metre.
3. Colour contour line locations are approximate.

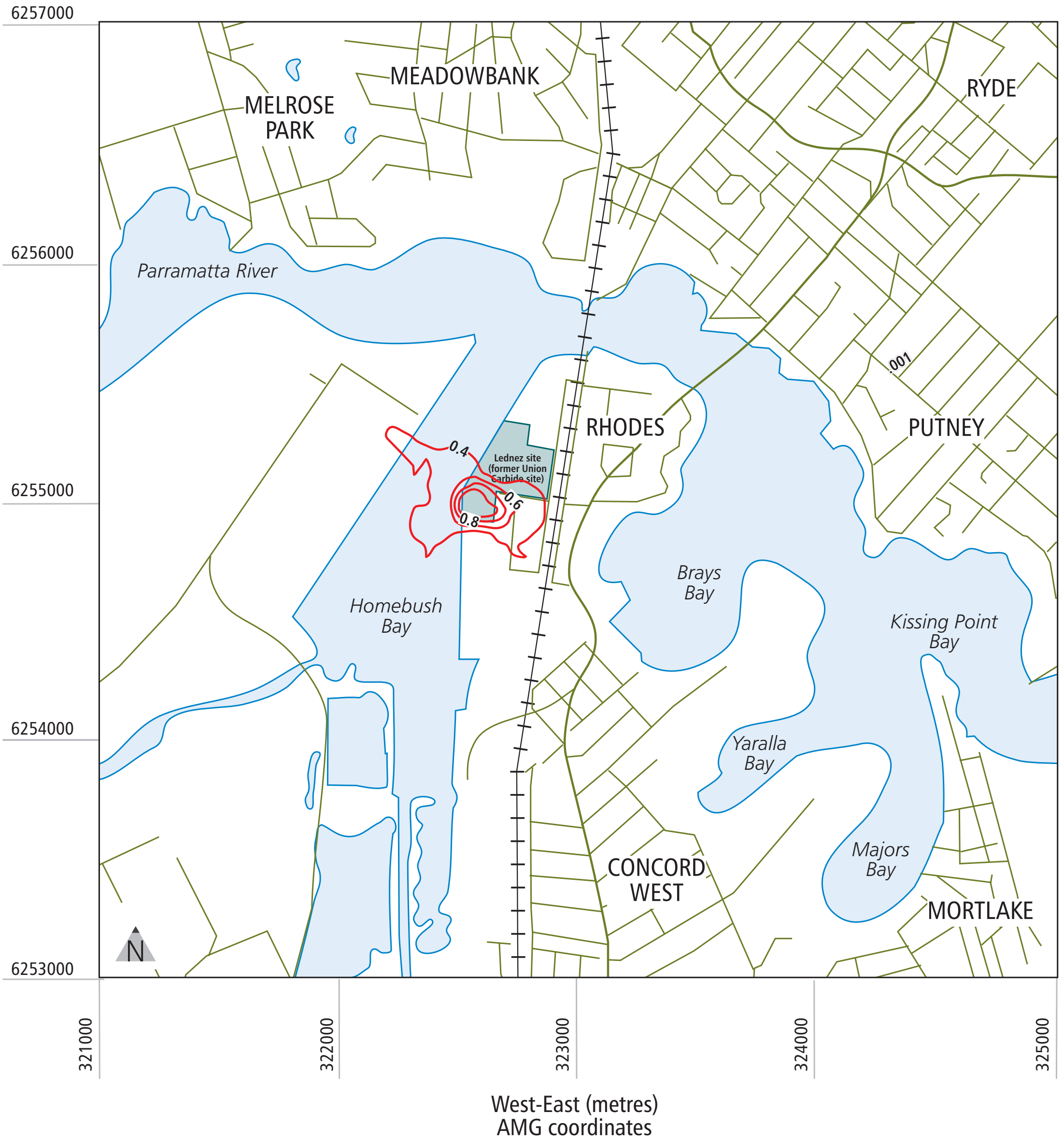


Figure 9.11 **Predicted Maximum 1-hour Average Carbon Monoxide Concentration at Ground Level due to Thermal Treatment Plant Emissions**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 31 milligrams per cubic metre.
3. Colour contour line locations are approximate.

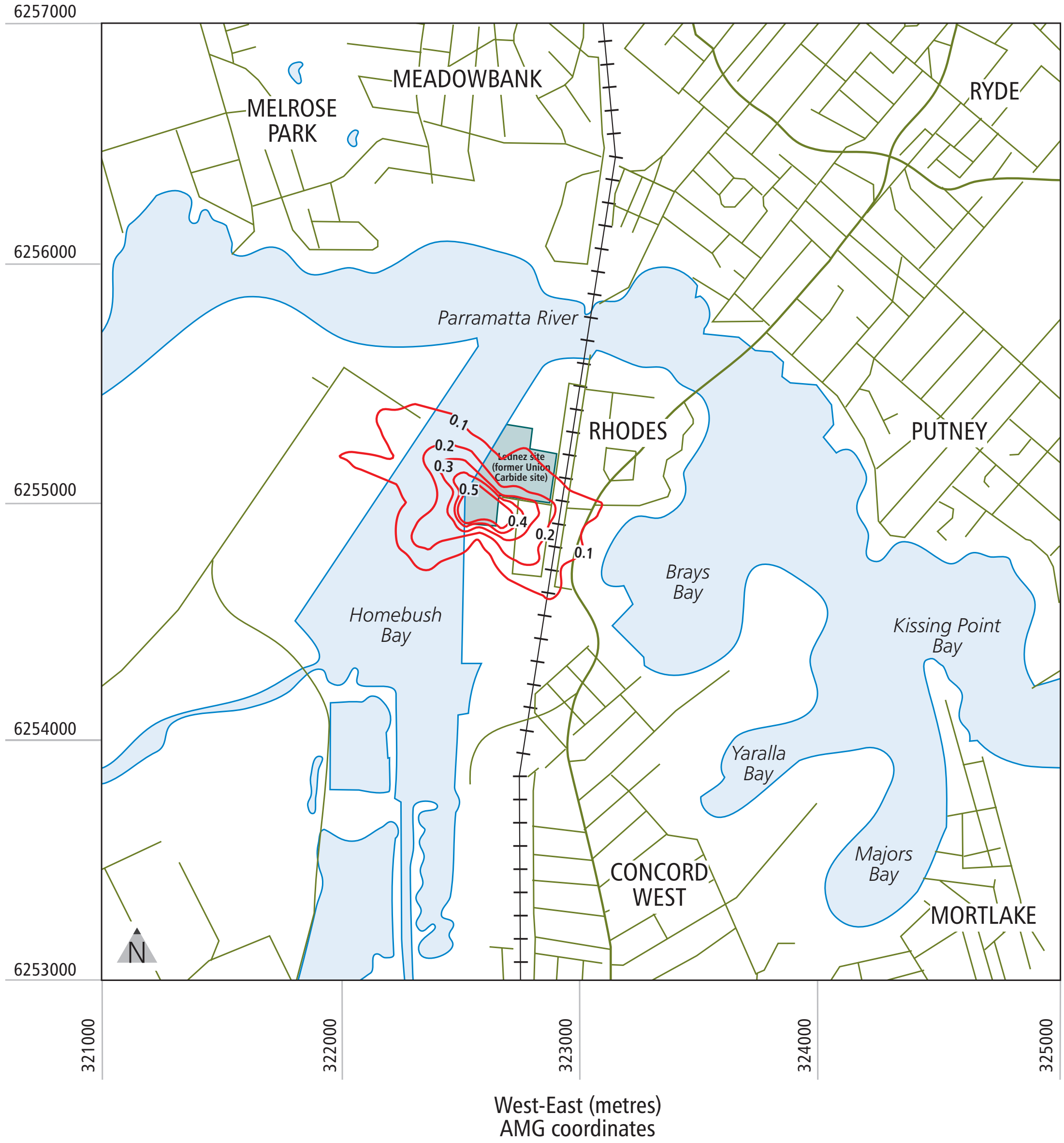


Figure 9.12 **Predicted Maximum 8-hour Average Carbon Monoxide Concentration at Ground Level due to Thermal Treatment Plant Emissions**

Notes: 1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 10 milligrams per cubic metre.
3. Colour contour line locations are approximate.

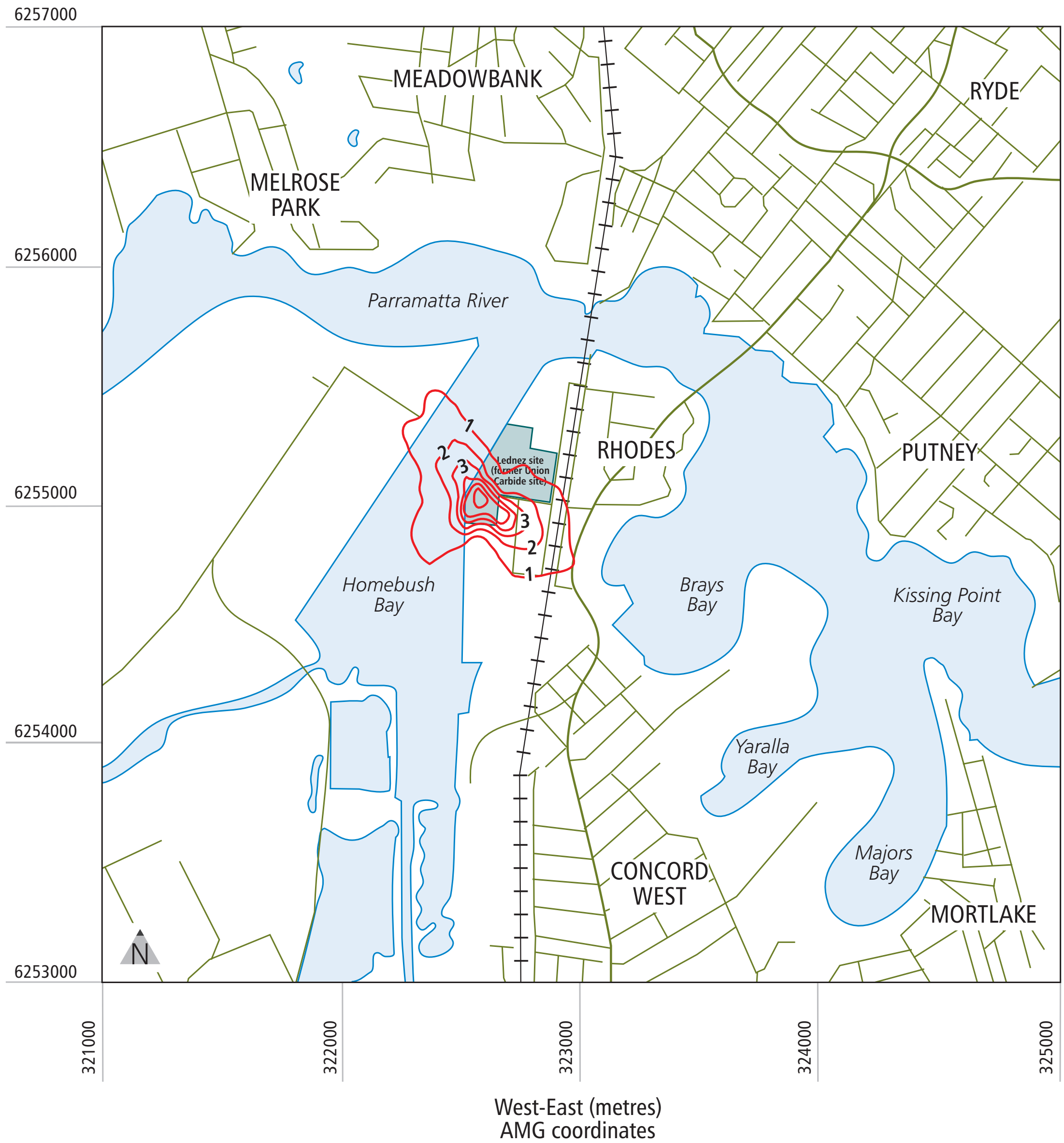


Figure 9.13 **Predicted Maximum 24-hour Average Particulate Matter less than 10 Microns Concentration at Ground Level due to Thermal Treatment Plant Emissions**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 50 micrograms per cubic metre.
3. Colour contour line locations are approximate.

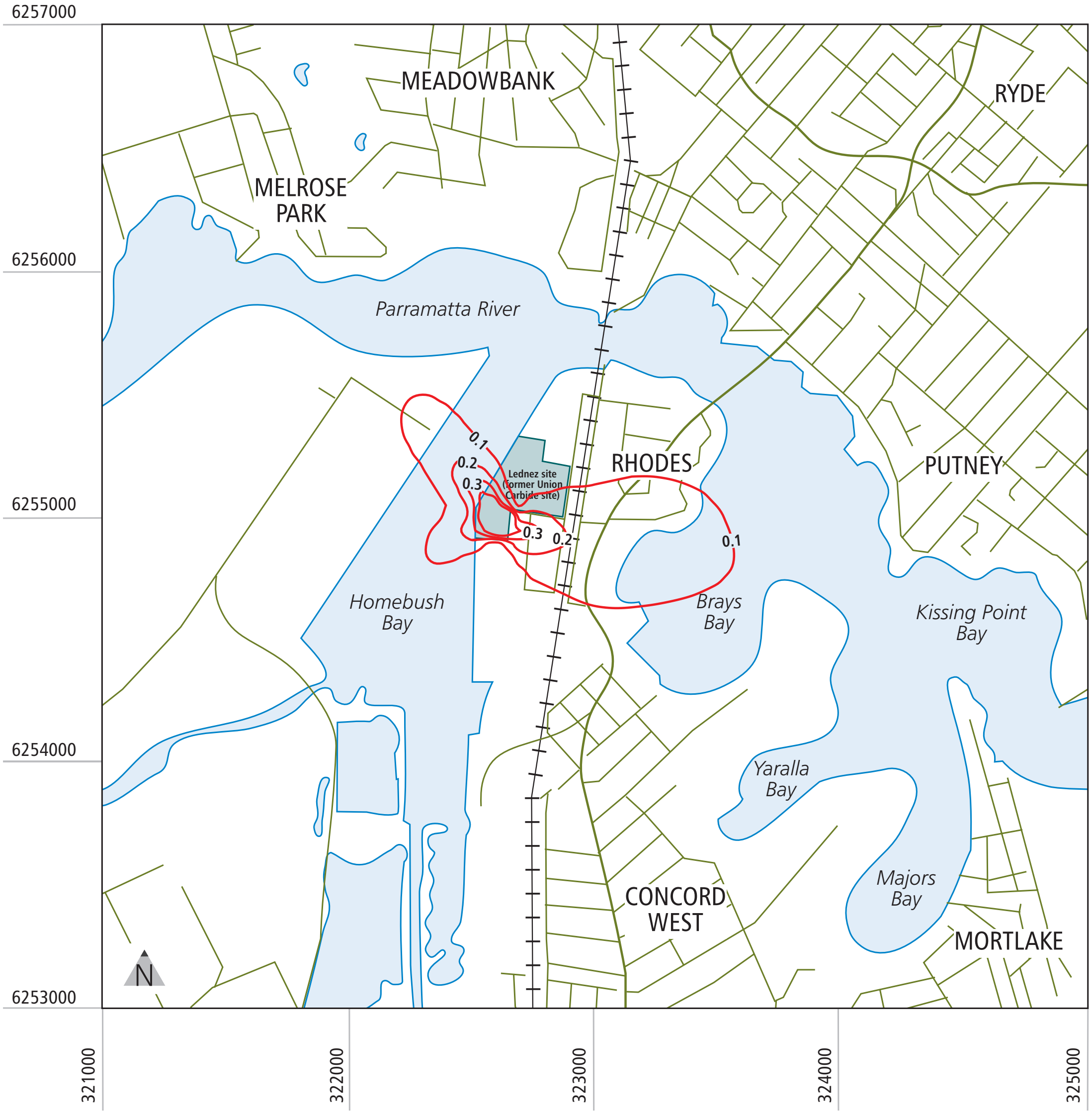


Figure 9.14 **Predicted Annual Average Particulate Matter less than 10 Microns Concentration at Ground Level due to Thermal Treatment Plant Emissions**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 30 micrograms per cubic metre.
3. Colour contour line locations are approximate.

It should be noted that all predictions for the thermal treatment plant are at ground level and do not take into account concentrations at elevated receptors, such as residents on balconies of multi-storey residential development. If the potential for this exposure to occur arises during the life of the remediation proposal, additional modelling may be required to determine impacts to residents at these locations.

The maximum concentrations are predicted to occur on-site due to the wake effects of existing buildings. All predicted off-site levels are below relevant air quality goals.

EPA monitoring at Lidcombe in 1999 and 2000, showed existing levels of NO_2 to be at a maximum of 146 micrograms per cubic metre. If this were added to the predicted maximum off-site level of 120 micrograms per cubic metre, the total of 266 micrograms per cubic metre would slightly exceed the goal of 245 micrograms per cubic metre. However this maximum level of NO_2 assumed total conversion of NO_x to NO_2, which is a very conservative assumption. Close to the stack where the maximum levels are predicted, NO_2 is likely to represent only 20 percent of the total NO_x concentration.

Background levels of CO are generally quite low apart from near busy roads, usually of the order of two to three micrograms per cubic metre. Adding the maximum predicted level of 12 micrograms per cubic metre to this would not result in exceedances of the one-hour goal of 31 micrograms per cubic metre.

All other pollutants apart from PM_{10} are likely to have very low background levels and the addition of the thermal treatment plant stack emissions would not result in any significant effect on air quality.

On an annual average basis, the background concentration for PM_{10} in the area is likely to be well below the goal of 30 micrograms per cubic metre. Data from 1999 and 2000 indicate that the annual average levels are below 20 micrograms per cubic metre. Adding this to the predicted maximum annual average of two micrograms per cubic metre would not result in exceedances of the goal. The maximum predicted 24-hour level of PM_{10} was 11.2 micrograms per cubic metre on-site and four micrograms per cubic metre off-site. In the 1999/2000 dataset which corresponds to the meteorological data used for the modelling, the maximum level for PM_{10} was 52.5 micrograms per cubic metre which exceeds the goal and the second highest was 43.9 micrograms per cubic metre. As the goal allows for five exceedances per year, adding the maximum predicted level to the maximum and second highest measured concentrations would not result in any additional exceedances of the 50 micrograms per cubic metre goal.

Ambient concentrations of metals and other air toxics are likely to be very low. Lead levels in Sydney, as measured by the EPA, are generally below the level of detection. Air toxic measurements including dioxin, are generally relatively low throughout Sydney (EPA, 1998c).

Odour

A screening assessment undertaken by Egis (Egis, 2002b) for potential odour impacts identified the following chemicals for evaluation:

- ethylbenzene
- xylenes
- chlorobenzene
- 1,2-Dichlorobenzene

- 1,4-Dichlorobenzene
- 2-Chlorophenol
- naphthalene.

The chemicals listed are based on the measured concentrations of volatile anthropogenic chemicals at the Lednez site and in the sediments of Homebush Bay. These do not include the naturally occurring organic chemicals that may be present in sediments in the bay including reduced sulphide compounds, such as hydrogen sulphide, produced by anaerobic bacteria, which on exposure could provide a significant odour source. No direct measurements of odour emissions from this source are available and consequently natural organics have not been included in this assessment, introducing uncertainty to the predicted odour impact.

The statistical program in AUSPLUME 5.4 was used for the following scenarios:

- Stage 1 and Stage 2 combined
- Stage 3.

The 99th percentile peak odour ground level concentrations were calculated for each of these scenarios. The results are summarised in **Figures 9.15** and **9.16**. As indicated on **Figure 9.15**, the combination of Stage 1/Stage 2 works would result in a higher off-site odour impact than that of the other stages. The areas of the coffer dams and the treatment stockpiles would be the major odour sources. The two-odour-unit contour, that is, the performance criterion for densely populated areas, extends marginally outside the site boundary on the north-west, south-east and southerly faces. It should be noted that there would be limited sensitive receptors in this area as it lies mostly over the coffer dam and bay work areas.

Sensitive receptors and residences are proximate to the south-east (at Blaxland Road) and south (at Mary Street) boundaries. **Figure 9.16** indicates that predicted 99^{th} percentile odour levels would not exceed 0.05 odour units in these areas. This is well below the EPA criteria of two odour units.

However, these odour concentration modelling results are based on emissions of anthropogenic chemicals (solvents) identified in the sediments and do not include potential odours from naturally occurring organic material. Due to this uncertainty and to the proximity of sensitive receptors, it is considered that there is a potential for odour impacts during excavation activities at the site, particularly during Stage 1 excavation.

9.5 Human Health Risk Assessment

9.5.1 Approach to Human Health Risk Assessment

In 2002, a site-specific human health risk assessment was undertaken by Egis Consulting to evaluate chemical emission rates from the remediation process and the dispersion of these chemicals into the local environment. The assessment also involved a comprehensive health risk assessment (and addendum report) for all carcinogenic and non-carcinogenic chemicals of interest for the site (Egis, 2002b and Egis, 2002c). This assessment was carried out in two components. The first assessment was undertaken absent of emission controls and based on the application of direct thermal desorption for treatment of soils on site. An addendum report was prepared subsequently to assess indirect thermal desorption. Both of these reports are provided in **Appendix E**.

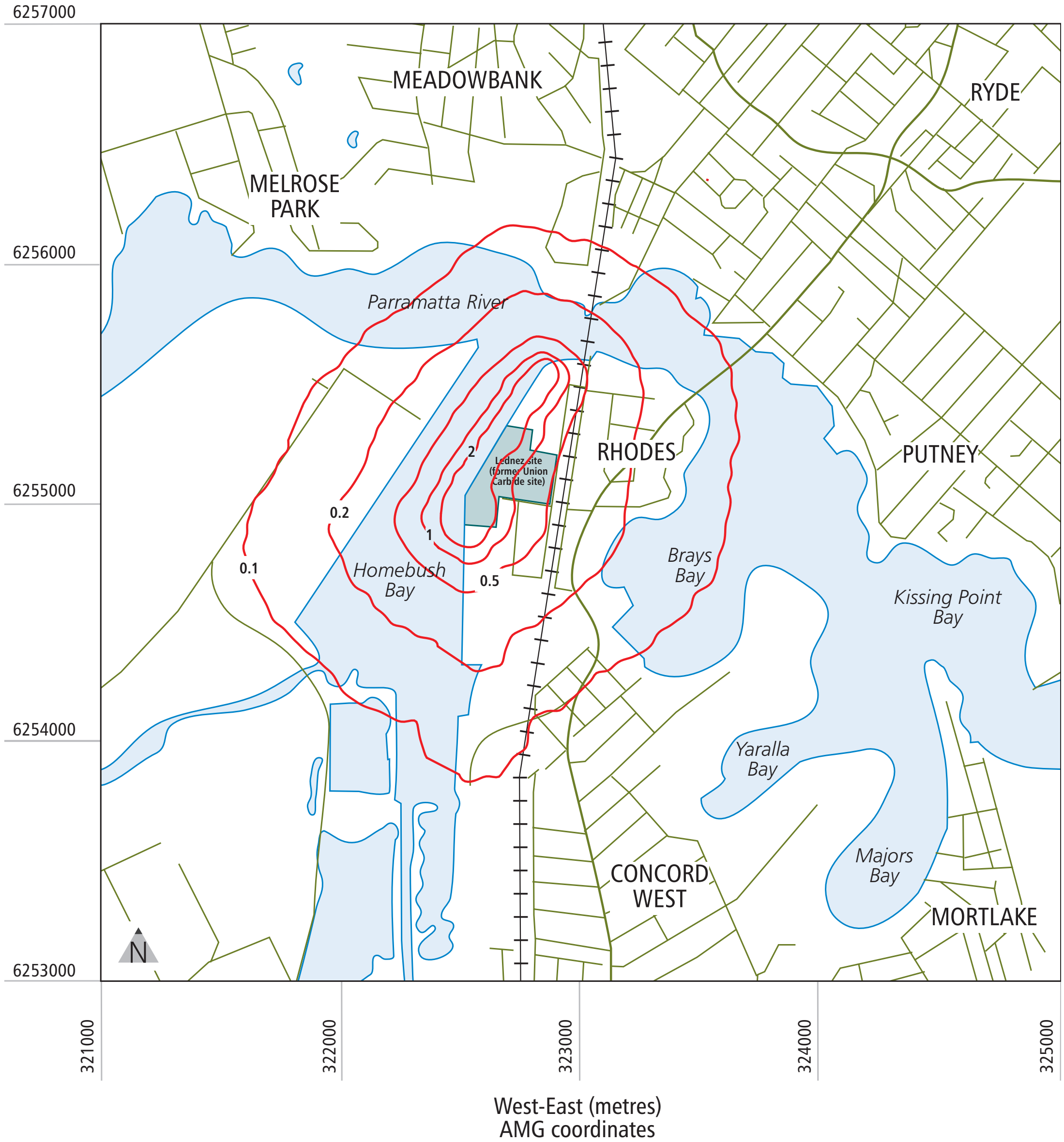


Figure 9.15 **Stages 1 and 2 – 99th Percentile Peak Odour Ground Level Concentrations**

Notes:
1. All units are in odour units.
2. Air quality goal for this figure is 2 odour units per cubic metre (where greater than 2000 residences are affected).
3. Contours shown include emission controls.
4. Colour contour line locations are approximate.

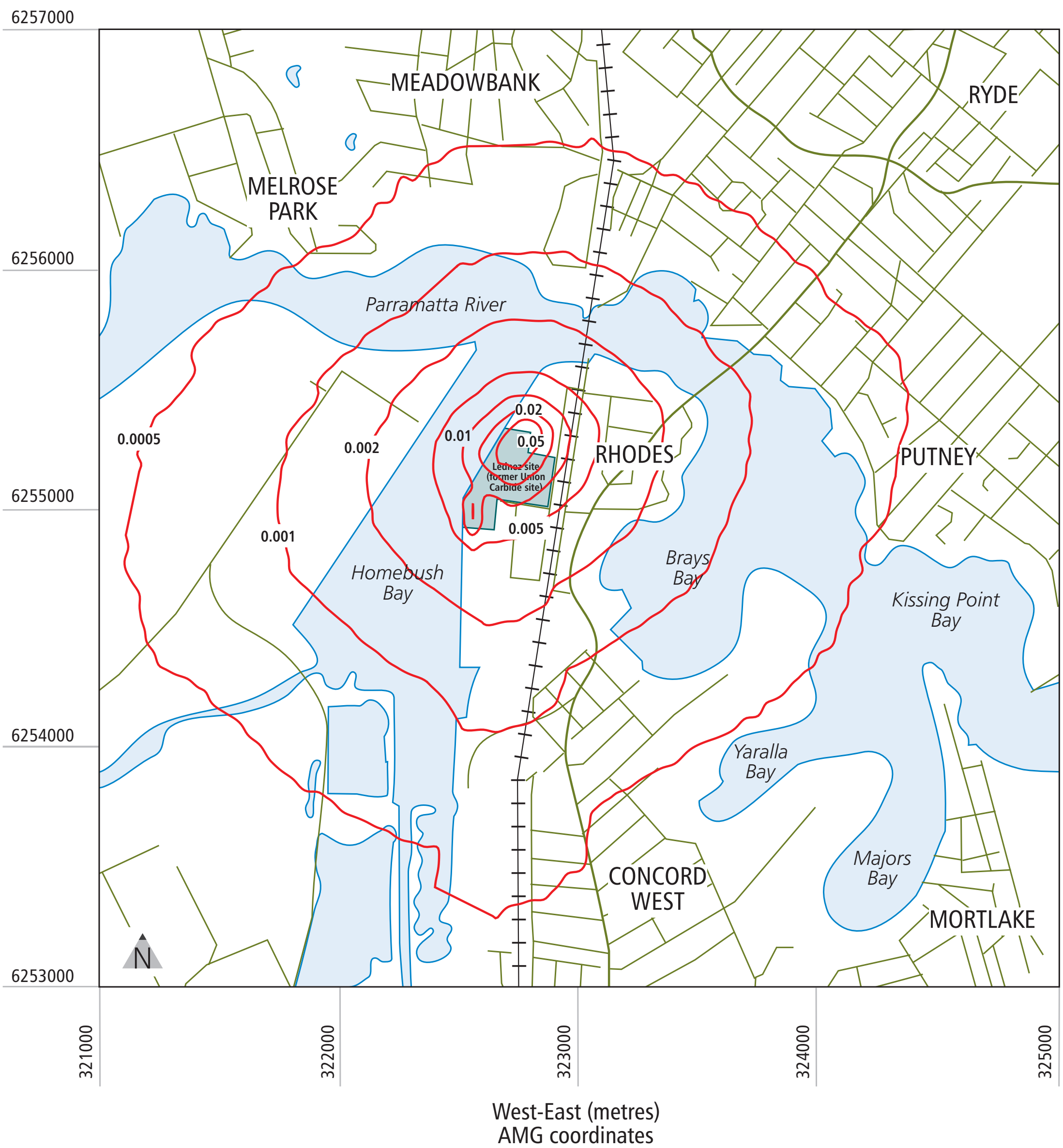


Figure 9.16 **Stage 3 – 99th Percentile Peak Odour Ground Level Concentrations**

Notes:
1. All units are in odour units.
2. Air quality goal for this figure is 2 odour units per cubic metre (where greater than 2000 residences are affected).
3. Contours shown include emission controls.
4. Colour contour line locations are approximate.

Human health risk assessment is a scientific process whereby chemical-specific toxicological data from animals or humans are combined with estimates of potential exposure to enable a prediction of whether the chemical in question poses an adverse risk to human health.

A tiered (or staged) approach was adopted to focus the risk assessment on those chemicals that pose the greatest potential risk. The approach involves two tiers, which are summarised in the following sections.

A screening assessment was carried out to identify the chemicals for evaluation for which health risks would be estimated. The screening assessment was designed to identify the chemicals that would be associated with the largest proportion of health risk from the site.

The following rankings were undertaken to determine which of the chemicals were most important:

- relative concentrations on-site
- potential for volatilisation
- relative toxicities.

The chemicals selected for evaluation are presented in **Table 9.11**.

Table 9.11 Summary of Chemicals for Further Evaluation

Non-volatile (via particulates)	Volatile (gases)
Dioxins	Dioxins
Carcinogenic polycyclic aromatic hydrocarbons	Benzene
Naphthalene	Chlorobenzene
Tetrachlorobenzenes	Dichlorobenzenes
Pentachlorobenzene	Tetrachlorobenzenes
Hexachlorobenzene	Pentachlorobenzene
DDD	Hexachlorobenzene
Dieldrin	Naphthalene

9.5.2 Site-specific Assessment

A site-specific assessment was carried out to provide a more comprehensive and in-depth evaluation of the potential risks associated with the chemicals selected for evaluation. This assessment takes into consideration site-specific information such as soil concentrations and the operation of the proposed thermal treatment plant for the site. It involves the assessment of human exposure to airborne contaminants during and after site development.

Figure 9.17 illustrates the estimated incremental lifetime risk of cancer associated with the proposed remediation activities. **Figure 9.18** illustrates the estimated non-carcinogenic hazard index associated with the proposed remediation activities.

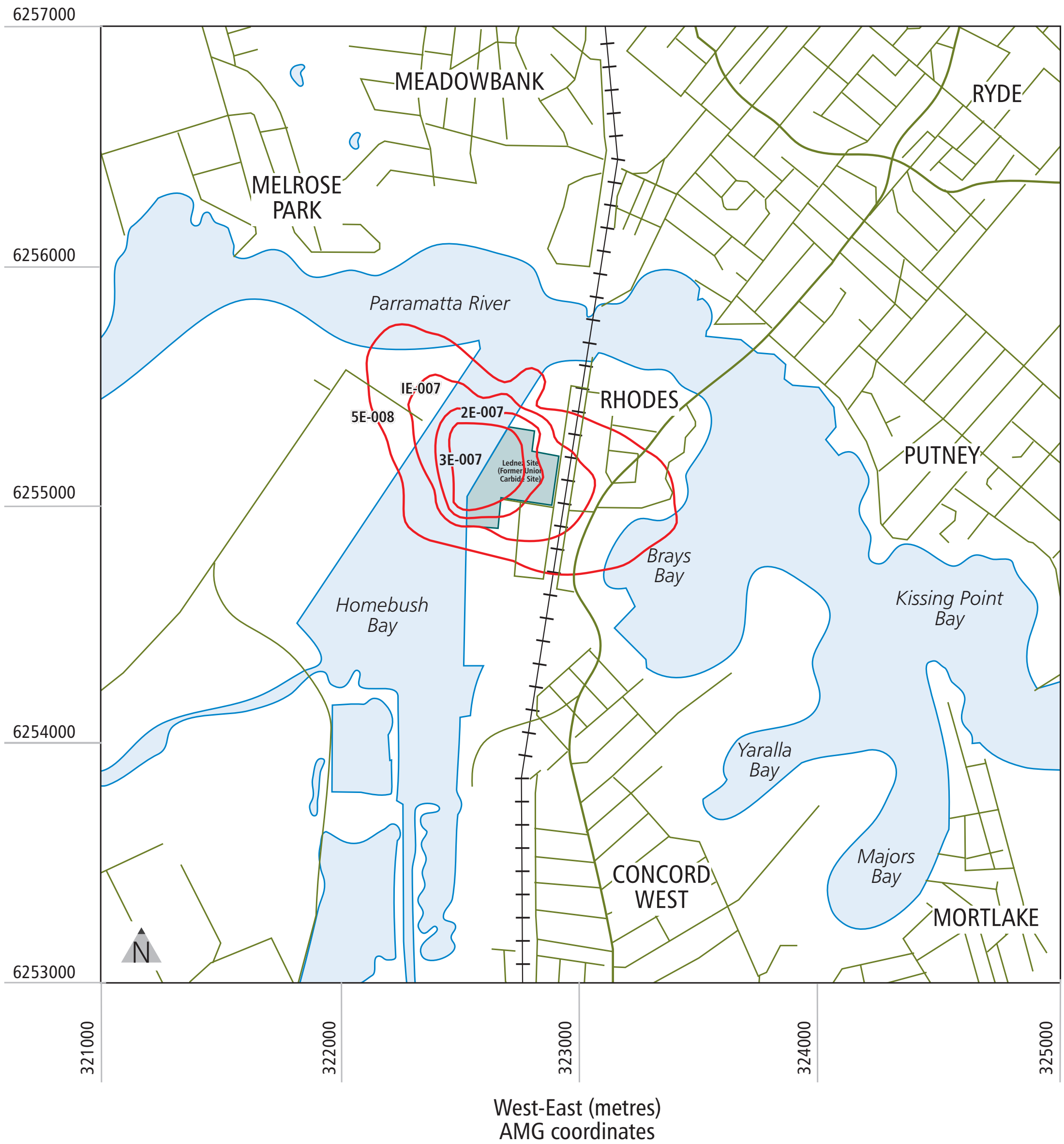


Figure 9.17 **Estimated Incremental Lifetime Risk of Cancer**

Notes:
1. The acceptable risk level is one in a million (also known as IE-006). A risk of 0.3 in a million (also known as 3E-007) is lower than this acceptable limit.
2. Contours shown include emission controls.
3. Colour contours line locations are approximate.

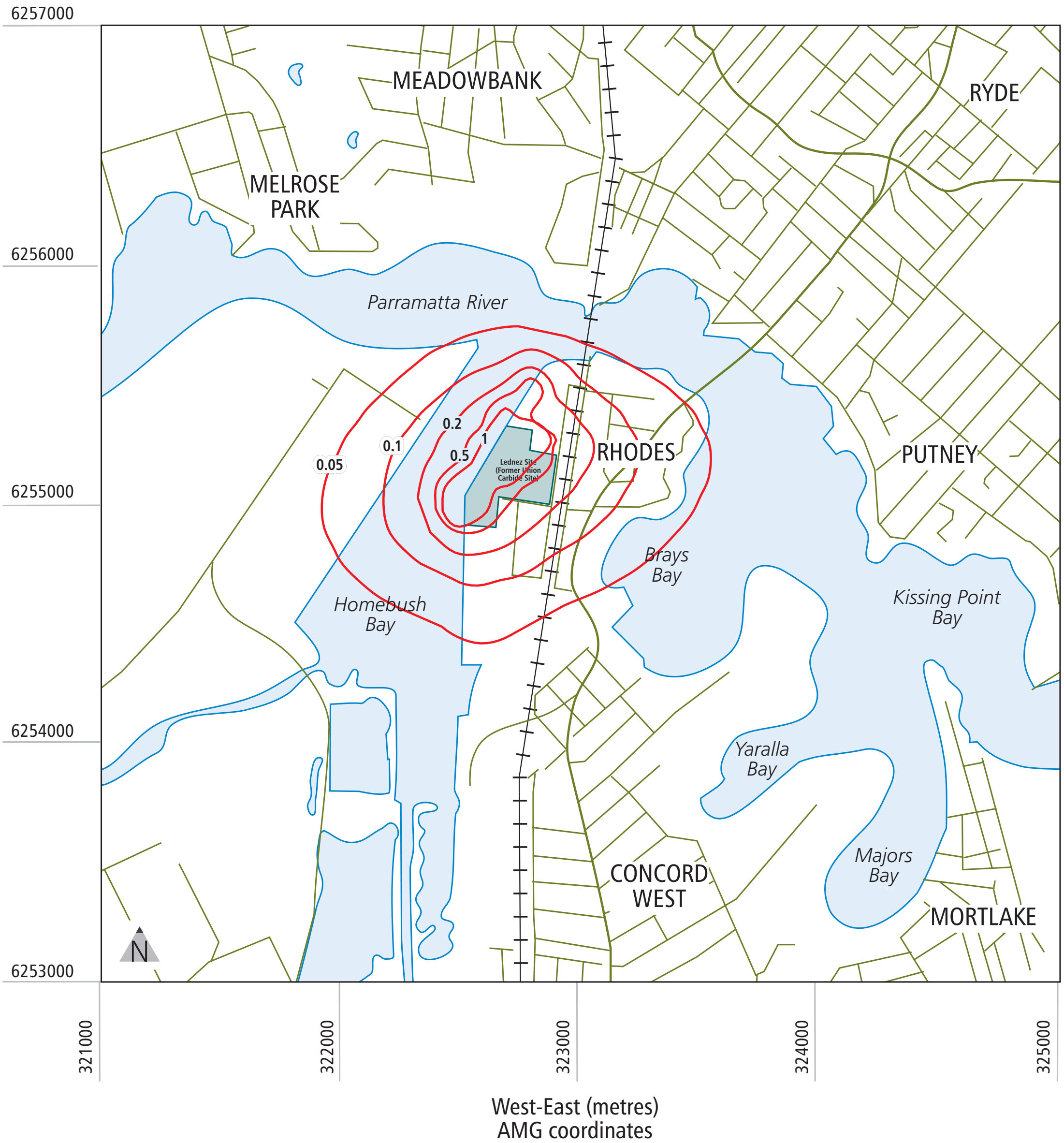


Figure 9.18 **Estimated Non-carcinogenic Hazard Index**

Notes: 1. Hazard index of less than 1.0 is considered acceptable.
2. Contours shown include emission controls.
3. Colour contours line locations are approximate.

The results can be summarised as follows:

- the lifetime risk of cancer for the highest exposed off-site individual was estimated to be less than 0.3 in a million. This estimate is less than the nominated risk level of one in a million
- the total non-carcinogenic hazard index for the maximum off-site exposed individual was less than the acceptable non-carcinogenic health effects limit of 1.0
- if residents are present on adjacent sites prior to the commencement of remediation activities at the site they would not be exposed to an increased level of carcinogenic or non-carcinogenic health risks above the nominated risk levels.

9.6 Greenhouse Gas Impacts

The major greenhouse emissions from the proposed remediation would arise from the carbon dioxide emissions from combustion of gas in the thermal treatment plant, the diesel fuel used during site works and electricity consumption by electrically powered equipment on-site.

An estimate of CO_2 emissions from the process unit over the life of the proposal has been provided by Thiess Services. The thermal treatment plant would consume approximately 250,000 gigajoules of natural gas over the life of the proposal. The CO_2 emission from combustion of this gas is estimated to be 59.4 kilograms of CO_2 per gigajoule of gas burned, a total 14,849 tonnes of CO_2.

Diesel consumption by mobile plant and generators is estimated to be 12 million litres. The carbon content of diesel fuel is approximately 0.67 kilograms per litre, which on complete combustion would produce 2.46 kilograms of CO_2 (0.67 kilograms by (12+32)/12). Therefore, burning 12 million litres of diesel would produce 29,589 tonnes of CO_2.

Electricity power consumed on-site is estimated to be 190,000 kilowatt hours over the life of the proposal. The total energy consumption would be 6.84 by 10^{11} joules (190,000 kilowatt hours by 3,600 seconds per hour).

Electricity for site operations would be sourced from the grid. In estimating carbon dioxide emissions resulting from electricity consumption it has been assumed that power is derived from coal-fired power plant in NSW. The Australian Greenhouse Office publishes CO_2 emission factors for Bayswater, Eraring, Mt Piper, Liddell, Munmorah, Vales Point, Wallerawang and Ashford power stations (Australian Greenhouse Office, 1999). The average emission factor for these assuming that the power stations are using their main fuel of black coal is 87.7 by 10^{-6} grams per joule. Thus the annual emission of CO_2 from consuming 6.84 by 10^{11} joules of electrical energy is 60 tonnes (87.7 by 10^{-6} grams per Joule times 6.84 by 10^{8} joules).

In summary the approximate total CO_2 emissions would be:

- 14,849 tonnes attributable to emissions from the thermal treatment plant
- 29,589 tonnes due to combustion of diesel in mobile plant and generators
- 60 tonnes due to consumption of electricity.

The total CO_2 emission is therefore estimated to be 44,490 tonnes over the life of the proposal or 8,898 tonnes annually assuming a five-year life span.

These emissions can be compared with the 458.2 Mega tonnes CO_2 equivalent estimated by Environment Australia to have been produced by Australia in reference year 1999 (excluding land clearing) (see *www.greenhouse/facts/pdfs/nggifs1s.pdf*). The total annual greenhouse gas emissions for the proposal are estimated to be 0.008 percent of Australia's 1999 emissions.

9.7 Mitigation Measures and Monitoring

9.7.1 Mitigation Measures

As discussed there are two activities of concern that could result in an impact on air quality, these are:

- fugitive emissions from earthworks and handling of contaminated material
- stack emissions from treatment of material by the thermal treatment plant.

Although no significant off-site impacts to air quality are predicted and on-site impacts are marginal, a full contingent of air quality measures would be implemented as part of the proposed remediation. Mitigation measures would focus primarily on the management of earthworks and ancillary site activities to ensure that emissions of dust, including any chemicals attached to the dust, are kept to the minimum level practicable. The air quality and risk assessment studies were conducted with the assumption that measures to minimise any impacts to local air quality were in place. Such measures included:

- water carts and/or water sprays would be used to ensure that all trafficked areas are kept in a damp condition. The application of water would help prevent drier, lighter materials from being transported around the site and off-site
- site speed limits imposed on all vehicles using the site
- a traffic management system would reduce site vehicle traffic to the minimum levels practicable. Traffic would also be directed along specific routes and these would be marked so that traffic is kept to maintained surfaces
- shade cloth attached to cyclone wire fencing to minimise the off-site transport of coarse particles
- boundary misting system installed to minimise off-site transportation of dust
- sealing materials used to stabilize inactive stockpiles and other exposed areas susceptible to wind erosion during dry windy conditions
- rumble strips and a wheel wash used to minimise the transport of dust/mud off-site
- progressive turfing of the remediated areas.

Additional mitigation measures that would be employed to further reduce the incidence of dust include:

- remediation of relatively small areas at a time. This has a number of benefits in terms of dust minimisation. Materials being excavated can be transported quickly and effectively to remediation areas before soil moisture declines and dust is created
- enclosure of the dust and odour-creating pre-treatment process. The pre-treatment process could potentially create substantial dust and odour emissions. For this reason, Thiess Services intends to construct a purpose-built building on-site to fully enclose the processes. Air from within this building would be filtered to remove particulate matter and passed through activated carbon to remove odours before being recirculated or discharged

- dust-generating operations would be suspended during dry, windy conditions
- excavation odour mitigation measures would include management by covers, liquid odour suppressant sprays and/or by minimising the surface area. Covers may comprise dry non-odorous soil or plastic sheeting such as low-density polyethylene or high-density polyethylene. Liquid odour suppressant sprays would be used, both directly at the excavation face and in boundary misting systems.

The thermal treatment plant would include in-built emission controls, including:

- high-efficiency filtering and scrubbing for the removal of fine dust carried by the desorption- gas stream
- closed loop desorption gas treatment process
- continuous emission monitoring capabilities
- a 20 metre high stack through which the natural gas combustion off-gases exit at a high velocity.

These in-built controls for the thermal treatment plant are important in determining the ground-level concentrations of emissions and have been taken into account in the modelling undertaken in this EIS. Modelling has shown that the ground-level concentrations of the emitted substances would be below their respective ambient air quality goals or below one in a million lifetime risk level. Therefore, the in-built controls in the thermal treatment plant are sufficient to comply with the relevant air quality goals.

9.7.2 Monitoring

An air quality monitoring program would also be implemented. All air monitoring work would be conducted by appropriately qualified and experienced personnel employed by a recognised air-monitoring consultancy. The selection of the sampling locations would be in accordance with the prevailing winds at the time and it is anticipated that the locations would generally be at the down wind boundary, in the pathways of potential air contaminants.

Dust monitoring would be carried out around the site to determine compliance with particulate matter (dust) goals. This would involve monitoring of dust fallout levels using dust deposition gauges, measurement of dust concentrations using high-volume samplers and continuous measurement of dust concentration with DustTrak monitors. This would provide real-time information and assist in refining dust control strategies.

The following monitoring is proposed:

- four high volume samplers, run on a monthly basis at the site boundaries, to determine total suspended particulate levels, semi-volatile organic compounds, volatile organic compounds and dioxins
- four dust deposition gauges at the site boundaries to measure dust deposition rates
- four DustTrak PM_{10} monitors for continuous measurement of dust concentration
- olfactory observation at site boundaries and in the surrounding residential areas using personnel specifically trained for odour level determination
- sampling pumps fitted with reactive tubes targeted to respond to volatile organic compounds, including chlorinated compounds.

In addition, a weather recording station would be established to provide information to site personnel on the prevailing wind direction, and to provide a continuous record of atmospheric conditions.

Ambient concentrations of hazardous substances during the works are predicted to be extremely low. Therefore, in order to measure accurately the concentration of any hazardous substances in ambient air high volume sampling techniques would be used to collect ambient air samples, coupled with sensitive laboratory analytical methods for the identification and quantification of hazardous substances.

Specifically the air quality monitoring would focus on measuring:

- dioxins and furans, as per USEPA method TO 9A
- chlorobenzenes, as per the National Institute of Occupational Safety and Health (NIOSH) Method 5517
- chlorophenols, as per NIOSH 2nd Edition Method P&CAM 337
- total respirable dust, Australian Standard 2922-1987 and Australian Standard 3580.9.6-1990
- dust deposition (total solids), as per Australian Standard 2922-1987 and Australian Standard 3580.10.1-1991
- continuous measurement of PM_{10} using a light scattering technique.

Results of monitoring would be made available to the Community Liaison Group.

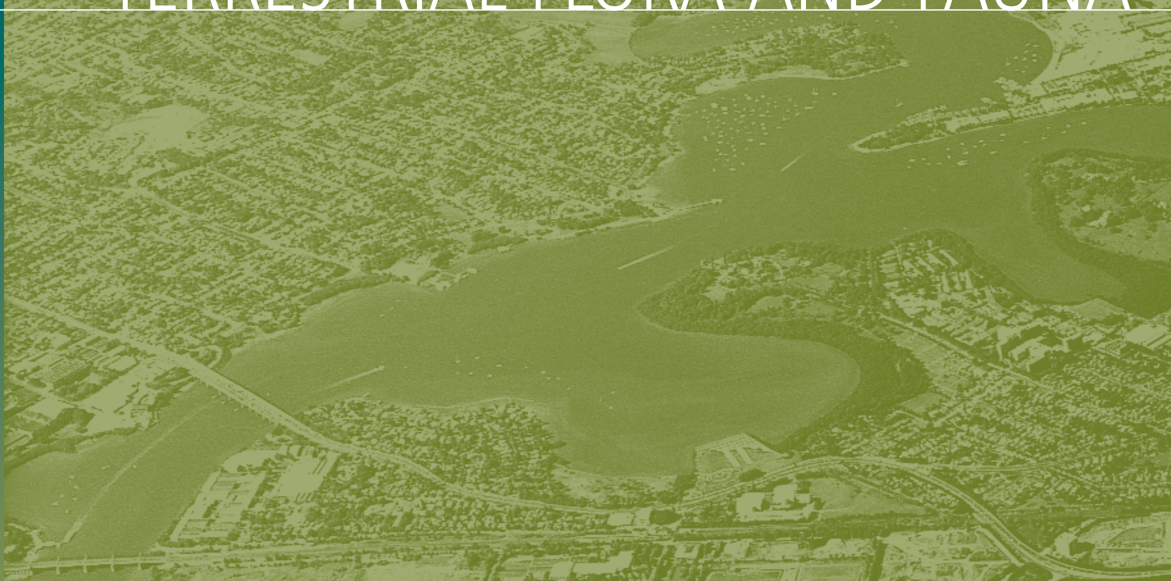
Additionally, a personal air-monitoring program would be carried out during all stages of the treatment/remediation works. The aims of that program would be to confirm that worker exposure to airborne hazardous substances is less than recognised occupational health standards, to confirm or modify the appropriateness of work procedures and to determine the need for personal protective equipment, particularly respirators, for specific site tasks.

Chapter 10

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

TERRESTRIAL FLORA AND FAUNA



Chapter 10

TERRESTRIAL FLORA AND FAUNA

This chapter summarises the key findings from the flora and fauna assessments undertaken which are more fully detailed in **Appendix F**.

In conducting the flora and fauna assessment, the study team has identified:

- flora and fauna which is listed under either the *Threatened Species Conservation Act 1995* or the *Environment Protection and Biodiversity Conservation Act 1999* and which occurs within 10 kilometres of the study area, and
- flora and fauna listed under that legislation which occurs within two kilometres of the study area.

For flora and fauna that occurs within 10 kilometres of the study area, preliminary consideration has been given to determine the likelihood of impacts on it and, in particular, whether or not there would be a significant impact on it within the meaning of the *Threatened Species Conservation Act 1995* or the *Environment Protection and Biodiversity Conservation Act 1999*.

For flora occurring within two kilometres of the study area, a more detailed assessment has been carried out. If there are identified impacts on any threatened species, or habitat listed under the *Threatened Species Conservation Act 1995*, an eight part test has been carried out to determine whether or not there would be a significant impact on that species or habitat.

For this proposal, an eight part test has been carried out for two species. These are the Green Sawfish and the Green and Golden Bell Frog. For further details, see **Technical Paper 10** and **Appendix F** respectively.

In the instance that species or habitat is listed under the *Environment Protection and Biodiversity Conservation Act 1999*, if an impact has been identified then an assessment of that impact is carried out in accordance with the guidelines under that Act.

10.1 Existing Environment

10.1.1 Flora

The native flora of the local area has been substantially altered as a result of commercial and residential development. This has included major alterations to the natural shoreline of the bays and rivers through the building of dykes and reclamation of mud flats.

There are several areas of remnant native vegetation remaining within two kilometres of the Lednez site. In addition, there are scattered individual remnant native trees within residential and commercial areas. The larger areas are more often a combination of regenerating native vegetation and planted native and exotic plant species rather than areas that have been left undisturbed.

Of the species listed on the *Threatened Species Conservation Act 1995*, there are 42 listed species of flora identified as being within 10 kilometres of the Lednez site. Only one flora species, Narrow-leaf Wilsonia (*Wilsonia backhousei)* has been identified as existing within two kilometres of the site. The key findings for the study area are summarised below.

Saltmarsh

Much of the saltmarsh in the study area is assigned to this habitat type by virtue of its floristic composition, rather than by its physical environment. Large stands of vegetation dominated by characteristic saltmarsh species occur at sites which are not currently intertidal either because they occur on filled areas above the tidal limit or because tidal exchange is prevented by bund walls. In the context of New South Wales, intertidal saltmarsh is one of the most rare habitat types and is poorly represented in conservation reserves (Adam, 1993). The Homebush Bay area contains the second largest concentration of saltmarsh in the Sydney region and the Silverwater Nature Reserve wetland (also known as the Newington Wetlands, see **Figure 7.1**) is the second largest single saltmarsh site after that at Towra Point on the southern shores of Botany Bay.

Narrow-leaf Wilsonia (*Wilsonia backhousei*) is listed as a vulnerable species on Schedule 2 of the *Threatened Species Conservation Act 1995* and is the only listed plant species known within the study area. The study area contains the largest remaining stands of Narrow-leaf Wilsonia in the Sydney Region, being mostly located in the northern areas of the Silverwater Nature Reserve.

Mangrove Forest

The shorelines of the estuaries within the study area are lined with some of the oldest and most significant stands of Grey Mangrove (*Avicennia marina*) in the Sydney Basin (Adams, 1993).

Eucalypt Woodlands

The most significant native woodland within the study area is that found within the Silverwater Nature Reserve (also known as the Newington Wetlands, see **Figure 7.1**). This community is listed in the *NSW Threatened Species Conservation Act 1995* and the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* as Shale/Sandstone Transition Forest. It is restricted to transitional areas between the clay soils derived from the Wianamatta shale and the sandy soils derived from Hawkesbury sandstone within the Sydney Basin Bioregion (EPA, 1997b).

The 19 hectare eucalypt woodland is the same type that once covered extensive areas of western Sydney's Cumberland Plain and is the last of its kind on the Parramatta River.

Fauna Habitats

There is a high diversity of remnant habitats within two kilometres of the Lednez site that are now rare in the Sydney region. These habitats correspond with eucalypt and *Casuarina* forests, mangrove forests, saltmarshes and saline and freshwater wetlands (Eckert, 2001). In addition, residential and commercial areas and grasslands provide habitat for a range of native fauna species.

Homebush Bay has been recognised at local, state, national and international levels as an area of high conservation value through its provision of habitat for a wide range of bird communities (Eckert, 2001). In particular, the shallow-water wetlands and mudflats provide a diversity of foraging and roosting sites for wading birds.

Habitat for vertebrate fauna, not including birds, is limited within the study area. It would be expected that domestic and feral animals, plus some of the more hardy native species, would exist within the residential and commercial areas of the study area. The most significant area of native habitat within the study area would be within the Newington Nature Reserve.

10.1.2 Fauna

Previous surveys of the local study area have identified the existence of 25 fauna species that have been listed under the *Threatened Species Conservation Act 1995*, *Environment Protection and Biodiversity Conservation Act 1999*, the J*apan-Australia Migratory Bird Agreement* and the C*hina-Australia Migratory Bird Agreement*.

Six listed amphibian species have been found to exist within a 10-kilometre radius of the site. One amphibian species, the Green and Golden Bell Frog (*Litoria aurea)*, has been identified as being within two kilometres of the Lednez site. The remaining five species are unlikely to be within two kilometres of the study area. A targeted search of the site has revealed no evidence of the Green and Golden Bell Frog.

Four listed reptile species have been identified as existing within a 10-kilometre radius of the site. No listed reptiles have been identified as having the potential of existing either on-site or within two kilometres.

Searches of the National Parks and Wildlife Service Wildlife Atlas and the *Environment Protection and Biodiversity Conservation Act 1999* online database found 56 listed bird species within 10 kilometres of the site. Of these, four have been determined as existing on-site, eight are likely to occur on-site and an additional seventeen are likely to occur within two kilometres of the site. An additional 18 bird species that are listed in the *China-Australia Migratory Bird Agreement* and *Japan-Australia Migratory Bird Agreement* have been identified as occurring in the local area in previous surveys. It should be noted that migratory species that are very widespread, vagrant or only occur in small numbers have not been mapped in the *Environment Protection and Biodiversity Conservation Act 1999* online database.

There are 22 listed mammal species identified as having the potential to exist within 10 kilometres of the site. Of these, eight are types of bat that are likely to occur within the local area. Two of these listed mammal species have been identified as occurring within two kilometres of the site.

10.2 Potential Impacts and Mitigation Measures

The impacts on flora and fauna were assessed with particular emphasis on those species or ecological communities or their habitats that have been listed as nationally significant in the *Environment Protection Biodiversity Conservation Act 1999* or listed as endangered or vulnerable in the *Threatened Species Conservation Act 1995*. In addition, the requirements of the *Environment Protection Biodiversity Conservation Act 1999* in relation to scheduled Ramsar Wetlands and World Heritage areas were examined. The proposed remediation is not located near any areas listed as World Heritage or within any catchments of Ramsar Wetlands.

10.2.1 Flora

No nationally threatened plant species or nationally endangered ecological communities were identified at the site.

The direct impacts on flora as a result of the proposed remediation activities are restricted to clearing of existing vegetation within the site. The only indirect effect of the proposal may be some deposition of dust on vegetation within the immediate vicinity of the site. The nearest area that contains significant flora are one to two kilometres south and south-west of the Lednez site. This includes the vulnerable species of saltmarsh, the Narrow-leaf Wilsonnia. As no direct or indirect impacts would be experienced by flora this far from the proposed activities, no further assessment is required.

10.2.2 Fauna

No nationally threatened fauna species has been recorded on the site. However suitable habitat occurs for the Green and Golden Bell Frog, which is listed as vulnerable.

Green and Golden Bell Frog

No Green and Golden Bell Frogs were detected on the site. Therefore, the site would not be classified as containing an important population as defined by the *Environmental Protection and Biodiversity Act 1999*. The Green and Golden Bell Frog is likely to occur within two kilometres of the site. However, the proposal would be highly unlikely to adversely affect habitat critical to the survival of the Green and Golden Bell Frog, nor would it be likely to result in the species declining. Any off-site effects resulting from dust produced by the works would not adversely affect the species, as the deposition is very low and very localised. The proposal would be unlikely to result in any invasive species that are harmful to the Green and Golden Bell Frog becoming established in the area and it would be highly unlikely to interfere with the recovery of this vulnerable species. Therefore, no further assessment of this species is required under this Act.

Other Amphibian, Reptile or Mammal Species

No other significant amphibian, reptile or mammal species were found to exist on the site, nor are they likely to exist there due to the highly disturbed and isolated nature of the site. However, there are eight significant mammal species; all bat species, likely to occur within two kilometres of the site.

Any off-site effects resulting from dust produced by the works would not adversely affect bat species, as the deposition is very low and very localised.

Migratory Species of Birds

Another group of species of national significance are migratory species. The migratory species that may potentially use the Lednez site are not at their limit of distribution in the area, nor are these species known to be declining in the locality.

Direct (on-site) impacts on these species resulting from the proposed remediation activities would be limited to:

- a loss of foraging habitat for wading birds in the intertidal zone adjacent to the Lednez site
- a loss of foraging habitat for terrestrial birds within the open areas and artificial freshwater habitats within the proposal area.

Consequently, the activity at the site is likely to disturb bird species so that they would use other habitats within the local and regional area. The Lednez site does not support a significant proportion of the populations of these species within the region. Therefore, because the Lednez site would not be considered to contain important habitat for these migratory species the above impacts on their habitat would not have any impact on the species.

Indirect (off-site) effects of the proposal would be limited to some deposition of dust on foraging habitats within the immediate vicinity of the site.

Night-time effects resulting from lights would not adversely affect bird species, as the proposed night-time remediation activities would blend into the existing ambient light environment of urban Rhodes.

The proposed remediation is also highly unlikely to disrupt the lifecycle of any populations of these migratory species. The remediation works would improve the quality of feeding habitats within the intertidal zone for these species and therefore would have a net benefit to these migratory birds.

Further, due to the mobile nature of migratory birds and the seasonal nature of their use of habitats, the proposed activity is not likely to have any impact on these species. Accordingly, no further assessment of these species is required.

10.2.3 Mitigation and Improvement Measures

Despite limited impacts on flora and fauna species, both on and off-site, measures to be taken to reduce adverse impacts of the activity and to enhance the ecological value of the site are:

- retention of native vegetation on-site as far as possible
- control of invasive weeds on-site
- use of local native species in the rehabilitation of the site
- control erosion and sedimentation
- check potential fauna habitats, including trees and other vegetation, created wetlands and buildings for fauna before disturbance and relocate species where found.

Chapter 11

REMEDIATION OF LEDNEZ SITE, RHODES and HOMEBUSH BAY

RISKS AND HAZARDS

Chapter 11

RISKS AND HAZARDS

11.1 Introduction

The requirements issued by the Director-General of the Department of Planning stipulate that the EIS must address:

- *acute risk impacts, that is, risk associated with "instantaneous" incidents or related to the site (as per guidance provided in the Planning NSW "Hazardous Industry Planning Paper" series)*
- *chronic risk impacts, that is, the long term risks (health impacts) associated with the operation of the proposed development.*

An assessment in accordance with Applying SEPP 33 Guidelines (DUAP, 1997b) was conducted to determine whether a preliminary hazard analysis (PHA) is required as part of this EIS. Based on that assessment it was concluded that a PHA is not required for the proposal. Planning NSW in their letter of December 2001 (**Appendix B**) subsequently confirmed that a PHA is not required for the proposal. Despite this, it is important to consider potentially hazardous incidents or activities associated with the proposed remediation and the potential for off-site impacts. Accordingly, a hazard identification and analysis exercise has been conducted.

Table 11.1 summarises the likely quantities of dangerous goods that would be stored and used on-site. **Table 11.2** shows the likely quantities of dangerous goods that would be transported to and from the site.

Table 11.1 Quantity of Dangerous Goods Stored or Used On-site

Hazardous materials	Class of dangerous goods	Mode of storage	Location on-site	Quantity	Screening levels	Preliminary hazard analysis required
Thermal plant operation						
Natural gas	2.1	Mains supply	Not applicable	Mains only, no storage on-site	Not applicable – mains supply	No
Oil/sludge residues	9	20,000 litres tank	Treatment area	20,000 litres per month	Not applicable *	No
Hydrated lime	8 (III)	Covered pile	Treatment area	10 tonnes	50 tonnes	No

• Class 9 materials are excluded from risk screening (Department of Urban Affairs and Planning, 1997b).

Table 11.1 Continuation

Hazardous materials	Class of dangerous goods	Mode of storage	Location on-site	Quantity	Screening levels	Preliminary hazard analysis required
Site earthworks						
Hydrated lime	8 (III)	Covered pile	Various	5 tonnes	50 tonnes	No
Diesel	3(III)	Mobile plant – filled from mini tanker	not applicable	Vehicle storage capacity only	<2 cubic metres	No
Petrol	3(II)	Utes, truck wash gurneys	not applicable	Vehicle storage capacity only	<1 cubic metre	No
Lubrication oils	3(III)	Drums	Treatment area	100 litres	<2 cubic metres	No
Water treatment						
Sodium hydroxide	8 (II)	Bags or drums	Treatment area	51 tonnes	25 tonnes	No

- Class 9 materials are excluded from risk screening (Department of Urban Affairs and Planning, 1997b).

Table 11.2 Quantity of Dangerous Goods Transported to and from the Site

Hazardous materials	Class of dangerous goods	Distance from any boundaries for dangerous goods classes 1.1 (explosives), 2.1 (flammable gases) and 3 (flammable liquids)	Peak weekly vehicle movements of hazardous materials to and from the facility	Screening levels – peak weekly vehicle movements	Typical quantity in each load	Transport risk considerations required
Thermal plant operation						
Natural gas	2.1	Mains supply	Mains supply	Mains supply	Mains supply	No
Oil/sludge residues	9	20 to 30 metres	1 monthly	>60 per week	20,000 litres	No
Hydrated lime	8 (III)	<20 metres	1 weekly	>30 per week	10 tonnes	No

Table 11.2 Continuation

Hazardous materials	Class of dangerous goods	Distance from any boundaries for dangerous foods classes 1.1 (explosives), 2.1 (flammable gases) and 3 (flammable liquids)	Peak weekly vehicle movements of hazardous materials to and from the dacility	Screening levels – peak weekly vehicle movements	Typical quantity in each load	Transport risk considerations required
Site earthworks						
Hydrated lime	8 (III)	<20 metres	1 weekly	>30 per week	5 tonnes	No
Diesel	3(III)	not applicable	1 weekly	>60 per week	2000 L	No
Petrol	3(II)	Varied with vehicle movements	not applicable	>30 per week	60 L	No
Lubrication oils	3(III)	<20 metres	1 every 2 weeks	>30 per week	100 L	No
Water treatment facility						
Sodium hydroxide	8 (II)	<20 metres	2 weekly	>30 per week	2 tonnes	No

A full hazard and operability (HAZOP) study would be commissioned as part of the thermal plant establishment and commissioning and ongoing site operational procedures. The hazard identification and analysis exercise is discussed below and in **Section 11.2**.

11.2 Hazard Identification and Analysis

Risk is defined as the likelihood of any adverse outcome. Risk levels are assessed from the consequences and likelihood of potential incidents.

The general objectives of hazard identification and analysis are to develop an understanding of the hazards and risks associated with the proposed remediation strategy, assess the consequences of these hazards and risks, examine mitigation measures that can be implemented and ensure that the level of risk is as low as reasonably practical and meets community standards. The specific objectives for the hazard identification and analysis study conducted for this EIS were to:

- identify the hazards and risks associated with the remediation proposal (causative factors)
- identify the impact or consequences of these risks
- identify the likelihood of the causative event occurring
- identify the major contributors to the risk level and identify any risk reduction options
- identify the controls/safeguards to manage these hazards (risk response)
- determine the residual risk levels affecting people and property.

To meet these objectives, a preliminary assessment of potential hazards and risks has been undertaken through evaluation of similar existing and proposed remediation operations in the area, input from Thiess Services, discussions with technical experts and a review of literature associated with these operations. Consultation with the relevant authorities, particularly Planning NSW and the EPA and the wider community, has also been undertaken to ensure that potential concerns have been assessed.

Risk reduction has been considered throughout the design of the remediation works regardless of the level of risk involved. Where practical, risk measures have been incorporated into the design of the plant and the methods proposed to remediate the site so that risk levels are as low as reasonably practicable.

11.3 Identification of Risks and Hazards

Risk and hazards associated with a proposal of this nature can be categorised as follows:

- natural hazards – these are likely to occur regardless of whether or not the Homebush Bay remediation proposal is to proceed or not. Natural risks that could affect this proposal include flooding, which is discussed in **Chapter 8**. Whilst it has been shown that the site is not at risk from a one-in-one-hundred-year flood, it could be susceptible to a maximum probable event. In this instance, mitigation of localised flooding may be required. Management of this would be achieved through good design and the application of engineered flood mitigation measures

- environmental hazards – these result from the remediation operations and affect the natural environment of the site and surrounds. This category includes the risk of air and noise pollution, the potential for surface or groundwater contamination and the potential for sediment impacts to the bay. For this remediation proposal, environmental hazards have been eliminated or reduced through good proposal design. Community input has contributed to the application of additional environmental management measures to further mitigate residual risk of exposure to environmental hazards. The various environmental hazards are addressed in **Chapter 7**, **Chapter 8**, **Chapter 9** and **Chapter 13** of this EIS. Environmental management procedures are also given in those chapters and summarised in **Chapter 18**

- occupational health and safety hazards – these result from the remediation operations and affect the health and safety of the site personnel and persons visiting the site. Risks are generally associated with failure of site occupational health and safety procedures. A full occupational health and safety plan would be required for this proposal before the commencement of on-site works. This is outlined in **Technical Paper 7**

- plant operational hazards – include hazards associated with the operation of the thermal treatment plant and other machinery on-site. These include, for example, plant failure, emergency shutdowns, plant emissions and incorrect batch feed into the plant. The management of mobile plant is also important. Hazard identification for operational hazards includes:

  - risks associated with the treatment of materials through the application of the thermal technology and risks associated with the preparation of feed materials for the thermal treatment plant

  - risks associated with the management of sediments recovered from the bay

  - risks associated with the preparation of materials excavated from the site

  - risks associated with the reinstatement of treated soils.

The results of the hazard identification and analysis study (also known as HAZAN) for operational hazards for this proposal are summarised in **Tables 11.3** to **11.6**.

Table 11.3 Summary of Identified Risks Associated with the Treatment of Organochlorine Contaminated Materials in the Thermal Treatment Plant

Causative factors	**Impact (consequence)**	**Likelihood**	**Raw risk (before controls)**	**Possible risk response (proposed controls)**	**Residual risk (after controls applied)**
Continuous operating plant	Noise nuisance off-site	Moderate	Moderate	Locate plant to minimise or provide screening	Low to very low
Vapours, gases and dusts	Odour nuisance off-site. Toxic vapours or dusts released to the atmosphere with potential adverse health effects	Potentially high if appropriate management and preventative means not provided	Moderate to high	All feed preparation operations that are likely to generate dust or odours to be conducted in the pre-treatment building. Occupational health and safety plan for safe working atmosphere	Very low
Emergency shutdown	Emergency shutdown would result in complete cessation of processing equipment and potential release of unplanned emissions from the process	Moderate likelihood of emergency shutdown but low likelihood of significant emissions from the process	Low	If an emergency shutdown occurs, the ID fan would stop and the gas in the system would remain in the process until the system could be restarted	Very low to insignificant
Sufficient lime not present to neutralise all hydrochloride formed due to relative overload or underfeeds of organochlorine compounds or lime	A larger portion of the hydrochloride formed from decomposition of chlorinated organic will be imparted to the gas stream	High	High	The packed scrubber system will control emission of hydrochloride and organochlorine compounds	Very low to insignificant
Failure of sodium hydroxide supply system	Hydrochloride dissolves in recycled quench water. Acidic conditions result in corrosion of equipment and loss of productivity	Moderate likelihood of sodium hydroxide pump failure. However, scrubber water in system has sufficient excess alkalinity to provide adequate neutralisation until plant can be shut down	Low	Ensure suitable corrosion-resistant materials are used. Monitor and adjust pH of quench water using sodium hydroxide. Provide automatic waste feed cut-off for low pH condition	Very low to insignificant

Table 11.3 Continuation

Causative factors	Impact (consequence)	Likelihood	Raw risk (before controls)	Possible risk response (proposed controls)	Residual risk (after controls applied)
Salt water in sediment and possibly in low soils from lime/tar reclamation areas	Corrosion failure of steel thermal desorption chamber, augers etc.	Low to moderate since stainless steel used for shell of contaminant desorption/heating chamber	Low to moderate	Proactive maintenance corrosion inspection procedure required	Very low
Spillages from the plant	Loss of containment of contaminated water, soils etc. could potentially contaminate soil and groundwater beneath and around plant	High	High	Provide impermeable pavement in plant area. Provide bunding to contain minimum of 110 percent of largest liquid storage and sump for rapid recovery	Very low

Table 11.4 Summary of Identified Risks Associated with the Management of Contaminated Sediments Recovered from the Bay

Causative factors	Impact (consequence)	Likelihood	Raw risk (before controls)	Possible risk response (proposed controls)	Residual risk (after controls applied)
Drainage of excess moisture (including rainwater) from sediment stockpile	Contamination of soil on-site and of underground water	High if stockpile excessively wet and if uncovered	Moderate to high	Stockpile sediment over contaminated areas. Divert any drainage to storage dam	Very low
On-site stormwater	Contamination of stormwater from spillages etc, of soils/sediments and environmental impact upon marine discharge	Moderate to high if stockpile, blending, transfer and treatment operations occur in largely uncovered areas and housekeeping poor	Moderate	Carry out operations and stockpile under covered areas. Drain all potentially affected stormwater to storage dam[1] constructed in the bay to contain area of contaminated sediment	Insignificant
Anaerobic sediment	Odour nuisance off-site	High if stockpile is new/wet and particularly if uncovered	Moderate to high	See control techniques in **Chapters 6** and **18**	Low to very low
Sediment composed of fine particulates	Contaminated dust off-site, disturbed during blending, crushing and transfer operations, with potential adverse health effects	Very low for stockpiled sediment as it is extracted wet and is expected to remain moist	Very low	Stockpile under cover is protected from winds. Water spray during blending and before transfer operations to suppress any dusts	Insignificant
Operating equipment and machinery	Noise nuisance off-site	High	High	See monitoring and control techniques in **Chapters 13** and **18**	Moderate to low

Table 11.4 Continuation

Causative factors	Impact (consequence)	Likelihood	Raw risk (before controls)	Possible risk response (proposed controls)	Residual risk (after controls applied)
Excavation	Landslip, soil movement and cracking could affect integrity of impermeable surface for sediment drainage stockpile resulting in contamination of soil on-site and ground water	Reclaimed area so possibly moderate to high likelihood	Low to moderate	Geological investigation, compacting or shoring up earth if and where necessary	Low to very low
Contaminated materials tracked from contaminated areas to uncontaminated areas	Toxic compounds contacting personnel or migration off-site	High	Moderate to high	Use dedicated equipment in contaminated areas. Decontamination required before removal of equipment from the contaminated area	Low
Volatile compounds exposed to atmosphere by disturbance of sediments	Toxic compounds released to the atmosphere with potential adverse health effects	Probably low given age of sediments and normal diffusion processes and low volatility of most known contaminants	Low	Monitor and treat sediments to minimise toxic emissions and avoid operations when onshore winds are high, if problem detected. Also see odour controls item above	Very low

Table 11.5 Summary of Identified Risks Associated with the Excavation of Contaminated Materials

Causative factors	Impact (consequence)	Likelihood	Raw risk (before controls)	Possible risk response (proposed controls)	Residual risk (after controls applied)
Drainage from rainwater that falls on stockpile	Contamination of soil on-site and of underground water	Moderate if extended period of rain and if stockpile absorbent and uncovered	Low to moderate	Stockpile control techniques to be as per **Chapter 6**	Insignificant
On-site stormwater	Contamination of stormwater from spillages etc. of contaminated soils/sediments and impact on marine discharge	Moderate to high if stockpile, blending, transfer and treatment operations occur in largely uncovered areas and housekeeping poor	Moderate	Drain all potentially affected stormwater to storage dam	Insignificant
Anaerobic odorous compounds exposed to atmosphere by disturbance of soils	Odour nuisance off-site	Low to very low as these are top 500 millimetres surface soils with some presence of lime	Low to very low	See control techniques in **Chapters 6** and **18**	Very low to insignificant
Contaminated materials partly composed of fine particulates	Contaminated dust off-site, disturbed during blending, crushing and transfer operations, with potential adverse health effects	Blending of sediment to be conducted to reduce variability in feedstock to treatment plant. The blending step is likely to generate fugitive dust, odour and organic emissions	Low to moderate in this relatively exposed location	All material blending operations will be conducted in an enclosed building. The material pre-treatment building will be equipped with a baghouse and carbon beds to capture dust and organics that may be liberated during material blending operations	Very low
Operating equipment and machinery including for crushing rocks /concrete	Noise nuisance off-site	High	High	See also control techniques in **Chapters 13** and **18**	Moderate to low

Table 11.5 Continuation

Causative factors	Impact (consequence)	Likelihood	Raw risk (before controls)	Possible risk response (proposed controls)	Residual risk (after controls applied)
Excavation and piling operations	Landslip, soil movement and cracking could potentially affect integrity of underground utilities (for example, stockpiles, cables), the cap on the Lednez site and foundation of the thermal treatment plant	Old reclaimed area, possibly moderate to high likelihood and depends on disturbances to potentially affected structures or services	Low to moderate	Geological investigation and "utilities search", vibration monitoring, compacting or shoring up earth if and where necessary and possibly in addition to intended sheet piling	Low to very low
Excavation and piling operations	Direct severance of active underground utilities (for example, pipelines, cables) or of inactive pipelines or tanks /vessels containing potentially dangerous materials resulting in fire, explosion and/or release of further contamination (possibly undetected) to soil and groundwater	Old industrial site on reclaimed area, so possibly moderate to high likelihood that pipelines, tanks/vessels are buried in reclaimed area. Lower likelihood of these actually containing potentially dangerous materials	Low to moderate regarding on-site impacts but low for off-site impacts, although community perceived risks may be high	"Utilities search" and probing investigations before excavation and piling operations	Low to very low
Contaminated materials tracked from contaminated areas to uncontaminated areas	Toxic compounds contacting personnel or migration off-site	High	Moderate to high	Utilise dedicated equipment in contaminated areas. Decontamination required before removal from the contaminated area	Low
Volatile compounds exposed to atmosphere by disturbance of sediments	Toxic compounds released to the atmosphere with potential adverse health effects	Low	Low to very low	Monitor and treat sediments to minimise toxic emissions and avoid operations when onshore winds, if problem detected. Also see odour controls in **Chapter 6**	Very low to insignificant

THIESS SERVICES

Table 11.6 Summary of Identified Risks Associated with the Reinstatement of Treated Soils

Causative factors	Impact (consequence)	Likelihood	Raw risk (before controls)	Possible risk response (proposed controls)	Residual risk (after controls applied)
Residual contaminants	Excess lime and OCCs in soils that do not meet expected specifications – potential for routes to adverse health effects or environmental impact	OCCs very low because of treatment	Moderate to low	Monitor contaminants to ensure only acceptable levels are reused. Re-treat soils that do not meet specifications	Low to very low
Treated soil composed of very fine particulates	Contaminated dust containing lime emitted from stockpiles and during transfers, backfilling and compacting operations	Very low for stockpile if initial/ongoing moisture content is maintained high. Low if fine water sprays used as needed for all handling and disposal operations	Low	Water spray as needed during handling, backfilling and compacting operations. Monitor levels of contaminants. Provide cap at levels considered unacceptable	Very low
On-site stormwater	Contamination of stormwater from contaminants (lime, residual organochlorine compounds) in treated soils in stockpile, spillages, backfilled sites etc. and subsequent environmental impact upon marine discharge	Very low for covered stockpile. Moderate for uncovered transfer and disposal operations due to solubility and alkalinity of excess lime in treated soils. Unacceptable concentrations of organochlorine compounds in run-off not expected	Low to moderate	Drain all potentially affected stormwater to storage dam. Avoid large excess of lime. Attempt to have transfer and disposal operations carried out during fine weather. Plans to be developed for the management of soil and water including stormwater	Very low

Table 11.6 Continuation

Causative factors	Impact (consequence)	Likelihood	Raw risk (before controls)	Possible risk response (proposed controls)	Residual risk (after controls applied)
Handling and backfilling/compacting machinery	Noise nuisance off-site	High	High	See control techniques in **Chapters 13** and **18**.	Moderate to low
Compacting operations	Vibrations could potentially result in landslip, soil movement and cracking, affecting integrity of underground utilities (for example, pipelines, cables), the cap on the site and foundation of contaminated soils processing plant	Old reclaimed area, possibly moderate to high likelihood and depends on distances to potentially affected structures or services	Low to moderate	Geological investigation and "utilities search", vibration monitoring, compacting or shoring up earth if and where necessary and possibly in addition to intended sheet piling	Low to very low

11.4 Contingency Planning and Emergency Response

A contingency plan and an emergency response plan would be prepared and issued to the EPA before the remediation works began. However, an outline of contingencies and emergency response planning is contained within the remediation action plans (see **Technical Paper 7**).

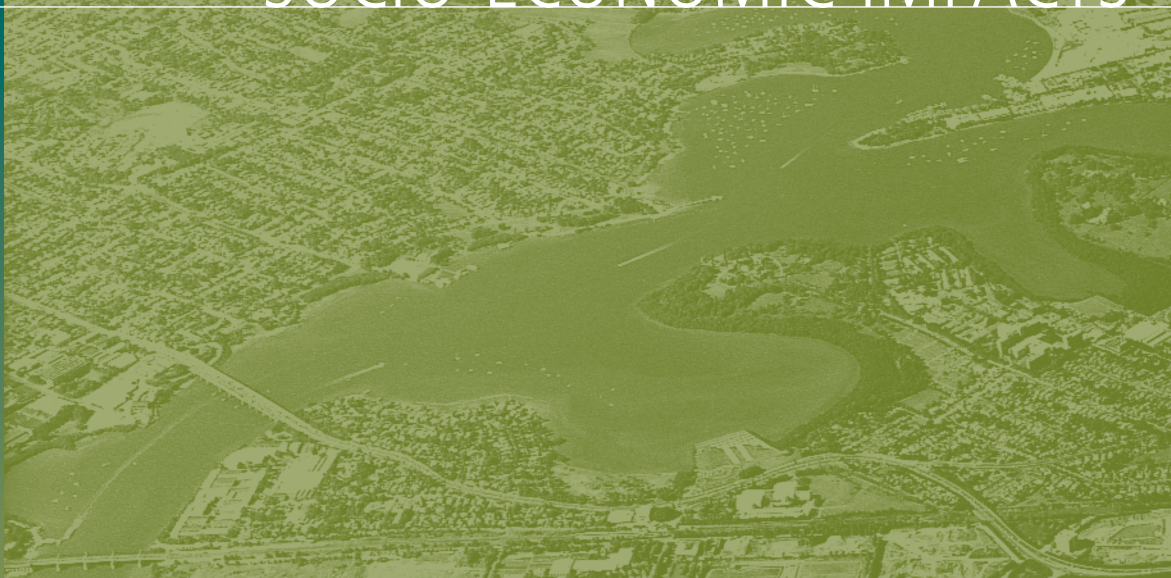
The purpose of a contingency plan is to identify unexpected situations that could occur during the project and to specify procedures that can be implemented to manage such situations and prevent adverse impacts on the environment and human health. Unexpected situations that have been identified include excavation of types of contaminants presently unknown, flooding of the site by extreme rainfall, the generation of unacceptable levels of dust and odours, noise and vibrations, the release of unacceptably contaminated volatile gases and spills and leaks of hazardous materials.

A detailed emergency response plan would be prepared and issued to the relevant authorities before the commencement of the remediation works. The purpose of the plan would be to identify possible emergency situations and to define procedures that would be used to ensure the safety of both on- and off-site personnel in the event of an emergency.

Part **E**

REMEDIATION OF
LEDNEZ SITE, RHODES and HOMEBUSH BAY

SOCIO-ECONOMIC IMPACTS



Chapter 12

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

LANDUSE PLANNING AND TRANSPORT

Chapter 12 LANDUSE PLANNING AND TRANSPORT

12.1 Landuses

12.1.1 Existing Landuses of the Site

The Lednez site is currently vacant and serving as a containment area for contaminated materials. The history of past uses of the site is provided in **Technical Paper 2** and summarised in **Chapter 4**.

12.1.2 Surrounding Landuse

The immediately adjoining properties to the north and south of the Lednez site are disused and largely vacant due to the presence of contamination and/or the cessation of the former industrial uses. Industrial uses remain in the area bounded by Gauthorpe, Walker, Mary and Marquet Streets. The main Northern Railway Line runs north-south to the east of Walker Street, separating the industrial uses on the western side of the Rhodes Peninsula from the residential, commercial and industrial uses on the eastern side.

At the southern end of Homebush Bay is Bicentennial Park, while the western edge of Homebush Bay is dominated by industrial uses and the Mariners Cove residential development. The landuses on the Rhodes Peninsula are shown on **Figure 12.1**.

12.1.3 Land Ownership

The Lednez site (Lot 10 DP 1007931) is owned by the Waterways Authority. The bed of Homebush Bay (part residual lands comprised in Certificate of Title, Volume 5018, Folio 1) is managed by the NSW Government. The ownership of surrounding properties is shown in **Figure 12.2**.

12.2 State Environmental Planning Controls and Policies

The following state environmental planning policies are relevant to the proposal:

- *State Environmental Planning Policy No. 55 – Remediation of Land*
- *State Environmental Planning Policy No. 56 – Sydney Harbour Foreshores and Tributaries*.

Figure 12.1 **Landuse**

- Residential
- Industrial
- Mixed use
- Open space
- Special uses
- Area depicts future landuses in accordance with Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula

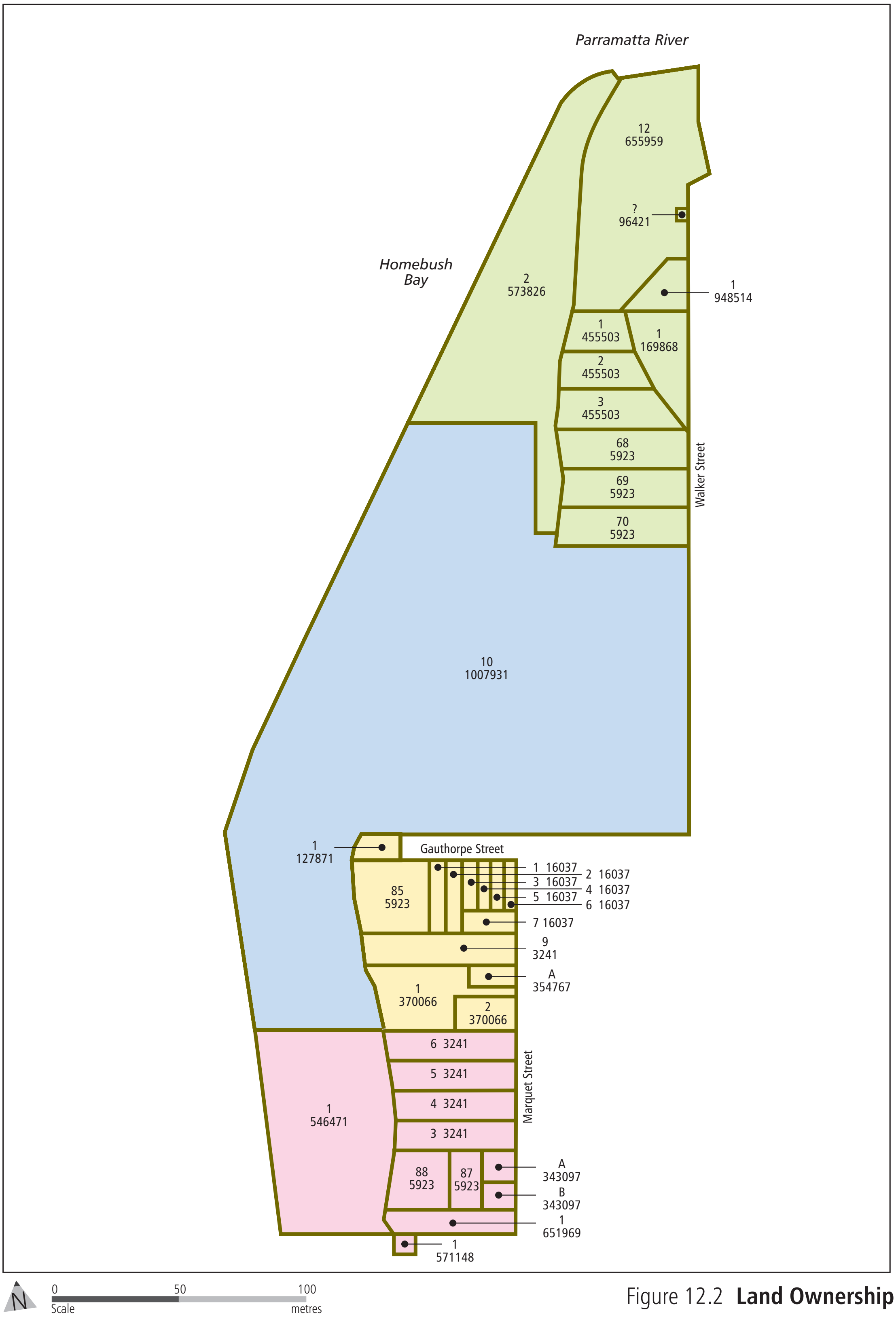


Figure 12.2 **Land Ownership**

Rhodes Peninsula Developments Pty Ltd	Statewide Developments Pty Ltd
NSW Waterways Authority	Orica Australia Pty Ltd

12.2.1 State Environmental Planning Policy No. 55

State Environmental Planning Policy No. 55 – Remediation of Land and the associated guidelines *Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land* (DUAP, 1998b) aims to provide a state-wide planning framework for the remediation of contaminated land. It promotes the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment. These issues are assessed in **Chapter 9**.

Table 12.1 assesses the matters considered in this EIS under Clause 7 of the policy.

The proposed remediation works would be consistent with the definition of "designated development" as defined under the *Environmental Planning and Assessment Regulation*, 1994. Under Clause 9 "designated development"

Table 12.1 Relevant Matters for Consideration under State Environmental Planning Policy No 55 – Remediation of Land

Relevant matters for consideration	Comment
Whether the land is contaminated	**Chapter 4** establishes the known level of contamination of the Lednez site and Homebush Bay
If the land is contaminated, the Department of Planning is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out	The purpose of the remediation is to make the site suitable for subsequent redevelopment for residential and open space purposes in accordance with zoning provisions of *Sydney Regional Environmental Plan No.29 – Rhodes Peninsula.* More specific detail on how this will be achieved is presented in **Technical Paper 7**
If the land requires remediation to be suitable for the purpose for which the development is proposed to be carried out, the Department of Planning is satisfied that the land will be remediated before the land is used for that purpose	This proposal is specifically aimed at remediating the land before it can be used for residential and open space purposes. The subsequent use of the site would be the subject of a separate development application

requires development consent. Under Clause 11, remediation works for designated development on a remediation-site are also declared to be state-significant development.

Clause 12 of this policy specifies that the consent authority must not refuse development consent for remediation works without substantial justification. Clause 17 requires that any remediation work must be carried out in accordance with:

- the EPA's contaminated land planning guidelines
- the guidelines in force under the *Contaminated Land Management Act*
- a plan of remediation, as approved by the consent authority and prepared in accordance with the contaminated land planning guidelines.

In addition, a notice of completion of the proposed works needs to be submitted to the Minister for Planning within 30 days after the completion of the work. Clause 18 specifies what information this notice of completion must contain.

12.2.2 State Environmental Planning Policy No. 56

State Environmental Planning Policy No. 56 – Sydney Harbour Foreshores and Tributaries aims to co-ordinate the planning and development of land comprising the foreshores of Sydney Harbour and its tributaries. It establishes guiding principles that must be taken into account in the preparation of environmental planning studies, masterplans, codes and guidelines and the assessment of development applications affecting land covered by the plan. **Table 12.2** considers the relevant guiding principles set out in Clause 7 of this policy.

Table 12.2 Relevant Guiding Principles to be Considered under State Environmental Planning Policy No. 56 – Sydney Harbour Foreshores and Tributaries

Relevant matters for consideration	Comment
Increasing public access to and use of, land on the foreshore	The proposal would facilitate public access to the Homebush Bay foreshore by remediating the land to a standard that permits future use of the site as open space
The fundamental importance of the need for land made available for public access, or use, on the foreshore to be in public ownership wherever possible, particularly land that is within the foreshore area as defined in the *Sydney Harbour Foreshore Authority Act 1998*	Clause 19 of *Sydney Regional Environmental Plan No.29 – Rhodes Peninsula* makes provision for the dedication and purchase of areas of open space for public use. This matter would be addressed in any subsequent development application for the residential development of the site
The conservation of significant bushland and other natural features along the foreshore, where consistent with conservation principles and their availability for public use and enjoyment	No significant bushland or natural features have been identified on the Lednez site as being worthy of conservation
The suitability of the site or part of the site for significant open space that will enhance the open space network existing along the harbour foreshores	An area of land adjacent to the foreshore has been zoned under *Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula* for the purpose of open space
The protection of significant natural and cultural heritage values, including marine ecological values	Remediation would reduce the levels of dioxin contamination in the sediments of Homebush Bay and would, over the long term, reduce levels of dioxins in fish and other aquatic species
The protection and improvement of unique visual qualities of the Harbour, its foreshores and tributaries	Progressive turfing of remediated areas would reduce the visual impact of the proposed remediation works. However, the visual quality of the foreshore when viewed from distant viewpoints would not be improved
The conservation of items of heritage significance identified in an environmental planning instrument or subject to an order under the *Heritage Act 1977*	No known items of heritage significance are located on the Lednez site and the site is not subject to any orders under the *Heritage Act*
The character of any development as viewed from the water and its compatibility and sympathy with the character of the surrounding foreshores	During the period of the remediation works the character of the Lednez site and its relationship to surrounding foreshores would not be permanently altered
The application of ecologically sustainable development principles	Remediation works would reduce the current risk of harm to human health and would reduce the levels of dioxin present in aquatic life in Homebush Bay. An assessment of the proposal having regard to the principles of ecologically sustainable development is provided in **Chapter 19**

Table 12.2 Continuation	
Relevant matters for consideration	**Comment**
The maintenance of a working-harbour character and functions by the retention of key waterfront industrial sites or, at a minimum, the integration of facilities for maritime activities into development and, wherever possible, the provision of public access through these sites to the foreshore	Whilst the Lednez site has been an industrial site, the activities on it have had no relation to maritime activities consistent with the concept of the working harbour. The intended use of the site post remediation may incorporate the provision of public access to the foreshore, but is subject to a separate development application process
The feasibility and compatibility of uses and, if necessary, appropriate measures to ensure coexistence of different landuses	The development application that accompanies this EIS does not seek a change of use. However, the proposal would facilitate the realisation of regional planning outcomes for the Rhodes Peninsula

The policy applies to Rhodes Peninsula but not to any portion of Homebush Bay. Rhodes Peninsula is classified as a site of strategic significance under Clause 13. Clause 14 of this policy requires that before development consent is granted for land covered by the policy, a masterplan for affected land be prepared, that this masterplan be considered and that proposed development is consistent with this masterplan. Notwithstanding, the Minister for Planning may waive compliance with the requirement to have a master plan for the affected land, where the Minister considers that other adequate planning controls apply, or because of the particular nature of a development, or for other reasons the Minister considers sufficient.

The proposed remediation is separate from any future development of the site and therefore would not require a masterplan.

12.3 Regional Environmental Plans

The following regional environmental plans are relevant to the proposal:

- *Sydney Regional Environmental Plan No. 22 – Parramatta River*
- *Sydney Regional Environmental Plan No. 24 – Homebush Bay Area*
- *Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula*.

12.3.1 Sydney Regional Environmental Plan No. 22

Sydney Regional Environmental Plan No. 22 – Parramatta River aims to establish a framework for coordinated planning, development and management of the Parramatta River and its foreshores. The plan also aims to ensure the natural, recreational, scenic, cultural and commercial values of the river are recognised and promoted in new developments. **Table 12.3** assesses the matters considered in this EIS under Clause 20.

Table 12.3 Relevant Matters for Consideration under Sydney Regional Environmental Plan No. 22 – Parramatta River

Relevant matters for consideration	Comment
The appearance of the development from the waterway and the foreshores	Progressive turfing of remediated areas would reduce the visual impact of the proposed remediation. However, the visual quality of the foreshore when viewed from distant viewpoints would not be improved
Whether the development will cause pollution or siltation of the waterway to an extent that would jeopardise any existing or potential uses of the waterway	The excavation method proposed for the Portion 1, Homebush Bay remediation works was selected because it represents the method least likely to cause pollution or siltation of the bay
Whether the development will have an adverse effect on wetlands or flora and fauna habitats	As discussed in **Chapter 10**, the remediation works are not likely to impact on wetlands or terrestrial flora and fauna habitats. Further the reduction in dioxin levels in the environment would reduce long term levels of dioxin in the surrounding ecological environment
The noise likely to be generated by the development and any adverse effect that any such noise would have on existing uses of the waterway or nearby land	Levels in excess of the EPA's Industrial Noise Policy daytime noise criteria are predicted at each of the three noise-sensitive receiver locations. An assessment of the noise impacts of the proposal is provided in **Chapter 13**
Whether the development will have an adverse effect on drainage patterns or cause shoreline erosion	Once completed the existing seawall would be reinstated in its current location. Site drainage would be managed to prevent sedimentation and soil erosion
Whether the development will cause excessive congestion of, or generate conflicts between, people using the waterway or the waterfront	The proposed remediation is not expected to generate congestion within the area or generate conflict
Any other relevant plan of management, urban design or other development control guidelines that apply to Parramatta River and its foreshores and which has been notified and provided to the consent authority by a public authority	All other relevant plans and guidelines have been considered in developing the proposal
The effects of that development on the heritage significance of a heritage item, its site, its vicinity or on a conservation area	No impacts are expected on heritage items, their sites, or areas within the vicinity of heritage items identified under this regional environmental plan
Any representations of the Waterways Planning and Development Advisory Committee	Referral to the Waterways Planning and Development Advisory Committee would occur during the assessment of the development application
Whether the development will affect swimming in the locality	Swimming is not currently prohibited in Homebush Bay. The proposal would not change this situation
The provision of pedestrian access in the locality of the development and the impact of the development on existing pedestrian access	Pedestrian access to the site would be prevented by security fencing. No pedestrian access would be available during or immediately after the remediation works
The importance of giving priority to onshore access to the foreshore and waterway rather than access by means of boardwalks	Remediation to a standard that permits later development of the site for residential and open space purposes would enable foreshore open space to be provided in accordance with *Sydney Regional Environmental Plan No.29 – Rhodes Peninsula*
Any development control plan prepared in respect of this plan or, until such a plan has been prepared, the "Design and Management Guidelines for Parramatta River" a copy of which is available at the Head Office of the Department	All relevant plans and guidelines have been considered in developing the proposal

Under Clause 28A of *Sydney Regional Environmental Plan No. 22 – Parramatta River*, the Minister for Planning is the consent authority for remediation works adjoining or adjacent to the Homebush Bay Area. The Minister when determining applications for the subject site must take into account the provisions of *Sydney Regional Environmental Plan No. 24 – Homebush Bay Area*.

Under Clause 18, proposals for dredging activities are also required to be referred to the Foreshores and Waterways Planning and Development Advisory Committee for comment.

12.3.2 Sydney Regional Environmental Plan No. 24

Sydney Regional Environmental Plan No. 24 – Homebush Bay Area aims to guide and co-ordinate the development of the Homebush Bay area in an environmentally sensitive manner. The planning objectives include to:

- preserve and protect the Homebush Bay area's regionally significant wetlands and woodlands
- promote a variety of types of development and landuses
- permit a range of ancillary development and landuses including land remediation and site rehabilitation.

This plan applies to the proposal by virtue of Clause 2, which includes the remediation of land adjoining or adjacent to the eastern boundary of the Homebush Bay Area. It should be noted that the Lednez site is not otherwise within the Homebush Bay Area as defined by the plan.

Table 12.4 assesses the matters relevant to consideration of this proposal under Clause 13.

Table 12.4 Relevant Matters for Consideration under Sydney Regional Environmental Plan No. 24 – Homebush Bay Area

Relevant matters for consideration	Comment
Any relevant masterplan prepared for the Homebush Bay Area	No masterplans apply to the Lednez site under this regional environmental plan
Any development control plans prepared for the land to which the application relates	See **Section 12.5**
The appearance, from the waterway and the foreshores, of the development	Progressive turfing of remediated areas would reduce the visual impact of the proposed remediation. However, the visual quality of the foreshore when viewed from distant viewpoints would not be improved
The impact of the development on significant views	The proposal would not remove or otherwise permanently alter significant views that occur in and around the Homebush Bay area
The effect of the development on drainage patterns, groundwater, flood patterns and wetland viability	Site drainage would be managed to prevent adverse impacts on surface or groundwater drainage patterns as described in **Chapter 18**
The extent to which the development encompasses the principles of ecologically sustainable development	An assessment of the proposal having regard to the principles of ecologically sustainable development is provided in **Chapter 19**
The impact of carrying out the development on environmental conservation areas and the natural environment, including flora and fauna and the habitats of the species identified in international agreements for the protection of migratory birds	Wetland, woodland and grassland/wetland environmental conservation areas identified under *Sydney Regional Environmental Plan No. 24 – Homebush Bay* would not be affected by the proposal. No direct or significant indirect impact on the habitat of species, for example waterfowl, is predicted

Table 12.4 Continuation

Relevant matters for consideration	Comment
The impact of carrying out the development on heritage items, heritage conservation areas and potential historical archaeological sites	There are no heritage items, conservation areas or potential historical archaeological sites identified under *Sydney Regional Environmental Plan No. 24 – Homebush Bay*
The views of the public and other authorities consulted by the consent authority under this plan	Consultation with a wide range of public authorities was undertaken during preparation of this EIS as described in **Chapter 3**. The views of public authorities would be sought by the Department of Planning during the assessment of this EIS in accordance with Clause 14
The issues listed in Schedule 7	The proposal is not defined as a "major public facility" or located within an environmental conservation area. Accordingly, the issues set out in Schedule 7 do not apply

The plan also specifies that the Minister for Planning cannot consent to development affecting potentially contaminated land unless he is satisfied that:

- adequate steps have been taken to identify whether land is contaminated and if so, whether remediation action needs to be taken
- where remediation action is needed, satisfactory arrangements have been entered into with the EPA to meet any requirements specified by that agency
- where land to be remediated contains or adjoins land which contains remnants of natural vegetation, consideration has been given to reinstatement on the land of vegetation of the same kind in a way which will enhance the remaining vegetation.

12.3.3 Sydney Regional Environmental Plan No. 29

Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula aims to promote the orderly, economic and ecologically sustainable use and development of land within the Rhodes Peninsula. This plan applies to the entire Lednez site generally above mean high water mark, with the exception of a small strip of water in Homebush Bay. The plan repeals all local environmental planning instruments to the extent that they apply to the site.

Table 12.5 assesses whether the proposal is consistent with the relevant planning principles for Rhodes Peninsula as set out in Clause 10 of the plan.

Table 12.5 Relevant Matters for Consideration under Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula

Relevant matters for consideration	Comment
Development should be carried out in a manner consistent with the principles of ecologically sustainable development	An assessment of the proposal having regard to the principles of ecologically sustainable development is provided in **Chapter 19**
Development of the Rhodes Peninsula is to provide for a significant increase in residential population, open space and limited commercial and retail uses	This proposal would facilitate the redevelopment of the Lednez site by remediating the land to a standard that permits future use of the site for residential and open space purposes. This would be consistent with the objectives of this regional environmental plan

Table 12.5 Continuation	
Relevant matters for consideration	**Comment**
A range of recreational opportunities for the residents, workers and the community is to be provided within the public domain	This proposal would facilitate the provision of recreational opportunities by remediating the land to a standard that permits future use of the site for open space purposes
Transport and traffic should be managed in accordance with a comprehensive plan that provides for the coordinated provision of infrastructure and the staging of its provision	Traffic generated by this proposal would not significantly add to existing volumes on local streets or Concord Road
Development within the Rhodes Peninsula is to make a significant contribution to ecological sustainability through reduced energy requirements, particularly those of a non-renewable nature and to waste reduction	Remediation of contaminated materials for re-use on-site would contribute significantly to waste reduction.
Water and energy efficient design criteria are to be promoted and soil erosion and sedimentation control measures implemented during remediation and construction phases	Potential surface water impacts on Homebush Bay and Parramatta River would be managed during the remediation works through an erosion control plan as described in **Chapter 8** and **Technical Paper 7**.
Development should not have adverse impacts on the water quality of Homebush Bay or the Parramatta River	The quality of both groundwater and surface water entering Homebush Bay would be improved following the remediation works
Appropriate re-vegetation of the foreshores is to be encouraged	Progressive turfing of remediated areas would reduce the visual impact of the proposed remediation. However, re-vegetation of the foreshores would not be undertaken as part of this proposal

The plan sets out zoning, building heights and precincts within the Rhodes Peninsula. Remediation of land is a use permissible with development consent in all zones within this area. Zoning of the site and surrounding area can be seen in **Figure 12.1**.

Clause 22 specifies that where development is likely to result in the disturbance of more than one tonne of soil, or lower the water table in areas where acid sulphate soils may exist, the consent authority must take the following matters into consideration:

- the adequacy of the acid sulphate soils management plan prepared for the proposed development in accordance with available Acid Sulfate Soils assessment guidelines, these being *Environmental Guidelines for Assessing and Managing Acid Sulphate Soils*, EPA (1995d) and *Acid Sulphate Soils Management Advisory Committee Draft Acid Sulphate Soils Planning Guidelines*, DUAP (1997a)
- the likelihood of the proposed development resulting in the discharge of acid waters
- any comments received from the Department of Land and Water Conservation.

These matters have been addressed in **Chapter 8**.

12.4 Local Environmental Plans

No local environmental plans apply to the subject site as a result of provisions within *Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula*.

12.5 Development Control Plans

A development control plan relates to matters that are considered to be of local significance for environmental planning for the local area or region to which the plan applies. Development control plans are a relevant matter for consideration in the assessment of development applications under Section 79C of the *Environmental Planning and Assessment Act*.

Two development control plans are applicable to the Lednez site. The first is the development control plan associated with *Sydney Regional Environmental Plan No. 22 – Parramatta River*. This plan was adopted in 1998 and applies to the Rhodes Peninsula. The principal aims of the plan are to:

- protect ecological communities
- ensure the scenic quality of the area is protected or enhanced
- provide setting and design principles for new buildings and waterside structures within the area
- identify potential foreshore access locations for the area.

This development control plan requires that all development applications affecting land covered by the proposal include an ecological and landscape assessment. These assessments are included as **Chapters 7**, **10** and **15** of this EIS. The plan does not set out any specific requirements in relation to site remediation or contaminated soil treatment works.

Planning NSW has also prepared a development control plan to regulate any development proposed for land covered by *Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula*. The plan includes transport management and community development plans. The aims of the plan are to facilitate the development of a high quality urban environment to establish the Rhodes Peninsula as an attractive, safe and vibrant part of Sydney. It does not set out any specific requirements in relation to site remediation or contaminated soil works.

12.6 Traffic and Transport

12.6.1 Existing Transport Network

Concord Road is a north-south arterial road connecting Ryde and Homebush Bay in western Sydney, providing major access to and from the site. Its intersection with Blaxland Road provides the only signalised intersection, allowing all turning movements. This can be seen in **Figure 12.3**. The other local streets connecting to Concord Road are sign-controlled (Concord Road/Averill Street and Concord Road/Denham Street).

Concord Road/Averill Street would be the critical intersection to and from the site if the origin/destination were north. Similarly, Concord Road/Blaxland Road is the critical intersection for origins/destinations south of the site.

Given restricted sight distance and/or space for turning long vehicles, the Concord Road/Blaxland Road intersection is preferred for all heavy vehicle movements.

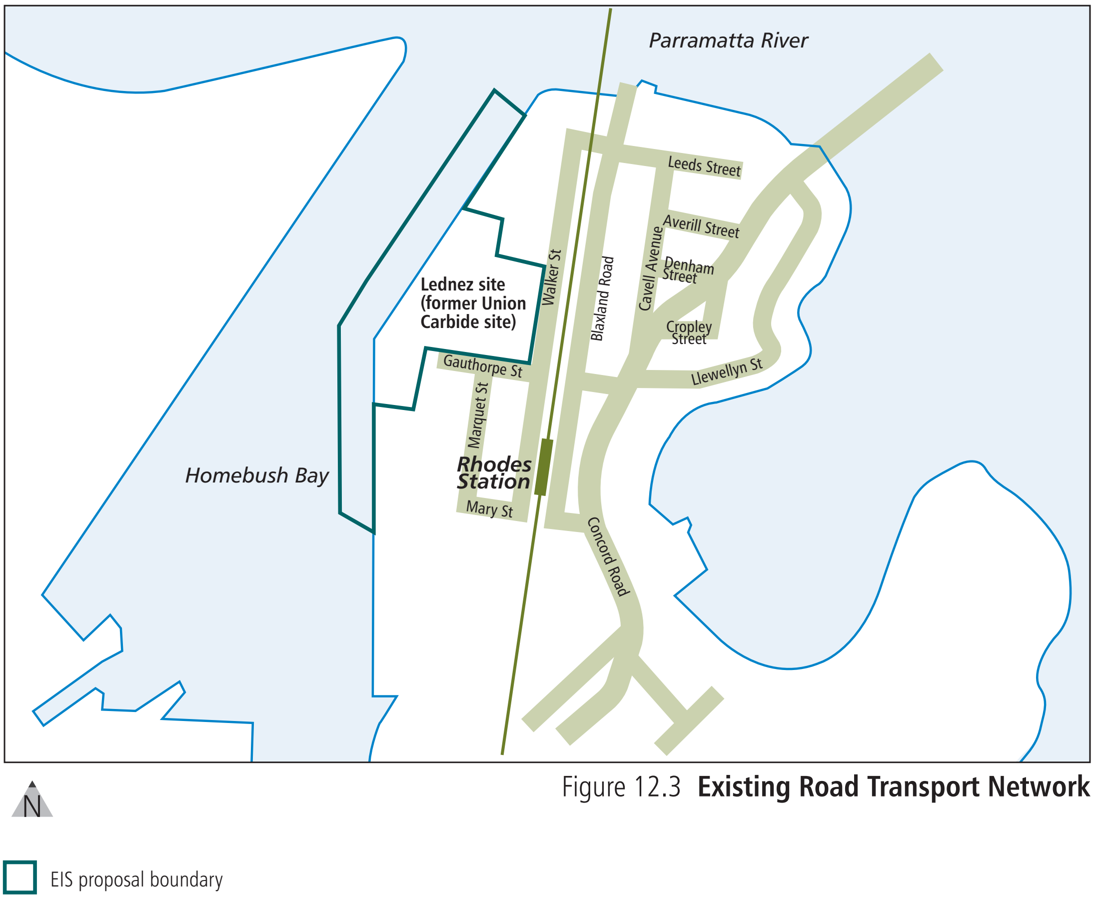


Figure 12.3 **Existing Road Transport Network**

12.6.2 Changes in Traffic Volumes

Based on information regarding site traffic movements provided by Thiess Services, the additional traffic movements generated by the site are classified into two types: heavy vehicles and light vehicles.

Heavy vehicles generated by the proposed site remediation include those delivering plant for remediation works, routine deliveries and decommissioning of plant. Light vehicles associated with the site would belong to the workforce, all of which are assumed to travel by car.

An analysis of the impact of changed traffic volumes was conducted for a "worst case" scenario. It assumes that 45 cars and three trucks would enter the site in the 30 minutes between 6.30 am to 7.00 am. Similarly it assumes that all of these vehicles would leave the site in the 30 minutes between 6.00 pm to 6.30 pm. This scenario assumes that each member of the workforce would drive a car to and from the site and that staff and heavy vehicles would arrive and leave the site at the same time. These are conservative assumptions.

The analysis indicates that expected additional "worst-case" site-generated traffic could be accommodated on the road network and critical intersections without any noticeable deterioration in levels of service and without a requirement for any upgrading of the network or the intersections (see **Appendix G**, **Volume 2**)).

Actual traffic flows are expected to be lower than the worst-case situation analysed.

12.7 Traffic Management

Members of the community have expressed some concern about the safety of right- and left-turning heavy vehicles at the Concord Road/Averill Street intersection. Accordingly, although the number of such movements may be very small, all heavy vehicle drivers approaching from, or departing to, the north via Concord Road would be required to use the Concord Road/Blaxland Road intersection rather than any other Concord Road intersection.

Chapter 13

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

NOISE AND VIBRATION

Chapter 13

NOISE AND VIBRATION

13.1 Selection of Noise Criteria

13.1.1 Construction and Operational Noise

The expected duration of the remediation works would be approximately five years. This is longer than would generally be allowed for noise classified as “construction noise” under the *Environmental Noise Control Manual* (EPA, 1994a). Therefore, the noise criteria used in this assessment are those derived from the EPA’s Industrial Noise Policy. General noise from the proposed remediation is therefore conservatively assessed using the same criteria as for operational noise from a permanent source.

The Industrial Noise Policy sets out two forms of noise criteria that need to be met by any proposed development. These are the intrusiveness criterion and the amenity criterion.

The intrusiveness criterion applies to residential landuses. This specifies the allowed L_{Aeq}. L_{Aeq} is defined as the equivalent continuous sound pressure level weighted over an average time interval from the proposed operation. The L_{Aeq} can be adjusted for certain “modifying factors” related to the type of noise emission. Regardless, it should not exceed the rating background level (RBL) at the receptor by more than five decibels (or dB(A)). In this case, noise from the Lednez site would be broad-band and non-impulsive in nature and it follows that none of the “modifying factors” described in the policy would apply.

The amenity criterion is intended to ensure that the total L_{Aeq} noise level from all industrial sources does not exceed specified limits. For suburban residences, the recommended “acceptable” sound pressure levels are: daytime –55 dB(A), evening –45 dB(A) and night-time –40 dB(A).

The amenity criteria apply to $L_{Aeq,Period}$ noise levels calculated over the entire day, evening or night-time period. Where certain operations occur for only part of a time period, noise from these operations contributes to the $L_{Aeq,Period}$ noise level in proportion to the time during which the operations occur. Similarly, where meteorological conditions vary during a period, the $L_{Aeq,Period}$ noise level is calculated taking account of the time during which each condition applies. This is in contrast to the intrusiveness criterion, for which the calculated $L_{Aeq,15min}$ noise level represents the highest noise levels typically encountered during the relevant time period.

In this case, because noise from other industrial sources is negligible at all receiver locations, the above noise levels represent criteria for noise from the proposal at all potentially affected residences.

Table 13.1 sets out the relevant intrusiveness and amenity criteria for the identified noise-sensitive receivers, the location of which is shown in **Figure 13.1**. During the daytime, intrusiveness criteria are clearly more stringent and are adopted for assessment. During the evening and night-time periods, amenity criteria are numerically one to two dB(A) lower than intrusiveness criteria. Because in this case evening and night-time noise levels would be relatively constant, $L_{Aeq,15min}$ and $L_{Aeq,Period}$ levels would be similar and the amenity criteria are effectively more stringent in these periods.

Table 13.1 Noise Criteria

Noise-sensitive receiver	Period	RBL,dB(A)	Intrusive criterion $L_{Aeq,15min}$, dB(A)	Amenity criterion $L_{Aeq, Period}$, dB(A)
A: Marquet Street	Day	40	45	55
	Evening	40	45	45
	Night	36	41	40
B: Blaxland Road	Day	42	47	55
	Evening	41	46	45
	Night	37	42	40
C: Meadow Crescent	Day	41	46	55
	Evening	40	45	45
	Night	35	40	40

Note: Day is 7 am – 6 pm, Evening is 6 pm – 10 pm, Night is 10 pm – 7 am.

13.1.2 Criteria for Road Traffic Noise

The proposal would generate a limited amount of traffic on public roads leading to and from the site. Criteria for assessment of noise from traffic on public roads are set out in *Environmental Criteria for Road Traffic Noise* (EPA, 1999).

Vehicles travelling to and from the Lednez site would use Concord Road and, depending on the vehicle type, would access the site as follows:

- light vehicles approaching from or leaving to the north – Averill Street, Cavell Avenue, Leeds Street and Walker Street
- light vehicles approaching from or leaving to the south – Blaxland Road and Walker Street
- heavy vehicles – Blaxland Road and Walker Street regardless of the direction of approach or departure.

The traffic impact assessment in **Chapter 12** indicates that vehicle movements associated with the remediation works would be concentrated in the periods approximately 30 minutes before the beginning of general site work and after the finish of this work, which would be 6.30 to 7.00 am and 6.00 to 6.30 pm respectively.

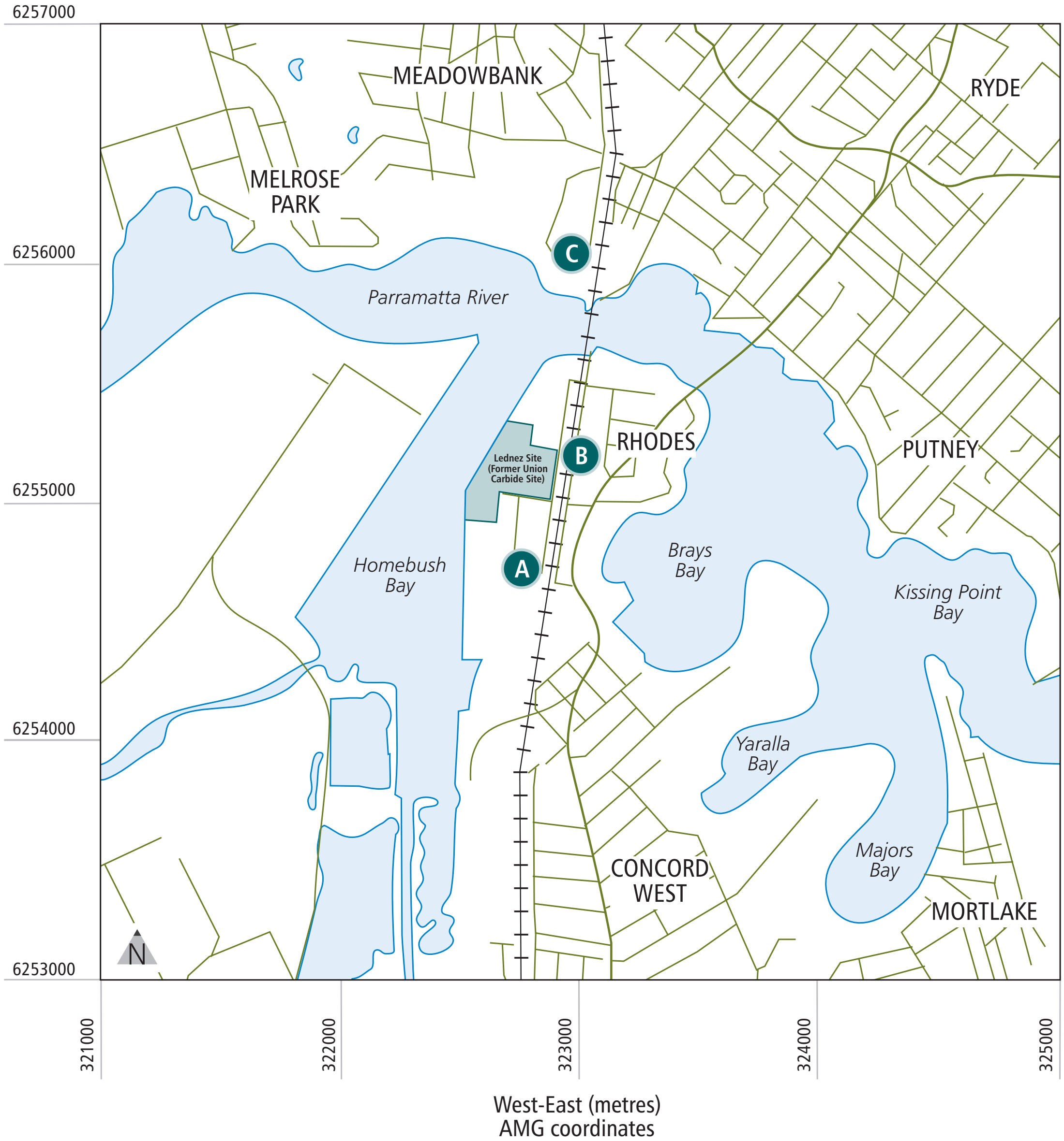


Figure 13.1 **Noise Monitoring Locations During Impact Assessment**

- A Marquet Street
- B Blaxland Road
- C Meadow Crescent

Existing traffic noise levels in both the 6.00 to 7.00 am and 6.00 to 7.00 pm periods exceed the above guidelines for a "local road". Where existing traffic noise already exceeds the above criteria, the guidelines note that:

Where feasible, existing noise levels should be mitigated to meet the noise criteria … In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than two dB.

Table 13.2 sets out the relevant traffic noise levels for both Blaxland Road and Averill Street. The criterion adopted for this proposal is that existing traffic noise levels should not be increased by more than two dB(A) in any hour by traffic associated with the remediation works.

Table 13.2 Calculated Traffic Noise Levels and Comparison with Existing Levels

Location	Traffic noise level $L_{Aeq,\ 1hr}$ -dB(A)				
	Site	Existing		Increase	
	Vehicles	6am–7am	6pm–7pm	6am–7am	6pm–7pm
Blaxland Road	52	60	59	0.6	0.8
Averill Street	48	>60	>59	<0.6	<0.8

13.2 Noise Monitoring

13.2.1 Locations

The nearest noise-sensitive receivers to the site, as shown in Figure 13.1, are:

- A: Marquet Street – a group of five residences to the south-east of the site. The closest of these is approximately 250 metres from the proposed thermal treatment plant and 300 to 550 metres from the major earthworks operations. Some shielding is provided by intermediate industrial buildings
- B: Blaxland Road – a row of approximately 20 residences and a community centre to the east of the site. These are approximately 150 metres from the closest point of the earthworks operations and 460 metres from the proposed thermal treatment plant. Some receivers are shielded from most of the site by intervening topography, but a number of residences toward the crest of Blaxland Road have only limited shielding from existing buildings and building facades
- C: Meadow Crescent – residences across the Parramatta River in Meadowbank, to the north of the site. The closest operations to these residences would be sediment extraction at the northern end of the proposed remediation site, at a distance of approximately 480 metres. General earthworks operations would be approximately 800 metres from these residences. There is no natural shielding available between the residences and the Lednez site.

13.2.2 Scenarios Modelled

To represent the range of noise levels from operations on the Lednez site, four scenarios were modelled for daytime operations. These represent a distinct point in time for daytime operations for each of the stages described in **Chapter 6**:

- Scenario 1: 0–6 months
- Scenario 2: 6–24 months

- Scenario 3: 24–42 months
- Scenario 4: 42–60 months.

General site equipment would operate during daylight hours only. This equipment would vary between seasons, but it is considered reasonable to compare noise levels under these scenarios with "daytime" criteria representing the period 7.00 am to 6.00 pm.

An additional "night" scenario represents operation of the thermal treatment plant and of associated equipment within the pre-treatment building on a 24-hour basis. These noise levels are compared with "night-time" criteria representing the period from 10.00 pm to 6.00 am.

The equipment and power levels for each scenario are shown in **Table 13.3**.

Table 13.3 Equipment Numbers and Sound Power Levels

Equipment	Number of items modelled				Sound power level, dB(A)
	Scenario 1 (0-6 months)	Scenario 2 (6-24 months)	Scenario 3 (24-42 months)	Scenario 4 (42-60 months)	
100 T crane	1	1	0	0	105
140 grader	2	3	2	2	110
150 mm dewater pump	5	5	0	0	107
25 T dump truck	9	9	10	10	108
25 T long reach excavator	1	1	1	1	106
30 T excavator	2	2	2	2	108
50 T crane	1	1	0	0	103
850 compactor	0	1	1	1	112
928 loader	0	0	2	2	110*
950 loader	1	1	1	1	110
966 loader	0	0	1	1	110*
Backhoe	1	1	1	1	102
Concrete crusher	0	1	0	0	113
D10 bulldozer + pushup	1	1	1	1	112
D10 bulldozer + ripper	1	1	1	1	112
D6 bulldozer	1	0	0	0	112
D7 bulldozer	1	1	1	2	112
Feed screens for thermal treatment plant	0	0	1	1	105*
Water cart	2	4	3	3	108

* Effective noise emission reduced when operating inside building.

The equipment listed in **Table 13.3** is regarded as representing the "worst case" in terms of potential noise impacts. The proponent believes that significantly fewer equipment items would be required in practice, and it would be rare for these to all operate simultaneously, as is assumed in the noise modelling. The only possible increase in equipment numbers compared with that used in modelling is the use of up to three dewatering pumps for sediment extraction in the later stages of the development. The noise impact from these items is relatively small, and is effectively modelled by including additional pumps in the first two modelled stages.

13.2.3 Modelling Procedures

The environmental noise model was used to calculate noise levels for each of the operational scenarios.

The modelling procedures used incorporated "worst case" assumptions for the emitted sound power levels from equipment, the location of equipment and the number of equipment items on-site. The feed area of the thermal treatment plant, together with all associated equipment, would be enclosed in a building. This equipment includes a screen and feeder unit and up to three front-end loaders.

For all operations, all doors to the pre-treatment building would be closed and any openings would be acoustically treated. Details of the construction of this enclosure are not currently defined, but it is conservatively assumed that such an enclosure would reduce noise emissions from front-end loaders by 15 dB(A) and emissions from the thermal treatment plant feed systems and associated equipment by at least six dB(A) allowing for possible loss of performance due to structure-borne noise.

13.2.4 Results

Existing noise levels were monitored at each of the noise-sensitive receivers. The noise monitoring equipment used for these measurements consisted of environmental noise loggers set to A-Weighted, fast response continuous monitoring over 15-minute sampling periods. Further information on the monitoring program and detailed results are presented in **Appendix H**.

Table 13.4 shows a summary of the measured noise levels for the daytime (7.00 am to 6.00 pm), evening (6.00 pm to 10.00 pm) and night-time (10.00 pm to 7.00 am) periods at each receiver. The table shows the overall $L_{Aeq,Period}$ noise level and the rating background level, which is used in determining noise criteria according to guidelines in the Industrial Noise Policy.

As required in the Industrial Noise Policy, the values in **Table 13.3** were determined after removing all data affected by wind speeds greater than five metres per second at the microphone or by rain. This was determined using data from the Bureau of Meteorology station at Homebush. Excluded sections of the data are marked in the graphs in **Appendix H**.

Table 13.5 shows calculated $L_{Aeq,15min}$ noise levels at the three noise-sensitive receivers. **Figure 13.2** shows daytime noise level contours calculated for Scenario 4 operations (42 – 60 months). Scenario 4 is considered to represent the worst-case, or close to the worst-case, for residences close to the site.

Table 13.5 shows that predicted night-time noise levels would be within the relevant criteria in all cases. Relatively high night-time levels at Blaxland Road are a result of the prevalence of light westerly winds at night, but calculated levels remain within the relevant criterion.

Table 13.4 Summary of Measured Noise Levels

Noise-sensitive receiver	Noise descriptor	Measured noise level, dB(A)		
		Day	Evening	Night
A: Marquet Street	L_{Aeq},Period	54	51	47
	RBL	40	40	36
B: Blaxland Road	L_{Aeq},Period	60	58	55
	RBL	42	41	37
C: Meadow Crescent	L_{Aeq},Period	59	58	48
	RBL	41	40	35

Table 13.5 Calculated Noise Levels, dB(A)

	A Blaxland Road	B Marquet Street	C Meadow Crescent
Daytime Criterion	**47**	**45**	**46**
Scenario 1	60	54	53
Scenario 2	61	52	47
Scenario 3	62	55	49
Scenario 4	62	56	49
Night-time Criterion	**40**	**40**	**40**
Night-time Scenario *	40	32	30

* Calculated when thermal treatment plant operating

At Meadow Crescent, daytime noise levels would be within three dB(A) of the relevant criterion with the exception of Scenario 1 operations. During Scenario 1, the noise level exceedance for these residences is up to seven dB(A), over a limited period at the beginning of the proposal.

At Marquet Street, relevant criteria would be exceeded by 7 to 11 dB(A) throughout the life of the remediation works and at Blaxland Road the exceedance is 13 to 15 dB(A).

13.3 Vibration Impacts

The only equipment on-site that is likely to cause significant ground vibration is a compactor operating to replace materials over the site. The closest that this equipment would be to any residence or other vibration-sensitive receiver is approximately 150 metres, when it operates at the northern-most part of the site.

Based on typical levels of ground vibration produced by similar equipment, vibration levels at a distance of 150 metres would be imperceptible and well within relevant criteria for both human response and potential damage to even the most sensitive building structures.

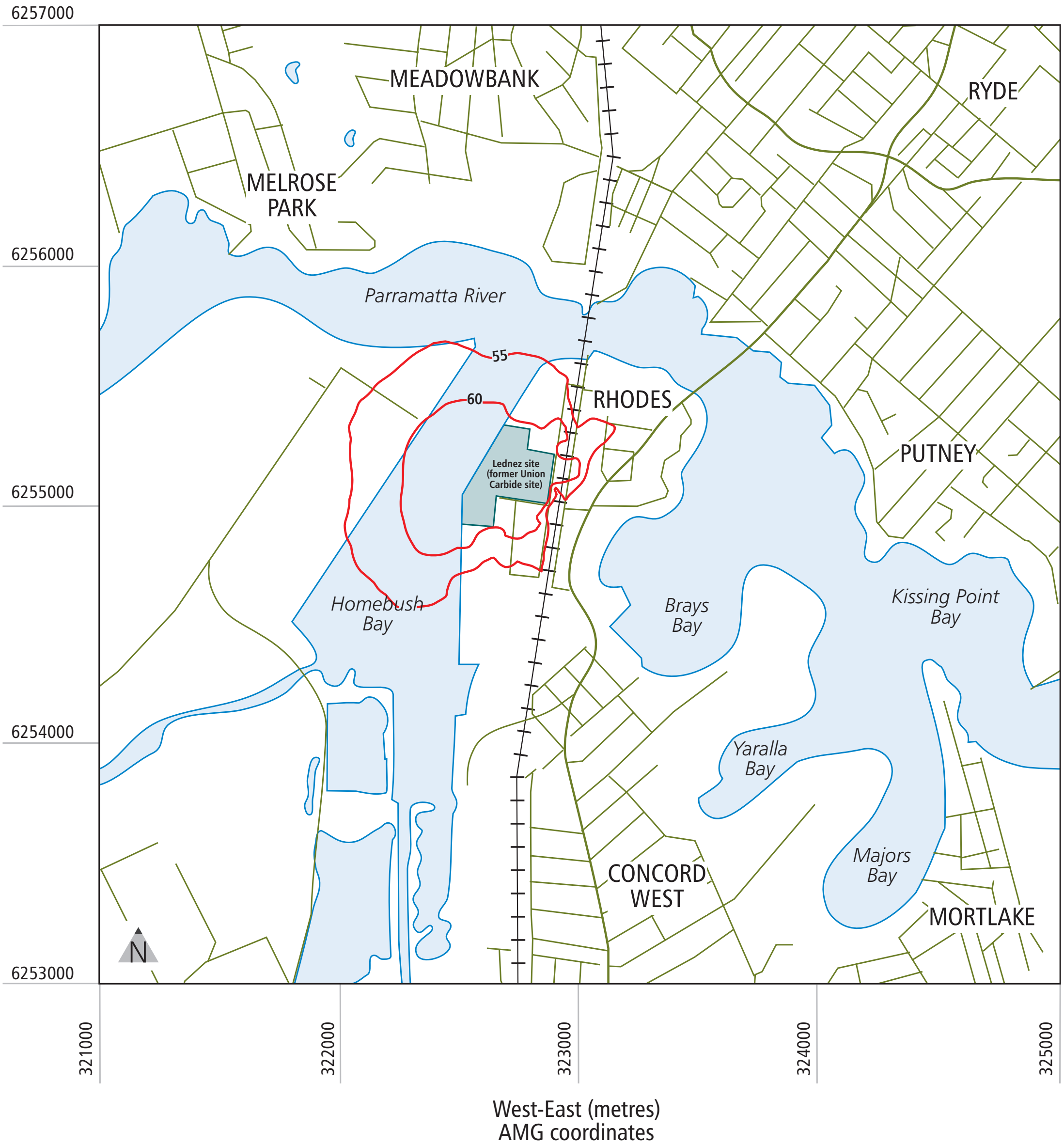


Figure 13.2 **Daytime Noise Level Contours for Scenario 4 (Worst Case)**

13.4 Proposed Monitoring and Mitigation Measures

13.4.1 Noise Monitoring

Given that predicted daytime noise levels from this operation are in excess of relevant criteria at a number of residences, the following noise management strategy is proposed:

- from the beginning of any earthmoving work on the site, noise levels would be monitored continuously at locations representative of residences in Marquet Street, Blaxland Road and Meadow Crescent. Monitoring would use unmanned noise loggers, supplemented by attended monitoring, initially for at least 15 minutes on each day of operations. Where feasible, unattended monitoring would be supplemented by equipment capable of determining the direction of incoming noise, to isolate the level of noise arriving from the Lednez site
- independent/random monitoring would be conducted by an independent consultant
- measured $L_{Aeq,15min}$ noise levels would be compared weekly with the daytime intrusiveness criteria in **Table 13.1** or, if the potential for exceedance is present, daily
- where noise levels due to on-site operations are found to exceed the relevant criteria on a regular basis (at least twice in each of two consecutive weeks), immediate steps would be taken to implement one or a combination of the noise control measures listed in **Section 13.4.2**, to ensure that the criteria are met
- this initial monitoring program would continue for at least two months, or until such time as compliance with the relevant criteria can be assumed to have been generally achieved. After this point, attended monitoring would be reduced to one day per week, or less often, depending on the degree of certainty with which criteria can be said to have been met
- if a noise complaint is received and if the complainant so requests, both unattended and attended monitoring would be instituted at the complainant's residence. If necessary, the proponent would implement mitigation measures required to achieve compliance with relevant criteria at that location and would re-monitor noise levels following implementation of those measures
- results of all monitoring would be made available to the Community Liaison Group, and to residents via their Community Liaison Group representatives.

13.4.2 Potential Noise Control Measures

In the event that noise monitoring indicates frequent exceedences of acceptable limits, consideration would be given to employ alternative mitigation measures such as those outlined below.

Blaxland Road

Trucks, dozers, a compactor and similar equipment in the excavation areas and to a lesser extent throughout the site would dominate noise levels for residences in Blaxland Road during the proposed remediation. Potential noise control methods are:

- controls on noise emission from individual plant items – an overall reduction in noise level of perhaps two to three dB(A) could be achieved in this way

- reduction in the number of plant items – the number of items modelled is conservatively high and lower equipment numbers could potentially be used. Reducing the number of items of mobile plant by a factor of two could reduce overall noise levels by two to three dB(A)
- an acoustic barrier/mound along the whole eastern site boundary–preliminary modelling indicates that, using a combination of an eight metre high barrier on the eastern site boundary, the maximum criterion exceedance during Scenarios 2 to 4 would be two dB(A). During Scenario 1, the potential noise reduction would be limited by noise from equipment to the north of the extraction area and control of this noise would require additional barriers or other controls. Lower barriers would achieve correspondingly higher noise levels and a barrier lower than about four metres on the eastern boundary would have minimal effect, due to the topography of the site. Construction of barriers in excess of four metres would be difficult and expensive
- a barrier along the eastern side of the railway reserve, between the site and the residences – construction of a barrier in this location would be more practical, as it would only need to be two to three metres high to achieve the same effect as an eight metre barrier on the site boundary. However, this would involve negotiation with, and approval by, rail authorities and may require track possession that would be disruptive for rail services.

Marquet Street

Noise at Marquet Street would be due largely to mobile plant operating throughout the site, at locations that would not be shielded by the existing building at the western end of Gauthorpe Street. The controls on noise emission and controls on the number of plant items as set out above for Blaxland Road also apply in this case. Using barriers, the maximum noise level exceedance could be reduced to three dB(A) using:

- a six metre high barrier on the site boundary adjacent to Gauthorpe Street
- a six metre barrier along the far southern site boundary from the waterline to beyond the line of the existing building, shielding residences in Marquet Street from equipment working in this area.

With eight metre high barriers, the maximum calculated exceedance is two dB(A). Again, construction of barriers over four metres would be difficult and expensive.

Meadow Crescent

During Scenario 1 (which is the only scenario for which the criterion is exceeded by more than three dB(A) at this location) noise at Meadow Crescent would be due largely to excavation of sediment in the northern coffer dams adjacent to the Meriton site (see **Chapter 6**). The silencing of water pumps within an appropriate enclosure would reduce noise emitted. Additional controls such as modification of excavator design or noise shielding for residences is considered impractical and cost prohibitive.

Chapter 14

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

CULTURAL HERITAGE

Chapter 14

CULTURAL HERITAGE

14.1 Land-based Heritage

14.1.1 Indigenous Heritage

Terrestrial Indigenous cultural heritage values of the Lednez site were examined through a review of previous landuse activities, as well as consultation with the relevant authorities and a review of existing registers. Due to the extent to which the site has been disturbed in the past, no field surveys were conducted.

Given the long history of continuous industrial use from 1928 until the mid 1980s, including the construction of factory buildings and other industrial structures and site remediation activities between 1988 to 1993, there is little potential for the original land component of the Lednez site to contain items of Indigenous heritage significance.

Consultation with the Aboriginal and Torres Strait Islander Commission, Metropolitan Land Council, the Native Title Tribunal and National Parks and Wildlife Service has verified that there are no known Indigenous items located on the Lednez site.

14.1.2 Non-indigenous Heritage

The terrestrial non-Indigenous cultural heritage values of the Lednez site were determined within a two kilometre radius through a review of previous landuse and activities, examination of heritage registers including the Register of the National Estate, the state Heritage Register, the Register of the National Trust of Australia (New South Wales Branch), relative state and regional environmental plans and the Resource Inventory in the *Parramatta River Foreshores Manual* (DUAP, 1998). Other relevant heritage documents were also reviewed, the NSW Heritage Office was contacted and a site visit was undertaken.

Land-based non-Indigenous state-listed heritage items either on or within a two kilometre radius of the site are listed in **Table 14.1.**

The site inspection and document review identified that there is a disused office building in the north-east corner of the Lednez site as well as a brick façade along the Walker Street boundary. A disused substation at the southern end of the main building also remains. A building report was prepared in 1999 to assess the structural state of this building (Artas Architects, 1999). The building, a two- to three-storey industrial style warehouse and the brick wall and the substation are described in this building report as having been heavily vandalised and in poor condition. The buildings are not covered by any heritage listings.

Table 14.1 State-listed Heritage Items within Two Kilometres of the Lednez Site

Heritage register	Items listed
Register of the National Estate	• John Whitton Rail Bridge, Meadowbank, a 114-year-old truss bridge referred to as the "Meadowbank rail bridges over Parramatta River" in the state Heritage Register • Homebush Bay Wetlands. Also known as Bicentennial Park, these are one of eight remnant wetlands that were once part of an extensive wetland system bordering the Parramatta River • Brays Bay Wetlands, important remnant of the wetlands of the Parramatta River, providing habitat for regionally diverse migratory wader bird species • Haslams Creek Wetlands, remnant wetlands that have been nominated for listing on the Register of the National Estate • Newington Armament Depot Conservation Area, Homebush Bay • Silverwater Salt Marsh, Holker Street, Homebush Bay
State Heritage Register Inventory	• Yaralla House (listing number 00119) • Joanna Walker Children's Memorial Hospital (listing number 00825) • Meadowbank rail bridges over Parramatta River (listing number 01189) • Rhodes railway station group (listing number 01235) • Sewage pumping station 42, Bennelong Road (listing number 01346) • Homebush Bay Scuttling Yard (referred to in correspondence from NSW Heritage Office but not confirmed in database search)
Parramatta River Foreshores Manual notes these unlisted non-Indigenous items as having heritage significance	• Former Phillips Industries site within Brays Bay Reserve. All that remains of this is a large concrete slab • Former Tullock's Phoenix Ironworks, Alfred Street, Rhodes, said to be of state significance, potentially containing archaeological remains • Former CSR site, Mary Street, Rhodes, said to contain industrial structures of state significance • Former Berger Paint site accessed from Alfred Street, Rhodes. Previously contained a brick building once used as a recycling station and said to be of state significance • Rider and Bell Factory Building, Cavell Avenue, Rhodes. Said to be of state significance due to its unique industrial use and processes • Parramatta and Lane Cove Rivers Landscapes
Heritage Register *Sydney Regional Environmental Plan Number 22 – Parramatta River*	• No items of heritage significance were listed in this document

Table 14.1 Continuation	
Heritage register	**Items listed**
Heritage Register *Sydney Regional Environmental Plan Number 24 – Homebush Bay*	• No items of heritage significance were in this document
Heritage Register *Sydney Regional Environmental Plan Number 29 – Rhodes Peninsula*	• No items of heritage significance were identified from this document

14.1.3 Potential Impacts and Mitigation Measures

The Lednez site is part of the Parramatta River landscape, which is regarded as historically significant in the *Parramatta River Foreshores Manual* (DUAP, 1998c). The disturbed condition of the site, high level of soil contamination and past demolition of industrial facilities detract from the site's heritage significance. The proposed remediation would not result in a fundamental change in the character of the landscape as it now stands and the alignment of the existing shoreline would be maintained.

During the course of the remediation, the building that remains in the north-east corner of the Lednez site would be demolished. The adjacent brick wall and substation would also be demolished. This would be consistent with the recommendations made by Artas Architects in 1999. A photographic record of these structures would be completed before their demolition.

Under the terms of the *National Parks and Wildlife Act 1974*, it is illegal to knowingly destroy, deface or damage any Indigenous relic or place without the written consent of the National Parks and Wildlife Service Director. Therefore, if any archaeological material is uncovered during the remediation proposal, work would cease and the discovery would be reported to National Parks and Wildlife Service so that a basic assessment of the material's nature, extent and potential significance could be made before work continued.

As part of site management procedures, a person experienced in Indigenous archaeology would administer a training program to site staff so that they could recognise any possible Indigenous sites exposed during earthworks.

14.2 Marine Heritage

In 2002, in response to a specific request by the NSW Heritage Office, Cosmos Archaeology carried out a maritime archaeology assessment that considered the possibility of submerged artefacts. A summary of the findings of this report follows and the full report is contained in **Appendix I** (**Volume 2**).

14.2.1 Indigenous

According to the Cosmos Archaeology report in 2002, the existing bed of Homebush Bay and the seabed that existed before reclamation could be largely undisturbed. These seabeds might have been used as campsites in times when the sea level was lower, over 14,000 years ago. Sites that could be submerged under the existing seabed or the reclaimed seabed include scatters of stone artefacts, rock shelters or shell middens.

Due to the historical depositional environment in Homebush Bay, if Indigenous sites were present beneath the existing or former seabed it is likely that they would be at depths of greater than 0.5 metres. As excavation into marine sediments is proposed to a depth of 0.5 metres, it is unlikely the remediation would have any impact on such sites.

14.2.2 Non-indigenous

Ship-breaking Activities

Homebush Bay is considered to be significant in maritime heritage as it is one of few remaining areas dedicated to ship breaking that contains physical remnants of this activity. The remains of most of the abandoned vessels, though deposited less than 50 years ago, are considered relics under the *NSW Heritage Act*, because the vessel components, such as hull plating, are older than 50 years of age. Cosmos Archaeology identified known and possible remains of abandoned vessels resulting from ship-breaking activities that occurred in Homebush Bay between 1966 and 1992 as having very high heritage significance. Five individual vessels have been identified in the bay as having some significance (*Ayrfield, Heoric, Karangi, Mortlake Bank, Crane Barge*). Details of these vessels can be found in **Appendix I**. Besides the vessels identified by Cosmos Archaeology, there are other vessels that have been reported as having been completely or partially broken up in Homebush Bay, so it is likely that remnants of previously unreported vessels also exist.

Cosmos Archaeology considers that it is unlikely that reclaimed areas that exist on the Lednez site contain vessel remains, since ship-breaking activities commenced after construction of the original seawalls. Although unlikely, it is possible that some remains have been incorporated into the seawall during later repairs. There is also a possibility that the shallow nature of the eastern portion of the bay might be due to accumulated detritus from ship-breaking activities.

Marine-based Structures Associated with Historical Activities

Remains of structures associated with the historical activities on the Lednez site include the following items:

- jetty – constructed in the 1930s, this jetty extended into Homebush Bay from the site
- wharf and dolphins – piled wharf and three dolphins to the north of the jetty represented in Maritime Services Board plans from 1950
- seawall, 1939 – this rock wall was constructed to allow reclamation of the area identified as R1 in **Figure 4.1**
- seawall, 1950 to 1958 – construction of this wall occurred between 1950 and 1958. The wall was commenced at the southern end of the Lednez site and extended to the northern end of the Meriton site. It was constructed to allow reclamation of areas identified as R2, R3 and R4 in **Figure 4.1**.

There are other materials associated with past landuses that Cosmos Archaeology suggests could be submerged in the reclaimed areas of the Lednez site or in Homebush Bay, comprising:

- small jetties and/or slips associated with early agricultural activity and low-intensity shoreline use
- waste materials or discarded machinery from industry
- accidentally dropped cargo or tools near the jetty.

14.2.3 Potential Impacts and Mitigation Measures

It would be unlikely that the proposed excavation of the present seabed would impact on significant cultural features or deposits. However, the proposed excavation of the reclaimed land would destroy the remains of jetty facilities and other cultural features and deposits considered "relics". This includes the 1930s jetty, the 1950s wharf and dolphins and the 1939 rock seawall. The 1958 seawall would be removed and replaced with a new seawall. Cosmos Archaeology considered these items to be of minimal to low significance.

Measures to be taken to preserve articles of heritage significance associated with Homebush Bay include:

- a photo record of the 1950s section of the seawall would be carried out before the commencement of the remediation
- a photo record of features associated with the 1930s jetty and the 1939 seawall, should they still be intact and identifiable, would be completed during the excavation
- work would cease immediately should any manufactured object or feature be uncovered that is not associated with the known submerged cultural remains identified in the report in **Appendix I** and a maritime archaeologist would be contacted for further advice on how to proceed
- work would cease immediately should any unexpected item be uncovered such as any sandstone outcrops, overhangs or caves and the NSW Heritage Office would be contacted.

Chapter 15

REMEDIATION OF LEDNEZ SITE, RHODES and HOMEBUSH BAY

VISUAL AND LANDSCAPE

Chapter 15

VISUAL AND LANDSCAPE

15.1 Scenic Quality

This chapter describes the visual and landscape character surrounding the Lednez site and the visual impacts associated with the different stages of the proposal and the related infrastructure.

The study area has been broken into the following five broad landscape units taking into account vegetation type and landscape cover:

- *wetlands/mangroves* – includes mangrove and saltmarsh areas along the shores of Homebush Bay and the Parramatta River
- *water bodies* – includes Homebush Bay and the Parramatta River
- *cleared industrial/open space* – mostly decommissioned industrial areas where infrastructure has been removed and some vegetation regrowth has occurred. Also includes some small open space parkland areas. The proposal site is included in this landscape unit
- *urban/residential elements* – typical urban areas with streets and residential housing
- *industrial* – areas of industry that include large warehouse/shed constructions.

Scenic quality is an assessment of the combination of elements used to identify the importance of the area of the proposed remediation to potential viewers. The basic premise of scenic quality assessment is that all landscapes have some value, but those with the highest diversity have the greatest potential for high scenic quality. The assessment of scenic quality ranks the landscape character units against scenic quality classes (high, moderate and low). These classes are based on the diversity of form, line, colour and texture, prominence of landform, prominence of vegetation and geology and water forms.

Based on the five landscape units above, the scenic quality of the area surrounding the site is summarised in **Table 15.1** and shown on **Figure 15.1**. The landscape unit with the highest scenic quality is wetland/mangroves, while the industrial landscape unit has a low scenic quality.

Table 15.1 Scenic Quality Assessments

Landscape rating unit	Scenic quality criteria proportional prominence of: Diversity of natural landscape elements	Landform	Vegetation	Water	Results
Wetlands /mangroves	high	moderate	high	moderate	high
Water bodies	moderate	–	–	high	moderate to high
Cleared industrial/open space	moderate	moderate	moderate	–	moderate
Urban/residential	moderate	low	low	–	low to moderate
Industrial	low	low	low	–	low

15.2 Existing Environment

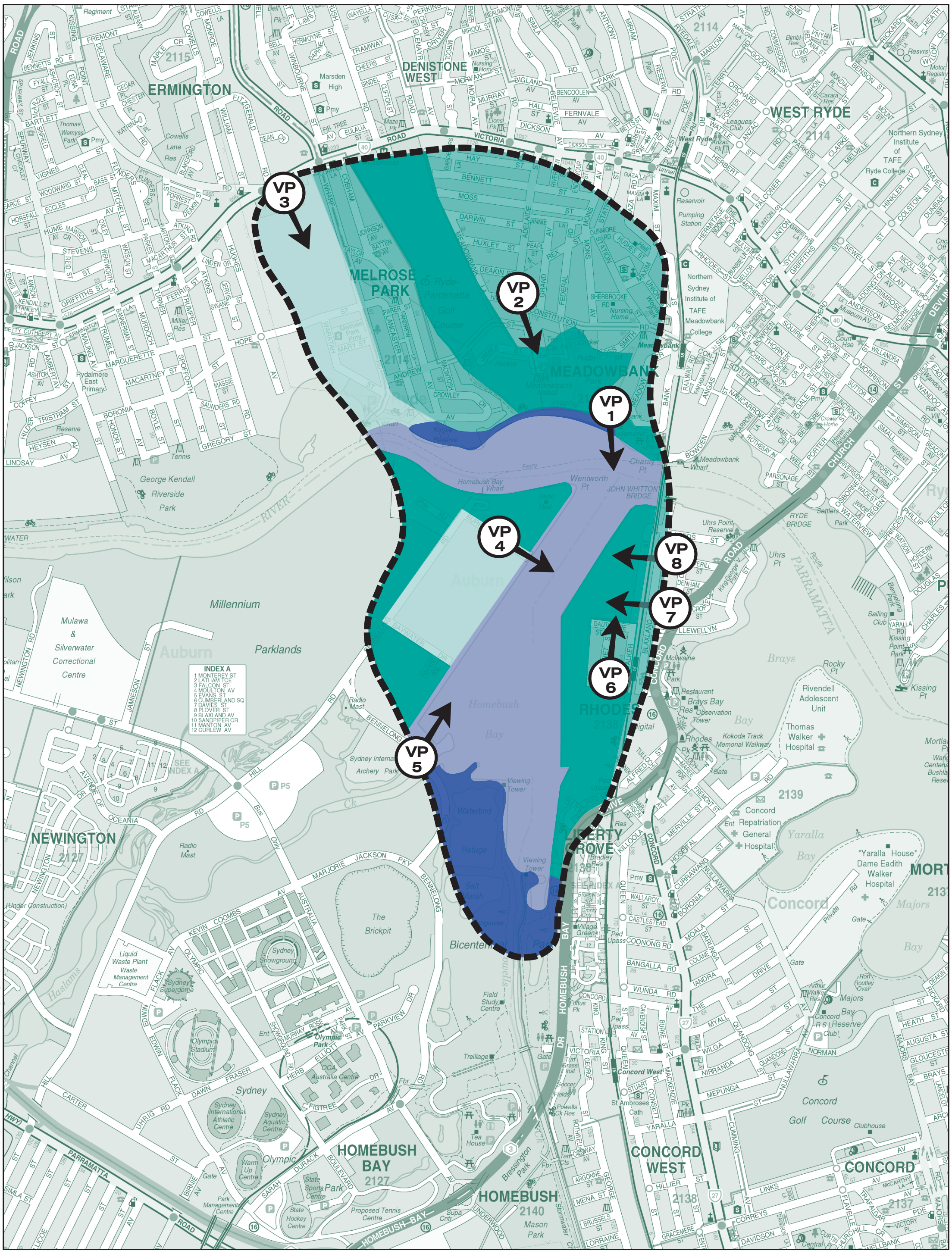
In describing the existing visual environment, the visual characteristics of the region, the surrounding area and the proposed remediation-site have been considered.

The regional landscape is typically urban with a mosaic of residential areas, industrial areas and parklands. Strong influences on visual character include water bodies such as the Parramatta River and Sydney Harbour. Homebush Bay is the most western bay of Sydney Harbour and effectively marks the confluence of Parramatta River and Sydney Harbour.

Homebush Bay and the Lednez site are situated in a landscape shaped by the combination of urban and industrial areas, parkland and the water of the bay itself. The Lednez site has been cleared and contains little vegetation. The site has been reshaped during previous remediation works, resulting in the area to the north of the site being at a greater elevation than the southern section. The areas neighbouring the site can be described as containing cleared land with regrowth to the north, a railway line and residential buildings to the east, factories and residential buildings to the south and a mix of industry and residential on the opposite shore of Homebush Bay, to the west. Wetlands are situated at the southern end of the bay in the vicinity of the confluence of Powells and Haslams Creeks. These wetlands are part of Bicentennial Park, which abuts the southern section of Homebush Bay.

15.3 Impact Assessment

Eight viewpoints were selected to enable an assessment of the visual and landscape impacts of the proposed remediation. The viewpoints were selected based on the potential for views of the site and as a representation of the likely views from those general areas. An observation study was undertaken in November 2001 to assess the existing visibility of the Lednez site from the eight selected viewpoints. The viewpoints are described in **Table 15.2** and shown in **Figure 15.1**. Photographs depicting views are provided as **Photographs 15.1** to **15.8**.



N
0 0.5 1
Scale kilometres

Figure 15.1 **Scenic Quality Assessment and Representative Viewpoints**

- Visual envelope catchment
- High scenic quality
- Moderate to high scenic quality
- Moderate scenic quality
- Low to moderate scenic quality
- Low scenic quality
- VP 1 Representative viewpoints of the site

Table 15.2 Location of Viewpoints

Viewpoint (VP) identifier	Location	Distance and views into the site
VP1	Open space/residential area, Meadowbank Memorial Park, Meadowbank	Approximately 200 metres from the site with restricted views toward the north of the site. Some screening of the site by trees on the Meriton site
VP2	Residential area, Adelaide Street, Meadowbank	Approximately one kilometre from the site with elevated views slightly restricted by trees along the Parramatta River
VP3	Residential/industrial area, Bartlett Park off Victoria Road, Ermington	Approximately two kilometres from the site with restricted elevated, long-distance views
VP4	Industrial area, Burroway Street, Homebush	Clear foreground views from a distance of approximately 200 metres. The entire length of the site can be seen with no restrictions
VP5	Residential apartments, near Powells Creek, Bennelong Road, Homebush Bay	Approximately 800 metres from the site with unrestricted views of the south-western section of the site
VP6	Industrial area, Marquet Street, Rhodes	Restricted views into the site from industrial area approximately 50 metres to the south. Vegetation partly screens the site
VP7	Road/railway easements, Walker Street, Rhodes	Slightly restricted views from less than 20 metres. Road users and passengers on passing trains would have slightly restricted views of the site
VP8	Residential area, Blaxland Road, Rhodes	Restricted views from approximately 50 metres. Site screened by vegetation and fencing

Photograph 15.1 **Viewpoint 1 looking across Parramatta River, from Meadowbank Memorial Park, with the proposed remediation site in the left background.**

Photograph 15.2 **Viewpoint 2 looking along Adelaide Street, Meadowbank with the remediation site in the far background.**

Photograph 15.3 **Viewpoint 3 looking from Bartlett Park off Victoria Road, Ermington towards the remediation site in the far background.**

Photograph 15.4 **Viewpoint 4 looking from Burroway Road directly opposite the site, across Homebush.**

Photograph 15.5 **Viewpoint 5 looking across Homebush Bay from residential apartments near Powells Creek, off Bennelong Road.**

Photograph 15.6 **Viewpoint 6 foreground views from Marquet Street looking north with the site behind the line of vegetation.**

Photograph 15.7 **Viewpoint 7 foreground views from Walker Street looking northwest with site fencing visible.**

Photograph 15.8 **Viewpoint 8 looking from Blaxland Road east across the railway with restricted views to the site.**

The following site activities would be likely to have visual impacts:

- on-site excavation, transport and storage of large quantities of soil and fill material. This would be achieved with the use of large excavation/transport machinery such as bulldozers, graders excavators and trucks. There is also a potential for visual impacts from dust created during excavation and transport of materials on-site
- exposed areas and stockpiles. At any one time there would be a typical open surface area of 4,200 square metres for excavation and 4,200 square metres for stockpiling with a maximum height of 20 metres for Category 2 or 3 stockpiles
- construction of a coffer dam in Homebush Bay, to a height of 3.5 metres, to enable excavation of contaminated sediments. The dam will be constructed in eight staged segments with each section extending into the bay as shown in **Figure 1.3**. The dam would be constructed from material taken from the site and would be likely to be the colour of sandstone or shale. A proposed mitigation measure is the use of a geofabric silt curtain against the dam wall to limit turbidity impacts. The colour of any potential geofabric has yet to be determined but it is typically black or grey
- the pre-treatment enclosure and the components of the treatment plant located outside the enclosure. The pre-treatment enclosure would be approximately six metres high and depending on the final configuration of the thermal plant, parts of the plant outside the enclosure could be up to 20 metres high. It is likely that steam would be vented from the plant and this could be visible at certain times.

15.4 Impacts and Mitigation Measures

Table 15.3 summarises the visual impacts of the activities described above for each of the eight viewpoints. The mitigation measures to be employed and the likely residual visual impact following the implementation of these measures are also presented.

Table 15.3 Impacts and Mitigation Measures

Viewpoint (VP) identifier	Impact of proposal	Mitigation measures	Residual impact
VP1	The greatest visual impact would be views of the coffer dam, particularly the northernmost segment. The visual impact is likely to be moderate to high	Shade cloth fencing on the northern boundary of the site Where possible, maintain screening vegetation Staging of coffer dam construction	Moderate to high
VP2	Visual impact limited due to the surrounding topography and vegetation along the Parramatta River. The visual impact is likely to be moderate	Shade cloth fencing on the northern boundary of the site Maintain screening vegetation Staging of coffer dam construction	Low to moderate
VP3	Views to the site are restricted due to distance, topography, existing buildings and vegetation screening. The visual impact from this area would be low	Shade cloth fencing on the northern boundary of the site Maintain screening vegetation Staging of coffer dam construction	Low
VP4	Any activity above ground level may have a potential impact as a foreground element to the western shore (industrial area). The visual impact is likely to be high	Maintain screening vegetation Staging of coffer dam construction Staging of excavation and treatment works to limit exposed areas Positioning and colouring of buildings and equipment to limit visual impact	High
VP5	The coffer dams would be visible from all apartments, whilst apartments on higher floors would have views in to the land-based activities Including treatment equipment and associated operations. The visual impact is likely to be high	Shade cloth fencing on the southern boundary of the site Staging of excavation and treatment works to limit exposed areas Staging of coffer dam construction Positioning and colouring of buildings and equipment to limit visual impact	Moderate to high

Table 15.3 Continuation

Viewpoint (VP) identifier	Impact of proposal	Mitigation measures	Residual impact
VP6	This viewpoint is less than 50 metres from the site and would have close foreground visual impacts. Views are screened by existing vegetation on the site boundary and the area is industrial with a low scenic quality. Visual impacts are likely to be moderate to high	Maintain screening vegetation along Gauthorpe Street Shade cloth fencing on the southern boundary of the site Staging of excavation and treatment works to limit exposed areas Positioning and colouring of buildings and equipment to limit visual impact	Moderate
VP7	VP7 would have close foreground visual impacts. There are no residential properties on the street and any views of the site would be from passing vehicles. There would also be fleeting impacts to commuters on passing trains. Visual impacts are likely to be low	Maintain screening vegetation along Walker Street Shade cloth fencing on the eastern boundary of the site Staging of excavation and treatment works to limit exposed areas Positioning and colouring of buildings and equipment to limit visual impact	Low
VP8	Views to the site are restricted by the railway easement, vegetation and fencing. Although this viewpoint is in a residential area, the restricted views make the visual impact low	Maintain screening vegetation along Walker Street Shade cloth fencing on the eastern boundary of the site Staging of excavation and treatment works to limit exposed areas Positioning and colouring of buildings and equipment to limit visual impact	Low

Completion of Remediation Works

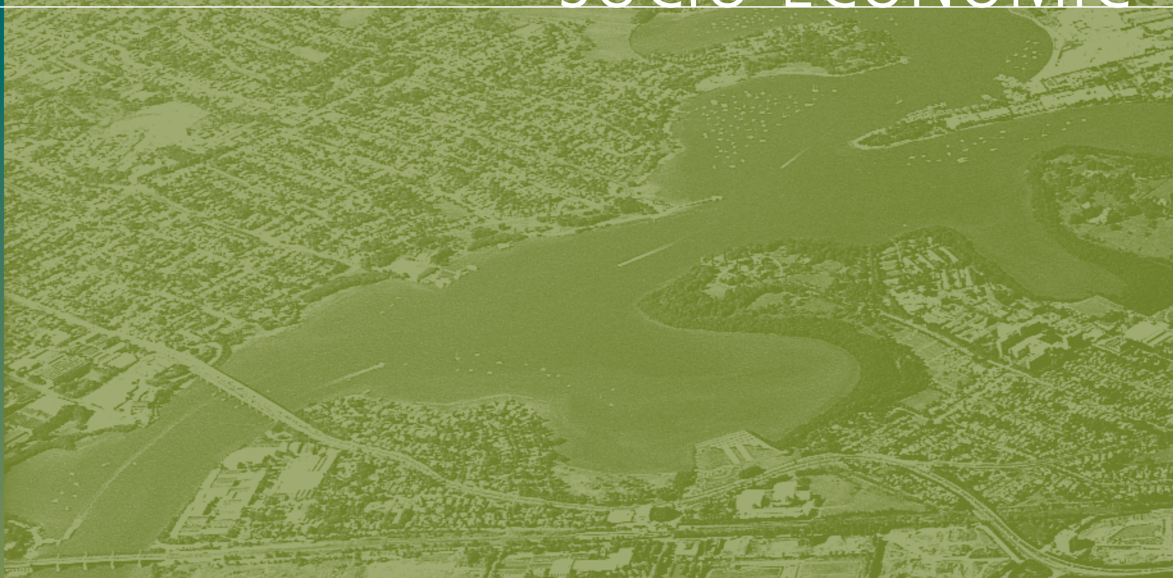
The site would be reshaped during the remediation process to integrate with the next stage of development. **Figure 6.16** illustrates the proposed finished elevations, which would comprise of basement excavations, roads and open space areas. Surfaces would be turfed as part of the dust management procedures. The coffer dams would be removed and the replacement seawall would be of a similar design and colour as the one that exists now. It would also maintain the existing alignment. Visual impacts following completion of the remediation works and before redevelopment are likely to be minimal.

Chapter 16

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

SOCIO-ECONOMIC



Chapter 16

SOCIO-ECONOMIC

16.1 Nature of Social and Economic Impacts

Social impacts may generally be defined as all changes in the structure and functioning of patterned social orderings that occur in conjunction with, or as a result of an environmental, technological, or social innovation or alteration (Witney, 1978 in Commonwealth Environment Protection Agency, 1994). Social impacts may refer to changes to people's way of life, culture, tradition or community structure, cohesion and stability. Broadly speaking, social impacts may be categorised as quantifiable, such as the likely effects on future population growth, or unquantifiable, such as community attitudes towards a proposal, community perceptions of hazards and risks and likely effects on community cohesion.

Economic impacts, on the other hand, are generally quantifiable at the local, regional and national level. Potential economic impacts include likely effects on employment and economic activity.

16.2 Social Impacts

Social impacts in the context of the proposed remediation of the Lednez site and Homebush Bay could be expected to include:

- community perceptions relating to hazards and risks associated with remediation of contaminated materials
- changes in landuse, amenity and community cohesion
- access to recreational opportunities.

16.2.1 Hazards and Risks

Human health and safety are highly valued by people living on the Rhodes Peninsula. This is demonstrated by the prevalence of hazard and risk as a stated issue of community concern in community consultations (see **Chapter 3**).

The principal issues associated with the remediation proposal relate to potential hazards and risks including:

- risks to human health as a result of degraded air quality
- environmental risks associated with the excavation, treatment and use of sediments and fill materials
- risks associated with the standards of ongoing site management and accountability as the remediation works are undertaken.

These issues are assessed in **Chapters 7** to **15** and are relevant in the context of social impacts because of people's perceptions of how these issues impact on their safety and general wellbeing.

On the basis of the assessments and investigations conducted and outlined in **Chapters 7** to **15**, the likely impact on community health and safety may be described as follows:

- air quality analysis based on predicted emissions of dust generated during on-site activities found that air quality goals for particulate matter would be met at all surrounding sensitive receptors
- air quality analysis based on emissions from the proposed thermal treatment plant found that emissions would comply with all air quality goals both on-site and off-site
- based on the predicted emissions associated with both the on-site excavations and the thermal treatment plant, the human health risk assessment found that there is negligible risk to the public from the proposal in terms of carcinogenic or non-carcinogenic emissions
- odours generated by anthropogenic organic materials on-site would be below the threshold levels and short term emissions caused by the excavation of sediments containing natural volatile compounds in the bay would be managed by the application of standard odour control procedures such as routine aeration of the odour materials and where an odour persists, the application of odour masking sprays
- noise generated during operation of the remediation activities has the potential to result in daytime exceedences of the relevant EPA goals of up to 15 dB(A). In practice, by careful up front monitoring and if required, subsequent application of a combination of techniques such as restriction of operations to minimise equipment numbers, noise attenuation mounds and barriers and the shrouding and muffling of equipment, noise exceedences would be greatly reduced. Predicted noise levels from night-time operations would be likely to remain within relevant criteria in all cases
- surface water and groundwater would meet the appropriate discharge criteria so that re-contamination of the waters and sediments of the bay does not occur.

With the implementation of the ongoing environmental management and monitoring measures described in **Chapter 6**, risks to human health would be as low as practically achievable.

In summary, no significant adverse health or safety impacts are expected that would be associated with the performance of the proposed remediation of the Lednez site and bay. However, community concerns over this issue can only be reduced with demonstrably robust environmental management, and monitoring procedures. **Chapter 18** outlines the environmental management plan and describes the environmental management and monitoring systems to be adopted for the proposed remediation.

16.2.2 Changes in Landuse and Amenity

Change and attitudes towards it, affects people's sense of community. Submissions made during consultation for this EIS identified significant community concern over the scale of future residential developments on the Lednez site and any associated increases in traffic movements or reduction in the amenity of the area. However, the scope of this EIS does not include these issues. The community would be given the opportunity to comment on the future residential redevelopment of the Lednez site when that development application is lodged.

Remediating the Lednez site to a standard that allows residential redevelopment would allow the alteration of the pattern of urban development on the Rhodes Peninsula. The remediation itself, however, would not affect people's existing sense of community.

16.2.3 Access to Recreational Opportunities

Remediation of the Lednez site and a portion of Homebush Bay is intended to improve the environmental condition of the bay and make the areas along its foreshore safe for recreational activities.

An indirect consequence relates to any future residential redevelopment of the site made possible by its remediation. *Sydney Regional Environmental Plan No. 29 – Rhodes Peninsula* rezones a foreshore strip extending along the entire eastern edge of Homebush Bay as open space. The availability of publicly accessible foreshore open space as part of a subsequent redevelopment would represent a significant contribution to the recreational opportunities available on the Rhodes Peninsula. This outcome would be facilitated by the remediation.

16.3 Economic Impacts

The economic impacts of the proposed remediation works include short-term income and employment impacts, effects on accommodation and other local businesses and potential impacts on property values in the local area.

16.3.1 Employment and Income Impacts

Direct employment opportunities are likely to be created for approximately 50 people for the first two years and approximately 30 people for the following three years.

Thiess Services is committed to using local contractors and employees where possible. However, specialist staff would be required to operate the thermal treatment plant.

The estimated number of employment opportunities per project phase, specified in terms of skilled, semi-skilled and unskilled employees, is given in **Table 16.1**.

Table 16.1 Employee Numbers and Breakdown

Project phase	Estimated number of employment opportunities
1 and 2	10 skilled
	15 semi-skilled
	25 unskilled
3	5 skilled
	10 semi-skilled
	15 unskilled
4	5 skilled
	10 semi-skilled
	15 unskilled

Indirect local employment opportunities would be for activities such as demolition contractors, landscapers, and chemical product suppliers, fencing contractors, earthmoving contractors and site security specialists.

It is estimated that about 21 per cent of the total project costs are made up of wages and salaries. Excluding wages and salaries, it is estimated that about 75 per cent of the remediation costs would be expended locally.

16.3.2 Community Infrastructure

As community facilities are currently limited on Rhodes Peninsula, there may be a minor increase in demand for community and social facilities, such as local food retailers and public transport.

Generally, employees are likely to take up residence throughout the Sydney metropolitan area, as no dedicated accommodation would be provided. Accommodation impacts would depend on the degree to which employees would be brought in temporarily from elsewhere. There is a potential for a short-term increase in demand for accommodation in local hotels/motels, in particular for the skilled people who would be brought in from outside the region.

It is expected that the workforce would integrate into the local community and use the existing facilities available to the local community members. No businesses would be affected by changes to access or loss of trade as a result of the proposed works.

16.3.3 Land and Property Values

The purpose of the remediation is to realise a higher and better use of the Lednez site, that is, to allow for future residential and open space landuses rather than industrial use. Residential development of the Lednez site and the surrounding industrial sites would be likely to positively contribute to the visual appearance of the Rhodes Peninsula and provide community facilities that are currently unavailable, such as foreshore access and open space. Increasing the residential population of the Rhodes Peninsula would also be likely to result in improved public transport and community services for the area.

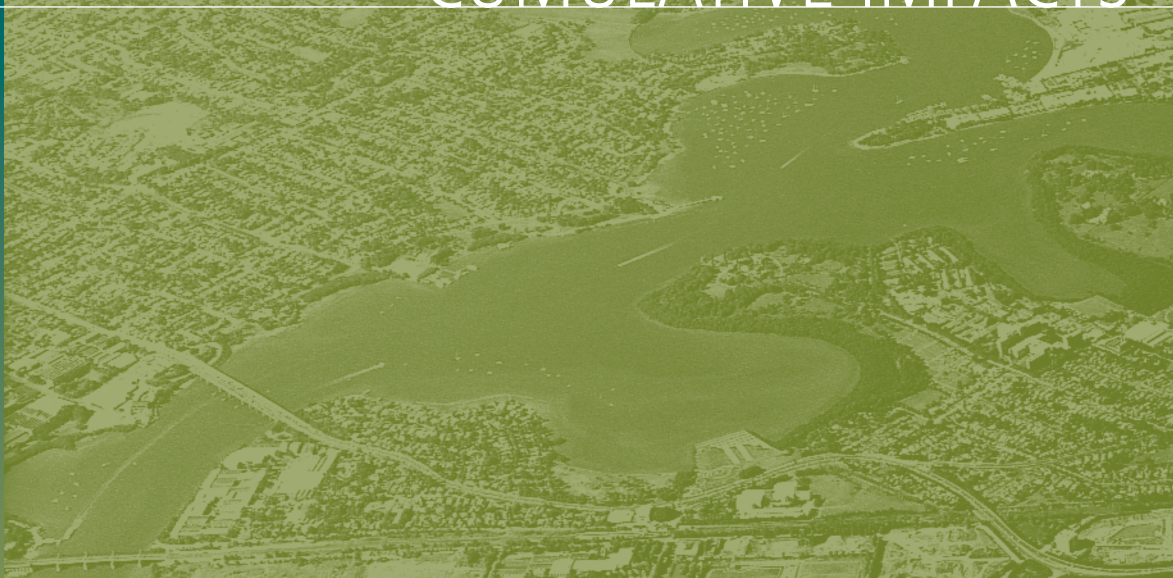
Overall, the remediation works would help to considerably increase the land value of the site. This improved land value would result in increased rate income for Canada Bay City Council improving its ability to fund improvements in the municipality. The remediation of the site and potential for redevelopment of the site are expected to boost the property prices in adjoining residential areas and draw new services to the area.

Part F

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

CUMULATIVE IMPACTS

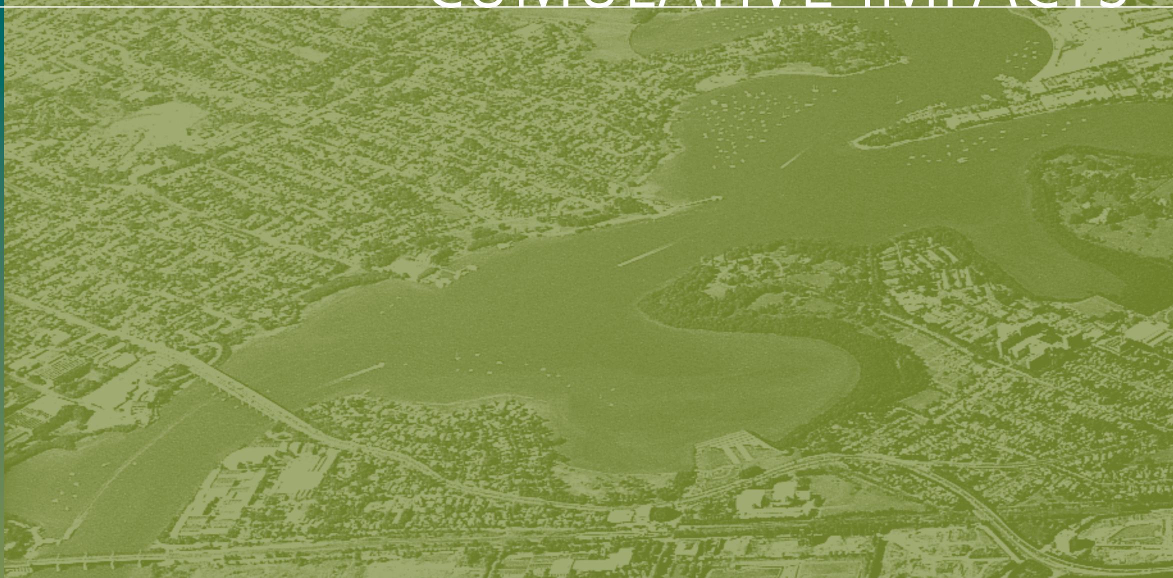


Chapter 17

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

CUMULATIVE IMPACTS



Chapter 17

CUMULATIVE IMPACTS

17.1 Assessing Cumulative Impacts

Cumulative impacts are likely to arise from the interaction of the proposed remediation works with other significant proposals and developments planned for the Rhodes Peninsula and Homebush Bay. Cumulative impacts from the proposed remediation and its interaction with existing developments are unlikely, as they tend not be similar in nature and are located some distance from the proposal. This section therefore deals with cumulative impacts resulting from:

- interactions with other remediation and construction works proposed on the Rhodes Peninsula and within the Homebush Bay area (as defined by the *Sydney Regional Environmental Plan No. 24 – Homebush Bay Area*)
- interaction of impacts identified for the proposed Lednez site remediation proposal with other residential development projects that may occur within the remediation timeframe.

The assessment for this proposal does not include cumulative impacts associated with the future residential development of the Lednez site and its interaction with other developments. Issues such as the combined impact of development traffic on local and regional roads, would be assessed as part of the environmental impact assessments for those proposals.

A review of the proposed and approved developments in the area has highlighted issues such as traffic generation and network capacity, air quality (and hence public health), visual impacts, surface water, groundwater and noise to be the key commulative issues.

17.2 Existing Environment

The Lednez site has been substantially contaminated as a result of previous chemical manufactured activities undertaken on the site. This contamination has impacted on Homebush Bay, particularly areas near the existing sea wall. Remediation of the Lednez site prior to 1993 has left several areas of contamination untreated and without full encapsulation. The site has been cleared of most vegetation and has relatively poor visual quality for a waterside parcel of land.

The areas neighbouring the site include cleared land with regrowth to the north (Meriton site), the Main Northern Railway line, residential buildings to the east, factories and residential buildings to the south and a mix of industry and residential on the opposite shore of Homebush Bay, to the west. There is a large construction site further to the south (former Orica site – McRoss Developments) and wetlands are situated at the southern end of the bay in the vicinity of the confluence of Powells and Haslams Creeks. These wetlands are a part of Bicentennial Park, which abuts the southern section of Homebush Bay.

17.3 Relevant Remediation and Construction Developments

The developments taken into consideration when assessing cumulative impacts from other remediation and construction projects in the area are summarised in **Table 17.1** and are located relative to the proposal site as shown in **Figure 17.1**.

Table 17.1 Key Remediation and Construction Development

Proposed development	Proposed works
Lednez site/Homebush Bay remediation	Remediation of the Lednez site and Homebush Bay using indirect thermal desorption
Meriton Apartments remediation	Remediation of the Meriton site using direct thermal desorption
Statewide Developments demolition	Demolition of an existing warehouse building located directly south and adjacent to the Lednez site
McRoss Development construction	Construction of residential apartments to the south of the Lednez site
Ingham Planning Bennelong Road remediation	Remediation of small areas on this site to the west of the Lednez site across the Bay

17.4 Residential Developments

Construction and occupation of residential developments on Rhodes Peninsula may coincide with the five-year duration of the proposed Lednez site and Homebush Bay remediation remediation. If remediation commenced in 2003 then it would likely not be finished until 2008. Residential developments that may be completed before remediation is finished are summarised in **Table 17.2.**

17.5 Traffic

Traffic analyses have shown that the proposed Lednez site and Homebush Bay remediation would have minimal impact on existing traffic levels.

The site access for traffic from the McRoss Developments is from Homebush Bay Drive. Accordingly, no cumulative impact during the McRoss construction phases is anticipated. Ultimately however, if the start date of the Lednez site remediation is delayed then the thoroughfare of traffic along proposed Shoreline Avenue (to the southern boundary of the Lednez site) would need to be considered as a potential cumulative impact.

Cumulative impacts may arise from the interaction of traffic from this proposal and the proposed remediation of the Meriton site. It has been assumed based on the advice by ERM Consultants that the Meriton site worst case would include light vehicle movements from 25 employees on a daily basis during the remediation phase. Analysis of traffic from the Meriton site remediation and this proposal has been undertaken to assess cumulative impacts on local traffic. Heavy vehicles from the Meriton thermal plant construction phase have not been assessed due to the short construction period (three to four weeks) and the limited number of vehicles (11).

As discussed in **Chapter 12**, 55 to 60 percent of traffic is likely to be to and from the south and the reminder to and from the north. Thus, traffic to and from the south and north for the Meriton remediation would likely be 14 and 11 light vehicles respectively.

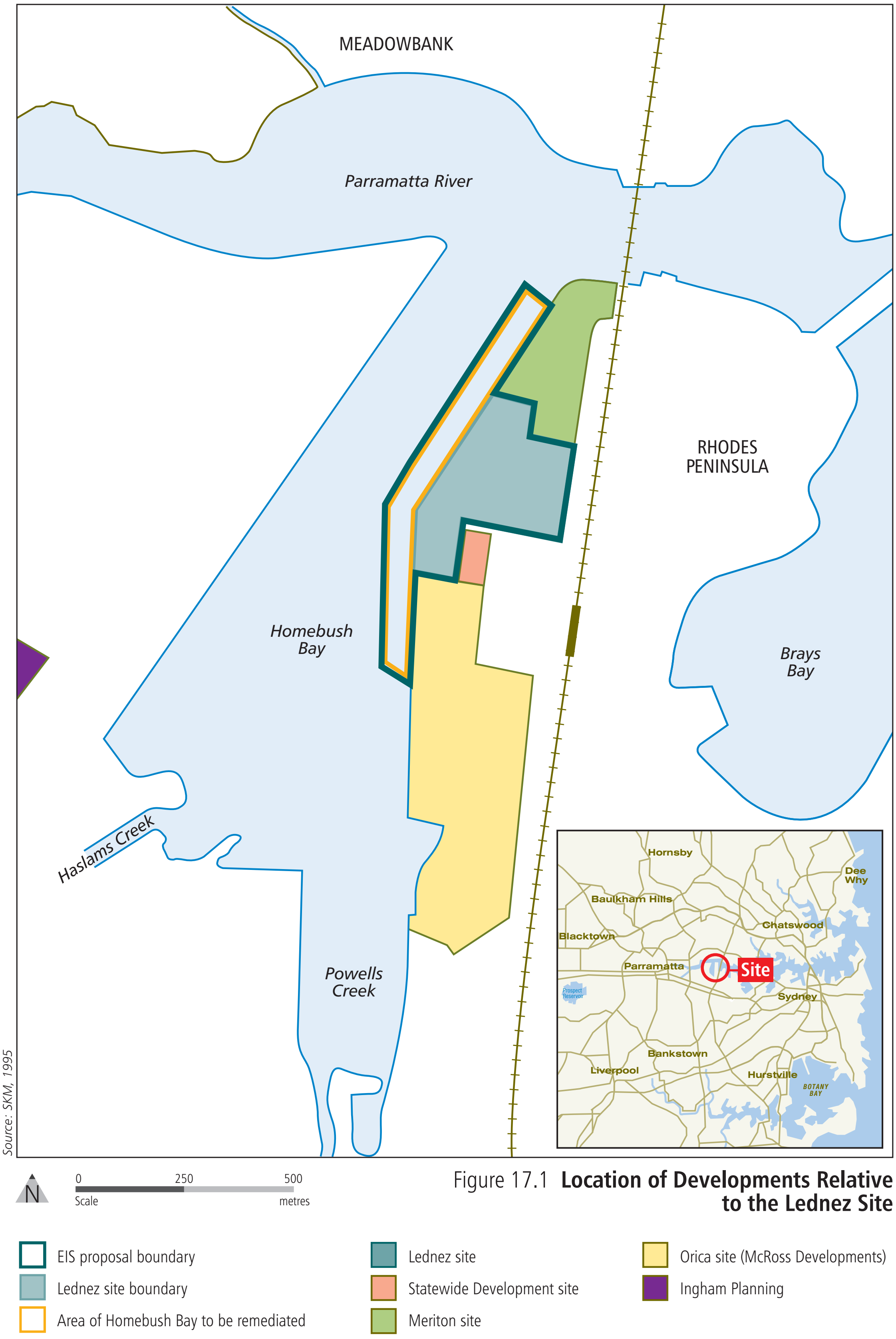


Figure 17.1 **Location of Developments Relative to the Lednez Site**

Table 17.2 Future Residential Developments

Proposed development	Proposed works	Proposed construction dates	Anticipated occupation date
Renewing Homebush Bay (RHB)	A development application for future landuse on the Lednez site has not been submitted. It is likely, however, that residential developments would be included in a Master Plan for the site. Construction of residential areas would begin on the north of the Lednez site while remediation of the southern section is still being undertaken	≈ 2005 (Stage 1)	≈ 2007 (for Stage 1 and progressive release thereafter)
Meriton Apartments	Although a development application has not been submitted for future site use, it has been assumed that residential/retail developments consistent with the objectives of Sydney Regional Environmental Plan No. 24 - Homebush Bay Area would be constructed	≈ 2004 (Stage 1)	≈ Anticipated to be available in 2005
Statewide Developments	Although a development application has not been submitted for future site use, it has been assumed that residential/retail developments consistent with the objectives of Sydney Regional Environmental Plan No. 24 - Homebush Bay Area would be constructed	To be determined	To be determined
McRoss Developments	Residential/retail development including 1800 waterfront units and town houses with a retail and commercial centre	Present – 2007	≈ 2003 for a package on the south west of the site, through to 2007 for the northern most packages

Assuming drivers are likely to adopt the shortest route to and from work, it can be further deduced that the 14 vehicles from the south would use the intersection of Concord Road and Blaxland Road; similarly the 11 vehicles would travel via the intersection of Concord Road and Averill Street.

As detailed in **Chapter 12**, the intersection of Blaxland Road and Leeds Street has ample spare capacity so the cumulative site remediation traffic makes no noticeable difference to the existing operational performance. Therefore the critical intersections would be Concord Road and Blaxland Road, and Concord Road and Averill Street.

Despite the addition of this traffic, both intersections continue to operate well in both peaks. In the unlikely event that traffic volumes on these intersections are significantly higher than those predicted, substantial capacity exists at nearby intersections that would easily cope with the overflow. Further information on the cumulative operational performance of these two critical intersections is presented in **Appendix G**.

17.6 Air Quality

The proposed remediation for both the Lednez site and the Meriton site would contribute some load to existing background levels of air pollutants in the area. The worst-case scenario would be if both sites were being remediated at their maximum rate simultaneously.

As with the air assessment in **Chapter 9**, sources of emissions on both sites are associated with site earthworks and the thermal treatment plants. .

Cumulative modelling was undertaken assuming both thermal plants were operating simultaneously and both excavation processes were taking place simultaneously. **Table 17.3** shows the predicted levels for the cumulative impacts for the common pollutants from the thermal plants.

Table 17.3 Cumulative Thermal Plant Air Emissions, Lednez/Homebush and Meriton Remediation Sites

Pollutant	Averaging time	Objective/standard (µg/m³)/risk factor	Maximum predicted concentrations due to cumulative effects of Lednez and Meriton sites proposal (µg/m³)	Risk level
Carbon monoxide	1 hour	31,000	10.6	NA **
	8 hour	10,000	5.6	NA **
Nitrogen oxides*	1 hour	245	47.6	NA **
	Annual	60	2.0	NA **
PM_{10}	24 hour	50	8.9	NA **
	Annual	30 (allows 5 exceedances per year)	1.4	NA **
SO_2	1 hour	570	1.63	NA **
	24 hour	225	0.4	NA **
	Annual	60	0.07	NA **
Mercury	Annual	1.09	4.15×10^{-3}	NA **
Lead	Annual	0.5	6.10×10^{-5}	NA **
Cadmium	Annual	1.8×10^{-3} ***	7.72×10^{-6}	1.39×10^{-8}
Nickel	Annual	3.8×10^{-4} ***	6.34×10^{-6}	2.41×10^{-9}
Dioxin	1 hour	3.0×10^{-5}	8.77×10^{-7}	NA **
Benzo(a)pyrene	Annual	8.7×10^{-2}	3.79×10^{-6}	3.3×10^{-7}

* assuming 100% of the NO_x is NO_2

µg/m³ micrograms per cubic metre

PM_{10} Particulate matter less than ten microns

** not applicable – risk is not the criterion used for assessment in this instance

*** risk factor for a lifetime exposure of 1 µg/m³

Figures **17.2 to 17.5** show the predicted cumulative dust impacts for the two projects. As with the Lednez proposal alone, cumulative effects from the simultaneous operation of both thermal treatment plants and excavation works on the Meriton and Lednez sites are generally negligible with ambient air concentrations remaining within acceptable limits. However, as shown in **Figure 17.2** there is an exceedence of the modelled 24-hour annual average for particulate matter less than 10 microns at ground level due to cumulative activities. It is important to note that this estimate was made without the inclusion of any emission control measures on the Lednez site so it anticipated that actual impacts would be much less. This can be demonstrated by a review of the "special receptor" analysis described in **Chapter 9** which shows that whilst exceedences are predicted in this area, the number of times this is likely to occur is minimal and when wind conditions are such that impacts may occur, then additional measures such as work stoppage would apply.

17.7 Visual

Cumulative short term visual impacts would be dependant on the remediation of the Meriton site and Lednez site/Homebush Bay being undertaken concurrently. Cumulative impacts would include an increased area of land excavation, greater numbers of machinery and the additional treatment plant. There would, however, be no increase in visual impact from work within the bay itself as the remediation of the Meriton site does not involve any works within the bay.

There is also likely to be cumulative visual impacts associated with the construction works currently being undertaken on the former Orica site to the south of the proposal. The former Orica site (McRoss Developments) is being redeveloped with residential and commercial buildings and includes typical construction activity visual impacts such as those from scaffolding, cranes and formwork.

The short-term cumulative visual impacts of developments on the peninsula are considered acceptable taking into account the relatively low visual quality of the site and nearby sites and the limited views to the site. In the longer term the visual quality of the site and the peninsula would be improved.

17.8 Surface Water and Groundwater

The short-term impacts from remediation are not likely to be amplified by other developments. Each of the remediation proposals and subsequent developments in the area would employ erosion and sediment control measures to minimise impacts. There would be a long-term improvement in surface water quality and groundwater from remediation of contaminated lands on the peninsula.

Until all remediation works have been completed, it would be important to ensure that if the remediation of one area occurs whilst the other is delayed, that measures such as sheet pile walls, bentonite walls or similar are employed to eliminate the opportunity for recontamination of remediated areas. This is particularly important at the Lednez site / Meriton boundary and the Meriton site / Homebush Bay boundaries.

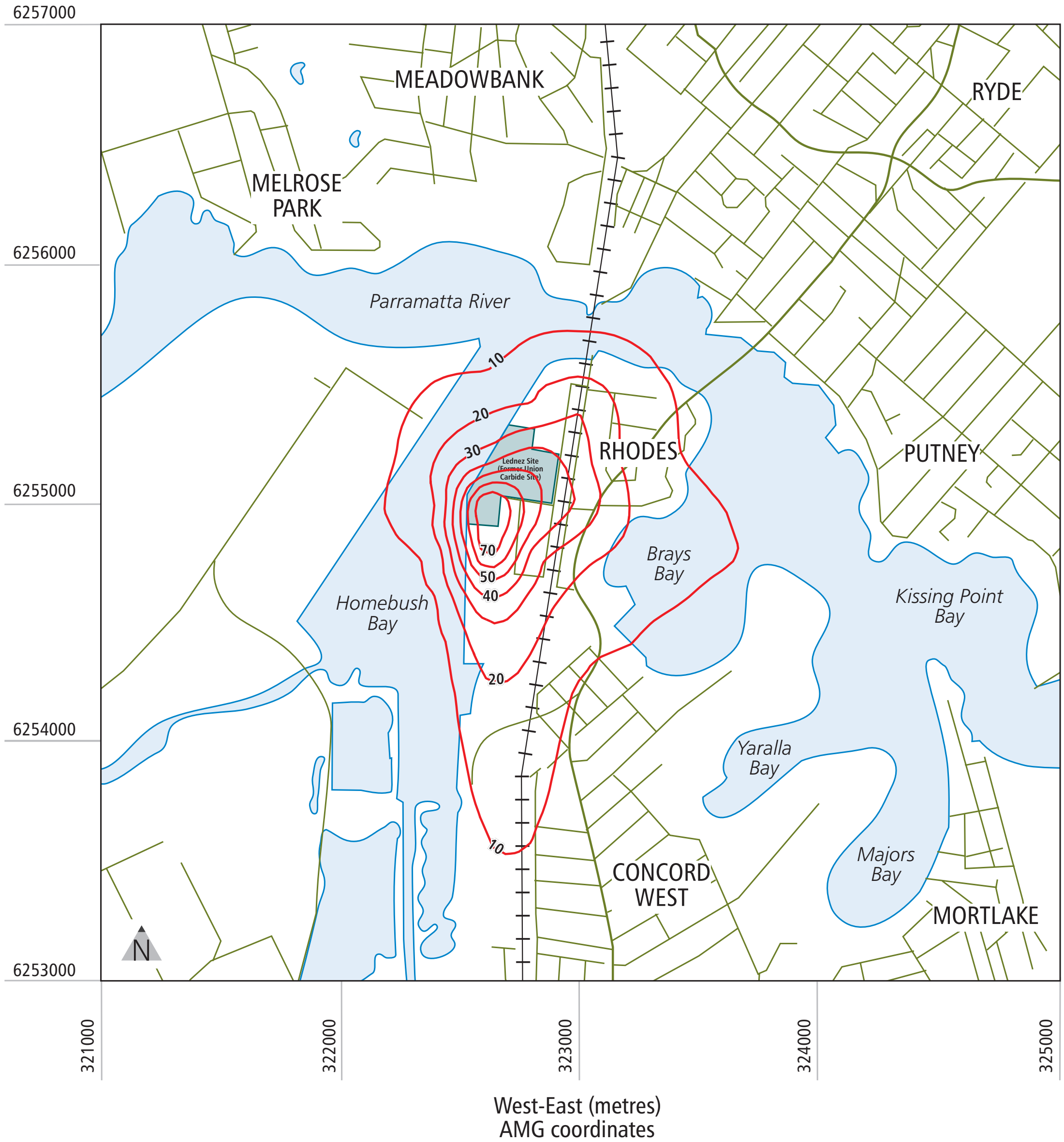


Figure 17.2 **Predicted Maximum 24-Hour Average Particulate Matter Less Than 10 Microns Concentration at Ground Level Due to Cumulative Excavation Activities**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 50 micrograms per cubic metre.
3. Contours shown do not include any emission controls.
4. Colour contour line locations are approximate.

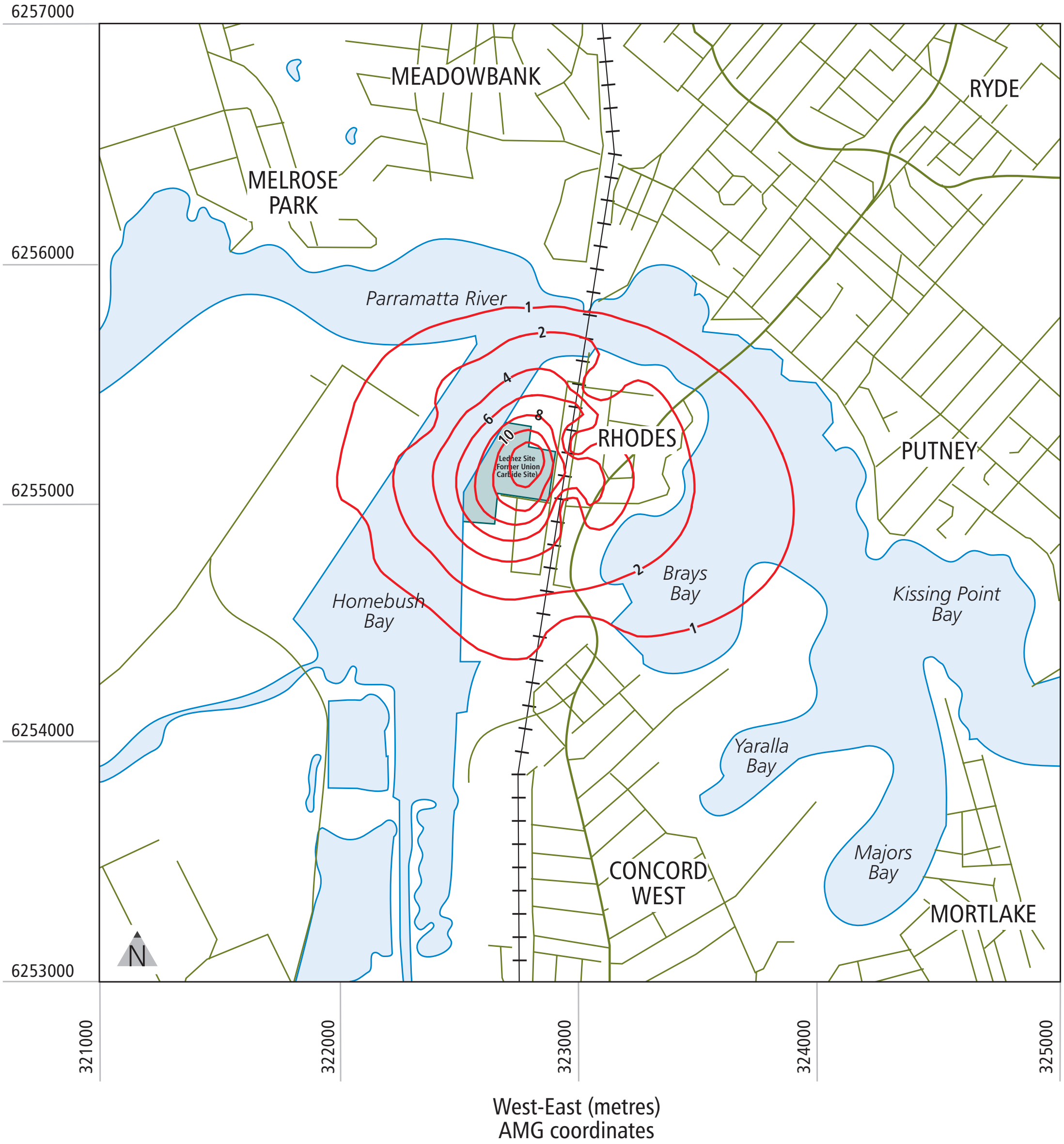


Figure 17.3 **Predicted Annual Average Particulate Matter Less Than 10 Microns Concentration at Ground Level Due to Cumulative Excavation Activities**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 30 micrograms per cubic metre.
3. Contours shown do not include any emission controls.
4. Colour contour line locations are approximate.

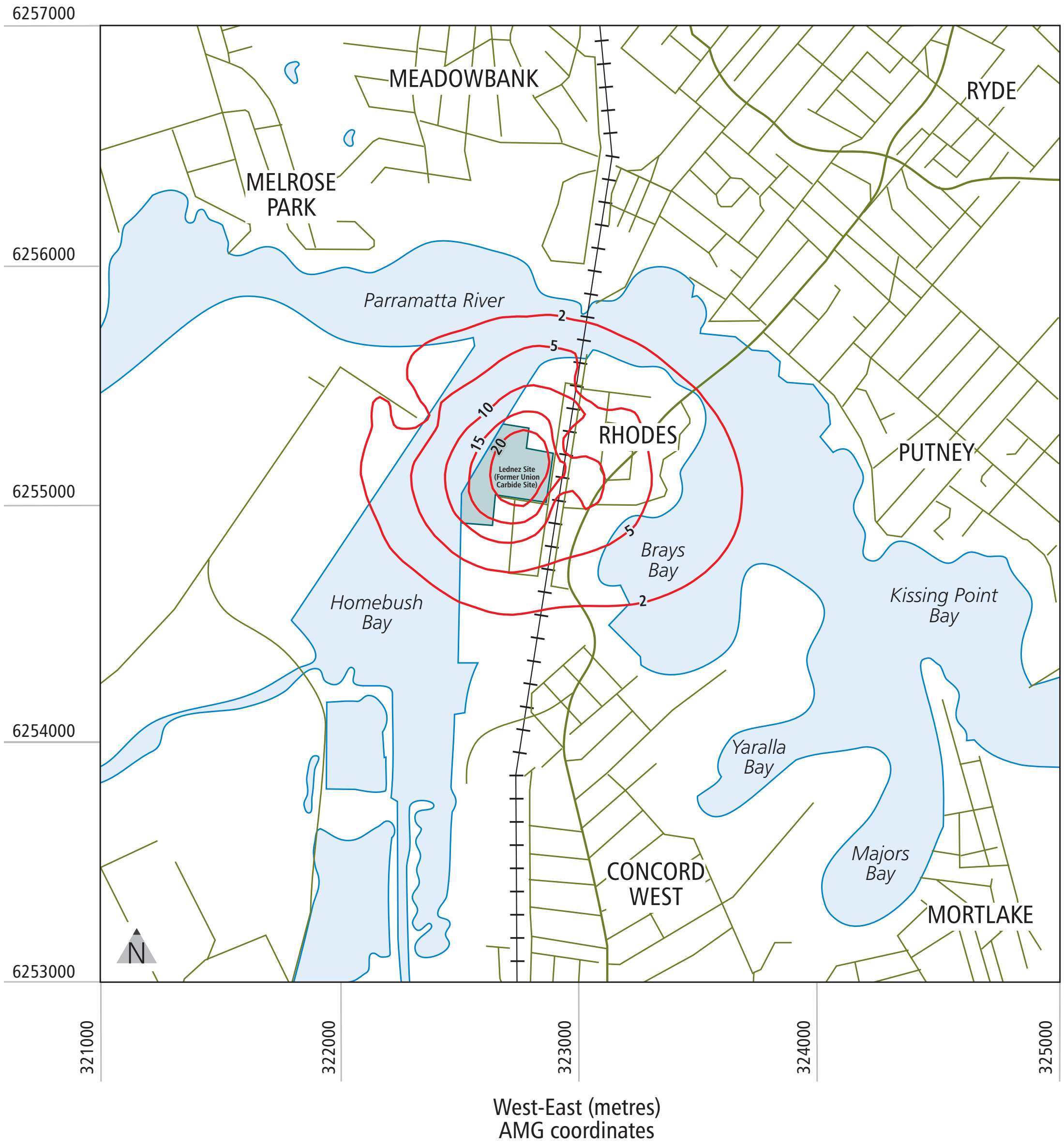


Figure 17.4 **Predicted Annual Average Total Suspended Particulate Concentration at Ground Level Due to Cumulative Excavation Activities**

Notes:
1. All units are in micrograms per cubic metre.
2. Air quality goal for this figure is 90 micrograms per cubic metre.
3. Contours shown do not include any emission controls.
4. Colour contour line locations are approximate.

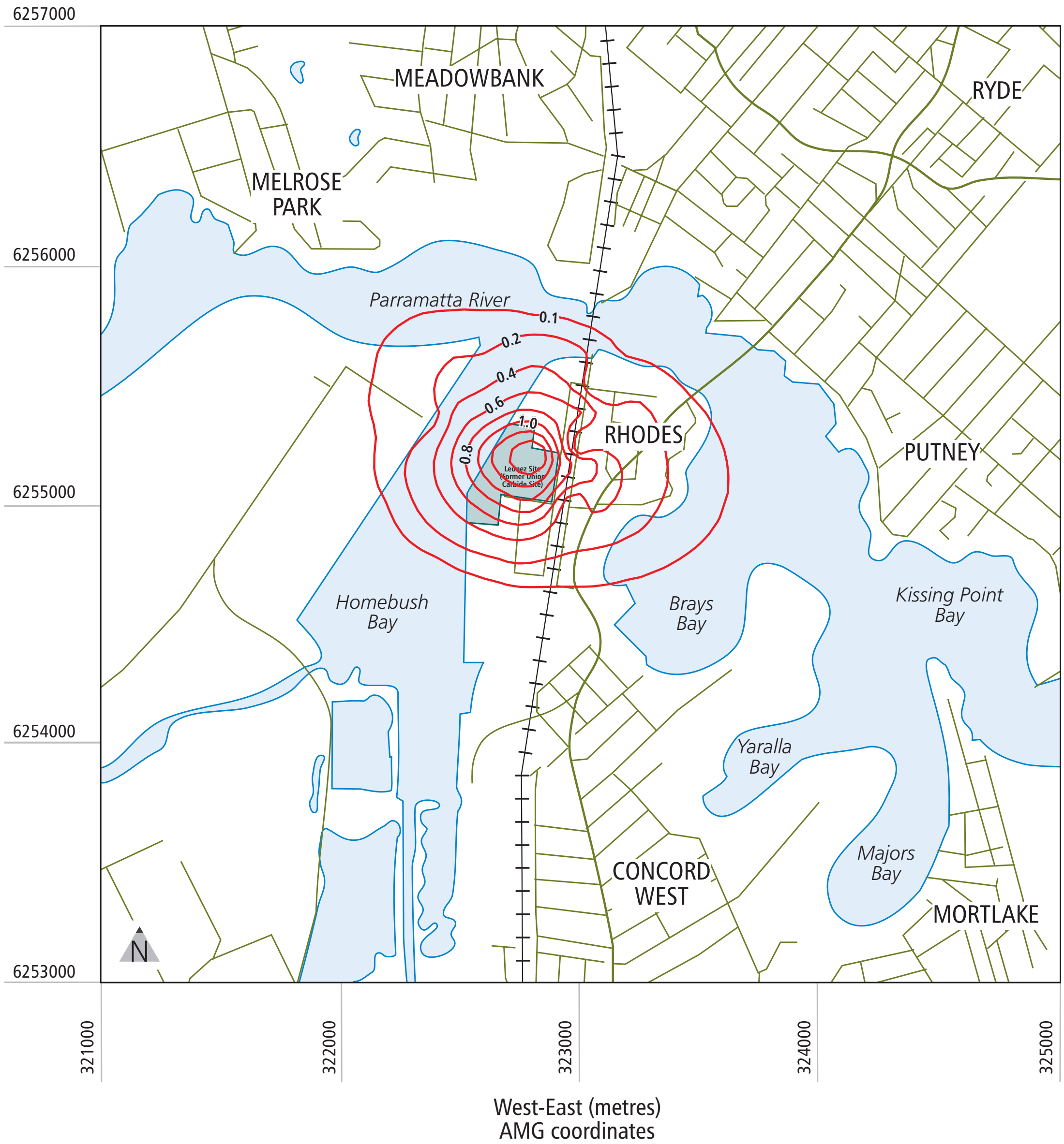


Figure 17.5 **Predicted Annual Average Dust Deposition Due to Cumulative Excavation Activities**

Notes:
1. All units are in grams per square metre per month.
2. Air quality goal for this figure is 2 grams per square metres per month.
3. Contours shown do not include any emission controls.
4. Colour contour line locations are approximate.

17.9 Noise

Cumulative impacts for the proposals on the Rhodes Peninsula are likely to exceed acceptable noise goals unless noise management or mitigation measures are applied effectively. Noise emissions from the proposed Meriton remediation site would be similar in nature and would overlap for the first two years of this proposal. It is likely that the cumulative effects of the two proposals would increase noise impacts on nearby receptors. There would also be cumulative impacts from the McRoss Developments construction site.

Mitigation measures such as the pre-treatment enclosure and ensuring high noise emission operations are undertaken during daytime hours would help reduce cumulative impacts on the Peninsula.

Part G

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

ENVIRONMENTAL MANAGEMENT AND MONITORING

Chapter 18

REMEDIATION OF LEDNEZ SITE, RHODES and HOMEBUSH BAY

ENVIRONMENTAL MANAGEMENT

Chapter 18

ENVIRONMENTAL MANAGEMENT

The following section includes an outline environmental management plan that comprises mitigation measures to be undertaken during the development and operation of the proposal to eliminate or minimise adverse environmental impacts. It is designed to demonstrate how minimisation and mitigation measures would ensure that the proposal complies with statutory obligations under the relevant licences or approvals, such as those required by the EPA under the *Protection of the Environment Operations Act 1997*.

18.1 Environmental Management System

Thiess Services' Environmental Management System satisfies the requirements of ISO 14001 Environmental Management Systems Specification and provides a management framework and strategy to effectively manage the environment and those operational activities considered to have an adverse impact on the environment. The system is certified by Quality Assurance Services to ISO 14001 and is accredited by the Construction Policy Steering Committee as satisfying the requirements of the *Environmental Management System Guidelines* (1999).

To ensure the suitability, adequacy and effectiveness of the system, Thiess Services and senior management reviews the system regularly. These reviews include consideration of incidents, non-conformances and corrective actions with an objective of continual improvement.

18.2 Outline Environmental Management Plan

An environmental management plan is a comprehensive technical document designed to take into account the commitments stated in the EIS, relevant codes, regulations, statutory obligations and the requirements of ISO 9002, ISO 14001 and conditions of consent or licence conditions. An environmental management plan is usually finalised during or following the development approval stage.

Issues to be addressed in an environmental management plan include:

- the proponent's environmental goals for the project
- methods for achieving these goals
- performance measures to be achieved , for example, noise levels in accordance with EPA standards
- timing of environmental safeguard implementation
- guidelines for emergencies, corrective action and procedures for notification of relevant parties and authorities
- the conditions of all licences and permits with copies attached.

The successful implementation of a large remediation proposal, such as that proposed requires that minimum standards of operation be established and enforced for all aspects of day-to-day operations. In addition, guidance on out of the ordinary situations and emergencies is required to ensure the smooth progress of the works at all times.

To this end, a detailed environmental management plan would be prepared for the proposal as part of the environmental management system based on the information contained in the environmental management plan outlined in this EIS. Environmental management and monitoring measures are also included in the remediation action plan for the proposal thus linking the day-to-day remediation and validation programs to the overarching management system.

An effective environmental management plan must be site-specific in terms of location, layout and design of technological features. Hence an outline of the environmental management plan has been prepared based on the findings of this EIS.

The outline environmental management plan provides the framework through which the proposal would be managed to comply with statutory requirements in terms of permits and licences. It documents mitigation measures established in the EIS and provides a basis for ensuring that these are implemented effectively.

Key components of this plan include the management and monitoring of issues associated with:

- air quality, including the management of dust and odour
- noise
- soils and waters on-site including surface water, groundwater, flood water, erosion and sediment management and the control of acid sulphate conditions
- construction of the coffer dam and Homebush Bay water quality
- risks and hazards including contingency and emergency response issues
- general construction and operational issues including complaints management, waste management, security, lighting and visitor procedures as well a management of other issues identified in this EIS such as heritage, visual and terrestrial flora and fauna.

18.2.1 Air Quality Management

The objective of an air quality management plan would be to minimise air quality impacts on the surrounding area. This includes controls on the amount of dust and odour that is generated from the proposed works, as well as the control of emissions from the thermal treatment plant.

Air quality requirements established as part of EPA licensing requirements would be incorporated in the environmental management plan and the responsibility for meeting statutory requirements delegated to appropriate project personnel. Monitoring of air quality would be carried out, with monitoring locations dependant on local climatic conditions.

Mitigation measures would focus primarily on the management of earthworks to ensure that emissions of dust, including any chemicals attached to the dust, are kept to the minimum level practicable.

18.2.2 Noise and Vibration Management

A noise management plan has been developed to ensure the proposal conforms to EPA guidelines and minimises noise emissions to the surrounding area. An outline of this is provided in **Chapter 13**. A noise management plan is provided as part of the noise assessment in **Appendix H**.

18.2.3 Water Management

The effective implementation of water management strategies is a key component of environmental management for this proposal. Water management has several aspects including the management of erosion and sediment control (surface water management), management of flood issues, management of groundwater, management of acid sulphate conditions and the management of impacts to the bay waters.

When more detailed design information is available, a more detailed water management plan would be prepared for the proposal. Such a plan would encompass the five elements listed above and would be based on the water management protocols described in **Chapter 6**.

Surface Water Management incorporating Erosion and Sediment Control

A detailed erosion and sediment control plan would be developed to manage and control the quality of the surface water leaving the remediation-site. This is especially important to prevent stormwater coming into contact with contaminated sediment. In this sense, the erosion and sediment control plan would manage "clean" and "dirty" surface water during remediation work.

The driving philosophy behind the erosion and sediment control plan is the provision of control measures regarded as "carriages" in the "treatment train". The entire "treatment train" needs to be implemented completely to ensure that the desired degree of soil and water management is achieved.

It is a given that site conditions would change daily throughout the life of the project. Control measure implementation would therefore need to respond to the particular site constraints prevailing at the time. However, the guidelines and principles of the Department of Housing's (1998) *Managing Urban Stormwater: Soils and Construction* would be adhered to at all times.

Flood Management

During the remediation, the frontage onto Homebush Bay would be modified during these stages from an existing level of three metres Australian Height Datum to the final landform level of two metres Australian Height Datum. The remediation works would be staged to maintain adequate freeboard would mitigate flooding.

Groundwater Management

The groundwater modelling study has shown that given the conservatism inherent in the model, groundwater monitoring after remediation would not be required unless final conditions are substantially worse than expected in terms of the key parameters, these being residual concentrations, organic carbon content and hydraulic conductivity. The decision as to whether a monitoring program is needed would be made once confirmatory data is available on actual residual concentrations of chemicals in the material to be reinstated and on other physical properties such as organic carbon content and hydraulic conductivity.

Acid Sulphate Soil Management

For the purpose of this proposal, all sediments excavated from Homebush Bay and reclaimed areas on the site would be assumed to be potential acid sulphate generating material.

Materials confirmed as acid sulphate soils would be treated by adding an appropriate quantity of lime as determined by the analytical results before reinstatement of such materials on-site. The addition and mixing of lime would be by conventional mechanical methods such as spreading and turning using hydraulic excavators.

18.2.4 Emergency Response Plan

A contingency plan and an emergency response plan would be prepared and issued to the EPA before the commencement of the works.

Unexpected situations that have been identified include:

- uncovering greater amounts of ground contamination than presently estimated
- uncovering types of contamination that are presently unknown
- insufficient clean material available on-site to backfill the remediated areas of the site and achieve the proposed final grades
- flooding of the site by extreme rainfall events
- generation of unacceptable levels of dust
- release of unacceptable levels of volatile gases
- generation of unacceptable odours
- generation of unacceptable noise and/or vibration levels
- a spill or leak of hazardous materials.

18.2.5 Construction and Operational Environmental Management Plan

A site specific construction and operational environmental management plan would be developed and as well as incorporating the plans listed above, would examine all other operational aspects such as plant commissioning procedures, waste management, site signage and reporting requirements, including complaints, licence and Government reporting requirements.

18.2.6 Summary of Environmental Management Measures

Environmental management measures for this proposal are summarised in **Table 18.1**. The rationale for applying each of these measures is included within the individual referenced sections of the EIS and the remediation action plans.

Table 18.1 Summary of Management and Mitigation Measures Proposed

Issue	Mitigation measure	Implementation phase	EIS reference
Hydrology and estuarine ecology of Homebush Bay	• stage of coffer dam construction • use silt curtains around coffer dams to reduce turbidity and sedimentation • close coffer dams at low tide to minimise trapped water • use suitably sized rock armour on the seaward face of the coffer dam to withstand wave forces and prevent any adverse wave field effects • use dewatering pumps to maintain the water level inside the coffer dam below the water level in the bay to prevent contamination seepage	Stage 1	Chapter 7
Acid sulphate soils	• dose soils with lime • where temporary stockpiling of untreated sulphate soils is required, the following additional management procedures would be followed: - collection and management of any waters that drain from the stockpiles - regular watering of stockpiles - location of lime on-site to be available to immediately balance pH where acid conditions occur • storage of untreated acid sulphate soils on-site for periods exceeding two weeks would be limited; where stockpiling exceeds two weeks, the material would be regularly spray irrigated and the pH would be monitored daily. If a pH of less than 6.0 is detected, the materials would be immediately treated with lime.	All	Chapter 8
Groundwater	• a high-permeability zone would be placed immediately behind the seawall to enhance tidal flushing • construct low permeability barrier on landward side of high permeability zone • adopt ecologically derived soil acceptance criteria within 40 metres of the seawall for reinstatement materials	All	Chapter 8

Table 18.1 Continuation

Issue	Mitigation measure	Implementation phase	EIS reference
Surface water	• stage development activities to minimise land disturbance • restrict vehicle access to designated and stabilised entry and exit points • provide sediment basins, sediment fences, catch drains, check dams, straw bale filters, and other structures to collect and treat 'dirty' run-off from disturbed areas • divert 'clean' run-off from upstream areas around disturbed construction areas • temporarily stabilise stockpiles and disturbed areas not associated with the ongoing remediation operations • stabilise and turf exposed areas immediately after completion of works • provide vegetated buffer strips to isolate un-disturbed, stable and rehabilitated areas from disturbed areas	All	Chapter 8
Flooding	• establish coffer dams • stage works progressively.	Stage 1	Chapter 8
Air quality and public health	• remediate small areas at a time • construct a purpose-built building on-site to fully enclose pre-treatment processes • use water carts and/or water sprays to suppress dust • set site speed limits • reduce site vehicle traffic to the minimum levels practicable and keep vehicles to set routes • apply shade cloth to external fences • employ boundary and internal sprinklers and misting system • use sealing materials to stabilise inactive stockpiles and other exposed areas susceptible to wind erosion during dry windy conditions	All	Chapter 9

Table 18.1 Continuation

Issue	Mitigation measure	Implementation phase	EIS reference
Air quality and public health (cont'd)	• employ rumble strips and a wheel wash for heavy vehicles • turf remediated areas (turf has been assessed as preferable to seeding on account of its immediate results in dust mitigation) • suspend major dust-generating operations during dry, high wind conditions. • manage odours with covers (non-odorous soil or plastic sheeting), liquid odour suppressant sprays (at the excavation face and in boundary misting systems), and/or by minimisation of the earthworks surface area. • excavate malodorous areas concurrently to minimise overall period of odour • restrict excavation of malodours material to periods of favourable wind conditions	All	Chapter 9
Terrestrial flora and fauna	• retain vegetation on-site as far as possible • control invasive weeds on-site • use local native species in the rehabilitation of the site • control erosion and sedimentation • check potential fauna habitats, including trees and other vegetation, created wetlands, sheds and other buildings for fauna before disturbance and relocate species if found	All	Chapter 10
Risks and hazards	• develop hazard and operability plan (HAZOP) for plant operation • develop emergency response plan • develop contingency plan • develop an occupational health and safety plan	All	Chapter 11

Table 18.1 Continuation

Issue	Mitigation measure	Implementation phase	EIS reference
Traffic and transport	• ensure heavy vehicles use the Concord Road / Blaxland Road intersection for northerly access to and from Concord Road.	All	Chapter 12
Noise and vibration	• excavation and hauling activities outside the pre-treatment facility will be restricted to between the hours of 7.00 am and 5.00 pm (Monday – Saturday) • all equipment operating in open areas would be fitted with residential silencers • control noise emission from individual plant items using noise attenuation measures • minimise plant operating on-site at the same time • construct acoustic barriers or mounds along site boundaries if required based on monitoring results • measure sound power levels for each item of plant to be used on the site before commencement and at six monthly intervals.	All	Chapter 13
Cultural heritage	• a photographic record of the brick wall and substation structures on the Lednez site would be taken before demolition • if any archaeological material is uncovered on the Lednez site during the proposed remediation proposal, work would cease and the discovery would be reported to the National Parks and Wildlife Service so that a basic assessment of the material's nature, extent and potential significance could be made before work continued • a person experienced in indigenous archaeology would administer a training program to site staff so that they could recognise any possible indigenous sites exposed during earthworks	All	Chapter 14

Table 18.1 Continuation

Issue	Mitigation measure	Implementation phase	EIS reference
Cultural heritage	• a photographic record of the 1950 section of the seawall is to be carried out before the commencement of the remediation proposal • a photographic record of features associated with the 1930's jetty and the 1939 seawall, should these still be intact and identifiable, would be taken during the excavation • work would cease immediately should any manufactured object or feature be uncovered in the bay • work would cease immediately should any unexpected item be uncovered such as any sandstone outcrops, overhangs or caves and the NSW Heritage Office would be contacted.	All	Chapter 14
Visual and landscape	• minimise exposed areas and stockpile heights to extent practicable • construct coffer dams from material taken from the site • replace the sea wall in its existing location using a similar design • stage excavation works to limit exposed areas • position and colour buildings and equipment to limit visual impact • apply shade cloth on external fencing • suppress visual dust • use existing vegetation where practicable to screen the site activities	All	Chapter 15
Socio-economic	• manage community perceptions through open and honest consultation via the liaison group	All	Chapter 15
Cumulative impacts	• apply all measures discussed above to minimise contribution to regional and cumulative issues • liaise with other land developers and stakeholders on the peninsula to resolve cumulative issues.	All	

18.3 Environmental Monitoring Program

Environmental monitoring and reporting is an essential activity during the remediation. The monitoring activities are designed around the assessment and mitigation measures outlined in this EIS.

There are a number of key elements that would be measured to provide information on the performance of protection and mitigation measures that are designed to reduce or remove any negative impacts of the proposal. These elements and their monitoring requirements are identified in **Table 18.2**.

Table 18.2 Outline Monitoring Program

Item to be monitored	Monitoring required	Location	When required/ frequency
Hydrology and estuarine ecology	Establish background turbidity in Homebush Bay and Brays Bay and track plumes in event of disturbance	3 data loggers placed in the bay to record time series for turbidity recording every 15 minutes	One month prior to commencement of works
	Turbidity compliance monitoring around silt curtain perimeter	20 data loggers taking rapid sampling for spatial turbidity survey	Daily
	Curtain integrity checks		Daily
	Sampling to determine species and abundance after colonisation of new substrata	Various	At 3, 12 and 24 months
Soils and waters	Monitor control measures and in particular discharges from sediment basins to ensure compliance with licensing requirements	At various locations on the Lednez site	Prior to discharge
	Regular monitoring of the pH of the stockpiles for acid sulphate conditions	Downstream of run-off from any stockpiles on the Lednez site	As required
	No groundwater monitoring proposed unless site conditions dramatically different than those modelled.	As required	As required
	Surface water monitoring of discharges before release to the bay, sewer or before reuse on-site.	Discharge locations	Before discharge
Air quality	Dust monitoring would be carried out around the site during excavation to provide real time information and to determine compliance with particulate matter (dust) goals. This would involve:	Locations would be dependant on localised wind conditions and would consider boundary goals, exposure pathways of potentially affected persons and monitoring of on-site personnel	
	• monitoring of dust fallout levels using four dust deposition gauges located at the site boundaries		Continuous
	• continuous measurement of dust concentration with DustTrak monitors		Continuous

Table 18.2 Continuation

Item to be monitored	Monitoring required	Location	When required/ frequency
Air quality (con'd)	• four high volume samplers located at the site boundaries, to determine total suspended particulate levels semi-volatile organic compounds, volatile organic compounds and dioxins.	At locations representative of residences in Marquet Street, Blaxland Road and Meadow Crescent	Monthly
	• olfactory observation using personnel specifically trained for odour level determination		Daily
	• a weather recording station would be used to provide information to site personnel on the prevailing wind direction, and to provide a continuous record of atmospheric conditions		Continuous
Noise and vibration	Noise levels will be monitored continuously using unmanned noise loggers. Monitoring will be supplemented by attended monitoring, initially for at least 15 minutes on each day of operations. Where feasible, unattended monitoring will be supplemented by equipment capable of determining the direction of incoming noise, to isolate the level of noise arriving from the proposal site.	Site based	For at least the first two months monitoring would be on a weekly basis or daily if there were a potential for exceedence. This would be reduced to once per week or less if it were shown that no exceedences were occurring.
Waste	Recording quantity, type and sources of waste.	Site based	Each disposal event
Incidents	Details of incidents that require particular measures such as uncovering unexpected materials, spills or emergencies.	Site based	Each event
Complaints management	Monitoring of complaints and actions taken to correct problems would be monitored by senior Thiess site staff so that any corrections can be made immediately and minimise chance of issue arising again	Site based	Each complaint

18.4 Community Liaison and Complaint Handling

The primary mechanism for liaison with the community would be through the Community Liaison Group. Specific presentations to the group regarding issues would be made at times as requested by the group, and would cover monitoring procedures and results, and general compliance issues. During the preparation of the EIS, Community Liaison Group meetings were generally held on a monthly basis. This may be the case during the remediation process however final timing would be held as agreed between Thiess Services and members of the Community Liaison Group.

Detailed complaints procedures and a register would be kept at the site to ensure that a coordinated approach is taken for identifying and dealing with any problems identified by the community. Issues raised by the community would be assessed at the Community Liaison Group.

The complaints handling and resolution procedure would include the following provisions:

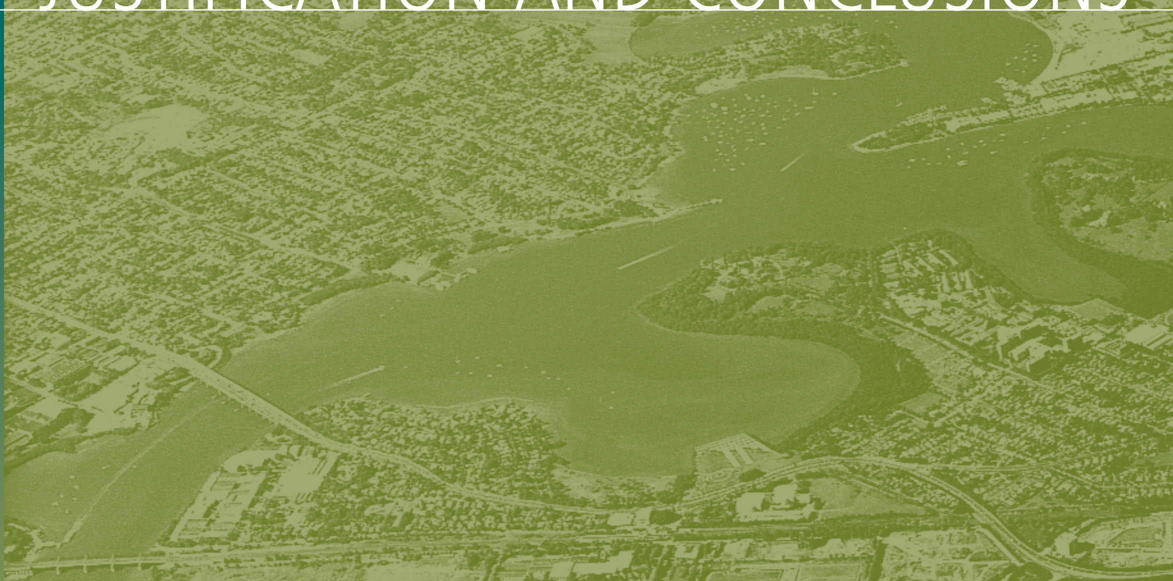
- identification of a contact person for complaints, who would have responsibility for investigation of all complaints, and subsequent contact with the complainant
- publication of a phone number which can be used for complaints, and which would be attended at all times when there is any activity on the site
- for each complaint received, prompt action to investigate whether any unusual activity may have given rise to complaint, and if so, action to prevent a recurrence
- if required, instigation of monitoring at the complainant's residence
- contact with the complainant as required to inform them of the progress of investigations
- recording of all complaints, including the nature of the complaint, investigations undertaken to resolve it, and all contact undertaken with the complainant.

Part H

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

JUSTIFICATION AND CONCLUSIONS

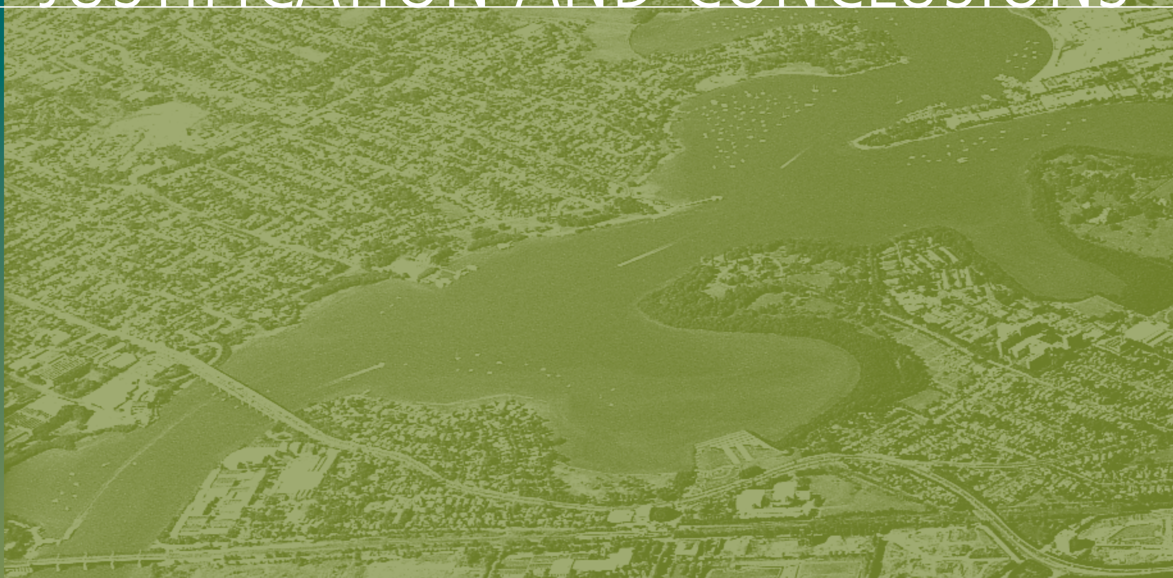


Chapter 19

REMEDIATION OF

LEDNEZ SITE, RHODES and HOMEBUSH BAY

JUSTIFICATION AND CONCLUSIONS



Chapter 19

JUSTIFICATION AND CONCLUSIONS

19.1 Justification

19.1.1 Historical Contamination

Historical industrial practices carried out on the Lednez site before 1986 resulted in the presence of contamination across the site and parts of Homebush Bay. This EIS has been prepared in relation to a proposal by Thiess Services to remediate the Lednez site and an area of the bay that has been affected by this former industrial usage.

The chronology of events that details the past and current use of the Lednez site and which provides information to describe the extent and nature of contamination, is extensive. This information is provided in detail in **Chapter 4** and in **Technical Papers 2**, **3** and **4**.

19.1.2 Standards

An important part of this proposal involves the establishment of appropriate standards (criteria) against which the present condition of the Lednez site and the bay may be assessed in terms of fitness for their present and intended future uses.

In circumstances where no guidelines exist or the criteria are applied in unusual circumstances, a risk assessment process is used to establish site-specific criteria.

For this proposal, the remediation standard that would apply have been developed by Sinclair Knight Merz for the bay and by Egis Consulting for the Lednez site, using EPA endorsed methodologies for risk assessment. The outcomes of these studies are detailed in **Chapters 4** and **5** and in **Technical Papers 5** and **6.**

19.1.3 Need for Remediation

The need for remediation of the Lednez site and Homebush Bay is a direct consequence of the desire of the NSW Government to remediate the Lednez site for residential landuse, improve the environmental condition of the bay, and improve the usability of the north-eastern foreshore of the bay. To achieve this, the following proposal objectives have been established by Thiess Services:

- to remediate the Lednez site to satisfy the requirements of the EPA accredited site auditor so that the site may be safely redeveloped for residential purposes

- with respect to Homebush Bay, remove dioxin contaminated sediment to improve human health and ecological conditions to the extent allowed by budgetary considerations and to ensure that the bay is safe for recreational purposes.

The Director-General's requirements clearly stipulate that the reasons for carrying out the proposal should have regard the biophysical, economic and social considerations, including the principles of ecologically sustainable development as described in **Chapter 1**. These principles have been considered throughout the design of the proposal, during consultation with stakeholders and in the preparation of the EIS. The implications of applying ecological sustainable development considerations to this proposal are shown in **Table 19.1**.

Table 19.1 Implications of Impacts for Ecologically Sustainable Development

Precautionary principle	Intergenerational equity	Conservation of biological diversity
Hydrology		
• Coffer dam to be wrapped in geotextile fabric and silt curtain to be installed to control turbidity • Coffer dams to be staged to minimise impact • Coffer dam designed taking into account wave action	• The proposal is not anticipated to have any long term impacts on the hydrology of the bay	• Coffer dams to be sealed at low tide to minimise the volume of water and aquatic fauna trapped • Trials of replacement substrate to be conducted focusing on re-colonisation rates and species diversity
Estuarine ecology		
• Dust and turbidity management measures in place to avoid impacts on surrounding mangroves and saltmarsh • Post-remediation monitoring to determine re-colonisation rates and diversity • Staging of coffer dam construction to localize impacts	• Removal of a significant amount of dioxin from the environment would result in a positive impact on ecological health	• Remediation to reduce risks to aquatic life currently prevailing • Increase in biodiversity of the bay due to the provision of new habitat • Assessment using test areas in similar environments • Treatment of site run-off before discharge to the bay
Soils, water and geology		
• Contaminant transport modelling in groundwater undertaken to demonstrate no long term ecological impacts from proposal • Excavated material to be assessed for potential to generate acid sulphate • Treatment of water from excavations before release or for reuse on-site • Mitigation measures in place to minimise the risk of contamination of groundwater	• Remediation to enable future use • Removal of a significant amount of dioxin from the environment would result in reduced long term negative impacts on human health	• Mitigation measures and monitoring are designed to minimise impacts to the surrounding area

Table 19.1 Continuation

Precautionary principle	Intergenerational equity	Conservation of biological diversity
• Ongoing sampling and analysis of waters throughout the project • Water management plan and erosion and sedimentation management plan would be developed		
Air quality		
• Dust, odour modelling indicates that that there are no long term impacts • Health risk modelling shows that there is negligible carcinogenic or non-carcinogenic health risks • Ongoing monitoring to be undertaken and Air Quality Management Plan enforced	• Negligible health impacts associated with the proposal means that future generations would not be affected as a result of this proposal	• No off-site air quality impacts associated with the proposal hence no loss of species or ecosystem diversity in the surrounding area
Terrestrial flora and fauna		
• Detailed surveys of the study area have been undertaken and mitigation measures proposed to control potential off-site impacts	• There will be a short term loss of habitat for waders while the bay is being remediated but ultimately an improvement in habitat for these birds • The proposal will not result in a loss of any species or communities	• Assessment has found that no threatened flora species or endangered communities are within the site boundaries • Surveys have found no significant amphibian, reptile or mammal species at the site • Remediation of the bay will improve habitat value for waders • Potential impacts on the remnant wetlands of Homebush Bay have been mitigated
Risks and hazards		
• The review of technology options has taken into consideration potential risks to the surrounding community • Assessment works have identified potential risks and hazards and safeguards have been built into the proposal to mitigate these risks • A contingency and emergency response plan would be in place	• Safeguards designed into the proposal would reduce the potential damage in the event of an incident	• Design of the proposal and the mitigation measures proposed are aimed at protection of the environment and its surrounds

Table 19.1 Continuation

Precautionary principle	Intergenerational equity	Conservation of biological diversity
Landuse planning and transport		
• The concerns of the local community have been identified through consultation and appropriate mitigation measures have been developed	• Remediation of the site is to enable future landuse consistent with the applicable planning documents • Transport numbers have been reduced by minimizing material entering and leaving the site. The transport needs will not impact on the existing transport network beyond existing capacities	• The remediation of the site would change the current landuse but would not affect biodiversity (refer to terrestrial flora and fauna above)
Noise and vibration		
• Modelling of the worst case scenario has been undertaken and mitigation measures developed • A noise management plan would be in place during the project	• Some surrounding residents may experience an increase in noise levels at various stages of the project • As the project is expected to take up to 5 years to complete, this impact would be restricted to the present generation	• Potential noise impacts would not have an impact on biological diversity
Cultural heritage		
• Searches of heritage registers and consultation with LALC, ATSIC, NPWS have not identified any indigenous artefacts • Excavations unlikely to contain previously undiscovered relics • There are no items of local, state or national significance on the site • Procedures would be in place for site workers to identify any artefacts as the project progresses and contact relevant authorities	• Replacement of the existing seawall would retain an example of straight seawall construction for future generations • Remediation of the site is unlikely to result in the degradation of heritage items	• Not applicable
Visual and landscape		
• Visual assessment has been undertaken to determine the short and long term impacts and mitigation measures	• Remediation of the land portion of the proposal would change the visual character permanently. The bay works would change the character temporarily	• Future planting of the site with native species would encourage biodiversity

Table 19.1 Continuation		
Precautionary principle	**Intergenerational equity**	**Conservation of biological diversity**
Socio-economic		
• Reduction in the negative perception presently associated with the Lednez site and the Rhodes Peninsula that stems from its contaminated state	• Increased opportunities for future generations through accessibility and improved usability of foreshore areas • Opportunities for recreational activities by future generations in the bay	• Long term improvement in biological diversity of both the bay and the Lednez site

The precautionary principle and inter-generational equity are aspects of ecological sustainable development that are important to this proposal, particularly with respect to determining whether remediation of the bay sediments is required and exactly how much of these sediments require removal and treatment. The precautionary principle focuses on the idea that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. Inter-generational equity focuses on the idea that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The proposed extent of remediation in the bay is based on the premise of reducing present risks associated with the bay. Much debate has been had over this issue and it is likely that the debate will continue even long after the proposal is undertaken. The question is, is it better to adopt a "do nothing" approach and wait another decade to see what irreversible environmental damage is caused by the continued dispersion of dioxin into the environment from the Lednez site and the contaminated bay sediments or is it appropriate to apply the precautionary principle and take immediate measures to reduce environmental degradation?.

If the Lednez site remains as is, the current statutory notices issued under the *Contaminated Land Management Act 1997* and the *Unhealthy Building Land Act 1990* would remain in place. This would result in ongoing maintenance and monitoring of the Lednez site and would preclude all but the most limited future landuse applications.

With respect to the bay, several human health and ecological risk assessments ranging from screening level assessments through to detailed assessments have been undertaken. Several sediment contamination investigations have also been undertaken. Based on these investigations, contaminated sediments in the bay, particularly those along the north-eastern foreshore, pose a significant risk of harm to human health and the environment. NSW Fisheries and the Environment Protection Authority have acknowledged this risk with the issuing of statutory notices that remain in force. If no remediation action were taken in the bay, the notices would remain in force until it can be demonstrated that the risk has, through other means such as natural attenuation, diminished to a level that is acceptable.

In terms of inter-generational equity, the remediation of the Lednez site would enable more sensitive landuses to be undertaken on the site than is currently permitted. It would enhance the diversity of landuses permitted at the site for both current and future generations. The proposed remediation of sediments in Homebush Bay would improve a severely degraded environment and would increase opportunities for future recreational use in Homebush Bay.

19.1.4 Proposed Technology

One of the most significant factors in selecting treatment technologies for remediation is ensuring that the process selected addresses the contaminants of concern. The prime contaminants to be treated are dioxins, however there are other contaminants that are also of concern and these would also need to be addressed by the appropriate treatment technology.

In selecting an appropriate treatment technology, an overview of current and best available technologies was undertaken. Eleven different processes were assessed and thermal desorption technology selected as the preferred option.

Direct and indirect thermal desorption technologies are both internationally proven and effective technologies for the treatment of dioxin contaminated materials. Whilst both methodologies are technically suitable, the preferred option for the treatment of dioxin contaminated materials for this proposal is indirect thermal desorption. This is due to the environmental advantages available through the application of the indirect method, being principally reduced emissions to the atmosphere. A discussion on the technology selection is provided in **Chapter 5**. For more information regarding the selected technology refer to **Technical Paper 9**.

19.2 Overview of Potential Impacts and Benefits

The proposal to remediate the Lednez site and a part of Homebush Bay offers both positive and negative impacts for the community and the environment of the Rhodes Peninsula. An overview of these impacts is provided in **Table 19.2** for two scenarios, with and without mitigation measures.

Table 19.2 Overview of Potential Impacts and Benefits

Impact without mitigation measures	Residual impact after mitigation measures applied (as per *Chapter 18*)
Hydrology of Homebush Bay	
Tidal currents and wind-induced flows would especially affect the silt curtain surrounding the coffer dams	The methods proposed for the use of silt curtains, in particular, the wrapping of silt curtains around the bay-side walls of the coffer dams would result in negligible impact (or damage) to the curtain as a result of tidal current or wind-induced flows
Wind-induced surface waves would lead to forces on the structures	Negligible. The coffer dams would be designed to be structurally sound height
Run-up of braking waves on the structures may lead to wave overtopping	Negligible as the high of the coffer dam walls exceeds the expected maximum wave heigh.
Increased turbidity can decrease light for photosynthesis; interfere with fish respiration and feeding.	Turbidity is expected to be minimal once coffer dams established. During construction of the coffer dams, silt curtains would limit the spread of any suspended sediments
Discolouration of normally clear surface waters	Turbidity is expected to be minimal once coffer dams established. During construction of the coffer dams, silt curtains would limit the spread of any suspended sediments

Table 19.2 Continuation

Impact without mitigation measures	**Residual impact after mitigation measures applied (as per *Chapter 18*)**
Sediment re-suspension can lead to increased dispersion of contaminants	During construction of the coffer dams, silt curtains would limit the spread of any suspended sediments
Seepage of contaminated water through coffer dam walls	Negligible seepage towards the bay as the water level outside of the dam wall would generally be at a level higher than that within the coffer dams
Changed flow and wave climate within the bay due to presence of coffer dam	Studies show that impacts expected if all six coffer dams were to be used at the same point in time, the impacts would be negligible. This proposal envisages that a maximum of two coffer dams would be in operation at any one point in time
Estuarine ecology	
Deposition of dust on the leaves and trunks of mangrove and saltmarsh plants. Smothering and reduction of exposed pneumatophore surface area (specialised root that assists the mangrove plants to "breathe")	Negligible as main cause of this occurring. This is unlikely to happen as maximum predicted off-site impacts would be within air quality goals
Removal of habitat	Insignificant as habitat that would be lost would be limited to the footprint of the coffer dams
Removal and death of all organisms occupying the upper part of the seabed in the Portion 1 area	Organisms that would be lost are abundant elsewhere in the bay, therefore no significant impact on long-term survival
Considerable physical disturbance and probable death of organisms in the lower levels of sediment in the Portion 1 area	Organisms that would be lost are abundant elsewhere in the bay, therefore no significant impact on long-term survival
Remediated area is likely to be colonised by a different suite of animals from those there now	Increased biodiversity within Homebush Bay
Displacement of fish and mobile invertebrates during construction	Negligible as these species would move to similar habitats in Homebush Bay and other nearby bays and re-enter the remediated areas after removal of the coffer dams
Death of fish and mobile invertebrates trapped within coffer dams	Impact minimised by staging of coffer dams and closure of coffer dams at low tide
Pollution of the bay by water-borne sediment	Negligible, contained in the first instance by coffer dam structures, then by secondary application of silt curtains
Reduction of dioxin levels in sediments	Long term, reduction to dioxin levels would aid any potential lifting of the fishing ban

Table 19.2 Continuation	
Impact without mitigation measures	**Residual impact after mitigation measures applied (as per *Chapter 18*)**
Geology, soils and water	
Acid sulphate soils	Acid sulphate conditions are expected so full management mechanisms have been built into the proposal as part of the earthworks plan
Human health on Lednez site	Negligible, so long as criteria determined in risk assessment are complied with
Mobilisation of contamination by excavating contaminated material	Unlikely as conditions within materials to be excavated are unsuitable for transpor.
Surface activities during the remediation program allowing release of contamination to the groundwater system	Negligible, with appropriate controls in place (storage on low permeability liners and on sealed surfaces of materials for treatment)
Discharge of contaminated water	Negligible. Contaminated water to be contained and treated before discharge
Long term migration of residual chemicals through the groundwater system	Migration would be extremely slow due to the low solubility of most of the chemicals present and the low permeability. Attenuation mechanisms would also act to reduce concentrations of chemicals and prevent contamination of bay waters
Impacts on the water quality of Homebush Bay (transport of sediment and contamination from the site)	Negligible with the various erosion and sediment control and water management practices to prevent these impacts
Flooding	Unlikely. Although freeboard would be reduced, the final levels would provide adequate freeboard for flood protection
Air quality and public health	
Exposure of site workers to toxic contaminants	Negligible. Appropriate protective clothing and training to be provided
Exposure of off-site receptors through dust and particulate emissions	Minimal, as maximum potential off-site impacts are predicted to be within air quality goals
Dust emissions from excavation and site work	Minimal, as maximum potential off-site impacts are predicted to be within air quality goals
Process emissions from the thermal treatment plant	Negligible as all predicted off-site levels are below relevant air quality goals
Odour	Potential for odour impacts during excavation activities at the site, particularly during Stage 1 excavations
Lifetime risk of cancer	The maximum predicted lifetime risk of cancer would be less than 0.3 in a million. This is lower than the nominated criteria level of one in a million
Non-carcinogenic hazards	Minimal as the hazard index is below the acceptable coefficient (threshold)
Greenhouse gas impacts	Approximately 44,000 tonnes of CO_2 emissions over the life of the project

Table 19.2 Continuation

Impact without mitigation measures	Residual impact after mitigation measures applied (as per *Chapter 18*)
Flora and fauna	
Clearing of existing vegetation within the site	Insignificant as no threatened or endangered species were identified at the site
Deposition of dust on vegetation within immediate vicinity of site	Insignificant as no significant flora within range of dust deposition and dust deposition within acceptable limits
Removal of Green and Golden Bell Frog habitat	No Green and Golden Bell Frogs were detected on the site and therefore proposed works are unlikely to adversely affect survival, cause species decline or interfere with recovery of this vulnerable species
Change in feeding habitat for migratory bird species	Site does not contain important habitat for these species. The remediation works would improve the quality of feeding habitats and have an overall net benefit
Deposition of dust on foraging habitats within the immediate vicinity of the site	Significant species of frog and bat located in proximity to the site would not be affected by dust, which would be within acceptable limits
Night-time effects on birds resulting from site lighting	Negligible due to the ambient light impacts from urban environment
Risks and hazards	
Adverse impacts from potential incidents related to hazards categorised as either natural, environmental, occupational health and safety or plant operational hazards	Incidents could occur but these hazards have been identified and mitigation measures incorporated into design of plant and proposed work methods. The residual risk ranges from insignificant to low for most identified risks. The exception being noise for which the upper level of residual risk is considered moderate
Traffic and transport	
Additional traffic generated for road network (both heavy and light vehicles)	Additional traffic can be accommodated on road networks and at critical intersections without any noticeable deterioration in levels of service
Safety concerns over right and left turning heavy vehicles at the Concord Road/Averill Street intersection	Negligible as heavy vehicles approaching from or departing to the north would be required to use the Concord Road/Blaxland Road intersection
Noise and vibration	
Noise impact on Blaxland Road, Marquet Street and Meadow Crescent residences from trucks, excavators, dozers and other plant and equipment	Noise to be monitored and where necessary mitigation measures would be implemented to achieve compliance with relevant criteria

Table 19.2 Continuation

Impact without mitigation measures	Residual impact after mitigation measures applied (as per *Chapter 18*)
Heritage	
Demolition of existing buildings on Lednez site	Existing buildings have no significance and are derelict
Excavation of Indigenous relics	Unlikely that relics remain on-site, however works would cease and the National Parks and Wildlife Service would be contacted if discovery of any sites or artefacts occurred
Excavation of cultural deposits	Remains of 1930s jetty facilities, 1950s wharf and dolphins, 1930 rock seawall would be destroyed and the 1950's seawall would be removed and replaced. These items are all considered to be of low heritage significance. Any unexpected findings would result in works ceasing and advise being sought from the NSW Heritage Office to ensure no destruction of significant items
Visual	
Impact from excavation and stockpiling of large quantities of material, construction of coffer dams and the pre-treatment building and thermal treatment plant	The residual impact from certain viewpoints would probably be high whilst work is in progress. Following completion of remediation, reinstatement of the site would result in minimal impact
Visual and landscape	
Community concern over health and safety	Reduced in the context of integrated environmental management, monitoring and licensing procedures routinely subject to independent audit and verification
Community concern over the scale of future residential developments	Beyond scope of EIS. The community would be given the opportunity to comment when the pertinent proponent lodges an application for the residential development
Access to recreational opportunities	Potential future opportunities for recreational activities. If future development proceeds, public access to foreshore open space may be available
Direct employment opportunities	Employment opportunities for 50 people in the first two years of the project and 30 people in the following two years
Indirect local employment opportunities	Various employment opportunities would be created by contractor requirements for various site activities
Community infrastructure	Minor increase in demand for (food retailers, public transport). Short-term increase in demand for accommodation in local hotels /motels
Land and property value	Boost property prices in adjoining residential areas as derelict site remediated

19.3 Conclusion

The remediation of the Lednez site and the north-eastern part of Homebush Bay adjacent to the Rhodes Peninsula is an important project aimed to return the sites to safe and sustainable use.

The standard of remediation will be governed by modern international and Australian practice. It will be carefully monitored and assessed by the Environment Protection Authority, the Department of Health and other relevant regulatory authorities.

The remediation technology, thermal treatment plant and other processes would be carefully controlled in accordance with licences issued by the Environment Protection Authority and other relevant regulatory authorities.

No development could occur on any part of the site until all relevant authorities, including an independent site auditor, are satisfied that the remediation has met the required standards after the work has been completed.

The proposal, as described in **Chapter 6**:

- upholds the integrity of ecological processes through implementation of mitigation measures and monitoring programs
- incorporates social, environmental and economic considerations in it's development
- addresses the concerns and values of the local community through the environmental assessment process.

The proposal has the overall benefits of:

- improving the amenity of Rhodes Peninsula and the area surrounding Homebush Bay
- removing the health risk associated with the Lednez site
- reducing the contaminant load available within the bay for dispersion throughout the environment
- improving the usability of the bay for recreational activities
- enhancing the economic viability of the local area

Any short-term localised environmental effects are outweighed by the long-term environmental and social benefits of removing serious contamination. Provided that the potential environmental impacts of the remediation works would be managed appropriately, the proposal would benefit the community and achieve a net positive environmental outcome.

If development consent is granted, the proposal would be further refined to address consent conditions during the detailed design phase of the project. The principles of ecologically sustainable development would continue to be taken into account in future detailed design work.

REMEDIATION OF LEDNEZ SITE, RHODES and HOMEBUSH BAY

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REFERENCES

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